

# The Perceptions of Junior Secondary School Pupils and Teachers about Science Classroom Learning Environments

Dr. Peter Attafuah (PhD)

Education Director, Bono Region | Ghana Education Service

Email: [drattafuah@gmail.com](mailto:drattafuah@gmail.com)

## Abstract

*The purpose of this study was to investigate junior secondary school pupils' perceptions as well as their respective science teachers' perception about their science classroom learning environment and determine whether these variables affect teaching and learning. Few studies have been conducted in this area in countries elsewhere and it has been found that there is a definite disparity between what pupils perceive to be effective teaching and learning in comparison to what teachers perceive. The intention of the study was to identify some of the factors that militated against effective teaching and learning of science in junior secondary schools and also find out some factors that promoted it. The hypothesis for the study was "There will be no significant difference between pupils' perceptions about science classroom learning environment and their respective science teachers' perceptions". The research design for the study was the survey method. The sample for the study consisted of 18 JSS3 classes selected at random from the Birim South district directorate of education in the eastern region of Ghana. The participants were made of 452 final year JSS pupils and their 10 respective science teachers (n = 462). The survey was conducted using a modified form of the 48-item short form of the Australian version of the Questionnaire on Teacher Interactions (QTI) developed by Wubbels (1993). Random interviews were conducted with an interview protocol carved out of the QTI using 6 pupils and 6 teachers who were also selected from the 462 participants. Permission was sought from the Birim South District Director of Education and invitation letters sent to the heads and science teachers of the participating schools. The researcher read through the QTI and the interview protocol explaining items for the respondents to make their own choices. Responses to the interview protocol for the pupils were recorded verbatim. Data collected from the teachers and pupils who participated in the survey were statistically analysed. The analysis was done according to the scales identified in the QTI as leadership, helpful/friendly, understanding, student responsibility and freedom, uncertain and dissatisfied, admonition and strict behaviours. The use of both quantitative and qualitative data collection methods from a range of sources provided a means of triangulation to strengthen the validity of the findings, which thus afforded a means of comparing data consistency and cross validation for the purpose of improving the rigour of the research design. Results from the study indicated that the pupils' perception of their science classroom learning environment is moderately positive due to the slightly lower or higher scores of the scales as compared to those of their corresponding teachers. Teachers however perceived it more positive than their pupils. Scales which enhance learning (leadership, understanding, student responsibility/freedom, and helping/friendly) were scored higher by the teachers than their pupils. Other scales (uncertain, admonishing, dissatisfied and strict behaviours of the teacher) were conversely scored lower by the teachers than their respective pupils. The study also revealed that there were associations between the different dimensions in the two variables; classroom learning environment and teacher interpersonal behaviour. Factors which militated against effective science classroom learning environment at the junior secondary schools and those factors which enhanced it were discussed.*

*Keywords: Pupils Perceptions, and Teachers Perceptions, Science Classroom Learning Environments*

## 1.0 INTRODUCTION

This chapter deals with the background to the study, statement of the problem, and the purpose of the study. It also provides research questions, hypothesis to the study, and significance of the study as well as delimitations and some definition of terms related to the study.

### 1.1 Background to the Study

Around the globe, in both developed and developing countries, science education has become a very important area. In an era of science and technology we can face the challenges of science only by making necessary provision for science education. In this grim situation, a positive teacher-student relationship and learning environment is very important. Students and teachers spend considerable amount of time in formal school settings (Linn, 1992). The teacher's behaviours, when interacting with students, have been found to have a considerable impact on the nature of learning environment that is created. Wubbels, Brekelmans & Hermans (1987) suggested that teacher-student interaction is a powerful force that can play a major role in influencing cognitive and affective development of students. Wubbels and Levy (1993) reaffirmed the role and significance of teacher behaviour in classroom environment and in particular how this can influence students' motivation leading to achievement.

The basic school child lives in an age and world dominated by science and technology. For any meaningful social and economic advancement to be made in the environment which he or she finds himself or herself, there is the need to understand and appreciate the impact of science on the environment. The child should therefore be guided to acquire the necessary scientific skills, concepts and attitudes that can enable him or her to survive in this changing world of science and technology. This, therefore, suggests that the science teacher should be of proven competence so as to be able to assist the young ones. In junior secondary schools in Ghana, some teachers who generally are not specialists but may have some interest in teaching general science do teach these pupils. This comes about as a result of lack of teachers in the field of science. Most graduate science teachers also do not like teaching at the basic level. The major goals of basic education are achieving basic literacy and numeracy amongst all the pupils as well as establishing foundations in science and other social sciences. The relative priority of various areas and the methods used to teach them, are an area of great concern.

Science teaching is a complex activity that lies at the heart of the vision of science education in Ghana (MEST, 2000). There are criteria for making judgment about science teaching standards. They describe what teachers of science at all grade levels should understand and be able to do. Teachers are central to education; they must not be placed in a position of being solely responsible for reform. Teachers will need to work within a collegial organization, and policy context that is supportive of good science teaching. In addition, the pupils must accept and share responsibility for their own learning. In the vision of science education, effective teachers of science create an environment in which they and their students work together as active learners. While students are engaged in learning about the natural world and the scientific principles needed to understand it, teachers are working with their colleagues to expand their knowledge about science teaching (Bereiter and Scardamalia, 1989). To teach science, teachers must have theoretical and practical knowledge and abilities about science learning and science teaching.

Any country striving to develop in order to raise the standard of living of its population and maintain a balanced economy must as a matter of absolute necessity adopt science and technology as the basis for achieving sustainable development. This seems to be the message from countries, which have transformed their economies from a developing to a developed one (MEST, 2000). Ghana like many other countries, has accepted the view that real economic and social development hinges on a well-planned and implemented science and technology education from the primary to the tertiary level. This in turn will require adequate, high quality science and technology manpower, which the school will be expected to produce (Adjepong, 1985). Since the attainment of independence, successive governments of Ghana have endeavoured to make science and technology critical bases for the country's development. Scientific education has also been deemed to be an important aspect of national programme for introducing science and technology into the country's development efforts. Capacities have been developed to ensure that the country has a high calibre of technical and scientific personnel needed for her to achieve her development objectives (Adjepong, 1985).

These measures, unfortunately, have had their attendant problems, mainly that of finance, though the Lagos plan of action called on African countries to devote some one percent of their Gross National Product for scientific and technological activities this had not been met. Over the years Ghana has been able to make available an average of about 0.3% of her GNP to support the country's science and technology programmes (MEST, 2000). Another area, which has affected the country's science and

technology efforts relates to coordination of these activities. Essentially, there was no coordination mechanism to make it possible for activities to be integrated to reduce duplication of efforts and to promote synergy, (MEST, 2000). Despite the various actions taken by successive governments, Ghana, unlike countries such as Singapore, South Korea and India, has not been able to develop fully the scientific and technological base to address the country's basic human needs of food security, clothing and transportation. These needs have been emphasized in Ghana's vision 2020. This long-term programme of objectives for Ghana, stakes its achievements on the adoption of science and technology as the tool by which socio-cultural and the economic problems of the individual, the community and the nation will be solved (MEST, 2000).

It is this aspiration of vision 2020, which has called for the formulation of a science and technology policy for the country. The implementation of this policy is envisaged to move the country's economy to a middle-income status and immensely improved standard of living by the year 2020. The realization of this dream of vision 2020 depends on a sound science education for the younger ones. It is important for the teacher to make teaching and learning of science interesting to the JSS pupils. The science teacher therefore needs to have a sound knowledge of science classroom teaching and learning environment so as to be able to perform. According to Wenglinsky (2003) "there has been little quantitative research into whether classroom practices, in concert with other teacher characteristics, have an impact on student learning that is comparable in size to that from background characteristics"(p.6). This study attempts to make a contribution to the literature by using both quantitative and qualitative means to study the impact on teachers and student's perceptions about the teaching and learning environment of science classrooms. The elements involved in the action called "teaching" and "learning" is multifaceted and somewhat illusional due to the impression that everyone "knows" what effective teaching and learning are, but no one can agree on how they are achieved. What may prove to be helpful, however, is whether the different perceptions of effective teaching and learning are, indeed, a factor in student achievement. This study therefore attempts to examine some specific part of the puzzle, namely whether there is some degree of similarity or difference between that of the student and teacher's perception about the teaching and learning environment of science classrooms.

Having taken stock of and given critical reflection on the performance of student-teachers of teacher training college for over three years (1994 -1997) as a science tutor, the researcher has become aware of some of the shortcomings or deficiencies in the teaching-learning processes at the basic level with regard to science. As a classroom teacher for over thirteen years, the researcher discovered early in his career that as he changed his teaching styles, his students likewise seemed to change. He found that his attention and concerns evolved from "content centered" to "student centered" to "learner centered". As a result, students became more productive and seemed to even enjoy his lessons more. They even became more pleasant to work with. The researcher's personal experience as a secondary school teacher convincingly suggested to him that students were not just able to become productive "scientists" but even the nonchalant students could be motivated to assume the responsibility to learn in the scientific oriented learning environment.

The researcher's curiosity also grew as he spoke with colleagues about his observations. Oftentimes he discovered that, a student who was blasé for a fellow teacher might be very proactive, or at least "average" in achievement in their work for him. The researcher soon began to realize there must be factors or interactions involved between the student and teacher that resulted in either a positive or negative effect on student achievement. Having taught for ten years, this variance between levels of student motivation, achievement and cooperation became more apparent. The researcher's curiosity was stimulated enough that he began his own search for explanations for his perceived "success" as a science teacher. This search led him to become a student of the teaching-learning process. This concept which is often ignored should be studied as a vital element in teaching and instruction. The classroom learning environment contains gems for those who patiently seek them (Nesmith, 1998). In his experience, the researcher had found that there is a relationship between student and teacher when considering students' learning. As a result of having taught in schools in different regions (Northern and Eastern) in Ghana, the researcher believes that the dynamics of a learning environment traverses cultural boundaries.

As a classroom teacher, the researcher had the opportunity to investigate and determine what "worked best for him". These opportunities, however, were haphazard, at first, and so required more

disciplined and systematic approaches to studying the interactions between student and teacher in order to more fully understand and appreciate the learning process. After much observation, reading and contemplation, the researcher attempted to begin the journey by listening to what students had to say about the interactions between teaching and learning, and student and teacher (Attafuah, 2003).

Student perceptions of these interactions became very important to the researcher. The perception of students was seen as “gems” to be placed under the researcher’s microscope for the purpose of revealing, describing, clarifying and comprehending the dynamics that transpires in every classroom during the process called “education”. To be able to decipher even some of the dynamics that occurs between a teacher and a student would be very worthy of investigation, especially should a variance between the two perceptions be established. The personal and inter personal interactions between the teacher and the student, both as individuals and as a group, comprises a large part of what happens in the learning environment that schools provide (Arowosafe & Irvine, 1992; Ferguson, 1998; Kramer, 1992; Rickards, 1998). These “relationships” typically last for only one year, and yet seem to have such lasting effects; either positive or negative, on the students’ perceptions of learning and teaching. Nearly every adult can remember various aspects of their learning regarding past teachers. For some, these are very positive and tend to encourage and motivate, but for others these are quite negative experiences and tend to daunt, if not haunt them.

## 1.2 Statement of the Problem

Attitudes associated with the teaching and learning of science appear to affect students’ participation in science as a subject (Linn,1992) and impacting performance in science (Weiss,1987). An international assessment of nine and thirteen-year-old students in twenty countries revealed that favourable teaching and learning environments of science classrooms influenced students’ performance. It is therefore vital that we give due notice to students’ needs, their perceptions about teaching and learning, and how to improve their teaching and learning experience (their success at school) (Rakow, 2000). Ghana needs skilled and talented population of students who will contribute to the country’s economic growth and improve vital areas of importance to the nation, especially in the area of science and technology. There is therefore the need to make junior secondary school pupils become interested in science lessons and also how to sustain this interest.

The emphasis in educational policy therefore, needs to be on learning and teachers need to become more “learning-centered” (Tobin, Khale, & Fraser, 1990). It is therefore important that we seek to understand the interpersonal relationship (learning environment) that occurs between students and their teachers. Science classrooms therefore need to be improved to enhance student learning, in the learning environment. It has been observed that in Ghana some teachers who teach science at the junior secondary schools are not friendly enough; they are impatient and are also very strict (Attafuah, 2003). Some have been found to be lacking understanding of some scientific concepts whilst others are not very sure of what they teach. These shortcomings have to some extent reduced students’ interest and enthusiasm for the study of science in the secondary school level (Attafuah, 2003).

Teachers of junior secondary school science need to have a second look at their worldviews concerning the nature and learning behaviours of their pupils. The researcher’s personal interview with first year students in a secondary school reveals that most science teachers use derogatory remarks when students are not able to perform well in science. Science teachers easily become annoyed when students ask questions or even require further explanation of concepts and phenomena. Others, according to the students are dissatisfied with their work (Attafuah, 2003). This attitude of the teacher has to be changed.

As classrooms become more socially and culturally diversified, understanding students’ different perceptions about science learning and teaching would provide educators with valuable information upon which to improve instruction and learning. Multicultural classrooms are more prevalent today than ever before (Appleby, 1996; Klauke, 1989; *The World Factbook*, 2002). What, and how, a student perceives the world is often flavoured by the respective culture(s), and therefore, students’ perception of the world and of learning should be very important to the classroom teachers. It is possible that simply taking notice of students’ opinion will have a positive instructional effect in, and of itself. Culture and cultural mores, for example, have shown to be very important factors in the aspect of motivation and learning.

Most science teachers at the junior secondary school level as well as student-teachers sent on off-campus teaching practice do not create favourable teaching and learning environment. They prefer teaching in the old didactic way of lecture, which leads to rote learning depriving learners from gaining firsthand experience (Attafuah, 2003). The researcher's personal experience in teacher training college reveals that, student-teachers complain of non-existence of teaching and learning materials and laboratories at the basic level. Teacher competencies are lacking in the educational system resulting in poor teaching performance and the creation of poor learning environments at the basic level with grave consequences (Adjepong, 1995). For example, lack of quality in science teaching at the basic level has resulted in:

- (i) Lack of required technological manpower in Ghana.
- (ii) Waning interest of students in scientific disciplines with a shift towards the humanities and business studies (Attafuah, 2003).
- (iii) Poor performance of students in general science at the Basic Education Certificate Examination (BECE).

Studies (CRIQPEG, 1992) have shown that the majority of primary school teachers do not teach science during the periods allocated on the timetable for the subject. Science periods are used to teach English language and Mathematics. This problem could be traced to lack of knowledge of subject matter, disinterestedness on the part of the teachers and their inability to create favourable learning environments for the study of science. Many teachers at the basic level lack confidence in their own abilities to teach science and hence are not able to create good environment for its teaching and learning. Other problems (Ahenkorah, 1985) that seriously affect the junior secondary school science classroom learning environment include:

- (i) Inability to use hands-on and inquiry approaches of teaching to enhance their output that will elicit quality learning among pupils at the basic level.
- (ii) Inability to relate science taught in the classroom to science in industry and the environment in general.
- (iii) Refusal of science teachers to consider the culture or the home background of their pupils.
- (iv) Poor response to pupils' questions during lessons.
- (v) Poor learning environment in general and in particular, poor teacher-pupil interpersonal relationship in the science classroom.
- (vi) Total neglect of the effect of the variables, gender, ethnicity, ability and grade on attitude of people towards science as a subject.

The society usually blames the teacher for the failure of students in their examinations. The problem could however be looked at from a multidimensional level. Included inter alia are the teacher, the student, the government, parents and the society at large (Ahenkorah, 1995). To augment these problems therefore, requires the creation of a favourable teaching and learning environment for science in junior secondary schools in Ghana.

### 1.3 Purpose of the Study

The purpose of the study was to identify first and foremost whether a relationship exists between the perceptions of J.S.S. pupils and the perceptions of their teachers about the teaching and learning environment of their science classrooms. The study thus seeks to find: How junior secondary school pupils perceive their science classroom learning environment to be. How junior secondary school science teachers also perceive their own classroom teaching and learning environment to be. The relationship that exist between junior secondary school pupils' perception and the perception of their science teachers about science classroom learning environment. It again explores ways of stimulating active learning by improving the quality of classroom interactions.

### 1.4 Research Questions

The following research questions have been identified to direct the research activity in the study.

1. What are the JSS pupils' perceptions' about their science classroom learning environment?
2. What are the JSS science teachers' perceptions' about their science classroom learning environment?



3. How do JSS pupils' perceptions and JSS science teachers' perceptions about science classroom learning environment differ?
4. How knowledgeable are the J.S.S. science teachers about the components of a typical classroom environment?
5. What are the perceptions of JSS pupils about the science classroom environments?  
created by out-of-field teachers?

### 1.5 Null Hypothesis

The hypothesis for this study was: "There will be no significant difference between pupils' perceptions about science classroom learning environment and their respective science teachers' perceptions".

### 1.6 Educational Significance of the Study

This research makes a lot of contributions towards the advancement of science education in Ghana. Included inter alia is the discovery of the causes of the waning interest in science among junior secondary school pupils in Ghana.

Guidance and counseling coordinators in particular could tap this source of information and utilize it at the junior secondary school level especially during career counseling and choice of programmes of study at the senior secondary school.

To determine whether there is a relationship between pupils' perceptions and teachers' perceptions about science classroom environment or not is vitally important to science educators, as well as for other disciplines (Callahan, Clark, & Kellough, 2002; Fraser & Fisher, 1983; Schunk 1995) for such a study would clarify whether the matching, or mismatching, of pupils' perceptions with teachers hinders, facilitates, or has no effect on achieving science process skills.

Science teachers at the junior secondary school level and teachers in general, could use the competencies suggested here in their teaching of science and in other related subjects.

Curriculum developers would also benefit immensely from the findings of this research work. It exposes the deficiencies of many teachers who teach science in the junior secondary schools. The developers of science curriculum could tap the information and probably revise the current teaching syllabus of science at the junior secondary school. Knowledge, skills, and attitudes to be achieved at the end of the lessons as well as teacher competencies, behaviour and expression work that also need to be respectively exhibited may be incorporated into the revised syllabus.

Teachers at the junior secondary schools in Ghana are expected to become motivated in teaching science when the findings and suggestions of this research are learned and practiced.

The study will also help junior secondary school science teachers to devise strategies for tapping alternative frameworks of the junior secondary school pupils. It is only when teachers of science realize that the minds of their pupils are not *tabular rasa* that they can adopt the constructivists approach to teaching and learning.

It is expected that the study will help teachers of science at the junior secondary schools to devise strategies and procedures for helping their pupils to bring about conceptual change and meaningful learning. It will thus help them to adopt a strategy that improves the learning environment or a positive teacher-pupil interpersonal relationship.

Circuit supervisors of schools may also benefit from this research since it is aimed at establishing principles for good conduct of teachers and science teachers in particular during science lessons (Appendix C, The QTI). They can therefore be in a position to offer better advice to the teachers.

Head teachers of junior secondary schools will also benefit from the findings of this research and can therefore use it to provide support to enhance the teaching performance of their science teachers.

This study designed for junior secondary school science classrooms would provide insight needed on how to train pre-service science teachers, as well as, how effective learning principles should be addressed in a science education methods unit.

This study also is distinct in that it seeks to contribute to a better understanding of some of the key variables that might influence pupil's attitudes, cognitive achievement, academic achievement, and hence involvement rate in junior secondary school science.

Furthermore, this study would contribute to the literature in the study of teacher-pupil interpersonal behaviour in science classes by providing data for the QTI from a large base of survey responses. The information from this study will help serve the needs of classroom science teachers, school administrators and educators who train preservice science teachers, in improving the effectiveness of teaching and learning of science at the junior secondary school level.

With these, it is crystal clear that this research would contribute immensely towards the advancement of science education in Ghana.

### 1.7 Delimitations of the Study

The subjects for the study were final year pupils in junior secondary schools in Ghana and their respective teachers of science. The responses were collected from ten schools in the Birim South District in the eastern region of Ghana. The schools were both private and public. Final year pupils (JSS3) were selected because they were supposed to have interacted better with their science teachers.

### 1.8 Definition of Terms

**Learning environment:** It is the entire setting for learning. It encompasses the relationships between and among students and teachers, as well as the expectations and norms for learning and behaviour. Teacher's behaviour, when interacting with students, has been found to have a considerable impact on the nature of learning environment. Positive classroom environments are associated with a range of important outcomes for students. This research is about teacher-pupil inter-personal relationship. This is measured through the eight scales of the four domains established by Wubbels (1993). These are leadership, understanding, uncertain, admonishing, helping/friendly, student responsibility, dissatisfied and strict behaviours put up by teachers in science classrooms.

**Perception:** Teachers' and Students' beliefs about the learning environment which determine whether or not the classroom climate has a positive effect. It tells how students and teachers perceive, distinguish, or make sense of the environment in which they interact.

**Effective Teaching and Learning:** This is defined as strategies and actions which motivates and help pupils to learn. It is assumed that if pupils learn then effectiveness is present. This study seeks however to ascertain how pupils perceive effective teaching and learning in science classroom environment to be. This is measured by pupils' responses using a Likert scale. Effective teaching is simply defined as the ability to help pupils learn, *effectively*. This issue in this study is not so much as what is effective teaching but rather how it bears on classroom environment.

**Concepts:** This refers to the ideas, generalizations and theories of science.

**Out-of-Field Teachers:** Teachers who have not been trained and certified in the area in which they teach. In this context, these are teachers who do not possess certificates as science teachers but find themselves teaching science in the junior secondary schools.

**Blasé:** Being bored or not excited. In this study, it refers to pupils who do not feel interested in a particular science teacher's class. Thus, those pupils who think their teachers' class seems boring and that they do not understand whatever he or she teaches.

**Junior Secondary School (JSS):** Now refers to Junior High School (JHS).

## 2.0 LITERATURE REVIEW

### 2.1 Theoretical framework of the Study

The concept of classroom environment assessment was pioneered by Herbert Walberg with the Harvard Project Physics. Wubbels, Fraser, Tobin and Fisher have also provided valuable research and data in the area of classroom environment during the last twenty years (Fisher & Fraser, 1990; Fisher, Rickards, & Fraser, 1996; Fraser, 1998a; Fraser, 1998b; Fraser, 1994c; Fraser, 1990d; Fraser & Fisher, 1983; Fraser & Fisher, 1982; Fraser & Tobin, 1991; Wubbels & Brekelmans, 1998; Wubbels, 1993). These studies are based on the use of instruments created by Wubbels, which is referred to as the *Questionnaire on Teacher Interaction* (QTI) (Brekelmans, Wubbels & Creton, 1990; Wubbels, 1993). These survey instruments, with some modifications, have been used internationally to assess students and teacher perceptions, in the Netherlands, Australia, Hong Kong, Singapore and the U.S.A. The modified QTI is a convenient

questionnaire with forty-eight items comprising eight sectors which form four proximity dimensions (Wubbels, 1993).

The four dimensions (or domains) include cooperation, opposition, dominance and submission and form quadrants (figure 1, p.20). Each quadrant gradually blends into its respective border. For example, as one becomes less “dominant” they become more “cooperative”, and the anti-thesis of “dominance” is “submission”. Such a scale provides a more life-like realm that one’s behaviour, attitude, or dispositions can include some or all of the four proximity dimensions. The eight sectors within these four dimensions of the QTI are: leadership, helpful/friendly, understanding, student responsibility and freedom, uncertain, dissatisfied, admonishing and strict behaviour (see table 1, p.38) superimposing the sectors over the proximity dimensions creates an octagonal figure (figure 2; page 39).

Table 1 - Description of scales addressed by the QTI

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 Domains and sectors addressed in the QTI

<i>Cooperation</i>	<i>Opposition</i>	<i>Dominance</i>	<i>Submission</i>
Understanding	Admonishing	Leadership	Uncertain
Helpful/Friendly & Freedom.	Dissatisfied	Strict Behaviour	Student responsibility

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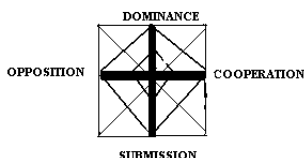


Figure 1: The four scales addressed by the QTI

## 2.2 Research on Learning Environments

Many pupils come from communities with widely differing cultural practices and at times the teaching and learning strategies adopted in science classrooms can be perceived as being in conflict with the natural learning strategies of the learner. Science teachers can use strategies that may inadvertently conflict with pupils’ previous learning patterns, home environments, mores and values. There is an increasing need for teachers to be sensitive to the important cultural milieu into which their teaching is placed (Thaman, 1993). Recent reviews (e.g., Fraser, 1994c, 1998b) have demonstrated the importance of the field of classroom environment research, particularly the use of student perceptions, over the last three decades, and how this field has contributed much to understanding and improving student achievement, particularly in science. For example, classroom environment assessments provide a means of monitoring, evaluating and improving science teaching and curriculum. A key to improving student achievement and attitudes is to create learning environments that emphasise those characteristics that have been found to be linked empirically with student outcomes. However, classroom environment research has been somewhat limited in primary schooling compared with secondary schooling (Rekha & Fisher, 2006).

Increasingly, cultural issues are being addressed within science education. The classroom teaching and learning is influenced by both the cultural world views of the student (Fisher & Waldrip, 1999) and the teacher argued that teachers from different cultural backgrounds from their students must be made aware of possible conflicts that might arise from their expectations of students. To survive the school process, some of these students, besides resisting assimilation (Driver, 1989), tend to



compartmentalize their learning. Changing students' views is not easy, especially when these views continue to be used by their family and peers. The challenge for the teacher is to stimulate learning while not resulting in the student becoming alienated from their society knowledge, beliefs and values. These views can directly impact on students' perceptions of teachers' interpersonal behaviour.

Teachers tend to find it difficult to understand the 'nature, causes and consequences of cultural conflicts in minority populations' (Delgado-Gaiten & Trueba, 1991, p.24). As schools are becoming increasingly diverse in their scope and clientele, any examination of the interaction of culturally sensitive factors of the pupils' learning environments with learning processes assumes critical importance. While there are a number of research studies in science concerning culture and education generally (Atwater, 1993, 1996), comparatively little research examines the interactions that occurs between students' culturally sensitive learning environment and their learning. It is timely and relevant to examine how this aspect of pupils' learning environments enhances or inhibits their learning within the junior secondary school science classroom. It is feasible that at the macro classroom level, there are distinctions that can be made between the ways of learning of different students.

In the past 27 years Moos' work has influenced the development on use of instruments in his research on human environments. Moos (1979) found that three general categories can be used in characterizing diverse learning environments. These findings emerged from Moos' work in a variety of environments including hospital wards, school classrooms, prisons, military companies, university residences and work milieus. The three dimensions are: *relationship dimensions*, which identify the nature and intensity of personal relationships within the environment and assess the extent to which people are involved in the environment and support and help each other, *personal development dimensions* which assess personal growth and self-enhancement; *personal maintenance and system change dimensions* which involve the extent to which the environment is orderly, clear in to assess the qualities of the classroom learning environment from the perspective of the student (Fraser, 1986, 1994d; Fraser & Walberg, 1995).

Examples of classrooms environment instruments include: the *Learning Environment Inventory* (LEI) (Fraser, Anderson, & Walberg, 1982) which measures students' perception of 15 environment dimensions of secondary school classrooms; the *Classroom Environment Scale* (CES) (Moos & Tricket, 1987) which contains nine scales for use in secondary school classrooms; the *My Class Inventory* (MCI) (Fraser, Anderson & Walberg, 1982) which is suitable for use with children in the 8-12 years of age range; and the *College and University Classroom Environment Inventory* (CCEI) (Fraser, Treagust, & Dennis, 1986) which is suitable for use in the tertiary education settings. Other more specialized instruments include : the *Individualized Classroom Environment Questionnaire* (ICEQ) (Fraser, 1990e) which assesses those dimensions with distinguished individualized classrooms from conventional ones; the *Science Laboratory Environment Inventory* (SLEI) (McRobbie & Fraser, 1993) suitable for assessing the environment of science laboratory classes at the senior secondary and at the tertiary levels; and the *Constructivist Learning Environment Survey* (CLES) (Taylor, Dawson, & Fraser, 1995) designed to assist researchers and teachers assess the degree to which a particular classroom environment is consistent with the constructivists epistemology. As the scales of all these instruments can be categorized into one of the dimensions of Moos' dimensions.

However, none of the instruments referred to above was designed specifically to assess culturally sensitive factors of the students learning environment and it is necessary to devise a new instrument. The new instrument that would be utilized in this study is based on previous learning environment scales. The selection of these scales would be guided by an examination of literature from the fields of anthropology, sociology and management theory, in particular, the work of Hofstede (1984) and his dimensions of culture. After collecting information with a detailed questionnaire from thousands of individuals working in multi-national corporations operating in 40 countries, Hofstede (1984) analyzed the data and identified four dimensions of culture, namely, *Power Distance*, *Uncertainty Avoidance*, *Individualism*, *Masculinity and Femininity*.

### 2.3 Students' Perception about Learning Environments

Students' beliefs about the learning environment determine whether or not the classroom climate has a positive effect. Yet students' perceptions and reactions to the learning environment may not match

the teacher's intentions. Changing the classroom environment to improve students' perceptions improves achievement as well as outcomes such as interest and motivation (Combs (1982). For example, students' positive perceptions of the classroom environment contribute to developing a favorable attitude toward mathematics (Combs, 1982).

Fraser and Wubbels (1995) noted that numerous programs have shown that students' perception of their classroom environment may account more for academic success than that of their background. Gentile (1997) found that improved teacher perceptions of school climate and morale had an important impact on the achievement level of middle school (J.S.S) students in the area of reading scores and mathematics scores, and thus in the achievement levels of middle school (JSS) children, in general. Until the mid-1980 only a small consideration had been given to the study of student perceptions. The practice of seeking a student's perception, or "person perception", as coined by psychologists and educators (Kramer, 1992, p.28), came into acceptance and recognition that perceptions are realistic to the one perceiving and may provide vital information on the teaching- learning interaction.

The need for determining students' perspective in education was established in the theories and works of Fullan (1994, 1991), Hargreaves (1992), Dunn (1988), Sizer (1992), and Glasser (1997, 1986). Combs (1982), over three decades ago, emphasized the affective domain as being vital component of the education process. He believed proper education cannot be achieved apart from addressing both the cognitive and the affective domains; for the affective domain is concerned about student attitudes, feelings, and emotions. The student's motivation to learn new tasks is an affective characteristic, according to Bloom (1983), Sizer (1992), and the Coalition of Essential Schools movement, supported the initiative that educational goals will vary as students themselves vary, and that learning should be personalized to the maximum feasible extent.

A generation ago, Buxon (1973) proposed changing the system to fit its students. The students' perceptions are vitally important in order to aid the student-school fit, (Dunn, 1988; Eccles, Midgley, Wigfield, et al., 1993; Fraser & Fisher, 1983; Marcus, 2001), therefore making the process of learning more effective and efficient. Darling-Hammond (1996) affirmed that teachers have a complex job and one expertise that they cannot afford to be without is an understanding of how students think and perceive learning. Kawasaki (1996) noted that the complexity of one's concept of science partly reflects one's national culture. "Perceptions can assist teachers," according to Dale Schunk "by showing how students think, which is useful for teaching". These theories are related to the impact of current reform and emphasize the need to consider the importance, educationally and socially, of knowing what students perceive, as compared to what we, as educators, hope they have perceived.

Goodlad (1984) and Schneider (1996), independently, noted that student' perceptions about learning are seldom sought, and students seldom make decisions about their own learning. According to Barell (1995), the criterion for effective learning is that students are in charge of their own learning; essentially, directing their own learning processes. One research team reasoned that adolescents base much of their efficacy on been responsible (Van Hoose & Straham, 1988). It should be our goal as educators to develop students into self-regulated learners able to think and make intelligent decisions in order to manage change (Schunk, 1995). According to Costa (1984), students can learn to understand and articulate their mental processes if teachers specifically encourage thinking about thinking (i.e. metacognition).

Van Hoose and Straham (1988) hold that we, as educators, are to steer adolescents through the transmissions of parent control, to peer control, on to the final goal of self- control. Covey (1989) recognized the importance of self-directedness, which he called "proactivity" (p.186). Barell (1995) noted that learning in schools is traditionally dominated and controlled by adults. Beane (1993) posited that even in the midst of educational reform, middle school (J.S.S.) educators are still having a disconcerted sense that while they have done a great deal by way of organizational work, there was still a void. To him, this missing void appeared to be students' perceptions. When considering the curriculum, Beane (1993) surmised that appropriate curriculum begins with relevant, accurate, and up to date concept of which much could be learned from knowing what students perceive. In his work, *From Rhetoric to Reality*, Beane (1993) equated curriculum developed apart from the teachers and young people who experience it, was anti-democratic and disgustingly dictatorial. May be this should cause us to reconsider the process. Could it be that we just do not know how students actually perceive education? We assume their perceptions

are those of our own. Little wonder students sense alienation, and even powerlessness, over what is happening to them academically (Oerlemans & Jenkins, 1988).

Since the mid-1990s, there has been a gradual, but significant, increase in the number of studies regarding student perceptions. More educational researchers are now attempting to study student perceptions in the classroom learning environment than any other time. Recently, Wenglinsky (2003) analyzed teacher classroom practices (teacher input and characteristic practices) with that of student academic performance. Campbell, Smith, Boulton-Lewis (2001) considered students' approaches to learning in regard to their teachers' approaches to teaching. Marchant, Paulson, and Rothlisberg (2001) studied student perceptions of family and school and how this affected academic achievement. These studies were centered principally upon the conceptual field of learning environments.

Learning environments are components of the educational experience, and are constructed by individuals and groups of individuals in a given setting. Learning environments consist of socially-mediated beliefs about opportunities to learn and the extent to which those opportunities are constructed by the social and physical milieu (Ferguson & Fraser, 1996). Learning environments are not only constructs, but are constructed by the interaction that occurs within a classroom between a teacher and students. It is within this environment that the foundation of learning transpires. This, however, is not to say that "learning necessarily follows from instruction" (Ahlgren, 2002, n.p.). However, student learning, according to Wenglinsky (2003), "is a product of the interaction between students and teachers, and both parties contribute to this interaction" (p.7).

Cochran-Smith (2003) reminded us of the complexity involved in teaching and the mishap we create by attempting to over-simplify descriptions of the process. It is not the intent of this study to over-simplify effective teaching and learning. "Effective teaching" is simply defined as the ability to help students learn, *effectively*. This issue in this study is not so much as what is effective teaching but rather how it bears on classroom environment. Educational researchers have reported on numerous occasions that students actively construct "knowledge on the basis of the knowledge they already hold" (Duit & Treagust, 1995, p.49). Students learn by constructing knowledge from their own personal experience. The reality that students construct their own meaning of an idea, concept or fact, is now referred to as constructivism.

Constructivists recognized that a student's learning is not something that takes place in a vacuum, but rather is embedded in a particular "social setting" of which that individual is a participant, namely, the classroom learning environment (Duit & Treagust, 1995, p. 49; Wadsworth, 1996). Clearly, there is more to constructivism than the explanation just rendered, however, the recognition of this interaction between the student, the environment, and the information to be learned, is of vital importance in understanding the concept of "personal perception". Duit and Treagust (1995) said it well. If the teacher asks a question and students try to understand it, they are able to do this only from their perspective and on the basis of the conceptions that they hold. If these conceptions are different from those of the teacher, and this unusually is the case, the students make sense of the questions in a way different from the teacher's way; the answer the students might give is interpreted by the teacher from his or her point of view. An endless circle of misunderstanding can occur in such communications situations, and these incidents frequently occur in teaching and learning. (p. 49).

Schunk (1992) considered that "there are many types of student perceptions that operate in the classroom" (p. xi). Students *learn*, consequently, when their concept, which is embedded in their own knowledge and evaluation of the environment, is compared and contrasted to that of their teacher's concept, which may, and typically is, from an entirely different environmental construct (Treagust, Duit, & Fraser, 1996). This construct of a class environment is a product of the interactivity that occurs within a class with a teacher and amongst peers. In a sense, a student's ability to learn is limited only to the degree to which a concept can be made personal. A personal concept is, therefore, a *percept*, or perception, which is identified by psychologists as, "person perception" Kramer, (1992, p. 28). This provides legitimacy to the study of students' and teachers' perceptions. A student's perception provides him or her with tools in which to decipher, translate, construct, and make sense out of any given concept. "Prior knowledge," according to Lorschach and Tobin (1997) "is used to make sense of data perceived by senses" (n.p.). Students' perceptions, therefore, are real and accurate *for each individual student*. For example, what happens when a student perceives that a teacher does not like him when this perception is very real and

factual to the student? It may not be true in reality, and in fact, the teacher may not feel that way at all about the student. The student's perception, however, will act as a filter through which the student will either limit or facilitate learning. Though Lorsch and Tobin (1997) recommend using constructivism as a "referent", it seems highly appropriate here to suggest that a student's perception, is, indeed, their referent to learning. Learning occurs through the senses and in the context of the environment in which the learner is a member. This places a great deal of importance and worth of student perceptions in the learning process. This study is unique in that student perceptions will be solicited, as well as that of their teachers', providing a means of comparing the effect of the perceptions of both, student and teacher, on student learning.

In discussing student perceptions on learning and teaching practices, Antonowich (1995) found that gifted middle school (J.S.S) students' perceived academic success regardless of the form of academic grouping practiced. Daniels, Kalkman, and McCombs (2001) established that primary students valued similar characteristics in teachers regardless of the classroom context. Marchant, Paulson, and Rothlisberg (2001) suggested that middle (J.S.S.) students' perceptions were predicative of their academic achievement. Robinson (2001) found out that middle (J.S.S.) school student' reports of their teacher supportiveness significantly predicted student science grades. This is a noteworthy concept and needs further investigation, for if student perceptions are of predictor of academic achievement, then what perceptions determines success or failure academically, and what influence or contrast does that of the teachers' perception have on this interplay? It has been noted that students' perceptions are not usually the same as that of the educators'. In examining instructional teaching methods, Hagborg (1994) found that students tended to rate teacher methods as more limited and more dependent on teacher direction than did teachers, who saw their methods as broader and requiring more student participation. Indeed, Rickards and Fisher (1998) found that teacher and student perceptions vary greatly from one another and that teachers always give themselves higher ratings than do students.

The seeking of students' perceptions regarding their educational experiences may be a step in the right direction to improve the learning process. It certainly could be a step in a more effective and efficient direction towards a more constructivistic ideology of student learning based on student perceptions and experiences. In the current study, it is supposed that student perceptions' regarding science classroom environment may not only be different from that of their respective science teacher. The larger the disparity between the two perceptions of science classroom environment, the greater the effect on student learning. Student perceptions are vital components, among other factors, that interact with teaching and learning to create classroom learning environments. Teacher, recognizing that students' perceptions are, indeed, mirror reflections of their perceived environment, will seek to provide an environment that is conducive to learning by endorsing effective teaching strategies (Honebein, 1996; Riesbeck, 1996). According to Wubbels & Brekelmans (1998) teacher observation instruments typically only seek to identify the observer perceptions of ongoing behaviours between *some specific number (n)* of students and the teacher. This perspective has been developed from the pioneering research of educators in the area of classroom environments (Aldridge & Fraser, 1997; Fraser, Anderson, & Walberg, 1982).

A comprehensive review of the literature by Assor and Connell (1992) documented the validity of student self-reports of students in grade 5 (age 10) or older, although responses may be biased by the student's tendency to respond in a manner that is socially desirable. McCaslin and Good (1996) found the same to be true concerning student interviews. Research summarized by Schunk (1992) demonstrated that student perceptions can mediate the relations between the classroom, school environment and student achievement. Spence, Dupree, and Hartmann (1997) moreover proposed a focus on adolescents' phenomenological experience as an important predictor of learning attitudes. Therefore, students reported on their perception of their school environment, classroom environment, their motivational beliefs, and use of learning strategies.

#### 2.4 Linking Students Perceptions about Learning and Classroom Environments

Why seek perceptions of students? Schunk (1992) defined "Student perception" as involving "perceptions of students' own abilities, self-concepts, goals, competence, effort, interest, attitudes, values, and emotions" (p. xi). Perceptions, therefore, have been defined in this study as how students perceive, distinguish, or make sense of the environment in which they interact. Callahan, Clark, and Kellough (2002)

interrelated classroom environment, student perceptions, and learning. They proposed that “certain perceptions by students must be in place” (p. 162). Psychologists describe this concept of perception more specifically as “person perception” (Kramer, 1992). Person’s perceptions are attributions made by individuals about events, situations or personalities. Pintrick, Cross, Kozma, and McKeachie (1986) have noted that an emphasis on students’ perceptions requires an assumption that students are active information processors who not only are affected by classroom events but have an effect on the events that occur in the classroom. This concept was originally proposed by Bandura (1978) as reciprocal determinism.

Perceptions are very important for they affect the learner as well as the instructor (Calahan, Clark, Kellough, 2002; Fisher & Rickards, 1998; Friedel, Marachi, & Midgley, 2002; Rickards & Fisher, 1996; Schneider, 1996). Student perceptions, according to Schunk (1992), represent “complex processes that are influenced by a variety of factors and that have diverse effects in school” (p.4). Student perceptions are typically assessed through questionnaires (surveys) or interviews in which students are presented various items asking about them believes and how they judge each item on a numerical scale (Ericsson & Simon, 1980; Frankel & Wallen, 2003; Gall, Gall & Borg, 2003; Nisbett & Wilson, 1977). The method of data collection in this study shall include a questionnaire in survey form, as well as one – on – one interviews with randomly selected teachers and students, alike. This provides the researcher with a sample to represent the population to which the findings of the data analysis could be generalized. Researchers have investigated students’ perceptions to determine their relation to teaching and students behaviours (Brophy & Good, 1986).

Historically, however, the study of student perceptions has received very little research attention. A great deal of interest in student perceptions surged simultaneously with the gradual diminishes in the dominance of behavioural psychology. At present, it is not uncommon for educational researchers to seek the perceptions of teachers; however, the impetus to consider possible comparisons between student perceptions with that of their respective science teachers, has been insufficient. More specifically, researchers studying the effects of students’ perceptions, and whether a variance exist with that of their teachers’ impact achievement, are almost nonexistent.

Only recently have school reformers invested much time and attention in examining the perceptions of students about learning. The standards movement has in fact, dominated the research scene for nearly a decade now, moving the present educational tide from that of a “child-centered” educational approach to a “standards-centered” educational approach. Apart from the political aspirations of some, most people genuinely want students to learn. Jackson and Davis (2000) suggested that, “improvement in student achievement across all groups requires a relentless focus on the heart of schooling- that is, on teaching and learning” (p.31).

Many suggestions have been made by educators and researchers, alike, as to how to improve student achievement. Some theorists have proposed research results in how to apply “brain based” strategies in the classroom (McGeehan, 2001; Pool, 1997; Rosenfield, 2002; Sylwester, 1997). Others have proposed improving learning via the endorsement of professional development schools (Wise, 1999). Some researchers have advised more rigorous teacher learning programmes and more course work (Wise, 1999; *Summary Data*, n.d.), or even the requirements for a master’s degree as a means of the renewal of one’s teaching certification (*Teacher Education*, 1999). Some of the educational reformers have proposed more standardized student-testing as a means of teacher evaluation and accountability (Archer, 2002). In other words, teacher accountability is perceived as judging a teacher’s competency by how well his or her students score on some specific standardised test. Nair (2002) approached learning reform from an entirely different angle by holding that school buildings should be redesigned for effective teaching and learning as based on research findings.

Day (2002) posited that changing the approach and perception of teaching to that of a “non-standard classroom” would facilitate learning. He proposed such conceptional changes as cooperative and authentic learning (Day, 2002). Several researchers have even suggested a form of homogenizing schools by segregating student populations according to socio-economic status or some other form of composition (Burns & Mason, 2002; Kahlenberg, 2001). Many science educators, however, are recommending that the learning experience can be improved by focusing more on the teacher-student relationships, and more distinctively, the learning environment (Fisher, Rickards & Fraser, 1996; Rickards,



1998; Schunk, 1995; Wubbels, 1993). Isbell (1999) studied student perceptions with the evaluation of web based learning, while other researchers have sought to examine the evaluation of classroom goals and maladaptive behaviours using student perceptions (Friedel, Marachi, & Midgley, 2002; Nair, 1999). Barman (1999), sought to determine student perceptions regarding scientists and how they study and use science, while Neathery (1997) studied student perceptions towards science as a course.

## 2.5 Student Achievement and Student-Teacher Relationships

Student achievement is unquestionably in the forefront in this era of standards and accountability, but achievement is typically, at least in practice, measured using standardised tests (Amrein & Berliner, 2002b, Bastera, 1999; Behuniak, 2002; Brown, n.d, Dorn, 2003; Haydel & Roeser, 2002; Newell, 2002; Stiggins, 2002; Wellstone, 2000; Wiggins, 1998). The use of standardised tests to measure student achievement is questionable (Bassett, 2002), Zwick, 2002). Consistent with Hamel and Hamel (2003), Glass (2003), Stiggins (2002), Amrein and Berliner (2002a, 2000b), and Winter (2002) the present practice of trying to determine student learning by way of standardised testing actually debilitates many students. Glass (2003) therefore, has called for a re- examination of assessment with a great emphasis on formative classroom assessment and how assessment might improve student learning. Test scores, alone, leave people on the far-end of “high-tech” as opposed to “high touch” (Naisbitt, 1999). This terminology is used by marketing magnates to express the continuum of very personal to very impersonal, cold and formal. Middle level (JSS) students undeniably need and crave the warmth and informality of a “high touch” approach to teaching and learning.

The contrast here is that of impersonal versus personal.

Research indicates that student perceptions can, mediate the relationship of teacher behaviours to student achievement, thus reinforcing the notion that teaching can influence student perceptions, which in turn affects achievement (Schunk, 1992). That students' perceptions can affect classroom events is also true. Schunk, (1992) in regards to student motivation introduced the concept of *locus of control* in which he emphasized *perceived control* over achievement and outcomes. In relationship to the current study, one might see how a student perception has a great deal of influence on whether the student perceives the ability to succeed or fail academically. This study will be significant, in that it attempts to extrapolate whether large difference between student perceptions of learning occurs when compared with that of their respective science teacher's perception.

## 2.6 Research on Interpersonal Teaching Behaviour

Interpersonal teaching behaviours are evaluated by having students record their perceptions regarding their teacher. These teacher practices or attitudes can be analysed in various ways. Daniel and Blount (1992) produced a middle school (J.S.S.) descriptive survey similar to the QTI which acted as a quantitative instrument for measuring organizational culture in middle schools (J.S.S.). Fisher and Rickards (1996) studied relationships between teacher and student interpersonal behaviour and their effects upon student attitudes in mathematics classes using the QTI. A similar study, also utilising the QTI, was conducted that same year by Fisher, Rickards and Fraser (1996) in assessing student-teacher interpersonal relationships in science classes. Their findings indicated a strong correlation for each dimension studied (Fisher, Rickards and Fraser, 1996).

The theoretical basis for the QTI was founded on the systems perspective of Leary (Wubbels, Creton, Holvast, 1998), namely the assumption that behaviour of participants influences each other interactively and mutually. Thus the behaviour of the teacher is influenced by the behaviour of the students, which in turn, then influences student behaviour. Leary proposed to map interpersonal behaviour by producing a two dimensional dichotomy. The first dimension labeled *Influenced*, which he believed to be made up of a continuum from Dominance, (D) to Submission, (S). The second dimension Leary called, *Proximity*, dimension and was made up of a continuum of Cooperation, (C) to Opposition, (O). In visual form (see Figure 2, p.39) these two dimensions are presented in a coordinate system divided into eight equal sectors (Wubbels, Creton, Levy & Hooymayors, 1993, p.16). The QTI assesses the eight sectors of teacher-student interaction. They provide a comprehensive description of teacher' interactions with their students. Table 1, p.19, presents a description and sample item for each scale of the QTI.

Table 2 - Description of Scales and Sample Items for each scale of the QTI

Scale name	Description of Scale (The extent to which the teacher...)	Sample Item
Leadership (Lea)	...Leads, organizes, gives orders, determines procedure and structures the classroom situation.	The teacher knows everything that goes in the classroom
Understanding (Und)	Listens with interest, emphasises, shows confidence and understanding and is open with students.	This teacher trusts us.
Uncertain (Unc)	... Behaves in an uncertain manner and keeps a low profile.	This teacher allows us to tell him or what to do.
Admonishing (Adm)	...Gets angry, expresses irritation and anger, forbids and punishes.	This teacher gets angry quickly.
Helping/Friendly (HFr)	...Shows interest, behaves in a friendly or considerate manner and inspires confidence and trust.	This teacher helps us with our work.
Student Responsibility	...Gives opportunity for independent work, gives freedom and inspires confidence and trust.	This teacher allows Freedom (SRe) us to take responsibility for what we do
Dissatisfied (Dis)	...expresses dissatisfaction, Looks unhappy, criticizes and waits for silence.	This teacher thinks that we cheat.
Strict (Str)	...checks, maintains silence and Strictly enforces the rules.	This teacher is strict.

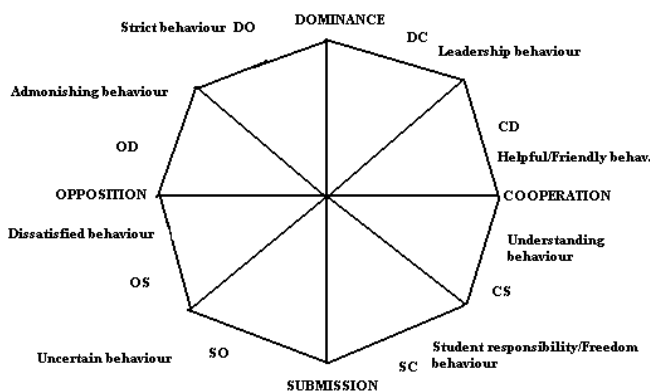


Figure 2: Diagram of the eight sectors within the four domains of the QTI

## 2.7 Use of Student Perceptual Data

Until the late 1960s a very strong tradition of trained observers coding teacher and student behaviours dominated classroom research. Indeed, it was a key recommendation of (Fisher, Rickards and Fraser, 1996) that instrument for research on teaching processes, where possible, should deal with the objective characteristics of classroom events. Clearly, this low-inference approach to research which often involved trained observers coding teacher and student behaviours was consistent with the behaviourism of the 1960s. One field which broke with this tradition in the late 1960s and used student perceptual data is the study of classroom psychosocial environments. Low-inference approaches which characterised early classroom environment research in the USA have given way to the use of the summary judgments of milieu inhabitants based on their long-term involvement in the particular setting. Since the mid-1960s, the strong trend in classroom environment research has been towards this high-inference approach with data collected from teachers and students. Support for this methodological approach is found in Walberg's (1976) perceptual model of the learning process which proposes that student learning involves student perceptions acting as mediators in the learning process. In addition, Walberg advocated the use of student perceptions to assess environments because students seemed quite able to perceive and weigh stimuli and to render predictively valid judgments of the social environment of their classes.

Several advantages of the use of measures that define the educational setting in terms of the inhabitants' perceptions have been suggested by Fraser (1994d), Walberg (1981) and Walberg (1976). First, students and teachers are at a good vantage point for making valid judgments about classrooms and schools. As they are immersed in the atmosphere for extended periods of time, this exposure allows students and teachers to form opinions based on long-term experience. This approach contrasts with short-term observations that often are associated with the use of external observers (e.g., snapshots of one or two lessons). From a methodological perspective, this means that the milieu inhabitants have more data to bring to the data collection stage.

Moreover, these data have been processed by the inhabitants, resulting in the formation of judgments. A second advantage of using student and teacher perceptions over the notes, codings and perceptions of observers is that students and teachers act on the basis of their perceptions. Accordingly, the assessment of these perceptions as determinants of behaviour is preferred to the reporting of an observer's assessment of classroom reality. Third, perceptions of classroom environment have been found to account for considerably more variance in student learning outcomes than have directly observed variables. Walberg, (1976) study of classroom interaction showed that student' perceptions of their own influences on the class, but not observer estimates of the class, predicted academic gains.

Walberg concluded that low-inference studies using observers could be a narrow approach to the understanding of classroom environments. That students are able to make valid summary judgments about schooling is best demonstrated by the classroom environment components of the present study which focus on cultural, factors and teacher-student interactions. Consequently, the study described in this paper utilised students' perceptions of their teachers' interactions with them and aspects of their classroom learning environment.

## 2.8 Teacher Perceptions about Classroom Learning Environment

There have been, in general, more studies conducted on teacher perceptions than on student perceptions, such as the study by Ross, Hannay, and Hogaboam-Gray (2001) which examined teacher perceptions on the impact of school reform on student achievement or that by Brown (n.d.) regarding learning and block scheduling. Most studies typically seek teacher perceptions apart from that of students such as studies which have sought teachers' perceptions on students' abilities, interest, and the value they attach to a task. Research has shown that teachers' perceptions do have an effect on student perceptions (Brophy & Good, 1974).

Wigfield and Harold (1992) found that student perceptions of their ability decrease across the elementary school years. A few researchers have sought the perceptions of both teacher and students. Alter (2001), for example, selected to determine student and teacher perceptions in high school chemistry courses in microcomputer-based laboratories. Akerson and Flick (1999) sought student and teacher

viewpoints on recognizing the importance of student ideas in elementary school science. Although there is little on student perceptions, the bulk of the research addressing this concept centres at the tertiary level; such as that used in traditional instructor evaluations completed by students. Little has been done in the area of student perceptions of effective teaching and learning, though a few studies have addressed this concept at the university level (Center, 2000; Nair, 1999), and another (Harrison, Fisher, & Henderson, 1997) having done so at the high school level. Even fewer studies can be found in the area of middle level (JSS) education.

In 1998 Rikards and Fisher conducted a study in which they surveyed 3,515 students in 164 schools in Western Australia utilising the Questionnaire on Teacher Interactions (QTI) to compare student and teacher perception of the teacher-student interaction within middle school classrooms of science and mathematics. The significance of this study was that teacher interactions did have an effect on students, and how students perceived teacher-student interactions were not usually the way the teacher perceived such interactions themselves. In truth, teachers' perceptions can be very different from that of students' (Ares & Gorrell 2002; D'Arcangelo, 2000; Duit, Treagust & Mansfield, 1996) determined that students viewed classrooms much more negatively than their teachers. Modern-day educational reform centres on programmes of academic standards as opposed to classroom-based interactions between a teacher and the student. There is a need to reverse the trend and begin to focus more on classroom-based interactions which greatly influences effective teaching and learning. Junior secondary school science education has much to gain from such focus.

The sectors within the octagon then further define the proximity dimensions. For instance, in the dimensions of dominance, one can sway to the left towards opposition or to the right towards cooperation. It is appropriate to state at this time that the statistical analysis of the QTI for internal consistency has satisfactory reliability (Wubbels, 1993). The QTI scales range from .76 to .84 for students' responses and .74 to .84 for teachers' responses (Fisher, Rickards, & Fraser, 1996). This study is unique in that it combines the dimensions under the appropriate sectors of the QTI with the Midwestern American sample. After an exhaustive search the researcher found no evidence that the QTI had been administered to a large sample of students in the Junior Secondary Schools in Ghana. Recent trend in education research requires a combination of qualitative and quantitative methods of data collection and analysis (Fraenkel & Wallen, 2003; Fraser & Walberg, 1995; Patton, 1990; Tobin & Fraser, 1998).

This is sometimes described as a "mixed-method design", or triangulation, but the concept is simply that of having more than one type of data (quantitative and qualitative) in order to compare results to determine whether the findings support the other (Fraenkel & Wallen, 2003, p.443). This concept of triangulation provides rigour and a means of trustworthiness in the study. By using multiple approaches one can identify new problems and possible solutions.

## 2.9 The Development of the Questionnaire on Teacher Interaction (QTI)

Here an historical perspective on learning environment instrument development is described, with the greater emphasis been placed on the origin of the Questionnaire on Teacher Interaction (QTI). Many educational studies of the 1950s and 1960s began to ascertain the social-behavioural associations in classrooms through experimental research. The instrument that have been used in studies of student perceptions in the past also tended to be those that considered learning (Fraser, 1998a, 1998b, 1994c, 1990d; Moos, 1979; Wubbels, 1993). The instruments used were a survey format and were typically scored on a 5-point numeric Likert scale. Classroom environment questionnaires have multiple uses, even that of evaluating "participator learning" (Forster, 1999).

Some of these early pioneering studies, like Moos', centered on the environment of mental hospitals or institutions of incarceration (Moos 1972). Of particular interest for this study is the approach taken by Walberg and Anderson in developing, trialing and validating the learning environment inventory (LEI) (Wubbels, Creton, & Hooymayers, 1985). The LEI became the "model" for perfecting, refining, and improving better psychosocial instruments ascertaining learning environments. Such inventories as the Classroom Environment Scale by Moos and Trikett (1974), the Treatment Perception Scale (TPS), the My Class Inventory (MCI) by Fisher and Fraser (1981), and the Individualised Classroom Environment Questionnaire (ICEQ), by Fraser (1990e) were utilized to quantify data gained from students regarding classroom environment for the purpose of analysis. The Questionnaire of Teacher Interaction (QTI) by

Wubbels and Levy (1993) soon followed. The American version of the QTI was produced some two years later (Wubbels & Levy, 1991), and the Australian version was established in 1993 (Fisher, Fraser & Wubbels, 1993).

The Australian version of the QTI is however more time economical than its counterpart with 48 items utilising a 5-point response scale (Fisher & Rickard 1996). This makes the QTI more functional for the classroom teachers to use with their students for it is less time consuming to administer and score. Nevertheless, all three versions of the QTI have shown to be valid and reliable instruments. The Australian version of the QTI has been made available for mathematics and science teachers for use in their own classrooms. This version is chosen for the current study because of the economy and time factor, as well as for its verification of being both valid and reliable.

## 2.10 The Issue of Out-of-Field Teachers and Learning Environment

The task of educating is a difficult one, but to complicate matters even more so, Gewertz (2002) reported that 50 percent of middle school (JSS) students are under the tutelage of teachers who lack the training of certification to teach in middle school (JSS). These teachers are considered as out-of-field (Seastrom, Gruber, Henke, McGrath, & Cohen, 2002) meaning they are not certified in the area in which they teach. What concept of effective teaching and learning would one have that is out-of-field compared to one who is in their trained field? Does this affect teacher quality? Some researchers think it does (Ravitch, 1998; *Teacher Quality*, 2002). What about differences in expectations? Knowing that expectations affect student achievement (Bamberg, 1994; Lumsden, 1997), such conditions made this study relevant and even vital, to understanding some of the unseen influences and interactions that occur within a science class between students and teachers. What about differences in their perceptions of teaching and learning? These are vital questions to ask in an era in which the government of Ghana and other stake holders are looking up to colleges of education to live up to expectation.

The debate of in-field versus out-of-field will continue to brew until answers are provided about how these two classifications affect student achievement. Byrnes (2001) noted that "meaningful perception" is very different for the expert and novice (p.78). An expert sees a meaningful whole whereas novice tends to see a collection of separate components. Conceivably, a teacher out-of-field will have a very different perception of effective teaching and learning in a course for which they are not trained as opposed to one being trained (Berliner, 1990; Borg & Ascione, 1982; Stallings, Needles, & Stayrook, 1979; Wenglinsky, 2003). These studies raise a serious issue regarding the practice of using out-of-field teachers. Does it mean that students experiencing the tutelage of an out-of-field teacher have an even greater variance in their perceptions of effective teaching and learning than that of their out-of-field teacher? This research provides answer to this big question.

The topic of out-of-field teachers has produced a vast amount of fervour in the media the last few years (Berliner, 2000). There has been, and continues to be, a great amount of debating in the United States over teaching credentialing. This was relevant to this study since training has a huge influence on a teacher's perception (Jerald, 2002). The practice of using out-of-field teachers has come to the forefront (Archer, 1999; Ingersoll, 1999; Jerald, 2002; *Many Middle*, 2002; Starr 2002) and is a growing issue as standards and accountability issues continue to seethe. There are various gradations of being out-of-field. Most of this concern stems from the fact that often teachers graduate from nationally accredited teaching programmes but are then shifted, or transferred, into areas of the school academic programme where they have little or no training. These teachers are referred to as out-of-field (Jerald, 2002; Seastrom, Gruber, Henke et al., 2002). They could be, for instance, masterful teacher in language or Arts but find themselves being put into a situation where they may teach science or say mathematics some part of the day. Or, often, the well-qualified mathematics teachers may have a few courses in science. Or a qualified teacher is totally removed from his/her area of expertise and placed out-of-field due to a shortage of teaching faculty. That itself should raise concern. There is, however, a worse scenario where one walks in from off the streets unprepared or untrained, and yet, is expected to teach.

In a study conducted by the United States Department of Education (Seastrom, Gruber, & Henke, 2002). It was found that in the middle grades (JSS) sciences, 30 to 40 percent of students were being taught by teachers who lacked the proper credentials. Some divisions of science, such as physical science



had as high as 56 percent of students having teachers who were not qualified (Seastrom, Gruber, Henke, 2002). This percentage is much higher for schools in poor socio-economic situations.

### 2.11 The Nature of Science in Junior Secondary Schools in Ghana

The teaching of science in Ghana started in the elementary schools as a form of practical science called health science (hygiene) nature study and gardening more than eight decades ago. However, the earliest document of science as a school science subject appeared in a report by the Education Committee of the Privy Council to the Colonial office dated 1847 (Forster, 1965). During the colonial era hygiene, nature study and gardening were made compulsory in training colleges to enable the prospective teachers to handle the subjects in the elementary schools. In the elementary schools the science curriculum consisted of nature study, hygiene and gardening or agriculture. In post elementary institutions (secondary schools and training colleges) general science, health science and agriculture were taught (Awuku, 1975).

The practical nature of the science courses could not be maintained for long. Criticisms were raised against it. It was seen as not offering conditions comparable to those in the clerical employment; was inferior in promoting social mobility; occupational structure of the country had limited opportunities and the belief that manual jobs were undignified (Forster, 1965). At the primary school level, nature study and hygiene gave way to the more theoretical course; integrated science in 1967. This was reviewed in 1974 and more recently in 1988. Environmental studies were also introduced at the primary level. The environmental studies dealt with problems related to the environment such as housing and diseases while the integrated science dealt with basic ideas in science such as plants and animals and their behaviour, and simple physical concepts such as simple machines and nature and properties of different forms of matter. In the primary school's science is taught by teachers who have not specialized in the teaching of science. The integrated science taught at this level is activity-oriented with the teacher expected to play a manager's role (Anamuah-Mensah, 1989). However actual classroom transactions tend to be based on chalk and talk. The teacher and the textbook become the authority for the pupils. Field trips which form an important component of the course at this level are rarely conducted.

The Junior Secondary School constitutes a three-year post primary education and provides opportunity for pupils to discover their interests, abilities, aptitudes and other potentials. It introduces them to basic scientific and technical knowledge and skills and prepares them for further academic work and acquisition of technical vocational skills at the secondary level (Executive Summary, 2003). The junior secondary school which replaced the middle school since 1987 offers integrated science and agricultural science courses. The teaching of science in the junior secondary school follows a pattern similar to that of the primary school. That is the chalk and talk method is given priority, practical experiences are reduced to a minimum because of the poor science background of the teachers (Anamuah-Mensah, 1989). There is also a great dependence on the teacher and the text book.

A general pattern that emerges from the above is that our science teaching emphasizes the teaching of knowledge or concepts of science to the neglect of other relevant areas such as the practical experiences. Concepts here refer to the ideas, generalizations and theories of science while practical refers to laboratory activities including experiments. An examination of the history of science indicates that these two aspects of science teaching are important for a proper understanding of the nature of science. Also neglect at all levels is the use of the concepts and practical experiences to provide solutions to societal or environmental issues. Any application to real life situations has been restricted to a few isolated concepts.

Science has been and continues to be presented as a cold blooded, impersonal superstructure that occurs only in the classroom ((Anamuah-Mensah, 1989). This has led to the lack of interest in science among pupils of the Junior Secondary Schools in Ghana. It has also led to science being seen as difficult and unrelated to the Ghanaian environment, low enrolment in science and especially for girls, lack of an inner confidence in applying formal scientific concepts to one's own daily life, and poor understanding of concepts as shown in examinations. Science is therefore perceived as an alien culture which is being forced on our young people. These people may therefore go through science education without the science education 'going through' them; i.e. changing them in any way. This form of education based on science

concepts seems to be best suited for the few intelligent students who continue to major in science or science related subjects like medicine, and engineering in the university.

Science is perhaps a unique subject on the school curriculum (UNESCO, 1962). It is unique because of the variety of materials and experiments necessary for its effective teaching. Science must be experienced. It must be learned and not learned about. Its effective teaching cannot be confined to the reading of textbooks or listening to lectures. The junior secondary school child must therefore be taken through a series of experiments to enable him/her to understand and appreciate the subject matter under study. Science is an intimate part of the environment – living things, the sky, the earth, the air, and water, heat, night, and forces such as gravity. Thus science in the junior secondary school cannot be taught without first-hand materials.

Good science teaching in the junior secondary school must be based on observation and experimentation. Performing experiments and learning, however, require special facilities, many of which are lacking in the junior secondary schools in Ghana. It is important to note however that most of the materials needed to enhance effective teaching and learning in the junior secondary schools can be obtained from the immediate environment. The junior secondary school science teacher also needs to manufacture some of these teaching and learning materials himself or herself for the enhancement of his or her own teaching performance.

## 2.12 Chapter Summary

This chapter discussed the theoretical framework of the study based on the QTI derived from the eight sectors which form four proximity dimensions (Wubbels, 1993). The four dimensions of teacher behaviour in the classroom are cooperation, opposition, dominance and submission. The eight sectors within the four dimensions are leadership, helpful/friendly, understanding, student responsibility and freedom, uncertain, dissatisfied, admonishing and strict behaviours. The chapter again discussed some research on learning environments which include students' perception about learning environments, linking students' perceptions about learning and classroom environments, student achievement and student-teacher relationships, interpersonal teaching behaviour, use of student perceptual data, teacher perceptions about classroom learning environment, the issue of out-of-field teachers about classroom learning environment as well as the nature of science in junior secondary schools in Ghana.

## 3.0 METHODOLOGY

In this chapter, the research design of the study is described along with the details of procedures used to conduct the study. This required participant selection, choice of instrument, and data collection and handling. The method of data analysis underpinning the study is also outlined.

### 3.1 Research Design

The objective of the research was to find out the relationship between J.S.S. pupils perception and the perception of their science teachers about science classroom learning environment. The research design for the study was based upon the *survey method*. This design was chosen because it allows various means of obtaining the perceptions (Crowl, 1996) of both pupils and teachers which have to be compared and contrasted.

### 3.2 Population and Sampling

The Population for the study consisted of JSS pupils and science teachers from a cross section of mainstream public and private schools in the Birim South district of Eastern region of Ghana. This was believed to be representative of the target population, typical of junior secondary schools in Ghana. Out of the 125 junior secondary schools in the Birim South District, 99 are public and 26 are private (data collected from the Eastern Regional Education office; Appendix L). Final year students were used because it was believed that they had interacted well enough with their science teachers. The total number of final-year students in the Birim South District Education Directorate (2006/7 academic year) was estimated to be 4,081. Out of this number of students, 3,413 were from public schools and 668 were from private schools.

Ten junior secondary schools were randomly sampled (probability sample) from the Birim South Educational Directorate and invited to participate in the study. In order to obtain a confidence level of 95%,

it was determined that a minimum of 400 junior secondary school students would need to be surveyed in order to provide 95percent confidence interval and population size,  $p=.05$  (Creative research systems, 2001). This study surveyed exactly 462 participants made of 452 students and 10 teachers from 10 different junior secondary schools. According to Jaeger (1988), the purpose of the sample survey method is “to describe specific characteristics of a large group of persons, objects or instruments” (p.495).

### 3.3 Research Instruments

The research instruments were two. First, the Questionnaire on Teacher Interaction (QTI), developed by Wubbels and Levy (1993) was adopted. This was followed by some student and teacher interviews which strengthened the validity of the results in the study. The QTI which had four domains; Dominance, Submission, Cooperation, and Opposition also had eight sectors or scales. Thus *Dominance* had the scales of leadership and strict behaviours; *Submission* had student responsibility/freedom and uncertain behaviours; *Cooperation* had understanding and helpful/friendly behaviours; *Opposition* also had the scales, dissatisfied and admonishing behaviours. These eight scales had forty-eight items evenly distributed among them. Thus each scale had six items from which the JSS3 pupils and their respective science teachers had to respond. Table 3 summarizes the distribution of the items over the scales and the domains.

Each item also had the weights of the rating scale ranging from zero to four and the respondents were to make a circle around the number corresponding to their respective perceptions of their science teacher's classroom behaviour. If the respondents *strongly agreed* with the item statement, they were to make a circle around four (4) and if they *strongly disagreed* with the item statement, they were to make a circle around the number, zero (0). If they *agreed* with the statement, they were to circle three (3) and if they *disagreed* with the statement, they were to circle one (1). If however, they were not sure, they were to circle two (2).

Table 3 - Distribution of Items over the Scales and the Domains of the QTI

Domain	Scale/ Sector	QTI Item Number
Dominance	Leadership behaviour (Lea)	1, 5, 9, 13, 17, 21
	Strict behaviour (Str)	28, 32, 36, 40, 44, 48
Submission	Student Responsibility/Freedom behaviour (SRe)	26, 30, 34, 38, 42, 46.
	Uncertain behaviour (Unc)	3, 7, 11, 15, 19, 23.
Cooperation	Understanding behaviour (Und)	2, 6, 10, 14, 18, 22.
	Helpful/friendly behaviour (HFr)	25, 29, 33, 37, 41, 45.
Opposition	Dissatisfied behaviour (Dis)	27, 31, 35, 39, 43, 45.
	Admonishing behaviour (Adm)	4, 8, 12, 16, 20, 24.

### 3.4 Validity of the Instruments

In determining the validity of the instruments, experts in science education who had undertaken research involving classroom studies, examined the QTI as well as the interview protocol. They suggested some modifications, which were made before piloting the instrument. Prior to this, the QTI and the interview protocol were given to some PhD students in science education to examine and give their comments and suggestions regarding specific items. Their responses varied in length and detail, but in general, were of a positive and supportive nature. The revised QTI and interview protocol were then piloted.

### 3.5 Reliability of the Instruments

The reliability of the instruments was determined after the pilot study. This gave Cronbach alpha of .84 which is reliable. According to Borg, Gall and Gall (1993), coefficient of reliability values above .75 are considered reliable.

### 3.6 Procedure for Data Collection

In September 2006, permission was sought from the Birim South District Director of Education, to enable the researcher submit letters describing the study rationale and procedure to heads of 10 randomly selected junior secondary schools (both private and public). Following this, an equal number of the same letter was sent to science teachers of these schools. Responses were collected in October, 2006 and analysed in November 2006. In addition to the 462 surveys, six students and six respective science teachers were randomly selected for interview.

### 3.7 Pilot Study

A pilot study was conducted prior to the submission of letters to the heads of schools and the respective science teachers. The essence of this was to test the appropriateness and effectiveness of the QTI. The Pilot study was done in one of the junior secondary schools in Akim Akroso in the Birim South district of Ghana. Forty -four students and a science teacher participated and this gave Cronbach alpha of .84 which is a reliable coefficient. The pilot study was very useful because it helped in the modification of the QTI and made it more effective. For example, the original QTI which had item one as "this teacher talks enthusiastically about science" was modified as "This teacher is very interested in science as a subject". This became necessary when it was observed that the pupils had difficulty in understanding unfamiliar words.

On the day the survey was conducted, the respondents were made to understand that the questionnaire was in no way a test and that what was required of them was to answer in a sincere manner. The respective science teachers were also supposed to respond to the same questionnaire as truly as possible how he/she conducts himself/herself in the science classroom. No names were used so pupils and teachers were assured of anonymity. The researcher took the respondents through the forty-eight item questionnaire explaining and citing examples to bring home meaning to statements which seemed difficult to be understood by the respondents. Immediately after this, a student from among the respondents was chosen for the interview. The respective science teacher was also given a copy of the interview protocol (Appendix D) to respond to. Verbatim quotes were used in recording the pupils' responses in the interview to avoid misrepresentation of the pupils' comments.

### 3.8 Survey with the QTI

The QTI was considered adequate in addressing the concepts of effective teaching and learning perceptions of teachers and pupils, alike. The rationale for this is explained in the following paragraphs. The QTI has shown to be a valuable and versatile tool for it is able to be used in a non-threatening survey to ascertain: 1) how pupils perceive their teachers' classroom behaviours to be, and 2) how teachers perceive their own teaching dispositions to be. In all formats the QTI has been shown to be a valid and reliable instrument in the Netherlands (Wubbels & Levy, 1993), the United States (Wubbels and Levy, 1991), and in Australia (Wubbels, 1993). In the pilot study in Australia, the QTI, containing 48 items, provided strong evidence for internal validity and potential usefulness (Fisher, Fraser, & Wubbels, 1993). In a follow-up study, Rickards and Fisher (1998) found that with a large data base of more than 3,589 students in 173 science classes, that reliability scores for individual students' scores ranged from .63 to .88 when used with individual students, and from .78 to .96 when used with class mean as the unit of analysis. The instrument chosen for this study is the Australian version of the QTI (Fisher, Fraser & Wubbels, 1993) based primarily on its validity and internal consistency, but more practically, because of its time efficiency in surveying an entire class. It is considered more economical in that it is shorter and thus more quickly administered to students.

The QTI has been shown to be a reliable instrument. Reliability is measured in terms of the ratio of true score variance to observed score variance, and a reliable test or survey should minimize the measurement error so that the error is not highly correlated with the true score. In contrast, the relationship between the true score and observed score should be strong. Cronbach's alpha coefficient examines this relationship and the higher the alpha coefficient the more reliable the test. Though there is no official line of demarcation, Nunnally (1978) has indicated that a reliability coefficient of 0.7 and above is acceptable for comparisons among groups. The QTI is, therefore, within the acceptable range for being

a reliable instrument for use with individual and class means as a unit. In this study, the objective of the researcher is to compare class mean scores to that of the respective teacher's mean scores.

Further cross-validation of the QTI is expected to support the internal consistency with either individual students or as analysis of class mean as a unit. It has been found that the QTI is capable of differentiating between the "perceptions of students in different classrooms" (Rickards & Fisher, 1996). With class membership, the QTI using one-way ANOVA, provided scale differentiation to be significant ( $p < .001$ ) between class and the F-Ratio statistic, which represented the proportion of variance explained by class membership, ranged from 0.22 to 0.35 for different classes (Rickards, & Fisher, 1996, n.p.). The QTI for student and teacher versions was adopted to assess perceptions of effective teaching and learning. Survey items assessed junior secondary pupils' perceptions of effective teaching and learning, as viewed in their perceptions of their science teachers' dispositions. All items were on five-point response scales, anchored with 1= "never" to 5="always". The internal consistency of scales was assessed with Cronbach's alpha (Cronbach, 1951) and the scales  $\alpha \geq .76$  for student-teacher measures for acceptability.

In this study, the participants were administered the self-report QTI questionnaire. Students responded to the 48 items that assessed perceptions of the science classroom learning environment, as provided by their science teacher. A five-point Likert scale (0= 'never' to 4 = 'always') was employed. The QTI instrument was used to survey this convenience sample, along with their respective science teachers. A pilot study was first conducted to establish the validity and reliability of the modified QTI in Ghana. On the day that the sample survey was administered, the researcher read the script to the pupils describing the study, and the directions for completing the questionnaire (appendix C). Final-year junior secondary school pupils were surveyed during a typical science lesson. Final-year students were selected for the study because they had interacted more with their science teacher. Participants completed the questionnaire in approximately 30 minutes or less. A post survey was later conducted and used for the analysis of this study.

### 3.9 The Interview

An interview protocol was used with each participant interviewed. The interview protocol actually confirmed students and scores of the QTI. The protocols for the interviews were based on provisional questions directly linked to the QTI. For example, where the QTI inquires about helpful or strictness, the interview protocol will pose a similar semi open-ended question. For example, "Would you say that your science teacher helps students behave more by making strict rules or by encouraging students to do what is right? Why do you think this way?" The interview questions were intentionally written in an informal, non-threatening manner so as to set participants at ease. Seven such questions were posed in which participants were required to answer and typically provide a reason for their answer and occasionally an example. Due to the consistency and structure of the interview protocol, student and teacher interviews were expected to be valuable in assuring triangulation in this study.

These questions were designed simply by reading through the QTI survey, as well as noting the eight domains being surveyed in the QTI. The purpose of the interview protocol was to provide consistency in interviewing various participants. It was believed that the interviews would provide verification for what was being surveyed. As with the QTI, the same questions were used for both students and teachers, with the exception that teachers were to merely answer from their own perception as the classroom teacher. For example, using question 5, the teacher would be asked, "Would you say that you help students behave more by making strict rules or by encouraging students to do what is right? Why do you think this way?"

### 3.10 Method of Data Analysis

In keeping with recent trends in the research on classroom learning environment, this study utilized both qualitative and quantitative methods (Fisher & Fraser, 1990; Fraser and Tobin, 1991; Fraser 1998a; Fraser, 1998b; Fraser, 1994c; Fisher, Rickards, & Fraser, 1996). According to Tobin and Fraser (1998), combining qualitative and quantitative methods of research provides multiple theoretical perspectives (observational and interpretive methods) into education in general, and the classroom, in particular. The practice of including a combination of both quantitative and qualitative measures is generally accepted as enhancing the study (Fraser & Tobin, 1991; Tobin & Fraser, 1998). The instrument used in this study was the Questionnaire on Teacher Interaction (QTI). Quantitative data were collected from the completed surveys



of JSS students and their respective science teachers. Item responses were tallied and means for each class were determined. Cronbach alpha coefficient and ANOVA (F-ratio) were employed to confirm the reliability and validity of the QTI employed in this study and found consistent with previous studies. The test of significance (t-test) was also computed to prove the hypotheses valid or not. Correlation between pupils and teacher scores were analysed using Pearson coefficient.

Qualitative data were collected from students and teachers, alike, using the interview protocol. Six students and six teachers were selected for impromptu interviews for the purpose of clarification of survey responses. Their responses were written directed without changing any word and these have been used to explain the science teachers' classroom interpersonal behaviour as perceived by the teachers and their respective pupils. Triangulation, as defined by Gall, Gall & Borg (2003), is a means of "using multiple data collection methods, data sources, analysis, or theories as corroborative evidence for the validity of qualitative research findings" (p. 640).

### 3.11 Chapter Summary

This chapter has provided a description of research design and the procedures followed to complete the study and the rationale that prompted the use of both qualitative and quantitative research methods. The survey method was found to be the most appropriate research design to be used for the study. The sample chosen (n=462) for the study were pupils of junior secondary schools in the Birim South district directorate of education and their respective science teachers. This chapter again discussed the research instruments, the procedure for data collection the method of data analysis used as well as the pilot study that gave the green light for the study. Chapter four will discuss the results of this study concerning students' general perceptions of the teaching and learning environment of science classrooms as nurtured by their science teachers'. The results of the survey will be discussed in lieu of the research questions.

## 4.0 DATA ANALYSIS

This chapter deals with detailed summary and discussion of the findings which surfaced from the surveys administered to JSS science teachers and their respective final year pupils. The purpose of the survey was to determine pupils' general perceptions of their science teachers' basic concepts and practices of effective teaching and learning.

### 4.1 Results

The results for the study have been presented and analysed in a quantitative and qualitative manner respectively under the research questions which guided the study.

#### 4.1.1 Research Question one: What are pupils' perceptions' about science classroom learning environment?

Table 4 presents the mean scores of how pupils perceive their science teacher's classroom interpersonal behaviours to be. They rated their teachers higher under *leadership* scale (3.73) than any other scale. This was followed by the scale *understanding* with a mean score of 3.71. The third scale was *helping/friendly* and this was given a mean score of 3.51. *Strict* nature of the science teacher was ranked fourth with a mean score of 3.16. The pupils however rated the other scales low. They were in the order, student *responsibility/freedom* (0.94), *dissatisfied* behaviours (0.94), *admonishing*, (0.89), and *uncertain* behaviour, (0.88).

This of course is a clear indication that pupils perceive their science teachers to possess high leadership skills, which can be seen in the way he/she leads, organizes lessons, give orders, determine procedures and structures the classroom situation. They also see their science teacher as someone who listens to them with interest, empathizes, shows confidence and understanding and is open with pupils. Again science teachers are seen to be helpful and friendly in the way they show interest in pupils work, behaves in a friendly and considerate manner and inspires confidence and trust. The moderately strict nature of science teachers such as maintaining silence and enforcing classroom rules is also seen and acknowledged by their pupils. It is also clear from the pupils mean scores that science teachers do not give much responsibility and freedom to learners. That is there is not much independent work for the learners.

The negative behaviours such as dissatisfaction of teachers in the way they look unhappy, criticizes and wait for silence, uncertain in the way they teach and also keeping of low profile and admonishing in the way they get angry, expresses irritation, forbids and punishes learners were all abysmally rated since learners saw very little of their science teachers in such behaviours.

Table 4 - Mean scores obtained from Pupils' Responses of the QTI

Scale	School										Mean
	A	B	C	D	E	F	G	H	I	J	
Lea	3.93	3.97	3.87	3.35	3.90	3.63	3.87	3.54	3.77	3.46	3.73
Und	3.85	3.36	3.96	3.78	3.88	3.65	3.78	3.55	3.63	3.61	3.71
Unc	0.69	1.40	0.15	1.06	0.16	1.02	0.73	1.24	1.48	0.50	0.88
Adm	0.93	1.52	0.46	0.88	0.66	0.74	0.99	0.88	0.93	0.86	0.89
HFr	3.41	3.15	3.63	2.82	3.53	3.44	3.41	3.94	3.91	3.89	3.51
SRe	1.15	1.34	0.58	1.51	0.67	1.35	1.21	0.68	0.35	0.56	0.94
Dis	1.34	1.20	0.44	1.18	0.71	0.22	1.31	1.62	0.77	0.56	0.94
Str	2.58	3.10	3.31	3.46	3.70	2.88	2.57	3.27	3.57	3.12	3.16

This is supported by the pupils' responses in the interview data curled out from Appendix E as follows:

*Teacher Classroom Behaviour: Teacher teaches us to do the right thing; He is a disciplinarian. Teacher is friendly and patient; He makes sure we understand what he teaches; Teacher is good, just, very kind, generous, and honest. He comes to class late, humble, respectful, insults us, Teacher talks harshly, He is neat, truant, drunkard. Collect bribe from students and gives them marks.* From these responses it could be said that pupils are very much aware of the nature of the classroom environment as established by their respective science teachers. Pupils were able to recognize various aspects which they believed to be good pedagogical practices. For instance, being a *disciplinarian, friendly and patient, honest, just etc.* Pupils also noted some bad pedagogical practices like being a *drunkard, talking to pupils harshly, truant, bribery etc.*

*Teachers Use of Competition and Cooperation: He allows us to work in groups and we like this very much, He conducts class test, organizes quiz and debate once a while and encourages us to work together. He ensures more cooperation than competition.* From the pupils' response, it is clear that they recognized the dichotomy between competition and cooperation in the science classroom. The pupils unanimously perceived that their science teachers attempted to promote more cooperative spirit in the classroom than competition. A critical look at the pupils' responses reveals that they preferred cooperative learning to competition. They want to work in groups to enhance their learning. Cooperation to the pupils is therefore a means of effective teaching and learning.

*Friendliness versus Helpfulness: He helps us one-on-one for understanding. Gives exercises, we feel free to go to him for help. Teacher is friendly and helpful, he advices us to do the right thing, He helps us to solve our problems, does not hate anyone, and allows us to express our views, smiles to everyone. He laughs with us. He explains things well. Not friendly at all, does not help us in our work, he drinks alcohol, He does not explain things well.* Pupils in this study did not generally rate their teachers as unfriendly. The only exception was pupil D whose response to the interview protocol cuts a slur on the image of the science teacher. This may be due to the inability of the teacher to review his teaching notes as a result of his drunkenness. The pupils saw their teachers as more helpful than friendly. Though both dispositions are apparently desired, pupils are able to discover some distinction when required to do so. It could be inferred that one could be friendly but not necessarily facilitate effective teaching and learning. It is good for a teacher to open up to enable pupils to approach him or her for explanation of concepts or phenomena that they may not understand.

*Teacher Strictness versus Responsibility. He gives us a lot of responsibilities and privileges because he wants us to learn. This outweighs his strictness. He is not very strict, allows us to take responsibilities. He allows us to contribute and take part in discussions. He asks class prefect to send books home for marking. Sometimes he gives individualized instruction.* Pupils unanimously stated that

their science teachers were strict and give responsibilities and privileges to them. They cited the example of blackboard monitor, class prefect and individualized responsibilities (Appendix E). They also said that their teachers reward them whenever they meet his or her expectation. This concept is very important for JSS pupils at this age, especially those just entering the JSS, find a transitional paradox where they would like to be “babies’ as in the primary school (class one to class six) experience but are often fearful in their new responsibilities that accompanied new freedoms (Nesmith, 1998). Here we see students recognizing the relationship between responsibility and privilege.

*Teacher satisfaction and Dissatisfaction: Yes, he is satisfied being a teacher because he always talks well about it. Sometimes he talks as if he doesn't like the job because the salary is not good. He is happy with the job. He teaches joyfully, he is always cheerful. He is satisfied. He smiles when teaching and explain things well. He laughs in class. Our contribution in class also makes him satisfied.* All the pupils perceived their teachers to be satisfied or very satisfied for being teachers. Uncertainty and discontent plays havoc on a teacher and is not something that can be easily hidden from pupils. Pupils typically get to know whether a teacher likes his or her subject by the way they behave and interact. The QTI provided a means of examining this disposition by use of the satisfied or dissatisfied dichotomy. Questions which addressed this on the QTI are 27, 31, 39, 43, 47. The intention here is to attempt to reveal a positive or a negative attitude of a science teacher especially towards his/her teaching disposition.

*Teacher Strictness versus Encouragement: Yes, he makes strict rules to make us behave; Our teacher makes rules to make us behave and also to prevent us from cheating. He thinks students have to be guided by elderly people to make them behave well. Sometimes he makes strict rules. He always encourages us to do what is right. He makes strict rules to make us change our bad behaviours.* This concept *making of strict rules and encouraging* pupils to do what is right is queried in the QTI in questions 28, 32, 36, 40, 44, and 48 and regarding *admonishing*, questions 4, 8, 12, 16, 20 and 24. Almost all the pupils indicated that their science teachers make strict rules to ensure that they do what is right. Also their teachers encourage them to do what is good. They also stated that strict rules prevent them from cheating, stealing and disturbing in class as well as other negative classroom behaviours. Strict rules therefore are seen as a means of deterrent from unaccepted behaviours of children.

*Teacher Pedagogical Practices: Teacher uses demonstration, he gives clear explanation when teaching, He also gives good introduction to lessons, He makes us work in groups. He makes us do class activity E.g. finding density of stone. Rewards us, punishes us, assist those who don't understand. He ensures that we do our corrections. He revises with us. He is ever ready to help us. He asks us some questions, use things around as examples, work more examples on the board.* Pupils' responses reveal several strategies employed by science teachers in the science classroom that enable them to learn best. These include; clear explanations, good introduction to lessons, demonstrations, collaborative learning, use of analogy, remedial teaching, experimentation, hands on approach to teaching, and Individualized instruction, exercising various modalities, accommodating different learning styles and willingness to go the extra mile. Pupils' response to this interview question is a clear indication that they are very mindful of what is effective teaching and learning.

#### 4.1.2 Research Question 2: What are teachers' perceptions' about science classroom learning environment?

Table 5 also provides the scale means for the respective science teachers. Teachers, like the pupils, also rated themselves in the same trend. The highest mean score for the teachers was 3.99 for *leadership* followed by *understanding* with a mean score of 3.92. *Helping /friendly* was the third and had a mean score of 3.57 whilst the *strict* nature of teachers had 2.93. Teachers rated themselves 1.20 for *students' responsibility/freedom*. The ratings by teachers for *admonishing, dissatisfaction and uncertain* behaviours were 0.74, 0.28 and 0.15 respectively. This obviously indicates how positive the teachers perceive their interactions with the learners to be. They exhibit very little of the negative behaviours as portrayed by their own mean scores. Thus teachers think that they possess very high leadership skills, understand their learners, they help their pupils to learn and are friendly to them. They again think that they give responsibility and freedom to pupils and are moderately strict. Teachers also feel that they do not admonish pupils so much and that they are certain and satisfied with their work.

Table 5 - Mean scores from the respective science teachers

Scale	School										Mean
	A	B	C	D	E	F	G	H	I	J	
Lea	4.00	4.00	4.00	3.97	3.98	3.98	4.00	4.00	4.00	3.98	3.99
Und	4.00	3.80	4.00	3.80	4.00	3.80	4.00	4.00	3.80	4.00	3.92
Unc	0.19	0.15	0.17	0.11	0.16	0.12	0.17	0.10	0.12	0.19	0.15
Adm	0.67	1.17	0.50	0.67	0.67	0.50	0.67	1.17	0.67	0.67	0.74
HFr	3.67	3.67	3.33	3.67	3.67	3.67	3.33	3.67	3.67	3.33	3.57
SRe	0.67	0.83	1.33	1.33	1.32	1.32	0.67	1.83	1.33	1.33	1.20
Dis	0.27	0.19	0.33	0.17	0.33	0.35	0.31	0.20	0.33	0.33	0.28
Str	3.33	3.67	2.17	2.83	2.83	2.67	3.67	3.33	2.17	2.83	2.93

Teachers' responses as provided by the interview data, were almost the same as their corresponding pupils. The following points have also been extracted from Appendix E as teachers' responses.

*Teacher Classroom Behaviour: I am democratic, patient, good decision taker, calm, not quick tempered, accommodating and tolerant. I discipline students when need be. Make good use of the contact hours; make teaching and learning effective by involving every student to contribute, friendly, involve students in lessons; I am an Organized class teacher. I am kind and have good sense of humor.* The philosophy of effective science teaching and learning could be observed from the teachers' responses. These science teachers have definite ideas regarding how science teachers ought to conduct themselves and how they can plan to accomplish their stated objectives. The science teachers perceive their classrooms to be democratic where they allow all pupils to take part in discussions and make contributions during lessons. These teachers are friendly, tolerant, calm, patient and disciplined. Teachers also possess good sense of humour and make use of the contact hours. These are all strong point for the promotion of an effective science classroom environment.

*Teachers' Use of Competition and Cooperation: Conduction of class test, examinations and class exercises to ensure competition. organization of debates, group work and discussions to ensure cooperation among pupils, use of competition and cooperation but cooperation is emphasized more, etc.* The teachers interviewed also perceived that they are more collaborative and cooperative in their approach to teaching and learning than they are competitive. Many teachers in practice however do not use cooperative learning and do not use collaborative approaches to teaching but from the responses of the pupils and the teachers it is clear that each teacher did in fact, perceive themselves in the same manner as did their respective pupils. They conduct class test, examinations and class exercises to bring about competition among the pupils.

*Friendliness versus Helpfulness: I am friendlier but more helpful. I don't discriminate; I help students to solve their problems, I am helpful because, I usually advice students to put up good behaviour. I punish them if they misbehave.* This originated from the QTI and requires students and teachers to choose from two good characteristics; that of being helpful and that of being friendly. They were queried on QTI item numbers 25, 29, 33, 37, 41 and 45. The statements on the QTI included, "This teacher helps us with our work", "This teacher is friendly", "This teacher is someone we can depend on", "This teacher has a sense of humour", "This teacher can take a joke" and finally, "This teacher's class is pleasant". The science teachers responded in the same way as the pupils did. Some were very clear and others were uncertain. Few felt that their dispositions as regard helpful/friendly were equal. Both dispositions are important in bringing about effective teaching and learning. Both teachers and pupils were able to decipher the complexities of a classroom learning environment.

*Teacher Strictness versus Responsibility: I assign students work, teach students about their responsibilities, I am a disciplinarian; I ensure that the right thing is done, I am not all that strict on my students, rather I ensure that they do the right thing; I give responsibilities and privileges to students. My strictness is normal; usually I give roles to every individual in the class. Each is responsible for what he*

or she does. The teachers' response to this question indicates that they have thought through these concepts of discipline, strictness, responsibilities and privileges. It is possible that these concepts have been dealt with in their training as teachers. JSS pupils want the freedom of their early school years, but they must be trained how to handle the responsibility that comes with freedom. These teachers seem to be moving in the direction which prepares pupils well for better learning.

*Teacher satisfaction and Dissatisfaction: I am satisfied. I do not show any sign of frustration in life. I share jokes with the students, I smile at them. I am satisfied because I do enjoy whatever I do in class. I love. Though I do my work well, I am not all that satisfied with the conditions in which I teach.* The teachers' responses clearly indicate that they are strongly dedicated. These teachers like their pupils have perceived apparently like what they are doing. It could be said that some of these teachers love the profession of teaching. It appears that the dissatisfied scale is negatively associated with cognitive achievement (Rickards & Fisher, 1996). This question was probably easier for the pupils to answer than for the teachers. The pupils can be frank and upfront with what they believe here; however, the teachers require a lot of self-confidence not to answer it according to what one thinks the researcher wants to hear. In other words, it is believed that most teachers who are not satisfied with their job did not want to answer with openness. In this study therefore, pupils' answers validated that of their teachers.

*Teacher Strictness versus Encouragement: I ensure that school rules are not broken by making strict rules, I encourage students to do the right thing by setting good examples myself. I make strict rules for students. I make strict rules. Correct students when they do wrong. I am a disciplinarian, I give punishment and reward to students.* The teachers also responded in the same way as their pupils did. The classroom teacher must keep order. He is the creative motivator of all the children. All the teachers answered the questions mentioning both sectors because they believed as teachers' rules here are necessary just as encouraging students to do the right things.

*Teacher Pedagogical Practices: I do demonstration; I use charts and the chalk board to explain concepts to children. I employ the learner centered method of teaching. I always maintain a democratic classroom atmosphere; I use the activity method of teaching. I use teaching and learning materials; I involve students during lessons. I organize group work, organize hands on activity for my children to learn better. Teaching and learning materials are used.* The responses reveal several strategies employed by science teachers in the science classroom that enable students to learn best. These include; clear explanations, good introduction to lessons, demonstrations, collaborative learning, use of analogy, remedial teaching, experimentation, hands on approach to teaching, and individualized instruction, exercising various modalities, accommodating different learning styles and willingness to go the extra mile. Students' response to this interview question is a clear indication that they are very mindful of what is effective teaching and learning. The responses by both teachers and students constitute a concept of teaching modalities and learning styles. Table 6 presents a comparison of the responses from the students and their respective science teachers regarding how they learn "best". It is an extrapolation from the survey responses comparing that of the students and the teachers. The purpose of this is to validate that many students are mindful of what is effective teaching and learning. From the comparison it can be observed that there are a few strategies that the students suggested that were not noted by the teachers. These of course are concepts of modalities and learning styles. Pupils may have more strategic ideas for learning that were not tapped in this study.

#### 4.1.3 Research Question 3: How do pupils' perceptions and teachers' perceptions about science classroom learning environment differ?

Table 6 presents both teachers and pupils mean scores for the eight scales surveyed and figure 3 is a graph of the mean scores of the perceptions of pupils and their respective teachers against the eight scales of the four dimensions of science teachers' classroom behaviours. This indicates a summary of the JSS3 pupils' perception as compared to the perception of JSS science teachers. A glance at the block graph (figure 3) reveals that scales which indicated positive behaviours (leadership, understanding, helping/friendly and strict) were scored higher by both science teachers and their respective students and those that indicated negative behaviours (uncertain, admonishing, dissatisfaction) were scored low. Students' responsibility/freedom though a positive behaviour was also scored low by both teachers and students.



Table 6

Comparison of Mean scores of Teachers and Pupils Responses from the QTI

	<i>Lea</i>	<i>Und</i>	<i>Unc</i>	<i>Adm</i>	<i>HFr</i>	<i>SRe</i>	<i>Dis</i>	<i>Str</i>
Teachers	3.99	3.92	0.15	0.74	3.57	1.20	0.28	2.93
Pupils	3.73	3.71	0.88	0.89	3.51	0.94	0.94	3.16

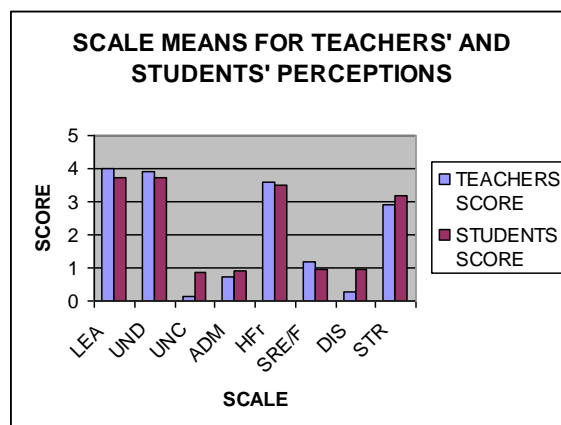


Figure 3: Scale Means for Teachers and their Respective Pupils Scores on the QTI

There is a striking similarity between the teachers' perceptions and the perceptions of their pupils. This reinforces the qualitative results obtained from the interviews. Emerging pattern from the above data and figure is a clear indication that junior secondary school pupils prefer teachers who are helpful and friendly, but do not want teachers who are uncertain when teaching. Also JSS pupils do not want teachers who are dissatisfied. These characteristics were at the opposite ends of the spectrum and appear to give pupils the most problems in learning environments. Teachers rated themselves more helpful/friendly than did their pupils.

Scale means for teachers and pupils were respectively 3.57 and 3.51. Also teachers rated themselves higher than the pupils under leadership (3.99:3.73). Teachers however rated themselves less uncertain than their pupils (0.15: 0.88) and also less admonishing than their pupils (0.74: 0.89). Teachers' score here mean that they have an insight into what is expected of a good teacher. Generally, both teachers and pupils rated the teachers' classroom behaviour very high under leadership, understanding, helpful/friendly, and strict behaviours. Pupils score for teachers strict behaviour was however higher than that of the teachers (3.16:2.93). This implies that these science teachers did not want to say that they are being over strict.

Scales which were scored low by both teachers and pupils were uncertain, admonishing, student responsibility and freedom as well as dissatisfaction. The characteristics measured by the QTI could be examined in relationship to adolescent development. For instance, the dimensions of dominance versus cooperation, one must consider how at this age, pupils seeking various levels of independence, react to dominance. It would be appropriate to mention here that as a pupil grow further and further along in developmental stages, they develop more and more dislike for a learning environment where dominance prevails.

Another observable characteristic of the QTI is that it is capable of differentiating between the perceptions of pupils in different schools about their science teachers' classroom behaviour. This means that pupils within the same class or in the same school perceived it relatively similarly while mean within school or class perceptions varied from school to school. This characteristic was explored for each scale of the QTI using one way ANOVA with JSS3 class membership as the main effect. It was found that each

QTI scale differentiated significantly ( $p < .001$ ) between classes and the F - Ratio representing the proportion of variance explained by class membership, ranged from .003 to .21 for different scales. Rickards and Fisher (1996) reported similar results with a range of .17 to .31.

These ANOVA and Cronbach Alpha coefficient (reliability) results attest to the validity of the QTI in this study. Appendix G provides the detailed calculation of the variance for all the scales from each participating school. Appendix H also shows the detailed procedure for calculating the Cronbach Alpha coefficient whilst Appendix I provide the detailed calculation of the ANOVA (F-Ratio) results. Table 7 is a summary of the internal consistency and the ability to differentiate with reference to the scales of the QTI.

Table 7 - Internal consistency and ability to differentiate between schools/ classroom for the QTI.

Scale	Unit of Analysis	Alpha Reliability	ANOVA Results/ F-Ratio
Lea	Individual	.89	.01
Und	Individual	.90	.003
Unc	Individual	.89	.21
Adm	Individual	.81	.09
HFr	Individual	.81	.01
SRe	Individual	.89	.16
Dis	Individual	.90	.13
Str	Individual	.90	.02

Table 8 produces the correlations between pupils' perceptions of teacher-pupil interpersonal behaviour and that of their respective science teachers with regard to science classroom environments. Pearson r was computed (Appendix J) because it correlates variables measured with scales that have different means and standard deviations and also because the z-score transformation always convert the numbers to a scale that permits comparison.

Table 8 - Correlation between QTI Scale means of Teachers' and Students' Perceptions of Science Teachers' Interpersonal Classroom behaviour

QTI Scale	Pearson r
0.003	
Understanding	0.031
Uncertain	-0.011
Admonishing	-0.231
Helping/Friendly	0.120
Student Responsibility/ Freedom	-0.110
Dissatisfied	-0.170
Strict	-0.410

Leadership

An examination of the simple correlation (r) figures in table 8 indicates that the relationship between teachers' perceptions of their science classroom behaviour and the perceptions of their respective pupils in JSS3 is weak ( $r < 0.5$ ). The implication here is that teachers' perception of their own behaviour in science classrooms differs from the way pupils perceive it to be. Those with positive correlation values (leadership, understanding and Helping/Friendly) have the tendency of increasing together. That is to say, both pupils and science teachers appear to perceive the teachers' classroom behaviour in the same way. On the contrary, the scales which correlated negatively show a clear indication that small values of teachers' score of the QTI were associated with comparatively larger values of the

pupils' score of the QTI or vice versa. This is true because pupils scored higher than teachers in these scales; uncertain, admonishing, student responsibility/freedom, dissatisfied and strict behaviours. It is therefore crystal clear that pupils' perception and teachers' perception in these scales which seem to talk negative about the teachers' classroom behaviour were at variance.

It can also be observed from the responses in the interview data that a great deal of what the pupils said about their science teachers' disposition and classroom environment elements coincided with what the teachers also said. A critical analysis of both responses by the pupils and the teachers to interview question one and two, reveals some commonalities, comfortable and relaxed classroom environment, orderly use of humour, establishment of routines and high standards. However, students B and D (Appendix E) reported very negatively of their teacher whose behaviour are unacceptable and does not enhance effective teaching and learning of science. These teachers were drunkards, irregular to class, insult pupils, speak harshly to pupils, refuse to score pupils exercises and collect bribe from students so as to inflate students' scores. Such a teacher of course will not be respected and would serve as a resistance to students' progress in science learning.

Table 9 presents a comparison of the responses from the pupils and their respective teachers regarding how they learn 'best'. It is an extrapolation from the survey responses comparing that of the pupils to the teachers. The purpose of this is to validate that many pupils are mindful of what is effective teaching and learning. From the comparison it could be observed that there are a few strategies for teaching and learning that the pupils suggested which were not noted by the teachers. These of course are concepts of modalities and learning styles. Pupils may have more strategic ideas for learning that were not tapped in this study.

Table 9 - Comparison of Pupils responses and teachers responses to interview question 7, regarding strategies for learning.

<i>Learning Strategy</i>	<i>Students Responses</i>	<i>Teachers Responses</i>
Clear explanations	*	
Demonstration	*	*
Good introduction of lesson	*	
Collaborative learning	*	*
Hands-on activities		*
Whole class examples	*	
Private one-on-one assistance	*	
Remedial teaching (corrections)	*	
Experiments	*	
Willingness to go the extra mile	*	

\* If mentioned by either student or teacher

#### 4.1.4 Research Question 4: How knowledgeable are the J.S.S. science teachers about the components of a typical classroom environment?

From the responses of the teachers to the interview protocol, it could be inferred that they are quite familiar with the components of a typical science classroom learning environment. The teachers said they allow pupils to work in groups i.e. collaborative learning, employ the activity method of teaching science as well as the demonstration method. J.S.S science teachers perceive that being friendly, possessing leadership skills, giving pupils responsibilities and freedom to work on their own and helping them when in difficulty are also some of the components of a typical science classroom learning environment. A critical look at the responses of the teachers to the QTI reveals that the teachers have very good knowledge of the components of classroom learning environment. This is evident from the fact that they scored themselves higher than their respective pupils under the scales; leadership, understanding, helping/friendly and student responsibility/ freedom behaviours of the teacher in the

classroom. They rather scored themselves lower than their respective pupils under the scales; uncertain, admonishing, dissatisfied and strict behaviours of the teacher in the classroom.

#### 4.1.5 Research Question 5: What are the perceptions of JSS pupils about the science classroom environments created by out-of-field teachers?

The number of out-of-field teachers (teachers who have not being trained as science teachers) who were interviewed in schools in the Birim South District Directorate of education is six out of ten representing 60% of teacher participants. Specifically, these schools were B, C, D, F, G, I and this is quite significant and alarming because schools within the Birim South District in areas of high poverty use more out-of-field teachers than areas of lower poverty. This issue was thought to be of vital importance in the application of the results from this study. If the perception of an expert, for example, credentialed in science is very different from that of a novice, then the effect on student learning and achievement becomes a serious concern for the school, the headmaster, and the parents, not to mention those students in transitional stages of development. If the perception of the teacher is not dependent upon being in or out of their field of training, then possibly there is an overreaction taking place regarding the out-of-field status of teachers.

In this study, the perception of pupils from schools (B, C, D, F, G, I) whose teachers were classified as out-of-field were not very different from those pupils whose teachers were classified as in-field (specialist), i.e., schools A, E, H, J. The mean scores of the QTI (table 4) testify to this. For instance, under *leadership, understanding, helping/friendly* all pupils scored above 3.0 whereas under *strict, uncertain, admonition, dissatisfied* and *student responsibility/freedom*, all pupils scored below 3.0. This shows that all the pupils perceived their respective science teachers both out-of field or in-field similarly. In addition, the responses by the pupils to the interview protocol were congruent for all the schools with the exception of pupils from school's B and D whose responses concerning their science teachers were inimical. For instance, they pointed out (Appendix E) that their teachers go to class drunk, they are truant, not lenient, gives a lot of exercises but would not mark, and sometimes collect bribe from pupils and award them marks or declare them pass. These remarks clearly indicate that the perceptions of pupils about teachers are mirror reflections of the behaviours of the teachers.

#### 4.2 Test of Significance

The hypothesis for the study was; "There will be no significant difference between pupils' perceptions about science classroom learning environment and their respective science teachers' perceptions". This hypothesis is a null hypothesis which implies that there really is not any difference between the perceptions of the pupils and the perceptions of the science teachers and if one is found in the study it is not a true difference, but a chance difference resulting from sampling error. Error could have arisen from some of the pupils who probably did not know exactly which number to score for a particular item.

Also error could have come about as a result of pupils who were not very sure of the disposition of their respective science teacher as demanded by the items in the QTI. Again, errors could have come about due to the teachers' failure to record the true nature of their own dispositions as seen by their pupils. Teachers by their training and exposure probably know what is good to make a classroom learning environment better and so would not record negative scores or statements about themselves. As pupils give their respective teachers the true score of their classroom dispositions the teachers tend to score themselves positively. These might have brought about some variations and as a result might have affected the *t*-score slightly.

#### 4.3 The *t*Test for Independent Samples

Table 10 provides the results of the *t*test obtained for the various scales for the study. The detailed calculation results are shown in Appendix K. In all the scales provided, the observed *t*-values,  $t_{18}$  were less than the *t*-critical,  $t_{crit}$ . Thus,  $t_{18} < t_{0.05}$  and so it is not significant. Hence the null hypothesis could not be rejected. This shows that the responses by both the teachers and their pupils were almost similar. This therefore implies that the teachers and their pupils perceive their classroom learning environment in the

same manner. There were however some slight differences between the scores of both pupils and the teachers as shown in figure 2.

This might be due to errors by the respondents in their recordings or probably as a result of the teachers' positive knowledge of the components of a typical classroom learning environment. For instance, a teacher must be knowledgeable, understand his or her pupils, friendly, not too strict, one who gives responsibility to students and also one who make rules to bring about order in the classroom. A teacher must also be a good leader in order to direct the affairs of the classroom well to promote learning. All these and many others, at the back of the mind of the teachers might have brought about the slight differences.

Table 10 - The  $t$  Test for Pupils' Perceptions and their Respective Teachers' Perceptions of Science teachers' classroom inter personal behaviour.

Scale	$t_{(18)}$	$t_{crit}$	df	Accept or Reject The Null hypothesis
Lea	.03896	1.734	18	accept
Und	.02971	1.734	18	accept
Unc	-.01137	1.734	18	accept
Adm	-.02543	1.734	18	accept
HFr	.00456	1.734	18	accept
SRe	.04791	1.734	18	accept
Dis	-.1204	1.734	18	accept
Str	-.04165	1.734	18	accept

$t_{crit} = .05$

#### 4.4 Chapter Summary

This chapter provided the results of the study. These results were presented respectively in both quantitative and qualitative manner. The figures for the scores of both pupils and their respective teachers of science were presented in table form under mean scores, alpha reliability and ANOVA. Pearson  $r$  and  $t$ -scores were also calculated. It could be seen from the pearson values that there was a positive correlation between the pupils' scores and that of their respective teachers for those behaviours which are positive and correlation coefficient for those behaviours which are negative. The  $t$ -score ( $t_{18} < t_{.05}$ ) lend support to the fact that the null hypothesis must be accepted.

Thus, there is no significant difference between the perception of the pupils and the perception of their respective teachers. However, there were some slight differences which might be due to errors on the part of either both teachers and pupils or the teachers' knowledge about the components of classroom learning environment. With the exception of very few responses to the interview protocol, the responses by both pupils and their respective science teachers were found to be similar. The next chapter sums up the findings of this research work.

#### 5.0 CONCLUSISON

This chapter gives a summary of the research study, conclusions derived from the quantitative and qualitative study, limitations to the study as well as some recommendations and suggestions for further research.

#### 5.1 Summary

This research observed the perceptions of pupils in junior secondary schools in Ghana about their science teachers' characteristic behaviours in science classrooms. It also looked at how the respective science teachers perceived their own classroom behaviours to be. It was hypothesised that, "There would be no significant difference between the perception of J.S.S. pupils and the perceptions of their respective science teachers". This was tested by five research questions which have been responded to in the conclusions. These research questions were;



*Research Question 1.* What are the JSS pupils' perceptions' about science classroom learning environment? *Research Question 2.* What are the science teachers' perceptions' about science classroom learning environment? *Research Question 3.* In what major ways, do pupils' perceptions and teachers' perceptions differ? *Research Question 4.* How knowledgeable are the J.S.S science teachers about the components of a typical classroom environment? *Research Question 5.* What are the perceptions of JSS pupils about the science classroom environments created by out-of-field teachers? Related literature was reviewed under student perception about learning and classroom environment, Student achievement and student-teacher relationships, research on interpersonal teaching behaviour, teacher perceptions about classroom learning environment, the issue of out-of-field teachers about classroom learning environment and the nature of science in junior secondary schools in Ghana.

The instrument chosen for this study is a modified form of the Australian version of the Questionnaire on Teacher Interactions QTI (Fisher, Fraser & Wubbels, 1993) which had forty-eight items scored under four domains and eight scales by both JSS pupils and their respective science teachers. Also an interview protocol was conducted using six teachers and six pupils selected at random from schools in the Birim South district directorate of education. JSS3 pupils were selected as the sample for the study because it was believed that they had interacted well enough with their science teachers and so could give better account of the behaviours of the said teachers. Both pretest and posttest proved reliable. A unique aspect of this study was that the classroom science teachers were surveyed alongside the pupils during the same period of time using the same questionnaire and interview protocol. Data collected were analysed quantitatively and qualitatively and conclusion drawn as follows.

## 5.2 Conclusion

The study showed that pupils of JSS3 in Birim South district and indeed of Ghana have moderately positive perception of their science classroom learning environment and teacher interpersonal behaviour. The results indicated that most pupils consider their teachers to be good leaders and understanding people. In the same vein, most of the pupils indicated that their teachers were helpful and friendly and tended to provide pupils with responsibility and freedom and general rule. They however rated their teachers low in the areas dealing with dissatisfied, uncertainty and admonishing. Likewise, most pupils perceive their science teachers to be quite content with their profession and not necessarily over strict.

In view of this, some aspects of their learning environment need to be improved to enable pupils develop greater interest in science and also urge them to offer science programmes in senior secondary schools. Teachers perceive their science classroom learning environment more positive than do their respective pupils. Teachers rated themselves very high in the scales which are educationally seen to be enhancing effective teaching and learning (leadership, understanding, student responsibility/freedom and helpful/friendly). Scales which do not generally enhance effective teaching and learning like dissatisfied, uncertain and admonishing were rated so low by the science teachers than their respective pupils.

The study indicated that out of the eight scales scored by both pupils and their respective science teachers, four were scored higher by both pupils and teachers. These were; leadership, understanding, helping/friendly and strict classroom behaviours. Teachers however rated themselves slightly higher than their pupils in Leadership, Understanding, and Helping / Friendly. Strict behaviour was rated slightly lower by the science teachers than the pupils. This shows that pupils prefer teachers who possessed:

- Leadership qualities: Teachers notice what happens in the classroom, lead discussions and class activities, organize pupils for activities, give orders, set tasks, determine procedures, structure learning environment, explain phenomena, concepts and process and hold attention.
- Understanding qualities: Listen with interest, emphasize points raised, show confidence and understanding in what they teach and do, accept apologies, look for ways to settle differences, patient and open to pupils.
- Helping/Friendly qualities: assist pupils in their class work, show interest in pupil's work, behave in a friendly or considerate manner, able to make a joke, inspires confidence and trust pupils.
- Strict qualities: moderately strict, keep reigns tight, check pupils' work, judge well, get class silent, set rules and exact norms.

Scales which were rated lower by both pupils and teachers were Uncertain, Admonishing, and Student Responsibility/Freedom and Dissatisfied behaviours. Here, with the exception of Students

Responsibilities/Freedom, teachers scored lower than the pupils. This means that though this scale (Students Responsibilities/Freedom) is a positive behaviour which ought to be exhibited well by teachers, it seems to be lacking. Teachers who give pupils Responsibilities/Freedom should give opportunity for independent work and also give freedom and responsibility to pupils.

The negative behaviours of teachers exhibited in the science classroom were abysmally rated by the teachers than the pupils. Teachers' perception here might have been influenced by their wider range of experience in the world and probably by their training. The characteristics of teachers who exhibit such behaviours are as follows:

- Uncertain behaviour: Keep a low profile, apologize, wait and see where the wind blows, admit when wrong, lack confidence, does not know where one is going.
- Admonishing behaviour: Get angry, take pupils to task, express irritation and anger, corrects, punishes and forbid.
- Dissatisfied behaviour: Wait for silence, consider pros and cons, keep quiet, show dissatisfaction, look glum, questions, and criticize.

Some factors which can militate against effective teaching and learning of science and also cause waning interest of science among pupils at the junior secondary schools in Ghana can be inferred from the study. These include: teachers little understanding of science education, lack of resources and materials, diminished amount of time, teacher centeredness approach to teaching, little opportunity for hands-on-activities, poor literacy, numeracy and interpersonal and communication skills (Rosier and Banks, 1990), being over strict, and admonishing, and failure to give student responsibilities.

The study also proved that teachers have their own philosophy of teaching and that cooperative and collaborative methods of teaching were means of effective teaching and learning. Students prefer teachers who are descent in all respect, comfortable and relaxed classroom environment, orderly use of humour, establishment of routines and high standard. Teachers ought to be helpful/friendly, moderately strict, disciplined and give pupils responsibilities and privileges to bring about effective teaching and learning. Students expect their teachers to be certain and satisfied with their work. Students are frank and upfront in what they believe whilst teachers require a lot of confidence not to answer according to what one thinks the researcher wants to hear. Teacher is a creative motivator of all children and that rules are necessary just as encouraging pupils to do the right thing.

Good pedagogical practices curled out of the study include; clear explanations to concepts and phenomena, demonstration, good introduction to lessons, collaborative learning, use of analogy, remedial teaching, experimentation, hands-on approach to teaching, Individualised instruction, accommodating different learning styles, exercising various modalities and willingness to go the extra mile. It can also be inferred from the study that teachers need to acquire certain competencies to enable them perform effectively in science classrooms at the junior secondary school level. These include *creativity* that would enable him or her to make new things and devise or design a model for effective teaching; *curiosity* that would help the teacher to explore, ask questions and inquire from the pupils or elsewhere to know more; *competence* that would enable the teacher to become capable enough in exercising his or her duties as a science teacher; *commitment* that would drive the teacher to give out his or her best; and *compassion* that would enable the teacher to understand the needs of the pupils and help them to understand whatever he or she teaches.

Pupils' perception of effective science classroom environment demonstrates to be a strong indicator of pupils learning depending upon the extent of difference with that of their science teachers. The research also found out that some of the science teachers were out-of-field teachers. Of the ten teachers who participated, only four were properly trained to teach science (representing 40%). Two of these were graduates with B Ed (Science Education) from the University of Education of Winneba and the other two were specialist teachers in science from Wesley College, Kumasi. The other six teachers were out of field (representing 60%). Two of these six teachers studied agriculture at a diploma awarding institution, three were untrained teachers (they had GCE A Levels) and the other two, who had teachers' certificate A, were not specialist in science teaching. Research has found that these out of field teachers have different perception of what is to be taught and how it is to be taught from those who are trained (Borg & Ascione, 1982, Byrnes, 2001). In so far as this study is concerned, however, these teachers had very clear, and with some exception, accurate perceptions of their classroom environment that they

attempt to implement. The pupils' perceptions about their respective science teachers' classroom behaviours also did not distinguish out-of field teachers from in-field teachers. All the responses given by the pupils from the various schools were congruent to each other.

### 5.3 Limitations of the Study

It has been said that any methodology used to explore learning environment will produce a landscape that is incomplete and represents only one of the possible portraits which is likely to be appealing and relevant to different stakeholders (Tobin & Fraser, 1998, p.623-640). Limitations to the design of this study tend to be centered on the inability to isolate independent variables, thus possibly showing correlation but not clearly a "cause and effect". Inferences were limited to the population been surveyed namely, that of junior secondary school science classes, and particularly Birim South District, though some generalizations were made.

In order to increase the generalisability, students from other regions, randomly chosen (i.e., probability sample), would need to be included, as well. Another limitation in this study was that of trying to get schools to accept the offer to participate. Most schools (private) have specific rules not to participate in outside studies unless permission is sought from the proprietor of the school. Some circuit supervisors (for public schools) withheld support because they felt the survey was a kind of comparative test for various circuits. Science teachers who responded to the questionnaire might also not give their true behaviours during science classes. They might have thought that a comparative study of finding out the best science teacher was under the sleeve of the researcher.

### 5.4 Recommendations

Students' perceptions are indeed mirror reflections of their perceived classroom environment. Classroom environment assessment provides a means of monitoring, evaluating and improving science teaching and learning. Teachers can therefore use the QTI or a modified one to ascertain their own teaching and learning environment. This would help them to modify their teaching strategies to enhance pupils learning. A national science policy to address the general waning interest of pupils in science must be drawn. Such a document must reflect the changing approach to science education in Ghana and must be based on integrated approach to science teaching at the junior secondary schools. It must also be concept based teaching methods, hands-on-experimental investigations and the training of enthusiastic, well-prepared teachers who are offered opportunities for professional development and advancement.

Finally, it is recommended that, practical based curriculum should be drawn for the training of specialist teachers with science degrees currently going on in the country. It should take into consideration the practical activities found in the course work of pupils at the JSS level. This will make these teachers competent enough to teach science at the junior secondary schools in Ghana. Science methods as part of the curriculum of science education should be emphasized. Some access, at least, specially designed laboratories for practical science should be provided for all junior secondary schools. Regular in-service training should be organized for science teachers and about three to four contact hours per week should be provided on the schools' timetable for science lessons. Science kit boxes could also be made and filled with common teaching and learning materials and given to science teachers on day of their graduation.

### 5.5 Suggestions for Further Research

In view of the limitations of this study, the following have been suggested for future research: Pupils in the primary schools need to be encouraged to have interest in science lessons. There is therefore the need to conduct the study at that level to ascertain whether teachers ensure favourable classroom learning environments or not. The study can also be replicated by other researchers in other parts of the country to provide comprehensive information about science classroom learning environments.

It is also very important for students on out-segment teaching practice to research into classroom discourse. This will enable them identify some of the factors that militate against effective teaching of science and to find solutions to them. Likewise, teachers who go out to observe students on teaching practice could also make use of the QTI to research into student-teachers' performance in the classroom. There is the need to conduct a research into the perceptions of out-of-field teachers and specialist about

their science classroom learning environment. This would establish whether the two holds the same view or not.

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