AN EXAMINATION OF THE RELATIONSHIP BETWEEN CLASSROOM CLIMATE AND STUDENT MATH ACHIEVEMENT BELIZE DISTRICT HIGH SCHOOLS

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PREFACE

The purpose of the study was to examine the relationship that exist classroom climate and student math achievement. The study also sought to determine the classroom climate variables that affect student math achievement. The majority of learning environments assessments was based on students' perceptions. Students' and teacher perceptions of the learning environment could give valuable information to improve the quality of learning and can evaluate the innovation in education (Fraser, 1998). In the study the researcher concluded that: (1). the independent variable, school type was statistically significant to student math achievement scores; (2). the independent variable, gender was not statistically significant to student mathematics performance and, (3). the other climate variables contributed very little to influence students' math scores on PSE.

In the study, the sample consisted of 18 high schools and 477 students from ninth grade or first form who sat the BPSE in 2011. The population came from the Belize District schools of 2700 students that provided a randomly selected sample of 540 study participants. The researcher used a Learning Environment Inventory (LEI) by (Fraser, 1992) to collect data on classroom climate and the Belize Primary School Examination (BPSE) for 2011 in order to obtain students' mathematics scores. The study was correlation.

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CHAPTER I

INTRODUCTION

Increasing math proficiency is a global agenda. Societies understand that to succeed in a global society, a person must master math skills, as well as, critical cultural and communications skills (World View, 2006). Every career uses some sort of math. More importantly, doing math helps the mind to reason and organize complicated situations or problems into clear, simple, and logical steps. The understanding of math is essential to gain a competitive edge in many fields in today's global economy (Patton, 2010). Therefore, math is not only necessary in an increasing number of jobs, but also in any high paying job that requires the ability to do math. Students in classrooms today must be able to solve problems, think critically, interpret solutions, analyze data and formulate questions. Training in mathematics also helps students to reason logically and enable them to form clear models of problems. Math is a way to understand all sorts of things in the world (Arnold, 2003).

In Belize, strong emphasis has being placed on math proficiency. However, every year a number of students do poorly on the math in the Belize Primary School Examination (BPSE). The BPSE is a standardized exam geared at testing students' proficiency in four areas: social studies, mathematics, English, and science. Students' performance on BPSE is calculated as a percentage score from the scores of three test scores. Data from the 2009 BPSE sitting indicate that math was the subject that many students performed poorly on with the math having a mean of 46.15 and a median of 49%. This indicated that more than 50% of the 6,858 students who sat the exam in 2009 scored below 49% in math (Guardian, 2009). In the 2009 sitting of BPSE the

schools that have better resources were the performing schools in all areas which included math. These included the top private and grant-aided schools (Guardian, 2009).

School has been and continues to be a major factor in a child's education both in terms of number of hours spent and the quality of teaching (Eggen & Kauchak, 2003). Thus, teachers play an important role in promoting the required knowledge, skills and attitudes for active participation in society (Ministry of Education, 2005). At the high school level, only 31% of teachers are actually qualified by any teacher training standard (Education Statistical Digest of Belize, 2005-2006). There were cases of young, untrained teachers, deficient in content and pedagogy, often placed in the Belizean classrooms. This has created problems in specific content areas, such as mathematics, and is reflected in the country's poor national performance in both national and regional examinations. Consequently, teachers need to ensure that students learn to apply their mathematical background and procedures to solve real life problems (DeVries & Zan, 1994).

The Importance of the Classroom Environment

Classroom environment, or climate as it is often called, is important in the learning process. Kowalski (1996) defined climate as "a comprehensive structure made up of culture, physical plant, organizational structure, social relationships, and individual behaviors" (p.16). This definition implies that climate is sporadic rather than static and was affected by constant changes in the environment or outside forces within the school system. Over the past years, the classroom learning environments have emerged as a thriving field of study (Deng, 1992; Edmonds & Frederiksen, 1979; Fisher & Fraser, 1981; Walberg, 1979). Climate can positively influence the wellbeing of the learning environment, or it can significantly impede learning (Freiberg, 1998). A growing body of research showed that an important key to preventing risks

and developing healthy schools where teaching and learning occurs in a positive school climate (Cohen, 2001). Considering the importance of climate and student learning, research in these areas in Belizean schools is of great important.

Problem Statement

In Belize, the BPSE has been used as a means to measure aptitude in math and other subjects, and concerted efforts have been made to improve math scores. Presently, efforts are being made by the Ministry of Education and Youth (MOEY) to develop teacher training and acquire the necessary resources for the improvement of schools in all areas and especially in mathematics. In a 2009 Teachers' Day address, Belize's Minister of Education, Patrick Faber, announced that $20 million from the Caribbean Development Bank (CDB) will be invested in teacher training.

While many efforts have been made to improve math scores, math learning remained poor in some schools and in others there have been improvement. The BPSE results over the years consistently show math as the lowest performing subject area in the exam. Math continues to be the lowest performing subject (The Hemispheric Project for the Preparation of Policies and Strategies for the Prevention of School Failure, 2005). In Belize, performance is at a higher level on BPSE at the schools with more resources, such as private schools and grant-aided schools, (Guardian, 2009).

One possible explanation for this difference in math scores in the different schools was school climate. Positive classroom climate is important for learning to occur. Achievement is related to climate and student attitudes for primary school mathematics (Goh & Fraser, 1996). Classroom climate studies were common worldwide, but in Belize there was limited research in this area and no such data exist. In fact, there was limited research in the area of education and

other areas of research. Considering the data on BPSE math scores and the non- existence of classroom climate data there was an important need for research in these areas. Thus, the purpose of the study was to investigate the relationship between classroom climate and math achievement of students in ninth grade Belize District High schools.

Purpose Statement

The purpose of the study was to investigate the relationships between classroom climate and math achievement in ninth grade. The dependent variable in the study was student achievement and the independent variable was classroom climate.

Questions That Will Guide the Study

The following research questions guided the study:

1. What is the relationship between students' perceptions of classroom climate and mathematics achievement?
2. What is the relationship between students' perceptions of specific classroom climate factors: personalization, involvement, cohesiveness, satisfaction, task orientation, innovation and individualization, and mathematics achievement?
3. Are there differences between student math achievement and school type?
4. Are there differences between student math achievement and gender?

Null Hypotheses

H1: There is no relationship between students' perceptions of classroom climate and mathematics achievement.

H2: There is no relationship between students' perception of personalization in the classroom and mathematics achievement.

H3: There is no relationship between students' perception of involvement in the classroom and mathematics achievement.

H4: There is no relationship between students' perception of cohesiveness and mathematics achievement.

H5: There is no relationship between students' perception of satisfaction in the classroom and mathematics achievement.

H6: There is no relationship between students' perception of task orientation in the classroom and mathematics achievement.

H7: There is no relationship between students' perception of innovation in the classroom and mathematics achievement.

H8: There is no relationship between students' perception of individualization in the classroom and mathematics achievement.

H9: There is no difference between student math achievement and school type.

H10: There is no difference between student math achievement and gender.

Significance of the Study

Many factors may be used to determine the success of student math achievement. Therefore, it was important to examine the various variables that may be significant to the learning environment. Learning environments not only have positive correlation with students' outcomes, motivation, and attitudes, but also teachers' motivation (Sinclair & Fraser, 2002). Therefore, this study has the following importance:

a) It will add to the body of existing literature that relates to the classroom learning environment variables and student achievement globally;

b) Assist in the creation of much needed literature on classroom climate and student math achievement for Belize;

c) Aid in providing crucial information to policymakers for the development of policies nationally in Belize;

d) Can be used to assist policy makers to determine what changes, if any, could be made to achieve improved student math performance on the BPSE; and

e) Can also heighten educators' awareness on the importance of classroom climate and achievement in math in Belizean classrooms, as well as, determine and fill existing gaps on student math achievement.

While there were several factors that influenced student achievement, studies indicated that the teacher and the classroom climate were two of the more important factors that determined student achievement. The teacher is in the unique position to have the largest impact on student achievement (Lasley, Siedentop & Yinger, 2006). Thus, it was in these contexts that the researcher sought to conduct the study so that an evaluation of the appropriateness of specific classroom climate factors and the influence on student math performance may be examined and ascertained.

Definition of Terms

In this study, the following terms needed to be defined:

Achievement: For the purpose of this study, success in a subject area.

Belize Primary School Examination or "BPSE" refers to a national examination that is administered by the Ministry of Education to students at the end of primary education to determine achievement in relation to the primary school curriculum (Belize Education Rules, 2000).

Classroom Climate: The mood or atmosphere created by a teacher in his or her classroom.

Classroom Environment: Intellectual, social, physical, etc., conditions within or exogenous to a classroom that influence the learning situation.

Government-aided school: A school in receipt of a grant-in-aid from the Government in accordance with the provisions of the Act (Belize Education Rules, 2000).

Government Schools in Belize: Schools maintained wholly from the General Revenue (Belize Education Rules, 2000).

Mathematics Achievement: Level of attainment in any or all mathematics skills, usually estimated by performance on a test (Belize Glossary of Education, 2000).

MOEY: Ministry of Education and Youth (Belize Education Rules, 2000).

PISA: A triennial survey of the knowledge and skills of 15-year-olds. It is the product of collaboration between participating countries and economies through the organization for Economic Co-operation and Development (OECD), and draws on leading international expertise to develop valid comparisons across countries and cultures.

Private Schools - Schools which are neither a government school nor a government-aided school (Belize Education Rules, 2000).

School - An institution that provides preschool, primary or secondary education; an "institution" refers to educational institutions providing some form of schooling (Belize Education Rules, 2000).

Specially-assisted school: A school that is in receipt of aid from the Government of Belize in the form of teacher salary for one or two teachers.

Teacher: A person appointed by the manager or managing authority of a school for the purpose of instructing students (Belize Education Rules, 2000).

TIMSS: Trends in Mathematics and Science Study.

Methodology

Description of Setting and Participants

The population for the high schools in the Belize District consisted of various managing authorities. The selected schools fell into three main categories namely: government-owned, grant-aided and specially-assisted schools. Government Schools are schools that are fully funded by the government; therefore, all expenditures such as teachers' salaries, utilities and maintenance are paid for by the government. Grant-aided schools are schools that were partially funded by the government. Therefore, the government paid 70% of the teachers' salaries and gave a subsidy grant to the schools for students' tuition. Specially-assisted schools are schools that received a grant for the management to pay one or two teachers in the school. Schools were coded as Catholic, Government, Protestant and Private for analytical purposes.

The target population comprised of 18 Belize District high schools, which represent a total population of 2700 male and female students collectively. From the 18 high schools selected for the sample, one was an *all girl* institution and one was an *all boy* institution. The remaining 14 schools were co-educational institutions. The population for this study represented only the first formers who took the Belize Primary School Examination in 2011. An average class size of 30 was used since this was an average of the number of students in Belize District classrooms. Also, there was an average of five (5) first forms in each of the schools with an average total of 180 students. Therefore, the researcher randomly selected the participants for the study by selecting every 6^{th} person form each class to be a part of the survey. Therefore, each person had a fair chance of being selected to be a part of the study. The total sample

population was 540 students from the various high schools. In order to differentiate between the various types of schools, the schools were grouped into four categories: Catholic, Government, Protestant, and Private. There were eight (8) Government Schools, seven (7) Catholic, five (5) Protestant schools, and two (2) Specially-assisted or Private schools. In the study the researcher compared students' classroom climate scores with those of students' BPSE math achievement scores, who sat the BPSE in 2011 and are presently in ninth grade in Belize District High Schools.

Instrument

Learning Environment Inventory (LEI) was the instrument used in the study. The instrument was first developed by Herbert Walberg (1968) and later modified by Barry Fraser (1992). It was used to examine students' perception of the learning climate of the classroom as a part of the activities involving research and evaluation of the abovementioned Harvard Project Physics. Permission to use the instrument was obtained from Professor Barry Fraser of Curtin University in Australia.

Epistemological Perspective

In the study the positivist view was the epistemological perspective and behaviorism was the theory used by the researcher. Positivism refers a set of philosophies and perspectives that indicates the best approach to uncovering the processes by which both physical and human events occur (Watson, 1930). Behaviorism is a theory of learning based upon the idea that all behaviors are acquired through conditioning which is concerned mainly with the observable and measurable aspects of human behavior (Watson, 1930). In defining behavior, behaviorist learning emphasized changes in behavior that result from stimulus-response associations made by the learner.

Behavior is directed by stimuli. An individual selects one response instead of another because of prior conditions and psychological drives present at the moment of the action (Parkay & Hass, 2000). The behaviorist theory (Skinner, 1950) emphasizes that only behaviors worthy of study are those that can be directly observed; thus, it is actions, rather than thoughts or emotions, which are the legitimate object of study. The behaviorist learning theory was not only important in achieving desired behavior in mainstream education, but also for special education teachers who have classroom behavior modification plans to implement for their students (Standridge, 2002). Since behaviorism was also based upon observable behaviors; the researcher felt that it would have been easier to collect and quantify data when conducting the research.

Assumptions

This study assumed that different classroom climate variables would have influenced student math achievement on BPSE. The study also assumed that students would have performed differently in different types of classroom climate settings. The study further assumed that the participants of the study will complete the questionnaire honestly and in a favorable school setting that would be free from distractions.

Limitations

The limitation of a study refers to factors that a researcher was unable to control or those factors that may impact the extent to which the findings can be effectively utilized (Gay, 2000). Correlation research merely demonstrates that a researcher can predict one variable from another variable and demonstrates that two variables were associated. Correlation research may also have limitations with respect to the generalizability of the findings. Thus, it may be uncertain whether the findings of this research may be generalized to other schools, students or situations. Therefore, there were limitations that encompassed the study. One limitation was that the study

was only being done in one area of Belize which was the Belize District. Therefore, high schools in the other five remaining districts were excluded from the study and the likelihood of important data could have been excluded. Another limitation was the fact that the sample of students in the study would not be a representative sample of the entire population of the ninth grade who sat the BPSE in 2011 in the entire country of Belize. Additionally, only the math scores were used in the study although science and social studies scores were also tested on the BPSE exam. Furthermore, only seven variables were examined, although there could be other variables that could affect student math achievement.

Finally, surveys are self-reporting instrument and are subject to human error (Kaplan, 1996). Consequently, students may or may not have correctly stated a true view or perception of the nature of the classroom climate at the time that the exam was sat. Lastly, there was the time factor that may have affected the perception of the students who were answering the survey since these students were already in ninth grade when the study was conducted. However, it is worth noting that LEI has been tested consistently over the last several decades for its validity and reliability in a manner that was similar to this study.

Summary

The purpose of this study was to investigate the relationships between classroom climate and math achievement in ninth grade in Belize District High Schools. The study sought to determine if there was a relationship between classroom climate and student math achievement in grades on BPSE. Using a revised version of LEI by Fraser (1994), the researcher tried to determine the specific classroom climate variables that affect student math achievement.

As was stated previously, there was no study of this nature that has been done in the country of Belize; therefore, information derived from this study is important to the development

of classroom climate studies and math achievement studies in Belize. Thus, there was a need for this study to be conducted in Belize. The subsequent chapters of this study include: Chapter Two- Literature Review, Chapter Three - Methodology, Chapter Four- Findings and Chapter Five -Conclusions, Recommendations and Suggestions for further related research.

CHAPTER 11

LITERATURE REVIEW

The purpose of this study was to investigate the relationship between classroom climate and math achievement in the Belize District. The study was done to find out if there was relationship between classroom climate variables and student math achievement on BPSE. The researcher, through an examination of related literature seeks to present an in depth understanding of classroom climate and student math achievement. The review of literature within this chapter encompasses the following areas: the importance of math, history of math educational development, history and development of the instrument, importance of school climate, teacher qualification and student achievement, teacher attitude and student achievement, teacher effectiveness and student achievement. Summary and conclusion close the section.

The Importance of Math

Mathematics is crucial not only for success in school, but also in becoming an informed citizen, being productive in one's chosen career, and fulfilling personal something (Murnane & Levy, 1997). Learning mathematics gives the student the foundation to be successful in other content areas during a student's educational experience. According to U.S. Department of Education's white paper-, *Mathematics Equals Opportunity White Paper - October 1997,* Murnane and Levy (1996), concluded that:

- Students who take a rigorous K-12 mathematics sequence were more likely to go to college than those who do not.
- Students of all income levels who do very rigorous math courses in high school were more likely to go to college.

- In the job market, students who have strong mathematics backgrounds were more likely to be employed and earn 38% more per hour that those with insufficient skills in algebra, geometry, measurement, and probability.

In another study conducted at Londonderry High School in New Hampshire, there were several areas of focus. Findings from this study indicated that during the primary years of a student' life the focus was on learning numbers and operation, basic measurement, and basic understanding of data. In the intermediate and middle school years, greater emphasis was placed on the practice and reinforcement of basic math facts and operations and increasing. Thus, the knowledge and understanding of skills in areas such as algebra and geometry were increased. At the high school level, the focus remained on improving the fundamental mathematical concepts and skills. The students were also taught new ways to analyze data and new perspectives in algebra and geometry.

History of Math Educational Development

Over several decades, many student achievement studies were conducted on math achievement. The extents of students' opportunity to learn any content in mathematics lies heavily and bear much meaning on students' mathematic achievement (Husen, 1967). The term o*pportunity to learn* (OTL) refers to what was studied or embodied in the tasks that students perform. In math, OTL included the scope of the mathematics presented, how the mathematics was taught, and the match between the students' entry skills and new material (Grouws & Cebulla, 1992). Grouws and Cebulla (2000) conducted a study where teachers were asked to rate the extent of student exposure to particular mathematical concepts and skills. The results of this study indicated that there were strong correlations between OTL scores and mean student

achievement scores, with high OTL scores associated with high achievement. Additionally, correlations were also found in subsequent studies, such as the *Second International Mathematics Study*, (McKnight, 1987) and the *Third International Mathematics and Science Study*, (Schmidt, McKnight, & Raizen, 1997). From these studies several classroom implications were apparent, which included the need to allocate sufficient time for math instruction at every grade level. Also, of notable importance was the fact that short class periods in math, whether instituted for whatever practical or philosophical reason, should be seriously questioned. These studies also highlighted the idea that there were special concerns for 30-35 minute class periods for math that were being implemented in some middle schools during this period.

Additionally, the findings pointed out that: (a) the use of textbooks that devoted major attention to review and that address little new content each year should be avoided or be heavily supplemented with other resources; (b) teachers should use textbooks as just one instructional tool among many others instead of being a slave to the textbook on a one-section-per-day basis, and (c) whole-class discussion which followed individual and group work improved student achievement.

Wood (1999) also solidifies the fact that whole-class discussion worked best when discussion expectations are clearly understood. Therefore, students in the classroom setting were expected to evaluate each other's opinions and reasoning through ways that were not critical to the other students' sharing. Findings from this study suggested that students were expected to be active listeners who participated in discussions and feel a sense of responsibility for each others' grasp of the concept or concepts. Therefore, the class discussions must be a summary of individual work in which key ideas were brought to the surface. Thus, the use of whole-class discussion could also be an effective diagnostic tool for determining the depth of students'

understanding and identifying students' misconceptions. The study further highlights the idea that teachers could identify areas of difficulty for particular students, as well as, ascertain areas of student success or progress. Teaching mathematics with a focus on number sense encourages students to become problem solvers in a wide variety of situations and to view mathematics as a discipline in which thinking is important (Wood, 1999). His study also indicated that number sense was related to having an intuitive feel for number size and combinations, and the ability to work flexibly with numbers in problem situations in order to make sound decisions and reasonable judgments. In addition, number sense also involves mentally computing, estimating, sensing number magnitudes, moving between representation systems for numbers, and judging the reasonableness of numerical results.

Markovits and Sowder (1994) studied seventh-grade classes where special units on number magnitude, mental computation and computational estimation were taught. From this study the researchers found that after this special instruction, students were more likely to use strategies that reflected sound number sense that was a long-lasting change. In a similar study of second graders, Cobb (1991) concluded that a problem-centered curriculum that emphasizes student interaction and self-generated solution methods improved students' number sense. The findings revealed that almost every student developed a variety of strategies to solve a wide range of problems. Therefore, students displayed increased determination in trying to solve the problems. Additionally, the results of the findings further highlighted the fact that in many classrooms efforts to reinforce the use of numbers is still not being given sufficient attention. The study recommends that as teachers develop strategies to teach the use of numbers, they should strongly consider moving beyond a unit-skills approach (i.e. a focus on single skills in isolation) to a more integrated approach. The integrated approach encourages the development

of number use in all classroom activities from the development of computational procedures to mathematical problem-solving.

History and Development of Instrument

Initial development and validation of a preliminary version of Learning Environment Inventory (LEI) began in the late 1960's in conjunction with the evaluation and research of a Harvard project Physics new course for high schools (Fraser, Anderson & Walberg 1982; Walberg & Anderson 1968). Continued efforts were made over several decades by Herbert Walberg and Rudolph Moos who also started separate research programs that began additional instrument development and validation on learning environments. It was during this process that Walberg (1968) developed LEI as a part of the activities involving research and evaluation of the abovementioned Harvard project physics. The rationale for developing the instrument consisted of three very important factors that included: (1) the prohibitive expense of classroom that caused the Harvard Project Physics evaluation group to seek a paper and pencil measure of classroom interaction that teachers could administer, (2) the traditional methods of observations that included mainly " low inference" variables which bear little relationship to pupil learning in past research (Rosenshine, 1971), and (3) the pupils were considered to be in the best position to assess their own learning environment, particularly as observer ratings had failed to provide valid measures of "high inference" variables within the class. Moos (1979) and Moos and Trickett (1987) also became engaged in the development of the social climate scales, along with scales that were being used in psychiatric hospitals and correctional institutions. These scales were later known as the classroom environment scale (CES) by (Fisher & Fraser, 1983).

The final version of the LEI instrument had a total of 105 items. In the instrument the respondents were asked to express various degrees of responses. The responses included four

response alternatives: (1) *Strongly Disagree*, (2) *Disagree*, (3) *Agree,* and (4) *Strongly Agree*. In the scoring procedure some of the items were reversed in the scoring direction (or polarity). An example of this was seen in one of the *Cohesiveness* scale item: *All students know each other very well*. This item was reversed in the *Speed* scale and was stated as *the pace of the class is rushed*. In the use of the instrument, the perceptions of students were examined comprehensively. LEI are an expansion and improvement of the Classroom Climate Questionnaire (CCQ) (Blank & Kershaw, 1998). The instrument is used to describe the nature of the interpersonal relationships in the class as well as the structural characteristics.

The LEI instrument has two distinct uses: (1) to assess the perceptions of an individual student and (2) to gauge the learning environment of the class as a group. The researchers noted that if the instrument was used for the former purpose, then the normal research procedures would apply with one caution. Since individuals' scores were measures of their perceptions of the group of which they were a part, the scores of different individuals within the class were not strictly independent. Therefore, since the scores of subjects within a class all relate to common class experiences, usually then it was the variance among scores rather than the scores themselves which were of educational and psychological interest. Additionally, since the class mean provided the best estimate of the collective student perceptions of the class, it should be used when a researcher was examining different conditions or treatments across classes. Therefore, if a study was addressing variables, such as curriculum or teacher characteristics, then the appropriate unit of analysis was the class mean. However, if a study was examining variables such as pupil sex, self-concept, or personality, then individual scores will be required in this study.

As Fraser (2002) suggested, "There are six areas of research which apply to classroom environment assessments" (p. 8). These were: (1) the relationship between student outcomes and classroom environment, (2) evaluation of educational performance, (3) differences between students' and teachers' perceptions of the same classrooms, (4) determinants of classroom environment, (5) use qualitative research methods, and (6) cross-national studies. Learning environment questionnaires provide information on the measure of students' learning outcomes, students' perceptions of their learning environment indicates that "learning environment instruments essentially measure the meaningful environments for students to a given classroom" (Anderson, Hamilton, & Hatte, 2004, p. 212). This study underpins the main idea of the relationship between classroom climate and student achievement.

Importance of School Climate

Globally, research studies indicate that the culture of schools is one of the main indicators of an effective school (Deal & Peterson, 1993). School culture also affects the climate of a school and by extension, the classroom climate. Educators have also continuously forged towards developing positive school cultures and by extension positive classroom climates. School climate is the social, ethical, emotional and academic school life experiences of school personnel, students and parents of the institution (Berkowitz, 2005).

A growing body of research that shows that an important key to preventing risks and developing healthy schools where teaching and learning occurs is a positive school climate (Cohen, 2001). Blum (2002) also discusses that a safe, caring responsive and participatory school climate usually encourages greater student attachment to the institution. Blum (2002) continues that school climate also assists in the development a foundation for holistic learning and is the hallmark of an effective school.

Van Houtte (2004) advocates for some clarity on the terms school culture and school climate and the role that both of them played in research based on school effectiveness. Van Houtte (2004) presents a theoretical framework with regards to school culture indicating that there is a specific branch of organizational culture that consisted of several dimensions and levels. Thus, school climate is referred to as the next level of school culture. This study indicates that a positive school climate is present in a school when students feel a sense of acceptance, security, comfort, caring, and trust. Furthermore, in schools where there is a positive school climate, there is also a sense of belonging. Consequently, this type of culture system also maintains a positive learning environment. The former study by (Van Houtte, 2005), on school culture suggest that educators need to persistently work in an effort to improve the culture and climate conditions of schools. These findings show that if a school has a positive climate, then the classroom climate will be more than likely positive.

Significance of Classroom Climate

Classroom environment or climate research has become a popular area of study. Relevant studies encompass several areas that include student behavior, student achievement, and students' perspectives. The climate of the classroom is described as a system comprising four sets of variables: the physical involvement, the organizational objectives, and characteristics of teachers and students (Schmidt & Cagran, 2006). Classroom climate is considered to be very important since it is a determinant of quality education in schools. There is a significant relationship between classroom climate and factors such as achievement, student engagement, behavior, self-efficacy, social and emotional development, principal leadership style, stages of educational reform, teacher burnout, and the overall quality of school life (Fraser, 1998 &

Freiberg, 1999). Therefore, the need for teachers to maintain positive climates or environments in the classrooms has been continuously emphasized in schools.

There are three types of classroom climate that the teacher can use in different situations (Borich, 1996). These types include the competitive, co-operative and individualistic. In competitive classrooms, students compete with one another and are usually led by the teacher with little autonomy for students. Although competition can be motivating to students; classrooms that are led by teachers have been found to enhance student achievement. Co-operative classrooms emphasized students' co-operation along with the teacher's timely intervention to guide the students towards learning goals. These types of classrooms are also effective in the development of crucial co-operative learning skills that can enhance student achievement. Individual classrooms emphasize students' individual work with little intervention by the teacher. This type of classroom could help in the student with the development of independent learning skills. In this study, the real possibility of access to participation in the classroom is one of the most important indicators of classroom climate. The voluntary participation in the classroom is much related to the climate of it (Okolo, 2007).

Learning environment assessment not only provides information on how to measure students' performance, but also information on the teachers' competences to create positive learning outcomes. The majority of learning environments assessments is based on students' perceptions. Fraser (1998) states, "students' and teacher perceptions of the learning environment could give valuable information to improve the quality of learning and can evaluate the innovation in education" (p. 122). Therefore, the learning environment assessments could measure aspects in the classrooms such as teacher, students, teaching, and the learning process. Patterson-Rowlett (2000) conducted a study on school effects and school climate research that

revealed that school environment affects academic achievement. Rowlett found that an important aspect of the school environment is classroom climate which has been found to influence achievement, attitude, behavior, self-concept, and future aspirations.

Brown and Campione (1996) stated that "a learning environment should be managed so that students are encouraged to set personal goals, actively gather meaningful information, monitor and evaluate their own learning and reflect personal learning experiences in different authentic environments and social contexts" (p. 439). A further study by Brown and Campione (1996) showed that teachers play an important role in creating constructive learning environments which could help students achieve best performances and meaningful learning experiences. Positive classroom climate could motivate both students and teacher to learn and teach effectively. Thus a teacher who creates a positive classroom climate such as having a good relationship with students helps students to achieve their learning outcomes (Jarvela, 1998). For example, the teacher who knows how to attract students' attention by using varied and interesting teaching strategies, humor, and positive reinforcements. In this type of classroom climate the students would enjoy their learning and express their ideas and opinions.

Davis (2007) conducted a study using one hundred three ninth and tenth grade algebra students who completed self-reports of motivation, classroom climate, and learning styles preferences. A nonverbal measure of aptitude and algebra pre-test was administered at the beginning of the academic year (August, 2007) and an algebra post test was administered at the midpoint of the academic year (February, 2007). Results indicated that self-reported levels of motivation were not significant predictors for achievement in algebra classes. In the case of classroom climate, students with lower ratings for classroom involvement and higher ratings of task orientation demonstrated higher increases in achievement than students with higher ratings

of involvement and lower ratings of task orientation. Conversely, in this study a student who displayed a thinking preference achieved high scores than student with demonstrating a feeling preference. Results show that students whose perceptions and preferences are more consistent with instructional style demonstrate higher short term gains in math than students with less congruent preferences and perceptions.

The creation of a positive classroom climate in schools require a specific focus on (1) ensuring that the curriculum promotes academic, social and emotional learning, (2) improving the quality of the classroom for both teachers and students, (3) enabling intrinsic motivation that will encourage classroom teaching and learning, and (4) supporting and enabling teachers to be effective with a wide range of students (Davis, 2007). Therefore, several factors are important to create and maintain a positive classroom climate which include: (a) the meaningful participation for staff and students in the decision making processes of the school, (b) social support mechanisms for both staff and students in the institution and a welcoming, caring and hopeful atmosphere, and (c) a variety of options for pursuing and reaching goals.

In another study, Guo (2004) examined the effects of classroom climate on the relations of children's social behaviors to school adjustment. This study was among the first to make contributions to the literature by exploring the effects of such classroom climate as teacher warmth, teacher admonishment, student relationship, class order and rule clarity, respectively, on the relations of pro-social, aggressive, victimized, delinquent and withdrawn behaviors to children's school adjustment in a sample of rural Chinese school children. Participants in the study included 3059 middle school students from 37 classes of a rural area in northern China. Peer nominations were used to measure children's pro-social, aggressive, withdrawn, victimized, delinquent behaviors and peers acceptance. Classroom climate factors used included teacher

warmth, teacher admonishment, student relationship, and class order and rule clarity. These were measured by student self-reports that were aggregated into classroom variables. Student academic achievement consisted of final exam scores for Chinese, mathematics, and English. Multilevel path analyses were used to explore the effects of classroom climate on the relations between children's social behaviors, their academic achievement and peer acceptance.

The results of this study showed that children's pro-social behavior positively predicted students' academic achievement and peer acceptance, whereas aggression, withdrawal, victimization and delinquency negatively predicted these two school adjustment variables. Except for pro-social behavior, the relations of different social behaviors to school adjustment varied significantly across classes. Multilevel results showed that teacher warmth negatively predicted aggression, withdrawn, victimization and delinquency. Teacher admonishment reduced the negative relation between aggression, withdrawn, victimization, delinquency, respectively, to school adjustment variables. Student relationship reinforced the negative relations of aggression, withdrawn, victimization, delinquency, respectively to school adjustment variables. Classroom order and rule clarity also enhanced the negative relation between aggression, withdrawn, victimization, delinquency, respectively, to school adjustment.

This study also proved that classroom climate variables had little effect on pro-social behavior and its relations to school adjustment variables. The results provided different understandings of children's school adjustment that is subject to the influence of children's social behaviors and peer relationship but also to the classroom climate and cultures. Therefore, teachers and researchers need to consider classroom cultures when studying and defining desirable versus undesirable social behaviors and how these behaviors contribute to successful versus unsuccessful school adjustment of the children perceived to be similarly supportive for

both technical and university path students. The study concludes that the possible influence by teachers, schools, race, age, and grade should be viewed with caution due to some limitations within the study.

Teacher Qualification and Student Achievement

In any education system, the need for trained teachers cannot be overemphasized. Greenwald, Hedges, and Laine (1996) found through a meta-analysis of previous studies that educational resources had a major effect on student achievement and one of the most crucial variables was teacher quality. The research shows that the more experienced the teacher, the more resilient and successful are the students (Borman & Overman, 2004; Okpala, Smith, Jones, and Ellis (2000); Tajalli & Opheim, 2004). The study also found that although teacher quality issues may vary from study to study, it is important to note that there is usually the teacher certification status variable. Ferguson (1991) concluded from a research in Texas and elsewhere that, "Good teachers have distinguishable impacts on student exam scores (p. 465). Sanders (1998) stated that "the single largest factor affecting academic growth of populations of students is differences in effectiveness of individual classroom teachers" (p. 27). Associated with this growing consensus that highly skilled teachers are the key to improving student achievement is the realization that a substantial number of teachers appear to be under qualified for their current teaching positions (Ingersoll, 1999). One strategy supported by the U.S. Department of Education is to allow individuals enrolled in alternative certification programs to be designated. In general, researchers have found that possessing a major or minor in mathematics or science is related to increased student achievement in these subject areas. Goldhaber and Brewer (2000) found that students with teachers with degrees in mathematics had greater gains in achievement than students with teachers with non mathematics degrees, but researchers found no such results

for science. In a previous study, Goldhaber and Brewer (1996) also found that subject specific training in mathematics and science has a significant and positive impact on student achievement in these areas. This suggests that greater subject-matter knowledge is associated with gains in student achievement, albeit only in the areas of mathematics and science. Conclusive in this study is the fact that students perform better in Mathematics when the teachers are qualified.

Wenglinsky (2002) identified the positive outcome of learned teacher classroom practices on student achievement. Wenglinsky used the data from a 1996 National Assessment of Educational Progress (NAEP) in mathematics and found that the effects of teacher classroom practices, in union with other teacher characteristics, were as significant to student achievement in mathematics as a student's background. The study found that the degree of certain classroom practices reported by teachers had an impact on students' mathematics achievement. These practices included individualized instruction, hands-on learning and higher-order thinking skills. Additionally, Wenglinsky (2002) found that mathematics and science teachers with an undergraduate minor or major in their field elicited greater gains in student performance. In fact, Wenglinsky noted that "students whose teachers majored or minored in the subject area that they are teaching outperform their peers by about 40% of a grade level in both math and science" (p. 45).

A more recent analysis by Wenglinsky (2000), who used multilevel structural equation modeling to analyze data from the NAEP, found that teachers with a major or minor in the subject area that they are assigned to teach produce greater gains in student achievement in both mathematics and science. The overall findings from these studies suggest that teacher subject-matter knowledge positively influences student achievement. This effect seems to be more pronounced for the upper grades than the lower grades. Darling-Hammond (2000) found that the

percentage of teachers with both a subject matter major and full state certification was positively associated with a state's reading and mathematics scores on the National Assessment of Educational Progress (NAEP).

Goldhaber and Brewer (2000) also concluded that twelve-grade students taught by teachers certified in mathematics had greater gains on a mathematics assessment than students taught by either uncertified teachers or teachers certified in non mathematics subject areas. Improperly certified teachers produced lower gains in student achievement than properly certified teachers. On the other hand, there were no differences in the gains in student achievement on a science assessment between students taught by teachers certified in science and students taught by either uncertified or improperly certified teachers.

In another study, Chiang, Miller and Rowan (1997) found that students taught by teachers with mathematics major had greater gains in student achievement, although the effect on student achievement was rather small. Also a recent study by Laczko-Kerr and Berliner (2002) directly addressed the issue of the effect of teacher certification on student achievement. The researchers created matched pairs of certified and uncertified teachers. Teachers were matched based on their certification status (an uncertified teacher was matched with a certified teacher) and were matched with teachers (a) within the same school, (b) within the same district, or (c) within similar districts. This matching procedure was adopted to "minimize exogenous variables associated with student achievement scores" (Laczko-Kerr & Berliner, (2002. p. 24). Based on their analysis of the gain scores of 109 matched pairs of teachers, the authors found that students in classrooms of under certified teachers would have made 20% more growth had they been assigned to certified teachers classrooms. Research on teacher qualification and student achievement suggests that both subject-matter knowledge and pedagogical knowledge are

positively related to student achievement. Results in a study by Alexander and Fuller (2004) showed that the estimates for the 1999 Texas state achievement exam scores for students who had certified teachers compared to noncertified teachers were statistically significant. On average, students who had a certified teacher had greater gains on the mathematics exam than students who had noncertified teachers, after controlling for several variables.

Monk (1994) found that, in many cases, undergraduate coursework in mathematics pedagogy contributed more to gains in student achievement than did undergraduate coursework in mathematics. He also found that undergraduate coursework in science pedagogy was positively associated with student achievement for students in Grade 11 and that graduate coursework in science pedagogy was positively associated with student performance in Grade 10. Ferguson and Womack (1993), measuring teacher effectiveness through supervisor evaluations, realized that education coursework explained a greater proportion of the variation in evaluations than did content knowledge as measured by standardized test scores. Education coursework explained 16% of the variance in the evaluations. Thus, Monk (1994) stated that, "It would appear that a good grasp of one's subject area is necessary but not a sufficient condition for effective teaching" (p. 142). These studies are further reinforced through a Secretary of Education's report (USDOE, 2002) which states:

> Research emphasizes the importance of recruiting teachers with solid content knowledge and verbal ability, but today's certification system seems to work against the recruitment of these individuals. Of course, many teachers are smart and know their subjects well, but our system allows too many talented candidates (p. 12).

These studies succinctly summarize the importance and effect of teacher qualification on student achievement. Thus the need for qualified teachers in the education system cannot be ignored by the policymakers.

Teacher Attitude and Student Achievement

Teachers' attitudes are an important factor in determining the success of students (Grosin, 1995). Unsuitable physical environment and teacher's personality characteristics lead to student indiscipline in classrooms (Patankar & Northam, 2003). Effective teaching requires that the teacher gives the student plenty of opportunities to contribute and elaborate on their own ideas, and that he or she genuinely listens to students say and attempts to consider this from other students' perspectives. In addition, it is important that students know that there is comfort in the classrooms and that they will be treated humanely when they do contribute. Wrong answers should not provoke negative reactions on the part of the teacher, but needs to be perceived as part of the students' learning process (Patankar & Northam, 2003). In order to provide the atmosphere for optimum learning, the teacher must have the class well- organized or disciplined. Classroom guidelines are needed for routine activities and general classroom behaviors.

Lin (2002) investigated teachers' perspectives on teacher value and the relationship between teacher value and classroom climate. The research questions guiding this study were concerned with (1) identification of values important to teachers; (2) the importance of teacher value on teachers' curriculum, teaching strategy, assessment, relationship with students, and classroom climate; (3) students' evaluations of classroom climate; and (4) the correlation between teachers' perceptions and students' evaluations. The study examined the school character (public or private), as well as the teachers' gender, country, age and number of years of teaching experience. Sixteen teachers completed a survey with questions that were designed for

the purposes of this study, and 459 students completed the *College and University Classroom Environment Inventory* developed by Fraser and Treagust in 1986. The researcher collected teachers' responses and implemented the investigations with students in the classroom on a specific day. The data was analyzed using the Statistical Package for the Social Science (SPSS) Version 10.0 for Microsoft Windows. Descriptive statistics were used to summarize demographic information and teachers' perspectives on teacher value. Pearson's correlation coefficient was also used to analyze the relationship between each teacher's perceptions and students' evaluations. Descriptive statistics were used to summarize demographic information and teachers' perspectives on teacher value. Pearson's correlation coefficient was also used to analyze the relationship between each teacher's perceptions and students' evaluations. Descriptive statistics were used to summarize demographic information and teachers' perspectives on teacher value. Pearson's correlation coefficient was also used to analyze the relationship between each teacher's perceptions and students' evaluations. This study concludes that teacher value is related to positive classroom climate.

Teacher Effectiveness and Student Achievement

Teaching and learning are complex tasks. In order for students to learn effectively, they must participate fully in the learning process. Students must be encouraged to ask and answer questions, attempt new approaches, make mistakes, and ask for assistance. The effect on student learning of changing a single teaching practice may be difficult to discern because of the simultaneous effects of both other teaching activities that surround it and the context in which the teaching takes place (Grouws & Cebulla, 2000).

The number of research studies conducted in mathematics education over the past three decades has increased dramatically (Kilpatrick, 1992). In these studies there are a wide variety

of areas which include research methodologies, content and grade levels. Results from these studies, together with relevant findings from research in other areas of studies that include studies on cognitive psychology, are being used to identify successful teaching practices and strategies. Furthermore, the results of studies that have been conducted indicates that teachers who seek to improve the effectiveness of their teaching must be careful to study the context in which the delivery is done and the types of students that they teach.

Wright (2005) conducted a study on the social network analysis of middle school classrooms. In studying student- teacher relations, Wright (2005) conducted direct observations in classrooms over a year, interviewed teachers and students, and collected questionnaire data from teachers and students. By utilizing network tools, a comparison and contrast on the structural composition of classrooms and student-teacher relations was done. This systematic structured observations of classrooms over extended periods of time provided data on student-teacher social interaction that are impossible to gather using self-report studies alone. Direct observation also offers insight into the social structural mechanisms through which student productivity is constrained or enabled in the classroom. This study was one of the first of its kind to utilize formal social network theory and methods to characterize classroom social structure. The development of this study offered a new set of variables - social networks- for policy makers and educators to access in order to enhance student productivity and teacher effectiveness in the classroom.

Heilman (1999) conducted a study to investigate the combined impact of reform efforts, content coverage, the importance of grades, honor roll, and non-school interests of students' pressure for teachers to replace strategies that motivate students with strategies that promote efficiency and competition. The study examined how teachers emphasized learning or

competitive goals and regulate the purpose of the class in response to the huge number of influences that determined the classroom climate. A researcher-developed survey instrument was used to collect data from a random cluster sample of 412 students in eighteen classrooms to determine the relationship between student effort and self-perceptions of ability to theories of motivation. Scales used in the survey instrument were teacher support, teacher control, organization and rules, and task orientation; task value and self-perceptions of ability; mastery-orientation and performance-orientation; mastery evaluation and performance evaluation. Independent samples t tests were done which indicated that mastery-oriented experiences of students are related to higher levels of self-perceptions of ability, effort, support, task value, organization and rules, and promotion of self-regulation than performance-oriented class experiences ($p < .05$).

A series of analyses of variance in this study found that effort levels (high, middle, and low effort) were related to self-perceptions of ability, task value, teacher support, teacher control, task orientation, organization and rules, mastery-orientation, promotion of self-regulation, and grades ($p < .05$). Competitive classroom experiences were found to have no significant relationship to student effort. Grade level and gender were significantly related to climate variables. It also reported that ninth grade students worked significantly harder than seniors ($p < .05$) while the upperclassmen results showed higher levels of teacher support, organization and rules, and mastery orientation ($p < .05$). The study indicates that females worked harder than males and received higher levels of teacher support ($p < .05$).

Another study by Olina and Sullivan (2002) investigated the effects of teacher evaluation and the combination of teacher evaluation and student self-evaluation on student performance and attitudes. Participants in the study were 189 Latvian high school students and their six

teachers. The six teachers were assigned to one of three treatment conditions: (a) no evaluation, (b) teacher evaluation, and (c) self-evaluation plus teacher evaluation. All groups completed a 12-lesson instructional program on how to conduct experiments and produce research reports. Students in the teacher-evaluation group received teacher evaluation on their initial research reports. Students in a self-plus-teacher evaluation group self-evaluated their reports and received teacher evaluation on them. The no-evaluation group received no formal evaluation instructions. Results of this study indicated that students in the teacher-evaluation and the self-plus teacher evaluation groups received significantly higher ratings on their final projects than those in the no-evaluation group. However, the no-evaluation group had more favorable attitudes toward the program than the other two groups, while the self-plus-teacher evaluation group was significantly more confident of their ability to independently conduct future research experiments.

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significantly more confident of their ability to independently conduct future research experiments.

Therefore, short class periods in mathematics whether instituted for whatever practical or philosophical reason, should be seriously questioned. These studies highlighted the fact that there was special concern for 30-35 minute class periods for math which was being implemented in some middle schools during this period. Additional findings of the study showed that the use of textbooks that devote major attention to review and that address little new content each year should be avoided or be heavily supplemented with other resources. The findings also suggest that teachers should use textbooks as just one instructional tool among many instead of being a slave to textbooks on a one-section-per-day basis. Whole-class discussion following individual and group work improves student achievement.

Research in student math achievement also suggest that the use of whole class discussion can be effective if it is used for explaining and sharing the many ways by which individual students arrive at solutions for math problems. This kind of interaction allows students to view the various ways of examining a situation and the diversity acceptable solutions to specific problems. Teaching mathematics with a focus on number sense encourages students to become problem solvers in a wide variety of situations and to view mathematics as a discipline in which thinking is important. Number sense relates to having an intuitive feel for number size and combinations, and the ability to work flexibly with numbers in problem situations in order to make sound decisions and reasonable judgments. It involves mentally computing, estimating, sensing number magnitudes, moving between representation systems for numbers, and judging the reasonableness of numerical results. Teaching mathematics with a focus on number sense encourages students to become problem solvers in a wide variety of situations and to view

mathematics as a discipline in which thinking is important. Number sense relates to having an intuitive feel for number size and combinations, and the ability to work flexibly with numbers in problem situations in order to make sound decisions and reasonable judgments. It involves mentally computing, estimating, sensing number magnitudes, moving between representation systems for numbers, and judging the reasonableness of numerical results. Markovits and Sowder (1994) studied seventh-grade classes where special units on number magnitude, mental computation and computational estimation were taught. Through this study it was found that after this special instruction, students were more likely to use strategies that reflected sound number sense, and that this was a long-lasting change.

Results showed that almost every student developed a variety of strategies to solve a wide range of problems. Students also displayed increased determination in trying to solve the problems. However, the findings also highlighted the fact that in many classrooms efforts to reinforce the use of numbers are still not given sufficient attention. Therefore, the study recommended that teachers develop strategies to teach the use of numbers, they should strongly consider moving beyond a unit-skills approach (i.e. a focus on single skills in isolation) to a more integrated approach that encourages the development of number use in all classroom activities, from the development of computational procedures to mathematical problem-solving.

Summary

This review of the literature on classroom climate and student math achievement indicates that there is a unified trend towards the promotion of the creation of suitable classroom climate for students that will influence student achievement in content areas. Classroom climate plays a vital role in the student achievement. The literature also points to the fact that the classroom climate factors such as school climate, teacher and student attitude and teacher

qualification are part of the many areas that affect student achievement in schools. This review highlighted several studies that clarify the vital role that the teacher plays in fostering a positive classroom climate along with student success and achievement in schools.

However, while there is also a great deal of agreement that classroom climate is important for achievement; there are still other areas to be investigated. Unsuitable physical environment and teacher's personality characteristics lead to student indiscipline in classrooms (Patnakar, 2007). The review of literature has also underscored the need for LEI to be used in this study. This research was an effort to determine the relationship between classroom climate and student achievement and has, no doubt, created literature on classroom climate for Belize and added to the body of research that exist globally.

CHAPTER 111

METHODOLOGY

This chapter gives a description of a proposed study design that will seek to determine if a relationship exists between classroom climate and student math achievement along with the variables that affect such relationship. The following sections are included in this chapter: purpose statement, the questions and hypotheses, a description of high schools in Belize, participants and sample size, a description of the instrument, and the research design and procedures. An explanation on ethical considerations and a summary are also included in this chapter.

Purpose Statement

The purpose of the study was to investigate the relationships between classroom climate and math achievement in ninth grade in Belize District high schools. The study also sought to determine the classroom climate factors that influence student math achievement of in ninth grade in Belize District High Schools. The dependent variable in the study is student achievement and the independent variable is classroom climate.

Research Questions and Hypotheses

The following research questions will guide the study:

1. What is the relationship between students' perceptions of the classroom climate and mathematics achievement?
2. What is the relationship between students' perceptions of specific classroom climate factors and mathematics achievement?
3. Are there differences between students' PSE Mathematics scores and gender?
4. Are there differences between students' PSE Mathematics scores and school type?

H1: There is no difference between students' perceptions of classroom climate and math achievement.

H2: There is no difference between students' perceptions of specific classroom climate factors and mathematics achievement.

H3: There is no difference students' perception of personalization and mathematics achievement.

H 4: There is no difference students' perception of involvement and mathematics achievement.

H5: There is no difference between students' perception of cohesiveness and mathematics achievement.

H6: There is no difference between students' perception of satisfaction and mathematics achievement.

H7: There is no difference between students' perception of task orientation and mathematics achievement.

H8: There is no difference between students' perception of innovation and mathematics achievement.

H9: There is no difference between students' perception of individualization and mathematics achievement.

H10: There is no difference between PSE Math Achievement Scores and gender.

H 11: There is no difference between students' PSE Math Achievement Scores and school type.

Belize District High Schools

High schools are located throughout the country of Belize and vary in location, population and managing authorities. Presently there are 49 high schools in the country of Belize. According to the Education Statistical Digest of Belize (2005- 06) the total number of secondary schools increased by 13 schools from 36 in 2001-02 to 49 in 2005-06. These 49 schools are a reflection of the entire high school population in the six districts of Belize namely: Orange Walk and Corozal Districts in the north, Stann Creek and Toledo Districts in the south, Cayo District in the west, and Belize District in the east. The Belize District is also inclusive of the Caye – San Pedro and Caye Caulker. However, it must be noted that two recently opened high schools are not accounted for in the previous data which brings the total to 18 high schools. The high school populations range from 90 students in one school to over 800 students in others. Students from these various high schools also come from various ethnic groups and backgrounds.

Besides location and population, high schools in country of Belize also differ in the type of managing authorities which include the government, churches, and private entities. For the purpose of this study, only the 18 high schools in the Belize District were used. A total of 13 of these high schools are located in the urban portion of the district, three in the rural area, one San Pedro, and one in Caye Caulker.

Participants

The target population that was studied includes 18 Belize District High Schools which represent a total population of 2700 male and female students collectively. Students were from various socio-economic backgrounds across the country in Belize also represent a wide cross section of the various ethnic groups in Belize. These included the Creole, Mestizo, Garifuna,

East Indian and Maya. Two of the proposed institutions that were selected for the sample were *all girl* institutions and one was an *all boy* institution with the other 15 being co-educational institutions. The number of high school in the Belize District is small; therefore, the researcher used all of the 18 high schools to obtain a random sample. This sample was indicative of the students to whom the survey instrument was distributed. For the study 540 questionnaires were issued and 477 were received. A response rate of 88% was received.

Description of Instrument

In the study a customized version of The Learning Environment Inventory (LEI) first developed by Herbert Walberg (1968) and later modified by Barry Fraser (1992) to examine students' perception of the learning climate of the classroom was used. The quantitative instrument was tested and used in several classroom climate studies in the past. The participants were students who sat the BPSE in 2011 at the grade eight levels and are presently in grades nine at high school. However, the same seven classroom climate variables- personalization, involvement, student cohesiveness, satisfaction, task orientation, innovation and individualization were used in the study.

Reliability and Validity

Several studies have been done to test and re-test the instrument that was used in this study. These studies include *The Harvard Project Physics* (1962- 72) that required the development of an instrument to assess learning environments in physics classrooms. This instrument was the start of the initial development and testing of Learning Environment Inventory (LEI) (Walberg, 1968), where students were asked to report their perceptions of the whole-class environment. Moos and Trickett (1974) later developed a series of environment measures which concluded with the Classroom Environment Scale (CES). CES was also used to

ask students for their perceptions of the learning environment of classrooms. Two questionnaires provided considerable milestone for the study of classroom learning environments, were used extensively for a variety of research purposes, and provided models for the development of a range of instruments over the next two decades. This set of studies also influenced Fraser, Giddings and McRobbie (1992) to propose a different form of a learning environment instrument to investigate students' personal perception of their role in the environment of the classroom rather than students' perception of the learning environment in the class as a whole. These two forms are the *personal form* and the *class form.* Later, there was the development of Classroom Climate Inventory (1986) and subsequently Learning Climate Inventory (1992) by Barry Fraser. Wong & Fraser (1996) further validated the instrument by administering the Personal Form to 1,592 grade 10 chemistry students in 56 classes in Singapore. Therefore, since the LEI was validated and proven reliable over several years of testing, the researcher used the instrument in its original form. Thus, the researcher did not alter the instrument in anyway. This guaranteed the validity and the reliability of the instrument in the conducting of the research.

Description of Survey

The Learning Climate Inventory survey is comprised of 49 items for the participants to answer. The survey has a range of four answers which include the following: SA = *Strongly Agree*, A = *Agree*, D = *Disagree* and SD = *Strongly Disagree*.

A score sheet accompanies the survey that divides the required item into seven categories that are clearly defined. These categories include the following:

1. Personalization- emphasizes opportunities for students to interact with the instructor and the instructor's concern for student' personal welfare;

2. Involvement - assesses extent to which students participate actively and attentively in class discussions and activities;

3. Student Cohesiveness looks at the extent to which students know, help and are friendly toward each other;

4. Satisfaction measures the degree of enjoyment of classes;

5. Task Orientation considers the extent to which class activities are clear and well organized;

6. Innovation is the extent to which the instructor plans new and unusual class activities, teaching techniques, and assignments; and

7. Individualization is the extent to which students are allowed to make decisions and are treated differently according to ability, interest and rate of working.

The score sheet also had some underlined items that were calculated from the responses of the participants using a specific formula for each range. This survey was appropriate for this study since it specifically addressed the classroom climate variables that the researcher examined.

Research Design and Procedure

Research design is important because it describes what actions need to be taken in research to continue, to assess, and to evaluate advancement. A clear plan of actions represents success in the study. For the purpose of this study a survey on classroom climate variables was used to gather the data. The quantitative approach is the design that was used since it is easier to collect, simplify and analyze data using this method. This data was used to determine if a correlation existed between classroom climate scores and student BPSE math achievement in Belize District high schools. This study was not used to determine cause or effect.

The purpose of the study was to investigate the relationships between classroom climate and math achievement in ninth graders who were eight graders when they sat the BPSE. The dependent variable in the study was student math achievement and the independent variable was classroom climate. Data for this study was gathered using the seven independent variables of LEI (personalization, involvement, student cohesiveness, satisfaction, task orientation, innovation, and individualization) and the dependent variable (BPSE math score). Existing data from the 2011 BPSE sitting was used to correlate with the data gathered from the instrument. In this study, data on gender and school type was also collected due to the coding of the high schools.

High Schools Selection

In this study, the researcher used only 18 high schools in the Belize District. The Belize District has the largest high school population of the 49 high schools across the entire country. The sample was drawn from all of the high schools that fell within the Belize District. Managements for the high schools ranged from grant- aided/ church state to government and privately owned status. Three of the proposed high schools are situated in the rural section of the Belize District, two are in the Cayes, and the other 14 are in Belize City.

Participants Selection

The researcher proposes to use a sample of 540 Belize District High School students from the total target population of (N= 2700) students. The sample was drawn from the total list of high schools in the Belize District. This was done so that the researcher can get a narrow, homogeneous or uniform sample that will make data collection and data analysis easy and simple. Once the sample was drawn, a random selection was done. Every participant was given a fair and equal chance to participate in the study. At the high school 30 surveys were

distributed to the participants through the principals at the school. A consent form was placed with each survey for each participant to take home in order for the participants to obtain permission from the parent or guardian to voluntarily participate in the study. The students were given LEI survey to answer. The surveys were collected one week after distribution. An appropriate day and date was arranged with the principals of the 18 high schools to collect the surveys from the institution in order to have started the data analysis process. The LEI has been used in this manner several times over the past two decades (Fraser, 1989; Fraser, 1987; Moos & Trickett, 1987 and Walberg, 1968). Therefore, the time frame for the data to be collected was suitable for the study.

Ethical Considerations

The researcher also ensured the adherence to the ethical standards and guidelines concerning the involvement of human subjects. Permission was obtained from Human Subject Research Board (HSRB) from Oklahoma State University to guarantee that the process of data collection was valid. Protecting participants' information was also required, hence personal data was kept confidential and their identities remained anonymous. The researcher ensured that the participants knew that any information given was kept confidential and that their participation would have been voluntary. Thus, the participants could have chosen to discontinue their participation at any time during the data collection process if they so desired. The safety of the participants was of utmost importance so that any intention of harm and maliciousness against the participants was prevented.

Additionally, the names of participating institutions were kept anonymous through the use of a coding system. Gay and Airsaian (2000) indicate that the use of descriptive designs in a study involving human subjects in real life situations, where events have already occurred,

reduce the chance of the researcher to influence the participants because the researcher will not be in direct contact with the participants of the study. Lack of the direct contact led to more credible data collection and the increased validity of the data on classroom climate and student achievement.

Data Analysis

The data in this study was analyzed using descriptive statistics. The Pearson product-moment correlations, multiple regression analysis, and analysis of variance (ANOVA) tests were used in the data analysis. These tests were used in order to investigate the relationships between classroom climate perceptions and learning outcomes using LEI and the mathematics scores from the 2011 (PSE). Several steps were employed. First, the ANOVA test was performed to determine if there is a significant difference between levels of means of the independent variables. Next, a Pearson product-moment correlation between the classroom climate variables studied and the PSE math achievement scores was obtained. Therefore, the means of the LEI scores, which include personalization, involvement, student cohesiveness, satisfaction, task orientation, innovation and individualization, were compared to the total means of the overall students' BPSE math scores. Finally, a multiple regression analysis was done in order to verify whether a combination of classroom climate variables determined the predictive power of BPSE math achievement.

Summary

The purpose of the study was to investigate the relationships between classroom climate and students' math achievement in 18 high schools in the Belize District. A random sample was drawn from the target population (N=2700). The total number of proposed participants was 540 students. The researcher used a tested instrument, the LEI, which aided in the collection of valid, reliable and necessary data for the analysis. The study was aimed at looking at correlation to

determine whether a relationship, if any, between the classroom climate variables and student math achievement existed. The data informed the development of graphs and tables to explain findings and solidify the study. The Statistical Package for the Social Sciences (SPSS) 19.0 by Nie (1968) was used to represent the statistical data in a form of graphs and tables for this proposed study.

CHAPTER 1V

FINDINGS

Chapter four discusses the results of the study on classroom climate and student math achievement. The purpose of study, sample population, design and findings are discussed.

Population

The population for the high schools in the Belize District consisted of various managing authorities. The selected schools fell into three main categories namely: government-owned, grant-aided and specially-assisted schools. Government Schools are schools that are fully funded by the government; therefore, all expenditures such as teachers' salaries, utilities and maintenance are paid for by the government. Grant-aided schools are schools that were partially funded by the government. Therefore, the government paid 70% of the teachers' salaries and gave a subsidy grant to the schools for students' tuition. Specially-assisted schools are schools that received a grant for the management to pay one or two teachers in the school. Schools were coded as Catholic, Government, Protestant and Private for analytical purposes.

The target population comprised of 18 Belize District high schools, which represent a total population of 2700 male and female students collectively. From the 18 high schools selected for the sample, one was an *all girl* institution and one was an *all boy institution*. The remaining 14 schools were co-educational institutions. The population for this study represented only the first formers who took the Belize Primary School Examination in 2011. An average class size of 30 was used since this was an average of the number of students in Belize District classrooms. The sample for this study was purposive and random. Therefore, the sample from the population was a total of 540 students from the various high schools. A total of 30 students

were sampled from each high school. In order to differentiate between the various types of schools, the schools were grouped into four categories: Catholic, Government, Protestant, and Private. There were eight (8) Government Schools, seven (7) Catholic, five (5) Protestant schools, and two (2) Specially-assisted or Private schools. In the study the researcher compared students' classroom climate scores with those of students' BPSE math achievement scores, who sat the BPSE in 2011 and are presently in ninth grade in Belize District High Schools.

Purpose of the Study

The purpose of the study was to investigate the relationships between classroom climate and math achievement in ninth grade. The dependent variable in the study was student achievement and the independent variable was classroom climate.

Design of Study

Research design is important because it describes what actions need to be taken in research to continue, to assess, and to evaluate advancement. For the purpose of this study a survey on classroom climate variables was used to gather the data. The quantitative approach is the design that was used since it is easier to collect, simplify and analyze data using this method. This data was used to determine if a correlation existed between classroom climate scores and student BPSE math achievement in Belize District high schools. This study was not used to determine cause or effect.

Assumptions of One-way ANOVA

The following are the assumptions of a one-way ANOVA that was first used to analyze the data:

1) An independent variable consists of two or more categorical independent groups. In this study the independent variable was sex and this had two groups namely: male and female;

2) A dependent variable is either interval or ratio (continuous). The PSE math achievement was the dependent variable and is a ratio or continuous variable; and 3) a dependent variable is approximately normally distributed for each category of the independent variable. An assessment of the normality of data is a prerequisite for many statistical tests as normal data is an underlying assumption in parametric testing. There are two main methods of assessing normality - graphically and numerically. The following methods were used to determine whether the data was normal and if this assumption was met in the data for the statistical tests.

The approaches were divided into two main themes: relying on statistical tests or visual inspection. Statistical tests have the advantage of making an objective judgment of normality, but are disadvantaged by not being sensitive enough at low sample sizes or overly sensitive to large sample sizes. As such, some statisticians prefer to use their experience to make a subjective judgment about the data from plots/graphs. Thus, graphical interpretation has the advantage of allowing good judgment to assess normality in situations when numerical tests might be over- or under- sensitive. However, graphical methods may also lack objectivity. Conversely, since the researcher did not have a great deal of experience interpreting normality through graphs, the best option was to use the numerical methods.

Research Question 3

Are there differences between student math achievement and school type?

Table 1 below presents the results from two well-known tests of normality, namely the Kolmogorov-Smirnov Test (1967) and the Shapiro-Wilk Test (1965). The researcher used both the Shapiro-Wilk Test and the Kolmogorov-Smirnov Test as the numerical means of assessing normality.

Table1. Test of Normality

Tests of Normality

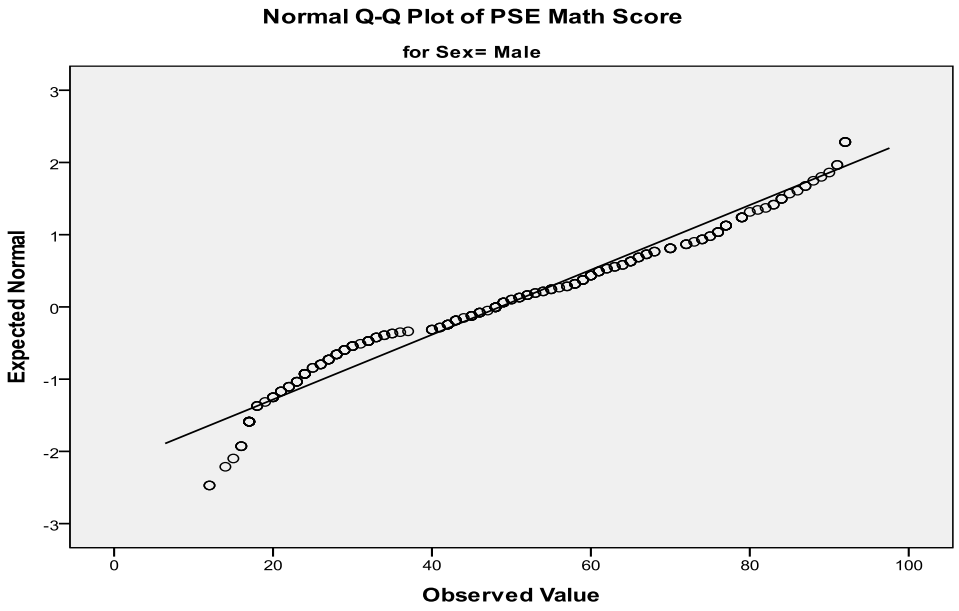
	Sex	Kolmogorov-Smirnova			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
PSE Math Score	Male	.100	222	.000	.954	222	.000
	Female	.097	255	.000	.961	255	.000

The table above shows that the PSE math achievement scores for each male and female group were not normally distributed. If the significance value of the Shapiro-Wilk test (Shapiro & Wilk, 1965) or the Kolmogorov-Smirnov test (Chakravarti, Laha & Roy, 1967) is greater than 0.05, then the data is normal for each category. If it was below 0.05, then the data significantly would deviate from a normal distribution.

Normal Q-Q Plot

In order to determine normality graphically, the researcher used the output of a normal Q-Q Plot. In the Q- Q Plot, if the data were normally distributed, then the data points will be close to the diagonal line. Conversely, if the data points stray from the line in an obvious non-linear fashion, then the data are not normally distributed. In the Q- Q Plot below the data is not normally distributed. This is easily seen by using the numerical methods since the normality of data based on plots is difficult to determine

Figure1.0. Normal Q-Q Plot of PSE Math Score



The one-way ANOVA is considered to be a robust test against the normal assumption. This means that it tolerates violations to its normality assumption rather well. In regards to the normality of group data, the one-way ANOVA can tolerate data that is non-normal (skewed or kurtotic distributions) with only a small affect on the Type I error rate. Equality of variances between the independent groups (homogeneity of variances). One of the assumptions of the one-way ANOVA is that the compared variances of the groups are similar. Table 2 Test of Homogeneity of Variances shows the result of Levene's test of homogeneity of variance, which tested for similar variances. It is noteworthy that if the significance value is greater than 0.05 (found in the significance column), then there is homogeneity of variances. Because Levene's *F* statistic had a significance value of 0.094 (which is more than 0.05), the assumption of Homogeneity of Variance was met.

Table 2.Test of Homogeneity of Variances

Test of Homogeneity of Variances

PSE Math Score

Levene Statistic	df1	df2	Sig.
16.878	3	473	0.094

Results and Analysis of One-way ANOVA

The descriptive table (see Table 3 below) provides some very useful descriptive statistics including the mean, standard deviation and 95% confidence intervals for the dependent variable (PSE math achievement scores) for each separate group (male and female) as well as, when all groups are combined (total). These figures are useful for the researcher to describe the data.

Table3. Descriptive Statistics on PSE Math Scores and Sex

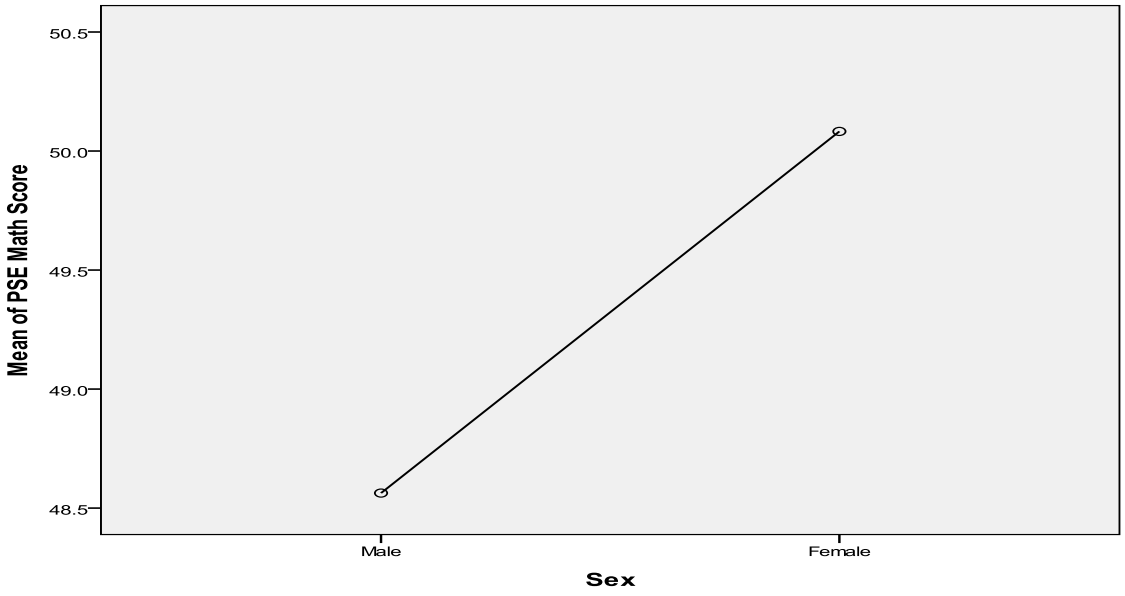
Descriptive Statistics on PSE Math Scores and Sex

PSE Math Score

Content Area	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Male	222	48.6	22.290	1.496	45.6	51.5	12.0	92.0
Female	255	50.1	21.985	1.377	47.4	52.8	11.0	95.0
Total	477	49.4	22.117	1.013	47.4	51.4	11.0	95.0

The Descriptive Statistics table above (Table 3) and the Means Plot Graph (Figure: 1.1) below showed that female students reported higher mean in PSE math achievement scores compared to male students.

Figure1.1. Means Plot of PSE Math Scores and Sex



Results of the ANOVA

The one-way between subjects ANOVA tests were conducted to examine whether there were significant differences in the mean PSE math achievement scores in sex (male and female) group means. These tests proved that there was no significant difference in the PSE math achievement scores between male (M = 48.6, SD = 22.290) and female (M = 50.1, SD = 21.985) Sex group; F (1, 475) = 0.560, p = 0.455. These results suggested that male students have PSE Math Achievement Scores that were not significantly different from female students.

Research Question 4

Are there differences in PSE math achievement scores between school types in schools?

The assumptions of a one-way ANOVA in this question indicate that:

1) The independent variable consists of two or more categorical independent groups. Independent variable is school type and this has 4 groups namely Catholic, Government, Pentecostal and Private Schools;

2) The dependent variable is either interval or ratio (continuous). PSE Math Achievement Scores is the dependent variable and is a ratio or a continuous variable; and

3) Dependent variable is approximately normally distributed for each category of the independent variables.

Table 4. Tests of Normality for School Type and PSE Score

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	School Type	Statistic	df	Sig.	Statistic	df	Sig.
PSE Math Score	Catholic	.106	86	.018	.960	86	.009
	Government	.162	224	.000	.904	224	.000
	Pentecostal	.076	136	.052	.985	136	.134
	Private	.120	31	.200	.952	31	.183

a. Lilliefors Significance Correction
This is a lower bound of the true significance.

Table 4 shows that the PSE math achievement scores for each group of school type was not normally distributed. How do we know this? If the significance of the Shapiro-Wilk test or the Kolmogorov-Smirnov test is greater the 0.05, then the data is normal for each category. If it is below 0.05 then the data significantly deviates from the normal distribution. In this case, Catholic and Government school type groups were not normally distributed; hence the assumption of normality was not met. However, the one-way ANOVA is considered a robust Test against the normality assumption. This means that it tolerates violations to its normality assumption rather well and, thus the reason why the researcher used this test.

Equality of Variances between the Independent Groups (homogeneity of variances)

One of the assumptions of the one-way ANOVA is that the variances of the groups that are being compared are similar. Table 5 below shows the test of homogeneity of variances

shows the result of Levene's test of homogeneity of variance, which tests for similar variances. If the significance value is greater than 0.05 (found in the **Sig.** column below), then there is homogeneity of variances. In the test, in Table 5, the Levene's *F* statistic had a significance value that was less than 0.001 and, therefore, the assumption of homogeneity of variance was met.

Table 5. Test of Homogeneity of Variance

Test of Homogeneity of Variances

PSE Math Score

Levene Statistic	df1	df2	Sig.
16.878	3	473	0.094

Robust Tests of Equality of Means Table

Even though there was a violation of the assumption of homogeneity of variances, the researcher used the traditional ANOVA by using the Welch test (Shapiro & Wilk, 1965). This was done in order to determine whether there were significant differences between the groups. Like the ANOVA test, if the significance value is less than 0.05, then there are statistically significant differences between groups. Hence, then there were statistically significant differences between school type groups since the p value in the Welch test was less than 0.05 ($p < 0.001$).

Table 6. Robust Tests of Equality of Means

Robust Tests of Equality of Means

PSE Math Score

	Statistic[a]	df1	df2	Sig.
Welch	125.811	3	151.155	.000

a. Asymptotically F distributed.

Independence of cases – This assumption is that data from different subjects are independent, which means that the behavior of one participant does not influence the behavior of another.

Results and Analysis of One-way ANOVA

Descriptive Statistics

The descriptive statistics table (see Table 7 below) provided some very useful descriptive statistics including the mean, standard deviation and 95% confidence intervals for the dependent variable PSE math achievement scores for each separate group of *School Type* (Catholic, Government, Pentecostal and Private Schools) as well as, when all groups were combined.

Table 7. Descriptive Statistics on PSE Math Scores and School Type

Descriptive Statistics on PSE Math Scores and School Type

PSE Math Scores

School Type	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Catholic	86	64.3	19.749	2.130	60.10	68.57	16	95
Government	224	40.6	21.136	1.412	37.79	43.36	11	87
Pentecostal	136	47.8	16.109	1.381	45.08	50.55	12	92
Private	31	78.3	8.537	1.533	75.16	81.42	60	91
Total	477	49.4	22.117	1.013	47.39	51.37	11	95

The descriptive statistics table above and the means plot below showed that students from private schools reported higher mean of math achievement scores than students from Catholic,

Pentecostal and Government Schools. Students from Catholic Schools reported higher mean of PSE math achievement scores than students from Pentecostal and Government Schools. Students from Pentecostal Schools reported higher mean of PSE math achievement scores than students from Government Schools.

Figure1.2. Graph of Mean of PSE Math Scores and School Type

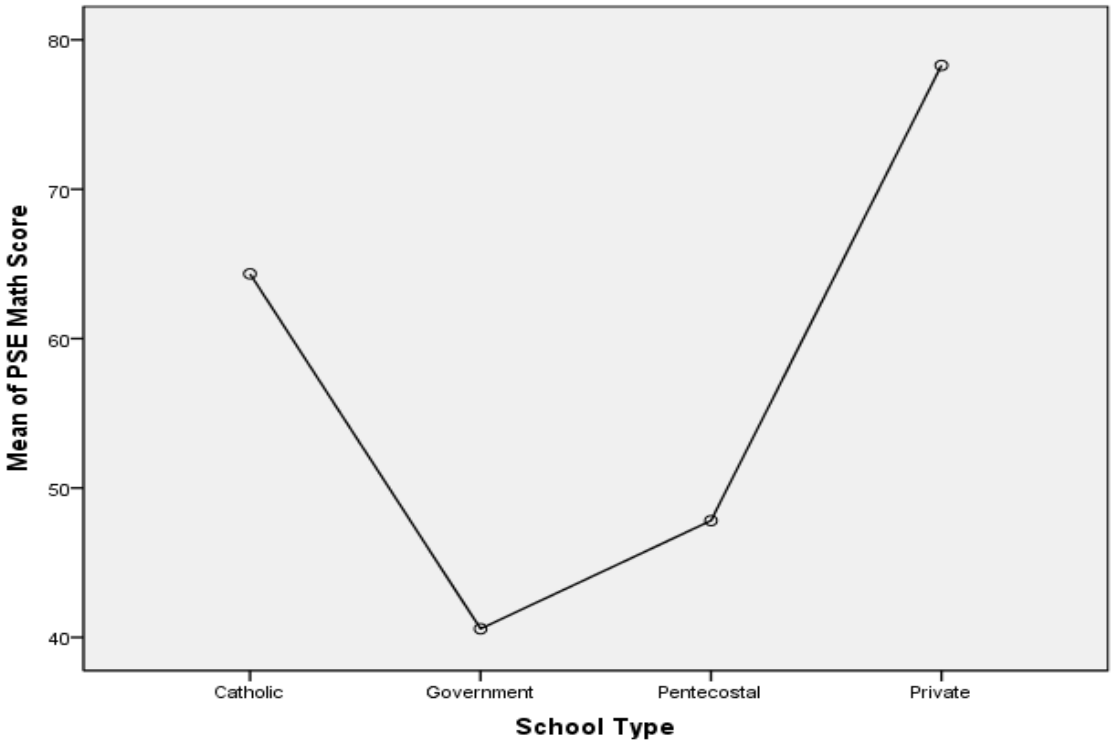


Table 8. PSE Math Score between Groups and Within Groups ANOVA

ANOVA

PSE Math Score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	62845.106	3	20948.369	58.288	.000
Within Groups	169992.722	473	359.393		
Total	232837.828	476			

The ANOVA table above shows the output of the ANOVA analysis and tells if there was a statistically significant difference in the PSE achievement math scores among school type (Catholic, Government, Pentecostal and Private Schools) group means. In this table the significance level is 0.000 (i.e. $p < 0.001$), which is less than 0.05 and, therefore, there is a statistically significant difference in the PSE achievement scores among school type groups.

Multiple/ Pair-Wise Comparisons

From the previous results there were significant differences in PSE math achievement scores from different school type groups as a whole. Table 9 below, Multiple Comparisons, shows which groups significantly differed from each other. The Games Howell test (Keppel & Wickens, 2004) is a generally preferred test for conducting post-hoc tests in a one-way ANOVA when the assumption of homogeneity of variance has been violated. The table below indicates that there is a significant difference in PSE math achievement scores between Catholic and Government Schools, Catholic and Pentecostal Schools ($p < 0.001$), Catholic ($p < 0.001$) and Private Schools ($p < 0.001$), Government and Pentecostal Schools ($p=0.002 < 0.05$), Government and Private Schools ($p < 0.001$) and Pentecostal and Private Schools ($p < 0.001$).

Table 9. Multiple Comparisons of PSE Math Score and School Type

Multiple Comparisons

PSE Math ScoreGames-Howell

(I) School Type	(J) School Type	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Catholic	Government	23.761*	2.555	.000	17.13	30.39
	Pentecostal	16.521*	2.538	.000	9.93	23.11
	Private	-13.953*	2.624	.000	-20.80	-7.11
Government	Catholic	-23.761*	2.555	.000	-30.39	-17.13
	Pentecostal	-7.240*	1.975	.002	-12.34	-2.14
	Private	-37.714*	2.085	.000	-43.17	-32.26
Pentecostal	Catholic	-16.521*	2.538	.000	-23.11	-9.93
	Government	7.240*	1.975	.002	2.14	12.34
	Private	-30.474*	2.064	.000	-35.88	-25.07
Private	Catholic	13.953*	2.624	.000	7.11	20.80
	Government	37.714*	2.085	.000	32.26	43.17
	Pentecostal	30.474*	2.064	.000	25.07	35.88

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

Results of the ANOVA

The one-way ANOVA test was conducted to examine whether there were statistically significant differences among students in different school types in relation to their PSE math achievement scores. There was at least one statistically significant difference between groups as determined by one-way ANOVA (F (3, 473) = 58.288, $p < 0.001$). A Games Howell post-hoc test (Keppel & Wickens, 2004) revealed that there were statistically significant differences between students PSE math achievement scores from Catholic (M = 64.3, SD = 19.749) ($p <$ 0.001) and those Government Schools (M = 40.6, SD = 21.136) ($p < 0.001$), Catholic (M = 64.3, SD = 19.749) and Pentecostal Schools (M = 47.8, SD = 16.109) ($p < 0.001$), Catholic (M = 64.3, SD = 19.749) and Private Schools (M = 78.3, SD = 8.537) ($p < 0.001$), Government (M = 40.6, SD = 21.136) and Pentecostal Schools (M = 47.8, SD = 16.109) ($p < 0.001$), Government (M =

40.6, *SD* = 21.136) and Private Schools (*M* = 78.3, *SD* = 8.537) ($p < 0.001$) and Pentecostal (*M* = 8.1, *SD* = 2.040) and Private Schools (*M* = 78.3, *SD* = 8.537) ($p < 0.001$).

From the results of the data the researcher concluded that the students from Private Schools reported significantly higher PSE math. Research design is important because it describes what actions need to be taken in research to continue, to assess, and to evaluate advancement. A clear plan of actions represents success in the study. For the purpose of this study a survey on classroom climate variables was used to gather the data. The quantitative approach is the design that was used since it is easier to collect, simplify and analyze data using this method. This data was used to determine if a correlation existed between classroom climate scores and student BPSE math achievement in Belize District high schools. This study was not used to determine cause or effect.

Students from Private schools reported significantly higher math achievement scores than students from Catholic, Pentecostal and Government, Schools. In addition students from Catholic Schools reported significantly higher math achievement scores than students from Pentecostal and Government Schools. Furthermore, students from Pentecostal Schools reported significantly higher math achievement scores than students from Government Schools.

Pearson Product Moment Correlation

In this section of the analysis, the bivariate analysis first looked at bivariate relationships between the dependent variable, PSE math achievement scores and each independent variables (i.e. personalization, involvement, student cohesiveness, satisfaction, task orientation, innovation, individualization, school type and sex) using Pearson product-moment correlation, point- biserial correlation and eta correlation (Rosenthal, Rosnow & Rubin, 2000). These

coefficients were selected because the data were quantitative (continuous) and quantitative (categorical).

The Pearson product-moment correlation coefficient measured the degree (strength of the relationship – i.e. weak, moderate, strong or independent [i.e. no relationships]) to which two continuous variables vary (direction of the relationship) together (i.e. direct or positive relationship) or oppositely (inverse or negative relationship). Pearson Research design is important because it describes what actions need to be taken in research to continue, to assess, and to evaluate advancement. A clear plan of actions represents success in the study. For the purpose of this study a survey on classroom climate variables was used to gather the data. The quantitative approach is the design that was used since it is easier to collect, simplify and analyze data using this method. This data was used to determine if a correlation existed between classroom climate scores and student BPSE math achievement in Belize District high schools. This study was not used to determine cause or effect.

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The product-moment correlation coefficient was chosen as a correlation coefficient because it was suitable for variables that were continuous (i.e. interval or ratio type). Additionally, point-biserial correlation coefficient measured the degree to which two variables

vary together and are used when one of the two variables is truly dichotomous (Rosenthal, Rosnow, & Rubin, 2000). A truly dichotomous variable is a categorical variable with two (2) levels and there is no underlying continuum between the categories (e.g. sex). Thus, the point-biserial correlation coefficient is related to a Pearson product-moment correlation coefficient since point-biserial correlation coefficient is equal to the Pearson product-moment correlation coefficient when the dichotomous variable was coded with different values. Eta is a coefficient of nonlinear association correlation coefficient measures of the strength of a relationship between a continuous dependent variable and a categorical (nominal, ordinal, or grouped interval) independent variable. Like the point-biserial correlation coefficient, the eta correlation coefficient is related to the Pearson product-moment correlation coefficient because for linear relationships, eta equals the Pearson product-moment correlation coefficient.

After computing the correlation coefficients for each pair of variables, the bivariate analysis then examined the coefficient of determination, which is the square of each of the correlation coefficients used in this study (i.e. Pearson product-moment correlation, point-biserial research design is important because it describes what actions need to be taken in research to continue, to assess, and to evaluate advancement. A clear plan of actions represents success in the study. For the purpose of this study a survey on classroom climate variables was used to gather the data. The quantitative approach is the design that was used since it is easier to collect, simplify and analyze data using this method. This data was used to determine if a correlation existed between classroom climate scores and student BPSE math achievement in Belize District high schools. This study was not used to determine cause or effect.

The coefficient of determination indicated how much variance PSE math achievement scores and each independent variable share (i.e. it described the proportion of variance in common between the two variables).

Correlation Analysis

A Pearson product-moment correlation coefficient was computed to assess the relationship between PSE math achievement scores and continuous independent variables (i.e. personalization, involvement, student cohesiveness, satisfaction, task orientation, innovation, and individualization). The results revealed that there were weak positive correlations between the PSE math achievement scores and student cohesiveness ($r = 0.219$, $n = 477$, $p < 0.001$), task orientation ($r = 0.149$, $n = 477$, $p = 0.001$), personalization ($r = 0.146$, $n = 477$, $p = 0.001$), involvement ($r = 0.139$, $n = 477$, $p = 0.002$), and satisfaction ($r = 0.016$, $n = 477$, $p = 0.720$) (see Table 10 below). Also there were weak negative correlations between the PSE math achievement scores and innovation ($r = -0.035$, $n = 477$, $p = 0.451$), and individualization ($r = -0.016$, $n = 477$, $p = 0.720$). The weak correlations between PSE and aforementioned continuous independent variables, implied that increases or decreases in PSE math achievement scores did not relate (or relate weakly) to increases or decreases in each of the continuous independent variables. That is, PSE math achievement scores and each continuous independent variable vary separately or independently. Hence, when the magnitudes of PSE math Achievement Scores were high, the magnitudes of the continuous independent variables were sometimes high and sometimes low.

Table10. Pearson Product Moment Correlation

Pearson Product-Moment Correlations Between PSE Math Score, Personalization, Involvement, Student Cohesiveness, Satisfaction, Task Orientation, Innovation, and Individualization

		PSE Math Score	Personalization	Involvement	Student Cohesiveness	Satisfaction	Task Orientation	Innovation	Individualization
PSE Math Score	Pearson Correlation	1	0.146**	0.139**	0.219**	.016	0.149**	-.035	-.016
	Sig. (2-tailed)		.001	.002	.000	.720	.001	.451	.720
	N	477	477	477	477	477	477	477	477
	Coefficient of Determination	100.00	2.13	1.93	4.80	0.03	2.22	0.12	0.03

**. Correlation is significant at the 0.01 level (2-tailed).

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

The independent variable School Type was then recoded into two (2) levels (Private and Non Private [i.e. Government and Churches]) to correct this Multicollinearity problem and hence this School Type variable with two levels was used in the regression analysis. To correct for the violations of the regression assumptions for Homoscedasticity and normality of errors, transformations of the continuous variables were computed and subsequent regression analyses were conducted using transformed and non-transformed continuous variables. In regression, transformation means that one changes the scale on which the variables are measured.

The results of the regression analyses with transformed variables revealed that the transformation did not fix the Homoscedasticity and normality of errors violations of the regression assumptions problem. The violations of these assumptions invalidate statistical inferences such as those made using a hypothesis test (e.g. tests of significance on the multiple correlation coefficient, R), deriving the p value for the ratio of the sample estimate of the regression coefficient of interest to an estimate of the standard error of the estimate, or by using the estimated standard error to derive a confidence interval.

Thus, since the transformation technique did not allow for valid regression analyses to be conducted, Heteroscedasticity-Robust Inference Method using a Heteroscedasticity-Consistent Standard Error Estimator (Hinckley, 1977; Long & Ervin, 2000; MacKinnon & White, 1985; White, 1980) was employed in this study. This technique uses Ordinary Least Squares to estimate the regression model as is with the Non-Robust Inference Method (i.e. the standard or usual Regression Method) aforementioned, however, the difference was that the standard errors were estimated using another method that does not require the Homoscedasticity assumption to be met. The Heteroscedasticity- Robust Inference Method using a Heteroscedasticity-Consistent Standard Error Estimator was selected since it reduced the effects of Heteroscedasticity on inferences and yet it did not require 1) the use of transformations of the independent, and/or dependent variable(s), and 2) rigorous computer simulation programs. Thus, the researcher had to look at the results of Regression using the Heteroscedasticity-Robust Inference Method and the Non- Heteroscedasticity-Robust Inference Method.

Heteroscedasticity-Robust Inference Regression Method (Using a Heteroscedasticity-Consistent Standard Error Estimator)

The Simultaneous Method, where all predictor variables aforementioned are entered at once in the model, was used for selecting the model since the researcher: specified the set of predictor variables that make up the model, had no prior ideas of the order of entry of which independent variables, and which independent variables will contribute significantly to the model. Using the Simultaneous Method (with the Heteroscedasticity-Robust Inference Method), a significant model emerged where $p < 0.001$ and $F(9, 467) = 38.60$, (see Table 11 below). Please note that this does not support the null hypothesis so we reject the null hypothesis that there is no relationship between PSE Math achievement scores and Personalization, Involvement,

Student Cohesiveness, Satisfaction, Task Orientation, Innovation, Individualization, School Type and Sex.

Table11. Heteroscedasticity- Consistent Model Summary

Heteroscedasticity-Consistent Model Summary[c]

Model	R Square	Adjusted R Square	F	df1	df2	p
Full	0.166[a]	0.164	38.597	9	467	0.000
Parsimonious	0.150[b]	0.149	153.951	2	474	0.000

a - Predictors: (Constant), School Type, Individualization, Male, Task Orientation, Innovation, Student Cohesiveness, Involvement, Personalization, and Satisfaction
b - Predictors: (Constant), School Type and Student Cohesiveness
c - Dependent Variable: PSE Math Score

Summary

The Adjusted R Square value was 0.164 (see Table 12 below). This indicates that 16.4% of the variance in PSE Math Achievement Scores was explained by the model. This table also indicates a low or weak positive correlation between the combination of all independent variables and PSE Math Achievement Scores.

Next to find out which of the independent variables have a significant linear relationship with PSE Math achievement scores the researcher looked at the p values in the Regression Coefficients Table. Results of the regression analysis (without the Heteroscedasticity-Robust Inference Method) provided partial confirmation for the research hypothesis since the combination of variables that significantly predicted PSE Math Achievement Scores or had a significant relationship with PSE Math Achievement Scores were only with School Type ($p < 0.001$), and Student Cohesiveness ($p = 0.003$) in Table12 below). The Beta (B) weights (or coefficients), presented in Table 13 tells us the individual contribution of each independent

variable to the model as well as the relationship between PSE Math Achievement Scores and each independent variable. School Type was the independent variable that contributed most to this model (i.e. strongest predictor of PSE Math Achievement Scores) since it had the largest B value of 13.253 or the smallest *p* value.

To determine the most parsimonious model for the Heteroscedasticity-Robust Inference Method, a backward stepwise model was employed. In this method, all independent variables were initially entered into the regression model and they were deleted if they made insignificant contribution to the model. Hence, the outcome will be a regression model with only significant independent variables. In this study, all independent variables were removed from the regression model except for School Type and Student Cohesiveness. The parsimonious model with only School Type and Student Cohesiveness independent variables was significant (i.e. $p < 0.001$ and $F(9, 467) = 38.60$) and had an adjusted R^2 value of 14.9% indicating that 14.9% of the variability in PSE Math achievement scores is explained by these independent variables (see Table 13 below).

Table12. Heteroscedasticity- Consistent Regression Coefficients Results

Heteroscedasticity-Consistent Regression Coefficients Results

	Beta Coefficient	SE(HC)	t	P>|t|
Constant	13.253	10.851	1.221	0.223
Personalization	1.269	2.138	0.594	0.553
Involvement	2.872	2.208	1.301	0.194
Student Cohesiveness	5.078	1.670	3.040	0.003
Satisfaction	-2.176	1.546	-1.408	0.160
Task Orientation	4.288	2.253	1.903	0.058
Innovation	-0.667	1.824	-0.366	0.715
Individualization	-1.272	1.914	-0.665	0.506
Male	-1.321	1.908	-0.692	0.489
School Type	27.253	2.176	12.526	0.000

Non-Robust Inference Method (Standard OLS Regression Method)

The Simultaneous Method (using the Standard Non-Robust Inference Method), where all independent variables are entered at once in the model produced a significant model ($F(9, 467) = 10.342$, $p < 0.001$ (see Table13 below) like the results of the Heteroscedasticity- Robust Inference Method. This does not support the null hypothesis so we reject the null hypothesis that there is no relationship between PSE Math achievement scores and Personalization, Involvement, Student Cohesiveness, Satisfaction, Task Orientation, Innovation, Individualization, School Type and Sex.

Table13. Regression and Residual ANOVA b

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	38694.931	9	4299.437	10.342	0.000[a]
	Residual	194142.897	467	415.724		
	Total	232837.828	476			

a - Predictors: (Constant), School Type, Individualization, Male, Task Orientation, Innovation, Student Cohesiveness, Involvement, Personalization, and Satisfaction
b - Dependent Variable: PSE Math Score

To find out which of the independent variables have a significant linear relationship with PSE Math achievement scores we will look at the p values in the Regression Coefficients Table. Results of the regression analysis provided partial confirmation for the research hypothesis since the variables that had a significant relationship with PSE Math Achievement Scores were only with School Type, Student Cohesiveness and Task Orientation. The Beta weights or coefficients, presented in Table13 below, suggest that Student Type contributed most to this model followed by Student Cohesiveness and Task Orientation. This is similar to the Heteroscedasticity-Robust Inference Method which had only School Type and Student Cohesiveness significantly contributing to the model.

Table 14. Regression Coefficients Model

Regression Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	13.253	10.598		1.251	0.212		
	Personalization	1.269	2.087	0.031	.608	0.543	0.703	1.422
	Involvement	2.872	1.974	0.071	1.455	0.146	0.740	1.352
	Student	5.078	1.598	0.146	3.177	0.002	0.847	1.180
	Satisfaction	-2.176	1.535	-0.074	-1.417	0.157	0.652	1.535
	Task	4.288	2.177	0.095	1.970	0.049	0.773	1.293
	Innovation	-0.667	1.809	-0.016	-.369	0.713	0.896	1.116
	Individualization	-1.272	1.856	-0.030	-.685	0.493	0.937	1.067
	Male	-1.321	1.902	-0.030	-.694	0.488	0.968	1.033
	School Type	27.253	3.919	0.304	6.955	0.000	0.934	1.071

a - Dependent Variable: PSE Math Score

The Adjusted R Square value for the full model was 0.150 (see Table14 below). This indicates that 15.0% of the variance in PSE Math Achievement Scores was explained by the model with all the independent variables. This table also indicates a low or weak positive correlation between the combination of all independent variables and PSE Math Achievement Scores.

Table 15. Model Summary a

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.408[a]	0.166	0.150	20.389

a - Predictors: (Constant), School Type, Individualization, Male, Task Orientation, Innovation, Student Cohesiveness, Involvement, Personalization, and Satisfaction

The coefficient of variation (Standard Error of the Estimate/Mean of PSE Math Achievement Scores) is 0.413 which is greater than 10% indicating that our prediction intervals of this model will be wide. Hence, this model would not be useful for prediction purposes.

To determine the most parsimonious model a backward stepwise model was employed. All independent variables were removed from the regression model except for School Type, Student Cohesiveness and Task Orientation. The parsimonious model with only School Type, Student Cohesiveness and Task Orientation independent variables had an adjusted R^2 value of 15.2% indicating that 15.2% of the variability in PSE Math achievement scores is explained by these independent variables (see Table15 below).

Table 16. Model Summary b

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.397[a]	0.158	0.152	20.362

a - Predictors: (Constant), School Type, Task Orientation, Student Cohesiveness
b - Dependent Variable: PSE Math Score

It is worthy to note that the full model with all independent variables yielded an adjusted R^2 value that is less than the model with just three independent variables (School Type, Student Cohesiveness and Task Orientation). This should not be the case and is a direct consequence of the violation of the Homoscedasticity and normality assumptions in the regression.

CHAPTER V

CONCLUSIONS, IMPLICATIONS AND REFLECTIONS

The purpose of the study was to examine the relationship that exist classroom climate and student math achievement. The study also sought to determine the classroom climate variables that affect student math achievement. In this study, students' perception of classroom climate was determined by using Learning Climate Inventory (LEI) and its seven subscales of personalization, involvement, student cohesiveness, satisfaction, task orientation, innovation and individualization. The dependent variable used was the PSE mathematics score of the Belize Primary School Examination. The researcher also examined school type and gender. The information gathered from this study is important since it will:

a) Add to the body of existing literature that relates to the classroom learning environment variables and student achievement globally;

b) Assist in the creation of much needed literature on classroom climate and student math achievement for Belize;

c) Aid in providing crucial information to policymakers for the development of policies nationally in Belize;

d) Can be used to assist policy makers to determine what changes, if any, could be made to achieve improved student math performance on the BPSE; and

e) Can also heighten educators' awareness on the importance of classroom climate and achievement in math in Belizean classrooms, as well as, determine and fill the existing gaps on classroom climate and student math achievement in Belize.

In the study, the sample consisted of 18 high schools and 477 students from ninth grade or first form who sat the BPSE in 2011. The population came from the Belize City

schools of 2700 students that provided a randomly selected sample of 540 study participants. Each school received 30 questionnaires and parent consent forms for the parents. Participation was voluntary and the participants could have opted to choose to not answer the questionnaire. The questionnaires were issued and collected from the students by the principals of the schools. Of the 540 questionnaires that were issued, the researcher received 477 back. This represented an 88% response rate which falls within the approved response rate of 80% under the research standards (citation).

The study was a quantitative correlation design. A one way ANOVA, Pearson product-moment correlation coefficient, and multiple regression analysis were used to analyze the data that were related to the research questions. A univariate analysis of variance was used to find out whether or not students' mathematics achievement scores were presumed to be determinant of the LEI subscales. The researcher used the Statistical Package Software System (SPSS) 19.0 to do the analysis.

Summary of Study

The purpose of this study was to investigate the relationships between classroom climate and math achievement in ninth grade in Belize District High Schools. The study sought to determine if there was a relationship between specific classroom climate and student math achievement in grades on BPSE. Using a revised version of Learning Environment Inventory (LEI) by Fraser (1992), the researcher was able to determine the specific classroom climate variables that affected student math achievement. The dependent variable in the study was student achievement and the independent variable was classroom climate. A set of research questions and hypotheses guided the study.

Following is the set of questions that guided the study:

1. What is the relationship between students' perceptions of classroom climate and mathematics achievement?

2. What is the relationship between students' perceptions of specific classroom climate factors: personalization, involvement, cohesiveness, satisfaction, task orientation, innovation and individualization, and mathematics achievement?

3. Are there differences between student math achievement and school type?

4. Are there differences between student math achievement and gender?

Null Hypotheses

H1: There is no relationship between students' perceptions of classroom climate and mathematics achievement.

H2: There is no relationship between students' perception of personalization in the classroom and mathematics achievement.

H3: There is no relationship between students' perception of involvement in the classroom and mathematics achievement.

H4: There is no relationship between students' perception of cohesiveness and mathematics achievement.

H5: There is no relationship between students' perception of satisfaction in the classroom and mathematics achievement.

H6: There is no relationship between students' perception of task orientation in the classroom and mathematics achievement.

H7: There is no relationship between students' perception of innovation in the classroom and mathematics achievement.

H8: There is no relationship between students' perception of individualization in the classroom and mathematics achievement.

H9: There is no difference between student math achievement and school type.

H10: There is no difference between student math achievement and gender.

Summary of Findings

Research Question 1

What is the relationship between students' perceptions of classroom climate and mathematics achievement?

The results of study indicated that with regard to the relationship between PSE math achievement scores and the continuous independent climate variables (i.e. personalization, involvement, student cohesiveness, satisfaction, task orientation, innovation, and individualization) there were weak positive correlations between the PSE math achievement scores and specific classroom climate variable such as student cohesiveness, task orientation, personalization, involvement, and satisfaction. Also there were weak negative correlations between the PSE math achievement scores and Innovation and Individualization. The weak correlations between PSE and aforementioned continuous independent variables implied that there may be increases or decreases in PSE math achievement. Thus, with the exception of school type each independent variable contributed very little of information about the PSE math achievement scores.

Research Question 2

What is the relationship between students' perceptions of specific classroom climate factors and mathematics achievement: personalization, involvement, cohesiveness, satisfaction, task orientation, innovation and individualization, and mathematics achievement?

School type was the independent variable that contributed most and was the strongest predictor of PSE math achievement scores in the study. The null hypotheses, there is no relationship between PSE math achievement scores and personalization, involvement, student cohesiveness, satisfaction, task orientation, innovation, individualization, school type and sex, was tested by performing the standard multiple regression analysis tests. Since school type was the independent variable that contributed most to PSE mathematics achievement scores, the null hypothesis, "There is no difference between PSE mathematics achievement scores and school type," must be rejected and the alternate hypothesis was accepted since there were significant differences between student math achievement and school type. Thus, the next research question is important.

Research Question 3

Are there differences between student math achievement and school type?

This question was supported and there were strong positive correlations between the two. There were combinations of variable that significantly predicted PSE math achievement scores or had a significant relationship with PSE math achievement scores. These variables were school type and student cohesiveness.

Research Question 4

Are there differences between student math achievement and gender?

From the study the point-biserial correlation coefficient results indicated that there was a negative and very weak correlation between PSE math achievement scores and sex. Therefore, due to these results, the null hypotheses that related to gender must be rejected.

Limitations of the Study

The limitation of a study refers to factors that a researcher was unable to control or those factors that may impact the extent to which the findings can be effectively utilized (Gay, 2009). Correlation research merely demonstrates that a researcher can predict one variable from another variable and demonstrates that two variables were associated. Correlation research may also have limitations with respect to the generalizability of the findings. Thus, it is uncertain to determine whether the findings of this research can be generalized to other schools, students or situations. Therefore, there were limitations that encompassed the study. One limitation concerned the selection of only one site for the data collection, which was the Belize District. Therefore, high schools in the other five remaining districts were excluded from the study and the likelihood of important data could have been excluded. Another limitation was the fact that the sample of students in the study would not be a representative sample of the entire grade nine who sat the BPSE in 2011 in the entire country of Belize. Additionally, only the math scores were used in the study although Science and Social Studies scores were also tested on the BPSE exam. Furthermore, only seven variables were examined although there could be other variables that could affect student math achievement.

Finally, surveys are self-reporting instrument and are subject to human error. Consequently, students may or may not have correctly stated a true view or perception of the classroom climate at the time that the exam was sat. Lastly, there was the time factor that may have affected the perception of the students who were answering the survey since these students were already in ninth grade when the study was conducted. However, it is worth noting that the LEI have been tested consistently over the last several decades for its validity and reliability in a manner that was consistent with the study, (Fraser, 1991).

Conclusions

The literature points to the fact that the classroom climate factors such as school climate, teacher and student attitude and teacher qualification are part of the many areas that affect student achievement in schools. Learning environment assessment not only provides information on how to measure the students' performance, but also information on the teachers' competences to create the positive learning outcomes. The purpose of the study was to examine the relationship that exist classroom climate and student math achievement. The study also sought to determine the classroom climate variables that affect student math achievement. The majority of learning environments assessments is based on students' perceptions. Students' and teacher perceptions of the learning environment could give valuable information to improve the quality of learning and can evaluate the innovation in education (Fraser, 1998).

From the findings of the study, the researcher concludes that: 1) the independent variables, school type is statistically significant to student math achievement scores. This is obvious since the school types, Private and Catholic, had a wide gap in PSE math performance over the other school types of Pentecostal and Government. 2). the independent variable, gender is not statistically significant to student mathematics performance. From the findings gender has no influence on PSE math performance. These results indicated that male students have PSE Math Achievement Scores that were not significantly different from female students, and 3). The classroom climate variables of student cohesiveness, task orientation, personalization, involvement and satisfaction contribute very little to influence students math scores on PSE since the results revealed that there were weak positive correlations between these variables and PSE math achievement. The weak correlations between PSE and the aforementioned continuous independent variables, imply that increases or decreases in PSE math achievement scores did not

relate (or relate weakly) to increases or decreases in each of the continuous independent variables. That is, PSE math achievement scores and each continuous independent variable vary separately or independently with each other.

Implications for Research, Theory, and Practice

Implications for Research

The data collected and the results of the study have many prospective implications for the education system in Belize, as well as, educators. The importance of creating and maintaining a positive classroom climate is crucial to ensure and maintain a positive impact on student achievement. For over two decades research on the classroom environment has confirmed that the environment may influence student outcomes (Fraser, 1991). However, there are still many questions that are still unanswered relating to classroom climate. Hence, other factors exist that can affect classroom climate and student math achievement in Belizean classrooms. These include factors such as teacher effectiveness, school leadership, socio-economic and physical setting. Therefore, there is a need for subsequent studies that will scaffold this study and add the development of additional classroom climate studies and findings for the development of education in Belize. Thus, the study has several implications for current and future research practice that follows below.

Since the study was done using the quantitative approach, there needs to be further research done using other approaches which can include: qualitative or mixed- method design in order to strengthen the data through triangulation. There is also the need for the study to be replicated in Belize's five remaining districts using a larger population and sample to aid in strategic planning and the development of education. The replication of the study can also add to the generalizability of the findings of the study to the other districts in Belize. In addition,

subsequent studies need to also include the Belizean teacher's perspective so that a clearer understanding of the comprehensible nature of classroom climate as it relates to the student and teacher's perspective in the Belizean context is realized.

Furthermore, it is obvious that the certification of the teachers is crucial in the teaching and learning process within the classroom setting. Therefore, there is a crucial need for current and future research on teacher certification in Belize. In addition, there is also a need for additional classroom climate studies that employ the case study approach that need to be done in both the primary and secondary schools in Belize. Studies of these types can be done to add to and further support findings on classroom climate and student achievement.

Implications for Theory

The results of the study have both theoretical and practical implications. The results also provide a better theoretical understanding of the nature of student achievement, causes of the achievement gap and the role that the teacher and plays in scaffolding student achievement. In addition, they imply practical considerations for teachers and administrators attempting to increase student achievement and reduce the achievement gap at their schools. In addition, the findings of the study also provide a number of general and theoretical implications that can be examined in future research for the educational field. These follow below.

1. High quality climates lead to higher levels of student achievement.
2. High student achievement PSE math scores seem to relate strongly to Private and Catholic schools within the context of schools with students of high academic performance.
3. Positive classroom climate is positively related to high student achievement.
4. High teacher qualification is positively related to positive classroom climate.

Implications for Practice

The study has several implications for the many stakeholders in education, principals, teachers, students and government leaders. This study can set the tone for improved classroom practices in the areas of classroom climate, student achievement in mathematics and other subject areas, as well as, in promoting the development of a stronger research culture in Belize.

The study is of crucial importance to education in Belize since the main setting for formal education is the classroom. In any educational institution the climate of the classroom sets the stage for learning to be effective or ineffective. Therefore, as was previously implied, the study has several implications for all stakeholders in education mainly educators in the form of administrators, the general teacher populace and the key human element in the classrooms, the students. The results of the study highlights the fact that students from Private schools reported significantly higher math achievement scores than students from Catholic, Pentecostal and Government, Schools. In addition students from Catholic Schools reported significantly higher math achievement scores than students from Pentecostal and Government Schools. Furthermore, students from Pentecostal Schools reported significantly higher math achievement scores than students from Government Schools.

Thus, all indications are that there is a wide gap in PSE math achievement between Government schools, Private and Catholic schools. However, in the case of the high performing schools, private and Catholic, there are practical implications that can be used in current and future research as means of developing standards for the improvement of PSE math in Government and Pentecostal schools. Having stated this, the implications for educational practitioners include the following:

1. In order to create positive classroom climates in school and high achievement levels in Government schools, there need to be fundamental changes in the manner in status quo in order to enhance strategies on how achievement is determined.

2. Assessment of the school climate and by extension the classroom climate needs to increased and existing structures must be assessed in order to diagnose the present state of classrooms at the school level. This will assist educators and policy makers in determining what needs to be implemented or amended so that the desired performance level in the schools is realized and maintained.

3. Stakeholders need to identify desirable and undesirable practices used in the classrooms in order to improve on classroom climate and delivery in schools.

4. Stakeholders need to ensure that students are equitably served across schools whether government, protestant, private or Catholic in order improve performance in all schools in the Belize District and by extension, the country of Belize.

5. Proper educational standard need to be set as it relates to teacher training, improved classroom climate and class size in order to improve student achievement.

Researcher Reflections

In Belize classroom climate is a term that is new and the research in this area is far from available. Classroom climate can be defined in many different ways according to classroom theories that have existed over the years, and the perceptions of educators and students alike. However, despite the many perceptions, there are many important findings from the research as a whole that can impact students' learning and behavior. Information gained from ongoing studies of classroom climate or environment continues to impact teachers' knowledge and students' performance. It can also aid in the learning about factors that may shape students' perceptions of

their learning environment, teachers' actions appear to students, and how changes are made to the learning environment to stimulate and encourage learning continue to be very important for research.

As theories of learning continue to develop and evolve, the need to examine, create and validate more classroom climate data continues to grow. This needs to be true for education and educational research in Belize. In aiming to determine classroom or classroom environment, it is important to apply information gathered from all areas of the school environment. This includes both opinion and perception that will form a wide- ranging and comprehensive representation of student achievement and by extension student success. The importance of classroom climate and student math performance and performance in other subject areas is very important in making meaningful strides to develop schools and education in Belize. Specific attention must be given to understanding the dynamics of the classrooms so that teachers will operate in an effective manner in order to produce the desired effects for upward movement in student achievement holistically.

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Appendix A

Learning Environment Inventory

The purpose of this study is to find out your perception of the Standard 6 Math class you were in at Primary School. The questionnaire assesses your opinion about what this class was actually like. Indicate your opinion about each statement by writing the appropriate initial in the blank: This instrument was developed by Barry J. Fraser, David F. Treagust, and Norman C. Dennis of Western Australian Institute of Technology

S A if you **STRONGLY AGREE** that it describes what this class is actually like.
A if you **AGREE** that it describes what this class is actually like.
D if you **DISAGREE** that it describes what this class is actually like.
S D if you **STRONGLY DISAGREE** that it describes what this class is actually like.

1._____The instructor considers students' feelings.

2._____The instructor talks rather than listens.

3._____The class is made up of individuals who don't know each other well.

4._____The students look forward to coming to classes.

5._____Students knows exactly what has to be done in our class.

6._____New ideas are seldom tried out in this class.

7._____All students in the class are expected to do the same work, in the same way and same time.

8._____The instructor talks individually with students.

9._____Students put effort into what they do in class.

10._____Each student knows the other members of the class by their first names.

11._____Students are dissatisfied with what is done in the class.

12._____Getting a certain amount of work done is important in this class.

13._____New and different ways of teaching are seldom used in this class.

14._____Students are generally allowed to work at own pace.

15._____The instructor goes out of his/her way to help students.

16. _____Students 'clock watch' in this class.

17._____Friendships are made among students in this class.

18._____After the class, the students have a sense of satisfaction.

19._____ The group often gets sidetracked instead of sticking to the point.

20._____The instructor thinks up innovative activities for students to do.

21._____Students have a say in how class time is spent.

22._____The instructor helps each student who is having trouble with the work.
23._____Students in this class pay attention to what others are saying.
24._____Students do not have much chance to get to know each other in this class.
25._____Classes are a waste of time.
26._____This is a disorganized class.
27._____Teaching approaches in this class are characterized by innovation and variety
28._____Students are allowed to choose activities and how they will work.
29._____The instructor seldom moves around the classroom to talk with students.
30._____Students seldom presents their work to the class.
31._____It takes a long time to get to know everybody by his/her first name in this class.
32._____ Classes are boring.
33. _____Class assignments are clear so everyone knows what to do.
34. _____The seating in this class is arranged in the same way each week.
35. _____Teaching approaches allow students to proceed at their own pace.
36. _____The instructor isn't interested in students' problems.
37. _____There are opportunities for students to express opinions in this class.
38. _____Students in this class get to know each other well.
39. _____Students enjoy going to this class.
40. _____This class seldom starts on time.
41. _____The instructor often thinks of unusual class activities.
42. _____There is little opportunity for a student to pursue his/her particular interest in class.
43. _____The instructor is unfriendly and inconsiderate toward students.
44. _____The instructor dominates class discussions.
45. _____Students in this class aren't very interested in getting to know other students.
46. _____Classes are interesting.
47. _____Activities in this class are clearly and carefully planned.
48. _____Students seem to do the same type of activities every class.
49. _____It is the instructor who decides what will be done in our class.

Appendix B
Score Sheet
Learning Environment Inventory

STEP I - Note the underlined items listed in the categories, which appear after Step 2. Determine and use the appropriate formula for calculation.

For no underlined items use this formula:

Number of students who mark strongly agree _____ X 5 = _____
Number of students who mark agree _____ X 4 = _____
Number of students who mark disagree _____ X 2 = _____
Number of students who mark strongly disagree _____X1 = _____
Number of omitted or invalid marks _____ X 3 = _____
FREQUENCY TOTAL = _____ _____ =
SCORE TOTAL

ITEM AVERAGE = SCORE TOTAL/FREQUENCY TOTAL

For underlined items use this formula:

Number of students who mark strongly agree _____ X 1 = _____
Number of students who mark agree _____ X 2 = _____
Number of students who mark disagree _____ X 4 = _____
Number of students who mark strongly disagree _____ X 5 = _____
Number of omitted or invalid marks _____ X 3 = _____

FREQUENCY TOTAL = _____ _____ = SCORE TOTAL

ITEM AVERAGE = SCORE TOTAL/FREQUENCY TOTAL

STEP 2 - use the worksheet below to record items averages in each of the Instrument seven categories

PERSONALIZATION - emphasizes opportunities for students to interact with the instructor and the instructor's concern for student' personal welfare.

Item 1 Item average _____
Item 8 Item average _____
Item 15 Item average _____
Item 22 Item average _____
Item 29 Item average _____
Item 35 Item average _____
Item 42 Item average _____
Item 49 Item average _____

INVOLVEMENT - assesses extent to which students participate actively and attentively in class discussions and activities.

Item 2 Item average _____
Item 9 Item average _____
Item 16 Item average _____
Item 23 Item average _____
Item 30 Item average _____
Item 37 Item average _____

Item 44 Item average _____

STUDENT COHESIVENESS - looks at the extent to which students know, help and are friendly toward each other.

Item 3 Item average _____
Item 10 Item average _____
Item 17 Item average _____
Item 24 Item average _____
Item 31 Item average _____
Item 38 Item average _____
Item 45 Item average _____

SATISFACTION - measures the degree of enjoyment of classes.

Item 4 Item average _____
Item 11 Item average _____
Item 18 Item average _____
Item 25 Item average _____
Item 32 Item average _____
Item 39 Item average _____
Item 46 Item average _____

TASK ORIENTATION - considers the extent to which class activities are clear and well organized.

Item 5 Item average _____
Item 12 Item average _____
Item 19 Item average _____
Item 26 Item average _____
Item 33 Item average _____
Item 40 Item average _____
Item 47 Item average _____

INNOVATION - to what extent does the instructor plan new and unusual class activities, teaching techniques, and assignments?

Item 6 Item average _____
Item 13 Item average _____
Item 20 Item average _____
Item 27 Item average _____
Item 34 Item average _____
Item 41 Item average _____
Item 48 Item average _____

INDIVIDUALIZATION - asks to what extent students are allowed to make decisions and are treated differentially according to ability, interest and rate of working.

Item 7 Item average _____
Item 14 Item average _____
Item 21 Item average _____
Item 28 Item average _____
Item 35 Item average _____
Item 42 Item average _____
Item 49 Item average _____

Appendix C

Permission to Use Instrument

From: Lorna McKay [mailto:lordmacbz@yahoo.com]
Sent: Wednesday, 17 November 2010 8:31 AM
To: Barry Fraser
Subject: RE: Permission to use instrument

RE: Permission to use instrument
Tuesday, November 16, 2010 7:55 PM
From: "Barry Fraser" <B.Fraser@curtin.edu.au>
To: "Lorna McKay" <lordmacbz@yahoo.com>
Lorna It is ok to use the LEI.
Barry Fraser

From: Lorna McKay [mailto:lordmacbz@yahoo.com]
Sent: Wednesday, 17 November 2010 9:30 AM
To: Barry Fraser
Subject: RE: Permission to use instrument
Thanks again. Is it possible for me to use the LEI also?
Yours in education,
Lorna McKay, M.Ed. J.P. (Mrs.)
Gwen Lizarraga High School
Principal
Belize City, Belize
Tel: 501 6001521
501 227 2671
FAX :501 227 4678

Appendix D

IRB APPROVAL LETTER

Oklahoma State University Institutional Review Board

Date: Thursday, November 10, 2011

IRB Application No ED11183

Proposal Title: An Examination of the Relationship between Classroom Climate and Student Math Achievement in Belize District High Schools

Reviewed and Processed as: Expedited

Status Recommended by Reviewers): Approved Protocol Expires: 11/9/2012

Principal investigator(s):

Lorna Marie Mckay	Edward Harris
6 Richard St.	308 Willard
Belize City, OK 74078	Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR46.

The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study,

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.

Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.

Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and

Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Beth McTernan in 219 ' Cordell north (phone: 405-744-5700, beth.mcteman@okstate.edu).

Sincerely,

Shelia Kennison,
Chair Institutional

Appendix E

Consent Letter

Managing Authority

November 8, 2011

Dear Managers:

My name is Lorna Mckay and I am a Doctoral student from Oklahoma State University Department of Education. Presently, I am conducting a study entitled "An Examination of the Relationship between Students' Perception of Classroom Climate and Math Achievement in Belize District High Schools."

I would like to involve your school in this study. The study will include your 30 students from first form answering of a survey on the learning environment within the classroom. The study will be done at the 18 high schools in the Belize District. All information received will remain completely confidential. Only my professors and I will have access to the data collected and the data will be used solely for the purpose of research. No child will be identified by name and no individual identities will be used in any reports or publications that may result from this study. Also you will be able to remove your school from the study at any time that you may see fit. Additionally, there will be no direct benefit to your school from participating in this study. However, the information gained from this research may help education professionals better understand how children engage in learning activities. Likewise, there will be no cost to you or your school as a result of taking part in this study or will there be any there will be no payment to you as a result of your school taking part in this study. If you have any questions about your rights as a research volunteer, you may contact the Oklahoma State University Institutional Review Board (IRB) Chair, Dr. Shelia Kennison at 219 Cordell North, Stillwater, OK 74078, 405- 744-3377 or irb@okstate.edu.

Participation in This Research Is Voluntary. I understand that I can choose not to have my school participate in this study, or to withdraw my school from participating at any time. I will discuss this research study with the Board of Management and explain the procedures that will take place. I will be given a copy of this consent form to keep.

Please indicate your participation or non- participation by checking the appropriate box and affixing your signature to the consent letter.

I do not give my consent to allow the school to participate. ☐

I give my consent to allow the school to participate. ☑

Signature of Board Chair/ Manager

Date 9/11/2011

Lorna Mckay
Doctoral Candidate

BELIZE UNION OF T.E.A. TEL: 223-5946

Okla. State Univ.
IRB
Approved 11/7/11
Expires
IRB # ED-11-183

Appendix E

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I do not give my consent to allow the school to participate. ☐
I give my consent to allow the school to participate. ☑

Signature of Board Chair/ Manager

November 9, 2011
Date

Belize High School

Lorna Mckay
Doctoral Candidate

Okla. State Univ.
IRB
Approved 11/7/11
Expires

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I give my consent to allow the school to participate. ☑

St. Clara, SAC
Signature of Board Chair/ Manager

9/11/11
Date

Mckay
Lorna Mckay
Doctoral Candidate

PALLOTTI HIGH SCHOOL
Princess Margaret Drive
P.O. Box 180
Belize City

Okla. State Univ.
IRB
Approved 11/7/11
Expires
IRB # ED-11-183

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I give my consent to allow the school to participate. ☑

PRESIDENT'S OFFICE P.O Box 548 Belize City Belize ST. JOHN'S COLLEGE

Signature of Board Chair/ Manager

9/11/11
Date

Lorna Mckay
Doctoral Candidate

Okla. State Univ. IRB
Approved 11/7/11
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I give my consent to allow the school to participate. ☑

Signature of Board Chair/ Manager

6th November 2011
Date

Lorna Mckay
Doctoral Candidate

SAMUEL SUKHNANDAN (M. E.d.)
PRINCIPAL
NAZARENE HIGH SCHOOL
P.O. Box 539
Belize City, Belize
Tel: 223-2248 Email- nhs@btl.net

Okla. State Univ.
IRB
Approved 11/7/11
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I do not give my consent to allow the school to participate. ☐

I give my consent to allow the school to participate. ☑

Rev. Rudolph Arthur for

Signature of Board Chair/ Manager

9 - 11 - 11

Date

General Manager Rev. R. Arthur 9 · 11 · 11 Government Primary School

Lorna Mckay

Doctoral Candidate

Okla. State Univ. IRB
Approved 11/7/11
Expires
IRB # ED-11-183

VITA

Lorna Marie Mckay

Candidate for the Degree of

Doctor of Education

Thesis: An Examination of the Relationship between Classroom Climate and Student Math Achievement in Belize District High Schools

Major Field: Higher Education

Biographical Data:

Education:

- Completed the requirements for the Doctor of Education in Higher Education at Oklahoma State University, Stillwater, Oklahoma in May, 2012
- Completed the requirements for the Master of Education at University of North Florida, Jacksonville, Florida in August, 2003
- Completed the requirements for the Bachelor of Science in Business at University College of Belize, Belize, Belize in May, 1997

Experience:

- February, 2004 – Present, Principal – Gwen Lizarraga High School.
- September, 2009 – Present, Administrator – Gwen Lizarraga High School Evening Division.
- August, 1998 – February, 2004, Teacher, Social Studies and Principles of Business, Wesley College.
- August, 1993 – August, 1998, Teacher, Belizean Studies and Geography at St. Catherine Academy.
- August, 1983 – August, 1993 Teacher, English, Literature, History, Geography and Social Studies at Excelsior High School.

Professional Memberships:

- 2011 - Present, Representative to Association of Tertiary Level Institutions of Belize (ATLIB) for Belize Association of Principals of Secondary Schools (BAPSS).
- 2010-2011 – Principal Represent on Restore Belize.
- 2008 – Present, Representative to Regional Education Council, Belize District for Belize Association of Principals of Secondary Schools (BAPSS).
- 2008 -2010 – Vice Chairperson, Regional Education Council, Belize District

Name: Lorna Marie Mckay Date of Degree: July, 2012
Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: AN EXAMINATION OF THE RELATIONSHIP BETWEEN CLASSROOM CLIMATE AND STUDENT MATH ACHIEVEMENT IN BELIZE DISTRICT HIGH SCHOOLS

Pages in Study: 102 Candidate for the Degree of Doctor of Education

Major Field: Higher Education

Scope and Method of Study:

In the study, the sample consisted of 18 high schools and 477 students from ninth grade or first form who sat the BPSE in 2011. The population came from the Belize District schools of 2700 students that provided a randomly selected sample of 540 study participants. The researcher used a Learning Environment Inventory (LEI) by (Fraser, 1992) to collect data on classroom climate and the Belize Primary School Examination (BPSE) for 2011 in order to obtain students' mathematics scores. The study was correlation.

The purpose of the study was to examine the relationship that exist classroom climate and student math achievement. The study also sought to determine the classroom climate variables that affect student math achievement. The majority of learning environments assessments is based on students' perceptions. Students' and teacher perceptions of the learning environment could give valuable information to improve the quality of learning and can evaluate the innovation in education (Fraser, 1998). From the literature reviewed and the findings from this study, the researcher concludes that: (1). the independent variable, school type is statistically significant to student math achievement scores; (2). the independent variable, gender is not statistically significant to student mathematics performance and, (3). the other climate variables contribute very little to influence students' math scores on PSE.

Findings and Conclusions: The results of study indicated that with regard to the relationship between PSE math achievement scores and the continuous independent climate variables (i.e. personalization, involvement, student cohesiveness, satisfaction, task orientation, innovation, and individualization) there were weak positive correlations between the PSE math achievement scores and specific classroom climate variable such as student cohesiveness, task orientation, personalization, involvement, and satisfaction. Also there were weak negative correlations between the PSE math achievement scores and innovation and individualization. The weak correlations between PSE and aforementioned continuous independent variables implied that there may be increases or decreases in PSE math achievement. Thus, with the exception of school type each independent variable contributed very little of information about the PSE math achievement scores.

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