UNIVERSITY OF CAPE COAST

AN INVESTIGATION INTO SENIOR SECONDARY SCHOOL ELECTIVE SCIENCE STUDENTS' PERCEPTION OF THEIR BIOLOGY CLASSROOM ENVIRONMENT AND THEIR ATTITUDE TOWARDS BIOLOGY

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BY

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ABSTRACT

This study focused on elective science students' perception of their biology classroom environment and their attitude towards biology in low and high academic achieving senior secondary schools in the Central Region of Ghana. Data were obtained with Biology Classroom Environment Questionnaire and Attitude towards Biology Questionnaire, administered on 356 third-year elective science students.

This was done after the senior secondary schools that offer elective science programme had been categorized into low and high academic achieving schools based on their performance in Senior Secondary School Certificate Examination / West Africa Senior Secondary School Examinations for four years. Two third year intact classes were randomly selected from four schools under each category.

One-way multivariate analysis of variance (MANOVA) and a follow-up analysis of variance (ANOVA) conducted showed that though elective science students in both school categories had a low perception of their biology classroom environment, they differed in their perception of their biology classroom environments which was influenced by teacher support, cooperation and equity. The difference was in favour of students' in low academic achieving schools. Mean scores and Independent sample t-tests also showed that students' in both school types had a positive attitude towards biology. Spearman's Correlation revealed that no relationship existed between elective science students' perception and attitude in both school types. However, Spearman's Correlation found a relationship among the sub scales of biology classroom environment.

It was, therefore, suggested in the thesis that, the study be replicated by another researcher using the actual performance of the schools in biology to find out the out come of the study.

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DEDICATION

To the everlasting memory of my sister Blessing Ama Otami

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CHAPTER ONE

INTRODUCTION

Background to the Study

Like many countries in the world, Ghana places strong emphasis on science education in its educational system. This is in response to the rapid advancement in science and technology which is believed will help the country to surge forward in keeping pace with the process of modernization like the rest of the world. Learning science is therefore, becoming more essential not for the well being of the individual, but also, for the society as a whole.

However, there have been concerns over low enrolments of senior secondary school (SSS) students in the general science programme in Ghana. Statistics from Ghana Education Service (GES) (as cited in Anamuah-Mensah, 2007) indicate that, about 20% of students in senior secondary schools participate in science stream class. The report expressed concern at the country's growing inability to fulfill national aspirations of producing sufficient science and technology base manpower if the trend were to be allowed to continue. Beside low enrolments of SSS students in the general science programme, perhaps an even greater concern has been low pass rate in the sciences (physics, chemistry and biology) in national examinations conducted by the West Africa Examination

Council (WAEC). The Council's results on achievements of elective science students in the general science programme have consistently shown that, percentage of elective science students who obtained credit passes in the science subjects are low (WAEC, 2002; 2003; 2004; 2005). Despite the uninspiring achievement of SSS elective science students in the sciences, it has been observed that percentage of credit passes in biology from 1999 to 2005 have been below 50% (Anamuah-Mensah, 2007). This worrying development has attracted the attention of many science educators in Ghana because of the central role biology plays in the world of science; as it is devoted to the study of activities of all living things. Again, biology guides and inculcates in learners skills, knowledge and attitudes necessary for professions like medicine, pharmacy, dentistry and agriculture. It is because of these essential functions of biology that Bibby (as cited in Shaibu & Olarewaju, 2007) called for biology education for every child in this contemporary world dominated by science.

In a bid to find solution to the poor performance of elective science students in biology, many reasons have come up as to why it is so. For example, studies have identified reasons such as students' poor attitude towards the subject, poor students' conception of some of the concepts in the subject, overloaded biology syllabus, teacher quality and socio-cultural factors as being partly responsible for students' underachievement in the subject. Though these factors have been identified to influence students' achievement in the subject, convincing evidence emerging from empirical studies indicate that, students' learning and achievements are also influenced by their classroom environments (Fraser, 1998;

Mucherah, 2008; Walberg, Fraser & Welch (as cited in Fraser, 2001). A study on senior secondary school biology students in Kenya by Mucherah (2008) reported strong associations between students' perceptions of their biology classroom environment and their achievement in the subject. The result obtained by Mucherah was consistent with that of Chui-Seng (2004) who noted that psychosocial dimensions, particularly those associated with classroom environment, have strong influence on students' learning outcomes.

The concept of classroom environment as applied to educational setting is viewed as a place where learners and teachers interact with each other and use a variety of tools and information resources in their pursuit of learning activities (Fout & Myers, 1998; Mucherah, 2008). Although classroom environment is a subtle concept, remarkable progress has been made over the last five decades to conceptualize, assess, and research into it (Fraser, 2001). Classrooms are specific places in schools where results of education, that is, understanding and application of knowledge in our lives are expected to be achieved, and these places have lots of influence on students in respect of achieving these noble goals (Fraser, 1981). Creating favorable classroom environments should therefore be of great importance to science educators since evidence from empirical studies suggests that classroom environment influences students' learning.

Perception as noted by Teh (as cited in Ampiah, 2006) influences human behaviour in science related issues and this has been found to exist worldwide. However, according to Rogers and Ford (1997) perception is a strong determinant for developing attitude towards learning. Positive attitude towards science has been reported to correlate highly with students' achievements (Dhindsa & Chung, 2003). Though substantial research works in science education in the past 30-40 years have been on students' attitude towards science, little has focused on a particular science discipline like biology, physics or chemistry (Osborne, Simpson & Collins, 2003). This partly presents false students' attitude towards a particular science discipline because science is not a homogeneous subject. Several studies by Myers and Fouts, Haladyna, and Talton and Simpson (as cited in Salta & Tzougraki, 2004) have found classroom environment as a significant determinant of students' attitude towards science, but little is known about classroom environment and students' attitude towards biology. It is important therefore, that the way students' perceive their biology classroom environment and their attitude towards the subject is investigated because of its effect on achievement in the subject as it has been reported in the literature (Taylor, 2004).

In Kenya, a study conducted has revealed that achievements in national school examinations were influenced by the kind of school one attended, and the availability of resources in the school (Mucherah, 2008). This is not very different in Ghana, where achievements of SSS elective science students in biology appear to be determined by the kind of school one attends. This is because results released by the West Africa Examinations Council in biology have consistently indicated that, schools that are well equipped in terms of science laboratories, textbooks, and qualified science teachers tend to produce better results while poorly equipped schools perform poorly in the subject (Addae-Mensah, 2003). While some authorities are of the view that schools with better achievements in biology have good infrastructure in terms of science laboratories, science textbooks, adequate number of qualified science teachers and many other reasons. It has also been noted that some schools with all these facilities do perform poorly in the subject in WAEC examinations (Addae-Mensah, 2003).

The question that one needs to ask is that, are these disparities in achievements in biology coming from the differences in biology classroom environments in the schools? Is the way students perceive their biology classroom environment influencing their attitude towards the subject? Is the attitude of the students towards the subject poor? According to Mucherah (2008) much has not been reported on these important aspects of science education in Africa, hence the need to do such an investigation in Ghana to find out why.

Statement of the Problem

The West African Examinations Council's (WAEC) Chief examiners' reports on the performance of senior secondary school (SSS) elective students in biology indicate that, generally achievements in the subject are very low (WAEC, 2002; 2003; 2004; 2005). For example, in 2002 out of 8,922 candidates who sat for the Biology paper, only 3,476 (39%) passed with grades A-D. In 2003 out of 9,581 candidates presented, only 3,772 (39.4%) obtained grades A-D. Also, in 2004 out of the 10,546 candidates, 5,051 (47.9%) passed with A-D, and in 2005 out of 14,176 candidates only 5,803 (40.7%) obtained grades A-D (Anamuah-Mensah, 2007; Anthony-Krueger, 2007).

Numerous reasons have been identified in the literature to be the underlying causes of the underachievement of SSS elective science students in biology. Some of these are that, students see the subject as difficult which according Abdul-Mumuni (1995), and Lakpini (2007), is influenced by their religious, social and cultural backgrounds. Some SSS elective science students also perceive biology as a subject that involves so much reading which makes it difficult for them (Mucherah, 2008). Again, Soyinbo, Eke and Ato (as cited in Shaibu and Olarewaju, 2007) noted that misconceptions students hold about some of the biology topics such as genetics and evolution also affect their understanding of the subject. Poor teaching methods employed by some SSS biology teachers in the teaching of the subject also influence students' achievements in the subject (Mucherah, 2008). Furthermore, inadequate laboratory-based biology practical work to link theory with practice has also been reported in the literature to affect students' learning outcomes in the subject (Anthony-Krueger, 2007). Large class sizes and SSS students' biology classroom environments have all been reported to have a strong association with SSS students' achievement in biology (Fisher & Fraser, 1986; Myint & Goh, 2001; Chui-Seng, 2004; Mucherah, 2008).

Even though these reasons have been identified in the literature as influencing SSS science students' achievements in biology, studies by Mucherah (2008) and Myint & Goh (2001) have reported that classroom environments perceived by students as being conducive tend to enhance the development of positive attitude towards a subject matter and hence, better achievement in it. However, most classroom environment studies have been carried out in developed countries like United States of America (USA), Australia, New Zealand and some countries in Asia such as Taiwan, Turkey, and Singapore. There is very little reported on how SSS science students perceive their biology classroom environment and their attitude towards the subject in Africa (Mucherah, 2008). Though a study on SSS science students' perception of their science laboratory learning environment have been reported in Ghana (Ampiah, 2006), little is known about how Ghanaian SSS elective science students perceive their biology classroom environments and their attitude towards the subject. It is therefore important that a study is carried out in Ghana to find out how SSS elective science students' perceive their biology classroom environments and their attitude towards the subject. Since, biology classroom environments which are found to be conducive tend to enhance the development of positive attitude towards the subject and thereby leading to higher achievement in it (Fraser & Fisher, 1998; Myint & Goh, 2001; Chui-Seng, 2004; Mucherah, 2008).

In spite of the underachievement of SSS elective science students in biology as indicated by WAEC examinations results, some SSS in Central Region have consistently obtained good pass rates in the sciences including biology in the WAEC organized examinations (WAEC, 2002, 2003, 2004, & 2005). The question that needs to be asked is why are some schools performing better than others? Could it be that the SSS that obtain better passes in the subject have better biology classroom environments and also more positive attitude towards the subject than the schools that obtain low passes in the subject? It is therefore, important to investigate how elective science students in SSS whose achievements in biology are better and those whose are poor, perceive their biology classroom environment where teaching and learning of the subject takes place and their attitude towards the subject.

Purpose of the Study

This study explored SSS elective science students in low academic achieving and high academic achieving schools perception of their biology classroom environment. It also investigated the elective science students in low academic achieving and high academic achieving schools attitude towards biology. It again explored, if any, association that exists between students' perception of their biology classroom environment and their attitude towards biology. The study finally attempted to find out if there exists any association among the various sub-scales of biology classroom environment in low and high academic achieving schools.

Hypotheses

The following hypotheses were formulated to guide the study.

1. There is no significant difference between elective science students' perception of their biology classroom environment in low and high academic achieving schools.
2. There is no significant difference between elective science students' attitude towards biology in low academic and high academic achieving schools.
3. There is no significant relationship between elective science students' perception of their biology classroom environment and their attitude

towards biology in high academic achieving and low academic achieving schools.

4. There is no significant relationship among the sub scales of biology classroom environment in low and high academic achieving schools.

Significance of the Study

The results of the study have provided information about how SSS elective science students in the school types perceive their biology classroom environments, and also, their attitude towards biology. The information gained from the study could be used to improve the aspects of biology classroom environment that hinder the teaching and learning of biology by making the information available to biology teachers in these schools. The study also provided information on the relationship between science students' perception of their biology classroom environment and their attitude towards biology. The results of the study could serve as a resource material for students/researchers who may like to undertake similar studies in future in this area.

Limitation

In carrying out the study, 23 senior secondary schools in the Central Region of Ghana that offered elective science programme (physics, chemistry and biology) in 2007/2008 academic year were categorised into low and high academic achieving schools. This categorisation was based on the general performances of the senior secondary schools in examinations organised by the West Africa Examinations Council in 2002, 2003, 2004, and 2005. The general performances of the schools were used because of the unwillingness of the headmasters of the schools to release the results of their performances in biology for the study. Also, the WAEC could not provide the results of the performances of these schools in biology due to technical problems; however they were able to provide the general results of the schools.

It was therefore assumed that the performance of the schools in the examinations in the years provided reflected their performances in biology, since there was no means of checking the performances of the schools in biology. This could however not be the actual case as a school could do well overall, but not in biology specifically. Hence the use of the outcome of the study should be done with circumspection, because the actual performances of the schools used were not specific to biology. Therefore, one needs to be very careful in generalizing the results of this study for biology.

Definition of Terms

Perception is an impression or understanding based on what is observed or thought.

Attitude is a personal view or general feeling about something which can be negative or positive.

Senior Secondary School Students were the final year students in secondary schools in Ghana in 2007/2008 academic year who did not experienced the current curriculum under operation in the senior high schools in Ghana currently.

Elective Science Students are students who offered the general science programme in secondary schools in Ghana in 2007/2008 academic year.

Organisation of the Rest of the Thesis

The second chapter is devoted to a review of literature relevant to the study, namely, theoretical background of classroom environment research, the historical background of the various instruments constructed to measure classroom environments and the past areas of classroom environment research. Furthermore, classroom environment and its association with other learning outcomes are also examined. The chapter again looks at the theoretical background of research into attitudes, and the various attempts made at measuring it. Students' attitude towards science was reviewed with regard to students in low and high academic achieving schools. Finally, the chapter attempted to link students' perception of their biology classroom environment and their attitude towards science, and also biology.

The third chapter provides information about the methodology used for the study. It provides detailed information on the research design, population, sample and sampling technique. It also gives a discussion on the instruments used for data collection and how they were developed and pilot-tested. Data collection procedure is discussed in detail and how data were obtained for the study and analysed are pointed out.

The fourth chapter provides the results and discussion of the study. The analytical tools used are also presented.

The fifth chapter gives a summary of the study, overview of the research problem and methodology, key findings and their interpretations with reference to the literature are also presented. Conclusions are drawn; recommendations made and suggestions given for future research.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Introduction

The purpose of this chapter is to review literature related to the study. The chapter gives information on the theoretical framework of classroom environment research, measurement of classroom environments with regard to biology classroom environments and the various instruments developed for such purposes, areas of past classroom environment research, and association between classroom environment and learning outcomes in relation to biology. The review of literature again looks at the concept of attitude, the measurement of attitude, and also the association between students' perception of their biology classroom environment and their attitude towards biology.

Theoretical Framework of Classroom Environment Research

Fraser (1998) has defined classroom environment as the social, psychological, and pedagogical contexts in which learning occurs. The above definition gives a broad view of classroom environment to encompass formal and informal learning situations across the spectrum of learning situations and instructional settings. Classroom environments research as noted by Fraser has its root in Lewin formula B=f (P, E) (as cited in Fraser, 1998). Where, behaviour (B) is a function of both the person (P) and the environment (E). This means that behaviour is influenced by one's environment. Fraser (1998) further went on to state that, Lewin distinguished between beta press (a description of the environment as perceived by people themselves in an environment) and alpha press (a description of the environment as observed by a detached observer). This categorisation therefore provided many advantages when considering beta press, particularly in schools and classrooms, because an outside observer could miss an important event and interactions. Murray (as cited in Fraser, 2000) applied Lewin's concepts of alpha and beta press to his needs-press model in which needs was referred to as an individual's motivation to achieve goals, while press describes how the environment either helps or hinders a person to meet his/her goals. The works of Lewin and Murray were later expanded by Stern, Stein, and Bloom (Fraser, 2000), who were of the view that differences existed between individual's perception, groups' perception, and the perception of an external observer. This led them to the categorization of an individual's views on an environment as Private Beta Press, and that of a collective group as Consensual Beta Press. This categorisation enabled analyses of data from different viewpoints, including the whole class or individual students to be done.

Walberg and Anderson (1968) and Moos (1979) independently examined participants' perception of various learning circumstances and developed a scheme for classifying human environments into three dimensions: Relationship, Personal Development, and System Maintenance and Change. These dimensions enabled different components of classroom environment to be classified and sorted. This therefore led to the development of Classroom Environment Scale (CES) (Moos, 1979; Moos & Trickett, 1987) which tried to link Moo's human environment dimensions to the school settings.

Earlier research and evaluation study known as the Harvard Project Physics (HPP) also stimulated Walberg and Anderson (1968) to develop the Learning Environment Inventory (LEI) to evaluate secondary school students' perception of their physics classroom environments. This study, together with Moos' work laid the basic foundation for the development of classroom environment instruments such as the LEI (Walberg & Anderson, 1968) and CES (Moos, 1979).

The idea that differences exist in perception of individuals as well as groups gave the justification to the growth of the field of classroom environment research at the secondary and post-secondary levels of education for both individuals and the whole class. Through the hard work of Moos and Walberg in the field of classroom environment, this area of study has grown and spread in its scope and depth, as evident through the numerous articles and books, regarding this field of study, and the international attention that this area has gained (Fraser, 1998; 2002; Fraser & Walberg, 1991; Aldridge, Laugksch, Seopa & Fraser, 2006). The development of an international journal in the field of classroom environment studies, Learning Environment Research (Fraser, 1998), as well as books such as Goh and Kline's (2000) Studies in Educational Leaning Environments have been of enormous help to inform players of education about the importance of this field of study.

Measurements of Classroom Environments

The assessment of science classroom environments has been through the use of questionnaires, which are modeled after Moos's (1979) initial work on human behaviour-environment effect. Moos's influence is still seen in the modifications of existing instruments and the creation of new ones that reflect current educational trends such as a constructivist pedagogy (Constructivist Learning Environment Survey, CLES; Taylor, Fraser & Fisher, 1997); the use of laptop computers in classrooms (Raaflaub & Fraser, 2002); Internet and technology-enriched classrooms (Aldridge, Fraser, Fisher & Wood, 2002; van den Berg, 2004; Zandvliet & Fraser, 2005); distance-education learning environment (Walker & Fraser, 2005); and the development of online surveys (Trinidad, Fraser & Aldridge, 2004). The human environment dimensions are classified as: relationship (which identifies the nature and intensity of personal relationship within the environment and assesses the extent to which people are involved in this environment and support and help each other), personal development dimension (which assesses basic directions along personal growth and self-enhancement occurs), and system change dimension (which involves the extent to which the environment is orderly, clear expectations, maintain control and it is responsive to change).

The latest instrument developed to assess secondary school students' perception of their science classroom environment, as reported by Fraser, (2000) is "The What Is Happening In this Class?" (WIHIC). This was done by Fraser, McRobbin, & Fisher in 1996. The construction of Biology Classroom

Environment Questionnaire which was used to measure elective science students' perception of their biology classroom environment in this study was modeled after the WIHIC and, this instrument is discussed in detail, in a later section of this chapter.

The Learning Environment Inventory (LEI) was initially developed in 1968 as part of the research and evaluation studies known as the Harvard Project Physics (HPP) (Walberg & Anderson, 1968). The development of LEI came from Walberg's social climate questionnaire (Walberg, 1968) designed to assess students' perception of their environment to test the idea that seven factors contributed to the variance in students' cognitive and affective outcomes. The seven factors were: student ability, age and motivation; the quality and quantity of instruction; and the psychological climate of the home; the classroom social group; the peer group outside the classroom, and the mass media. The testing of this model confirmed the validity of the instrument, and showed that students' achievements and attitudes were influenced jointly by a number of factors rather than only one dominant factor. Again, the study of Walberg and Anderson (1968) reported that classroom and school environments were particularly strong influence on students' outcomes, even when a number of factors were controlled.

The (HPP) assessed fifteen different classroom environment scales and some of them are related to the social relationship dimension of student cohesiveness and equity sub-scales used in this study to assessed students' perception of their biology classroom environment. Social relationships inherent in classroom situations and the perceived fairness in the classrooms are seen as important aspects of classroom environment studies from the beginning of this field of research. The final version of the LEI which was developed had 105 items with seven scales measuring typical school classrooms. The respondents to items in this instrument are allowed to express a degree of agreement or disagreements with statements choosing from four responses (strongly disagrees, disagree, disagree and strongly agree). However, to assess the reliability and validity of the LEI, Fraser, Anderson, and Walberg (1991) reported that the instrument was reliable and a valid measure of classroom environment. Scales from this instrument have also been used in Japanese language to determine its factor structure quite recently by Hirata and Sako (1998), and were found to be very useful.

Moos (1979) in an attempt to measure social environments in which humans interact, though not all of it involved educational settings, he integrated the measurement of perceptions of those involved in the environment for the study. The Classroom Environment Survey (CES) was therefore developed for his study. The environments Moos studied included psychiatric hospitals, prisons, university residences, and work environments (Fisher & Fraser, 1998; Moos, 1979; Moos & Trickett, 1987). The original version of the CES consisted of 242 items with 13 dimensions (Trickett & Moos, 1987). It was then subject to some modifications; and the final published version contained 90 items (nine scales with 10 items in each of the scales) with a True–False response format for each item. The CES contain scales that measure relationship dimensions of teacher support and involvement, sub-scales of classroom environment as well as personal development areas like task orientation. The development of LEI and CES opened the way for the construction of other classroom environment instruments to measure classroom environments.

The Individualised Classroom Environment Questionnaire (ICEQ) was developed to examine individualised as well as enquiry-based classrooms in an attempt to measure how they are related to the environment. As a result, personalisation and participant dimensions were included as components of the survey. The initial version of the ICEQ (Fraser, 1998) was developed after interviewing teachers and secondary school students. Thereafter, selected experts, teachers, and junior high school students reviewed the survey in a draft form and it was then modified into a shorter version of 50 items (10 items in each five scales). The ICEQ is answered by responding to a five–point Likert-type scale response format with the alternatives (Almost never, Seldom, Sometimes, Often and Very often). Asghar and Fraser (1995) used the ICEQ to investigate the relationship between secondary school students' perceptions of their science classroom environment and their attitude towards science in Brunei, and it was found to be valid which was established through a series factorial analysis and reliable which ranged between 0.86 to 0.96.

Another instrument "My Classroom Inventory (MCI)", a simplified version of LEI was developed to be used among children aged 8-12 years (Fishers & Fraser, 1981; Majeed, Fraser & Aldridge, 2002). This instrument was suitable for primary school pupils due to its simplicity in wording. However, it has been reported that it has been used at junior high school level, especially with students who have limited reading skills in English. The MCI has 38 items in five scales with a two point (Yes – No) response format. However, Fraser and O'Brien (1985) modified it into a shorter version with 25 items.

Colleges and University Classroom Environment Inventory (CUCEI) was also developed to examine high education classroom environments. It was not designed to assess lecture or laboratory settings, but rather to examine perceptions in small classrooms settings (Taylor, Fraser & Fisher, 1997). The scales in CUCEI included personal development dimension of task orientation, which is not included in this study, and relationship dimension of involvement and student cohesiveness which are important component of this work. The original version of the CUCEI combines features of LEI, CES and ICEQ. The final version of the CUCEI has seven scales, each containing seven items. Each item has four possible responses of strongly agree, agree, disagree, and strongly disagree (Fraser, 1998). Though developed for high educational situations, the dimensions involved are also suitable for investigating secondary school classrooms as well.

The CUCEI has recently been used as a design to improve classroom environment of preservice primary teachers both in university setting and the students' own classrooms (Yarrow, Millwater & Fraser, 2003). Jomer, Malone and Haimes (2002) in using CUCEI to assess the inclusive nature of classroom environment in a university setting reported that, students differ in their perception of their actual classrooms from the preferred environment. They also reported that the instrument was a reliable and a valid measure of university classroom environments.

Questionnaire on Teacher Interaction (QTI) originated from the Netherlands with its focal point at assessing the nature, and quality of interpersonal relationships between teachers and students (Wubbels & Levy, 1993). The development of this instrument was based on the theoretical model of proximity (cooperation-opposition) and influence (dominance-submission), which measures students' perception in eight areas of behaviour and relationship in the classroom (Leary as cited in Fraser, 2000). The behavioural and relationship areas proposed by Leary according to Fraser (2000) are; leadership, helping/friendly, understanding, student responsibility and freedom, uncertain, dissatisfied, admonishing and strict. This instrument had 48 items with a five –point frequency response scale ranging from (never to always). In addition, the QTI has been cross-validated and was found to be useful in various countries (Goh & Fraser, 1998; Lee & Fraser, 2001; Quek, Wong & Fraser, 2005; Scott & Fisher, 2004).

The scales in QTI instrument which measures student-teacher interaction is an important component of educational environment research which has been generally acknowledged and lies in the heart of teacher support sub-scale of science classroom environment. The QTI is still used to determine relationship between teachers and students in their science classroom environment.

In a study in South Korea to find out senior secondary school students-teachers relationship in their science classrooms, it was reported that the students preferred teachers who were strong, friendly leaders and understanding, less uncertain, dissatisfy and admonishing to average teachers (Lee & Fraser, 2002). Earlier studies with QTI also focused on outcome-environment associations for outcomes such as achievement and attitudes toward computers, and science (Quek, Wong & Fraser, 2005).

Science Laboratory Environment Inventory (SLEI) was specifically developed to assess the learning environment of science laboratories at the senior secondary and university levels (Fisher, Fraser & McRobbie, 1996), since laboratories are very important in teaching and learning of science. Though the laboratory settings are part of the larger science classroom settings, there are unique characteristics associated with laboratory settings. SLEI was therefore designed to assess this important science setting. The SLEI has five scales with seven items in each scale. The SLEI has some scales which also measure student cohesiveness in the laboratory setting, which is very important in the learning process. Items in SLEI have five possible frequency responses format (almost never, seldom, sometimes, often and very often). The SLEI has proven to be a reliable and valid instrument to assess science laboratory environments in Singapore, South Korea, South Africa and the USA (Henderson, Fisher, & Fraser, 2000; Quek, Wong & Fraser, 2005). It has been used in biology, chemistry and physics laboratory environments; and in all cases they were found to be useful as stated in Quek, et al, (2005). The development of SLEI has motivated the development of other specialized instrument such as the Distance and Open Learning Environment Scale (DOLES). Maor and Fraser (2004) have used this instrument to investigate computer-assisted learning environment in Canada.

The Constructivist Learning Environment Scale (CLES) was developed with a special focus on student–centered settings and to assist researchers, and teachers to assess the degree to which a particular classroom environment was consistent with a constructivist epistemology (Taylor, Fraser & Fraser, 1997). The constructivist theory of learning states that, individuals learn based on their previously-constructed active negotiations within classroom and consensus building. The CLES was therefore developed to assist teachers to alter their classroom environment in compliance with this critical constructivist epistemology (Taylor, et al, 1997). This instrument has 30 items (five scales with six items in each scale). Each item has a five – point Likert-type scale format (almost never, seldom, sometimes, often and almost always). The CLEI has been cross-validated in USA (Nix, Fraser & Ledbetter, 2005) Korea (Lee & Fraser, 2001) South Africa (Aldridge, Fraser & Sebela, 2003) and Australia and Taiwan (Aldridge, Taylor, Fraser & Chen, 2000). The CLES which measures how teachers apply the constructivist principles in science classrooms is pertinent because constructivists views permeates the world of education today, and it is essential in many of the aspect that contemporary classroom environment instrument attempts to measure. It must be therefore noted that, the constructivists' viewpoint cannot be achieved in classrooms without teacher support and equity.

What Is Happening In This Class? (WIHIC)

The "What Is Happening In this Class?" (WIHIC) questionnaire was developed by Fraser, McRobbie and Fisher in 1996 to combine important scales from past questionnaires with contemporary dimensions to bring parsimony to the field of classroom environment. Since its development, the WIHIC has been found to be consistently reliable and valid across several subject areas in science, and in several countries, such as in Australia, Taiwan, Brunei, the United States, South Africa, and Canada (Aldridge & Fraser, 2000; Aldridge, Fraser & Huang, 1999; Aldridge, Laugksch, Fraser & Seopa, 2006; Zandvliet & Fraser, 2005), mathematics in Indonesia (Margianti, Aldridge & Fraser, 2004), and mathematics and geography in Singapore (Fraser & Chionh, 2000). Recently, a large cross-national validation of the WIHIC was conducted using confirmatory factor analysis (Dorman, 2003) with close to 4,000 mathematics and science high school students from Australia, the UK, and Canada and was also found to be valid and reliable. More recently, Asian researchers have again cross validated several questionnaires in English-speaking countries (Singapore and Brunei), but also have completed the laborious task of translating, back-translating and validating these instruments in the Chinese, Indonesian, Korean, and Malay languages (Fraser, 2002; Kim, Fisher & Fraser, 2000; Scott & Fisher, 2004) all to assess the quality of the instrument.

Originally, the WIHIC had eight scales, with 10 statements in each scale, but was later modified to seven scales with 8 items in each scale. This was after rigorous statistical analyses of data collected from students and teachers (Huang, Aldridge & Fraser, 1999) have been done. The seven scales of the new WIHIC include three dimensions of Moos' categorization of human environment. The student cohesiveness, teacher support, and involvement scales in the instrument measure the environment from the relationship perspective both in a student–to–student and a student-to-teacher direction. The investigation, task orientation, and cooperation scales of the instrument examine the personal development dimension the Moos' human environment focusing on aspect of the classroom environment that measure students' motivation and unique learning styles. The equity scale however, measures system maintenance and change dimension which is related to the perceived fairness of the classroom structure and the instructor. However, looking at the WIHIC scales, it is evident that many of them were adapted from earlier instruments developed to assess classroom environment. Each scale of this instrument comprised eight items, using a five-point Likert-type rating scale (Always to Almost never), a composite value for each scale is assigned to an item for analyses. Even though WIHIC exist in both "preferred" and "actual" forms, a modified version of the actual form is normally used in order to identify the perceptions of the subjects involved regarding the classroom environment within which they are located.

The validation of this instrument has been to find association between educational issues and classroom environment. Another important feature of studies for which WIHIC has been used is to find within class gender differences in students' perception of their science classroom environment (Fraser & Aldridge, 2002; Fraser & Chionh, 2000; Kim, Fisher & Fraser, 2000). These types of studies enable possible difference between males and females perception of their classroom environment from the same classroom situation to be examined. In all these studies, females tend to hold more favorable perceptions than do males in the same classroom environment. Furthermore, WIHIC has been used in a number of cross-national studies (Zindveliet & Fraser, 2005; Adolphe, Fraser, &

Aldridge, 2003). These studies have been extremely important because they do not only bring out differences in the educational environments of different nations but also, their similarities. These studies also take into account the idea that varieties of cultures and language influence the classroom environment. They are also used to determine whether other factors affect classroom environment or achievement of students. Also, studies that have used WIHIC to determine possible association between classroom environment factors and attitudes towards educational issues, specifically biology (Chui-Seng, 2004; Cakiroghi, Rakici & Telli, 2007) are the most relevant for this study.

The relationship between the perceived classroom environment and students' attitude towards a specific subject can give greater insight into the outward behaviour of students of that subject. Though, studies to fine association between students' perceptions of their classroom environments and their attitudes towards science have been done, little has been reported within the area of biology classroom environment. Studies that have employed WIHIC scales and ideas of very best classroom environment aspects for the past three decades have given insight into science classroom environments in secondary schools, though that of Africa and for that matter Ghana is not much.

The robustness and reliability of WIHIC in a variety of classroom environment studies across the world, and in a variety of languages offers a tool that can investigate aspects of classroom environment efficiently. It is on the bases these qualities of WIHIC as stated that informed its selection to serve as a guide to the construction of the BCEQ used specifically for this study. The construction of BCEQ for this study became necessary due to the fact that, some of the dimensions in the original instrument cannot apply in the typical Ghanaian senior secondary school classroom**.**

Areas of Past Research into Classroom Environment and the Instruments Used

Studies of classroom environments in which WIHIC has been employed have shown greater variety, and also given greater insight into the field of classroom environment research. Africa has also enjoyed the use of WIHIC to assess its students' perception of their science classroom environments (Mucherah, 2008, in Kenya; Zindveliet & Fraser, 2005; Adolphe, Fraser, & Aldridge, 2003, in South Africa). Many of the classroom environment studies have used most of the instruments mentioned. Some of these instruments have also served as a guide to develop others to suit the context in which it was used. The SLEI developed by Fraser, McRobbie & Giddling (1993) served as a guide in constructing the Science Laboratory Environment Questionnaire (SLEQ) used in Ghana to assess secondary school students' perception of their science laboratory learning environment (Ampiah, 2006). Most of these studies have attempted to connect areas of educational theory and practice.

In reviewing past studies in these areas, a clearer picture of the areas that have not received attention would be identified. However, most of the past investigations into classroom environments have followed particular lines. Fraser (1998) identified these areas as presented in Table 1.

Table 1

Areas of Past Research in the Field of Classroom Environment and their Emphases

Research Area	Main Emphasis of Research
Association between students outcome and environment	Investigation of association between perceptions of psychosocial characteristics of classroom and students' cognitive and affective learning outcomes.
Evaluations of educational innovations	Process criteria used in the evaluations of educational criteria area obtained via classroom environment instrument.
Student- Teacher Differences	Investigation of perceived differences between the students and teachers in a classroom situation. Differences could be between actual and preferred environment.
Personal Environment fit	Research into whether student achievement depends on similarity between preferred and actual environment.

Table 1 cont'd

Research Areas	Main Emphasis on Research Areas
Teacher Improvement	Instruments provide feedback information for use in five-step procedure for reflecting upon, discussing, and attempting to improve classroom environment.
Combining Research methods	Research instruments the use of both qualitative and quantitative methods in the same study in order to identify salient features of classroom environment studied.
School psychology	Research instruments can be used to identify areas of classroom life and difference that impact the mental emotional welfare of students.
Limits between environments	Attempts to identify connections and influences of multiple environments involved in the education process both in and out of the formal school.
Cross-national studies	Unique abilities to investigate the similarities and differences between the educational environments of various countries as well as to question the

Table 1 cont'd

Research Areas	Main Emphasis of Research Area
Transitions between Grade levels	practices and beliefs of a given country. Research on the effect of students moving from one level of education to another, such as from primary to junior high school.
Teacher Education	Opportunities to include the topics of learning environments in programmes for the preparation and training of future educators.
Teacher Assessment	Dimensions of learning environments can yield insight into present teaching methods and focus, as well as possible effectiveness from the students' perspective.

Fraser, (1998)

However, Goh and Khine, (2002) streamlined the areas identified by Fraser into five basic lines of classroom environment studies. These are; association between students outcomes and environment, determinants of classroom environment (including evaluation of educational innovations), differences between students and teachers perception of the same classroom, use of qualitative research methods, and cross national studies. However, this study falls within two areas that have been identified by Goh and Khine. Firstly, this study attempts to examine relationship between classroom environment and students' outcome, specifically attitude. Secondly, it combines both qualitative and quantitative procedures which are being advocated in this area of studies (Taylor, 2004). Though many studies have used classroom environment instruments to investigate and analyse classroom environments and its influence on students achievement and attitudes, most of these were done in Australia, US, UK, Turkey with very little done in Africa and for that matter Ghana.

Past Research on Determinants of Classroom Environments

Most of classroom environment dimensions have been used as independent variables in studies aimed at identifying how factors like subject matter and grade level vary with classroom environment dimensions (Fraser, 1994). Determinants mostly assessed with classroom environments are achievements, and attitudes.

A study by Hirata and Sako (1998) reported differences between classroom environment perceptions of at–risk students (non–attendees and delinquents) and normal students in Japan with a sample of 635 from four junior high schools using Japanese version of the classroom environment scales and their attitude towards science. Again, Quek, Wong and Fraser (2005) investigated the impact of the chemistry laboratory environment, teacher–student interaction, and students' attitudes towards chemistry for 200 gifted secondary school students in Singapore. In Brunei, Khine and Fisher (2001; 2002) reported cultural differences in students' classroom environment perceptions and secondary school students' attitude to science. Mucherah, (2008) investigated the perception of secondary school students' of their biology classroom environment and their goal structure in Kenya and reported that there was a positive relationship between biology classroom environment and the students' goal structure. However, attitudes toward various science- related issues have dominated the determinants assessed but, in assessing the science related issues, those of biology have enjoyed little prominence in the literature (Mucherah, 2008).

Theoretical Framework of Research into Attitudes

Herbert Spencer is credited to be one of the first researchers to have come out with the term "Attitude" (Ajzen & Fishbein as cited in Reid, 2006). However, Dewey's philosophy kick started attitude research in science education as noted by Reid. He again reports that Dewey stressed the need for teaching scientific attitudes as an essential aspect of educating reflective thinkers. He further stated that, Waller and earlier efforts by Likert and Thurston to develop instruments to measure scientific attitude also gave some meaning to the earlier works into attitudes.

The concept "attitude" and its associated effects on learning have been a matter of concern and discussion in educational circles for years, yet research into attitudes remains relatively new on the educational research timeline (Osborne, Simpson, & Collins, 2003). It formally began in the 1920s when Thurstone noted that attitudes were measurable (Simpson, Koballa, Oliver, & Crawley, 1994). By the 1960s and 1970s, attitudinal research had greatly increased, with a focus in one of these three areas: measurement of student attitudes; measurement of change in student attitudes following various treatment methods; and identification of relationships in support of student attitude and science-related behaviours (Simpson et al., 1994). Researchers in the late 1970s and early 1980s regarded attitudes as “both facilitators and products of science learning and research efforts focused on documenting student attitudes and their relationship with science achievement” (Koballa & Glynn, 2007). By 1990s, attitudinal research began to lag somewhat because it appeared no real direction or results were being provided for improving attitudes in classroom practice. The drop had been large enough to cause concern among educators, and at the same time, warrant closer examination by researchers. As a result, attitudes of students have become one of the targeted areas of study because studies have demonstrated that, attitudes play an important role in how students benefit from their academic experiences (Redish, Saul, & Steinberg, 1998). Studies by (Simpson, Koballa, Oliver, & Crawley, 1994; Weinberg, 2000; and Thompson & Mintzes, 2002) have reported that attitudes are not reflections of what humans are pre-thought or predisposed to do, but that, attitudes are inferred from behaviours. However, Simpson, Koballa, Oliver, and Crawley (1994) have noted that prior knowledge is a predisposition gleaned from initial opinion a person develops. According to Baldwin, Ebert-May, and Burns (1999) prior knowledge and experience shape the knowledge acquisition process which in turn affect students’ attitudes.

The last decade has experienced tremendous growth and expansion in science education and a corresponding research into “student attitudes that shape and are shaped by student classroom experiences” (Adams, Perkins, Dubson, Finkelstein, & Wieman, 2006). Part of the growth in research into attitudes may be due, in part, to the steady decline in the number of students in the science oriented careers (Osborne, Simpson & Collins, 2003).

Past Studies on Attitude towards Science

Past researches have shown that the classroom and home environments impact on attitude towards science. Simpson and Oliver (1990) found highly positive relationships between student, self, school, family and attitude. Other studies into attitudes have focused on gender and related issues. Simpson, Koballa, Oliver, & Crawley (1994) reported that gender is one of the most significant factors related to student attitude towards science. Cannon and Simpson (1985) and Weinberg (2000) researched into gender, as did Simpson and Oliver (1990). Cannon and Simpson (1985) found that gender was not a significant factor in determining student attitude towards science. This tied in well with what Simpson and Oliver (1990) found that gender was not as significant a factor as they had expected, although males exhibited more positive attitudes toward science and females were more motivated to achieve in science. However, Weinberg (2000) concluded that gender is significant when predicting students' attitude towards the science teacher and enjoyment in science related areas. Both grade level and ethnicity proved to be significant predictors for five of the six attitudes towards science sub-scales (Weinberg, 2000). While the literature has demonstrated the importance of gender in research into attitudes, this study did not focus only on gender; it also looked at the relationship between student attitudes and classroom environment.

There are differences between attitude towards science and scientific attitudes (Gogolin & Swartz, 1992; Simpson, Simon & Collins, 1994). Scientific attitudes are “ways in which scientists believe in and conduct their work” (Simpson, Simpson & Collins, 2003, pp 1051). Attitudes toward science represent “a person’s positive or negative response to the enterprise of science. Put in another way, they refer specifically to whether a person likes or dislikes science. The focus of this study is not toward scientific attitudes but on the attitude towards biology which is one of the sciences anyway. Only a few attitudes towards biology inventories have focused specifically on students’ attitudes or perceptions toward the subject (Dalgety, Coll, & Jones, 2003; Gogolin & Swartz, 1992; Kitchen, Reeve, Bell, Sudweeks & Bradshaw, 2007; Weinberg, 2000). Therefore, the purpose of this work, attitude towards science and more specifically biology, refers to an individual’s thoughts, or motivation to understand science, particularly biology. Attitude is one of the affective elements which have been identified and researched into for about nine decades but there seem to be no clear cut definition in the literature as to what attitudes are. Osborne, Simpson and Collins (2003) categorized attitude into four aspects which could help in the prospect of defining what attitude is:

i. emotions aroused in a situation
ii. emotion associated with a stimulus
iii. expected consequences
iv. relationship of a situation to personal values.

Though these areas are broadly defined, at least it gives a framework within which to categories constructs involved in this area of research. All of the aspects are involved in some form or another when the concept of attitude towards science is used in the literature.

McLeod (as cited in Taylor, 2004) looked at attitudes from a different angle. He preferred to use the term “affect” to describe the broad notion of all emotions, beliefs, and feelings regarding science. McLeod divided the affective domain of science into beliefs, emotions, and attitudes. From McLeod’s categorisation, attitudes are focused on the likes and dislikes of students, the enjoyment that they feel during lessons and the preference that they have during instruction. This area of preference is closely related to the preferred environment of classroom environment studies. This area when put in the context of McLeod classification of attitudes exist more in the classrooms hence the preference for his classification. Positive attitudes towards a subject is an important goal of most science curricular, both as desirable outcomes in their own right and because students with positive attitudes are likely to choose further courses in the sciences and seek employment in science related fields.

In a literature review by Ramsdem (1998), and Osborne, Simpson & Collins, (2003) students’ attitude toward science decrease with age and that boys show more positive attitudes towards science than girls. Furthermore, in a cross-national study of secondary school science students’ in high academic and low academic achieving schools in Korea, Coleman (2004) reported that science students in high academic achieving schools showed a positive attitude towards science as compared with science students in low academic achieving schools who showed negative attitude towards science. The report however was not consistent with a similar study carried out in Singapore where there was no significant difference in attitude towards science between students in both high and low academic achieving schools. The students in both school types reported a positive attitude towards science. The study by Coleman however used science which gives the impression that science is homogenous subject and hence gives a false impression of attitude of students from these categories of schools. The issue is that, attitudes of students could vary with regard to the various sciences (physics, chemistry and biology). Hence there is the need to find what students' attitude towards a specific science subject is in low and high academic achieving schools.

Measurement of Attitudes

A review of instruments for measuring attitude towards science is important because this study sought to investigate how the biology classroom environment is associated with students' attitudes towards biology. According to Laforgia (1988) and Schibeci (1984) open-ended questions, interviews, preference ranking, close-item questionnaire (such as Likert-scales), and projective techniques are the common techniques used to measure students' attitude towards any academic subject. Closed item attitude questionnaire that has gained popularity among science educators is the Test of Science Related Attitude (TOSRA) (Fraser, 1981). The original TOSRA had 70 statements (10 items in each of the seven scales) which ties in extremely well with Klopfer's (1971) categorisation scheme for six affective aims for science education, attitude to science and scientists; attitude to inquiry; adoptions of science attitudes like curiosity and open-mindedness; enjoyment of science learning experiences; interest in science apart from learning experience and interest in career in science. The response format of TOSRA comprise Likert-type scale which students indicate their degree of agreement with each statement using strongly agree, agree, not decided, disagree, and strongly disagree. However, there is disagreement in the literature as to whether the response-format should be four or five. While some authorities say it should be four, making it four then means that the respondents are going to be forced to make decisions whiles they might not be willing to. The TOSRA normally has both positively and negatively-phrased statements, the negatively worded statements are normally reversed for analytical purposes.

The validity of TOSRA has been checked with several studies world wide; Australia (Fraser & Butts, 1982; Lucas & Tulip, 1980; Schibeci & McGraw, 1981), USA (Lightburn & Fraser, 2002; Pickett & Fraser, 2002); (Wong & Fraser 1996) in Singapore; and (Adolphe, Fraser & Aldridge 2003) in South Africa. There have been several studies that have used modified version of TOSRA and have found it to be consistent with the original TOSRA. However, the TORSA served as a guide to construct ATBQ for this study to measure elective science students attitudes towards biology due to its reported reliability in measuring science related attitudes (Aldridge, Fraser, Taylor, & Chen, 2000; Quek, Wong & Fraser, 2005).

Areas of attitude towards biology have been investigated to a limited extent in Africa and for that matter in Ghana and its relationship with classroom environment. Each of these areas of study is important but, putting them together in a study like this would shed new light on association between classroom environment and students attitude towards biology to enable us see clearly what is happening in biology classrooms in Ghana.

Attitude towards Biology

Students attitudes have been extensively studied (Dhindsa & Chung, 2003; Osborne, Simpson, & Collins, 2003) but these studies have focused greatly on science in general (Dawson, 2000) with little attention paid to particular disciplines like biology, physics or chemistry (Salta & Tzougraki, 2004). This could present a camouflage picture of students' attitude towards a particular science subject (Spall, 2003).

Prokop, Tuncer and Chuda (2007) in a data collected from 655 senior high school students in Slovakia reported that gender influence students' attitudes toward biology. They reported that males perceive biology as a difficult school subject than females. The above findings is extremely consistent with that of Baram-Tsabari and Yarden (2005) who reported that male secondary school students in Tanzania see biology as a more difficulty school subject than female students, Prokop, Tuncer & Chuda, (2007) also found that senior secondary school students' attitudes toward biology was influenced by the teacher and the learning environment.

In Ghana, Yidana (2004) reported that male senior secondary school students see biology as a difficult school subject as compared with females who see biology as not difficult. He also reported that male secondary school students' attitude towards biology was influenced by their social backgrounds and the pedagogical strategies employed by their biology teachers in the classroom.

Generally, it appears from the literature that, studies that have investigated students' attitudes towards biology have concentrated on gender differences with little information on whole class students' attitudes towards the subject. Also, since the achievement levels in biology differ in schools, it is important that attitudes of students in these different school types be investigated. This study therefore pays attention to this anomaly in the literature.

Association between Perception of Biology Classroom Environment and Attitude towards Biology

Most previous classroom environment studies investigated association between student outcomes (cognitive and affective) and their perceptions of their classroom environment (Fraser & Fisher, 1982; Haetel, Walberg & Haetel, 1981; McRobbie & Fraser, 1993). In all these studies, associations between students' attitude towards biology and their perception of their biology classroom environment have been reported with regard to gender.

Khoo and Fraser (1998) established a relationship between student's attitudes and their perception using the sub-scales of student cohesiveness, teacher support, involvement, cooperation and equity of "What is Happening in this Class?" (WIHIC) using a sample of 250 students in computing classes in South

Korea. In the study using simple correlation, a significant positive association was found between students' perception and their attitude towards the use of computers. Further, Henderson, Fisher and Fraser (1998) reported that secondary school students' perception of their biology classroom environment with regard to the sub-scales of classroom environment had a relationship with a positive attitudinal outcome when WIHIC was used in Australia with a sample of 640, using simple correlation.

Fraser and Chionh (2000) in a study in Singapore to find out whether there is association between students' perception of their classroom environment using WIHIC sub-scales and their attitudes, self-esteem, and achievement among 2310 secondary school biology students in 75 classes using Spearman's Rank Order Correlation reported a significant positive relationship between students' perception of their classroom environment and their attitude towards biology.

Riah (2003) in an investigation into secondary school students' perception of their chemistry theory classroom environment, using a sample of 564 in Taiwan, reported that the chemistry students perceive their chemistry classroom environment as having high levels of student cohesiveness, teacher support, cooperation and equity and low levels of involvement. However, Riah did not find any significant correlation between the students' perception of their chemistry classroom environment and their attitude towards chemistry. Riah's finding is in congruent with that of Chui-seng (2004), who in his study involving a sample of 636 secondary school students perception of their biology classroom environment reported high levels of student cohesiveness, teacher support, cooperation and equity and low levels of involvement sub-scale of classroom environment. However, he found a negative association between students' perception of their classroom environment across the sub-scales and their attitude towards biology.

Telli, Rakici and Cakirogli (2007) establish a significant positive relationship between students' attitude towards biology and their perception of their biology classroom environment using WIHIC with a sample of 1250 in Turkey. Their study revealed low teacher support and involvement sub-scales of biology classroom environment as against high students cohesiveness, cooperation and equity in seven senior high schools.

Mucherah (2008) in investigating science students' perception of their classroom and its relationship with their achievement in biology in Kenya reported that the students' have a low perception of their classroom environment across all the sub-scales except in the involvement sub-scale. Again, he established a positive relationship between the students' perception of their biology classroom environment and their achievement in the subject.

Summary of Findings

These two fields of study, viz, research into classroom environments and attitudes towards biology are important. Even though attitude has no clear cut definition, the concepts that they investigate are significant in contemporary education because they are readily seen and felt in classrooms of today's students.

It was identified in this review that classroom environment and attitude towards biology involved in the study are grounded in rich theories and have enjoyed considerable attention by researchers in the fields. The fields of classroom environments originated in a separate work of Moss and Walberg and has expend in scope and depth.

Numerous instruments have been constructed to assess various dimensions of classroom environments. The latest have being the WIHIC constructed by Fraser, Fisher, and McRobbie to assess the psychosocial factors of science classroom environments. This instrument has become a worldwide instrument with unquestionable validity and reliability, for which the Biology Classroom Environment Questionnaire used in this study, was modeled after.

Further, attitudes of students in high achieving and low achieving schools towards science have been reported in the literature, but there appears to be no similar studies in the area of biology. This study, therefore pays attention to this area of neglect. Investigations into attitude towards biology were also found to be mainly focused on gender differences and students' were reported to have positive attitude towards biology compared with male students. It appeared from this review that, no study therefore has reported students' attitude toward biology without gender considerations. Studies of students' attitudes toward biology were also seen to have been focused mainly on association of achievement in biology and attitude towards the subject, with very little done on classroom environment and students' attitude towards biology.

Though classroom environment and students' attitude towards biology may have been worked on separately in Ghana, this study is the first to link classroom environment and students' attitude towards biology which could present a clear picture of what is happening in Ghanaian biology classroom environments and the students' attitudes towards biology. It could also reveal if any, association between perception of biology classroom environment and the students attitude towards biology.

CHAPTER THREE

METHODOLOGY

Introduction

This chapter provides information on how the study was conducted. It also gives information on the research design, population, sample and sampling procedure, instruments and detailed procedure for data collection and analyses.

Research Design

A cross-sectional survey was used in carrying out the study. This design was used in order to test four hypotheses formulated to guide the study. The first hypothesis was to find out if any, differences in elective science students' perception of their biology classroom environment in low academic achieving and high academic achieving schools. The second hypothesis was also to find out if any, differences in SSS elective science students' attitude towards biology in low and high academic achieving schools. However, the third hypothesis was to find out if any, relationship existed between elective science students' perceptions of their biology classroom environment and their attitude towards biology. Finally, the fourth hypothesis was to test whether relationships exist among the biology classroom environment sub-scales in both school types.

To accomplish this, schools in Central Region that offered general science programme in 2007/2008 academic year were categorised into low and high academic achieving schools based on the individual school's achievement in SSSCE/WASSCE. Science students in two elective science intact-classes from schools with more than two streams of science classes were randomly selected. Schools with two or less streams had those classes automatically selected to be part of the study since two classes were chosen from the eight schools that participated in the study. This was done after four schools each had been randomly selected from the two school categories. A five-point Likert-type scale Biology Classroom Environment Questionnaire (BCEQ) and Attitude towards Biology Questionnaire (ABTQ) were developed and administered to elective science students in both low and high academic achieving schools to measure their perception of their biology classroom environments, and their attitude towards biology.

Cross-sectional survey was more suitable for the study because it sought to describe how SSS3 elective science students in low and high academic achieving schools perceive their biology classroom environment and their attitude towards biology with out manipulation the environment in which they found themselves by responding to the questionnaires between November and December 2008 (Creswell, 2003; Cohen, Manion, & Morrison, 2001; Fraenkel & Wallen, 2000; Mitchell & Jolly, 2004; Nworgu, 2006). Furthermore, to analyse the information obtained from elective science students in the different school types, some individual items were analysed and those that showed statistical significance difference between the students in the school types were also looked at so as to bring to the fore specific issues of students' perception of their biology classroom environment and their attitude towards biology (Taylor, 2004).

However, the difficulties involved in using cross-sectional survey for the study lay with ensuring that the students in the different school types understood the items on the instruments clearly and also answered them thoughtfully and honestly. Few students in both school types also did not complete some of the items in the questionnaires as well as some also not returning their instruments and therefore such instruments were not added to make meaningful analysis of the information on it (Fraenkel & Wallen, 2000)

Population

The target population for the study comprised all third-year SSS elective science students in all the 23 SSS in Central Region who offered elective science programme in 2008/2009 academic year. Five of these schools were single sex school and the rest were co-educational schools. Also, 18 of the schools were boarding whiles the remaining five were day schools.

Sampling

A multi-stage sampling technique (Shaughnessis, Zechmeister & Zechmeister, 1997) was employed in the study. This is a situation where two or more sampling techniques are employed in a single study. The 23 SSS that offered elective science programme (physics, chemistry and biology) in 2007/2008 academic year out of the 50 SSS in Central Region were categorised into high academic and low academic achieving schools. The categorisation of the schools was based on the general performances of the schools in Senior Secondary School Certificate Examination (SSSCE) / West Africa Secondary School Certificate Examination (WASSCE) in 2002, 2003, 2004, and 2005. The general performances of these years were used because the headmasters of the schools were not willing to release the performance of their schools in biology for the study. Furthermore, the WAEC could not also provide the results of the individual schools in biology due to technical problems, and only provided the general performance of the schools in SSSCE in the said years.

In categorising the schools, senior secondary schools in Central Region that offer elective science programme that fell within the top 50 schools out of the 474 public senior secondary schools nationwide in 2002, 2003, 2004, and 2005 were categorised as high academic achieving schools. However, schools that fell within the last 50 schools in the performance list of the years stated above were also categorised as being low academic achieving schools.

Four senior secondary schools under each stratum were randomly selected using computer generated random numbers; this was done to give the schools in each stratum equal chances of being part of the study. From these four schools under each stratum, elective science students in two intact classes were randomly selected using computer generated random numbers from schools that had more than two streams of classes because of limited time available for the study, and the cost implications. Schools that had two or less streams of classes had those classes automatically selected to be part of the study. The schools that fell within the low academic achieving schools category had an average class size of 35 students and schools within the high academic achieving schools category mostly had between three and four streams of science classes with an average class size of 30.

In all, 356 elective science students from the different school categories participated in the study. One hundred and thirty nine students comprising 38.9% females and 61.2% male with a mean age of 17.9 years and a standard deviation of 0.72 years were from the low academic achieving schools. In the high academic achieving schools there were 217 elective science students comprising 51.2% females and 48.9% males with a mean age of 17.2 years and a standard deviation of 0.84 years.

Instruments

Biology Classroom Environment Questionnaire (BCEQ) and Attitudes towards Biology Questionnaire (ATBQ) were the main instruments used for data collection. In constructing the BCEQ, "What Is Happening In This Class?" (WIHIC) instrument developed by Fraser, McRobbie and Fisher (1996) to measure senior secondary school students' perception of their science classroom environment served as a guide. This is because; it has been internationally validated through several statistical procedures and has reported acceptable reliabilities in all these studies (Fraser, 2000). In developing the BCEQ for the study, WIHIC which was generally developed to measure secondary school students' perception of their science classroom environment served as a guide, in that it was assumed that the five sub scales of the seven sub scales in the original WIHIC existed in biology classrooms in Ghana.

However, since some items on the original WIHIC for example, “My teacher takes interest in me,” could be misinterpreted to means something different in the Ghanaian context the five sub scales of student cohesiveness, teacher support, involvement, cooperation, and equity of the original WIHIC were assumed to exist in Ghanaian classrooms and eight items were wrote to reflect each sub scale making it a 40-item instrument. However, the reliabilities recorded for each sub-scale under the Biology Classroom Environment Questionnaire confirmed that the sub scales exist in the biology classrooms. The inter item correlation coefficient between the items under the Cronbach alpha coefficients analyses were all above 0.30, which meant that the items were highly consistent and a good measure of a particular sub-scale (Fraser, 2000).

The Attitude towards Biology Questionnaire was constructed using the Test of Science Related Attitude (TOSRA) developed by Fraser (1981) as a guide. The TOSRA was used because it has been used in a number of cross-national studies to measure secondary school students’ attitude to science and it has recorded acceptable reliabilities in all these investigations. In developing the ATBQ it was assumed that attitude towards biology was a unidimentional and since the items on the original TOSRA did not reflect the Ghanaian context, 12 items were wrote under the attitude unidimentional instrument. The items were then subjected to inter item correlation coefficient analyses and reported inter item correlation coefficients of above 0.30 making it suitable for the study in Ghana. Table 2 presents the scales and their brief descriptions as used in the BCEQ.

Table 2

Sub scales of BCEQ and their Descriptions.

Scale	Description
Student cohesiveness	extent to which students know, help and are friendly toward each other.
Teacher support	extent to which the teacher is interested in the students, while displaying characteristics of helpfulness, trustfulness, and friendliness.
Involvement	extent to which students are involved and participate in science classroom discussion.
Cooperation	extent to which students cooperate rather than compete with one another on learning tasks.
Equity	extent to which students are treated equally.

Validity of the Instruments

The BCEQ and ATBQ constructed for this study were made available to experts in the Department of Science and Mathematics Education of the University of Cape Coast in the area of classroom environment and attitudes to assess its face and content validity. It was also made available to teachers in the schools where they were pilot-tested for them to point out any unclear statement(s) or term(s) that could confuse the students. Students and teachers who participated in the pilot-testing of the instruments were not part of the actual study to control possible biases.

Pilot-Testing of the Instruments

The BCEQ and ATBQ were pilot-tested in two schools in Central Region during their biology lessons, which had the same characteristics as the schools used for the actual study. Reliabilities for both instruments were determined using Cronbach alpha coefficient. Cronbach alpha was suitable for determining the internal consistency of the items in the instruments because the responses were not to be scored either right or wrong. Since the BCEQ was multi-dimensional in nature, reliability for each dimension was determined. The reliability coefficients obtained for the sub-scales were; Student cohesiveness, 0.80; teacher support, 0.81; involvement, 0.82; cooperation, 0.87; and equity, 0.82. These values however exceeded the reliability coefficient threshold value of 0.60 acceptable for research purposes as noted by Nunnally (as cited in Ampiah, 2006). The reliability coefficient for ATBQ was estimated to be 0.89 which was also above the threshold value of 0.60 as noted by Nunnally (as cited in Ampiah).

Data Collection Procedure

The BCEQ and ATBQ were administered to students in the classes selected in both school types to participate in the study by the researcher. This was done in November and December which was the first term of 2008/2009 academic year. Before this was done, permission was sought from the headmasters and heads of departments whose schools and students were used in the study. This was done by obtaining a written permission from the Department of Science and Mathematics Education of the University of Cape Coast to these individuals. The senior secondary schools that were used in the study were visited to establish rapport first with the teachers and students before the actual date for data collection. Data were then collected by the researcher by moving from one school to another. The data collection was done within a period of four weeks. In each school the students were given the BCEQ to complete after which the ATBQ was then given. This was done in order for the students to get a clearer understanding to respond to the items in the instruments appropriately.

Both BCEQ and ATBQ were administered to the students in all the eight school involved in the study in English, which is the main medium of instruction in Ghanaian secondary schools. The instructions on the instruments were read out to the students, confidentiality of their responses was assured before they were allowed to read the items on their own. The researcher was also available when the instruments were being completed to ensure high return rate of the instruments, and also to ensure all items in both instruments were responded to. The completed instruments were collected the same day. Teachers whose classes were involved in the study were asked to excuse the students, since their presence during the completion of the instruments could influence the students' responses to the items. It took an average of one hour for the students in a class to complete both instruments.

Data Analysis

Information to test if any, difference in elective science students' perception of their biology classroom environment in low and high academic achieving schools was obtained from SSS 3 elective science students in the different school types using the BCEQ. The items in the BCEQ were assigned values on a five-point Likert-type scale format (5-very often, 4-often, 3-sometimes, 2-seldom, 1-almost never). Negative statements had its values reversed. Since the scale was on a five–point Likert-type scale format, three, the mid-value was chosen as an average value to which mean scores above it were considered to be high perception and those below it were then considered to be low perception. The mean and standard deviation scores for each dimension of the BCEQ were estimated, and elective science students' perception of their biology classroom environment was measured using the mean and standard deviation scores. One-way multivariate analysis of variance (MANOVA) was conducted to determine differences in elective science students in both school types perception of their biology classroom environment with the five biology classroom environment sub scales as the dependent variable and the school type as the independent variable. A corresponding one-way analysis of variance (ANOVA) with school type as the independent variable was conducted for each of the sub-scales of the BCEQ individually as a follow up test to the MANOVA to determine where the significant differences that existed between the school categories of their biology classroom environment were coming from. Similarly, independent t-tests were conducted on the items constituting each sub-scale of BCEQ to comment on the items that showed significant difference between the students in the different school types.

The ATBQ was used to obtain information to test if any, the differences in elective science students' attitude towards biology in both low and high academic achieving schools. The items on the ATBQ were assigned values on a five-point

Likert-type scale format (5-strongly agree, 4-agree, 3-undecided, 2-disagree, 1-strongly disagree). Negative items were however reversed to take the reversed value. Since the scale was in a five–point Likert-type scale format, three being the mid- value was chosen as an average value to which scores above it was considered to be positive attitude and those below it were also considered to be negative attitude. Mean and Standard Deviation scores of the responses on the attitude instrument for both school types were estimated to measure elective science students' attitude towards biology. Further, independent sample t-tests were also conducted on the items in the attitude instrument to determine those that showed significant difference between the students in both school types.

In order to determine whether there was any association between elective science students' perception of their biology classroom environment and their attitudes towards biology, Spearman's Rank Order Correlation was conducted to test for the association. Furthermore to test for the hypothesis that there is no significant relationship between the sub-scales of the biology classroom environment of the BCEQ, Spearman's Rank Order Correlation was again used.

In analysing most of the data collected with the various classroom environment instruments to measure students' perception of their biology classroom environment, rigorous data computations such as ANOVA (Mucherah, 2008; Telli, Rakici & Cakirogli, 2007), MANOVA (Fraser, 2002) have often been used. These kinds of data computations are done in the bulk data which tend to leave vital details out (Reid, 2006). To prevent this kind of incomplete analysis, Reid therefore suggests that individual items that are of interest could be analysed to gain deeper insight into the information obtained from rigorous data manipulations. Even though MANOVA and ANOVA were employed to find out if differences exist between elective science students in the different school types, independent sample t-test analyses were also conducted on the items constituting the individual sub-scales to gain more insight into the information obtained as suggested by Reid.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

In this chapter, the results obtained from the analyses of elective science students' perception of their biology classroom environment, their attitude towards biology, the relationship between their perception of their biology classroom environment and their attitude towards biology, and the relationship among the sub-scales of biology classroom environment are presented. These are discussed in relation to the four hypotheses formulated to guide the study.

Elective Science Students' Perception of their Biology Classroom Environment

The first hypothesis sought to test, if any, differences in elective science students' perception of their biology classroom environment in both low and high academic achieving schools. To test this hypothesis, five areas of biology classroom environment namely; student cohesiveness, teacher support, involvement, cooperation, and equity were of interest. The students' perception of their biology classroom environment across the five sub scales were analysed using mean and standard deviation scores obtained from their responses.

As indicated by the mean and standard deviation scores in Table 3, elective science students in both school types had a low perception of their biology classroom environment. This is because none of the mean scores obtained was equal or above the average mean score of 3.

Table 3

Mean (M) and Standard Deviation (SD) Scores for LAS and HAS on Biology Classroom Environment (BCE) Sub scales.

BCE	School type			
Sub-scales	LAS		HAS	
	M	SD	M	SD
Student cohesiveness	2.4	0.7	2.2	0.7
Teacher support	2.2	0.8	1.9	0.8
Involvement	2.5	0.7	2.4	0.8
Cooperation	2.5	0.7	1.9	0.6
Equity	2.2	0.8	1.9	0.8

N=139 (LAS) = low academic achieving schools; Average Mean Score=3

N=217(HAS) =high academic achieving schools.

To find out whether there were differences in elective science students' perception of their biology classroom environment in both school types across the five sub scales of interest, One-way Multivariate Analysis of Variance (MANOVA) was used. This was however done after a preliminary assumption test had been conducted to check for normality, linearity, univariate and multivariate outliers, and homogeneity of variance-covariance matrices, with no serious violations noted. Wilks' Lambda (λ) value of 0.81 was statistically significant F (10,704) =7.76, p<0.001; partial eta squared= 0.10, indicating that the population mean scores on the five sub scales of biology classroom environment are the same for elective science student in low and high academic achieving schools. This means that there is statistically significant difference between the perception of elective science students in low and high academic achieving schools across the five sub scales of their biology classroom environment. A corresponding Analysis of Variance (ANOVA) with school types as an independent variable was conducted for each of the biology classroom environment sub scales as a follow-up test to the MANOVA. This was to determine the sub scale(s) which was/were contributing to the differences between the elective sciences students' perception of their biology classroom environment in both school types.

As shown in Table 4, Analysis of Variance (ANOVA) with biology classroom environment as dependent variable was considered individually for all the five sub scales as a follow-up test to the MANOVA. Sub scales of biology classroom environment that were statistically significant using a Bonferroni adjusted alpha level of 0.005, were teacher support: F(2,365)=6.6, p=0.002, partial eta squared=0.036; cooperation: F (2,356)=27.88, p<0.001, partial eta square=0.14; and equity: F (2,356) =8.39, p<0.001; partial eta squared=0.05. The partial eta squared recorded for the three sub scales indicate that three out of the five sub scales, teacher support, cooperation and equity accounts for the variances in elective science students' in low and high academic achieving schools perception of their biology classroom environment. In all 63.2% of the variation that existed between elective science students in both school type was explained by their perception of their biology classroom environment.

An inspection of the mean scores as presented in Table 3 indicates that elective science students in low academic achieving schools had a slightly high levels of teacher support (M=2.2, SD=0.8) than elective science students in high academic achieving schools (M=1.9, SD=0.8). A further inspection of mean scores as reported in Table 3 reveals that elective science students in low academic achieving schools had a slightly high level of cooperation (M=2.5, SD=0.7) than elective science students in high academic achieving schools (M=1.9, SD=0.6). Similarly, mean scores as reported in Table 3 indicate that elective science students in low academic achieving schools again had a slightly high level of equity: (M=2.2, SD=0.8) than their counterparts in high academic achieving schools (M=1.9, SD=0.8).

The results of one way ANOVA as a follow-up test to the MANOVA on the five sub scales of biology classroom environment are shown in Table 4.

Table 4

Results of ANOVA as a follow up to the One-way MANOVA on the five sub scales of Biology Classroom Environment

Classroom Environment Sub-scales	Df	Mean squared	F	p-values	Partial Eta Squared
Student Cohesiveness	2	1.6	4.1	0.018	0.02
Teacher Support	2	4.1	6.6	0.002*	0.04
Involvement	2	0.9	1.5	0.235	0.01
Cooperation	2	11.8	27.9	0.001*	0.14
Equity	2	5.5	8.4	0.001*	0.05

*Bonferroni Adjusted significant at $P<0.005$.

However, three out of eight items as shown in Table 5 constituting student cohesiveness sub scale showered statistically significant difference between elective science students in both school types.

Table 5

Means Scores (M) and Standard Deviation (SD) for items constituting Student Cohesiveness in low and high academic achieving schools.

Item No	Statements	School Groups	M	SD	t	P
1	Discussion groups are formed among students in the biology class whenever assignments are given.	LAS	3.19	1.45	0.87	0.385
		HAS	3.31	1.14		
2	I am not afraid to respond to questions in the biology class.	LAS	2.35	1.32	0.81	0.421
		HAS	2.24	1.22		
3	I am friendly to all students in the biology class.	LAS	1.62	1.02	1.55	0.123
		HAS	1.46	0.89		
4	I enjoy being in the biology class	LAS	1.94	1.29	0.92	0.358
		HAS	1.82	0.97		
5	I am able to study well with other students in the biology class.	LAS	2.35	1.29	2.93	0.004*
		HAS	1.98	1.03		

Table 5 cont'd

item No	Statement	School Group	M	SD	t	P
6	`I help other students in the biology class who have difficulty in studying the subject.	LAS HAS	2.88 2.68	1.26 1.09	1.65	0.100
7	It is easily noticed when I am not in the biology class.	LAS HAS	2.28 2.38	1.45 1.36	0.62	0.520
8	I can approach any student in the biology class when I need explanation to some biology problem	LAS HAS	2.43 1.64	1.29 0.96	6.23	0.001*

*Significance at P<0.05; Degree of freedom (df) = 354;N=356; Average Score=3

N=139(LAS) = low academic achieving schools;

N=217(HAS) = high academic achieving schools

Item 5 which sought information on whether elective science students were able to study well in their biology classrooms in both school types showed a significant difference between the science students in the two school types t (354)=2.94, p=004. The mean and standard deviation scores of elective science students in low academic achieving schools (M=2.35, SD=1.29) and high academic achieving schools (M=1.98, SD=1.03) indicate that, elective science students in low academic achieving schools were able to study well in their biology classrooms as against science students in high academic achieving schools. This is indicated by 51.8% of the respondents in low academic achieving school who were of the view that they were able to study well in their biology classroom as against 41.5% respondents in high academic achieving schools who were of the same view (see Appendix C for Frequencies and Percentages of Responses). However, effect size statistics conducted on the differences between elective science students in both school types (d=0.3) indicates that, the difference between elective science students in both school types is small (see Appendix D for computation of effect size). Again, item 8 in the same student cohesiveness sub-scale of biology classroom environment sought information on how elective science students in both school types were helped by their colleagues to solve biology problems. Statistical analysis conducted on the item showed significant difference between science students in these schools with $\underline{t}$ (354) =6.27, $\underline{p}<0.001$.

As reported in Table 5, the mean and standard deviation scores of low and high academic achieving schools ($\underline{M}$=2.43, $\underline{SD}$=1.29) and ($\underline{M}$=1.64, $\underline{SD}$=0.94) respectively indicate that, elective science students in low academic achieving schools were helped by their colleagues to solve biology problems in their biology classrooms more than science students in high academic achieving schools. This response was provided by 83.4% of science students in low academic achieving schools as against 60.4% of students in high academic achieving schools. However, confirmation on the differences between science students in both school types by way of effect size computation (d=0.7) indicates that, the difference between the students from the different school types is large.

On teacher support sub scale of biology classroom environment, three out of eight items constituting this sub scale showed statistically significant difference between elective science students in both school types. From Table 6, item 10 which sought information on whether biology teachers accepts suggestions from their students concerning their teaching styles also showed significant difference between science students in both school types $\underline{t}(354) = 2.00$, $\underline{p}=0.05$. The mean and standard deviation scores recorded ($\underline{M}$=2.22, $\underline{SD}$ =1.29) and ($\underline{M}$ =1.94, $\underline{SD}$ =1.09) for low and high academic achieving schools science students' respectively reveal that, 74.8% of science students in low academic achieving schools perceive their biology teachers to accept their input to change their teaching style as against 63.2% of their colleagues in high academic achieving schools whose input were not accepted by their biology teachers. Test conducted to confirm the differences between elective science students in both school types by way of effect size (d=0.2) indicates that, the difference between elective science students is small.

Item 12, which showed significant difference between elective science students in both school types $\underline{t}$ (357) =3.44, $\underline{P}<0.001$, sought information on how biology teachers in both school types help their students when they have difficulty with regard to studying biology. Mean and standard deviation scores for elective science students ($\underline{M}$=2.47, $\underline{SD}$=1.24) and ($\underline{M}$=2.03, $\underline{SD}$=1.12) in low and high academic achieving schools as a presented in Table 6 reports that 81.3% of elective science students in low academic achieving schools perceive their teachers to help them when they have difficulty in studying the subject compared with 69.2% of their colleagues in high academic achieving schools. Again to confirm the differences in how elective science students' in both school types perceive the help their biology teachers give them when they have difficulty in studying the subject, effect size statistics (d=0.4) indicates that, the differences in how elective science students perceive their biology teachers help them in low and high academic achieving schools is medium.

Also, item 13 sought information on how biology teachers of both categories of schools maintain a healthy relationship with their elective science students outside their biology classrooms. Statistical test reveals a significant difference, $\underline{t}$ (357) =7.04, $\underline{p}<0.001$ between elective science students in both school types. The mean scores as presented in Table 5 ($\underline{M}$=2.99, $\underline{SD}$=1.60) and ($\underline{M}$=1.90, $\underline{SD}$=1.13) for low and high academic achieving schools respectively, suggests that, 62.6% of elective science students in low academic achieving schools perceive their biology teachers as maintaining a healthy relationship with them outside their elective biology classrooms. On the other hand, 50.2% of students in high academic achieving schools perceive their biology teachers as keeping a good relationship with them outside their biology classrooms. Effect size statistics computed on the differences between how biology teachers maintain a healthy relationship with their students outside their biology classroom (d=0.8) indicates that, the differences is large.

Items in the teacher support sub scale of biology classroom environment that showed a significant difference between the elective science students in both school types are shown in Table 6.

Table 6

Mean (M) and Standard Deviation (SD) Scores for items constituting Teacher Support in low and high academic achieving schools.

Item No.	Statements	School Groups	M	SD	t	P
9	The biology teacher ensures that I understand what he/she teaches in class.	LAS	1.88	1.19	0.45	0.652
		HAS	1.83	1.0		
10	The biology teacher willingly accepts my comments on how he/she has explained.	LAS	2.47	1.30	2.01	0.046*
		HAS	2.20	1.19		
11	When requested by students during biology lessons the teacher willingly goes over things he/she had taught.	LAS	1.91	1.14	1.86	0.064
		HAS	1.71	0.96		
12	The biology teacher helps me when I have difficulty studying the subject.	LAS	2.47	1.24	3.44	0.001*
		HAS	2.03	1.12		
13	The biology teacher maintains a healthy student-teacher relationship with me after class.	LAS	2.99	1.60	7.04	0.001*
		HAS	1.90	1.13		

Table 6 cont'd

Item No	Statement	School Group	M	SD	t	p
14	The biology teacher talks excitedly about the subject which encourages me to study the subject.	LAS	2.01	1.30	0.05	0.957
		HAS	2.00	1.13		
15	The biology teacher motivates me in class.	LAS	1.96	1.25	0.72	0.470
		HAS	1.88	1.04		
16	My biology teacher asks me questions to find out if I understand the lesson.	LAS	2.06	1.27	0.48	0.484
		HAS	1.97	1.12		

*Significance at $P < 0.05$; Degree of freedom (df) = 354; Average Score=3

N=139 (LAS) = low academic achieving schools;

N=217(HAS) = high academic achieving schools

Similarly, item 19 in the involvement sub-scale of biology classroom environment sought information on how science students' in low and high academic achieving schools involve themselves in elective biology classroom decision making. Statistical analysis conducted on the item reported significant difference between elective science students in both school types t (357) = -2.52, p=0.012. The mean and standard deviation scores of (M=2.30, SD=1.18) and (M=2.63, SD=1.19) elective science students in low and high academic achieving schools respectively indicate that, 46.9 % of students from high academic achieving schools involve themselves in biology classroom decision making as against 47.0% of their colleagues from low academic achieving schools.

However, effect size statistics conducted on the difference between elective science students in both school types (d=0.3) confirms the marginal difference between the students in the school types.

Also some items constituting the involvement sub scale of biology classroom environment showed significant differences between the elective science students of both school types as presented in Table 7.

Table 7

Mean (M) and Standard Deviation (SD) Scores of items constituting Involvement in low and high academic achieving schools.

Item No	Statement	School Groups	M	SD	t	P
17	I participate in class discussions during biology lessons.	LAS	2.17	1.15	1.02	0.309
		HAS	2.30	1.14		
18	I make suggestions during biology class discussion.	LAS	2.45	1.21	1.10	0.272
		HAS	2.60	1.23		
19	I am involved in decision making in the biology classroom.	LAS	2.30	1.18	2.52	0.012*
		HAS	2.63	1.19		
20	My suggestions are normally accepted during biology classroom discussions.	LAS	2.58	1.07	0.89	0.377
		HAS	2.47	1.04		

Table 7 cont'd

Item No	Statement	School Group	M	SD	t	p
21	I ask my biology teacher questions when I have difficulty in understanding a lesson.	LAS HAS	2.14 2.05	1.22 1.13	0.68	0.498
22	I explain my ideas in biology to other students in the class.	LAS HAS	2.53 2.41	1.22 1.10	0.89	0.376
23	I get help from other students in the biology when I have difficulty in solving biology problem.	LAS HAS	1.62 1.93	1.24 1.01	5.50	0.001*
24	I am asked to explain how I solve biology problems in class.	LAS HAS	3.16 3.14	1.27 1.27	0.15	0.020*

*Significance at P<0.05, Degree of freedom (df) = 354, Average Score=3

N=139 (LAS) = low academic achieving schools.

N=217(HAS) = high academic achieving schools.

Item 23 which sought information on how the elective science students were helpful by their colleagues when they have difficulty in solving biology problems, showed significant difference between science students in both school types $t(354)=5.50$, $p<0.001$. The mean and standard deviation scores for elective science students in both low and high academic achieving schools (M=1.62, SD=1.24) and (M=1.93, SD=1.01) respectively as presented in Table 6 indicate that, 74.6% of science students in high academic achieving schools perceive their colleagues to be helpful in their studies biology while as 45.3% of those from low academic achieving schools. Effect size (d=0.6) analysis conducted to determine the extent to which science students in low and high academic achieving schools differ in helping their colleagues' reports that, the difference is medium.

Statistical analysis on item 24 which sought to find the extent to which elective science students were made to explain a concept in class, showed significant difference between elective science students in both school types t (354)=0.15, P=0.020. This means that there were differences in the way elective science students in both school types were made to explain a concept in class. However, examination of the mean scores (M=3.16, SD=1.27) and (M=3.14, SD=1.27) for science students in both low and high academic achieving schools respectively as presented in Table 7 indicate that, 64% of elective science students in low academic achieving schools were of the view that they were made to explain concepts in their biology classrooms as against 62% of their counterparts in high academic achieving schools. Effect size computed on the difference (d=0.02) indicates that the difference between the school groups was very small.

Again some items constituting the cooperation sub scale of biology classroom environment showed significant difference between elective science students in both school types. Apart from item 31, the remaining seven out of the eight items as presented in Table 8, reported significant differences between science students in both school types. Item 25, sought information on how elective science students in both school types cooperate with one another when they were put in groups to do biology assignments was significant t (354) =3.01, P=0.003. Furthermore the mean and standard deviation scores (M=2.45, SD=1.24) and (M=2.07, SD=1.06) of responses provided by elective science students in low academic and high academic achieving schools respectively report that, science students in low achieving were of the view that there were more cooperation amongst them as against their counterparts in high academic achieving schools who perceive less cooperation amongst them. Effect size statistics conducted on the difference between the students in both school types (d=0.3) indicate that the difference is small.

Similarly Item 26, also showed significant difference between elective science students in both school types when statistical test was conducted on it t(354) =9.57,p<0.001. It sought information from elective science students on how often they share their biology books and other educational materials with their colleagues in their biology classrooms. Mean and standard deviation scores (M=2.94, SD=1.45) and (M=1.62, SD=0.91) as presented in Table 7 indicate that, elective science students' in low academic achieving schools do share their biology books and other educational materials with their mates in their biology classrooms as against their colleagues in high academic achieving schools who "almost never" share the biology books and other educational materials with their colleagues in biology classrooms. However, the extent to which elective science students in both school groups differ on this practice was assessed by computing effect size statistics on the item. Effect size of (d=1.0) indicated that the differences between elective science students in both school groups is large.

Table 8

Mean (M) and Standard Deviation (SD) Scores of items constituting Cooperation in low and high academic achieving schools.

Item No.	Statement	School type	M	SD	t	P
25	I cooperate with other students when doing biology assignment.	LAS	2.45	1.24	3.01	0.003*
		HAS	2.07	1.06		
26	I share my biology and other educational materials with other students in the biology class.	LAS	2.94	1.45	9.58	0.001*
		HAS	1.62	0.91		
27	There is team work amongst us when put in groups to do biology exercise.	LAS	2.62	1.50	3.77	0.001*
		HAS	2.05	1.20		
28	There is much competition amongst us in the biology class.	LAS	2.30	1.38	2.75	0.006*
		HAS	1.91	1.17		

Table 8 cont'd

Item No	Statements	School Groups	M	SD	t	p
29	I learn from other students in the biology class.	LAS	2.18	1.24	5.06	0.001*
		HAS	1.57	0.86		
30	I enjoy learning with other students in the biology class.	LAS	2.24	1.26	3.71	0.001*
		HAS	1.81	0.85		
31	My suggestions are accepted by my colleagues in the biology class.	LAS	2.58	1.01	0.22	0.823
		HAS	2.55	0.87		
32	Other students in the biology class help me with my studies so that I do better in the subject.	LAS	2.77	1.32	3.76	0.001*
		HAS	2.27	1.15		

*Significance at $P < 0.05$, Degree of freedom (df) = 354, Average Score=3

N=139 (LAS) = low academic achieving schools;

N=217 (HAS) = high academic achieving schools

On whether there was team work amongst elective science students in both school types when they were put into groups in their biology classrooms for academic work of item 27 tested significant t (357) =3.77, p<0.001. The mean and standard deviation scores (M=2.62, SD=1.50) and (M=2.05, SD=1.20) for low and high academic achieving schools respectively, indicates that elective science students in low academic achieving schools cooperate on learning tasks than those in high academic achieving schools during group studies in biology. Effect size computed on the item (d=0.4) indicates that the difference is large.

Again, item 28 which sought information from science students in both school types on whether there was competition amongst them in their biology classrooms reported significant difference in the statistical tests conducted on the item $t(354)=2.75$, $p=0.006$. The mean and standard deviation scores (M=2.03, SD=1.38) and (M=1.91, SD=1.17) of science students in low and high academic achieving schools respectively indicate that, elective science students' in low academic achieving schools perceive there was competition amongst them in their biology classrooms, whereas those in high academic achieving schools perceive that there was no competition amongst them. The difference between students in both school groups by way of effect size (d=0.3) is small.

On item 29, which asked elective science students in both school types whether they learn from their colleagues in their biology classrooms, analysis on the item showed significant differences between elective science students in both school types, $t(354)=5.06$, $P<0.001$. The mean and standard deviation scores (M=2.18, SD=1.24) and (M=1.57, SD=0.86) of low and high academic achieving schools show that, elective science students in low academic achieving schools learn from their colleagues in their biology classrooms, whereas those in high academic achieving schools "almost never" learn from their colleagues in their biology classrooms. Effect size statistics computed (d=0.5) indicate that the difference was medium.

Item 30 sought information on whether science students in low and high academic achieving schools enjoy learning with other science students in their biology classrooms. Analysis on the item showed significant differences between science students in both school types, t (354) =3.71, p<0.001. As indicated by the mean and standard deviation scores (M=2.24, SD=1.22) and (M=1.81, SD=0.85) of low and high academic achieving schools respectively, science students in low academic achieving schools do enjoy learning with their colleagues in their biology classroom as against science students in high academic achieving schools who "almost never" enjoy learning in their biology classrooms with their colleagues. Effect size computed on the item (0.4) shows that, the difference between science students in both school types is medium. Again item 32 showed significant difference t (357) =3.76, p<0.001 between science students in both school types. This item was on whether science students in both category of school encourage their colleagues to do well in biology. The mean and standard deviation scores (M=2.77, SD=1.32) and (M=2.27, SD=1.15) for science students in low and high academic achieving schools respectively suggest that, science students in low academic achieving schools encourage their colleagues to do better in biology than their counterparts in high academic achieving schools do. Effect size statistics (d=0.4) indicate that the difference between students to encourage their colleagues to do well in the subject is medium.

Similarly, as with student cohesiveness, teacher support and involvement sub-scales of biology classroom environment some, items constituting the equity sub-scale of biology classroom environment showed significant difference between elective science students in low and high academic achieving schools. Item 33 which sought information from elective science students as to whether their biology teachers gave their questions equal attention as their colleagues tested significant t (357) =2.92, p=0.004. This means that there were disparities in the way biology teachers give attention to questions of their elective science students in their biology classrooms. Examination of the means and standard deviation scores (M=2.61, SD=1.50) and (M=2.16, SD=2.16) for low and high academic achieving schools respectively indicates that 52.5% of science students in low academic achieving schools were of the view that they receive equal treatment of their questions in their biology classrooms as against 42.0% of their colleague in high academic achieving schools. However, effect size statistics conducted on the item (d=0.3) indicates that the difference between science students in both school groups is small.

Item 34 which also sought the views of science students in both low and high academic achieving schools on whether they receive the same amount of help from their biology teachers tested significant. This meant differences exist between science students of both school categories t (354) =3.20, p=0.002. The means and standard deviation scores (M=2.52, SD=1.46) and (M=2.05, SD=1.20) for low and high academic achieving schools depict that science students in low academic achieving schools receive some amount of help from their biology teachers more than their colleagues from high academic achieving schools. This difference is also shown by the effect size computed on the item (d=0.3), which indicates that the difference is small.

On whether elective science students in the different school types have the same amount say in their biology class of item 35 was significant t (354) = 4.52, p<0.001. The mean and standard deviation scores (M=2.37, SD=1.21) and (M=1.82, SD=1.02) for science students in low and high academic achieving schools respectively indicate that, science students in low academic achieving schools have some amount of say in their biology classrooms as against their colleagues in high academic achieving school who "almost never" have a say in their biology classroom. However, effect size computed on the item (d=0.5) show that the difference between students in both low and high academic achieving schools in terms of having a say in their biology classroom is medium.

Again, item 36 on how friendly biology teachers of these school categories were to their elective science students, analysis on the item showed a significant difference between the friendliness of biology teachers in both schools types t (354) =2.19, P=0.030. The mean and standard deviation scores (M=1.88, SD=1.25) and (M=1.62, SD=0.90) for low and high academic achieving schools report that, biology teachers in low academic achieving schools are friendlier towards their students than their colleagues in high academic achieving schools. Effect size statistics computed on the item (d=0.2) confirm the difference between students from both school groups is small.

Table 9

Mean (M) and Standard Deviation (SD) Scores of items constituting Equity in low academic and high academic achieving schools.

Item No.	Statements	School type	M	SD	t	P
33	My biology teacher gives my questions much attention as he/she does to other students questions.	LAS HAS	2.61 2.16	1.50 1.29	2.92	0.004*
34	I get the same amount of help from my biology teacher as he/she gives to other students.	LAS HAS	2.52 2.05	1.46 1.20	3.20	0.002*
35	I get the same amount of say in the biology class as other students.	LAS HA	2.37 1.82	1.21 1.02	4.52	0.001*
36	The biology teacher is friendly to me the same way he /she is other to other students.	LAS HAS	1.88 1.62	1.25 0.89	2.19	0.030*

Table 9 cont'd

Items No	Statements	School Groups	M	SD	t	P
37	I receive the same encouragement from my biology teacher as other students do.	LAS HAS	1.91 1.64	1.16 0.04	2.35	0.020*
38	The biology teacher trusts me to get certain amount of work done as other students in the biology class.	LAS HAS	2.05 1.87	1.14 1.04	1.57	0.117
39	My work in biology receives as much praise as other students' work.	LAS HAS	2.39 2.23	1.13 1.16	1.27	0.204
40	I get the same opportunity to answer questions in the biology class as do other students.	LAS HAS	1.95 1.72	1.18 0.97	2.00	0.046

*Significance at $P < 0.05$; Degree of freedom (df) = 354; Average Score= 3

N=139; (LAS) = low academic achieving schools,

N=217; (HAS) = high academic achieving schools.

Also, Item 37 sought elective science students' views on the level of encouragement they receive from their biology teachers in both school groups. Analysis on the item t (354) =2.35, p=0.020 showed significant differences between the levels of encouragement science students in both schools types receive from their biology teachers. The means and standard deviation scores (M=1.91, SD=1.16) and (M=1.64, SD=0.04) of science students in low and high academic achieving schools respectively indicate that, elective science students in low academic achieving school receive encouragement from their biology teachers than their colleagues in high academic achieving schools. However, as shown by the effect size computed on the item (d=0.3) the difference between the science students in both school types on whether they receive encouragement from their biology teachers is small.

From the analyses of the first hypothesis which sought to test if any differences existed in elective science students in low and high academic achieving schools perception of their biology classroom environment. Five sub scales namely; student cohesiveness, teacher support, involvement, cooperation and equity were of interest. The students' perception of their biology classroom environment was determined by using their mean and standard deviation scores across the five sub scales. However to determine differences between the students' in both school types perception of their biology classroom environment MANOVA and a follow-up ANOVA were conducted. Independent sample t-test was also conducted on the items constituting the various sub-scales.

Generally, from the analyses conducted on first hypothesis, even though elective science students in both school types had a low perception of their biology classroom environment. Students in both school types showed significant differences in how they perceive their biology classroom environment. The differences were in the areas of teacher support, cooperation, and equity sub-scales. This was however in favour of elective science students in low academic achieving schools. This results contradict what Riah (2003), Chui-Seng (2004) and Mucherah, (2008) found in their study with science students in Taiwan, Brunei and Kenya respectively, as science students in those countries had a high perception across all except the involvement sub scale of their biology classrooms. However, low perception of elective science students in both school types with regard to the involvement sub scale of their biology classroom environment ties in with what Riah, Chui-Seng and Mucherah found in their studies.

Elective Science Students' Attitude towards Biology

The second hypothesis sought to test the differences, if any, elective science students in both low and high academic achieving schools attitude towards biology. This was done by considering attitude towards biology as unidimentional. Attitude of elective science students towards biology was analysed using the mean and standard deviation scores of responses provided by the students. Also, Independent sample t-test was conducted to determine differences in attitude of the elective science students in both school types. Furthermore, an Independent sample t-test was conducted on items constituting the attitude towards biology dimension.

Table 10

Mean (M) and Standard Deviation (SD) Scores of items constituting Attitude towards Biology in low and high academic achieving schools.

Items No.	Statements	School type	M	SD	t	P
1	It is best to find out why something is true by checking it from biology textbooks than being told by the teacher.	LAS	4.09	1.42	1.12	0.265
		HAS	3.93	1.26		
2	The topics covered in biology are not interesting.	LAS	3.47	1.38	0.73	0.468
		HAS	3.36	1.42		
3	There should be more biology lessons every week.	LAS	4.14	1.20	5.67	0.001*
		HAS	3.41	1.16		
4	Biology is one of the most Interesting science subjects.	LAS	4.58	0.91	3.89	0.001*
		HAS	4.13	1.15		
5	I am always prepared for biology lessons.	LAS	4.37	1.26	4.94	0.001*
		HAS	3.72	1.13		
6	Biology lessons are boring.	LAS	3.68	1.60	1.68	0.102
		HAS	3.40	1.45		
7	It is important to study biology at school.	LAS	4.53	0.96	-1.37	0.195
		HAS	4.65	0.75		

Table 10 cont'd

Items No	Statements	School Groups	M	SD	t	p
8	I would like to study biology related course at the highest level of my education.	LAS	4.27	1.09	1.57	0.104
		HAS	4.06	1.28		
9	Doing well in biology is important to me	LAS	4.52	0.783	-5.51	0.001*
		HAS	4.86	0.38		
10	I really enjoy biology lessons.	LAS	4.31	1.38	2.27	0.029*
		HAS	4.00	1.16		
11	I would enjoy science the more if there were no biology lessons.	LAS	2.14	1.21	1.84	0.062
		HAS	1.90	1.11		
12	Biology is the most difficult of all the science subjects.	LAS	1.97	1.11	0.49	0.622
		HAS	1.91	1.16		

*Significant at p>0.05; Degree of freedom (df) = 354; Average Mean Score =3

From Table10 elective science students in both school types had mean scores greater than the average mean score of three (3). These therefore suggest that elective science students in both school types have a positive attitude towards biology. Again, the mean scores of elective science students in both school types as presented in Table 10 depict that, students in low academic achieving schools have a slightly high positive attitude towards biology than their counterparts in high academic achieving schools.

However, independent sample t-test t (354) =1.17,p =0.198 conducted to determine whether there was a significant difference between students in both low and high academic achieving schools with regard to their attitude towards biology showed that there is no significant difference between the students in both school types. The results from analyses of the second hypothesis is similar to Coleman (2004) who reported that science students in low and high achieving schools in Singapore have a positive attitude towards science. The results of the second hypothesis however contradicts a similar work by Coleman in South Korea where science students in low achieving schools had a negative attitude whiles those from high achieving schools had a positive attitude towards science.

Association between Perception of Biology Classroom Environment and Attitude toward Biology

The third hypothesis which was to test the relationship between elective science students' perception of their biology classroom environment and their attitude towards biology was done using Spearman's rank order correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumptions of normality, linearity and homoscendasticity. There was virtually no correlation between the two variables ($r = 0.02$, $n = 356$, $p > 0.05$), with elective science students' perception having no association with their attitude.

From the analyses of the third hypothesis, which was to find out if there exist any association between elective science students perception of their classroom and their attitude towards biology, Spearman's rank order correlation revealed that, virtually no relationship exists between elective science students' perception of their biology classroom environment and their attitude toward biology in both school types. This is shown in Figure 1

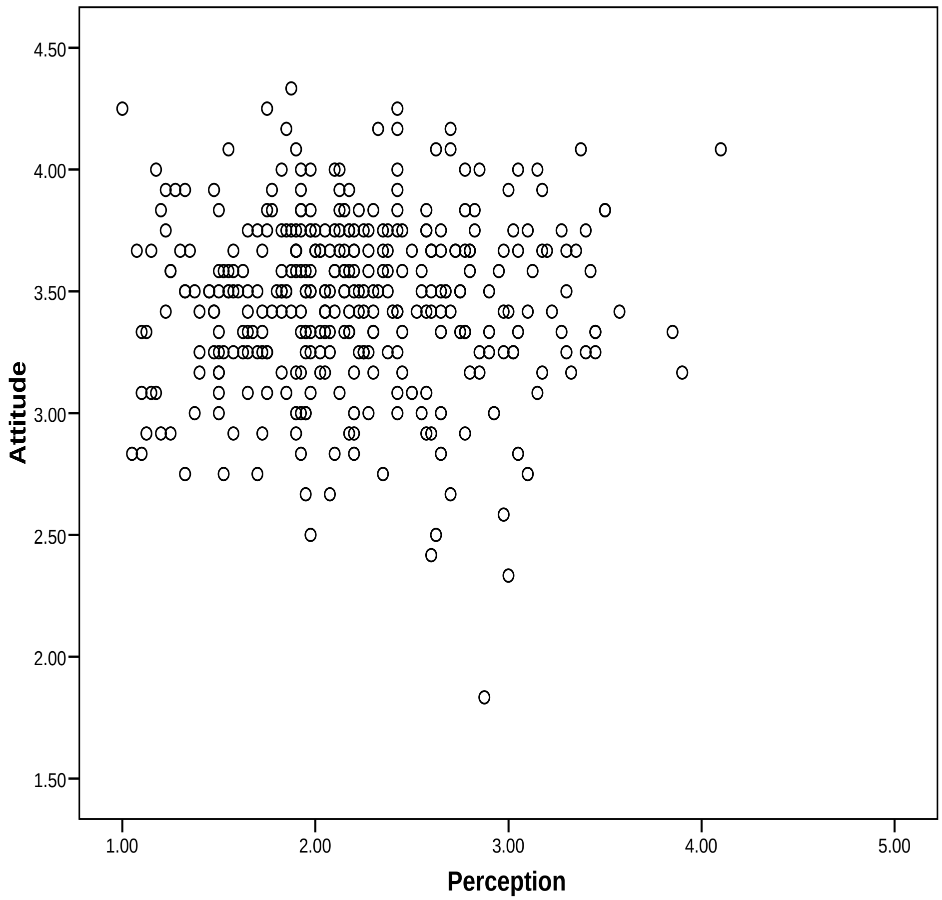


Figure 1: **A Scatter Plot Showing the Correlation between Students' Perceptions of their Biology Classroom Environment and their Attitude towards Biology in LAS and HAS**

The findings of the study with regard to third hypothesis is not in agreement with what (Khoo & Fraser, 1998; Fraser & Chionh, 2000; and Telli, Rakici & Cakirogli, 2007) found in their works in which they established a relationship between students perception of their classroom environment and their attitude towards biology. The results from the analysis of the third hypothesis is not surprising as perception and attitudes are independent concepts and one' attitude does not necessarily depend on his/ her perception.

Relationship among the Sub scales of Biology Classroom Environment in LAS and HAS

The fourth hypothesis that there is no significant relationship among the five sub scales of biology classroom environment in low and high academic achieving school was also tested using the Spearman's rank order correlation. A Bonferroni Adjustment to control for Type I error among the 10 comparisons, p-value of less than 0.005 was required for significance. Table 13 presents the results of correlations among the sub scales of biology classroom environment in low academic achieving schools.

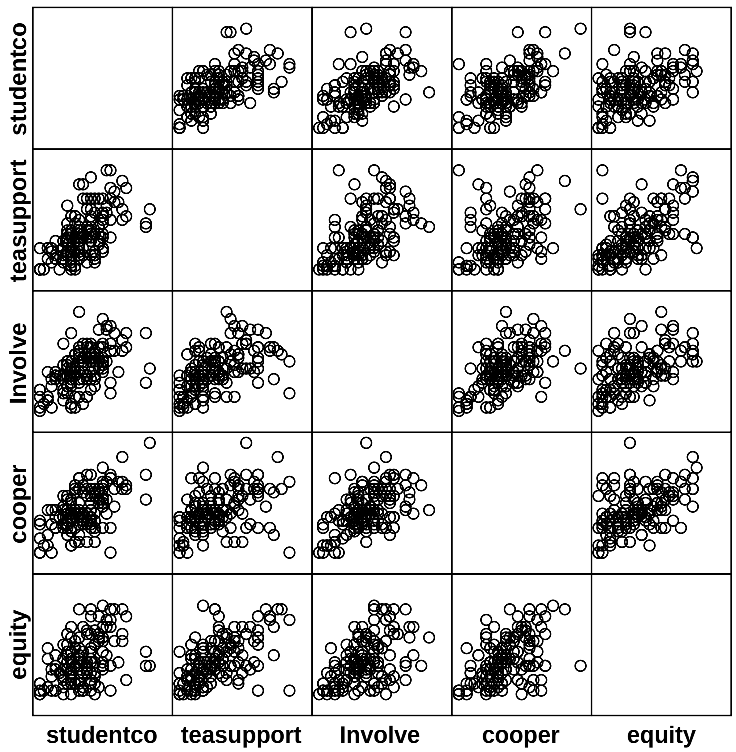
Table 13

Results of Spearman's Correlation among the Sub scales of Biology Classroom Environment in LAS

Biology Classroom Environment	Student cohesiveness	Teacher Support	Involvement	Cooperation	Equity
Student cohesiveness		0.61*	0.56*	0.51*	0.43*
Teacher Support			0.53*	0.43*	0.59*
Involvement				0.52*	0.45*
Cooperation					0.45*
Equity					

* r values significant at $p<0.005$; N=139

The results of the correlational analyses as shown in Table 13 for the sub scales of biology classroom environment in low academic achieving schools indicate that, there is positive relationships among the sub scales which were statistically significant at p<0.005. This therefore means that, as a particular sub scale in the biology classroom environment increases, it results in an increase in a corresponding sub scale of the same environment. Hence the null hypothesis that there is no significant relationship among the five biology classroom environment sub-scales in LAS was rejected. The relationships among the sub-scales in LAS are shown in the scatter plot matrix present in the Figure 2.



Student cohesiveness = studentco; Teacher support = teasupport

Involvement =Involve; Cooperation = cooper;

Figure 2: **A Scatter Plot Matrix showing the Relationship among Student Cohesiveness, Teacher Support, Involvement, Cooperation and Equity in LAS**

On the relationship among the five sub scales of biology classroom environment in HAS, the correlational analyses as shown in Table 14 below indicates that, there is also a positive statistically significant relationships among all the sub scales.

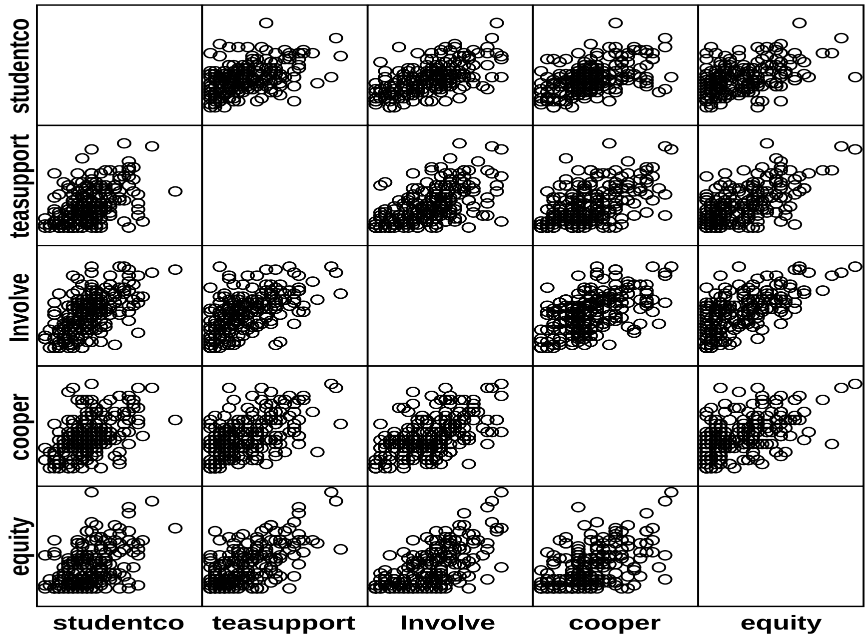
Table 14

Results of Spearman's Correlation among the Sub scales of Biology Classroom Environment in HAS.

Biology Classroom Environment Sub-scales	Student cohesiveness	Teacher support	Involvement	Cooperation	Equity
Student cohesiveness		0.44*	0.56*	0.49*	0.44*
Teacher Support			0.61*	0.51*	0.59*
Involvement				0.56*	0.62*
Cooperation					0.52*
Equity					

*r value Significant at p<0.005; N=217

The results as indicated in Table 14 suggest that as a particular sub scale of elective science students' biology classroom environment increases it results in a corresponding increase in other sub scales of the biology classroom environment. The relationship among the sub scales of elective science students' perception of their biology classroom environment in HAS is presented in the scatter plot matrix shown in Figure 3.



Student cohesiveness = studentco; Teacher support = teasupport

Involvement =Involve; Cooperation = cooper;

Figure 3: **A Scatter Plot Matrix showing the Relationship among Student Cohesiveness, Teacher Support, Involvement, Cooperation and Equity in HAS**

From the analyses of the hypothesis that there is no significant relationship among the five sub scales of biology classroom environment in low and high academic achieving schools was test with Spearman's rank order correlation. It was however revealed from the correlational analyses that, there are significant positive relationships among all the five sub scales of biology classroom environment in both school types. Hence the hypothesis that there is no significant relationship among the five sub scales of biology classroom environment is rejected.

Table 15 shows description of the five sub scales of biology classroom environment in both school types.

Table 15

Descriptions of Biology Classroom Environment Variables

Biology Classroom Environment Sub-scales	Definition
Student cohesiveness	High scores on this variable indicate that respondents know, help and are friendly towards each other.
Teacher support	High scores on this variable indicate that respondents see their teachers to be interested in them, while displaying characteristics of helpfulness, trustfulness, and friendliness.
Involvement	High scores on this variable indicate that respondents are involved and participate in science classroom discussions.
Cooperation	High scores on this variable indicate that respondents cooperate rather than compete with one another on learning tasks.
Equity	High scores on this variable indicate that respondents see that they were equally treated in their biology classrooms.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATONS

In this concluding chapter, overview of the research problem and methodology, and the key findings of the study are presented, the limitation of the study is also indicated as well as recommendations and suggestions for future research are as well pointed out.

Summary

Overview of the Research Problem and Methodology

The problem that prompted this study was senior secondary school elective science students' low achievement in biology in WAEC's organized examinations. In trying to come out with a solution to this problem, many factors were identified in the literature which appears to have possible links with low achievements of elective science students in biology (Anamuah-Mensah, 2007; Anthony-Krueger, 2007). Even though many factors have been identified in the literature to influence SSS elective science students' achievement in biology classroom environments appears to be one of the strongest influence on students' achievement in science-related programmes. However, most of the studies carried out to investigate how science students perceive their science classroom environments have been done in advanced countries like USA, Australia, Korea and Turkey with very little reported on this important dimension in Africa (Mucherah, 2008). Though studies on how science students perceive their science laboratory learning environment has been reported in Ghana (Ampiah, 2006) much is not known about how Ghanaians elective science students' perceive their biology classroom environments (non laboratory).

Attitudes towards science have also been identified to have influence on students' achievement in science. Conducive classroom environments have also been found to enhance the development of positive attitudes particularly with regard to the sciences: physics, chemistry and Biology (Myint & Goh, 2001). This study was therefore carried out to investigate elective science students' perception of their biology classroom environments and their attitude towards biology.

To accomplish this, a cross-sectional survey design was used. The schools in Central Region were categorised into low and high academic achieving schools based on their individual performance in SSSCE. Science students' in two elective science classes from schools with more than two streams of science classes were randomly selected. Schools with two or less streams had those classes automatically selected to be part of the study. This was done after four schools each had been randomly selected from the two school categories. A five-point Likert-type scale Biology Classroom Environment (BCEQ) and Attitude towards Biology Questionnaire (ABTQ) were developed and administered to elective science students' in both low and high academic achieving schools to measure their perception of their biology classroom environments, and their attitude towards biology.

Key findings

1. It was found in this study that elective science students' in both low and high academic achieving schools had a low perception of their biology classroom environments across all the five sub-scales. However, differences were found between the students in both low and high academic achieving schools in the areas of teacher support, cooperation, and equity sub-scales of biology classroom environment. This was in favour of elective science students' in low academic achieving schools.

2. It was also found in this study that elective science students in both low and high academic achieving schools had a positive attitude towards biology. There was however no significant difference between students in low and high academic achieving schools attitude towards biology.

3. The study found no relationship between students' perception of their biology classroom environment and attitude towards biology in both low and high academic achieving schools.

4. The results of the study also revealed a positive significant relationship among all the five sub-scales of biology classroom environment. Hence elective science students' perceptions of their biology classroom environment were significantly influenced by all the five sub-scales.

Conclusions

It can be concluded from the results of the study that elective science students in both low and high academic achieving schools had low perception of their biology classroom environments but significantly in favour of students in low academic achieving schools. The elective students' perception of their biology classroom environment was therefore not influenced by school type.

Also, students in both low and high academic achieving schools had a positive attitude towards biology. This seems to suggest that elective science students' attitude towards biology was not also influenced school type.

No relationship established between elective science students' perception of their biology classroom environment and their attitude towards biology seem to suggest that one's perception may not necessarily influence his/her attitude. This was also again not influenced by school type.

The relationship among the sub-scales of biology classroom environment in both low and in high academic achieving schools indicates that students' perception of their biology classroom environment was influenced by all the sub-scales.

Recommendations

The following recommendations are offered based on the outcome of the study.

1. Biology teachers should adopt teaching strategies that will improve their classroom environments so that students will form good perception of their biology classroom environment.
2. Biology teachers should give more group assignments to students to encourage more interactions among the students to enable students help each other.
3. Biology teachers should also capitalize on the positive attitude of students towards biology to teach the subject.

Limitation of the Study

In categorizing the schools into low and high academic achieving schools, the general performance of the schools in WAEC examinations were used. Since, a school can perform well generally and not do well in biology, the use of the outcome of this study should be with circumspection.

Suggestions for Future Research

It is suggested that the study be replicated using the individual schools achievements in biology for categorisation of the schools into low and high academic achieving schools. Again, the study may also be extended to cover science students' perception of their biology classroom environment, their attitude towards biology and their achievement in the subject.

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Appendix A

BIOLOGY CLASSROOM ENVIRONMENT QUESTIONNAIRE

INTRODUCTION

This questionnaire contains statements about practices which could take place in the biology class. You will be asked how often each practice takes place in the biology class.

There are no ‘correct’ or ‘wrong’ answers. Your responses will be used for research purposes. Confidentiality of your response will be assured.

Think about how well each statements. If you change your mind about any response just cross it out and tick another one.

Some statements in this questionnaire are fairly similar to other statements. Do not worry about it.

Pleas make a tick (√) in the box against your response.

Thanks for your maximum cooperation.

SECTION A

BIOGRAPHIC DATA

1. Sex : Male [ ] Female [ ]

2. Age:............................

3. School's Name: ....

SECTION B

How often do the statements describe practices that take place in your biology classroom?

	Very Often	Often	Sometimes	Seldom	Almost Never
Discussion groups are formed among students in the biology class whenever assignments are given.					
I am not afraid to respond to questions in the biology class					
I am friendly to all students in the biology class.					
I enjoy being in the biology class					
I am able to study well with other students in the biology					

class					
I help other students in the biology class who have difficulty in studying the subject.					
It is easily noticed when I am not in the biology class.					
I can approach any student in the biology class when I need explanation to some biology problems.					
The biology teacher always ensures that I understand what he/she teaches in class.					
The biology teacher willingly accepts my comments on how he/she teaches.					
When requested by a student during biology lessons the teacher willingly goes over things he/she has explained.					
The biology teacher helps me when I have difficulty studying the subject.					
The biology teacher maintains					

a healthy student-teacher relationship with me after class.					
The biology teacher talks excitedly about the subject which encourages me to study it.					
The biology teacher motivates me to bring out the best in me.					
My biology teacher ask me questions To find out if I understand the lesson.					
I participate in class discussions during biology lessons.					
I make suggestions during biology class discussions.					
I am involved in decision making in the biology					
My ideas and suggestions are accepted during biology class discussions.					
I ask my biology teacher questions when I have					

difficulty in understanding					
I explain my ideas in biology to other students in the class.					
I get help from other students in the biology class when u have difficulty in solving biology problems.					
I am asked to explain how I solve biology problems in class					
I cooperate with other students when doing biology assignments.					
I share my books and other educational materials with other students in the biology class.					
When studying in a group with student in the biology class, there is teamwork.					
There is much competition among us in the biology class.					
I learn from other students in the biology class.					
I enjoy learning with other					

students in the biology class					
My comments are easily accepted by students in the biology class.					
Other students in the biology class help me with my studies so that I perform better in the subject.					
My biology teacher gives as much attention to my questions as do other students' questions.					
I get the same amount of help from my biology teacher as the students in the class.					
I have the same amount of say in the biology class as other student do.					
The biology teacher is friendly to me the same as he/she is to other students in the biology class.					
I receive the same encouragement from my biology teacher as other					

students do.					
The biology teacher trusts me to get certain amount of work done as other students in the biology class					
My work in biology receives as much praise as other students' work in the biology class.					
I get the same opportunity to answer questions in the biology class as do other students.					

Appendix B

ATTITUDE TOWARDS BIOLOGY QUESTIONNAIRE

INTRODUCTION

This questionnaire contains statements about what your opinions are concerning the study of biology. You will be asked the extent to which you agree or disagree to the statements.

There are no ‘correct’ or ‘wrong’ answers. Your responses will be used for research purposes.
Confidentiality of your responses is therefore assured.

Be sure to give a response to all statements. If you change your mind about any response just cross it out and tick another.

Some statements in this questionnaire are fairly similar to other statements. Do not worry about it.

Please make a tick [√] in the box against your response.

Thanks for your maximum cooperation.

To what extent do you agree with the following statements concerning elective biology?

STATEMENTS		Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1	It is best to find out why something is true by checking it from biology textbooks than being told.					
2	The topics covered in biology are not interesting.					
3	There should be more biology lesson every week.					
4	Biology is one of the most interesting science subjects.					
5	I am always prepared for biology lessons.					
6	Biology lessons are boring.					
7	It is important to study biology at school.					
8	I would like to study biology					

	related course at the highest level of my education.					
9	Do well in biology is important to me.					
10	I enjoy biology lessons.					
11	I would enjoy science more if there were no biology lessons.					
12	Biology is the most difficult of all the science subjects.					

Appendix C

Frequencies and Percentages of Responses of students from Low and High Academic Achieving Schools of the Student Cohesiveness Scale of the BCEQ

Item No.	Schooltype	Vo (%)	O (%)	So(%)	Se(%)	An(%)
	LA	41(29.5)	9(6.5)	52(37.4)	9(6.5)	28(20.1)
1	HA	42(19.4)	44(20.3)	87(40.1)	28(12.9)	16(7.4)
	LA	16(11.5)	5(3.6)	41(29.5)	26(18.7)	5(36.7)
2	HA	17(7.8)	12(5.5)	55(25.3)	54(24.9)	29(36.4)
	LA	5(3.6)	5(3.6)	10(7.2)	31(22.3)	88(63.3)
3	HA	4(1.8)	6(2.8)	16(7.4)	34(15.7)	157(72.4)
	LA	12(8.6)	4(2.9)	27(19.4)	17(12.2)	79(56.8)
4	HA	5(2.3)	4(1.8)	44(20.3)	59(27.2)	105(48.4)
	LA	10(7.2)	11(7.9)	46(33.1)	23(16.5)	49(35.3)
5	HA	5(2.3)	12(5.5)	47(21.7)	63(29.0)	90(41.5)
	LA	18(12.9)	21(15.1)	55(39.6)	17(12.2)	28(20.1)
6	HA	11(5.1)	33(15.2)	86(39.6)	49(22.6)	38(17.5)
7	LA	20(14.4)	8(5.8)	26(18.7)	22(15.8)	63(45.3)
	HA	20(9.2)	30(13.8)	46(21.2)	37(17.1)	84(38.7)
8	LA	14(10.1)	9(6.5)	47(33.8)	22(15.8)	47(33.8)
	HA	4(1.8)	7(3.2)	26(12.0)	49(22.6)	131(60.4)

VO=Very Often, O=Often, So=Sometimes, Se=Seldom, An=Almost Never

Frequencies and Percentages of Responses of the Teacher Support scale of both Low and High Academic Achieving schools.

Item No.	Schooltype	Vo(%)	O(%)	So(%)	Se(%)	An(%)
9	LA	6(4.3)	11(7.9)	22(15.8)	22(15.8)	78(56.1)
	HA	7(3.2)	6(2.8)	37(17.1)	60(27.6)	107(49.3)
	LA	16(5.0)	7(5.0)	21(15.1)	36(25.9)	68(48.9)
10	HA	13(6.0)	17(7.8)	50(26.3)	57(26.3)	80(36.9)
	LA	7(5.0)	7(5.0)	21(15.1)	36(25.9)	68(48.9)
11	HA	3(1.4)	6(2.0)	41(18.9)	41(18.9)	126(58.1)
	LA	11(7.9)	15(10.8)	44(31.7)	28(20.1)	41(29.5)
12	HA	8(3.7)	16(7.4)	43(19.8)	57(26.3)	93(42.9)
	LA	44(31.7)	8(5.8)	25(18.0)	27(19.4)	35(25.2)
13	HA	9(4.1)	14(6.5)	32(14.7)	53(24.4)	109(50.2)
	LA	11(7.9)	9(6.5)	24(17.3)	21(15.1)	74(53.2)
14	HA	10(4.6)	12(5.5)	41(18.9)	59(27.2)	95(43.8)
	LA	10(7.2)	10(7.2)	16(11.5)	32(23.0)	71(57.1)
15	HA	4(1.8)	13(6.0)	41(18.9)	53(24.4)	106(48.8)
16	LA	10(7.2)	10(7.2)	25 (18.0)	27(19.47)	67(48.2)
	HA	6(2.8)	19(8.8)	39(18.0)	57(23.5)	102(102)

Vo=Very Often, O=Often, So=Sometimes, Se=Seldom, An=Almost Never

Frequencies and Percentages of Responses of the Involvement scale in both school types.

Items No.	Schooltype	Vo(%)	O(%)	So(%)	Se(%)	An(%)
17	LA	5(3.6)	14(10.1)	34(24.5)	33(23.7)	53(38.1)
	HA	7(2.3)	24(11.1)	69(31.8)	44(20.3)	73(33.6)
	LA	9(6.5)	18(12.9)	38(27.3)	36(25.9)	38(27.3)
18	HA	15(6.9)	36(16.6)	69(31.8)	41(18.9)	56(25.8)
	LA	10(7.2)	8(5.8)	40(28.8)	37(26.6)	44(20.3)
19	HA	18(8.3)	29(13.4)	68(31.3)	58(26.7)	44(20.3)
	LA	8(5.8)	11(7.9)	61(43.9)	32(23.0)	27(19.4)
20	HA	8(3.7)	20(9.2)	84(38.7)	60(27.6)	45(20.7)
	LA	10(7.2)	5(3.6)	39(28.1)	25(18.0)	60(43.2)
21	HA	9(4.1)	16(7.4)	42(19.4)	60(27.6)	90(41.5)
	LA	11(7.9)	14(10.1)	50(36.0)	26(18.7)	38(27.3)
22	HA	8(3.7)	23(10.6)	77(35.5)	52(24.0)	57(26.3)
	LA	13(9.4)	17(12.2)	46(33.1)	30(21.6)	33(23.7)
23	HA	5(2.3)	11(5.1)	39(18.0)	71(32.7)	91(41.9)
	LA	28(20.1)	22(15.8)	57(36.7)	20(14.4)	18(12.9)
24	HA	39(18.0)	44(20.3)	73(13.8)	30(13.8)	31(14.3)

VO=Very Often, O=Often, So=Sometimes, Se=Seldom, An=Almost Never

Frequencies and Percentage of Responses of the Cooperation scale of the BCEQ in both school type.

Item No.	Schooltype	Vo(%)	O(%)	So(%)	Se(%)	An(%)
25	LA	12(3.6)	14(10.1)	38(27.3)	36(25.9)	39(28.1)
	HA	7(3.2)	11(5.1)	55(25.3)	61(28.1)	83(38.2)
	LA	29(20.9)	19(13.7)	39(28.1)	18(12.9)	34(24.5)
26	HA	6(2.8)	2(0.9)	21(9.7)	63(29.0)	125(27.8)
	LA	28(20.1)	10(7.2)	26(18.7)	31(22.3)	44(31.7)
27	HA	14(6.5)	12(5.5)	40(18.4)	56(25.8)	95(43.8)
	LA	16(11.5)	14(10.1)	21(9.7)	33(23.7)	55(39.6)
28	HA	10(4.6)	15(6.9)	34(15.7)	45(20.7)	113(52.1)
	LA	11(7.9)	7(5.0)	34(24.5)	31(22.3)	56(40.3)
29	HA	2(0.9)	5(2.3)	26(12.0)	49(22.6)	135(62.2)
	LA	9(6.5)	12(8.6)	33(23.7)	235(25.2)	50(36.0)
30	HA	0(0)	4(1.8)	49(22.6)	65(30.0)	99(45.6)
	LA	8(5.8)	5(5.8)	62(44.6)	39(28.1)	22(15.8)
31	HA	2(0.9)	20(9.2)	103(47.5)	63(29.0)	29(13.4)
32	LA	18(12.9)	22(15.8)	40(28.8)	28(20.1)	31(22.3)
	HA	12(5.5)	17(7.8)	58(26.7)	61(28.1)	69(31.8)

VO=Very Often, O=Often, So=Sometimes, Se=Seldom, An=Almost Never

Frequencies and Percentages of Responses of the Equity scale in both Low Academic Achieving and High Academic Achieving Schools.

Items No.	Schooltype	Vo(%)	O (%)	So(%)	Se (%)	An(%)
33	LA	27(19.4)	11(7.9)	28(20.1)	27(19.4)	46(33.1)
	HA	18(8.3)	20(9.2)	33(15.2)	54(24.9)	92(42.4)
34	LA	21(15.1)	17(12.2)	23(16.5)	30(21.6)	48(34.5)
	HA	11(5.1)	16(7.4)	46(21.2)	43(19.8)	101(46.5)
35	LA	9(6.5)	16(11.5)	34(24.5)	39(28.1)	41(29.5)
	HA	5(2.3)	12(5.5)	31(14.3)	59(27.2)	110(50.7)
36	LA	10(7.2)	8(5.8)	17(12.2)	25(18.0)	79(56.8)
	HA	4(1.8)	5(2.3)	22(10.1)	59(27.2)	127(58.5)
37	LA	6(4.3)	9(6.5)	24(17.3)	28(20.1)	72(57.8)
	HA	5(2.3)	3(1.4)	27(12.4)	56(25.8)	126(58.1)
38	LA	6(4.3)	10(7.2)	27(19.4)	38(27.3)	58(41.7)
	HA	4(1.8)	16(7.4)	32(4.7)	60(27.6)	105(48.4)
39	LA	9(6.5)	9(6.5)	44(31.7)	42(30.2)	35(25.2)
	HA	9(4.1)	21(9.7)	58(26.7)	52(24.0)	77(35.5)
40	LA	5(3.6)	12(3.6)	20(14.4)	36(25.9)	66(47.5)
	HA	3(1.4)	12(5.5)	26(12.0)	57(26.3)	119(54.8)

VO=Very Often, O=Often, So=Sometimes, Se=Seldom, An=Almost Never

Frequencies and Percentages of Responses of items in the Attitude scale of both School types.

Item No.	Schooltype	SA(%)	A(%)	U(%)	D(%)	SD(%)
1	LA	66(47.5)	47(33.8)	2(1.4)	11(7.9)	13(9.4)
	HA	92(42.4)	60(27.6)	28(12.9)	27(12.3)	10(4.6)
2	LA	3(2.2)	15(10.8)	10(7.2)	59(42.2)	52(37.4)
	HA	7(3.2)	23(10.6)	17(7.8)	101(46.5)	69(31.8)
3	LA	56(40.3)	55(39.6)	13(9.4)	9(6.5)	6(4.3)
	HA	42(19.4)	71(32.7)	52(24.0)	39(18.0)	13(6.0)
4	LA	84(60.4)	49(35.3)	2(1.4)	2(1.4)	2(1.4)
	HA	111(51.2)	62(28.6)	16(7.4)	18(8.3)	10(4.6)
5	LA	65(46.8)	56(40.3)	6(4.3)	7(5.0)	5(3.6)
	HA	63(29.0)	77(35.5)	38(17.5)	32(14.7)	7(3.2)
6	LA	11(7.9)	9(6.5)	12(8.6)	55(39.6)	52(37.4)
	HA	13(6.0)	30(13.8)	31(14.3)	90(41.5)	53(24.4)
7	LA	88(63.3)	42(30.2)	3(2.2)	1(0.7)	5(3.6)
	HA	162(74.7)	45(20.7)	3(1.4)	3(1.4)	4(1.8)
8	LA	81(58.3)	33(23.7)	11(7.9)	9(6.5)	5(3.6)
	HA	122(56.2)	30(13.8)	38(17.5)	10(4.6)	17(7.8)
9	LA	88(63.3)	42(30.2)	4(2.9)	3(2.2)	2(1.4)
	HA	189(87.1)	27(12.4)	1(0.5)	0(0)	0(0)
10	LA	71(51.1)	46(33.1)	5(3.6)	10(7.2)	7(5.0)
	HA	78(35.9)	96(44.2)	18(8.3)	11(5.1)	14(6.5)
11	LA	7(5.0)	18(12.9)	15(10.8)	46(33.1)	53(38.1)
	HA	11(5.1)	11(5.1)	24(11.7)	71(32.7)	100(46.1)
12	LA	9(6.5)	14(10.1)	5(3.6)	47(33.8)	64(46.0)

HA	12(5.5)	12(5.5)	27(12.4)	59(27.2)	107(49.3)

SA=Strongly Agree, A=Agree, U=Undecided, D=Disagree, SD= Strongly Disagree

Appendix D

Computing Effect Size for Independents Samples t-test

Effect size, $d = t\sqrt{\frac{N_1 + N_2}{N_1 N_2}}$ where,

t - represents the t-value

N_1 and N_2- represent the two different sample sizes

From Table 3

t = 2.76 $N_1 = 139$ $N_2 = 217$

$$d = 2.76\sqrt{\frac{356}{30163}}$$

$$d = 2.76(0.1086)$$

$$d = 0.29 \approx 0.3$$

Regardless of sign, d values of 0.2, 0.5 and 0.8 traditionally represents small, medium and large effect size respectively.

Appendix E

List of Senior Secondary Schools that offered Elective Science Programme in 2007/2008 Academic Years in Central Region

Aburaman Senior Secondary School

Aggrey Memorial Senior Secondary School

Kwanyako Senior Secondary/Technical School

Nsaba Presbyterian Senior Secondary School

Swedru Senior Secondary School

Bisease Senior Secondary School

Apam Senior Secondary School

Postin T.I Senior Secondary School

Breman Asikuma Senior Secondary School

Adisadel College

Ghana National College

Holy Child School

Mfantsipim School

St. Augustine's College

University Practice Senior Secondary school

Wesley Girls' High School

Boa Amponsem Senior Secondary school

Edinaman Senior Secondary School

Ekumfi T.I. Ahmd. Senior Secondary School

Mfantsiman Girls' Senior Secondary School

Twifo Praso Senior Secondary School

Winneba Senior Secondary School

Assin Manso Senior Secondary School