UNIVERSITY OF CAPE COAST

SENIOR SECONDARY SCHOOL STUDENTS' PERCEPTION OF THEIR CORE MATHEMATICS CLASSROOM ENVIRONMENT AND ATTITUDE TOWARDS CORE MATHEMATICS

FORSTER DANSO NTOW

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BY

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THESIS SUBMITTED
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DECLARATION

Candidate's Declaration

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

Candidate's Signature: …………………………….. Date: ……………………………

Name: Forster Danso Ntow

Supervisors' Declaration

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

Principal Supervisor's Signature: ………………………. Date…………………………

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ABSTRACT

The main aim of this study was to determine how SSS3 students perceive their core mathematics classroom environment and their attitude towards core mathematics as well as investigate possible association(s) between learning environment instrument subscales and attitude. A sample of 342 SSS3 students was used for the study comprising 159 students from single-sex male schools, 117 from single-sex female school and 66 students from co-educational school. These students were selected from four SSSs which were sampled out of the 10 SSSs in the Cape Coast Metropolis.

Generally, SSS3 students from the various school-types were found to have a positive perception of their core mathematics learning environment. A one-way multivariate analysis (MANOVA) was used to identify differences in SSS3 students' perception of their core mathematics learning environment among the school types. Two differences were identified among the students from the different school-types namely Teacher Support and Equity and were highest among single-sex male SSS3 students. The results of the study showed that SSS3 students' attitude towards core mathematics was positive irrespective of school-type. Also, no significant differences in attitude towards core mathematics were detected among the students from the different school-types using one-way analysis of variance (ANOVA).

From the results obtained, it is recommended among others that core mathematics teachers should capitalize on the differences among the students' perceptions of their learning environment in order to increase their students' positive perception of the core mathematics environment.

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DEDICATION

This work is dedicated to Mr. Benjamin Y. Sokpe for his encouragement and support during the course of my studies.

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CHAPTER ONE

INTRODUCTION

Background of the Study

Mathematics as a subject has played and continues to play a crucial role in the advancement of technology. In this era of technological advancement, the importance of mathematics is highly evident in its applicability in almost all school subjects like economics, accounting and in the arts (logic). With increasing technological development in the past 20 years, there have been fundamental changes in educational systems with respect to factors such as teachers, students and learning environments (Yilmaz & Cavas, 2006).

Cockcroft (as cited by Githua & Mwangi, 2003), stated that life without mathematics is an almost impossibility and that it would be difficult to live a normal life in very many parts of the world without it. Cockcroft further highlighted the importance of mathematics by citing the document entitled Principles and Standards for School Mathematics (National Council of Teachers of Mathematics, 2000) where the following appears: “those who understand and can do mathematics will have significantly enhanced opportunities and options for shaping their future” (p. 5).

Partly because of the utility-value of mathematics to all people irrespective of the job the individuals may be involved in or the school programmes being pursued, the study of mathematics has been made compulsory for all students up to the secondary school level in countries like Ghana, Kenya and Australia (Curriculum Research and Development Division [CRDD], 2002; Githua & Mwangi, 2003).

In Ghana, a failure on the mathematics papers at both basic education level (Basic Education Certificate Examinations) as well as secondary school level (Senior Secondary School Certificate Examinations [SSSCE] or the West African Senior Secondary School Certificate Examinations [WASSCE] Core Mathematics) organized by the West African Examinations Council (WAEC) denies the candidate progression to the next level of his or her education. In other countries such as Australia, mathematics results are used as a critical filter for higher education and future vocations signalling the great importance countries all over the world attach to the subject, that is, mathematics (Collis, 1987).

Furthermore, in Ghana, the mathematics curriculum for the Senior Secondary School (SSS) core mathematics aims to develop in students basic quantitative skills as well as help them to appreciate the usefulness of mathematics in other school subjects and in other vocations such as commerce (CRDD, 2002). These aims are also captured in the new teaching syllabus for the senior high school (CRDD, 2007), buttressing the importance the country attaches to mathematics education.

Despite the importance the country attaches to mathematics education, all is not well as far as achievement in mathematics is concerned. In the 2003 Trends in International Mathematics and Science Study (TIMSS) mathematics test for grade 8 pupils, for example, the report pointed out that out of the 45 countries that participated, Ghana finished 44^{th}. It reported further that Ghanaian students scored an average of 277 compared to the international average of 466. Students' underachievement in mathematics is further captured in the Chief Examiner for Core Mathematics reports on the SSSCE (WAEC, 2002-2005).

Richards (as cited in Eshun, 2000) stated that most people believe that among all school subjects, mathematics is the most feared subject. He goes further to state that if asked to sum up their view of mathematics at school many people would describe it in terms of one, if not all, of the three D's- dull, difficult and dislike.

Eshun (1999) reported that despite the numerous learning theories that have been propounded by researchers such as Bruner, Skemp and Piaget, the learning of mathematics is far from satisfactory. He goes further to report of underachievement in mathematics by significantly large numbers of children in many countries.

As a result of the importance of mathematics in our daily lives, students' underachievement has become a source of worry to parents, students as well as mathematics educators necessitating studies being carried out to determine the causes of this underachievement. Some of the factors include error in reasoning, difficulty of mathematics and teacher influence.

Borasi (1990) reported that the conceptions, attitudes and expectations of students regarding mathematics and teaching of mathematics are very significant factors underlying their school experience and subsequent achievement in the subject. Another factor which has emerged from the literature as having influence on students' outcomes is the classroom environment (Webster & Fisher, 2003; Fraser, 2001). Fraser (2001) reported that students spend approximately 20,000 hours in classrooms by the time that they graduate from university. In Ghana, the situation is not different as people start schooling at age 4 (kindergarten) till age 15 (Junior High School), (Ministry of Education, Youth and Sports [MOEYS], 2004). This number of years spent schooling makes it imperative for the school environment to be made conducive to enable the students to learn since the classroom learning environment has been found to be one of the strong determinants of students' outcomes.

As a result of the influence the classroom learning environment has on students' learning and other affective outcomes such as attitude and anxiety (Mucherah, 2008), it is important to investigate how students perceive their core mathematics classroom environment and the relationship, if any, existing between the classroom learning environment and students' attitude towards core mathematics in Ghanaian Senior Secondary Schools.

Statement of the Problem

Githua and Mwangi (2003) noted that the demands of the new century require that all students acquire an understanding of concepts, skills, and a positive attitude towards mathematics in order to be successful. They further stressed the necessity of mathematics to every individual and the need to ensure that all persons who study it attain some level of mastery in the subject.

However, in Ghana, students' achievements on the SSSCE indicate that students' achievements are not encouraging as over the past eight years about 30% of candidates have consistently failed the core mathematics paper set by the West African Examinations Council (WAEC), (Anamuah-Mensah, 2007). The underachievement of

SSS students in the core mathematics paper calls for concern since a pass in core mathematics is crucial if a student wants to progress from the SSS level to any of the tertiary institutions in Ghana.

In looking at students' underachievement in mathematics, Volet (1997) noted that achievement in the subject could be linked to a complex and dynamic interaction between cognitive, affective and motivational variables thereby portraying the role affective and attitudinal variables play as far as learning of mathematics is concerned. The role attitudinal and affective variables play as far as learning of mathematics is concerned was noted by Singh, Granville and Dika (2002) who indicated that these two variables are salient factors affecting students achievement in mathematics. A number of factors have been identified to influence SSS students' achievement in core mathematics such as poor selection of test items to respond to, and use of inappropriate methods. Other factors include SSS students' perception of mathematics as a difficult subject as well as teacher influence. Furthermore, Walberg's theory of educational productivity (Helding, 2006) identified nine factors which contribute to variance in students' cognitive and affective outcomes which include: student ability, age and motivation, the quality and quantity of instruction, the psychological environment of the home, and the classroom environment.

Fraser (as cited in Webster & Fisher, 2003) defined the field of learning environment research as referring to the social, psychological, and pedagogical contexts in which learning occurs and which affect student achievement and attitudes. According to Fisher and Webster (2003) the school level environment can influence the behaviour of teachers and students and consequently their success in the teaching and learning process. They also indicated that the mathematics classroom learning environment if it is not all that conducive for learning can have a negative influence on students' outcomes such as their attitude and achievement in that particular subject.

From the literature there is a strong indication that the classroom learning environment has a crucial role to play as far as students' outcomes such as achievement, anxiety and attitude are concerned. It also pre-supposes that how the classroom environment is organized is a crucial factor in determining students' achievements or performances. Taylor (2004) identified research into possible connection between mathematics and learning environments as a future research concern.

There are lots of interactions that go on in the core mathematics classroom which have direct bearing on students such as; student-teacher relationship, student-student interactions as stated earlier on which have an influence on students' attitudes and perceptions towards the study of mathematics. A study of students' perception of their environment is desirable since it has been found that students' psychosocial perception of their learning environment can make a difference in how students learn and achieve their goals (Ampiah, 2006). Tel (as cited in Ampiah, 2006) reports that perceptions influence human behaviour. As Eshun (2000) rightly put it, the task for research in mathematics education is to provide information that would help to understand better, how, where and why people learn or do not learn mathematics.

In view of the underachievement of students in core mathematics, a research that is carried out in Ghana concerning factors that operate in the core mathematics classroom environment as far as its influence on their attitude and perception is concerned is very much needed.

Purpose of the Study

The study sought to find out SSS3 students' perception of their core mathematics classroom learning environment as well as their attitude towards mathematics. It shall also sought to find out whether there was any variation in perception by students from co-educational and single-sex schools of their core mathematics classroom environment. The study also focused on SSS3 students' attitude towards core mathematics to determine whether they had a positive or negative attitude towards the subject as well as an investigation to determine whether there existed any relationship between students' perception of their core mathematics classroom environment and their attitude towards core mathematics.

Research Questions/ Hypotheses

The study focused on the following research questions and hypotheses:

<u>Research Questions</u>

1).What are SSS3 students' perceptions of their core mathematics classroom learning environment in terms of the learning environment subscales?

2) What is SSS3 students' attitude towards core mathematics?

<u>Null Hypotheses</u>

1) There are no significant differences in SSS3 students' perceptions of their core mathematics learning environment based upon school-type.

2) There are no significant differences in SSS3 students' attitude towards core mathematics learning environment based upon school-type.

3) There is no association between SSS3 students' perceptions of their core mathematics learning environment and their attitude towards core mathematics.

4) There are no associations among subscales on the MCEI.

Significance of the Study

As a result of this study, differences among SSS3 students' perceptions of their core mathematics learning environment based upon school-type were identified being Teacher Support and Equity all being highest among SM SSS3 students. This provided useful information about what emphases core mathematics teachers should place on the core mathematics classroom which would promote SSS3 students' positive perceptions of their core mathematics environment in SM schools.

Secondly, this study identified subscales which correlate positively with each other in the core mathematics environment of the various school-types. This might give an insight into what factors core mathematics teachers should seek to improve in order to enhance their students' positive perception of their learning environment.

Aside this, the findings from this study, it is hoped, will add to the growing knowledge of mathematics classroom learning environment to guide mathematics educators.

Limitation

Despite the efforts of the researcher to ensure the validity and reliability of the findings of this study, a limitation of this study had to do with classifying all the classes as one 'big' core mathematics environment for each school-type. This was due to the inadequate number of classes used which made it impossible to carry out the analysis using individual classes as unit of analysis. However, this was not expected to affect the results obtained significantly since the classes used for this study were being handled by the same core mathematics teacher for each school-type and these teachers are expected to portray a consistent pattern of behaviour irrespective of the class they found themselves in.

Delimitations

Since this study was to find out second cycle schools students' perceptions of their core mathematics classroom environment, the study was restricted to only SSSs since these schools offer core mathematics since at the time of the study technical institutions were not offering core mathematics. Again, although there were 10 SSSs in the Cape Coast Metropolitan Assembly at the time of conducting this study, it was confined to only four schools as the population for the study. This study was also restricted to SSS3 students since they were believed to have studied core mathematics for a longer period of time to form a better perception of their core mathematics classroom environment compared to those in SSS2 and SSS1.

Organisation of the Rest of the Thesis

The rest of the thesis was organized in four parts. Chapter Two provided a review of the theoretical framework that underpinned this study, influence perceptions have on the classroom environment, empirical findings concerning classroom environment, attitude of students towards mathematics and findings of studies that combined classroom environment and attitude. It ended with a summary of the findings from the review and its implications as far as this study was concerned.

The third chapter dealt with the research design, instruments development, how reliabilities and validity of the instruments were ensured and the statistical tools used in analysing the data gathered.

Chapter Four discussed the findings from this study research question by research question as well as the hypotheses that were formulated and tested. Chapter Five highlighted the major findings from this study, conclusions that were drawn, their implications to educational practice and recommendations made and suggestions for future research.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Mathematics is the basis for modern scientific and technological developments and an important means of cogent, concise and unambiguous communication (Githua & Mwangi, 2003). Although mathematics has assumed an important role in the pre-tertiary school curriculum; its study is fraught with difficulties. Some of these difficulties are as a result of too many subjects being taught in schools, as well as these subjects being poorly taught owing to shortages of teachers and teaching and learning materials (MOE, 2004).

Studies carried out by some researchers such as (Eshun, 2000; & Fraser, 1998) to determine the causes of the poor achievement on the core mathematics papers indicate that some of the factors are:

1) Perceived difficulty of the subject,

2) Teacher influence,

3) Students' attitude towards mathematics and

4) The learning environment the student finds himself or herself.

On the perceived difficulty of the subject, there are quite a number of people who have commented on it and attributed it to why they dreaded school. For example, Robertson, an Australian novelist comments on her achievement in mathematics as follows: “My particular bogey was mathematics, a subject to which I seem to have been born deaf and blind and quite incurable. Yet as things stood, I had to grind at it with the rest” (Eshun, 2000; p. 2).

In reviewing literature concerning students’ perceptions of their core mathematics classroom environment and their attitude towards core mathematics, the review focused on the following areas; theoretical framework of the study, influence of perceptions on learning environment, empirical review of mathematics learning environment and attitude of students towards mathematics.

Theoretical Framework

The field of learning environment research has been defined by Fraser (1998a) as “the social, psychological, and pedagogical contexts in which learning occurs and which affects students’ achievement and attitude” (p.3). He also explained classroom environment as involving the shared perceptions of the students and teachers in a particular environment (Taylor, 2004). From Fraser’s explanation of what classroom environment is all about, the learning environment is seen to be created by two main actors namely; the teacher and the students who interact to form the climate. Again, Fraser’s definition of what learning environment research is indicates that the people in this learning environment are socially active who do not only interact but more importantly react to whatever is going on around them.

The idea of there being constant social interaction among participants in the learning environment is given further support considering Stern’s theory of person-environment congruence in which complementary combinations of personal needs and environmental press enhance student outcomes (Fraser, 1998b). This theory emphasizes the important role the environment in which an individual finds himself or herself influences his or her educational outcomes. The theory also gives an indication that the classroom environment is not formed by an individual but rather all the people who find themselves in the classroom. These people play a complementary role in order to create an atmosphere that promotes teaching and learning.

Although the learning environment is seen as a crucial element as far as teaching and learning is concerned, Fraser (2007) cautions that it should be seen to be one factor in a multifactor psychosocial model of educational productivity. This model holds that “learning is a multiplicative, diminishing-returns function of the following:

1) student’s age,

2) ability, and motivation;

3) the psychosocial environments of the home, and the classroom,

4) the peer group, and

5) the mass media.

It holds that if any of the factors is at zero point, then in principle, learning cannot take place. Again, from the model, it is always better to improve upon a factor that serves as a constraint to learning than to seek to raise a factor that is already high. However, in order to determine which of the factors is dominant in the learning process, it is expedient to examine each of these factors and that is the reason why the classroom environment is the focus of this study. Since the classroom environment has been identified from empirical studies to be one of the major factors as far as learning is concerned, it is necessary to determine the factors that operate in the core mathematics classroom which can be improved to ensure that effective learning takes place.

Although classroom environment is perceived to be a subtle concept as a result of the multiplicity of factors that operate in there, this environment can be assessed and studied. Ever since the pioneering works of Moos and Walberg concerning the field of learning environment research, lots of studies have been carried out by researchers to assess this environment (Fraser, 1998b; Myint & Goh, 2001). These initial studies helped define the parameters within which learning environment studies should be conducted.

Moos (as cited in Brok, Fisher & Waldrip, 2005), for example, identified three general dimensions into which all learning environment research should address namely;

a) relationship dimension which identifies the nature and intensity of personal relationship within the environment and assesses the extent to which people are involved in the environment and support and help each other.

b) personal development dimension which assesses personal growth and self-enhancement and

c) system maintenance and system change dimension which involves the extent to which the environment is orderly, clear in expectations, maintains control, and is responsive to change.

Moos' categorization has helped a great deal as to what learning environment research should focus on and the subsequent development of instruments to address these three dimensions. In developing the MCEI, Moos' three dimensions informed the choice of the various subscales.

Influence of Perceptions of Classroom Environment on Learning

How individuals perceive an object, a person or the environment in which they find themselves has quite often tended to influence their subsequent behaviour. Attribution Theorists for instance are of the view that how an individual perceives causality have consequences on the individual's perceptions (Webster & Fisher, 2003). Attribution theory seeks to explain how an individual understands and reacts to personal achievement, that is, the factors that the individual judges to have influenced him or her be it internal or external. Furthermore, Webster and Fisher (2003) noted that "the social ecological setting in which students function can affect their attitudes and moods, their behavior and self-concept and general sense of well-being" (p.311). These findings give an indication that how an individual perceives the learning environment may have certain consequences on the individual's subsequent behaviour.

According to the Theory of Reasoned Action (Ilevbare, 2008), "attitude is an independent measure of affect for or against the attitude object, which is a function of belief, strength and evaluative aspect associated with each attribute" (p.123). What this means is that any attempt to improve students' achievement in core mathematics must take into account the classroom environment since the classroom environment can serve as an attitudinal object.

Furthermore, Goal Theorists indicate that the learning environment can have influence on learning goals and targets and assessment procedures as far teaching and learning is concerned. Goal theorists postulate that instructional practices, and the nature of educational tasks and assignments, can promote either mastery or helpless motivational patterns, which can have profound influence on student achievement

(Mucherah, 2008). The net effect of this theory is that whether the learning environment is perceived as either positive or negative may influence the participants in the learning environment.

Studies conducted to determine the influence of learning environment on students seem to point to the idea of cause and effect relationship between learning environment and student behaviour as well as the teaching and learning process. Webster and Fisher (2003) have reported the influence of the learning environment on how teachers present the school curriculum. In their study conducted in 57 Australian secondary schools involving 620 teachers and 4,645 students, they reported that the way in which curriculum is presented by teachers is directly proportional to how they perceive the learning environment at the school level ($\gamma = 0.476$). They reported further that the more positive the learning environment was with regards to Affiliation, Professional Interest, Empowerment and Innovation, the more teacher-directed the instructions were presented in the classroom. In giving further support to the influence perception has on learning environment, Brekelmans, Sleegers and Fraser (2001) reported from their investigation of the relation between students' perceptions of teacher-student relationship that stronger perceptions of teacher influence increased according to the degree to which teachers got their students to be involved in the teaching-learning activities. Furthermore, Fraser and Kahle (2007) in a secondary analysis of data obtained from 7,000 students in 392 classes in 200 different schools concerning their perceptions of three environments; class, home, and peers as well as students' attitude reported that all three environments accounted for statistically significant amounts of unique variance in students' attitude.

Learning Environments Research

Research involving classroom learning environment has typically moved away from the use of a detached observer to describe the environment to a milieu of inhabitants. This movement towards the use of the main actors in the classroom, that is, students and teachers is not without support. Fraser and Tobin (1991) argue that students are the best judges of their classroom environment since they are at an advantage position to make judgement having gone through varying learning environments to form an accurate impression. From Fraser and Tobin's argument, this study focused on how SSS3 students in the core mathematics environment perceive their learning environment. This is because they have been in the core mathematics learning environment for quite a long time and since perception takes a long time to be formed, they would be able to give an accurate account of whatever goes on in their classrooms based upon their experiences in different learning environments.

Earlier research studies involved the development and validation of instruments such as:

1) Learning Environment Inventory (LEI)

2) Classroom Environment Scale (CES)

3) My Class Inventory (MCI)

4) Constructivist Learning Environment (CLE) and

5) What Is Happening In This Class (WIHIC) questionnaires (Fraser, 1998; Taylor, 2004).

What Is Happening In this Classroom Instrument

The WIHIC instrument is a versatile instrument which combines modified versions of salient scales from a wide range of existing questionnaires that accommodate contemporary educational issues such as equity and cooperation (Koul & Fisher, 2005). The WIHIC instrument originally comprised eight scales but has been revised to seven scales and 56 items with eight items under each scale (Taylor, 2004). The modified scales are:

1) Student cohesiveness,

2) Teacher support

3) Involvement

4) Investigation

5) Task orientation

6) Cooperation and

7) Equity.

While both a 'preferred' and an 'actual' form of the instrument have been developed, in carrying out this study the 'actual' form of the WIHIC served as a guide in developing the MCEI. This is because the 'actual' form helps the researcher to identify the perceptions of the subjects involved in the study regarding the learning environment within which they are presently located. The 'preferred' form on the other hand requires the respondents to indicate how they wish their classroom environment was unlike the 'actual' where they indicate how they perceive their present learning environment to be which is what this study sought to do, that is, find out how the respondents perceive their core mathematics classroom to be.

Although the WIHIC instrument has seven scales, the MCEI comprises five scales out of these seven namely;

1) Student cohesiveness

2) Teacher support

3) Involvement,

4) Cooperation and

5) Equity.

The other two scales on the modified WIHIC instrument namely task orientation and investigation were not used in carrying out this study since they apply in a classroom setting with constructivist teaching strategy which does not exist in the schools involved in this study.

Areas of Past Research in Learning Environment

Taylor (2004) identified 12 distinct areas that involve classroom learning environments. Some of these areas have been explored extensively by many researchers using different learning environment research instruments across different countries and continents (Goh & Khine, 2002). Table 1 gives a summary of areas of past research in learning environments and their main emphases.

Table 1

Areas of Past Research in Learning Environments and their Main Emphasis

Research Area	Main Emphases of Research
Associations between student outcomes and Environment	Investigation of associations between perceptions of psychosocial

	characteristics of a classroom and students' cognitive and affective learning outcomes
Evaluations of Educational Innovations	Process criteria used in the evaluation of educational criteria are obtained via classroom learning environment instruments
Student– Teacher Differences	Investigation of perceived differences between the students and teacher in a classroom situation. Differences could be between actual or preferred environments
Person-Environment Fit	Research into whether student achievement depends on the similarity between preferred and actual classroom environment
Teacher Improvement	Instruments provide feedback for use in five-step procedure for reflecting upon, discussing, and attempting to improve classroom environment
Combining Research Methods	Research involving the use of both

Table 1 Cont'd

	quantitative and qualitative methods in the same study in order to identify salient features of the environment studied
School Psychology	Research instruments can be used to identify areas of classroom life and differences that impact the mental and emotional welfare of students
Links between Environments	Attempts to identify connections and influences of multiple environments involved in the education process, both in and out of the formal school
Cross-national studies	Unique abilities to investigate the similarities and differences between the educational environments of various countries, as well as to question the practices and beliefs of a given country
Transitions between Grade levels	Research on the effect of students moving from one level of education to another, such as from primary to junior high school
Teacher Education	Opportunities to include the topic of

Table 1 Cont'd	learning environments in programmes for the preparation and training of future educators
Teacher Assessment	Dimensions of learning environments can yield insight into present teaching methods and focus, as well as possible effectiveness from the student perspective

(Taylor, 2004)

From the literature review, it appears that the strongest tradition in past classroom environment research has involved investigation of associations between students' cognitive and affective learning outcomes and their perceptions of psychosocial characteristics of their classrooms.

Classroom Environment Findings

Haertel, Walberg and Haertel (as cited in Fraser, 2007) in their studies concerning classroom environment comprising 17,805 students revealed that a variety of students' outcome measures were consistently higher in classes that were perceived as being high on cohesiveness, satisfaction and goal-direction and with relatively smaller amounts of disorganization and friction using the My Class Inventory (MCI) instrument. In another study conducted in Singapore by Goh, Young and Fraser (as cited in Fraser; 1998b) using a sample of 1,512 primary mathematics students in 39 classes established associations between the classroom environment and attitude based upon the perceived patterns of teacher-student interaction. Furthermore, in a study conducted in Australia by Fisher, Henderson and Fraser (as cited in Fraser,1998b) involving 3,994 high school science and mathematics students using the Questionnaire on Teacher Interaction (QTI) reported associations between students' outcomes and perceived patterns of teacher-student interaction.

Aldridge, Fraser and Huang (1999), in their study of the ninth-grade mathematics learning environment in Hong Kong, reported that many students identified the teacher as the most crucial element in a positive classroom environment. These teachers, the report revealed, kept order and discipline while creating an atmosphere that was not boring or solemn. The influence teachers exert on students is further captured in a study conducted by Wubbels and Brekelmans (2005). The two researchers investigated students' and teachers' perceptions of the teacher-student relationships in secondary school classrooms and reported that teacher-student relationship appropriate for high student outcomes are characterised by a high degree of teacher influence and proximity towards students.

Definition of Attitude towards Mathematics

Attitude has been defined in several ways by different researchers in the field. In his review of attitudinal studies, Reid (2006) reports that there are as many definitions of the term 'attitude' as there are researchers. This situation he attributed to the difficulty associated with attempts aimed at providing a concise definition of the term 'attitude' which has proved quite elusive. Koballa and Glynn (2007) define attitude as "a general and enduring positive or negative feeling about some person, object, or issue" (p.6). This definition implies that attitude is always formed towards something or a person based upon how an individual perceives it and can be towards a subject of study or a teacher as in a classroom situation.

Neale (as cited in Ma & Kishor, 1997) defined attitude towards mathematics as an aggregated measure of " a liking or disliking of mathematics, a tendency to engage in or avoid mathematical activities, a belief that one is good or bad at mathematics, and a belief that mathematics is useful or useless" (p.27). From the definition offered by Neale, attitude is seen to be formed as a result of a multiplicity of factors which together influence the individual's subsequent behaviour either positively or negatively.

Eshun (2000) defined attitude towards mathematics as "a disposition towards an aspect of mathematics that has been acquired by an individual through his or her beliefs and experiences but could be changed" (p.2). His definition implies that attitude is not all that permanent a situation which has been suspected all along. What is not known are the experiences which students can be taken through to positively shape their attitude towards mathematics.

Di Martino and Zan (as cited in Hannula, 2002) looked at two basic approaches to defining attitude towards mathematics:

1. A 'simple' definition describes it as the degree of affect associated with mathematics; that is, attitude is the emotional disposition towards mathematics. This definition looks at attitude in terms of affect (emotions) ignoring other aspects of the term such as one's perceptions, emotions, etc.
2. The second definition looks at attitude in terms of three components; emotional response, beliefs, and behaviour as components of attitude. Attitude towards mathematics has been studied with regards to finding associations between the construct and other variables of interest such

> as anxiety and achievement. Implicit in much of this research is the assumption that positive affect might lead to positive achievement and behaviour (McLeod, 1992).

For the purposes of this research, attitude towards mathematics is defined as one's experiences with mathematics which have either negatively or positively influenced the individual's subsequent reaction towards the subject. These experiences may be one's perception of the learning environment and emotions attached to the study of mathematics.

Empirical Review of Attitude Research

From the literature, a lot of attitudinal studies have been carried out which includes among others; attitude and its influence on students' achievement in mathematics and investigation of gender differences (Fennema & Sherman, 1976; Mason, 2003; Sandman, 1980 & Tapia; Marsh, 2004). McLeod (1992) indicated that affective background factors play a central role in learning mathematics and in maintaining a continued interest in the subject. With regards to the effect of attitude on students' learning, Mallam (1993) indicated that, "negative attitude … can powerfully inhibit intellect and curiosity and keep us from learning what is well within our power to understand" (p.223) which lends weight to the need to examine SSS3 students' attitude towards core mathematics. Ruffell, Mason and Allen (1998) indicated that students who hold positive attitude towards mathematics tended to express a generally favourable perception towards mathematics although Fraser and Butts (as cited in Ruffell, et al, 1998) found no significant correlation among students' attitude and mathematics. Also, Hammouri (2004) in a study of the effects of student-related variables on achievement in mathematics of 3736 Jordanian 8th-graders reported that attitude was among the affective variables that led to variation in mathematics achievement of the students.

Whereas a lot of such studies have reported gender differences at the secondary school level, quite a few of these studies have found differences in attitude towards mathematics among early elementary students although noticeable differences begin to appear in their attitude as they age (Taylor, 2004). Rathbone (1989) noted that children at the elementary school like mathematics and that there are no significant differences in attitude of girls and boys, however, differences begin to appear as students' progress in school.

The Fourth National Assessment of Educational Progress (NAEP) Mathematics Assessment report indicated that males were more likely to report being good in mathematics, even though both genders were equally likely to report enjoying mathematics (Steinback & Gwizdala, 1995). They also reported significant gender differences in attitude towards mathematics, self-confidence, and perceived usefulness, in favour of males.

Taylor (2004) in a study of 745 students in four high schools in Southern California attitude towards mathematics reported that students' attitude towards mathematics was positive. This followed an investigation he carried out concerning students' attitude towards mathematics using The Test of Mathematics Related Attitude (TOMRA). Students' attitude towards mathematics was found to be influenced by two factors on the TOMRA namely enjoyment of mathematics and normality of mathematicians.

Mallam (2002) in a study involving 240 female students drawn from five co-educational and six all-girls' secondary schools in Plateau State, Nigeria, reported that females attending all-girls' schools had more positive attitude towards mathematics than females attending co-educational schools. This finding indicates that even among the same gender, differences in attitude towards mathematics may exist based upon school-type.

Eshun (2000) in a study of attitude of secondary school students involving 1419 students from 12 secondary schools in the Central and Western Regions of Ghana reported that students' attitude towards mathematics was positive on all the eight variables measured namely:

1) Usefulness of mathematics
2) Confidence in learning mathematics
3) Success in mathematics
4) Effective motivation
5) Mathematics anxiety
6) Mathematics as a male domain
7) Understanding mathematics and
8) Like doing mathematics.

The three highest responses were on the variables: like mathematics, confidence in learning mathematics and usefulness of mathematics in that order. The least positive response was for mathematics anxiety followed by motivation. He further reported differences in attitude towards core mathematics based upon school-type. Girls in single-sex schools expressed more confidence in doing mathematics compared to boys in single-sex schools while girls in mixed schools expressed far less confidence than boys from single and mixed schools.

Classroom Environment and Attitude Research Findings

The belief that secondary school students' perception of their learning environment has an influence on their attitude towards mathematics is championed by researchers such as Fraser and Fisher among many others. Dungan and Thurlow (1989) reporting from a meta-analysis of literature on attitude towards mathematics identified associations between students' attitude towards mathematics and teacher qualities, student personality or social factors, gender, parental influences, peer influences and intelligence. Pintrich (as cited in Koballa & Glynn, 2007) intimated that affective outcomes such as motivation and attitude are influenced by contextual factors such as classroom organization, teacher authority, the nature of classroom academic tasks, and evaluation which gives the impression that one of the major factors influencing students' attitude is the classroom environment.

Haladyna (as cited in Hannula, 2002) indicated that the general attitude of a class towards mathematics is related to the quality of the teaching and the social-psychological climate of the class. This finding indicates that for students to form an attitude towards mathematics, it depends on what goes on in the classroom as far as teaching and learning is concerned, that is, whether the learning environment is deemed by the students to be conducive for learning or not. The belief that the learning environment an individual finds himself or herself in has an influence on students' learning is supported by Collis (1987) who indicated that single-sex school environments have tended to be more closely associated with positive attitude towards mathematics, particularly in favour of girls. The single-sex environment he believes reduces incidences of sexual harassment and bullying associated with mixed-sex classrooms. He reported further that girls tend to prefer lower levels of social competition and a warmer teaching style.

Again, Hembree and Tobias (as cited in Mensah, 2007) reported in their study which assessed students' predisposition towards mathematics using their autobiographical account that anxieties and internalized messages (positive and negative) affected students' attitude and confidence to engage in mathematics and science which are developed through the influence of teachers, classmates and family. Fraser and Chionh (2000) for example, established associations between the seven WIHIC scales such as student cohesiveness, involvement, teacher support and equity and three student outcomes including attitude of 2,310 mathematics and geography students in 75 classes. Empirical probes of the educational productivity model which is made up of factors such as quality and quantity of instruction; the psychosocial environments of the home, the classroom and the peer group by Fraser, Welch and Walberg (as cited in Fraser, 1998) revealed classroom and school environment to be a strong predictor of both achievement and attitude even when a comprehensive set of other factors was held constant. These studies give an indication that perhaps a more positive perception of the mathematics learning environment may lead to an appreciable change in attitude of students towards mathematics

Taylor (2004) in a study of how 745 students in four high schools in Southern California perceived their mathematics reported that students' perceived their mathematics learning environment to be positive on all 7 WIHIC scales they were measured on as well as finding association between classroom environment and students' attitude towards core mathematics. The strongest scale was equity with teacher support and involvement being the least perceived scale. He further reported significant gender differences on four of the WIHIC scales with females having significantly higher perceptions of the mathematics classroom environment in the areas of equity, student cohesiveness, task orientation and cooperation and teacher support.

Although quite a number of studies have reported associations among perception of classroom environment and students' attitude towards mathematics, a study conducted by Goh and Fraser (1998) in Singapore did not find any such association. Their study which combined two research instruments namely the MCI and QTI research instruments and focused on the achievement and attitude of 1512 primary mathematics students indicated that the two instruments each uniquely accounted for an appreciable proportion of the variance in achievement, but not in attitude. Aldridge et al (1999), also caution against results indicating association between perception of learning environment and attitude by stating that although classroom dimensions provide useful information as to dimensions that could be manipulated to improved student outcomes, they do not identify causal factors. Even in instances where there have been reported association between classroom environment and attitude, Ampiah (2004) cautioned out that it cannot be concluded in absolute terms that the nature of the learning environment caused the observed student attitudinal outcome.

Summary of Literature Review

From the review, a lot of work has been done in the field of learning environment and attitude research. In the field of learning environment research, the concept 'Learning Environment' is clearly measureable based upon Moos' three dimensions namely; relationship dimension, personal development dimension and system change and system maintenance dimension (Fraser, 1998).

As a result of Moos' classification the five subscales on the MCEI was each designed to measure a specific dimension in order to capture the core mathematics environment. The various MCEI subscales and the dimension they each fall under are as follows:

1) Relationship dimension- Student Cohesiveness, Teacher Support and Involvement.
2) Personal development dimension- Cooperation
3) System change and System maintenance dimension-Equity

Again, it was evident that a lot of instruments have been developed by past researchers such as My Class Inventory (MCI), Learning Environment Inventory (LEI) and What Is Happening In this Class (WIHIC) to measure various aspects of the learning environment. These studies have included investigations of teacher-student differences, evaluations of educational innovations and associations between student outcomes and learning environment (Taylor, 2004). Despite the availability of numerous learning environment instruments, a new instrument, named MCEI, was developed since the already existing ones were developed in culturally different settings making their adoption into the Ghanaian setting impossible.

Generally, students' perceptions of their mathematics environment were found to be positive with reported cases of association(s) with some student outcomes such as attitude and anxiety as reported by researchers such as Taylor (2004), Young and Fraser (as cited in Fraser, 1998) among others. In addition, secondary school students were found to have a positive attitude towards mathematics as reported by researchers such as Eshun (2000) and Taylor (2004) with Eshun reporting of differences in attitude of secondary school students based upon school-type. The review also revealed that although some researchers have reported instances of associations between classroom environment and attitude such as Pintrich (as cited in Koballa & Glynn, 2007) and Taylor (2004) there are others such as Goh and Fraser (1998) who did not any such relationships. The inclusiveness of studies which have investigated the relationship between classroom environment and attitude may be an indication that all is not known about these two variables.

Although quite a lot of studies have been conducted concerning classroom environment and attitude, it was observed that such studies relied heavily upon quantitative techniques in analysing the data obtained thereby leading to loss of rich details. This concern is also shared by Reid (2006) who indicated that the use of quantitative techniques in analysing attitude data has been of little help in understanding it. This is because quantitative techniques such as MANOVA, factor analysis, etc which lead to obscuring details and loss of rich detail are employed. He argues further that the use of scaling process will although inevitably lead to loss of detail but gross trends and factors may well still be apparent. To overcome the issue of loss of detail, Reid suggests analyzing each question and then ‘qualitatively adding’ the outcomes obtained. As a result of Reid’s suggestion, the items on the MCEI and MAQ were analysed item by item in order to identify any noticeable trends in SSS3 students’ responses.

CHAPTER THREE

METHODOLOGY

This chapter deals with the research method used in carrying out this study. It discusses the research design, population, instruments developed and how reliabilities and validity of the MCEI and MAQ instruments were ensured. In order to determine SSS3 students' perceptions of their core mathematics learning environment and their attitude towards core mathematics as well as any association(s) between these two scales, two research questions and four hypotheses were formulated. The data collection and data analyses procedures are also discussed.

Research Design

The cross-sectional survey was used in this study. A survey of SSS3 core mathematics students' perceptions of their core mathematics learning environment as well as their attitude towards core mathematics was conducted from which inferences were made about how these students perceived their core mathematics learning environment and their attitude towards core mathematics.

This design was considered appropriate since the study sought to describe the learning environment as perceived by the SSS3 students and their attitude towards core mathematics without manipulating the environment within which they found themselves. The aim was to produce a 'snapshot' of SSS3 core mathematics students' perceptions of their core mathematics learning environment and their attitude towards core mathematics (Cohen, Manion & Morrison, 2000: Nworgu, 2006). Again, Fraenkel and Wallen (2000) indicated that cross-sectional survey has the potential of providing a lot of useful information about the subjects of the study for instance how they perceived their core mathematics learning and their attitude towards core mathematics.

Mitchell and Jolley (2004) also noted that the cross-sectional survey is more economical because it makes it possible for many subjects to be studied at the same time. This was the case in this study since as many as 342 SSS3 students were sampled and studied at the same time as well as the economy of time to both the researcher and the schools involved in this study since each of the four senior secondary schools involved in this study was visited only once during the data collection stage.

Although this design was efficient, weaknesses identified in using this design were; ensuring that questions were clear and not misleading, getting respondents to answer questions thoughtfully and honestly, (Fraenkel & Wallen, 2000; Cohen, et al, 2000). This was because in answering the items on the two instruments that is, MCEI and MAQ, the researcher had to give further explanation on some of the items and also from time to time advice the respondents to take their time to read the statements before responding to them.

The SSS3 students were given two sets of questionnaires; a perception and an attitude towards mathematics instruments namely MCEI and MAQ respectively. The "What Is Happening In This Class (WIHIC)" and "Test Of Mathematics Related Attitudes (TOMRA)" instruments served as guides in developing the MCEI and MAQ respectively to find out how SSS3 students perceived their core mathematics classroom environment and their attitude towards core mathematics.

Population

The target population of this study was all SSS3 core mathematics students in all the 10 SSS schools comprising five single-sex and five mixed schools, in the Cape Coast Metropolitan Area during the 2008/2009 academic year. Out of this number of schools, four of them served as the sample for the study comprising three single-sex schools with the remaining school being a co-educational school.

Sample and Sampling Technique

In all, 342 SSS3 students during the 2008/9 academic year formed the sample for the study. There were 66(19.3%) students from co-educational schools (CE), 159(46.5%) from single-sex male schools (SM) and 117(34.2%) from single-sex female schools (SF). The age distribution of the respondents ranged from 16 years to 20 years with an average age of 17.1 years and a standard deviation of 0.8.

A multi-stage sampling technique was used to obtain the schools that participated in the study (Shaughnessis, Zechmeister & Zechmeister, 1997). The four schools were first selected using simple random sampling technique (table of random numbers). From these four schools, nine intact SSS3 classes were selected using convenience sampling method. These SSS3 classes were selected because they happened to be the classes that were having core mathematics lessons at the time of the data collection. Two classes each were selected from the SM and CE schools with the fourth school which happened to be the only SF school having three intact classes selected in order to increase the number of female participants in the study.

Instruments

Data for the study were collected using two sets of five-point Likert scale type questionnaires measuring SSS3 students' perceptions of their core mathematics environment and their attitude towards core mathematics. A Mathematics Classroom Environment Inventory (MCEI) instrument was used to measure SSS3 students' perceptions of their core mathematics classroom environment. The MCEI was developed based upon the seven scales of the WIHIC questionnaire developed by Fraser, McRobbie and Fisher (1996).

The scales used in developing the MCEI were Student Cohesiveness, Teacher Support, Involvement, Cooperation, and Equity. Investigation, and Task Orientation scales on the WIHIC instrument were not used since they were perceived to be appropriate in a classroom in which constructivism is the main teaching strategy. The MCEI had five subscales in all with each subscale having eight items bringing the total number of items on the MCEI to 40. The responses on the MCEI ranged from Almost Never, Seldom, Sometimes, Often and Very Often in that continuum. These options were scored as follows: Very Often-5, Often-4, Sometimes-3, Seldom-2 and Almost Never-1 where a value of 5 indicated that the classroom practice being measured takes place almost on a regular basis while 1 was interpreted as the SSS3 students perceiving the classroom practice to hardly take place.

Since the items on the WIHIC scales were developed based upon the cultures of the countries in which they were used, some of the items on it were modified to reflect the Ghanaian culture and make the items more understandable to the respondents. For example, an original item on the WIHIC instrument was, "My mathematics teacher takes interest in me" which could be interpreted in the Ghanaian culture as a teacher having an amorous relationship with a student was modified to read," My core mathematics teacher maintains a healthy student-teacher relationship with me even after his/her lesson has ended.

The second instrument, the Mathematics Attitude Questionnaire (MAQ), was developed to measure SSS3 students' attitude towards mathematics using the Test Of Mathematics-Related Attitude (TOMRA) developed by Taylor (2004) as a guide. The TOMRA measures students' attitude in four areas namely:

1) Normality of Mathematicians
2) Attitude towards Mathematics Inquiry
3) Adoption of Mathematics Attitude and
4) Enjoyment of Mathematics Lessons

A five point Likert-scale was used in developing the MAQ and the items on it were developed based upon two subscales namely Attitude towards Mathematics Inquiry and Enjoyment of Mathematics Lessons of the TOMRA. These two subscales were used as they were perceived to be acquired in the learning environment. There were 12 items in all on the MAQ with responses ranging from Strongly Disagree, Disagree, Undecided, Agree and Strongly Agree in that continuum. These responses were assigned the following values; Strongly Disagree-1, Disagree-2, Undecided-3, Agree-4 and Strongly Agree-5 for positively worded statements with the scoring being reversed for negatively worded statements to reflect the degree to which the respondents possessed that attitudinal trait being measured.

Validity

The two instruments (MCEI and MAQ) were given to my two supervisors to determine the face validity of the instruments especially since one of them had conducted a similar research involving classroom environment. Again, two colleagues who have taught at the SSS level before were also given the instruments to assess the items. Through this process the appropriateness of the language used was checked in order that the students understood the items on it. Again, certain wordings which were perceived to be ambiguous were also modified as well as checking the various items to ensure that the items really measured what they were intended to measure.

Pilot Testing

The two instruments (MCEI and MAQ) were pilot- tested in a school in the Komenda-Edina-Eguafo-Abirem (KEEA) district in the Central Region of Ghana with similar characteristics as those that were used for the actual study in the Cape Coast Metropolitan Area such as their offering of core mathematics. Forty SSS3 students from two intact classes who were having core mathematics lessons at the time of conducting the pilot-test were used. In all, there were 28 males and 12 females who took part in the pilot- test with each student responding to the two instruments.

The two instruments were retrieved from the SSS3 respondents immediately after completion and the data obtained analysed by computing their reliabilities and inter-item correlations. Based upon the inter-item correlation, some of the items were modified.

Reliability

The reliabilities of the two instruments were estimated using the Cronbach Alpha to determine whether each item under the various subscales was related to each other after the pilot- testing exercise and again after the actual data collection for the studies. During pilot- testing exercise, the reliability estimates obtained using the Cronbach Alpha ranged from 0.51 to 0.79 for the five subscales on the MCEI whiles on the MAQ the reliability estimate was 0.77. During the actual data collection exercise the reliability estimates obtained ranged from 0.60 to 0.89 on the Mathematics Classroom Environment Inventory (MCEI) subscales (as shown in Table 2). On the Mathematics Attitude Questionnaire (MAQ) instrument, the alpha reliability estimate obtained was 0.76. Table 2 gives the reliability estimates of the subscales on the MCEI after the actual data collection exercise.

Table 2

Reliability Estimates of the Subscales on the MCEI

Subscale	Reliability Estimate	No. of Items
Student Cohesiveness	0.60	8
Teacher Support	0.82	8
Involvement	0.81	8
Cooperation	0.60	8
Equity	0.89	8

These reliability estimates were considered appropriate based upon the threshold of 0.60 suggested by Nunnaly (as cited in Ampiah, 2006) in determining whether a research instrument is reliable or not and revealed that these subscales were reliable.

Data Collection Procedure

Data were collected for the study using the MCEI and MAQ developed within the months of November and December, 2008. Prior to the actual data collection, the four secondary schools were visited by the researcher to establish rapport between the researcher and the schools in question and also agree on when to collect the data. On the day of administrating the questionnaires in the various schools, the purpose of the study was explained to the respondents as well as they being assured of confidentiality of their responses.

The instruments were administered by the researcher in the various schools during core mathematics lesson periods so that the respondents will be in the core mathematics environment to respond accordingly. The students were made to respond to the two instruments after which the two instruments were immediately collected. In all, 342 questionnaires were distributed and all were collected indicating a 100% return rate.

Data Analysis

To answer research question one on how SSS3 students' perceived their core mathematics classroom environment based upon the five subscales on the MCEI, the data obtained from the students on the MCEI were scored for individual students after which individual item means and overall subscale means were calculated for each school-type. The 'Sometimes' response, which was coded 3, served as the average which was used to determine the direction of students' responses that is, whether they had a positive or negative perception of their core mathematics environment.

In order to do this, the responses that were obtained from the data collection process were coded from 1-5 for positively worded items from 'Almost Never' to 'Very Often' in that continuum. This indicated the relative standing of the individuals on the dimensions on the perception instrument. After obtaining the mean of means, those items which recorded means above the overall scale mean were selected and commented on as well as those items whose means fell below the subscale mean for the various school- types. Again, items which were expected to record either higher mean values or lower mean values but turned out otherwise were also commented on.

The second research question sought to determine SSS3 students' attitude towards core mathematics. To answer this question, individual item means and frequency distributions of the various items on the MAQ instrument were computed. The responses that were obtained from the data collection process were coded from 1-5 for positively worded items from Strongly Disagree to Strongly Agree in that continuum whiles for negatively worded statements the coding was reversed. The Undecided response, which was coded 3, served as the average which was used to determine the direction of students' responses, that is, whether positive or negative attitude.

Research hypothesis one was on whether there were any significant differences in SSS3 students' perceptions of their core mathematics learning environment based upon school-type. To test this hypothesis, a one-way multivariate analysis of variance (MANOVA) was conducted. The second hypothesis was used to investigate any school-type related differences in SSS3 students' attitude towards core mathematics and was analysed using one-way analysis of variance (ANOVA). The third and fourth research hypotheses were used to determine any possible associations between MCEI subscales and attitude, and among subscales on the MCEI respectively. To test these research hypotheses, Spearman Rank Correlation tests were conducted. The results from the ANOVA and correlation tests were each corrected for type one error using Bonferroni correction procedure.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

In this chapter, the findings from the study into SSS3 students' perceptions of their core mathematics classroom environment and their attitude towards core mathematics are presented and discussed in relation to the research questions and hypotheses formulated to guide the study. The research questions were analysed quantitatively using the five subscales on the MCEI namely; Student Cohesiveness, Teacher Support, Involvement, Cooperation and Equity and the MAQ. The results of the study are presented under the following headings:

1. SSS3 Students' Perceptions of their Core Mathematics Classroom Environment
2. SSS3 Students' Attitude towards Core Mathematics
3. Differences in SSS3 Students' Perceptions of their Core Mathematics Classroom Environment on the MCEI subscales
4. Differences in SSS3 Students' Attitude towards Core Mathematics
5. Association between SSS 3 students' Attitude and Perception
6. Association(s) among MCEI Subscales

SSS3 Students' Perceptions of their Core Mathematics Classroom Environment

In order to determine SSS3 students' perceptions of their core mathematics learning environment, a research question was formulated as follows; 'What are SSS3 students' perceptions of their core mathematics classroom learning environment?'

From the results (as shown in Table 3) the SSS3 students who participated in the study from the different school-types perceived their core mathematics classroom environment to be positive in terms of the five subscales they were measured on namely; Student Cohesiveness, Teacher Support, Involvement, Cooperation and Equity. The subscale which was perceived to be most positive by CE SSS3 students was Student Cohesiveness (M= 3.7, S.D = 0.5) with the least perceived subscale being Involvement (M = 3.2, S.D = 0.6) as shown in Table 3. SSS3 students from SM schools however perceived Equity to be the most positive subscale in their core mathematics classroom (M = 4.0, S.D = 0.7) with the Involvement subscale being the least perceived (M = 3.4, S.D = 0.7) as shown in Table 3. However, SSS3 students from SF school perceived three subscales to be most positive in their core mathematics classroom namely; Student Cohesiveness (M = 3.7, S.D = 0.5), Cooperation (M = 3.7, S.D = 0.5) and Equity (M = 3.7, S.D = 0.9) with the least perceived subscale being Involvement (M = 3.3, S.D = 0.8) as shown in Table 3.

These results indicate that although SSS3 students from the various school-types perceived different subscales to be the most positive in their core mathematics classroom environment, they were unanimous in perceiving the Involvement subscale to be the least positive. These findings may be an indication that core mathematics lessons are not all that participatory irrespective of school-type. The overall subscale means and standard deviations obtained on the MCEI are presented in Table 3.

Table 3

Overall Subscale Means and Standard deviations on the MCEI based upon School-type

MCEI Subscales	School type					
	CE (N= 66)		S M (N= 159)		S F (N= 117)	
	Mean	S.D	Mean	S.D	Mean	S.D
Student Cohesiveness	3.7	0.5	3.8	0.5	3.7	0.5
Teacher Support	3.6	0.7	3.9	0.7	3.5	0.8
Involvement	3.2	0.6	3.4	0.7	3.3	0.8
Cooperation	3.6	0.6	3.6	0.6	3.7	0.5
Equity	3.3	0.9	4.0	0.7	3.7	0.9

Overall, SSS3 students from CE, SM and SF schools perceived their core mathematics learning environment to be positive as measured on the Student Cohesiveness subscale. This gives an indication that on the whole, SSS3 students from the different school-types are friendly to and supportive of each other. The overall means and standard deviations recorded on this subscale for CE, SM and SF SSS 3 students were M = 3.7 and S.D = 0.5, M = 3.8 and S.D = 0.5, and M = 3.8and S.D = 0.5 respectively (as shown in Table 3).

This positive perception of Student Cohesiveness is portrayed by looking at item three on which the following means and standard deviations were obtained; M = 4.3 and S.D = 0.9, M = 4.6 and S.D = 0.7, and M = 4.4 and S.D = 0.9 for CE, SM and SF SSS3 students respectively (as shown in Table 4). This item was used to find out from the respondents whether they were friendly to the other students in their respective core mathematics classrooms. From the frequency distribution table (as shown in Appendix C), 36(54.6%) out of the 66 respondents from CE school indicated that very often they were friendly to their colleagues with only one [1(1.5%)] respondent responding 'almost never.' With regards to SSS3 students from SM schools, the frequency distribution table (as shown in Appendix C) indicated that 112(70.4%) out of 159 respondents selected 'very often' with only two [2(1.3%)] selecting 'almost never.' Considering SSS3 students from SF school, the distribution pattern of responses on item three were as follows; 'very often'= 72(61.5%) and 'almost never'= 3(2.6%) out of 117 respondents. This indicates that SSS3 from the three school-types perceived their core mathematics learning environment to be friendly.

Again, item five on this subscale recorded mean values above the average of 3.0 for all three categories of schools indicating a congenial learning atmosphere. This was used to find out from the respondents whether they were able to study well in their classrooms. From Table 4, the mean and standard deviation of scores on item five were as follows: M = 4.0 and S.D = 1.1, M = 3.9 and S.D = 1.1 and M = 4.1 and S.D = 0.9 for CE, SM and SF SSS3 students respectively. The distribution of responses on this item indicated that for CE school SSS 3 students, only six [6(9.1%)] perceived this practice to be negative against 45(78.2%) out of 66 respondents (as shown in Appendix C) who perceived the practice to be positive. With regards to SSS3 students from SM schools, the distribution of responses (as shown in Appendix C) revealed that only 18(11.3%) out of 159 respondents perceived the practice being measured to be negative against 102(64.1%) of respondents who perceived the classroom practice to be positive. Again, the distribution of responses on item five for SF SSS3 students indicated that the majority of them, 94(80.3%) out of 159 respondents perceived the classroom practice measured on item five to be positive with only six [6(5.2%)] out of this number perceiving the practice to be negative (as shown in Appendix C).

Although, generally SSS3 students' from the various school-types perceived their core mathematics learning environment to be positive on the Student Cohesiveness subscale, there were noticeable differences in perceptions on item seven. On item seven which sought to measure SSS3 students' perception on whether strict rules were needed to maintain discipline in the various school-types, the mean scores and standard deviations obtained for SSS3 students from CE, SM and SF were M = 3.2 and S.D = 1.1, M = 3.3 and S.D = 1.3 and M = 2 .7 and S.D = 1.2 respectively (as shown in Table 4). The mean scores and standard deviations of the items on the Student Cohesiveness subscale are presented in Table 4. From the means scores, whereas SSS3 students from SF school felt that no strict rules were needed to maintain discipline in their core mathematics classrooms, their colleagues from CE and SM schools felt otherwise. These responses may be an indication that there is greater cohesion among SSS3 students in SF school compared to what exist in both CE and SM schools. The distribution of responses indicated that the following percentages of SSS3 students felt that strict rules were needed in their core mathematics classroom to maintain rules; 27 (41.0%) out of 66 respondents from CE school, 67(42.2%) out of 159 from SM schools and 25(21.4%) out of 117 from SF (as shown in Appendix C). Table 4 presents the mean scores and standard deviations obtained on the Student Cohesiveness subscale.

Table 4

Mean and Standard of Scores on the Student Cohesiveness Subscale by School-type

Items	Statements	School type					
		CE (N = 66)		S M (N =159)		S F (N = 117)	
		Mean	S.D	Mean	S.D	Mean	S.D
1	It is easy to form discussion groups in my core mathematics class	3.1	1.0	2.9	1.3	3.0	1.2
2	When asked a question during core mathematics fraid to respond	3.4	1.4	3.9	1.2	3.5	1.3

Table 4 Cont'd

Items	Statements	School type					
		CE (N = 66)		S M (N =159)		S F (N = 117)	
		Mean	S.D	Mean	S.D	Mean	S.D
3	I am friendly to the students in my core mathematics class	4.3	0.9	4.6	0.7	4.4	0.9
4	I enjoy being in the core mathematics class	3.9	0.9	4.2	1.0	4.1	0.9
5	I am able to study well with other core maths students in	4.0	1.1	3.9	1.1	4.1	0.9

	my core maths class						
6	I help other students in this class who are having difficulty with their studies in core mathematics	3.4	0.9	3.6	1.2	3.5	1.1
7	In my core maths class strict rules are needed to maintain discipline	3.2	0.9	3.3	1.3	2.7	1.2
8	When I have difficulty in studying core maths, I get help from other students in my core maths class	4.0	1.1	4.0	1.0	4.3	1 .0

The next subscale on the MCEI was Teacher Support. The Teacher Support subscale was used to determine the extent to which teachers help, relate, trust and show interest in their students. The overall mean scores and standard deviations on this subscale for CE, SM and SF SSS3 students were as follows;

M = 3.6 and S.D = 0.7, M = 3.9 and S.D = 0.7 and M = 3 .5 and S.D = 0.8 respectively (as shown in Table 3). This indicates that SSS3 students from CE, SM and SF schools perceived the support received from their core mathematics teachers to be positive.

Particularly, item 11 was perceived to be the most positive on the Teacher Support subscale with mean value of 4.4 and standard deviation of 0.8 for CE SSS3 students, mean value of 4.3 and standard deviation of 1.0 for SM SSS3 students with

SSS3 students from SF school obtaining a mean value of 4.1 and a standard deviation of 1.0 (as shown in Table 5). From the frequency distribution table, 38(57.6%) responded 'very often' with only 1 (1.5%) responded 'almost never' for CE SSS 3 (as shown in Appendix D). Again, the majority of SSS3 students from SM schools supported the view of their colleagues from CE school as the following percentages indicate, 96(60.4%) selecting 'very often' against 6(3.8%) who felt that the classroom practice being measured hardly takes place (as shown in Appendix D). Furthermore, 49(41.9%) out of 117 SSS3 students respondents from SF selected 'very often' with only 7(6.0%) out of this number selecting 'almost never'(as shown in Appendix D). The responses on this item indicated that the respondents perceived their core mathematics teachers to be willing to explain things all over again when they have difficulty following a lesson. This revelation is interesting considering the general public's impression that teachers are in a hurry to complete a supposedly overloaded syllabus and shortened school calendar.

Item 13 was on whether core mathematics teachers maintained a healthy relationship with their students even after their lessons have ended. The following mean scores and standard deviations were recorded on this item; $\underline{M}$ = 3.7 and $\underline{S.D}$ = 1.2, $\underline{M}$ = 4.2 and $\underline{S.D}$ = 1.1 and $\underline{M}$ = 3.7 and $\underline{S.D}$ = 1.3 for CE, SM and SF SSS3 students respectively (as shown in Table 5). The distribution of responses indicated that the number of respondents who perceived this classroom practice to be positive were as follows; 38 (67.6%) out of 66 respondents for CE, 126(79.3%) out of 159 respondents for SM and 68 (58.1%) out of 117 respondents for SF SSS3 students (as shown in Appendix D). The responses on item 13 strengthen the case that SSS3 students from

CE, SM and SF schools perceive their core mathematics to be friendly and supportive of them.

Again, on item 15, the mean scores indicated that SSS3 students from CE, SM and SF schools perceived the level of motivation they received from their core mathematics teachers to be positive. The following mean scores and standard deviations were obtained on this item; M = 3.7 and S.D = 1.1, M = 4.3 and S.D = 1.0 and M = 3.5 and S.D = 1.3 for CE, SM and SF SSS3 students respectively (as shown in Table 5). A look at the frequency distribution table indicated that the following percentages of SSS3 students perceived the level of motivation received from their core mathematics teachers to be positive; 38(57.6%) out of 66 respondents from CE school, 126(79.3%) out of 159 respondents from SF schools and 58(49.6%) out of 117 respondents from SF school (as shown in Appendix D). The distribution of responses on item 15 indicates that SSS3 students from SM schools perceive their core mathematics teachers to be more motivating compared to their colleagues from CE and SM schools. The mean scores and standard deviations of the items on the Student Cohesiveness subscale are presented in Table 5.

Table 5

Mean Scores and Standard deviations on the Teacher Support Subscale by School-type

Items	Statements	School type					
		CE (N = 66)		S M (N = 159)		S F (N = 117)	
		Mean	S.D	Mean	S.D	Mean	S.D

Table 5 Cont'd

9	My core maths teacher takes a personal interest in my	3.1	1.3	3.3	1.3	3.1	1.2
10	My core maths teacher listens to and accepts my comments on how he/she teaches	3.3	1.4	3.5	1.3	3.2	1.1
11	My core maths teacher is willing to explain things again when requested to do so by any core maths student	4.4	0.8	4.3	1.0	4.1	1.0
12	My core maths teacher helps me when I have difficulty in studying core mathematics	3.6	1.2	3.8	1.1	3.5	1.2
13	My core mathematics teacher maintains a healthy student-teacher relationship with me even after his/her lesson has ended	3.7	1.2	4.2	1.1	3.7	1.3
14	My core mathematics teacher talks excitedly about core maths which encourages us to study core mathematics	3.6	1.2	4.2	1.0	3.1	1.3

15	My core maths teacher motivates me to bring out the best in me in core maths	3.7	1.1	4.3	1.0	3.5	1.3
16	My core maths teacher ask me questions during lessons	3.4	1.0	3.7	1.0	3.6	1.0

The third subscale, Involvement, measured the extent to which SSS3 students have attentative interest, participate in discussions, perform additional work and enjoy the class. The overall mean scores obtained were as follows; M = 3.2 and S.D = 0.6, M = 3.4 and S.D = 0.7, and M = 3.3and S.D = 0.8 for CE, SM and SF SSS3 students respectively (as shown in Table 3). The overall mean scores indicate that SSS3 students perceive their level of involvement in core mathematics classroom activities to be positive irrespective of school-type. With the exception of two items, (19 and 20), whose mean scores were below 3.00 indicating a negative perception on those items, the remaining six items on the Involvement subscale recorded mean scores above 3.00 for all school-types which indicated a positive perception on those items.

Item 23 had the highest item mean score of 4.0 with a standard deviation of 1.0 for SSS3 students from CE school; mean score of 3.9 with a standard deviation of 1.1 for SSS3 students from SM schools and a mean score of 4.2 with a standard deviation of 0.9 for SSS3 students from SF school (as shown in Table 6). The mean scores on item 23 indicate that SSS3 students from the different school-types are interested in and also involved in each others studies. From the distribution of responses on this item, the number of SSS3 students who indicated that this classroom practice was positive were as follows; 49(74.3%) out of 66 respondents from CE school, 106(66.6%) out of 159 respondents from SM schools and 94(80.3%) out of 117 respondents from SF school(as shown in Appendix E).

Item 17 was used to measure SSS 3 students from CE, SM and SF schools level of participation in core mathematics lessons. The mean scores obtained on this item indicated that the students perceived their level of participation in core mathematics lessons to be positive irrespective of school-type. The following mean scores and standard deviations were obtained on this item; M = 3.3 and S.D = 1.0, M = 3.6 and S.D = 1.1 and M = 3.5 and S.D = 1.1 for CE, SM and SF SSS3 students respectively (as shown in Table 6). From the distribution of responses on this item, 26(39.4%) out of 66 respondents from CE school, 80(50.3%) out of 159 respondents from SM schools and 51(43.5%) out of 117 respondents from SF school indicated that their level of participation was positive (as shown in Appendix E). Although SSS3 students perceived their level of participation in core mathematics lessons to be positive, the mean scores on this item for CE, SM and SF schools were just above average.

Although SSS3 students perceived their level of involvement in classroom activities to be positive, items 19 and 20 on the Involvement subscale recorded mean scores below 3.0. Item 19 was to find out from the respondents whether their core mathematics teachers involved them in making decisions. The following mean scores and standard deviations were obtained; M = 2.4 and S.D = 1.1, M = 2.9 and S.D = 1.2 and M = 2.5 and S.D = 1.2 for CE, SM and SF SSS 3 students respectively (as shown in Table 6). From the frequency distribution table, only nine [9(13.6%) out of 66 respondents from CE school indicated that their level of involvement in making decisions was positive with the number of SSS3 students who indicated that such a practice was positive being 47(29.5%) out of 159 respondents and 23(19.7%) out of 117 respondents from SM and SF schools respectively (as shown in Appendix E).

Item 20 was used to measure SSS3 students' perception of the level to which their core mathematics teachers use their ideas and suggestions during classroom discussions. The mean scores and standard deviations obtained for CE, SM and SF schools were as follows; M = 2.3 and S.D = 1.1, M = 2.9 and S.D = 1.1 and M = 2.6 and S.D = 1.1 respectively (as shown in Table 6). The distribution of responses indicated that the following percentages of SSS3 students perceived this practice to be positive in their core mathematics classroom; 8(12.1%) out of 66 respondents from CE school, 38(23.9%) out of 159 from SM schools and 23(19.7%) out of 117 from SF (as shown in Appendix E). A possible reason for such low percentages obtained on this item could be the teaching strategy employed by the majority of core mathematics teachers whose classrooms were used which happened to be mostly "lecture approach" (as observed during the data collection exercise). This teaching strategy gives little room for interaction between instructor and students. Again, it may be possible that teachers hardly solicit for information from their students as to how they teach so that their views could be incorporated into their teaching plans more so when the practice of evaluating teachers by students at SSS level hardly takes place.

These responses give the impression that core mathematics teachers in these classrooms hardly find out from their students how their teaching strategies are affecting them in order to make an evaluative judgement and come out with a more suitable teaching methodology, if so required. This lack of interaction between teachers and their students may lead to a situation where core mathematics teachers are unable to identify the needs of these students and so as to remedy them.

The low levels of SSS3 students perceived involvement in classroom activities including decision making is not a good practice as these students are the main participants in the teaching process. As a result, their concerns should always be paramount which can only be known through their active involvement in lessons in order to promote quality teaching and learning.

From the mean scores and distribution of responses on the Involvement subscale, SSS3 students from CE, SM and SF schools perceive their level of involvement in core mathematics lessons by their core mathematics teachers to be just above average. Not only did they indicate that they were not fully involved in core mathematics lessons but also their ideas and suggestions were hardly sought for by their core mathematics teachers. This situation is not a good development since for students to understand mathematical concepts, they need not be passive learners, and instead they should be active agents in the teaching and learning process. As such, core mathematics teachers would be expected to apply teaching strategies that encourage greater student participation in the teaching and learning process. Table 6 presents the means scores and standard deviations of items on the Involvement subscale.

Table 6

Mean scores and Standard deviations of items on the Involvement Subscale by School-type

Items	Statements	School type					
		CE (N = 66)		SM (N = 159)		SF (N = 117)	
		Mean	S.D	Mean	S.D	Mean	S.D
17	I participate in class discussions during core mathematics lessons	3.3	1.0	3.6	1.1	3.5	1.1
18	I make suggestions during core mathematics lessons	3.0	1.2	3.3	1.1	3.1	1.1
19	My core mathematics teacher involves me in making decisions concerning core mathematics	2.4	1.1	2.9	1.2	2.5	1.2
20	My ideas and suggestions are used	2.3	1.1	2.9	1.1	2.6	1.1

during core mathematics

Table 6 Cont'd

Items	Statements	School type					
		CE (N = 66)		SM (N = 159)		SF (N = 117)	
		Mean	S.D	Mean	S.D	Mean	S.D
21	I ask my core mathematics teacher questions when I have difficulty following a lesson	3.6	1.0	3.6	1.2	3.5	1.2
22	I explain my ideas in core mathematics to other students in the core mathematics class	3.5	0.9	3.5	1.1	3.5	1.1
23	I get help from other students when having difficulty in solving core mathematics questions	4.0	1.0	3.9	1.1	4.2	0.9
24	I am asked to explain how I solve core mathematics problems	3.1	1.1	3.3	1.2	3.1	1.2

The fourth subscale on the MCEI was Cooperation. This subscale was used to measure the extent to which students competed with one another on learning tasks. The overall mean scores on this subscale for CE, SM and SF were as follows; M = 3.6 and S.D = 0.6, M = 3.6 and S.D = 0.6 and M = 3.7 and S.D = 0.5 respectively (as shown in Table 3). The mean scores recorded indicate that SSS 3 students' perceived the level of cooperation in their core mathematics classrooms to be positive.

Item 29 had high mean scores for CE, SM and SF schools which were as follows; M = 4.0 and S.D = 1.1, M =3.9 and S.D = 1.0 and M = 4.1 and S.D = 0.9 respectively (as shown in Table 7) indicating a positive perception on this item for all school-types. This item sought to find out from SSS3 students whether they learned from other students in their core mathematics classroom. This willingness to help each other is consistent with the responses on item four on the Student Cohesiveness subscale where students indicated that they enjoyed being in their core mathematics classrooms. The distribution of responses indicated that the number of SSS3 students who indicated that such a practice was positive in their core mathematics classroom were as follows; 47(71.2%) out of 66 respondents from CE school, 108(67.9%) out of 159 from SM schools and 91(77.8%) out of 117 from SF (as shown in Appendix F).

The desire to see each other progress was also evident from responses on item 26 which recorded the following mean scores and standard deviations; M = 4.1 and S.D = 1.1, M =3.7 and S.D = 1.1 and M = 4.0 and S.D = 1.0 for CE, SM and SF schools respectively (as shown in Table 7). The distribution of responses on item 26 indicated that the following percentages of SSS3 students perceived this practice to be positive in their core mathematics classroom; 49(74.2%) out of 66 respondents from CE school, 99(62.3%) out of 159 from SM schools and 87(74.4%) out of 117 from SF (as shown in Appendix F).

Although on the whole SSS3 students from CE, SM and SF schools perceived the level of cooperation in their core mathematics classrooms to be positive, differences were observed among them on item 28. When SSS3 students were asked whether they perceived the level of competition in their core mathematics classrooms to be so great as to lead to selfish tendencies, those from CE and SF perceived such practice to be negative with those from SM schools being undecided. The mean scores and standard deviations for CE, SM and SF schools were as follows; M = 2.7 and S.D = 1.3, M =3.0 and S.D = 1.4 and M = 2.2 and S.D = 1.4 respectively (as shown in Table 7). The distribution of responses indicated that the following percentages of SSS3 students perceived this classroom practice to be negative in their classroom, 29(43.9%) out of 66 respondents from CE school, 56(35.3%) out of 159 from SM schools and 80(68.4%) out of 117 from SF. (as shown in Appendix F). Table 7 presents the mean scores and standard deviations obtained on the Cooperation subscale based upon school-type.

From the item means and distribution of responses on the Cooperation subscale, it gives an indication that SSS3 students do not only view their core mathematics to be friendly and conducive for learning but more importantly they are interested in the academic progression of each other. As a result of this, not only do they share their learning materials among themselves but also, when one encounters any learning difficulty there are other students in the core mathematics classroom who are willing to help putting aside any selfish ambitions.

Table 7

Mean and Standard of Scores on the Cooperation Subscale for CE, SM and SF Schools

Items	Statements	School type					
		CE (N = 66)		SM (N = 159)		SF (N = 117)	
		Mean	S.D	Mean	S.D	Mean	S.D
25	I cooperate with other core mathematics students when doing core mathematics assignments	3.7	1.1	3.8	1.1	4.1	0.9
26	I share my books and other educational materials with other students when doing core mathematics assignments	4.1	1.1	3.7	1.1	4.0	1.0

Table 7 Cont’d

27	When studying core mathematics in the form of group discussions class, there is team work	3.9	1.0	3.4	1.3	3.7	1.1
28	In my core mathematics class there is great competition among us which leads to selfishness	2.7	1.3	3.0	1.4	2.2	1.4
29	I learn from other core mathematics students in my core mathematics class	4.0	1.1	3.9	1.0	4.1	0.9
30	I work happily with other students in my core mathematics class	3.9	1.1	3.8	1.0	4.2	0.8
31	The other students offering core mathematics in this class respond to any concern(s) I have on their work	3.3	1.0	3.3	1.1	3.4	1.0

The Equity subscale sought to measure SSS3 students’ perception of the level of treatment received from their core mathematics teachers. The overall subscale mean scores and standard deviations for CE, SM and SF schools on the Equity subscale were as follows; M = 3.3 and S.D = 0.9, M = 4.0 and S.D = 0.7 and M = 3.7 and S.D = 0.9

respectively (as shown in Table 3) indicating a positive perception on this subscale for all school-types. All the eight items on the Equity subscale were perceived to be positive by SSS3 students from CE, SM and SF.

The positive perception of teacher equity is reflected in the responses on item 37 on the subscale with mean scores and standard deviations obtained on it being as follows; M = 3.6 and S.D = 1.2, M = 4.1 and S.D = 1.0 and M = 3.8 and S.D = 1.1 for CE, SM and SF schools respectively (as shown in Table 8). The item was used to find out from the respondents whether they perceived the level of encouragement received from their teachers to be the same. The distribution of responses indicated that the following percentages of SSS3 students perceived the level of encouragement received from their core mathematics teachers to be positive in their core mathematics classroom were as follows; 39(59.1%) out of 66 respondents from CE school, 124(78.0%) out of 159 from SM schools and 73(72.4%) out of 117 from SF. (as shown in Appendix G).

Again, the mean scores on item 36 indicated that SSS3 students perceived their core mathematics teachers' treatment of them to be positive. The mean scores and standard deviations for CE, SM and SF schools were as follows; M = 3.2 and S.D = 1.2, M = 4.2 and S.D = 0.9 and M = 4.0 and S.D = 1.2 respectively (as shown in Table 8). The distribution of responses on item 36 indicated that the following percentages of SSS3 students perceived the treatment received from their core mathematics teachers to be equitable; 27(40.9%) out of 66 respondents from CE school, 123(77.3%) out of 159 from SM schools and 81(69.2%) out of 117 from SF. (as shown in Appendix G).

The perception of core mathematics teachers being fair by SSS3 students from CE, SM and SF schools was further strengthened considering the responses on item 40.

The mean scores and standard deviations for CE, SM and SF schools were M = 3.4 and S.D = 1.2, M = 4.1 and S.D = 1.1 and M = 3.8 and S.D = 1.1 respectively (as shown in Table 8). The distribution of responses indicated that the following percentages of SSS3 students perceived the level of encouragement received from their core mathematics teachers to be positive in their core mathematics classroom were as follows; 31(46.9%) out of 66 respondents from CE school, 117(73.5%) out of 159 from SM schools and 74(63.3%) out of 117 from SF. (as shown in Appendix G).

The responses on the item showed that the majority, especially SSS3 students from SM and SF schools, it was realized that the majority of respondents on the item perceived their core mathematics teachers to have as much trust in them as they trusted other students in the core mathematics class. The response pattern on this item was quite surprising considering that generally, mathematics is considered to be a difficult subject. On the basis of the perceived difficulty of the subject, one would think the teachers will place their trust in students who are doing well in the subject which is not the case. Table 8 gives the item means and standard deviations on the equity subscale based upon school-type.

Table 8

Mean scores and Standard deviation of items on the Equity Subscale by School-type

Items	Statements	School type					
		CE (N = 66)		S M (N = 159)		S F (N = 117)	
		Mean	S.D	Mean	S.D	Mean	S.D

Table 8 Cont'd

33	My core mathematics teacher gives as much attention to my questions as he/she gives to the other students	3.3	1.2	3.9	1.1	3.7	1.1

Items	Statements	School type					
		CE (N = 66)		S M (N = 159)		S F (N = 117)	
		Mean	S.D	Mean	S.D	Mean	S.D
34	I get the same amount of help from my core mathematics teacher as the other students in this class	3.2	1.1	3.9	1.1	3.6	1.2
35	I have the same amount of say in the core mathematics class as the other students in this class	3.3	1.2	4.0	1.0	3.8	1.2
36	My core mathematics teacher treats me the same way as he treats the other students in this class	3.2	1.2	4.2	0.9	4.0	1.2

37	I receive the same encouragement as the other core mathematics students in this class	3.6	1.2	4.1	1.0	3.8	1.1

Table 8 Cont'd

Items	Statements	School type					
		CE (N = 66)		S M (N = 159)		S F (N = 117)	
		Mean	S.D	Mean	S.D	Mean	S.D
38	My work receives as much praise as the other students' work	3.2	1.3	3.8	1.2	3.2	1.2
39	I get the same opportunity to answer questions during core mathematics lessons as the other students, work	3.3	1.1	4.0	1.0	3.9	1.1
40	My core mathematics teacher trusts me to get a work in core mathematics done as he /she trusts the other core mathematics students in	3.4	1.2	4.1	1.1	3.8	1.1

this class

The positive perception of their classrooms in terms of the five scales confirms the findings of Koul and Fisher (2005) and Taylor (2004) among others. The item means indicate that the subscale that the respondents from CE school perceived to be the most positive in their core mathematics classroom was Student Cohesiveness, followed by Teacher Support with Involvement being the least positive. On the other hand, SM SSS3 students perceived Equity to be the most positive followed by Teacher Support with Involvement being the least positive. However, SF SSS3 students perceived three subscales to be most positive namely Student Cohesiveness, Cooperation and Equity with Involvement being the least positive.

Section 2: SSS 3 Students' Attitude towards Core Mathematics

The second research question sought to determine SSS3 students' attitude towards core mathematics. From the mean scores obtained on the 12 items on the MAQ, SSS3 students were found to have a positive attitude towards core mathematics irrespective of school-type.

Item one was used to find out whether respondents persevere on a mathematical problem until they have solved it themselves. The mean scores and standard deviations obtained on this item were as follows; M = 4.4 and S.D = 0.8, M = 4.3 and S.D = 1.1 and M = 3.8 and S.D = 1.2 for CE, SM and SF respectively (as shown in Table 9). The distribution of responses indicated that the following percentages of SSS3 students persevered on mathematics item until they have solved it themselves; 58(87.9%) out of 66 respondents from CE school, 133(83.7%) out of 159 from SM schools and

80(68.3%) out of 117 from SF. (as shown in Appendix H). The mean scores and frequency distribution showed that SSS3 students have a positive attitude towards mathematical inquiry irrespective of school-type.

Item 6 was used to find out from SSS3 students whether they would agree with the other core mathematics students in their class as to the solution to a problem rather than investigate it themselves. The mean scores and standard deviations obtained on this item were as follows; M = 4.2 and S.D = 0.7, M = 4.2 and S.D = 0.7 and M = 4.1 and S.D = 0.7 for CE, SM and SF respectively (as shown in Table 9) indicating a positive attitude towards mathematical inquiry (a subscale on the MAQ) irrespective of school-type. The distribution of responses indicated that the following percentages of SSS3 students would rather solve a mathematics problem themselves than agree to a solution offered by the other students in their core mathematics classrooms; 58(87.8%) out of 66 respondents from CE school, 133(83.7%) out of 159 from SM schools and 95(81.2%) out of 117 from SF (as shown in Appendix H).

This may give an indication that the respondents have a strong disposition towards mathematical inquiry which should be encouraged among all mathematics students. This will let them be convinced of the truth of mathematical statements rather than use these truths as merely instruments for learning, that is, to encourage relational learning rather than instrumental learning.

Item two was also used to find out whether SSS3 students' enjoy mathematics lessons. The statement was about whether the respondents saw mathematics lessons as fun. The mean scores and standard deviations obtained on this item were as follows; M = 4.3 and S.D = 0.6, M = 4.3 and S.D = 0.6 and M = 4.2 and S.D = 0.7 for CE, SM and

SF respectively (as shown in Table 9) indicating a positive attitude of SSS3 students irrespective of school-type. The distribution of responses indicated that the following percentages of SSS3 students enjoyed mathematics lessons; 62(94.0%) out of 66 respondents from Co-edu school, 148(93.1%) out of 159 from SM schools and 95(81.2%) out of 117 from SF. (as shown in Appendix H).

A further indication of SSS3 students' enjoyment of core mathematics lessons is captured through their responses on item four. Item four was used to find out from the respondents whether they dislike core mathematics lessons. The mean scores and standard deviations obtained on this item were as follows; M = 4.6 and S.D = 0.6, M = 4.5 and S.D = 0.6 and M = 4.4 and S.D = 0.7 for CE, SM and SF respectively (as shown in Table 9) indicating a positive attitude of SSS3 students irrespective of school-type. The distribution of responses indicated that the following percentages of SSS3 students enjoyed mathematics lessons as measured on item four; 64(96.9%) out of 66 respondents from CE school, 147(92.5%) out of 159 from SM schools and 105(89.7%) out of 117 from SF. (as shown in Appendix H).

Item 12 on the MAQ was used to find out from the respondents whether they would enjoy school more if there were no core mathematics lessons. The mean scores and standard deviations obtained on this item were as follows; M = 4.5 and S.D = 0.7, M = 4.5 and S.D = 0.7 and M = 4.4 and S.D = 0.7 for Co-edu, S.M and S.F respectively (as shown in Table 9) indicating a positive attitude towards mathematical inquiry. The distribution of responses indicated that the following percentages of SSS3 students did not agree to the statement; 60(90.9%) out of 66 respondents from CE school, 62(53.0%) out of 159 from SM schools and 105 (89.7%) out of 117 respondents from SF. (as shown in Appendix H). The responses on this item may give an indication that the respondents treasure mathematics in their school curriculum. The mean scores and standard deviations obtained on this item are presented in Table 9.

Table 9

Mean Scores and Standard deviations of items on the MAQ Scale by School-type

Items	Statements	School type					
		CE (N = 66)		SM (N = 159)		SF (N = 117)	
		Mean	S.D	Mean	S.D	Mean	S.D
1	I would prefer to find out why something is true by solving a mathematics problem than by being told.	4.4	0.8	4.3	1.1	3.8	1.2
2	Mathematics lessons are not fun	4.3	0.6	4.3	0.6	4.2	0.7
3	Solving mathematics problem is not as good as finding out information directly from teachers	4.1	0.7	4.3	0.6	4.2	0.7
4	I dislike core mathematics lessons.	4.6	0.6	4.5	0.6	4.4	0.7

Table 9 Cont'd

Items	Statements	School type					
		CE (N = 66)		SM (N = 159)		SF (N = 117)	
		Mean	S.D	Mean	S.D	Mean	S.D
5	There should be more core mathematics lessons each week	3.9	1.2	3.7	1.2	3.3	1.2
6	I would rather agree with the other core mathematics students in this class as to the solution to a problem than investigate it myself.	4.2	0.7	4.2	0.7	4.1	0.7
7	Mathematics is one of the most interesting school subjects.	4.4	0.9	4.3	1.0	3.9	1.9
8	It is better to ask the core mathematics teacher the answer to a core mathematics problem	4.3	0.6	4.3	0.7	4.2	0.6

	than to find out by trying a mathematics problem.						
9	I really enjoy core mathematics lesson periods.	4.0	1.0	4.0	0.7	3.8	0.8
	The topics covered in core mathematics lessons are not interesting.	4.2	0.6	4.2	0.7	4.1	0.7

Table 9 Cont'd

Items	Statements	School type					
		CE (N = 66)		SM (N = 159)		SF (N = 117)	
		Mean	S.D	Mean	S.D	Mean	S.D
11	I look forward to core mathematics lessons.	3.9	1.0	3.9	1.0	3.5	0.8
12	I would enjoy school more if there were no core mathematics lessons.	4.5	0.7	4.5	0.7	4.4	0.7

Section 3: Differences in SSS 3 Students' Perceptions of their Core Mathematics Classrooms on MCEI subscales

Null Hypothesis One

Research hypothesis one was stated as follows; there is no significant difference between CE, SM and SF SSS3 students' perceptions of their core mathematics classroom environment. To test this hypothesis, one-way multivariate analysis of variance (MANOVA) was used to determine any school-type related differences with MCEI subscales as dependent variables and school-type as independent variable. The results of the MANOVA test indicated that Wilks' lambda (λ) value of 0.82 with partial eta squared value of 0.094 was statistically significant, $F(10,672) = 7.0$; $p<0.01$ which indicates that the hypothesis that the population means on the subscales are the same for CE, SM and SF schools cannot be supported, and was therefore rejected. The overall mean scores obtained by CE, SM and SF schools showed that there was a significant difference indicating that SM students were the most positive in their perception of their core mathematics learning environment. From the results obtained (factor analysis), it was observed that the five subscales on the MCEI explained 45.7% of the variance with variation among the various school-types being 9.4%. A univariate analysis of variance (ANOVA) with school-type as independent variable was therefore conducted as a follow up test to the MANOVA to determine whether there were significant differences between school-type on each subscale on the MCEI. The overall mean scores and standard deviations for each subscale on the MCEI and F ratio for CE, SM and SF SSS3 students are shown in Table 10.

Table 10

Univariate ANOVA on each Subscale of the MCEI as a follow up test to the MANOVA

Subscales	Mean			Standard deviation			F	p- value
	CE	SM	SF	CE	SM	SF		
Student	3.7	3.8	3.7	0.5	0.5	0.5	1.4	0.24

Cohesiveness								
Teacher	3.6	3.9	3.5	0.7	0.7	0.8	13.8	0.001*
Support								
Involvement	3.2	3.4	3.3	0.6	0.7	0.8	2.6	0.08
Cooperation	3.6	3.6	3.7	0.6	0.6	0.5	1.4	0.26
Equity	3.3	4.0	3.7	0.9	0.7	0.9	17.0	0.001*

Bonferroni modified, Significant *$p < 0.001$, N = 66 (CE School), N = 159 (SM School) and N = 117 (SF School)

These findings indicate that S.M SSS3 students perceive their core mathematics classrooms to be the most positive followed by CE and SF SSS3 students in that order. The findings of SSS3 SM students finding their classroom environment to be more favourable than SF SSS3 students contradicts the findings of Taylor (2004) who found females to perceive a more favourable environment than males.

These findings reveal two points in which the differences are related. The first point has to do with social and motivational differences between males and females (considering SM and SF schools) in the SSS3 setting. It would appear from these results that although building a positive structure is important to both males and females from these school-types; SSS3 students from SM schools would prefer a social structure where teachers are more supportive of them compared to those from SF school. This means that core mathematics teachers in SM schools should seek ways of drawing their students to themselves.

The second focal point of these gender differences is the perceived level of Equity in the SSS3 core mathematics classrooms. The finding that females perceive less

Equity in their core mathematics classrooms is however, contrary to Taylor's finding where females perceived a higher Equity than their male counterparts (Taylor, 2004).

There were, however, no statistically significant differences in perceptions of SSS3 students based upon school-type on Student Cohesiveness, Involvement and Cooperation subscales. The absence of a statistically significant difference on the Involvement subscale among school-types is not all that surprising considering that SSS3 students perceived their level of involvement in core mathematics lessons to be just above average. SSS3 students' perception that they were not deeply involved in core mathematics classroom activities is consistent with the findings of Taylor (2004) who reported that high school students' perception of their involvement in mathematics classroom activities did not differ significantly on the basis gender.

Section 4: Differences in SSS3 Students' Attitude towards Core Mathematics

Null Hypothesis Two

Null hypothesis two states that there is no significant difference between CE, SM and SF SSS3 students' attitude towards core mathematics. To test this hypothesis, school-type related differences were explored using one-way analysis of variance (ANOVA) with attitude as dependent variable and school-type as the independent variable. The result obtained from the ANOVA test indicated no statistically significant difference in attitude of SSS3 students based upon type of school. The results of the ANOVA test are presented in Table 11.

Table 11

Univariate ANOVA on SSS3 Students' Attitude towards Core Mathematics based upon School-type

School type	Sum of	d. f.	Mean	F	p- value

	squares		square		
Between groups	14.5	25	0.6	1.1	0.3
Within groups	160.9	316	0.5		
Total	175.4	341			

Test not significant at 0.05 alpha level, N = 66(CE School), N = 159(SM Schools) and N = 117(SF School)

The finding of SSS3 students having positive attitude towards core mathematics is consistent with the findings of Eshun (2000) and Taylor (2004). However, whereas Eshun (2000) found significant differences in attitude towards core mathematics based upon type of school; this study did not find any such differences.

Section 5: Association(s) between SSS 3 students Attitude and Perception

<u>Null Hypothesis Three</u>

In order to determine whether there was any association between SSS3 students' perceptions of their core mathematics classroom environment and their attitude towards core mathematics, a null hypothesis was formulated as follows: there is no significant association between SSS3 students' perceptions of their core mathematics classroom environment and their attitude towards core mathematics.

The results from the Spearman's rank correlation tests indicate that there was no association between students' perception of their classroom environment and attitude towards core mathematics. This may give an indication that there are other factors which may be influencing students learning and not the classroom environment. Figure 1 presents the scatter plot obtained from the correlation between perception and attitude towards core mathematics. From Figure 1, it is seen that there is virtually no linear

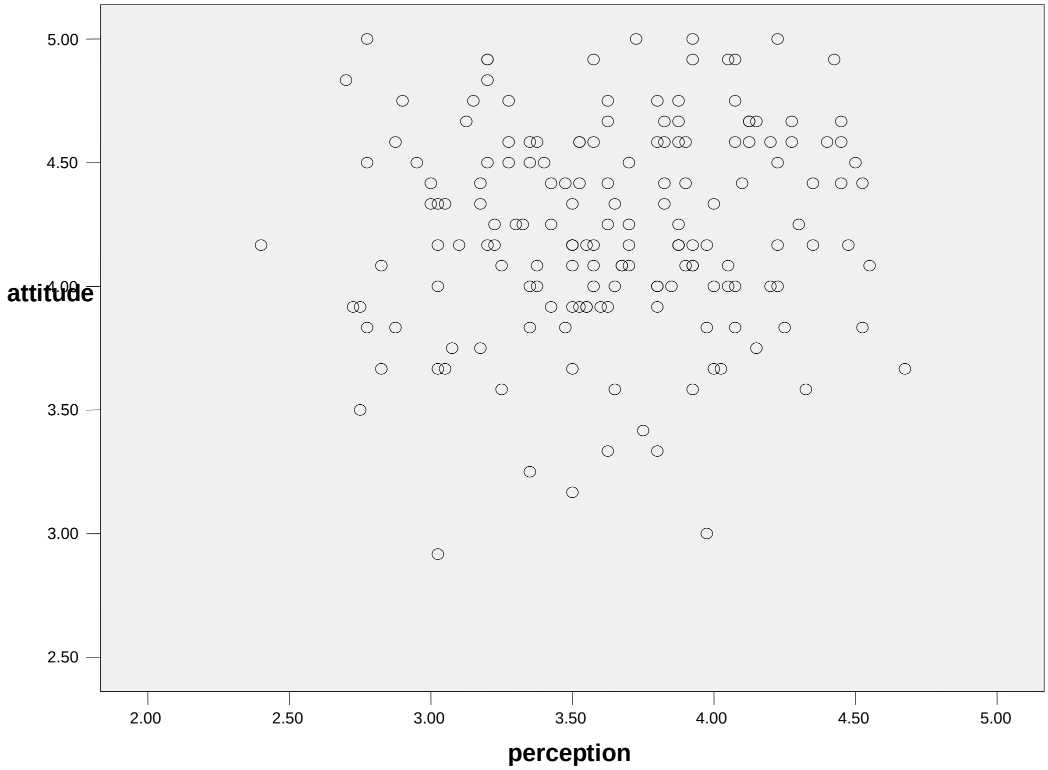

Figure 1: **Correlation between Perception of Learning Environment and Attitude.**

In considering these results, much emphasis should not be placed on the low level of simple correlation as in Figure 1 since this very low value might have arisen partly because of multicollinearity which exists when the dependent variables possess a high level of correlation with each other which pertains in this case. According to Butler (as cited in Taylor, 2004), the interaction of variables can reduce the precision of the coefficients in the analysis.

However, Shumacker, Mount and Monahan (as cited in Taylor, 2004) argue that low multiple correlations can be meaningful and simply reflect a weak underlying relationship between the dependent variable and the independent variables. This can be interpreted that the learning environment subscales have weak relationship with attitude and not as a result of interaction among them.

Section 6: Association(s) among MCEI Subscales

In order to determine the level of interaction among the five subscales on the MCEI, a simple correlation test was conducted using Spearman's rank correlation coefficient for each school-type.

Null Hypothesis Four

Hypothesis four was formulated to determine the level of interaction among the MCEI subscales. Hypothesis four states that there are no significant associations among MCEI subscales for each school-type. To test this hypothesis, Spearman correlation tests were conducted for each school-type. The results of the correlation matrix for each school-type are presented in Tables 12, 13 and 14.

Table 12

Correlation Matrix for subscales on the MCEI for CE Schools

MCEI Subscales	St. Coh	T. Support	Involvement	Coop.	Equity
St. Coh	1.00				
T. Support	0.31	1.00			
Involvement	0.40*	0.51*	1.00		
Cooperation	0.29	0.09	0.36*	1.00	
Equity	0.26	0.65*	0.54*	0.17	1.00

r-values significant at *$\underline{p} < 0.005$, N=66 (CE school)

The results from Table 12 on the Spearman correlation test indicate that for SM SSS3 students, there were significant correlations among Equity subscale and the following subscales; Student Cohesiveness, Teacher Support, Involvement and

Cooperation. Again, there were significant correlations among Involvement subscale and Student Cohesiveness and Teacher Support subscales. Further significant correlations were recorded among Cooperation subscale and Student Cohesiveness and Involvement subscales. This indicates that for those subscales which correlated significantly with each other, an increase in one of the subscales will lead to a corresponding increase in the other subscale.

Figure 2 presents the scatter plot obtained for the correlation among subscales on the MCEI for CE SSS3 students. The scatter plot indicates that although there are significant correlations some of these subscales, there are noticeable outliers.

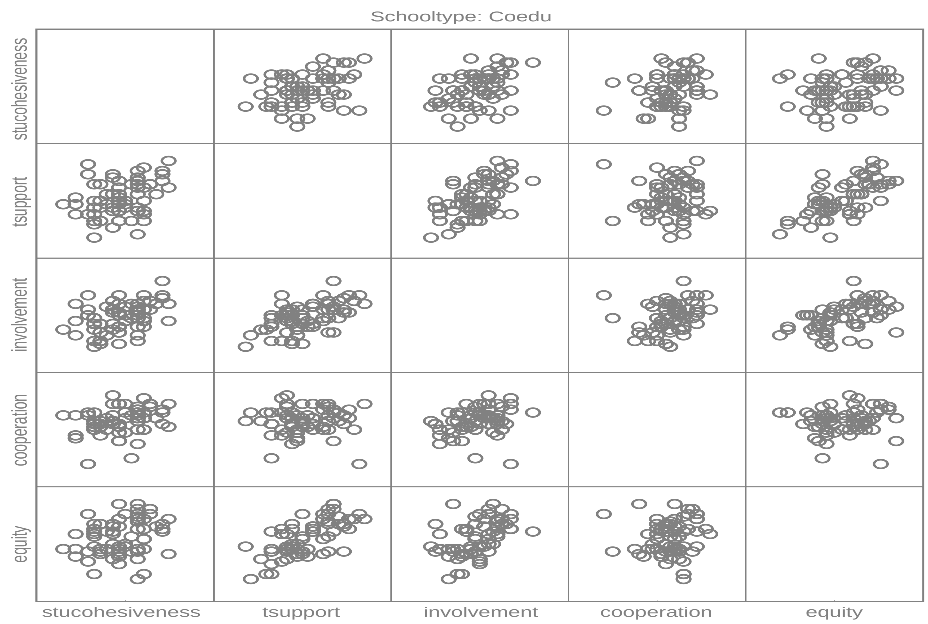

Figure 2: **Correlation among MCEI Subscales for CE SSS3 Students**

Figure 3 presents the scatter plot obtained for the correlation among subscales on the MCEI for SM SSS3 students.

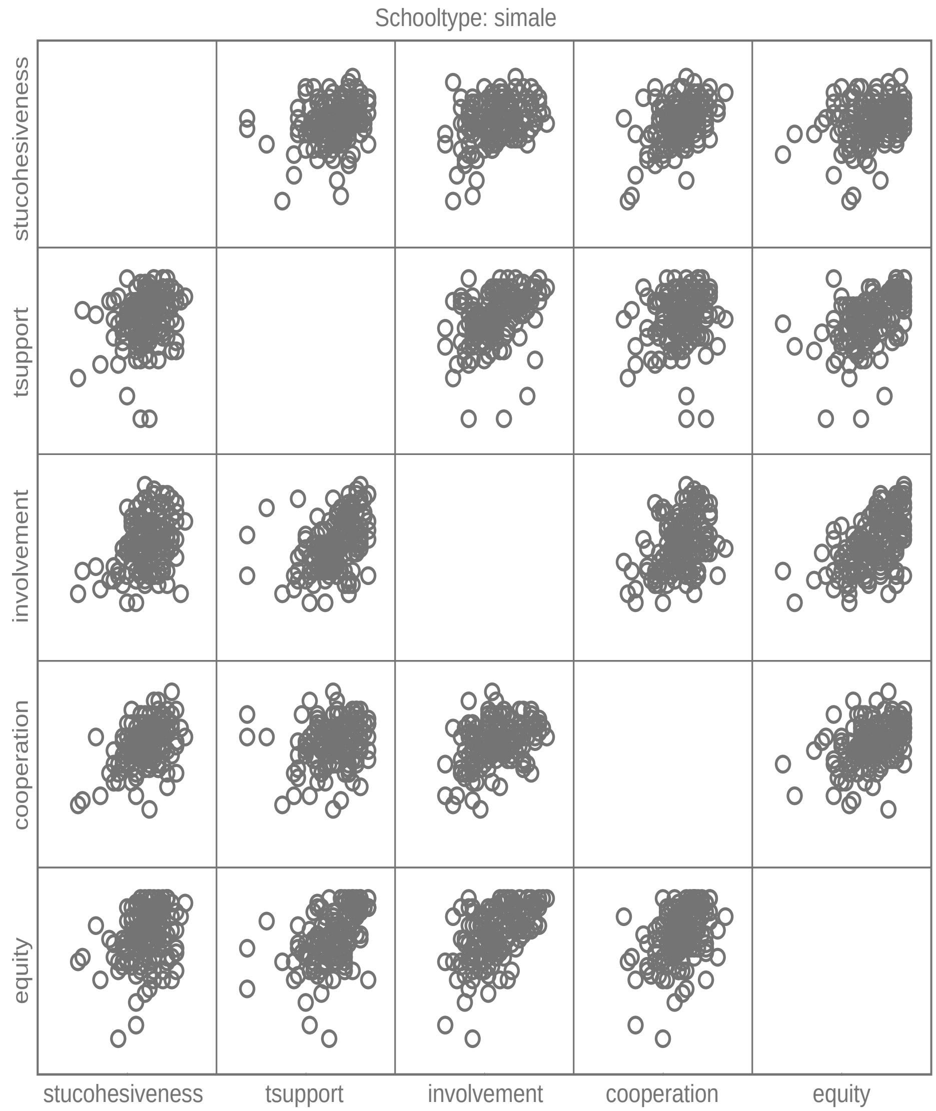

Figure 3: **Correlation among MCEI subscales for SM SSS3 students**

The scatter plot indicates that although there exist correlations among all the subscales there still exist some outliers.

The results from the correlation matrix for SM SSS3 students indicate that there are significant correlations among all the subscales except among Cooperation and Teacher Support subscales (as shown in Table 13). These results indicate that for SM SSS3 core mathematics classrooms, an increase in the levels of any of the subscales will lead to increase in the other subscales except among Cooperation and Teacher Support subscales. Table 13 shows the correlation matrix obtained on the MCEI subscales for SM SSS3 students

Table 13

Correlation Matrix for subscales on the MCEI for SM Schools

MCEI Subscales	St. Coh	T. Support	Involvement	Coop.	Equity
St. Coh	1.00				
T. Support	0.29*	1.00			
Involvement	0.30*	0.50*	1.00		
Cooperation	0.34*	0.19	0.38*	1.00	
Equity	0.29*	0.58*	0.54*	0.46*	1.00

r-values significant at *$p < 0.005$, N=159 (SM schools)

The results obtained from the correlation matrix for SF SSS3 students indicate that an improvement in any of the subscales will lead to an increase in the remaining subscales. Table 14 presents the correlation matrix test for SF SSS3 students on the MCEI subscale.

Table 14

Correlation Matrix for Subscales on the MCEI for SF Schools

MCEI Subscales	St. Coh	T. Support	Involvement	Coop.	Equity
St. Coh	1.00				
T. Support	0.42*	1.00			
Involvement	0.59*	0.63*	1.00		
Cooperation	0.37*	0.32*	0.35*	1.00	
Equity	0.40*	0.68*	0.57*	0.36*	1.00

r-values significant at *p < 0.005, N=117 (SF School)

The results of the scatter plot matrix for subscales on the MCEI indicate that although there are correlations among these subscales, there are noticeable outliers in some cases. Figure 4 presents the scatter plot obtained for the correlation among subscales on the MCEI for SF SSS3 students.

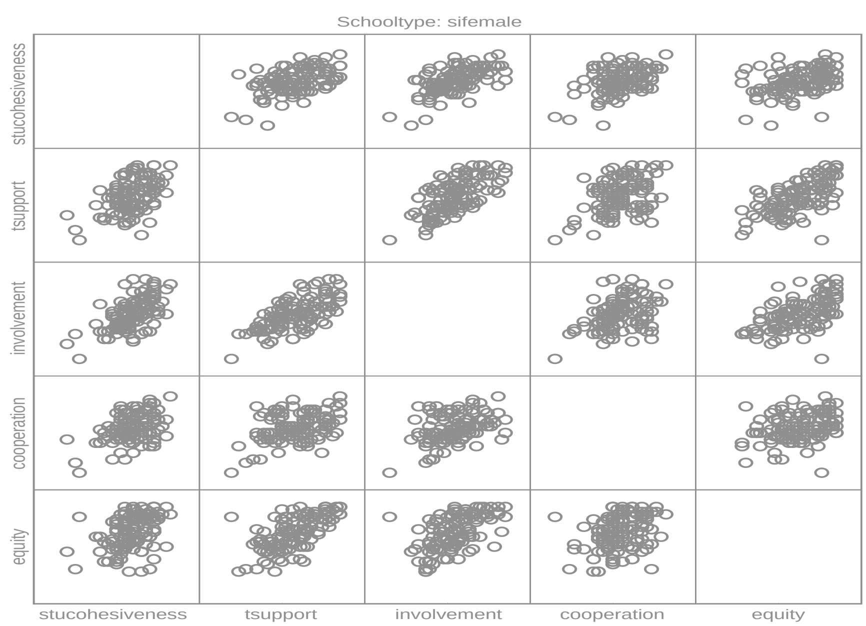

Figure 4: **Correlation among MCEI subscales for SF SSS3 students**

Table 15 gives a brief description of the subscales on the MCEI namely; Student Cohesiveness, Teacher Support, Involvement, Cooperation and Equity.

Table 15

Description of the Subscales on the MCEI

Subscales	Description
Student Cohesiveness	Extent to which students are friendly to and supportive of each other
Teacher Support	Extent to which teachers help, relate to, trust and show interest in their students
Involvement	Extent to which students are involved in classroom activities by their core mathematics teachers
Cooperation	Extent to which students are prepared to help each other out in their studies rather than compete against each other leading to selfishness
Equity	Extent to which students view the treatment they receive from their teachers to be equitable

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Overview of Research Problem and Methodology

This chapter begins with a summary of this study and the research questions and hypotheses which guided it. Specific findings and conclusions from the data analyses are discussed as well as a conclusion of the findings from the study. In addition, certain recommendations are offered and suggestions for further research put forward.

The findings of this study have been divided into six sections, each relating to the research objectives and hypotheses that underpinned the study. The first section deals with SSS3 students' perceptions of their core mathematics learning environment with respect to the five subscales on the MCEI. The second section focuses on SSS3 students' attitude towards core mathematics while the third section is on an investigation of school-type related differences in perception of the core mathematics classroom environment. The fourth section is on an investigation into school-type related differences in students' attitude towards core mathematics. The fifth and sixth sections deal with simple correlation tests which were conducted to explore any possible association(s) between classroom environment subscales and attitude on one hand as well as among subscales on the MCEI.

In carrying out this study, a cross-sectional survey was used. This design ensured that the SSS3 students were studied in their core mathematics environment without manipulating their environment.

Summary of Key Findings

1. Generally, SSS3 students perceived their core mathematics learning environment to be positive on all the five subscales they were measured on. Although SSS3 students from the CE, SM and SF schools perceived different subscales on the MCEI to be the most positive in their core mathematics classrooms, they all perceived Involvement to be the least positive with mean values obtained on this subscale being just above average for each school-type.

2. SSS3 students were generally found to have a positive attitude towards core mathematics irrespective of school-type.

3. There were statistically significant school-type related differences on two of the MCEI subscales namely Teacher Support and Equity. SSS3 students from SM schools perceived their core mathematics to be highest on both Teacher Support and Equity subscales, followed by those from CE on the Teacher Support subscale and SF SSS3 students on the Equity subscale. The findings of significant differences on these two subscales were all in favour of SM SSS3 students in terms of the level of positive perception of the core mathematics classroom environment. These findings indicate that perception of core mathematics environment depends upon school-type.

4. The results of the one-way ANOVA indicated no significant school-type related differences in attitude towards core mathematics. This finding gives an indication that attitude towards core mathematics is not dependent upon school-type.

5. Generally, there was no significant association between MCEI subscales namely; Student Cohesiveness, Teacher Support, Involvement, Cooperation and Equity and SSS3 students' attitude towards core mathematics.

6. There were significant associations among all subscales on the MCEI except between Cooperation and Teacher Support for SM SSS3 students. In the case of SF SSS3 students, significant associations were reported among all subscales on the MCEI. Again, for CE SSS3 students, significant associations were reported among all subscales except among the following: Teacher Support and Student Cohesiveness, Cooperation and Student Cohesiveness, Cooperation and Teacher Support, Equity and Student Cohesiveness, and Equity and Cooperation.

Conclusion

SSS3 students' perceptions of their core mathematics learning environment was found to be positive for all school-types, that is, CE, SM and SF schools. However, there were significant differences in SSS3 students' perceptions of their core mathematics learning environment which were all in favour of SM SSS3 students. The finding of differences in perception of the core mathematics environment based upon school-type seems to suggest that perception of learning environment is school-type dependent. It also seems to suggest that SSS3 students from SM schools perception of their core mathematics learning environment are greatly influenced by Teacher Support and Equity as a result of which core mathematics teachers in this school-type should implement teaching strategies that will continually improve SSS3 students' positive perception.

Also, the finding that SSS3 students from CE, SM and SF schools all had a positive attitude towards core mathematics with no significant school-type related differences in attitude being detected gives an indication that attitude towards core mathematics does not depend upon school-type.

The result that there was no association between perception of core mathematics classroom environment and attitude towards core mathematics may be an indication that there are other factors operating in the core mathematics learning environment influencing students' learning of core mathematics and not the core mathematics classroom environment or their attitude towards core mathematics.

The simple correlation tests showed that there were significant correlations among the MCEI subscales for the various school-types.

Recommendations

From the findings of this study, the following recommendations are offered:

1. As a result of the findings on the correlation among MCEI subscales, core mathematics teachers in these secondary schools should implement teaching strategies that will improve upon their students' positive perception of their core mathematics learning environment.
2. It is also evident from the test conducted on differences in perceptions of SSS3 students concerning their core mathematics environment that SSS3 students from CE, SM and SF schools preferred different social settings. Hence, core mathematics educators should capitalize on these differences to improve upon their students' positive perception of their core mathematics classroom environment

3. Since SSS3 students indicated that their level of involvement in core mathematics lessons was just above average, core mathematics educators are encouraged to introduce teaching and learning strategies that will get their students more involved in core mathematics lessons.
4. Since SSS3 students had a positive attitude towards core mathematics, irrespective of school-type, core mathematics teachers should capitalize on this positive attitude to help students' learning of core mathematics.

Suggestions for Further Research

In order to continue building upon the literature on SSS3 students' perceptions of their core mathematics learning environment and any possible influence this learning environment may have on students' attitude towards core mathematics, the following suggestions are put forward:

1. In analysing the data obtained, the core mathematics classrooms were lumped together for the various school-types because the classes used for the study were insufficient to allow for data analysis based upon class. This is not all that good since it is possible that the classroom environments may differ from one class to another even in the same school. It is therefore suggested that the study be replicated in other Senior Secondary Schools with more classes involved in order to obtain more knowledge concerning the factors that influence SSS3 students' perceptions of their core mathematics learning environment and also identify differences among core mathematics classes.

2. From this study, it emerged that SSS3 students' level of involvement in core mathematics classroom activities were just above average but the reasons why students

indicated that their involvement was average was not determined. Since the reasons informing students' responses on the Involvement subscale are not known, a combination of both qualitative and quantitative data collection techniques should be employed in further research studies to ensure clarity of issues that may arise after the quantitative analyses.

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APPENDICES

Appendix A

Mathematics Classroom Environment Inventory Instrument

Directions for Students

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

There are no 'right' or 'wrong' answers. Your responses will be treated as confidential and will only be used for the purposes of this research.

Think about how well each statement describes what the core mathematics class is like to you.

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

Some statements in this questionnaire are fairly similar to other statements. Don't worry about this. Please give your opinion about all statements by ticking [√] in the box against your response.

Section A

Biographic Data

1. **Sex:** **Male** [ ] **Female** [ ]

Age: ____________________

Section B

To what extent do you agree with the following statements?

	Statement	Very Often	Often	Sometimes	Seldom	Almost Never
1.	It is easy to form discussion groups in my core mathematics class					
2.	When asked a question during core mathematics lessons, I am not afraid to respond					
3.	I am friendly to the students in my core mathematics class					
4.	I enjoy being in the core mathematics class					
5	I am able to study well with other core mathematics students in my core mathematics class					
6.	I help other students in this class who are having difficulty with their studies in core mathematics					
7	In my core mathematics class strict rules					

	are needed to maintain discipline					
8.	When I have difficulty in studying core mathematics, I get help from other students in my core mathematics class					
9.	My core math teacher takes a personal interest in my studies in core mathematics					
10.	My core mathematics teacher listens to and accepts my comments on how he/she teaches					
11.	My core mathematics teacher is willing to explain things again when requested to do so by any core mathematics student					
12.	My core mathematics teacher helps me when I have difficulty in studying core mathematics					
13.	My core mathematics teacher maintains a healthy student-teacher relationship with me even after his/her lesson has ended					
14	My core mathematics teacher talks excitedly about core mathematics which					

	encourages us to study core mathematics					
15	My core mathematics teacher motivates me to bring out the best in me in core mathematics					
16	My core math teacher asks me questions during lessons.					
17.	I participate in class discussions during core mathematics lessons					
18.	I make suggestions during core mathematics lessons					
19.	My core mathematics teacher involves me in making decisions concerning core mathematics					
20.	My ideas and suggestions are used during core mathematics classroom discussions					
21.	I ask my core mathematics teacher questions when I have difficulty following a lesson					
22.	I explain my ideas in core mathematics to					

	other students in the core mathematics class					
23.	I get help from other students when having difficulty in solving core mathematics questions					
24.	I am asked to explain how I solve mathematics problems					
25.	I cooperate with other core mathematics students when doing core mathematics assignments					
26.	I share my books and other educational materials with other students when doing core mathematics assignments					
27.	When studying core mathematics in the form of group discussions with students in my class, there is teamwork					
28.	In my core mathematics class there is great competition among us which leads to selfishness					
29.	I learn from other core mathematics students in my core mathematics class					

30.	I work happily with other students in my core mathematics class					
31.	The other students offering core mathematics in this class respond to any concern(s) I have on their work					
32.	Other core mathematics students in this class help me in my studies so that I can perform better in core mathematics					
33.	My core mathematics teacher gives as much attention to my questions as he/she gives to the other students					
34.	I get the same amount of help from my core mathematics teacher as the other students in this class					
35.	I have the same amount of say in the core math class as the other students					
36.	My core mathematics teacher treats me the same way as he/she treats the other students in this class					

37.	I receive the same encouragement as the other core mathematics students in this class					
38.	My work receives as much praise as the other core mathematics students' work					
39.	I get the same opportunity to answer questions during core mathematics lessons as the other students in this class					
40.	My core mathematics teacher trusts me to get a work in core mathematics done just as he/she trusts the other core mathematics students in this class					

Appendix B

Mathematics Attitude Questionnaire

Directions for Students

This questionnaire contains statements which will seek to find out what your opinions are concerning the study of core mathematics.

There are no 'right' or 'wrong' answers. Your responses will be treated as confidential and will only be used for the purposes of this research.

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

Some statements in this questionnaire are fairly similar to other statements. Don't worry about this. Please give your opinion about all statements by ticking [√] in the box against your response.

Thank you for your maximum co-operation.

Biographic Data

1. **Sex:** **Male** [ ] **Female** [ ]

2. Age: ________________________

Section B

To what extent do you agree with the following statements concerning core mathematics?

		Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
1.	I would prefer to find out why something is true by solving a mathematics problem than by being told.					
2.	Mathematics lessons are not fun.					
3.	It is better to search for information concerning core mathematics on my own problem than from my core mathematics teacher.					

4.	I dislike core mathematics lessons.					
5.	There should be more core mathematics lessons each week.					
6.	I would rather agree with the other core mathematics students in this class as to the solution to a problem than investigate it myself.					
7.	Mathematics is one of the most interesting school subjects.					
8.	It is better to ask the core mathematics teacher the answer to a core mathematics problem than to find out by trying a mathematics problem.					
9.	I really enjoy core mathematics lesson periods.					
10.	The topics covered in core mathematics lessons are not interesting.					

11.	I look forward to core mathematics lessons.					
12.	I would enjoy school more if there were no core mathematics lessons.					

Appendix C

Distribution of responses (%) on the Student Cohesiveness Subscale by School-type

Items	School-type	A.N (%)	Se (%)	S (%)	O (%)	V.O (%)
1	Co-edu	4(6.1)	13(19.7)	30(45.5)	12(18.2)	7(10.6)
	S.M	29(18.2)	24(15.1)	55(34.6)	31(19.5)	20(12.6)
	S.F	16(13.7)	23(19.7)	39(33.3)	25(21.4)	14(12.0)
2	Co-edu	8(12.1)	9(13.6)	15(22.7)	15(22.7)	19(28.8)
	S.M	12(7.5)	10(6.3)	33(20.8)	38(23.9)	66(41.5)
	S.F	10(8.5)	12(10.3)	38(32.5)	18(15.4)	39(33.3)
3	Co-edu	1(1.5)	2(3.0)	8(12.1)	19(28.8)	36(54.5)
	S.M	2(1.3)		12(7.5)	33(20.8)	112(70.4)

	S.F	3(2.6)	2(1.7)	9(7.7)	31(26.5)	72(61.5)
4	Co-edu		2(3.0)	22(33.3)	21(31.8)	21(31.8)
	S.M	3(1.9)	4(2.5)	35(22.0)	30(18.9)	87(54.7)
	S.F	2(1.7)	3(2.6)	23(19.7)	40(34.2)	49(41.9)
5	Co-edu	2(3.0)	4(6.1)	15(22.7)	19(28.8)	26(39.4)
	S.M	8(5.0)	10(6.3)	39(24.5)	42(26.4)	60(37.7)
	S.F	3(2.6)	3(2.6)	17(14.5)	46(39.3)	48(41.0)
6	Co-edu	1(1.5)	8(12.1)	30(45.5)	18(27.3)	9(13.6)
	S.M	10(6.3)	16(10.1)	51(32.1)	40(25.2)	42(26.4)
	S.F	3(2.6)	14(12.0)	42(35.9)	36(30.8)	22(18.8)
7	Co-edu	5(7.6)	12(18.2)	22(33.3)	17(25.8)	10(15.2)
	S.M	17(10.7)	23(14.5)	52(32.7)	33(20.8)	34(21.4)
	S.F	23(19.7)	29(24.8)	40(34.2)	13(11.1)	12(10.3)
8	Co-edu	2(3.0)	3(4.5)	13(19.7)	21(31.8)	27(40.9)
	S.M	4(2.5)	11(6.9)	38(23.9)	36(22.6)	70(44.0)
	S.F	2(1.7)	5(4.3)	15(12.8)	34(29.1)	61(52.1)

A.N-Almost Never, Se-Seldom, S-Sometimes, O-often, V.O-Very Often

Appendix D

Distribution of Responses (%) on the Teacher Support Subscale by School-type

Items	School-type	A.N (%)	Se (%)	S (%)	O (%)	V.O (%)
9	Co-edu	9(13.6)	11(16.7)	24(36.4)	10(15.2)	12(18.2)
	S.M	18(11.3)	21(13.2)	52(32.7)	33(20.8)	35(22.0)
	S.F	9(7.7)	27(23.1)	42(35.9)	21(17.9)	18(15.4)
10	Co-edu	4(6.1)	10(15.2)	25(37.9)	14(21.2)	13(19.7)
	S.M	20(12.6)	15(9.4)	38(23.9)	39(24.5)	47(29.6)
	S.F	10(8.5)	23(19.7)	37(31.6)	32(27.4)	15(12.8)
11	Co-edu	1(1.5)		7(10.6)	20(30.3)	38(57.6)
	S.M	6(3.8)	4(2.5)	18(11.3)	35(22.0)	96(60.4)

	S.F	3(2.6)	2(1.7)	25(21.4)	38(32.5)	49(41.9)
12	Co-edu	4(6.1)	8(12.1)	17(25.8)	17(25.8)	20(30.3)
	S.M	6(3.8)	9(5.7)	41(25.8)	50(31.4)	53(33.3)
	S.F	7(6.0)	18(15.4)	31(26.5)	29(24.8)	32(27.4)
13	Co-edu	3(4.5)	7(10.6)	19(28.8)	14(21.2)	23(34.8)
	S.M	7(4.4)	8(5.0)	15(9.4)	38(23.9)	91(57.2)
	S.F	11(9.4)	13(11.1)	25(21.4)	24(20.5)	44(37.6)
14	Co-edu	3(4.5)	12(18.2)	15(22.7)	17(25.8)	19(28.8)
	S.M	2(1.3)	6(3.8)	29(18.2)	38(23.9)	84(52.8)
	S.F	15(12.8)	26(22.2)	30(25.6)	20(17.1)	26(22.2)
15	Co-edu	2(3.0)	7(10.6)	19(28.8)	21(31.8)	17(25.8)
	S.M	6(3.8)	4(2.5)	23(14.5)	37(23.3)	89(56.0)
	S.F	9(7.7)	20(17.1)	30(25.6)	22(18.8)	36(30.8)
16	Co-edu	2(3.0)	7(10.6)	29(43.9)	17(25.8)	11(16.7)
	S.M	3(1.9)	14(8.8)	51(32.1)	45(28.3)	46(28.9)
	S.F	2(1.7)	12(10.3)	44(37.6)	31(26.5)	28(23.9)

A.N-Almost Never, Se-Seldom, S-Sometimes, O-often, V.O-Very Often

Appendix E

Distribution of Responses (%) on the Involvement Subscale by School-type

Items	School-type	A.N (%)	Se (%)	S (%)	O (%)	V.O (%)
17	Co-edu	3(4.5)	7(10.6)	30(45.5)	17(25.8)	9(13.6)
	S.M	5(3.1)	15(9.4)	59(37.1)	42(26.4)	38(23.9)
	S.F	4(3.4)	17(14.5)	45(38.5)	21(17.9)	30(25.6)
18	Co-edu	7(10.6)	15(22.7)	25(37.9)	8(12.1)	11(16.7)
	S.M	11(6.9)	23(14.5)	61(38.4)	34(21.4)	30(18.9)
	S.F	9(7.7)	26(22.2)	43(36.8)	24(20.5)	15(12.8)

19	Co-edu	16(24.2)	17(25.8)	24(36.4)	6(9.1)	3(4.5)
	S.M	26(16.4)	26(16.4)	60(37.7)	29(18.2)	18(11.3)
	S.F	30(25.6)	30(25.6)	34(29.1)	14(12.0)	9(7.7)
20	Co-edu	19(28.8)	16(24.2)	23(34.8)	6(9.1)	2(3.0)
	S.M	20(12.6)	34(21.4)	67(42.1)	20(12.6)	18(11.3)
	S.F	24(20.5)	33(28.2)	37(31.6)	16(13.7)	7(6.0)
21	Co-edu	2(3.0)	5(7.6)	23(34.8)	23(34.8)	13(19.7)
	S.M	11(6.9)	14(8.8)	48(30.2)	36(22.6)	50(31.4)
	S.F	6(5.1)	17(14.5)	36(30.8)	29(24.8)	29(24.8)
22	Co-edu	1(1.5)	7(10.6)	25(37.9)	23(34.8)	10(15.2)
	S.M	5(3.1)	20(12.6)	51(32.1)	50(31.4)	33(20.8)
	S.F	5(4.3)	13(11.1)	38(32.5)	36(30.8)	25(21.4)
23	Co-edu	2(3.0)	2(3.0)	13(19.7)	24(36.4)	25(37.9)
	S.M	3(1.9)	13(8.2)	37(23.3)	43(27.0)	63(39.6)
	S.F	3(2.6)	1(0.9)	19(16.2)	37(31.6)	57(48.7)
24	Co-edu	8(12.1)	10(15.2)	22(33.3)	21(31.8)	5(7.6)
	S.M	13(8.2)	26(16.4)	53(33.3)	36(22.6)	31(19.5)
	S.F	12(10.3)	23(19.7)	44(37.6)	16(13.7)	22(18.8)

A.N-Almost Never, Se-Seldom, S-Sometimes, O-often, V.O-Very Often

Appendix F

Distribution of Responses (%) on the Cooperation Subscale by School-type

Items	School-type	A.N (%)	Se (%)	S (%)	O (%)	V.O (%)
25	Co-edu	2(3.0)	6(9.1)	21(31.8)	18(27.3)	19(28.8)
	S.M	4(2.5)	12(7.5)	46(28.9)	44(27.7)	53(33.3)
	S.F	2(1.7)	2(1.7)	22(18.8)	42(35.9)	49(41.9)
26	Co-edu	2(3.0)	4(6.1)	11(16.7)	20(30.3)	29(43.9)
	S.M	10(6.3)	6(3.8)	44(27.7)	55(34.6)	44(27.7)

	S.F	3(2.6)	5(4.3)	22(18.8)	43(36.8)	44(37.6)
27	Co-edu	2(3.0)	3(4.5)	13(19.7)	27(40.9)	21(31.8)
	S.M	20(12.6)	14(8.8)	40(25.2)	46(28.9)	39(24.5)
	S.F	5(4.3)	13(11.1)	26(22.2)	43(36.8)	30(25.6)
28	Co-edu	16(24.2)	13(19.7)	19(28.8)	11(16.7)	7(10.6)
	S.M	33(20.8)	23(14.5)	46(28.9)	24(15.1)	33(20.8)
	S.F	47(40.2)	33(28.2)	17(14.5)	4(3.4)	16(13.7)
29	Co-edu	2(3.0)	6(9.1)	11(16.7)	21(31.8)	26(39.4)
	S.M	5(3.1)	7(4.4)	39(24.5)	55(34.6)	53(33.3)
	S.F		7(6.0)	19(16.2)	47(40.2)	44(37.6)
30	Co-edu	4(6.1)	2(3.0)	12(18.2)	29(43.9)	19(28.8)
	S.M	3(1.9)	9(5.7)	42(26.4)	62(39.0)	43(27.0)
	S.F		4(3.4)	21(17.9)	44(37.6)	48(41.0)
31	Co-edu	2(3.0)	11(16.7)	25(37.9)	18(27.3)	10(15.2)
	S.M	11(6.9)	21(13.2)	61(38.4)	46(28.9)	20(12.6)
	S.F	6(5.1)	11(9.4)	46(39.3)	37(31.6)	17(14.5)
32	Co-edu	4(6.1)	2(3.0)	26(39.4)	21(31.8)	13(19.7)
	S.M	5(3.1)	15(9.4)	47(29.6)	55(34.6)	37(23.3)
	S.F	3(2.6)	7(6.0)	31(26.5)	43(36.8)	33(28.2)

A.N-Almost Never, Se-Seldom, S-Sometimes, O-often, V.O-Very Often

Appendix G

Distribution of Responses (%) on the Equity Subscale by School-type

Items	School-type	A.N (%)	Se (%)	O	O (%)	V.O (%)
33	Co-edu	6(9.1)	10(15.2)	19(28.8)	20(30.3)	11(16.7)
	S.M	8(5.0)	7(4.4)	35(22.0)	48(30.2)	61(38.4)
	S.F	4(3.4)	14(12.0)	32(27.4)	30(25.6)	37(31.6)
34	Co-edu	5(7.6)	12(18.2)	23(34.8)	16(24.2)	10(15.2)

	S.M	9(5.7)	7(4.4)	34(21.4)	52(32.7)	57(35.8)
	S.F	6(5.1)	12(10.3)	35(29.9)	28(23.9)	36(30.8)
35	Co-edu	5(7.6)	13(19.7)	20(30.3)	15(22.7)	12(18.2)
	S.M	3(1.9)	9(5.7)	36(22.6)	47(29.6)	64(40.3)
	S.F	6(5.1)	12(10.3)	25(21.4)	32(27.4)	42(35.9)
36	Co-edu	6(9.1)	13(19.7)	20(30.3)	15(22.7)	12(18.2)
	S.M	1(0.6)	6(3.8)	29(18.2)	50(31.4)	73(45.9)
	S.F	3(2.6)	11(9.4)	22(18.8)	30(25.6)	51(43.6)
37	Co-edu	4(6.1)	7(10.6)	16(24.2)	22(33.3)	17(25.8)
	S.M	4(2.5)	9(5.7)	22(13.8)	51(32.1)	73(45.9)
	S.F	2(1.7)	12(10.3)	30(25.6)	32(27.4)	41(35.0)
38	Co-edu	7(10.6)	12(18.2)	22(33.3)	11(16.7)	14(21.2)
	S.M	9(5.7)	9(5.7)	44(27.7)	41(25.8)	56(35.2)
	S.F	8(6.8)	24(20.5)	37(31.6)	27(23.1)	21(17.9)
39	Co-edu	3(4.5)	13(19.7)	21(31.8)	20(30.3)	9(13.6)
	S.M	4(2.5)	7(4.4)	39(24.5)	50(31.4)	59(37.1)
	S.F	2(1.7)	13(11.1)	25(21.4)	35(29.9)	42(35.9)
40	Co-edu	5(7.6)	10(15.2)	20(30.3)	15(22.7)	16(24.2)
	S.M	6(3.8)	9(5.7)	27(17.0)	43(27.0)	74(46.5)
	S.F	3(2.6)	12(10.3)	28(23.9)	36(30.8)	38(32.5)

A.N-Almost Never, Se-Seldom, S-Sometimes, O-often, V.O-Very Often

Appendix H

Distribution of Responses (%) on the MAQ by School-type

Item	School-type	S.D	D	U	A	S.A
1	Co-edu		2(3.0)	6(9.1)	22(33.3)	36(54.6)
	S.M	7(4.4)	7(4.4)	12(7.5)	40(25.2)	93(58.5)
	S.F	5(4.3)	14(12.0)	18(15.4)	39(33.3)	41(35.0)
2	Co-edu			4(6.1)	37(56.1)	25(37.9)

	S.M			11(6.9)	85(53.5)	63(39.6)
	S.F			22(18.8)	52(44.4)	43(36.8)
3	Co-edu			15(22.7)	29(43.9)	22(33.3)
	S.M			17(10.7)	81(50.9)	61(38.4)
	S.F			16(13.7	56(47.9)	45(38.5)
4	Co-edu			2(3.0)	22(33.3)	42(63.6)
	S.M			12(7.5)	51(32.1)	96(60.4)
	S.F			12(10.3)	46(39.3)	59(50.4)
5	Co-edu	5(7.6)	3(4.5)	14(21.2)	17(25.8)	27(40.9)
	S.M	14(8.8)	11(6.9)	33(20.8)	47(29.6)	54(34.0)
	S.F	12(10.3)	21(17.9)	22(18.8)	42(35.9)	20(17.1)
6	Co-edu			8(12.1)	35(53.0)	23(34.8)
	S.M			26(16.4)	79(49.7)	54(34.0)
	S.F			22(18.8)	64(54.7)	31(26.5)
7	Co-edu	2(3.0)	2(3.0)	3(4.5)	19(28.8)	40(60.6)
	S.M	5(3.1)	7(4.4)	13(8.2)	52(32.7)	82(51.6)
	S.F	4(3.4)	12(10.3)	12(10.3)	47(40.2)	42(35.9)
8	Co-edu			6(9.1)	35(53.0)	25(37.9)
	S.M			19(11.9)	75(47.2)	65(40.9)
	S.F			12(10.3)	73(62.4)	32(27.4)
9	Co-edu	3(4.5)	4(6.1)	4(6.1)	34(51.5)	21(31.8)

	S.M	6(3.8)	12(7.5)	25(15.7)	48(30.2)	68(42.8)
	S.F		6(5.1)	34(29.1)	56(47.9)	21(17.9)
10	Co-edu			6(9.1)	40(60.6)	20(30.3)
	S.M			24(15.1)	80(50.3)	55(34.6)
	S.F			19(16.2)	65(55.6)	33(28.2)
11	Co-edu	2(3.0)	5(7.6)	9(13.6)	32(48.5)	18(27.3)
	S.M	5(3.1)	12(7.5)	28(17.6)	67(42.1)	47(29.9)
	S.F		13(11.1)	42(35.9)	48(41.0)	14(12.0)
12	Co-edu			6(9.1)	23(34.8)	37(56.1)
	S.M		13(11.1)	42(35.9)	48(41.0)	14(12.0)
	S.F			12(10.3)	44(37.6)	61(52.1)

S.D – Strongly Disagree, D – Disagree, U – Undecided, A – Agree

S.A – Strongly Agree