Science and Mathematics Education Centre

Learning Environment and Attitudes among Mathematics Students with Specific Learning Disabilities in Self-Contained and Inclusion Classes

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DECLARATION

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university. To the best of my knowledge and belief, this thesis contains no material previously published by any person except where due acknowledgement has been made

Signature:

Christine Gennis Thomas-Bell

Date: June 2015

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This thesis is dedicated to my daughter, Emily Addison Bell. You are the sunshine of my life. I look forward to reading your PhD thesis one day. Mommy loves you.

ABSTRACT

This research involved the attitudes and classroom environment perceptions of students with specific learning disabilities in inclusion classes, general-education students in inclusion classes, and students with specific learning disabilities in self-contained classes. The What Is Happening In this Class? (WIHIC) questionnaire was used to assess students' perceptions of their classroom environment (Student Cohesiveness, Teacher Support, Involvement, Task Orientation, and Cooperation) and the Test Of Mathematics Related Attitudes (TOMRA) was chosen for assessing students' attitudes (Enjoyment of Mathematics Lessons and Adoption of Mathematical Attitudes).

The research was carried out in Broward County Public Schools in Florida, United States, with a sample of 242 eighth-grade mathematics students (70 students with specific learning difficulties and 172 general-education students). This sample was relatively small because of the limited population of students with specific learning disabilities in each school.

In order to check the structure of the questionnaire, principal axis factor analysis with varimax rotation and Kaiser normalization was conducted. The seven-scale *a priori* structure of the questionnaire containing learning environment and attitude scales was supported, with 56% of the variance being accounted for.

Differences between groups were investigated using a one-way MANOVA and ANOVAs. Students with specific learning disabilities in integrated settings had

higher scores than students with disabilities in separate settings on every scale, and these differences were statistically significant for Task Orientation and Enjoyment. Effect sizes were 0.70 and 0.56 standard deviations for these scales, which are moderate to large.

For students in integrated classes, general-education student had significantly higher scores than students with specific learning disabilities for all WIHIC scales and Adoption of Mathematical Attitudes, with effect sizes for these scales ranging from 0.35 to 0.51 standard deviations (moderate magnitudes). However, levels of Enjoyment were similar for general-education students and students with specific learning disabilities.

When associations between the nature of the classroom environment and students' attitudes towards mathematics were investigated, simple correlation analysis showed that all five WIHIC scales were significantly related to each attitude scale, and multiple regression analysis revealed that every WIHIC scale except Student Cohesiveness was a significant independent predictor of each attitude scale when the other WIHIC scales were mutually controlled. All bivariate and multivariate associations were positive, which replicates considerable past research into associations between classroom environment and student attitudes.

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BACKGROUND AND RATIONALE

1.1 Introduction

The topic of inclusion for students who are diagnosed with having specific learning disabilities has been the focus of a continuing debate among educators, parents and advocates. Structuring programs for students with specific learning disabilities has been somewhat difficult because these programs require special education teachers and general education teachers to restructure their classroom to accommodate the needs of teachers, students, parents, and the school. Questions asked about inclusion include whether inclusion of students with specific learning disabilities should be full-time or part-time. One of the first steps for determining the appropriate placement regarding inclusion for students with specific learning disabilities is implementing a legal structure for educating these students. Students with specific learning disabilities should be included in inclusionary courses based on their skills, particularly those courses that are interactive. Inclusionary courses, when implemented appropriately, can enhance the social skills and learning of students with special needs, as well as bringing awareness to the general education population (Power-deFur & Orelove, 1997).

Including students with specific learning disabilities in a general-education class is one thing, but how these students feel about being in a class with the general-education population is another aspect to be considered. Many students with specific learning disabilities don't like to be away from their general-education peers in a self-contained class for much of the school day because they don't feel 'normal'. However, they have combined classes for electives, such as physical education and fine arts. Depending on the level of students' learning disability, they are accompanied to the elective class with a special education aide who stays with them in the class to ensure that they are on task and displaying appropriate classroom behavior. The higher the students' functioning, the more independence they are given for elective classes.

Inclusion is the relationship between two classes that exists when all members of the first are also members of the second; that is, students with specific learning disabilities are members of the general-education class. The main concern for all involved is how this act of inclusion can successfully be accomplished. Students with specific learning disabilities have certain limited abilities in a specific area (e.g. mathematics and reading), but each student is also unique. Typically, in the school district where my study was conducted, inclusion classes have two teachers, namely, a general education teacher and a special education teacher. The special education teacher uses certain strategies to assist students with specific learning disabilities to access the general-education curriculum.

According to Mellard (2005), students with specific learning disabilities should be included in courses that match their strengths. If a student with autism is particularly good at mathematics and can successfully compete with general-education students in this area, there is no reason for the student to be in a self-contained classroom for this subject area. If this same student, however, struggles in every other subject area, a special education or resource classroom is likely to be more conducive to his or her learning needs. Students with specific learning disabilities should be placed in the least restrictive environment possible.

I focused in my study on the learning environments perceived by students with specific learning disabilities in inclusion and self-contained classrooms as part of the growing field of learning environments. Specifically, I investigated the attitudes and classroom learning environments of general-education students in inclusion classes, students with specific learning disabilities in inclusion classes, and students with specific learning disabilities in self-contained special-education classes.

In this chapter, I clarify the background of this study (Section 1.2), the Broward County Public School System (Section 1.3), and the purposes of the study and the underlying research question (1.4). The chapter also contains an overview of the organization of the chapters for the remainder of this thesis (Section 1.5).

1.2 Background of the Study

This section provides background information that is relevant to the study. It gives a brief introduction to the field of learning environments (Section 1.2.1), specific learning disabilities (Section 1.2.2), the identification of students with specific learning disabilities (Section 1.2.3), and inclusion (Section 1.2.4).

1.2.1 Field of Learning Environments

Because my study drew on and contributed to the field of learning environments research, this field is briefly introduced here and reviewed comprehensively in Chapter 2. Learning environment refers to the social, physical, psychological, and pedagogical context in which learning occurs and which affects student achievement and attitudes (Fraser, 1998). Teaching takes place within an environment which includes the physical setting, the climate and student expectations. The learning environment plays an important part in education and influences what students learn and the way in which they learn. The learning environment is very important to the success of students of all ages, especially those students with learning disabilities. "Although classroom environment is a subtle concept, remarkable progress has been made over the last two decades in conceptualizing, assessing and researching it" (Fraser, 2001, p. 3).

The field of learning environments has undergone remarkable growth, diversification, and internationalization during the past 40 years (Fraser 2012, 2014). In my study, I investigated the learning environment perceived by students with specific learning disabilities in inclusion and self-contained classrooms as part of the growing field of learning environment studies. Many researchers have investigated the effect of the learning environment on students' academic and affective achievement in school and the impact of their disability, particularly when in an inclusive classroom setting or an inclusion program. Teachers are aware that the environment or climate of a classroom is both important in its own right and influential in student learning. Many researchers have become interested in investigating the classroom environment and have used a variety of scales to measure the perceptions of students of their classroom environment and how they are affected by it.

International research efforts involving the conceptualization, assessment, and investigation of perceptions of aspects of the classroom environment have firmly established classroom environment as a thriving field of study (Fraser, 2012, 2014; Fraser & Walberg, 1991). For example, classroom environment research has focused on constructivist classroom environments (Aldridge, Fraser, Taylor, & Chen, 2000; Taylor, Fraser, & Fisher, 1997; Nix, Fraser & Ledbetter, 2005), computer-assisted instruction classroom (Teh & Fraser, 1994), and teacher interpersonal behavior in the classroom (Wubbels & Brekelmans, 2012; Wubbels, Creton, Levy, & Hooymayers, 1993). Classroom environment instruments have been used as sources of predictor and criterion variables in a variety of research studies. Use of student perceptions of actual classroom environment as independent variables in several different countries have established relationships between the nature of the classroom environment and various student cognitive and affective outcomes (Aldridge & Fraser, 2008; Fraser, 2014; Fraser & Fisher, 1982; Haertel, Walberg & Haertel, 1981). Research involving a person–environment fit perspective has shown that students achieve better where there is greater congruence between the actual classroom environment and that preferred by students (Fraser & Fisher, 1983a). Classroom environment variable have been used as criterion variables in the investigation of sex differences (Fraser & McRobbie, 1995; Peer & Fraser, 2015) and the evaluation of educational programs (Aldridge & Fraser, 2008; Lightburn & Fraser, 2007; Nix, Fraser & Ledbetter, 2005; Wolf & Fraser, 2008). The combination of qualitative and quantitative methods has been a feature of several learning environment studies (Aldridge & Fraser, 2008; Fraser & Tobin, 1991; Tobin & Fraser, 1998).

From as early as 1936, Kurt Lewin (1936) recognized that the environment is a determinant of human behavior. Following Lewin's work, Murray (1938) proposed a Needs−Press Model in which situational variables found in the environment account for a degree of behavioral variance. Foundations for classroom environment research were laid when the work of Lewin and Murray assumed particular significance. Lewin (1936) introduced the formula B=f(P, E) to describe human behavior (B) as a function of two interdependent influences, the Person (P) and the Environment (E). Murray (1938) developed this theory to describe the concepts of personal needs of individuals (including goals and drives) and the environmental press (including stimulus, treatment, and process variables). Murray's needs−press theories led to the development of various measures that rarely were considered in early studies.

Building on the work of Lewin and Murray, two research programs involved developing instruments that could be used to assess classroom learning environments. Herbert Walberg's Learning Environment Inventory (Anderson & Walberg, 1974) and Rudolf Moos's Classroom Environment Scale (Moos & Trickett, 1987) were the first instruments developed to assess students' perceptions of their learning environment, and these paved the way for the development of many subsequent instruments (Fraser, 2012).

In the past three decades, much attention has been given to the development and use of instruments to assess the qualities classroom learning environments from the perspective of the students (Fraser, 2012, 2014). As well, the association between learning environment variables and student outcomes has provided a particular rationale and focus for the use of learning environment instruments. Walberg's theory of educational productivity (Walberg, 1981) holds that there are nine factors which contribute to variance in students' cognitive and affective outcomes: student ability, age and motivation; the quality and content of instruction; and the psychological climate of the home, the classroom social group, the peer group outside the classroom, and the mass media (especially television viewing). Tests of this model of educational productivity attested to the importance of the learning environment, among a set of other factors, in co-determining student outcomes (Fraser, Walberg, Welch & Hattie, 1987).

1.2.2 Specific Learning Disabilities

Specific Learning Disability (SLD) is a general term that refers to different types of learning problems that can prevent someone from learning and using certain skills such as reading, writing, listening, speaking and mathematical computation. A learning disability is a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that can manifest itself in an imperfect ability to listen, think, speak, read, write, spell or do mathematical calculations. This includes conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia as stated in the *Individuals with Disabilities Education Act* (IDEA) (1997). The definition further states that learning disabilities do not include learning problems that are primarily the result of visual, hearing, or motor disabilities, of mental retardation, of emotional disturbance, or of environmental, cultural or economic disadvantage.

The main types of learning disabilities among students in my study were dyscalculia and dyslexia, which involve processing problems that interfere with learning basic skills such as reading, writing and/or mathematics. Dyscalculia is a specific learning disability that affects a person's ability to understand numbers and learn mathematical facts. Dyslexia is a specific learning disability that affects reading and related language-based processing skills and which can affect reading fluency, decoding, reading comprehension, recall, writing, spelling and sometimes speech.

1.2.3 Identification of Students with Specific Learning Disabilities

The students who participated in this study were labeled as having specific learning disabilities after having been officially identified by the procedures adopted by all schools in Broward County, Florida, and based upon guidelines suggested by Schwab Learning (Baumel, 2003). These students were eligible to receive special educational services under the IDEA (Individuals with Disabilities Education Act) federal law. However, students with severe physical or intellectual disabilities were not included in my study. The process of identification of students with learning difficulties in Broward County is carried out by a committee that includes a general-education teacher, special-education teacher, school psychologist, exceptional student education facilitator, school counselor, and school administrator. Sometimes, depending on the circumstances, a social worker, physician, or occupational therapist can be a member of the committee. Parent permission has to be granted for all assessments to be undertaken. The parent provides the committee with key information about the child's history, talents, and behavior at home.

The Wechsler Intelligence Scale for Children Third Edition (WISC–III) is administered by the school psychologist to any student who has been referred to the special education department by a teacher or parent. The psychologist also generate an overall score for general ability and a score for verbal comprehension, perceptual reasoning, processing speed and working memory.

However, a student's classification as having a specific learning disability must be based on multiple indicators (e.g. school grades, classroom performance, behavior problems, school attendance record, teachers' recommendation, and possibly hearing and visual tests) in addition to the WISC–III. For students with specific learning disabilities, often there is a discrepancy between their academic performance at school and their general ability as assessed using the WISC. The students who are classified as having specific learning disabilities usually achieve below average and have oral and/or written communication problems. The assessment and identification procedures focus on a student's performance over time, in a variety of settings, with different people, and under different circumstances.

1.2.4 Inclusion

Heward (2003, p.61) describes inclusion as educating students with disabilities in regular classrooms. Inclusion is a term which expresses commitment to educate each child, to the maximum extent appropriate, in the school and classroom which he or she would otherwise attend (Downing & Eichinger, 2003, p. 26). Inclusion involves bringing the support services to the child, rather than moving the child to the services, and requires only that the child benefits from being in the class rather than having to keep up with the other students. Full inclusion means that all students, regardless of handicapping condition or severity, are in a regular classroom/program full-time. All services must be taken to the child in that setting. Many parents and teachers support inclusion because it is challenging and allows students to work to their highest potential. Being educated in this setting also prepares students to work in integrated settings with their non-disabled peers.

1.3 Broward County School District, Florida

This research was carried out in the state of Florida, United States, in Broward County which is a diverse, urban community with green space, parks and beautiful "Blue Wave" beaches. The County's 1,220 square miles consists of 31 municipalities. Broward is the nation's eighteenth largest county and is home to nearly 1.8 million people (www.broward.org). Broward County's ethnic and racial diversity, state-of the art healthcare, myriad of housing options, and advanced transportation system afford its residents exceptional quality of life. The area features world-famous dining, theatre, nightlife, and shopping, as well as golf, deep sea fishing, boating, and an abundance of other recreational activities. With South Florida's year-round warm climate, there are unlimited opportunities for fun in the sun on the beach or in the park. The median income for a family in Broward County is $51,251 U.S. and only 14.3% of families are below the poverty line (U.S. Census Bureau, 2013).

Broward County Public Schools (BCPS), where this research was carried out, is the sixth-largest largest fully-accredited K−12 and adult school system in the United States and the second largest in the state of Florida. BCPS is Florida's first fully-accredited school system since 1962 and has over 260,000 students and approximately 175,000 adult students in 238 schools, centers and technical colleges, and 102 charter schools. BCPS serves a diverse student population. Students are from 204 different countries and speak 135 different languages, which explains the need in my study for a parental permission form in the three major languages represented in the school district (www.BrowardSchools.com).

1.4 Purpose of the Study and Research Questions

The main purpose of the study was to provide insight into the classroom learning environments of students with specific learning disabilities in inclusion mathematics classes. The What Is Happening In this Class (WIHIC)? questionnaire (Aldridge & Fraser, 2000) was used to measure students' perceptions of their classroom learning environment. To measure students' attitudes toward Mathematics, a modified version of the Test of Science-Related Attitudes (TOSRA; Fraser, 1981) was used.

The study specifically addressed the following three main research questions:

1. *Are the What Is Happening In this Class? (WIHIC) questionnaire and the Test of Mathematics Related Attitudes (TOMRA) valid and reliable when used with students with specific learning disabilities?*

2. *Are there differences between students with specific learning disabilities in self-contained classes, students with specific learning disabilities in inclusion classes, and general-education students in inclusion classes in terms of their perceptions of classroom environment and their attitudes to mathematics?*

3. *Are there associations between the nature of the classroom environment and students' attitudes to mathematics?*

1.5 Organization of the Thesis

This thesis comprises five chapters. The first chapter included discussion of the rationale for the present study and provided a brief background to the study, including information about the field of learning environments and about special education, especially inclusion classes. The chapter included identification of the purposes of the present study and provided information about Broward County.

Chapter 2 reviews literature pertaining to learning environment and student attitudes. It highlights past research developments and findings. Also, this chapter reviews literature on education for students with specific learning disabilities.

Chapter 3 discusses methodology and provides insights into procedural aspects of the present study. This includes the research design used in the different phases of the study, the choice of learning environment and attitude scales, and the study's sample. Discussed in this chapter too is the administration of the questionnaires and data collection, as well as statistical procedures employed in the data analysis to answer my research questions.

Chapter 4 reports the data analysis and findings for the present study, including the reliability and validity of the classroom environment and attitude scales, differences between students with specific learning disabilities in self–contained and inclusion classes, and differences between students with specific learning disabilities and general-education students in inclusion classes. The chapter also reports associations between student outcomes (attitudes) and classroom environment.

Chapter 5 concludes the thesis with an overview of the entire thesis. Also, it summarizes the findings from the study in terms of: the validation of each assessment instrument; differences between students with specific learning disabilities in inclusion classes, students with specific learning disabilities in self-contained classes, and general-education students in inclusion classes; and associations between student attitudes and classroom environment. This chapter also discusses the practical implications of the findings from the study, significance of the study, limitations to the present study, and suggestions for further research.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

Chapter 2 is a review of the literature pertaining to the topics of learning environments, attitudes, and students with specific learning disabilities in inclusion and self-contained classes.

The structure of this chapter is summarized as follows:

2.2 Field of Learning Environments

- 2.2.1 Historical Perspective on the Field of Learning Environment
- 2.2.2 Instruments used to Measure Learning Environments
  - 2.2.2.1 Learning Environment Inventory (LEI)
  - 2.2.2.2 Classroom Environment Scale (CES)
  - 2.2.2.3 Individualized Classroom Environment Questionnaire (ICEQ)
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  - 2.2.2.8 What Is Happening In this Class? (WIHIC)
  - 2.2.2.9 Other Questionnaires
- 2.2.3 Research on Learning Environments

2.2 Field of Learning Environments

Learning environment refers to the social, physical, psychological, and pedagogical context in which learning occurs and which affects student achievement and attitudes (Fraser, 2000). Teaching takes place within an environment that includes the physical setting, the climate and student expectations. The Merriam Webster's Collegiate Dictionary defines environment as the circumstances, objects or conditions in which one is surrounded. Although there are different aspects to the word environment, in the context of a classroom and for the purposes of learning environment research, it can be defined as the shared perceptions of the students and sometimes the teachers in that environment (Fraser, 2001).

There are three aspects of the classroom environment: the physical, human, and social. The physical environment includes the material and setting, including furniture, lighting, and how furniture and objects are laid out in the classroom. That is, how the desk and chairs are arranged, how appealing the bulletin boards are, and the temperature of the room. Research on the classroom environment has shown that the physical arrangement can affect the behavior of both students and teachers (Savage, 1999; Stewart & Evans, 1997; Weinstein, 1992), and that a well-structured classroom tends to lead to improved student academic and behavioral outcomes (MacAulay, 1990; Walker, Colvin & Ramsey, 1995; Walker & Walker, 1991). The human environment encompasses how the teacher facilitates learning and plays an important part in making it more conducive to learning for all students. Brophy and Putnam (1979) have shown in past studies that effective learning is related to a positive classroom environment. The social environment of the classroom includes the perceptions of students and how they interact with their teacher and classmates. Recent research has indicated that these various dimensions of the classroom social environment, although separate, can be measured quickly and reliably, and are related significantly to students' motivation, self regulated learning, classroom behavior (both positive and negative), social relationships, and achievement (Ryan & Patrick, 2001). In my study, the emphasis was placed on the social environment.

In working with students with learning disabilities, sometimes their Individual Education Plan (IEP) states how they should be seated in the classroom in close proximity to the board, because of a visual problem, or in close proximity to the teacher if there is a hearing problem or if the student needs constant reinforcement or redirection. Research of classroom learning environments suggests that classrooms should be organized to accommodate a variety of activities throughout the day and to meet the teacher's instructional goals (Savage, 1999; Weinstein, 1992).

The learning environment plays an important part in education and influences what students learn and the way in which they learn. The learning environment is very important to the success of students of all ages, especially those students with learning disabilities. "Although classroom environment is a subtle concept, remarkable progress has been made over the last two decades in conceptualizing, assessing and researching it" (Fraser, 2001, p. 3). The field of learning environments has undergone remarkable growth, diversification, and internationalization during the past 30−40 years and has influenced a lot of other research and has been included in books (Aldridge & Fraser, 2008; Fisher & Khine, 2006; Fraser, 1986; Fraser & Walberg, 1991; Goh & Khine, 2002; Khine & Fisher, 2003; Moos 1979; Walberg, 1976; Wubbels & Levy, 1993), literature reviews (Fraser 1994, 1998, 2007, 2012, 2014), the American Educational Research Association's Special Interest Group (SIG) on Learning Environments which started in the mid-1980s, the initiation in 1998 of Kluwer/Springer's *Learning Environments Research: An International Journal*, and the Sense Publishers' book series commencing in 2008: *Advances in Learning Environments Research* (Aldridge and Fraser, 2008).

2.2.1 Historical Perspective on the Field of Learning Environments

The first researchers to develop the precursors to learning environment studies were Lewin (1936) and Murray (1938). While conducting research in business settings, Lewin (1936) realized that considering both the learning environment and the individuality of subjects was a good way of determining and analyzing human behavior. Lewin (1936) developed the formula *B*=f(*P*,*E*) in which behavior (*B)* is a function (f) of people (*P*) and their environment (*E*). The familiar *B*=f(*P,E*) formula of Lewin (1936) also referred to as the person−environment interaction paradigm (Hunt, 1975). In the classroom setting, behavior (learning) would be viewed as being jointly determined by the person (the learner) and the environment (way of teaching).

Murray (1938) introduced the term *alpha press* to describe the environment as it is viewed by people who function within that particular situation and the term *beta press* to describe the environment as perceived by milieu inhabitants. The needs−press theory that was further developed by Murray (1938) was mostly used it in the study of personality rather than in the study of teaching–learning processes in the classroom. This model was used to explain an individual's behavior within an environment as the result of the interaction between a person's needs and the external environment.

Stern, Stein and Bloom (1956) extended Murray's *beta press* by suggesting that there is a distinction between *private beta press* (a person's unique view of the environment) and *consensual beta press* (a shared view of the environment). Private and consensual beta press could differ from each other, and both could differ from the detached view of alpha press of a trained non-participant observer.

A framework for the analysis of the classroom group as a unique social system was developed by Getzels and Thelen (1960). A theory of person–environment congruence, in which complementary combinations of personal needs and environmental press enhance student outcomes, was developed by Stern (1970). Later, Doyle (1986) proposed that the classroom environment be viewed from an ecological viewpoint, placing strong emphasis on inter-relationships and communications among all members in the classroom community.

Walberg and Moos pioneered many extensive research studies into perceptions of classroom environment from the 1960s. Classroom environment research really began to attract attention from the late 1960s with the much-heralded work of, first, Walberg (Walberg & Anderson, 1968a, 1968b) who developed the widely-used Learning Environment Inventory (LEI) in connection with the research and evaluation related to Harvard Project Physics and, second, Moos who began developing the first of his social climate scales, including those for use in psychiatric hospitals and correctional institutions, which ultimately resulted in the development of the Classroom Environment Scale (CES) (Moos, 1979; Moos & Trickett, 1987; Trickett & Moos, 1973). A distinct tradition of research on students' perceptions in their classroom environment emerged (Fraser, 1986; Fraser & Walberg, 1981) as evidenced in the impressive list of literature reviews concerning the field (e.g. Fraser, 1994, 1998, 2007, 2012) and a guest-edited journal issue (McRobbie & Ellett, 1997).

2.2.2 Instruments Used to Measure Learning Environment

Many researchers have become interested in investigating the classroom environment and have used a variety of scales to measure students' perceptions of their classroom environment and how they are affected by it (Fraser, 1998). Because of the importance of research into learning environments, numerous instruments have been developed. These questionnaires have been written for different educational levels. Some of the instruments used for assessing classroom environment are: the Learning Environment Inventory (LEI), Classroom Environment Scale (CES), Individualized Classroom Environment Questionnaire (ICEQ), My Class Inventory (MCI), Questionnaire on Teacher Interaction (QTI), Constructivist Learning Environment Survey (CLES), Science Laboratory Environment Inventory (SLEI), and What Is Happening In this Class? (WIHIC) questionnaire. These are discussed further in this section and are overviewed in Table 2.1 which provides a classification of scales contained in eight classroom environment instruments according to Moos' scheme. Many of these instruments are similar in nature because they share Moos' (1974) three basic types of dimension which are relationship dimensions, personal development dimensions, and system maintenance and system change dimensions. The relationship dimension indentifies the nature and intensity of personal relationships within the environment and assesses the extent to which people are involved in the environment and support and help each other. The personal development dimension assesses basic directions along which personal growth and self-enhancement tend to occur. System change dimensions involve the extent to which the environment is orderly, clear in expectations, maintains control and is responsive to change.

Table 2.1 overviews eight of the classroom environment instruments, showing each individual scale and its classification according to Moos' scheme. Some of the questionnaires are suitable for use in the elementary school, including students with learning disabilities. Sections 2.2.2.1 to 2.2.2.8 briefly describe each instrument.

TABLE 2.1 Overview of Scales Contained in Eight Classroom Environment Instruments (LEI, CES, ICEQ, MCI, QTI, SLEI, CLES, and WIHIC)

Instrument	Level	Item per Scale	Moos's Classification: Relationship Dimensions	Moos's Classification: Personal Development Dimensions	Moos's Classification: Systems Maintenance and Change Dimensions
Learning Environment Inventory (LEI)	Secondary	7	Cohesiveness Friction Favouritism Cliqueness Satisfaction Apathy	Speed Difficulty Competitiveness	Diversity Formality Material Environment Goal Direction Disorganization Democracy
Classroom Environment Scale (CES)	Secondary	10	Involvement Affiliation Teacher Support	Task Orientation Competition	Order and Organization Rule Clarity Teacher Control Innovation
Individualized Classroom Environment Questionnaire (ICEQ)	Secondary	10	Personalization Participation	Independence Investigation	Differentiation
My Class Inventory (MCI)	Elementary	6–9	Cohesiveness Friction Satisfaction	Difficulty Competitiveness	
Questionnaire on Teacher Interaction (QTI)	Secondary/ Primary	8–10	Leadership Helpful/Friendly Understanding Student Responsibility/ Freedom Uncertain Dissatisfied Admonishing Strict		
Science Laboratory Environment Inventory (SLEI)	Upper Secondary/ Higher Education		Student Cohesiveness	Open-endedness Integration	Rule Clarity Material Environment
Constructivist Learning Environment Survey (CLES)	Secondary	7	Personal Relevance Uncertainty	Critical Voice Scared Control	Student Negotiation
What Is Happening In this Class? (WIHIC)	Secondary	8	Student Cohesiveness Teacher Support Involvement	Investigation Task Orientation Cooperation	Equity

Based on Fraser (2012).

2.2.2.1 Learning Environment Inventory (LEI)

As noted above, the initial development and validation of a preliminary version of the Learning Environment Inventory (LEI) began in the late 1960s in conjunction with the evaluation and research related to Harvard Project Physics (Fraser, Anderson & Walberg, 1982; Walberg & Anderson, 1968). The Learning Environment Inventory (LEI) measures student perceptions of the social climate of high school classrooms. The final version of the LEI has 105 statements (or seven items per scale) descriptive of typical school classes. This instrument has 15 climate scales and measures the student's perception of what the classroom is like using the four responses of Strongly Disagree, Disagree, Agree, and Strongly Agree.

2.2.2.2 Classroom Environment Scale (CES)

The Classroom Environment Scale (CES) was developed by Rudolf Moos at Stanford University (Trickett & Moos, 1973; Moos & Trickett 1974) and grew out of a comprehensive program of research involving perceptual measures of a variety of human environments including psychiatric hospitals, prisons, university residences and work locations (Moos, 1974). The final published version contains nine scales with 10 items of True−False response format in each scale. Published materials include a test manual, a questionnaire, an answer sheet and a transparent hand scoring key. Typical items in the CES are "The teacher takes a personal interest in the students" (Teacher Support) and "There is a clear set of rules for students to follow" (Rule Clarity). This instrument has nine scales with 10 items that require a

True or False response. In Australia, Fisher and Fraser (1983b) cross-validated the CES with a sample of 1083 grade 8 and 9 science students in Tasmania, Australia.

2.2.2.3 Individualized Classroom Environment Questionnaire (ICEQ)

The Individualized Classroom Environment Questionnaire (ICEQ) is designed to measure student or teacher perceptions of actual and preferred classroom learning environment along dimensions which differentiate individualized classrooms from conventional ones. These dimensions are Personalization, Participation, Independence, Investigation, and Differentiation (Fraser, 1990; Rentoul & Fraser, 1979). The initial ICEQ (Rentoul & Fraser, 1979) was developed by interviewing teachers and students, reviewing the literature on individualized, open and inquiry-based education, and seeking the reactions to the draft versions from teachers and junior high school students. The ICEQ has 50 items to which respondents choose Almost Never, Seldom, Sometimes, Often and Very Often when answering the questionnaire. A shorter version of the ICEQ (Fraser, 1998; Fraser & Fisher 1983b) was developed in order to facilitate teachers and students who were interested in an instrument that would take less time to administer and score. The shorter version of the ICEQ has only 25 items designed for easy scoring and short testing time; however, it still exhibits satisfactory reliability for class means.

2.2.2.4 My Class Inventory (MCI)

The Learning Environment Inventory (LEI) has been simplified to form the My Class Inventory (MCI) for use among children aged 8−12 years (Fisher & Fraser, 1981; Fraser, Anderson & Walberg, 1982; Fraser & O'Brien, 1985). To make it less tiring for students, the MCI has only five scales and a two-point response format. The Yes or No format makes it user-friendly for students with learning disabilities. Many of these students have reading difficulties but, because of the nature of the MCI, they are able to use it effectively. Fraser (1990) pointed out four important ways in which the MCI differs from the LEI. First, in order to minimize fatigue among younger children, the MCI contains only five of the LEI's original 15 scales. Second, the item wording is simplified to enhance readability. Third, the LEI's four point response format is reduced to a two point (Yes–No) response format. Fourth, students answer on the questionnaire itself instead of on a separate response sheet to avoid errors in transferring responses from one place to another (Fraser, 1998).

Goh, Young and Fraser (1995) conducted research that focused on the learning environment of primary school mathematics in Singapore. The primary aim was to examine relationships between students' perceptions of their science classroom environment and their achievement and attitudes. Another purpose was to explore differences between actual and preferred perceptions, as well as differences between boys and girls. Goh, Young and Fraser (1995) modified the MCI by using Seldom, Sometimes and Most of the Time as the response alternatives and included a Task Orientation scale. The sample consisted of seven intact classes of Primary 5 pupils from one coeducational government primary school in Singapore. Positive associations were found between the nature of the primary science class environment and the students' attitudinal and achievement outcomes. In addition, it was found that girls held more favorable perceptions than boys.

In Brunei Darussalam, Majeed, Fraser and Aldridge (2002) used an English-language version of the MCI among 1565 lower-secondary mathematics students in 81 classes in 15 government schools. When Majeed and his colleagues removed the MCI's Satisfaction scale to use as an outcome variable, they established a satisfactory factor structure and sound reliability for a refined three-scale version of the MCI assessing Cohesiveness, Difficulty and Competition. These researchers reported sex differences in learning environment perceptions and associations between students' satisfaction and the nature of the classroom environment.

In Texas, Scott Houston, Fraser and Ledbetter (2008) used the MCI in an evaluation of science kits among a sample of 588 grade 3−5 students. As well as attesting to the validity of the MCI, data analyses suggested that using science kits was associated with a more positive learning environment in terms of student satisfaction and cohesiveness.

In a small-scale evaluation of a K–5 mathematics program that integrates children's literature called Project SMILE (Science and Mathematics Integrated with Literature Experiences), Mink and Fraser (2005) used the MCI, attitude scales and qualitative methods among a sample of 120 5th grade mathematics students in Florida. The implementation of SMILE was found to have a positive impact in that there was congruence between students' actual and preferred classroom environment.

Sink and Spencer (2005) advocate the use of the MCI as an accountability tool for elementary school counselors. Using a large sample of 2835 grade 4−6 students in an urban school district in Washington State, these researchers found that an 18-item revision of the MCI (assessing Cohesiveness, Friction and Satisfaction) was psychometrically sound. Implications for elementary school counseling programs and practices and their evaluation were considered by the authors.

2.2.2.5 Questionnaire on Teacher Interaction (QTI)

The Questionnaire on Teacher Interaction (QTI) was developed specially for evaluating teacher–student relationships in secondary schools (Wubbels, Brekelmans & Hoomayers, 1991; Wubbels & Levy 1993). This research originated in the Netherlands and involves the types of interpersonal relationships that exist between students and their teachers. Students rate the teacher based on his/her behavior towards them and in the classroom. The QTI assesses student perceptions of eight behavior aspects: Leadership, Helpful/Friendly, Understanding, Student Responsibility/Freedom, Uncertain, Dissatisfied, Admonishing and Strict. The response alternatives range from Never to Always on a five-point scale (namely 0 to 4). The original version of the QTI has 77 items (Wubbels, Creton & Hooymayers, 1985). Following this, an American version with 64 items (Wubbels & Levy, 1993) and then an Australian version with 48 items (Goh & Fraser, 1996) were developed.

The QTI has been cross-validated at different grade levels in the USA (Wubbels & Levy, 1993), Australia (Fisher, Henderson & Fraser, 1997), Singapore (Goh & Fraser, 1996), Brunei (Riah & Fraser, 1998) and Indonesia (Fraser, Aldridge & Soerjaningsih, 2010). Some examples of classroom environment research involving the use of the QTI include: a study of the professional development of teachers (Fisher, Fraser & Cresswell, 1995); research in secondary science classrooms

(Fisher, Goh, Wong & Rickards, 1997); the assessment of teacher–student interpersonal relationships in mathematics classrooms (Fisher, Rickards & Fraser, 1996; Rickards & Fisher, 1996); the investigation of sex differences in biology students' perceptions of teacher–student relationships (Henderson, Fisher & Fraser, 1995); associations between learning environments and student outcomes (Henderson, Fisher & Fraser, 1995); the relationship between teacher personality and interpersonal teacher behavior (Kent, Fisher & Fraser, 1995); and the relationship between science students' perceptions of their teacher's interpersonal behavior, students' cultural environment and the students' preferred student–teacher interpersonal behavior (Waldrip & Fisher, 1999).

In Brunei Darussalam, Scott and Fisher (2004) validated a version of the QTI in standard Malay with 3104 students in 136 elementary-school classrooms and showed that achievement was related positively to cooperative behaviors and negatively to submissive behaviors. In Singapore, Quek, Wong and Fraser (2005) validated an English version of the QTI with 497 gifted and non-gifted secondary-school chemistry students and reported some stream (i.e. gifted and non-gifted) and sex differences in QTI scores. In Korea, a translated version of the QTI was validated and used by Lee, Fraser and Fisher (2003) among 439 science students, and by Kim, Fisher, and Fraser (2000) among 543 students. In Indonesia, a translated version of the QTI was validated with a sample of 422 university students by Fraser, Aldridge and Soerjaningsih (2010).

These studies show that the type of interaction that students have with their teacher is very important and can influence how well they perform in the class. Students with disabilities especially benefit from interacting with their teachers because this helps them to feel comfortable in their learning environment and to succeed. A good feature of the QTI is that one gets information on how students or their teachers perceive each other.

2.2.2.6 Constructivist Learning Environment Survey (CLES)

The Constructivist Learning Environment Survey (CLES) (Taylor, Dawson & Fraser 1995; Taylor, Fraser & Fisher 1997) was developed to assist researchers and teachers to assess the degree to which a particular classroom's environment is consistent with a constructivist epistemology. This instrument has 30 items and a five-point frequency response scale (Almost Never, Seldom, Sometimes, Often and Almost Always). The CLES is based on three principles of constructivism: learning as a construction of knowledge; that knowledge is constructed inter-subjectively; and that the learner is an interactive co-constructor of scientific knowledge (Taylor, Dawson & Fraser, 1995; Taylor, Fraser & Fisher, 1997; Taylor, Fraser & White, 1994). The CLES contains five scales (Personal Relevance, Uncertainty, Critical Voice, Shared Control, and Student Negotiation), with seven items per scale.

The CLES was translated into Korean and has been validated with 1083 students in high school science classes in Korea (Kim, Fisher & Fraser, 1999). The English version of the CLES was validated with 1081 students in Australia and a Chinese version was administered to 1879 students in Taiwan (Aldridge, Fraser, Taylor & Chen, 2000). The CLES also has been used successfully in South Africa (Aldridge, Fraser, & Sebela 2004) and in several studies in the USA (Dryden & Fraser, 1996; Johnson & McClure, 2004; Nix, Fraser & Ledbetter, 2005).

Working with a diverse sample of 1,079 students in 59 science classes in North Texas, Nix, Fraser and Ledbetter (2005) reported strong support for the validity of the CLES. Following the removal of four items, each of the remaining 26 items had a factor loading of at least 0.40 on its own scale and less than 0.40 on all other scales, with a total of 45.5% of the variance being accounted for. Alpha reliabilities for different CLES scales ranged from 0.87 to 0.93 when the class mean was used as the unit of analysis, and all CLES scales were capable of differentiating significantly between the perceptions of students in different classes.

In a cross-national study of junior high-school science classroom learning environments, the English version of the CLES was administered to 1,081 students in 50 classes in Australia while a Mandarin translation was administered to 1,879 students in 50 classes in Taiwan. Aldridge, Fraser, Taylor and Chen (2000) reported sound validity (factor structure, reliability and ability to differentiate between classrooms) for both English and Mandarin versions of the CLES. Additionally, these researchers reported that Australian classes were perceived as being more constructivist than Taiwanese classes (especially in terms of Critical Voice and Student Negotiation).

In South Africa, Aldridge, Fraser and Sebela (2004) administered the English version of the CLES to 1,864 grade 4-6 mathematics learners in 43 classes. This led to the cross-validation of this version of the CLES for this population in terms of factorial validity, internal consistency reliability and ability to differentiate between classrooms. The primary focus of this study was to assist South African teachers to become more reflective practitioners in their daily classroom teaching. Through the use of the CLES in teacher action research, some improvements in the constructivist orientation of classrooms were achieved during a 12-week intervention.

Peiro and Fraser (2009) modified the CLES, translated it into Spanish, and administered this version to 739 grade K–3 science students in Miami-Dade, Florida, USA. Analyses supported the validity of the modified English and Spanish versions when used with these young children. Strong and positive associations were found between students' attitudes and the nature of the classroom environment, and a three-month classroom intervention led to large and educationally-important changes in classroom environment.

Koh and Fraser (2014) used a modified version of the CLES to evaluate the effectiveness of a pedagogical model known as the Mixed Mode Delivery (MMD) model. Comparisons were made between 2,216 secondary school students taught by the preservice teachers in an MMD group and 991 students in a control group in terms of the relative magnitudes of the gap between the actual and preferred learning environment in students' school classrooms. This study also supported the factorial validity and internal consistency reliability of the CLES.

2.2.2.7 Science Laboratory Environment Inventory (SLEI)

The Science Laboratory Environment Inventory (SLEI) is an instrument specially suited to assess the environment of science laboratory classes at the senior high school or higher education levels (Fraser, Giddings & McRobbie, 1995; Fraser & McRobbie, 1995; Fraser, McRobbie & Giddings, 1993). The SLEI has five scales (each with seven items) and the five response alternatives are Almost Never, Seldom, Sometimes, Often and Very Often.

The SLEI's Open-endedness scale assesses the extent to which laboratory activities emphasize an open-ended divergent approach to experimentation. In other words, can students explore problems for which the answer is not already known? Integration refers to the extent to which the laboratory activities are integrated with non-laboratory and theory classes. For instance, does what is being taught via lectures support what is being taught in the laboratory?

The SLEI was field tested and validated simultaneously with a sample of 5,447 students in 269 classes in six different countries (the USA, Canada, England, Israel, Australia and Nigeria) (Fraser & McRobbie, 1995). It has been cross-validated with 1,594 Australian students in 92 classes (Fraser & McRobbie, 1995), 489 senior high school biology students in Australia (Fisher, Henderson & Fraser, 1997), two different samples of grade 10 chemistry students in Singapore (Quek, Wong & Fraser, 2005; Wong & Fraser, 1995), 440 Grade 10 and 11 science students in Korea (Fraser & Lee, 2009), 644 Grade 10 chemistry students in Brunei (Riah & Fraser, 1998), and 761 high school biology students in Miami, Florida, USA (Lightburn & Fraser, 2007) .

Fraser and Lee (2009) translated the SLEI into Korean language for use in a study of differences between the classroom environments of three streams (science-independent, science-oriented and humanities). The sample consisted of 439 high school students divided among these three streams. The Korean version of the SLEI exhibited sound factorial reliability and was able to differentiate between the perceptions of students in different classes. Generally, students in the science-independent stream perceived their laboratory classroom environments more favorable than did students in either of the other two streams.

Working with a sample of 761 high-school biology students in 25 classes in southeastern USA, Lightburn & Fraser (2007) used the SLEI in an evaluation of the effectiveness of using anthropometry activities. Data analyses supported not only the SLEI's validity (in terms of factor structure, internal consistency reliability and ability to differentiate between classrooms), but they also suggested that there was a positive influence of using anthropometric activities in terms of both classroom learning environment and student attitudes.

2.2.2.8 What Is Happening In this Class? (WIHIC) Questionnaire

Based on past studies, Fraser, Fisher, and McRobbie (1996) developed a new learning environmental instrument called What Is Happening In this Class? (WIHIC) which incorporates scales that have been used and found to be significant predictors of learning outcomes. They also included additional scales which were designed to measure current concerns in classrooms, such as equity issues.

The WIHIC was selected for my study in order to gather data about students' perceptions of their classroom learning environment because it is the most-frequently used classroom instrument around the world today (Fraser, 2012). According to Dorman (2008), the WIHIC has achieved almost bandwagon status in the assessment of classroom environments.

The original 90-item nine-scale version of the WIHIC was refined by statistical analysis of data from 355 junior high-school science students, and extensive interviewing of students about their views of their classroom environments in general, the wording and salience of individual items and their questionnaire responses. The final version of the WIHIC questionnaire contains seven eight-item scales, namely, Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation and Equity (Aldridge, Fraser & Huang, 1999).

The WIHIC has been used in the English language and validated in numerous studies in:

- Singapore with 2310 grade 10 geography and mathematics students (Chionh & Fraser, 2009), 250 working adults attending computing courses (Khoo & Fraser, 2008) and 1081 primary science students (Peer & Fraser, 2015).
- India with 1021 science students in 31 classes (Koul & Fisher, 2005),
- Australia and Canada with 1404 students in 81 networked classrooms (Zandvliet & Fraser, 2004, 2005)

- Australia with 567 secondary science students (Fraser, Aldridge & Adolphe, 2010)
- Canada with 1173 grade 7–12 mathematics and science students (Fraser & Raaflaub, 2013).

The WIHIC also has been used and crossvalidated in:

- the Indonesian language with 594 secondary science students (Fraser, Aldridge & Adolphe, 2010) and 1400 lower-secondary science students (Wahyudi & Treagust, 2004)
- the Arabic language with 352 college students (Afari, Aldridge, Fraser & Khine, 2013) and 763 college students (MacLeod & Fraser, 2010)
- the Korean language with 543 grade 8 science students (Kim, Fisher & Fraser, 2000)
- the IziZulu language (South Africa) with 1077 grade 4–7 students (Aldridge, Fraser & Ntuli, 2009).

Of particular relevance to my study, which involved the use of the WIHIC, is the fact that the WIHIC has been used and crossvalidated extensively in the USA in:

- New York with 1431 middle-school science students (Wolf & Fraser, 2008) and with 1097 grade 7 and 8 science students (Cohn & Fraser, in press)
- Florida with 924 grade 8–10 science students (Helding & Fraser, 2013), 78 parents and 172 kindergarten students (Robinson & Fraser, 2013), 573 grade 3–5 students (Pickett & Fraser, 2009), 120 parents and 520 grade 4 and 5 students (Allen & Fraser, 2007), and 223 Hispanic grade 4–6 students (Adamski, Fraser & Peiro, 2013).

- California with 525 female university science students (Martin-Dunlop & Fraser, 2008), 661 middle-school mathematics students (Ogbuehi & Fraser, 2007), 665 middle-school science students (den Brok, Fisher, Rickards & Bull, 2006), and 745 high-school mathematics students (Taylor & Fraser, 2013).

Aldridge and Fraser (2000) and Aldridge, Fraser and Huang (1999) investigated the learning environments in science classes in Taiwan and Australia using the WIHIC. A Mandarin version of the personal form of the (WIHIC) questionnaire was developed for the Taiwanese students. The procedure for developing the questionnaire started with the English version of the WIHIC questionnaire being translated into Mandarin by educators in Taiwan. Afterwards, the Mandarin version was back translated into English by an independent third party. The back translations were checked to ensure that the Mandarin version retained the original meanings and concepts in the original English version. Modifications were made to the original English version of the WIHIC to create parallel questionnaires, one in English and one in Mandarin. This study involved validating the WIHIC with 1081 Australian students and 1879 Taiwanese students in junior high-school science classes.

A comprehensive validation of the WIHIC was conducted by Dorman (2003) using a cross-national sample of 3,980 high school students from Australia, the UK and Canada. Confirmatory factor analysis supported the seven-scale a priori structure, with fit statistics indicating a good fit of the model to the data. The use of multi-sample analyses within structural equation modeling substantiated invariant factor structures for the three grouping variables of country, grade level and student sex.

Dorman's study supported "the wide international applicability of the WIHIC as a valid measure of classroom psychosocial environment" (p. 231).

Dorman (2008) used both the actual and preferred forms of the WIHIC with a sample of 978 secondary-school students in Australia. Separate confirmatory factor analyses for the actual and preferred forms supported the seven-scale a priori structure, with fit statistics again indicating a good fit of the models to the data. The use of multitrait–multimethod modeling with the seven scales as traits and the two forms of the instrument as methods supported the WIHIC's construct validity. This research provided "strong evidence of the sound psychometric properties of the WIHIC" (p. 179).

The WIHIC was selected for use in this study because of the appropriateness of its dimensions and because of its proven validity and reliability in numerous past studies in various countries. The WIHIC questionnaire's use in my study is discussed further in Chapters 3 and 4. Although the original WIHIC assesses seven dimensions of the classroom environment, only five scales of these were utilized in my study: Student Cohesiveness, Teacher Support, Involvement, Task Orientation, and Cooperation. Students were asked to respond to each statement by indicating whether it represented a situation which happen Almost Never, Seldom, Sometimes, Often, or Almost Always.

2.2.2.9 Other Questionnaires

The Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI) incorporates all of the WIHIC's seven scales, but also includes the Differentiation scale from the Individualized Classroom Climate Environment Questionnaire (ICEQ, Fraser, 1990), a Computer Usage scale, and a Young Adults Ethos scale (the extent to which teachers give students responsibility and treat them as adults). The TROFLEI has 80 items (8 per scale) and a five-point frequency response format. The TROFLEI has been validated with 2317 students of 166 grade 11 and 12 classes in Australia (Aldridge & Fraser, 2008) and with a sample of 1249 Australian students (Aldridge, Dorman & Fraser, 2004). When the TROFLEI was used in monitoring the success of a new school, data from 4146 grade 8–13 students supported the efficacy of the school's programs (Aldridge & Fraser, 2008).

Welch, Cakir, Peterson and Ray (2012) cross-validated and used the TROFLEI with 980 grade 9–12 students in Turkey and 130 grade 9–12 students in the USA. Koul, Fisher and Shaw (2011) validated the TROFLEI with a sample of 1027 high-school students in New Zealand. These researchers reported sex differences in TROFLEI scores and associations between students' attitudes and TROFLEI scores. In Florida, Earle (2014) cross-validated the TROFLEI with 949 grade 6–8 mathematics students and employed TROFLEI dimensions as criteria of effectiveness in evaluating an online curriculum resource.

The Constructivist-Orientated Learning Environment Survey (COLES) incorporates six of the WIHIC's seven scales (while omitting Investigation). Like the TROFLEI,

the COLES also includes the scales of Differentiation and Young Adults Ethos. In addition, the COLES includes the Personal Relevance scale from the CLES. Importantly, the COLES has two scales related to assessment. Formative Assessment assesses the extent to which students feel that the assessment tasks make a positive contribution to their learning, whereas Assessment Criteria assesses the extent to which assessment criteria are explicit so that the basis for judgement is clear and public. Aldridge, Fraser, Bell and Dorman (2012) validated the COLES with a sample of 2043 grade 11 and 12 students from 147 Western Australian classes.
Recently, modified versions of the COLES have been cross-validated and used with samples of 264 undergraduate biology students at a historically-Black university in the USA (Martin-Dunlop, 2015) and 296 high-school students studying various subjects in 17 classes in Western Australia (Henderson & Loh, 2015).

Walker and Fraser (2005) developed the Distance Education Learning Environment Survey (DELES) to assess post-secondary distance-education settings. This online questionnaire has six scales (Instructor Support, Student Interaction and Collaboration, Personal Relevance, Authentic Learning, Active Learning, and Student Autonomy). When field tested in Texas with 680 university students, the DELES exhibited strong factorial validity and internal consistency reliability. In a recent study, Walker and colleagues developed a Spanish version of DELES (the Sp-DELES) and field tested in with 265 Health Psychology students at the University of Alicante (Ferrer-Cascales, Reig-Ferrer, Herranz-Bellido, Vallejo-Muñoz, Fernández-Pascual, and Albaladejo-Blázquez, 2010). Analysis supported the factor structure (with 72.9% of the variance accounted for and alpha reliabilities ranging from 0.86 to 0.97 for different scales).

Fisher and Waldrip (1997, 1999) developed the 40-item Cultural Learning Environment Questionnaire (CLEQ) to assess culturally-sensitive factors (Equity, Collaboration, Risk Involvement, Cooperation, Teacher Authority, Modelling, Congruence, and Communication). The CLEQ was validated with 3031 secondary science students in Australia by Fisher and Waldrip, and cross-validated with 475 teacher trainees at the University of Brunei Darussalam by Dhindsa and Fraser (2004).

Zandvliet (2013) developed the Place-Based and Constructivist Environment Survey (PLACES) and adapted it to form the SMILES for use among elementary-school students. The PLACES assesses Student Cohesion, Integration, Involvement, Teacher Support, Cooperation, Open-Endedness, and Environment Interaction, whereas SMILES assesses Relevance/Integration, Critical Voice, Student Negotiation, Group Cohesiveness, Student Involvement, Shared Control, Open-Endedness, and Environmental Interaction. Zandvliet (2013) confirmed the validity and reliability of SMILES and found that its scales supported an ecological view of classrooms in which learning environment factors such as pedagogy and environmental interaction work together to create positive learning environments.

2.2.3 Research on Learning Environments

Research on the learning environment originated in Western countries, but many researchers in other countries worldwide have now realized its importance and have been conducting this type of research. Some of the main questionnaires that were developed in Western countries have been adapted (and often translated into other languages) and cross-validated for use in several Asian countries, including Singapore (Chionh & Fraser, 1998; Goh & Fraser, 1998; Goh, Young, & Fraser, 1995; Teh & Fraser, 1994, 1995a, 1995b; Wong & Fraser, 1995, 1996), Brunei (Riah & Fraser, 1998; Scott & Fisher, 2000), Korea (Kim, Fisher & Fraser, 1999; Fraser & Lee, 2009), Taiwan (Aldridge & Fraser, 2000; Aldridge, Fraser & Huang, 1999; Aldridge, Fraser, Taylor & Chen, 2000), the United Arab Emirates (Afari et. al., 2013; Hasan & Fraser, 2015; MacLeod & Fraser, 2010), and Indonesia (Fraser, 1986; Fraser, Aldridge & Adolphe, 2010; Fraser, Pearse & Azmi, 1982; Margianti & Fraser, 2001; Paige, 1979; Schibeci, Rideng & Fraser, 1987). Some of these studies included questionnaires that were translated into their national language for administration. Past Asian research studies established the validity of classroom environment instruments that had been translated into the Indian (Walberg, Singh, & Rasher, 1997) and Indonesian (Schibeci, Rideng & Fraser, 1987) languages and replicated associations between student outcomes and classroom environment perceptions.

2.2.3.1 Associations between Classroom Environment and Student Outcomes

Past research has investigated associations between measures of students' outcomes and their perceptions of classroom environment. Fraser (1994) tabulated 64 past studies of associations that have involved a variety of cognitive and affective outcome measures, a variety of classroom environments instruments and a variety of samples (ranging across numerous countries and grade levels).

In a study in Australia (Fraser & Fisher, 1982b), sizeable associations between student perceptions of classroom environment and student outcomes lent support to a positive link between classroom environment and students' outcomes. Studies conducted in the Southeast Asian countries, such as Indonesia (Fraser, 1985; Fraser, Pearse & Azmi, 1982; Margianti, Fraser, & Aldridge, 2001b; Schibeci, Rideng & Fraser, 1987), Singapore (Chionh & Fraser, 2009; Goh, Young, & Fraser, 1995; Teh & Fraser, 1994; Wong & Fraser, 1996) and Brunei (Riah & Fraser, 1998) replicated prior research in that the nature of the psychological and social climate of classrooms was found to be an important determinant of student outcomes (Fraser, 2014).

Positive associations between classroom environments and students' attitudes towards science have reported in many studies (Fraser, Aldridge & Adolphe, 2010; Fraser & Fisher, 1982a; Fraser & McRobbie, 1995; Goh, Young & Fraser, 1995; Haladyna, Olsen & Shaughnessy, 1982; Keeves, 1972; Krynowsky, 1988; Manley, 1977; Schibeci, Rideng & Fraser, 1987; Wong & Fraser, 1966). However, the studies that were conducted by Anderson and Walberg (1968), in association with work with Harvard Project Physics, found that there was a negative correlation between the classroom environment variable of stratification and students' attitudes to physics.

Recent studies of associations between student outcomes and classroom environment have been extended from conventional classrooms to science laboratories in research by Fraser, Giddings and McRobbie (1995) which involved 5,447 senior high school and university students in 269 laboratory classes in Autralia, the USA, England, Canada, Israel and Nigeria. This research was the first of its kind in that the Science Laboratory Environment Inventory (SLEI) was being used for the first time. This instrument was validated and used in the six countries simultaneously. Significant associations were found between the nature of the science laboratory environment and affective outcomes. These findings replicated prior research in science classrooms and contributed to the development and validation of a new form of the SLEI. Overall, the study provided insights into the merits and pitfalls of cross-national research of this nature (Fraser, Giddings & McRobbie, 1995; Fraser, McRobbie & Giddings, 1993).

2.2.3.2 Evaluation of Educational Programs

Instruments used to assess the classroom environment can give researchers information that can be used in the evaluation of educational programs. For example, Maor and Fraser (1996) found that students perceived that their classes became more inquiry-oriented when they incorporated a classroom environment instrument when evaluating the use of a computerized database. In Singapore, classroom environment measures were used as dependent variables in the evaluation of computer-assisted learning (Teh & Fraser, 1994) and computer application courses for adults (Khoo & Fraser, 2008). My study used learning environment assessments in mathematics classrooms to identify differences in learning environment perceptions between students with and without specific learning disabilities in inclusion and self-contained classes.

In Miami-Dade County, Florida, Helding (2012) conducted a study of the effectiveness of the National Board Certified (NBC) teachers using the WIHIC and TOSRA. The objectives of her study were to determine if NBC teachers were more effective than non-NBC teachers in terms of secondary-school students' perceptions of their science learning environment, attitudes toward science, and science achievement. The participants consisted of 30 teachers and their 927 students, consisting of 443 students from 21 classes taught by NBC teachers and 484 students from 17 classes taught by non-NBC teachers. Statistically significant differences were found in favor of NBC teachers for numerous classroom environment scales (Teacher Support, Involvement, Task Orientation, Investigation and Cooperation) and for student attitudes.

Wolf and Fraser (2008) used the WIHIC to evaluate the effectiveness of using inquiry-based laboratory activities in terms of learning environment, attitudes, and achievement with 1, 434 middle-school science students in New York. This study revealed that inquiry instruction promoted more Student Cohesiveness than non-inquiry instruction. It also showed differences between male and female students in terms of the effectiveness of inquiry instruction.

Lightburn and Fraser (2007) evaluated the use of anthroprometric activities among high-school science students in Miami, Florida. The students were observed in a laboratory environment while gathering, processing and analyzing data that they collected from measuring the human body. This study revealed a positive influence for using anthroprometric activities in terms of students' attitudes and their perceptions of their classroom learning environments.

Martin-Dunlop and Fraser (2008) evaluated an innovative science course for prospective elementary school teachers using a learning environment perspective with a sample of 525 fourth-year female students at a university in California. Effect sizes were unusually large (over 1.5 standard deviations for every scale), with students perceiving the classroom environment more favorably for the innovative course than for their previous courses.

Hilton (2006) used the WIHIC and TOMRA in evaluating the use of hands-on manipulatives in mathematics. This study was conducted in two phases and included 817 fourth-grade and fifth-grade students from elementary schools in Florida. Students used hands-on manipulatives for 60% of the instructional time in Phase 1 of the study and 40% of the time in Phase 2. Although there was extensive use of hands-on manipulatives in the Miami-Dade County Public Schools, pretest–posttest changes in Phase 2 of the study did not support the effectiveness of using manipulatives. However, in Phase 1 of the study, the group using manipulatives for more time (60%) perceived significantly less Friction in the classroom than did the group using manipulatives for less time (40%). The effect size was approximately a quarter of a standard deviation (0.26), suggesting that the effect was small to moderate.

A modified version of the Constructivist Learning Environment Survey (CLES) was used in Singapore to evaluate the effectiveness of a pedagogical model called Mixed Mode Delivery (MMD) (Koh & Fraser, 2014). The researchers made comparisons between 2,216 secondary students taught by preservice teachers in a MMD group and 991 students in a control group in terms of the learning environment in their classrooms. The findings of this study showed a positive impact of the MMD in terms of students' perceptions of their classroom environments for all CLES scales.

Long and Fraser (2015) evaluated the effectiveness of two alternative middle-school science curriculum sequences, namely, a general science model and a topic-specific model (i.e., physics, chemistry, etc.), with a sample of 367 grade 8 science students from two U.S. states. Science was enjoyed more by students following the topic-specific sequence (statistically significant with an effect size of 0.74 standard deviations). Also, the general curriculum model was more effective than the specific model for Hispanic students in terms of Task Orientation, but the two alternative curriculum sequences were equally effective for Caucasian students.

Afari, Aldridge and Fraser (2012), in their study conducted in the United Arab Emirates (UAE), showed how introducing games into college-level mathematics classes was effective in terms of improving students' perceptions of their learning environment and their attitudes towards mathematics. Two surveys were administered in English and Arabic after modification to improve relevance to college-level mathematics students in the UAE. Of the 352 students surveyed, 90 were exposed to mathematics games. It was found that, over time, students perceived statistically significantly more teacher support, involvement, personal relevance, enjoyment of mathematics lessons and academic effectiveness.

2.3 Attitudes to Mathematics

When children start school, their attitudes towards learning have been influenced primarily by their home environments (Lumsden, 1994). However, success or failure in early-school experiences influences these initial attitudes which, in turn, have an impact on subsequent classroom situations (Lumsden, 1994; Reynolds & Walberg, 1992). In addition, students' attitudes are affected by their interactions with their peers (Fishbein & Ajzen, 1975; Reynolds & Walberg, 1992). Positive and learned responses also can have an impact on students' attitudes as they get older (Dossey, Mullis, Lindquist & Chambers, 1988).

In 1928, Thurstone defined an attitude as "the sum-total of a man's inclinations and feelings, prejudice and bias, preconceived ideas, fears, threats and convictions about any specific topic" (Thurstone, 1928, p. 531). Kerlinger, 1986, p. 453) defined an attitude as "an organized predisposition to think, feel, perceive, and believe toward a referent or cognitive object". Attitude can have a cognitive component, an affective component, and a behavioral component (McGuire, 1969).

Although there are various methods for assessing attitudes (e.g. Osgood's semantic differential or Guttman scales), Likert scales are the most common method in the social sciences (Tittle & Hill, 1967). Likert (1932) developed an approach in which respondents specify their level of agreement or disagreement to a series of statements on an agree–disagree scale. This measurement approach is used in the attitude questionnaire used in my study.

My study focused on students' attitudes towards mathematics, which influence the extent to which student outcomes are realized (Reed et al., 2010). The conceptions, attitudes and expectations of students regarding mathematics teaching and learning are thought to be significant factors underlying their school experiences and outcomes (Borasi, 1990; Reed, Drijvers & Kirschner, 2010).

In the field of mathematics education, McLeod (1992) defined attitude as a construct that represents an individual's degree of affect associated with a certain subject. Based in this point of view, attitude towards mathematics is an emotional disposition toward mathematics, such as the likes and dislikes of students, the enjoyment that they feel during lessons, and the preferences that they have during mathematics instruction (Aiken, 2002; Haladyna, Shaughnessy, & Shaughnessy, 1983).

Because students' attitudes towards mathematics were important constructs in my study, the Test of Mathematics Related Attitudes (TOMRA) was used to assess two aspects of attitudes. Section 2.4.1 and 2.4.2 below consider TOMRA in more detail.

2.3.1 Test of Mathematics Related Attitudes (TOMRA)

The Test of Mathematics Related Attitudes (TOMRA) is a modified form of the Test of Science Related Abilities (TOSRA), which was developed by Fraser (1981) to measure students' attitudes toward their science classes. Fraser based the scales of his instrument on a taxonomy of the affective domain related to science education in which Klopfer (1971) classified different attitudinal aims into six categories: manifestation of favorable attitudes towards science and scientist, acceptance of scientific enquiry as a way of thought, adoption of scientific attitudes, enjoyment of science learning experiences, development of interest in science and science-related activities, and development of interest in pursuing a career in science.

Because Fraser (1978) noted potential problems with several instruments used in the assessment of attitudes towards science (e.g. low statistical reliability, a lack of economy of items, and the combination of distinct attitude concepts into a single scale which creates a mixture of variables), he developed the TOSRA. The TOSRA builds on a previous group of five attitude scales which were extended and improved to create the final version of the TOSRA with seven scales consisting of ten items each (Fraser, 1981). The response format used in the TOSRA is a five-point Likert scale consisting of Strongly Agree, Agree, Not Sure, Disagree, or Strongly Disagree.

The TOSRA has been used to investigate associations between attitudes and achievement, but many researchers also used it to investigate associations between classroom environment and attitudes (Wong & Fraser, 1996). The TOSRA was found to be valid and reliable in both its English and Indonesian versions when used in a study of learning environments and attitudes with 1161 students in Australia and Indonesia (Fraser, Aldridge & Adolphe, 2010).

Several studies have used the TOSRA in a modified form to assess the attitudes of students in mathematics classes (Ogbuehi & Fraser, 2007; Spinner & Fraser, 2005). The same seven scales in the TOSRA are used in the TOMRA, but the word 'mathematics' replaces the word 'science'. For example, Adoption of Scientific Attitudes was changed to Adoption of Mathematical Attitudes. Two TOMRA scales, namely, Adoption of Mathematical Attitudes and Enjoyment of Mathematics Lessons, were incorporated into my study to investigate the associations between the nature of the classroom environment and attitudes towards mathematics, and to identifying differences between groups of students (e.g. students with specific learning disabilities in integrated and self-contained classes) in terms of their perceptions of classroom environment and their attitudes to mathematics.

In addition to TOSRA's extensive use in science, and its adaptation to mathematics, it is noteworthy that the TOSRA has been adapted for other subject areas. The TOSRA has been cross-validated and found useful in research involving the assessment of attitudes to the subject areas of geography (Walker, 2006), English (Liu & Frser, 2013), and Spanish (Adamski, Fraser & Peiro, 2013).

2.3.2 Past Studies of Attitudes towards Mathematics Using TOMRA

Several studies have investigated students' attitudes to learning mathematics using the TOMRA. Spinner and Fraser (2005) assessed students' attitudes to mathematics using the Enjoyment of Mathematics Lessons and Normality of Mathematicians scales from TOMRA. The TOMRA's factor structure and internal reliability were supported. The effectiveness of an innovative mathematics program, called the Class Banking System, was supported for a sample of elementary-school students in Florida in terms of scores on these two TOMRA scales.

Ogbuehi and Fraser (2007) used two scales of TOMRA, namely, Normality of Mathematicians and Enjoyment of Mathematics Lessons, with a sasmple of 661 middle-school mathematics students in 22 classrooms at four inner-city schools in California. The factor structure of this two-scale version of TOMRA was supported (with 32% of the variance accounted for and eigenvalues of 1.90 and 4.52). Alpha reliabilities were 0.64 and 0.82 with the student as the unit of analysis and 0.89 and 0.86 with the class mean as the unit of analysis. These researchers reported that an experimental group that experienced an innovative strategy for learning systems of linear equations experienced larger pretest–posttest improvements in TOMRA scores than a control group.

Castillo, Peiro and Fraser (2006) used the Attitude to Inquiry and Enjoyment of Mathematics Lessons scales of TOMRA in a study involving 600 high-school mathematics students in 30 classes in Florida. Factor analysis supported TOMRA's factor structure and scales alpha reliabilities were over 0.90 with the student as the unit of analysis. Statistically significant grade-level differences were reported for the Inquiry scale but not for Enjoyment.

Earle (2014) used three scales from TOMRA (Enjoyment of Mathematics Lessons, Attitude to Mathematical Inquiry, and Normality of Mathematicians) in an evaluation of online resources among a sample of 949 middle-school students in 49 mathematics classes in Florida. This study supported the factorial validity and internal consistency reliability of TOMRA, but indicated neither an advantage nor a disadvantage for using these online resources in terms of students' attitudes.

Some studies in mathematics education have involved the use of just one TOMRA scale, namely, Enjoyment of Mathematics Lessons. In the United Emirates, Aldridge, Afari and Fraser (2013) reported an alpha reliability of 0.95 for this scale for a sample of 352 mathematics students attending three higher-education institutions. Enjoyment scores were found to be significantly related to Teacher Support and Personal Relevance in the learning environment and to student Academic Efficacy. Using a large sample of 1173 grade 7–12 mathematics students in 73 mathematics and science classes in Ontario, Canada, Fraser and Raaflaub

(2013) reported an alpha reliability of over 0.90. Mathematics students reported lower Enjoyment than science students; male mathematics students reported higher Enjoyment than female mathematics students; and positive associations were found between student Enjoyment in mathematics and their classroom learning environments.

2.4 Special Education and Specific Learning Disabilities

Special education is an individually planned, specialized, intensive, goal-directed program. When practised most effectively and ethically, special education is also characterized by the use of research-based teaching methods, the application of which is guided by direct and frequent measures of student performance (Bushell & Baer, 1994; Greenwood & Maheady, 1997). Special education is determined by the level of instruction provided by teachers (Heward & Dardig, 2001). Contrary to the contentions of some, special education research has produced a significant and reliable knowledge base about effective teaching practices (Lovitt, 2000; Spear-Swerling & Sternberg, 2001; Vaughn, Gersten & Chard, 2000).

Special education can be seen as an intervention. Heward (2003) describes three phases of intervention. First, preventive intervention is designed to prevent potential or minor problems from becoming a disability. Second, remedial intervention attempts to eliminate the effects of a disability by teaching skills to students for independent and successful functioning, such as social, personal and vocational skills. Third, compensatory intervention involves teaching the use of skills or devices to enable successful functioning in spite of the disability.

2.4.1 Definition of Specific Learning Disabilities

The definition of specific learning disabilities has gone through several revisions over the years beginning in the 1960's. Samuel Kirk is credited as the originator of the term Learning Disabilities. A learning disability refers to retardation, disorder, or delayed development in one or more of the processes of speech, language, reading, writing, arithmetic, or other school subject resulting from a psychological handicap caused by a possible cerebral dysfunction and/or emotional or behavioral disturbances. It is not the result of mental retardation, sensory deprivation, or cultural and instructional factors (Kirk, 1962, p. 263).

With a lot of focus on this new phenomena, in 1965, Barbara Bateman, one of Kirk's students, also came up with a definition of learning disabilities. Children who have learning disorders are those who manifest an educationally significant discrepancy between their estimated potential and actual level of performance related to basic disorders in the learning process, which might or might not be accompanied by demonstrable central nervous system dysfunction, and which are not secondary to generalized mental retardation, educational or cultural deprivation, severe emotional disturbance, or sensory loss (Bateman, 1965, p. 220).

The United States Office of Education (USOE) formed a committee in 1968 to issue a report on learning disabilities and to write a definition of learning disabilities that might be used as a basis for legislation for funding programs. The committee, chaired by Samuel Kirk, offered a definition similar to Kirk's 1962 definition: Children with special (specific) learning disabilities exhibit a disorder in one or more of the basic psychological processes involved in understanding or in using spoken and written language. These might be manifested in disorders of listening, thinking, talking, reading, writing, spelling or arithmetic. They include conditions which have been referred to as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, developmental aphasia, etc. They do not include learning problems that are caused primarily by visual, hearing or motor handicaps, mental retardation, emotional disturbance, or environmental disadvantage (USOE, 1968, p. 34).

The Individuals with Disabilities Education Act of 1997 (IDEA - 20 U.S.C. §1401 [30]) defined specific learning disabilities as a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written that can manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations, including conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia.

With this definition, learning disabilities do not include learning problems that are primarily the result of visual, hearing, or motor disabilities, mental retardation, emotional disturbance, or environmental, cultural, or economic disadvantage.

The Individuals with Disabilities Education Act of 1997 was reauthorized in 2004. Though the definition was not changed, the Individuals with Disabilities Education Act have changed the way in which schools determine if the student has a Specific Learning Disability. The Individuals with Disabilities Education Act is a funding legislation at the United States of America federal level that originated with Public

Law No. 94-142, also known as the Education of the Handicapped Act, and which requires periodic reauthorization, resulting in not only renewed funding but also in successive amendments (Zirkel, 2002 p. 3).

Students with Specific Learning Disabilities require an Individual Education Plan (IEP) so that they can benefit fully from their education. William Heward (2003, p. 61) defined an IEP as “a system for spelling out where the child is, where he or she should be going, how they will get there, and how to tell if and when they have arrived”.

The Individual Education Plan is a legal document that is a road map used for students with exceptionalities as they progress through the educational system. Teachers, parents, school administrators, related service personnel and students (after age 14 years) make up the individual education plan team who create goals and objectives for the student and determine the appropriate placement for them in the educational setting.

Almost 3 million children in the United States (ages 6 to 21 years) have some form of learning disability and receive special education in school. The *Twenty-fourth Annual Report to Congress* (U.S. Department of Education, 2002) states that, although over half of all children who receive special education have a learning disability, no cure has been found for specific learning disabilities. However, children with specific learning disabilities can be high achievers and they can learn to compensate for their disability and be successful with the appropriate support.

2.4.2 Identification of Students with Specific Learning Disabilities

If a student is suspected as having a Specific Learning Disability (SLD), the teacher, parent, or other concerned individual makes a referral for a special education evaluation. The Individuals with Disabilities Education Act of 1997 stipulated that, in order for children to be considered as having a specific learning disability, they would have to exhibit severe discrepancies between ability and achievement in one or more of seven achievement areas. The seven achievement areas are oral expression, listening comprehension, written expression, basic reading skills, reading comprehension, mathematics calculation or mathematical reasoning. The team might not identify a child if the severe discrepancy between ability and achievement is primarily the result of a visual, hearing or motor handicap, mental retardation, emotional disturbance or environmental, cultural or economic disadvantage (Ahearn, 2008). The regulations, however, give no guidelines as to how severe discrepancies should be identified. This caused many states to come up with their own way of identifying students with specific learning disabilities.

Much effort has been made to find an appropriate method to identify the presence of specific learning disabilities with objectivity and precision. However, research conducted by Bradley et al. (2002, p. 383) on implementation of the most commonly used variations of this approach demonstrates that reaching a valid, purely-numerical basis for determining specific learning disability eligibility is not possible. According to Bradley et al. (2002, pp. 582−585), measurement of these processes for identifying the presence of a learning disability is currently not an acceptable method of specific learning disability identification because knowledge in this area is inadequate and serious problems exist in reliably assessing those processes.

Recent United States federal policies permit approaches to the identification of students with learning disabilities that emphasize failure of students to respond to interventions rather than the discrepancy approach (Vaughn & Fuchs, 2003). With the reauthorization of the Individuals with Disabilities Education Act by congress, the law was changed in relation to how the schools would identify children with specific learning disabilities. Section 1414(b) of Wrightslaw: Special Education Law (2nd edition, p. 97) states that schools should not be required to take into consideration whether a child has a severe discrepancy between achievement and intellectual ability.

Response to Intervention (RtI) is a new and highly effective approach to identifying students at risk for learning disabilities and working with all students to ensure their educational success (National Center for Learning Disabilities, 2006). Today, many educators, researchers, and other professionals are exploring the usefulness of a Response to Intervention approach as an alternative that can provide (1) data for more effective and earlier identification of students with specific learning disabilities and (2) a systematic way to ensure that students experiencing educational difficulties receive more timely and effective support (Gresham, 2002; Learning Disabilities Roundtable, 2002, 2005; National Research Council, 2002; President’s Commission on Excellence in Special Education, 2002).

The main aim of response to intervention is to identify disabilities once students start experiencing any difficulty in their studies instead of waiting until it is too late so the teachers and support staff can help these students to be high achievers. In addition to the preventive and remedial services that this approach can provide to at-risk students, it shows promise for contributing useful data for identifying specific learning disabilities. Thus, a student exhibiting (1) significantly low achievement and (2) insufficient response to intervention can be regarded as being at risk for specific learning disabilities and, in turn, as possibly in need of special education and related services. The assumption behind this paradigm, which has been referred to as a 'dual discrepancy' (L. S. Fuchs, Fuchs, & Speece, 2002), is that, when provided with high-quality instruction and remedial services, a student without disabilities can make satisfactory progress.

2.4.3 Special Services for Inclusion and Self-Contained Classes

Heward (2003) describes inclusion as educating students with disabilities in regular classrooms. Inclusion is a term that expresses commitment to educate the child to the maximum extent appropriate, in the school and classroom which he or she would normally attend (Downing & Eichinger, 2003). Inclusion is the practice of educating all or most children in the same classroom, including children with physical, mental, and developmental disabilities (McBrien & Brandt, 1997). When a child is placed in an inclusion setting, the support services are brought to the child rather than moving the child to the services.

Building a positive learning environment for students with disabilities in the general-education class is very challenging. Teachers recognize that students with severe disabilities tend to learn at a slower rate and need repeated practice opportunities to acquire and maintain specific skills and to generalize these skills to other settings. Downing and Eichinger (2003) recommend that educators provide multiple opportunities to practice essential skills. The adaptations and modifications that are directed toward students with disabilities are beneficial to other students in the general education setting. In her book *Inclusion Strategies for Success*, Peggy Hammeken, (2000) stated that inclusion education helps students become more accepting and sensitive to one another. She further mentioned that, when students with special needs were included in the general education setting, all students benefit.

The Individuals with Disabilities Education Act (IDEA), as amended in 2004, does not require inclusion. Instead, the law requires that children with disabilities be educated in the Least Restrictive Environment (LRE) appropriate to meet their 'unique needs.' Truelove et al. 2007 (p. 336) believes that occasionally removing students with disabilities from the regular classroom for specialized instruction to meet their educational needs is appropriate. He further mentioned that teachers who implement different instructional strategies and activities to promote skill acquisition create a classroom climate that promotes a sense of belonging for all students in inclusive classrooms.

The inclusion classroom has a support facilitator who meets the needs of the students with disabilities by adapting the work to their academic ability. Both general and special education teachers possess a wealth of information because of their education and experience. With the introduction of inclusive education, both special education teachers and general education teachers work together and share their knowledge to achieve a common goal. Before special education strategies can be implemented, the students should be grouped carefully so that students and teachers complement each other and create an environment that is conducive to learning. Students should be grouped according to grade level, subject area or level of disability to have a sense of balance in the classroom. It is very important to the student that the curriculum and instruction be adapted for those in the inclusion classes who are working below grade level, including those who have been identified as having a disability.

The main goal of placing students in an inclusion classroom is for all students with specific learning disabilities to benefit both academically and socially in the regular education classroom setting rather than in separate special education settings. As a result of inclusion, the majority of students with disabilities are placed in regular education classrooms for at least a portion of each school day (U.S. Department of Education, 2003).

The Individuals with Disabilities Education Act (IDEA) requires that a continuum of placement options be available to meet the needs of students with disabilities. The Individuals with Disabilities Act also requires that, to the maximum extent appropriate, children with disabilities are educated with children who are not disabled, and that special classes, separate schooling, or other removal of children with disabilities from the regular environment occurs only when the nature or severity of the disability is such that education in regular classes in conjunction with the use of supplementary aids and services cannot be attained satisfactorily (IDEA Sec. 612 (5) (B)). Students should be given every opportunity possible to integrate with the regular population even though they might experience difficulty in keeping up academically. The students with disabilities who are included in the general education classroom are privileged with a second teacher who provides different instructional strategies that promote understanding of the subject matter. If we merely place a student in a general education class with no thought about how to actively involve the student, we could have minimal or no expectations of the student or might influence the student's peers to have a negative impression (Downing & Eichinger, 2003).

This researcher realized that, in the school setting, students in self-contained classes mix with the general population during elective classes, in the hallways, and during lunch. However, students in self-contained settings are required to remain together for the core academic subjects of Reading, Writing, and Mathematics. I also recognized that students, who are placed in a self-contained class with students of varying exceptionalities, have a special education teacher, whose students work at various academic levels. Classrooms in this setting are more structured and have various daily routines.

2.4.4 Students with Specific Learning Disabilities and the Learning Environment

For many students with learning disabilities, the structure of the classroom environment determines failure or success. These students are often easily distracted by different things going on in the room. The WIHIC questionnaire alerts the educator to the concerns of the students and assists in making adjustments to enable a more conducive learning environment for them. This questionnaire has been used in different countries and researchers have investigated associations between student outcomes and student perceptions of their classroom learning environment (Fraser, 2012). The WIHIC has been translated into the different languages and administered to different students where similarities in associations between student outcomes and classroom environment perceptions were observed. Although other studies provide useful information to educators regarding classroom environment dimensions that could be changed to improve student outcomes, they do not identify causal factors associated with the classroom environment (Aldridge, Fraser, Huang, 1999). Research revealed that Australian students consistently perceived their learning environments more favorably than Taiwanese students, but Taiwanese students had more positive attitudes to their science class. The WIHIC was chosen for my study because it is very simple and can be easily understood by students with learning disabilities, because of its wording.

2.5 Summary of Chapter 2

Research on students with learning disabilities in the field of learning environments has been rare. Some of the few learning environment researchers who have ventured into the field of learning disabilities are Adams and Adams (2000), who adapted the School Level Environment Questionnaire (SLEQ, Fisher & Fraser, 1991) for use among students with special needs, and Sencen (2006), who adapted the Science Laboratory Environment Inventory (SLEI, Fraser, Giddings & McRobbie, 1995) for use with students with hearing impairments. Another learning environment researcher (Orange, 2007) investigated the learning environment of students with learning disabilities in inclusive and self-contained science classrooms.

I chose the What Is Happening In this Class? (WIHIC) questionnaire (Fraser, Fisher & McRobbie, 1996) after reviewing related literature and found that it was highly appropriate for this study. This chapter provided a literature review of related studies, whereas the next chapter describes the research methods that were used in the study.

With 4–6% of all students classified as having specific learning disabilities (SLD) in public schools in the United States, every teacher can expect to find students with learning disabilities in the classroom. Success for these students with specific learning disabilities requires a focus on individual achievement, individual progress, and individual learning. Despite obstacles, recent research suggests that we can teach these students how to learn and put them into a position to compete.

The literature review in this chapter suggests that classroom environment research opens new windows for viewing the teaching and learning process. The ready availability of a variety of classroom environment questionnaires makes it possible for educators to investigate the nature of the learning environment in classrooms and laboratory settings from teachers' and students' perspectives.

This chapter provided a review of literature related to the eight learning environment questionnaires listed in Table 2.1: Learning Environment Inventory (LEI), Classroom Environment Scale (CES), Individualized Classroom Environment

Questionnaire (ICEQ), My Class Inventory (MCI), Questionnaire on Teacher Interaction (QTI), Science Laboratory Environment Inventory (SLEI), Constructivist Learning Environment Survey (CLES), What Is Happening In this Class? (WIHIC).

This review of literature reveals that the strongest tradition in past classroom environment research has been the investigation of associations between student outcomes and student perceptions of psychosocial characteristics of their classroom environments Research using perceptions of both teachers and students across varying grade levels (elementary, middle, high and higher education), different subject areas (science, mathematics, languages), different types of schools and various countries (USA, Canada, Australia, Israel, and Asia) supports the contention that the learning environments of classrooms account for considerable variance in student outcomes. This important line of research was pursued in my study.

Chapter 3

RESEARCH METHODS

3.1 Introduction

Researchers have become interested in students with specific learning disabilities and, more recently, specifically in how they perceive their learning environments. The quality of the learning environment of a student, especially one with learning disabilities, is vital to academic success. As discussed in Chapter 1, I investigated the attitudes and learning environment perceived by students with specific learning disabilities in inclusion and self-contained classrooms in middle schools in Broward County in Florida. The research questions were answered using the data that were collected from a sample using a modified version of the What Is Happening In this Class? (WIHIC) questionnaire and the Test of Mathematical Abilities (TOMRA) questionnaire.

This chapter is devoted to the research methods used in the study, including a description of the sample (Section 3.2), ethical issues (Section 3.3), questionnaire administration (Section 3.4), the questionnaires used (Section 3.5), and methods of data analysis (Section 3.6). The following research questions were answered by this study:

Research Question #1

Is the What Is Happening In this Class? (WIHIC) questionnaire and the Test of Mathematics Related Attitudes (TOMRA) valid and reliable when used with students with specific learning disabilities?

Research Question #2

Are there differences between students with specific learning disabilities in self-contained classes, students with specific learning disabilities in inclusion classes, and general-education students in inclusion classes in terms of their perceptions of classroom environment and their attitudes to mathematics?

Research Question #3

Are there associations between the nature of the classroom environment and students' attitudes to mathematics?

3.2 Sample

This study was carried out in Broward County Public Schools in the state of Florida, United States, which provides a free and appropriate education for all children in the county. The study was conducted in approximately 20 inclusion classes and 10 self-contained classes, and it included students with specific learning disabilities and general-education students in inclusion classes, as well as students with specific learning disabilities in self-contained classes.

The average number of students in a self-contained class in Broward County Public Schools is 12. Included in these classes are 6th, 7th, and 8th graders between the ages of 11 and 15 years who have varying disabilities. The study was geared towards students in the eighth grade between the ages of 11 and 15 years who have a specific learning disability. This sample was quite small because of the small number of students with specific learning disabilities in each school. The sample of self-contained classes was even smaller for the same reason.

The main types of learning disabilities involved in my study were dyslexia and dyscalculia, which interfere with learning basic skills such as reading, writing and/or mathematics. Dyslexia is a specific learning disability that affects reading and language-based processing skills and can affect reading fluency, decoding, reading comprehension, recall, writing, spelling, and sometimes speech. Dyscalculia is a specific learning disability that affects a person's ability to understand numbers and learn mathematical facts.

The sample for this study was selected from the Exceptional Student Education Department in Middle Schools in Broward County Public Schools. The website www.browardschools.com states that Broward is one of the largest school districts in the country and has over 260,000 students from approximately 166 different countries. There are currently 340 schools and education centers of which 42 are middle schools. There are about 53,520 students enrolled in middle schools in

Broward County. The students in the Exceptional Student Education Department in Broward County Public Schools comprise about 10% of the school population. The students in this department all have Individual Education Plans (IEPs) that outline their course of study, goals and objectives for each school year. An IEP is developed annually for each student by a team which consists of the Exceptional Student Education (ESE) teacher, general education teacher, the student, parent(s), ESE specialist and, depending on the services that the student receives, possibly the school psychologist, a behavior specialist, or a student advocate (Wright et al., 2007). The IEP reflects the student's present level of performance, goals and objectives for the upcoming year, assessments that the student has undertaken, and input from all the students' teachers and their parents. The IEP also indicates the student's disability and the services that they receive in the school setting to help them to be successful.

3.3 Ethical Issues

There are procedures that had to be followed by the researcher in order to carry out this study. Permission was sought from both the Curtin University Human Research Ethics Committee (HREC) and the Broward County Public Schools Research Department. The schools where the researcher wanted to carry out the study were contacted and permission was obtained from the school principal. The school principal identified a contact person on the staff of the school to work with me in implementing the study. Permission was also sought from the parents for the students to be a part of the study using a student informed consent form. Once this was in place, the students responded to the questionnaire via computers and their responses were analyzed. The following subsections give information about how the researcher sought permission from the Curtin University Human Research Ethics Department and the Broward County School District in Florida.

3.3.1 Permission to Conduct Research from the Curtin University Human Research Ethics Committee

The researcher obtained written permission from the HREC at Curtin University for Approval of Research with Minimal Risk (Ethical Requirements) for the study. An ethics proposal was submitted to the HREC which included the objectives, background, significance, facilities and resources, data storage, timeline, and methods for obtaining informed consent form. Consent forms were given to parents rather than students because of their age. Parents' informed consent forms were available in English, Spanish, and Haitian Creole to accommodate the diverse population in this school district. Once the Curtin University Human Research Ethics Committee reviewed my research proposal, an approval was sent with a protocol approval number SMEC20060036 on September 24, 2007 which was valid for a period of 12 months. The approval form included a standard statement which must be included in all information to the participants. The statement indicated that approval for the study was given by the Curtin University HREC. This document was presented to the Broward County School District as a part of my application to conduct research.

3.3.2 Permission to Conduct Research from the Broward County School District

The researcher also had to get permission from the Broward County Public Schools Research Department in order to conduct the study. The research department was presented with an application to conduct research, which is the first step in the process of having any sort of interaction with the students. This application included an identification form for the researcher, research review form, approval for the study from Curtin University Human Research Ethics Committee (HREC), proposal, summary of the research, aims of the research, research methods and ethical issues, copies of the questionnaires that were to be used in the study, and an informed consent form for research subjects in English, Spanish, and Haitian Creole. Florida has a high immigrant population from Haiti, Central and South America, with a high percentage of the parents only speaking their home language, and therefore there was a need for this form to be translated into two other languages. The applicant identification form for the researcher included the title of the research project and the researcher's contact information. The research review form included the title of the research project, the reason for which the project was being conducted, the name of the affiliated university, the start and end dates of the research, the primary research questions to be addressed, the research activities, the instruments to be used, and the number of participants anticipated for the study. A copy was provided of the research questionnaire which is called what "What Is Your Opinion of this Class" which includes scales of the What Is Happening In this Class? (WIHIC) and the Test of Mathematics Related Attitudes (TOMRA). These were all submitted to the Research Services Department for review by the director.

3.3.3 Permission to Conduct Research from Individual Schools in the Broward County School District

Upon approval from the Broward County School District, the researcher was given a letter from the Research Department that was addressed to school principals stating that approval was granted for the research to be conducted. The approval from the Curtin University Human Research Ethics Committee was also presented to the schools' principals. The letter stated that the staff of the Broward County Research Department had reviewed the research request and had found that the research methods were compatible with a public school setting and that the research questions were of interest to the school district. The principals' permission was sought by the researcher through district e-mail which was followed up with a telephone call and a meeting. After getting approval from principals to conduct the study on their campus, the researcher was then directed to a specific teacher who would be the contact person for the duration of the study and who would identify the teachers and the students who would be suitable for the study. In most cases, the contact person was the ESE specialist or a support facilitator for the eighth grade. A support facilitator is a teacher who is responsible for documenting mastery and the educating of students who have an IEP. Support facilitators are usually certified ESE teachers who often co-teach in a general education classroom in order to incorporate ESE strategies in an attempt to make students with specific learning disabilities successful in their setting. The ESE teacher is the one who facilitates the IEP meetings and makes sure that all ESE students are in compliance with regulations under the Individuals with Disabilities Education Act and are being offered services as outlined in their IEPs.

3.3.4 Permission to Conduct Research from Parents

Permission was sought from parents, through a parent consent form, for their children to take part in the study. The parents were given the opportunity to contact the researcher by telephone or email to ask as many questions as they wanted regarding the study before allowing their children to participate in the study. Contact information for the researcher was provided on consent form. This consent form made the parents aware of the researcher, her university and professional affiliations, and her contact information. It also included the purpose of the study, procedures, possible risks or discomforts, possible benefits, compensation, possible costs, confidentiality, and sources of further information about the study. There was a section of the form where parents gave authorization for their children to take part in the study. An informed consent form was translated into Haitian Creole and Spanish because of the high immigrant population from Haiti, Central and South America and the high percentage of the parents only speaking their home language.

3.4 Questionnaire Administration

When the classes were identified, the teachers were notified and given an overview of the study to be conducted in the classroom setting. They were made familiar with the survey instrument and how students would access it via computer. The students to be surveyed were identified based on their class and their disability. This study was focused on students with a specific learning disability in inclusion classes, students with a specific disability in self-contained classes, and general-education students in inclusion classes. The students in the targeted classes were given an informed consent form in the first language of their parents, and were asked to return the consent form whether or not the parents gave their permission for the students to take part in the survey.

The teachers, support facilitator, and ESE specialist decided on the date when the survey would be administered. Students who were absent from school were given the survey upon their return. The ESE specialist outlined ethical guidelines that would be followed when conducting research with students within that department. The ESE specialist also assisted in identifying the specific classes whose students would be the participants in this study. These students were 8^{th} graders with specific learning disabilities in inclusion classes, general education 8^{th} graders in inclusion classes, and 8^{th} graders with specific learning disabilities in self-contained classes. The teachers of these classes were contacted and the procedures and instructions for carrying out the survey were given.

Before gathering data, a parent consent form was distributed to students in English, Haitian Creole, and Spanish. In this letter, the researcher sought permission to administer the questionnaires and to conduct the research. The signed parental permission forms were collected by the teacher. (A copy of each parent consent form is provided in Appendix B.) Based on the return of the parent consent forms, a list of eligible student participants was submitted to the teacher who then identified from the inclusion class those students with a specific learning disability.

The researcher gave verbal and written instructions to the teachers who administered these questionnaires. Both students and parents were informed that the study was confidential and that students providing their names on the questionnaire were merely for identification purposes. This also allowed me to match one student with his or her disability. Later on, students were assigned a number to protect their identities. Each questionnaire took about 20 minutes for the teacher to administer.

The survey was either undertaken in the computer laboratory, by using a wireless laptop computer in the classroom, or by using pen and paper. For those taking the survey online, the questionnaire was posted on the researcher's website. The participants followed the link to the website to Student Survey which they completed and submitted. The responses to each student questionnaire were automatically sent to the researcher. The time allotted for the survey was one class period. Students with specific learning disabilities were given additional assistance by, for example, reading directions aloud, clarifying directions, and providing extra time. The students' names were not used in the report and were used by the researcher to ensure that each student completed the survey.

3.5 Questionnaires

In conducting this study, quantitative methods of data collection were used to provide a better picture of the learning environments that were studied. Liebscher (1998, pp. 668) stated: "A quantitative research methodology is appropriate where quantifiable measures of variables of interest are possible, where hypotheses can be formulated and tested, and inferences drawn from samples to populations."

To gather quantitative information, modified versions of the What Is Happening In this Class? (WIHIC) questionnaire and the Test Of Mathematics Related Attitudes (TOMRA) were administered to students to measure their learning environment perceptions and the attitudes of students.

3.5.1 What Is Happening In this Class? (WIHIC) Questionnaire

The WIHIC is the most- widely used learning environment questionnaire in the world today. Its development involved combining modified versions of salient scales from a range of existing questionnaires with additional scales that accommodate contemporary educational concerns. The WIHIC's authors originally designed a 90-item nine- scale version which was refined based on both statistical analysis of data from 355 junior high school science students and interviewing of students (Fraser, Fisher & McRobbie, 1996). Later, analysis of data from an Australian sample of 1081 students in 50 classes and a Taiwanese sample of 1879 students in 50 classes (Aldridge & Fraser, 2000; Aldridge, Fraser & Huang, 1999) led to a final form of the WIHIC containing seven eight- item scales (Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, Equity), with frequency response alternatives of Almost Never, Seldom, Sometimes, Often and Very Often. The WIHIC was reviewed in detail in Chapter 2, Section 2.2.2.8.

The WIHIC is made up of seven scales and 56 items (Fraser, Fisher, & McRobbie, 1996; Aldridge & Fraser, 2000). Table 3.1 provides a scale description and sample item for each scale in the original form of the WIHIC.

TABLE 3.1 Descriptive Information for Each WIHIC Scale

Scale Name	Description	Sample Item
Student Cohesiveness	Extent to which students know, help and are supportive of each other.	I work well with others.
Teacher Support	Extent to which the teacher helps, befriends, trusts and is interested in students.	The teacher talks with me.
Involvement	Extent to which students have attentive interest, participate in discussions.	I do additional work and enjoy the class.
Investigation	Emphasis on the skills and processes of inquiry and their use in problem solving and investigation.	I am given a choice in which investigations I do.
Task Orientation	Extent to which it is important to complete activities planned and to stay on subject matter.	I know what has to be done in this class.
Cooperation	Extent to which students cooperate rather than compete with one another on learning tasks.	I cooperate with other students when doing assignment work.
Equity	Extent to which students are treated equally by the teacher.	I get to use the equipment as much as other students.

The WIHIC uses a five-point frequency response scale and requires students to signify how often they perceive a classroom practice is occurring. The response alternatives of Almost Never, Seldom, Sometimes, Often, and Almost Always are scored on a five-point basis.
Based on Aldridge, Fraser and Huang (1999).

Although the WIHIC is a relatively new instrument, it has been utilized in Asia frequently and has been translated into several Asian languages and cross-validated:

- An English version has been cross-validated in Brunei Darussalam with samples of 644 Grade 10 Chemistry students (Riah & Fraser, 1998) and 1188 Form 5 science students (Khine & Fisher, 2001).
- Three studies have validated and used an English version of the WIHIC in Singapore. Chionh and Fraser (2009) reported strong validity and reliability for both an actual and a preferred form of the WIHIC when it was responded to for the subjects of mathematics and geography by a sample of 2310 students in 75 senior high school classes. Khoo and Fraser (2008) used the

WIHIC with a sample of 250 adults attending computer courses in 23 classes in four Singaporean computing schools. Peer and Fraser (2015) used the WIHIC with 1081 primary science students in 55 classes.

- A Chinese version of the WIHIC has been developed for use in Taiwan and cross-validated with a sample of 1879 junior high school students in 50 classes (Aldridge & Fraser, 2000; Aldridge, Fraser & Huang, 1999).
- Chua, Wong and Chen (2011) developed a Chinese-language version of the WIHIC, based on the Taiwanese version of Aldridge, Fraser and Huang (1999). This is a bilingual instrument with every item presented in both English and Chinese. Detailed procedures were used to develop this Chinese version, which was cross-validated with a sample of 1460 students in 50 classes.
- The WIHIC has been translated into the Korean language and validated with a sample of 543 Grade 8 students in 12 schools (Kim et al., 2000).
- The WIHIC has been translated into the Indonesian language and used with university students in computing-related courses. The validity and usefulness of the WIHIC has been established for samples of 2498 university students in 50 computing classes (Margianti, Fraser & Aldridge, 2001) and 422 students in 12 research methods classes (Soerjaningsih, Fraser & Aldridge, 2001). Also, the WIHIC was used with 594 students from 18 classes in Indonesia and 567 students from 18 classes in Australia in investigating the strength of the associations between students' perceptions of their classroom environment and their attitude to science (Fraser, Aldridge & Adolphe, 2010).

The WIHIC has been cross-validated and used in a number of studies in North America among:

- 573 elementary science students in Florida by Pickett and Fraser (2009)
- 525 female prospective elementary teachers in a large university in California by Martin-Dunlop and Fraser (2008)
- 30 National Board Certified secondary school teachers and 927 students in Miami, Florida by Helding and Fraser (2013)
- 172 kindergarten students and 78 parents in Florida by Robinson and Fraser (2013)
- 661 middle-school mathematics students in California by Ogbuehi and Fraser (2007)
- 1434 middle-school science students in New York by Wolf and Fraser (2008).

The WIHIC was chosen for this study based on all the evidence in the above research supporting its validity. Section 2.2.2.8 in Chapter 2 reviewed the use of the WIHIC questionnaire in more detail and a copy of the WIHIC is provided in Appendix A.

3.5.2 Test Of Mathematics Related Attitudes (TOMRA)

Items from the Test Of Mathematics-Related Attitudes (TOMRA) were used to assess students' attitude towards mathematics in my study. The TOMRA was reviewed in detail in Section 2.3.2 in Chapter 2. The questionnaire items were modified from Fraser's (1981) Test of Science-Related Attitudes (TOSRA), which was designed to measure the attitudes toward science of students in secondary school. The original TOSRA includes 7 scales, with a total of 70 items, and is based on Klopfer's (1971) classification of affective aims for science education. Table 3.1 gives descriptive information for each TOMRA scale.

TABLE 3.2 Descriptive Information for Each TOMRA Scale

Scale Name	Klopfer's (1971) Category	Sample Item
Social Implications of Mathematics	Manifestation of a favorable attitude towards mathematics and mathematicians	Money spent on mathematics is worth spending.
Normality of Mathematicians	Manifestation of a favorable attitude towards mathematics and mathematicians	Mathematicians like sport as much as other people do.
Attitude to Mathematical Inquiry	Acceptance of mathematical inquiry as a way of thought	I would rather solve a problem by doing it myself than to be told the answer.
Adoption of Attitudes	Adoption of mathematical attitudes	I am curious about the world in which we live.
Enjoyment of Mathematics Lessons	Enjoyment of mathematics learning experiences	I really enjoy going to mathematics lessons.
Leisure Interest in Mathematics	Development of interest in mathematics and mathematics-related activities	I like reading newspaper articles about mathematics.
Career Interest in Mathematics	Development of interest in pursuing a career in mathematics	Working as a mathematician would be an interesting way to make a living.

Based on Fraser (1981)

This study utilized two scales from the TOMRA to assess Adoption of Mathematical Attitudes and Enjoyment of Mathematics Lessons (based on two of TOSRA's original scales). The scales were selected according to their suitability for use with middle-school students with specific learning disabilities in a diverse Hispanic community in the Broward County School District, Florida. The wording of some negatively-worded items was changed to make them more suitable for students based on their age and ability. Also, 'pupil' was changed to 'student', which is a more familiar word for participants.

Because the researcher was aware of time constraints that would be in place, the number of items was reduced from 10 to 8 for each scale. Also, to make it easier for students to answer, a change was made to TOSRA's original response format (Strongly Disagree, Disagree, Not Sure, Agree and Strongly Agree) to make it identical to the response format of the WIHIC scale (Almost Never, Seldom, Sometimes, Often and Almost Always).

Furthermore, I was aware that negatively-worded and reverse-scored items could prove confusing to students (especially those with specific learning disabilities) and could adversely affect the reliability and validity of scales (Schriesheim, Eisenbach & Hill, 1991; Schriesheim & Hill, 1981). Therefore, I changed any negatively-worded items chosen from TOMRA to transform them into positively-worded items.

3.6 Methods of Data Analysis

For my first research question involving the validation of the survey instrument, I conducted factor analysis to check the structure or factorial validity of the learning environment and attitude scales. Principal axis factoring with varimax rotation and Kaiser normalization was used. The criteria for the retention of any item were that it must have a factor loading of at least 0.40 with its own scale and less than 0.40 with each of the other scales.

Cronbach's alpha coefficient was used as a measure of each scale's internal consistency reliability. Also ANOVA was used for the actual form of each classroom environment scale to determine whether it could differentiate between the perceptions of students in the classes of different teachers. (This characteristic was not relevant to the two attitude scales.)

For my second research question, one-way MANOVAs and follow-up ANOVAs were used to investigate the statistical significance of differences between students with specific learning disabilities in self-contained classes, students with specific learning disabilities in inclusion classes, and general-education students in inclusion classes. The set of dependent variables consisted of the five WIHIC learning environment scales and the two TOMRA attitude scales. If the multivariate test using Wilks' lambda criterion reveals that the between-group differences are significant for the whole set of dependent variables, then this would justify interpreting the univariate ANOVA results for each individual dependent variable. Effect sizes, expressed in standard deviation units, were also used to describe the magnitude of differences between these groups. Cohen's *d* is the difference between the means of two groups divided by the pooled standard deviation.

For my third research question, associations between students' perceptions of their classroom learning environment and student outcomes (attitudes) were investigated using simple correlation and multiple regression analyses. The simple correlation describes the bivariate relationship between an attitude scale and a learning environment dimension. Multiple regression analysis provides information about the joint influence of correlated WIHIC scales on attitudes for each of the two scales of TOMRA. The multiple correlation describes the joint influence of the set of environment scales on each attitude, whereas the standardized regression coefficients provide information about which environment scales are independently associated with an attitude outcome when the other environment scales are mutually controlled.

3.7 Chapter Summary

The research methods, sample sizes, procedures for collecting data, the survey instruments, and how data were analyzed were all described in this chapter.

The sample consisted of 242 eighth-grade mathematics students in 20 inclusion classes and 10 self-contained classes. Of the 242 students, 70 were identified as having a specific learning disability and 172 were general-education students. This relatively small sample size arose because of the limited population of students with specific learning disabilities in each school.

Overall, my study's three main goals were to find out: whether it is possible to develop and validate suitable measures of classroom environment and student attitudes towards mathematics; whether there are differences between students with specific learning disabilities in self-contained classes, students with specific learning disabilities in inclusion classes, and general-education students in inclusion classes in terms of their perceptions of classroom environment and their attitudes to mathematics, and whether there are relationships between classroom environment and students' attitudes towards mathematics.

The two survey instruments that were used to measure learning environments and attitudes were the WIHIC and the TOMRA. The five scales used from the WIHIC were Student Cohesiveness, Teacher Support, Involvement, Task Orientation and Cooperation. Adoption of Mathematical Attitudes and Enjoyment of Mathematics Lessons were the two scales used from the TOMRA. The WIHIC and TOSRA were selected for my study because of their relevance and proven validity and usefulness in past studies in countries around the world.

Validation of the survey instruments was carried out using factor analysis to check the structure or factorial validity of instruments. Cronbach's alpha coefficient was used as a measure of each scale's internal consistency reliability. Also ANOVA was used for the actual form of each scale of the classroom environment instrument to determine whether it could differentiate between the perceptions of students in the classes of different teachers.

A one-way MANOVA and follow-up ANOVAs were used to investigate differences between students with specific learning disabilities in self-contained classes, students with specific learning disabilities in inclusion classes, and general-education students in inclusion classes. Effect sizes, expressed in standard deviation units, were also used to describe the magnitude of differences between groups.

Associations between students' perceptions of their classroom learning environment and student outcomes (attitudes) were investigated using simple correlation and multiple regression analyses. Multiple regression analysis provided information about the joint influence of correlated WIHIC scales on attitudes for each of the two scales of TOMRA. The multiple correlation described the joint influence of the set of environment scales on each attitude, whereas the standardized regression coefficient provided information about which environment scale was independently associated with an attitude outcome when the other environment scales were mutually controlled.

The next chapter, Chapter 4, reports the results of the data analyses that were undertaken to answer the three research questions.

Chapter 4

ANALYSES AND RESULTS

4.1 Introduction and Overview

As previously discussed in Chapter 1, the major aims of this research involved: first, validation of measures of classroom environment and students' attitudes toward mathematics; second, an investigation of differences between students with specific learning disabilities in self-contained classes, students with specific learning disabilities in inclusion classes, and general-education students in inclusion classes; and, third, investigation of relationships between classroom environment and students' attitudes.

In my study, two instruments were modified to suit middle-school students and administered to a sample which consisted of 242 eighth-grade students in Broward County to gather data about the attitudes of students and their perceptions of their learning environment. The learning environment was measured using the What Is Happening In this Class? (WIHIC) (Aldridge, Fraser & Huang, 1999; Dorman, 2003; Ogbuehi & Fraser, 2007), which combines modified versions of salient scales from a wide range of existing questionnaires with additional scales that accommodate contemporary educational concerns. Although the WIHIC assesses seven dimensions of the classroom environment, only the following five scales were utilized in my study: Student Cohesiveness, Teacher Support, Involvement, Task Orientation, and Cooperation. Section 2.2.2.8 in Chapter 2 and Section 3.4.2 in Chapter 3 discussed the WIHIC questionnaire in detail and provided information about past studies involving the WIHIC in various countries.

Two scales from the TOMRA (Test of Mathematics Related Attitudes), a modified version of the widely-used TOSRA (Test of Science Related Attitudes; Fraser, 1981), were used to assess Enjoyment of Mathematics Lessons and Adoption of Mathematical Attitudes. A recent example of a study in which the TOSRA was modified for use among mathematics students is Ogbuehi and Fraser (2007). I adapted eight items from the TOSRA's Enjoyment of Science Lessons scale to assess the extent to which students in my sample were satisfied with and looked forward to their mathematics classes, and eight items to assess Adoption of Mathematical attitudes (e.g. open-mindedness). The TOMRA was discussed in more detail in Section 2.3.2 of Chapter 2. Information is also given about the TOSRA in Chapter 3, Section 3.4.1.

The data collected using the WIHIC and TOMRA were analyzed and used to answer the following research questions:

Research Question #1

> *Is the What Is Happening In this Class? (WIHIC) questionnaire and the Test of Mathematics Related Attitudes (TOMRA) valid and reliable when used with students with specific learning disabilities?*

Research Question #2

Are there differences between (a) students with specific learning disabilities in self-contained and inclusion classes and (b) between students with specific learning disabilities and general-education students in inclusion classes in terms of their perceptions of classroom environment and their attitudes to mathematics?

Research Question #3

Are there associations between the nature of the classroom environment and students' attitudes to mathematics?

The contents of Chapter 4 are organized using the headings and subheadings as follows:

4.3.2 Differences Between Students with Specific Learning Disabilities and General-Education in Integrated Classes

4.4 Associations between Student Attitudes and Classroom Environment

4.5 Conclusion.

4.2 Validity and Reliability of the WIHIC and TOMRA

Because it is very important for educational researchers to check the validity and reliability of instruments that are used, one of the goals of this research was to cross-validate the WIHIC and the TOMRA with my sample. The findings for the validity and reliability of the WIHIC and TOMRA questionnaires are presented below using the following organization. Factor analysis was used to check whether the *a priori* structure of the multiscale instruments used in my study could be replicated with my sample of middle-school students in Florida. For the 56 items in all learning environment and attitude scales, principal axis factor analysis (with varimax rotation and Kaiser normalization) was undertaken. The criteria for the retention of any item was that its factor loading was at least 0.40 on its a *priori* scale and less than 0.40 on all other scales in the instrument.

4.2.1 Factor Structure of the WIHIC and TOMRA

The results of the factor analysis are shown in Table 4.1 for my sample consisting of 242 eighth-grade students in middle schools across Broward County, Florida. The questionnaire for my study was administered online using SurveyGold software (copyright © 1998-2005 Golden Hills Software, Inc.), which helps to create and conduct paper, telephone, and web surveys. This software was utilized in my study because the researcher felt that its use would enable students to take less time to respond to items.

The criteria for retention of any item were that its factor loading must be at least 0.40 with its own scale and less than 0.40 with each of the other six scales in the questionnaire. The application of these criteria led to the removal of eight items (three items from Student Cohesiveness, one item from Teacher Support, three items from Involvement and one item from Adoption of Mathematical Attitudes) to form a refined version of the questionnaire with 48 items in the original seven scales. Table 4.1 shows that, for the remaining 48 questionnaire items, the factor loading was at least 0.40 on the item's own scale and less than 0.40 on all other scales.

The bottom of Table 4.1 shows that the proportion of variance accounted for by different scales ranged from 1.87% to 33.67%, with a total of 56.35%. Eigenvalues ranged from 1.36 to 16.59 for different scales. Overall, the factor analysis results reported in Table 4.1 support the seven-scale *a priori* structure of the questionnaire containing learning environment and attitude scales.

4.2.2 Internal Consistency Reliability, Discriminant Validity, and Ability to Differentiate Between Classrooms of Different Teachers

Table 4.2 reports further evidence to support the validity and reliability of the learning environment and attitude questionnaire containing 48 items for the same sample of 242 students. Table 4.2 shows that the internal consistency reliability was high for every scale, with Cronbach alpha coefficients ranging from 0.83 to 0.94 for different scales. Internal consistency is a measure of reliability of different survey items intended to measure the same characteristics. The highest reliability was found for the Enjoyment of Mathematics Lessons scale.

TABLE 4.1 Factor Analysis Results for WIHIC and TOMRA Scales

Item	Factor Loadings						
	Student Cohesiveness	Teacher Support	Involvement	Task Orientation	Cooperation	Adoption	Enjoyment
SC6	0.65						
SC7	0.42						
SC9	0.65						
SC10	0.47						
SC12	0.66						
TS14		0.64					
TS15		0.59					
TS16		0.69					
TS18		0.55					
TS19		0.70					
TS20		0.46					
TS21		0.47					
IN22			0.57				
IN23			0.65				
IN25			0.62				
IN26			0.52				
IN27			0.46				
TO30				0.78			
TO31				0.62			
TO32				0.66			
TO33				0.63			
TO34				0.67			
TO35				0.56			
TO36				0.71			
TO37				0.63			
CO38					0.53		
CO39					0.57		
CO40					0.55		
CO41					0.58		
CO42					0.71		
CO43					0.66		
CO44					0.57		
CO45					0.51		
AD46						0.43	
AD48						0.49	
AD49						0.73	
AD50						0.59	
AD51						0.48	
AD52						0.49	
AD53						0.56	
EN54							0.73
EN55							0.82
EN56							0.64
EN57							0.82
EN58							0.79
EN59							0.87
EN60							0.71
EN61							0.79
% Variance	2.50	2.96	1.87	7.57	4.60	3.20	33.67
Eigenvalue	1.61	1.86	1.36	3.96	2.65	2.00	16.59

N=242
Factor loadings less than 0.40 have been omitted.
Principal axis factor analysis with varimax rotation and Kaiser normalization.
Total variance = 56.35%

The discriminant validity of different scales (using the mean correlation of a scale with the other scales as a convenient index) is reported in Table 4.2, which shows that values ranged from 0.41 to 0.56. Discriminant validity is the extent to which scales that are believed to assess unrelated constructs are, in fact, unrelated. Although these values suggest a degree of overlap in terms of raw scores on these questionnaire scales, the factor analysis reported in Table 4.1 above attests to the independence of factor scores.

Finally, I investigated the ability of each of the five learning environment scales to differentiate between the perceptions of students in the classrooms of different teachers. (This criterion is not relevant for the two attitude scales.) For each WIHIC scale, ANOVA was conducted with the teacher as the independent variable. The last column of Table 4.2 shows that each WIHIC scale was capable of differentiating significantly (p<0.05) between the perceptions of students in the classrooms of different teachers. The eta^2 statistic (or the proportion of variance accounted for) ranged from 0.07 to 0.26 for different scales.

TABLE 4.2 Internal Consistency Reliability (Cronbach Alpha Coefficient), Discriminant Validity (Mean Correlation with Other Scales) for WIHIC and TOMRA Scales and Ability of WIHIC Scales to Differentiate Between the Classes of Different Teachers

Scale	No. of Items	Alpha Reliability	Mean Correlation with other Scales	ANOVA Eta^2
WIHIC				
Student Cohesiveness	5	0.83	0.48	0.16**
Teacher Support	7	0.88	0.53	0.07*
Involvement	5	0.85	0.54	0.08*
Task Orientation	8	0.90	0.52	0.26**
Cooperation	8	0.89	0.56	0.07*
TOMRA				
Adoption of Mathematical Attitudes	7	0.82	0.50	
Enjoyment of Mathematics Lessons	8	0.94	0.41	

N=242 student in the classes of 9 teachers
*p<0.05, **p<0.01.
Eta^2 is the ratio of 'between' and 'total' sums of squares.

4.3 Differences Between Students with Specific Learning Disabilities and General-Education Students in Different Settings

For the set of five learning environment scales and two attitude scales as dependent variables, MANOVA was conducted to investigate differences between (1) students with specific learning disabilities in integrated and self-contained classes and (2) students with specific learning disabilities and general-education students in integrated settings. Because the multivariate test yielded statistically significant results using Wilks' lambda criterion in each case, the univariate ANOVA results were interpreted for each individual WIHIC and TOMRA scale.

Effect size is simply a way of quantifying the size of the difference between two groups and can be applied to any measured variable in education or social science. The use of effect sizes, however, has generally been limited to meta-analysis − for combining and comparing estimates from different studies and their use is all too rare in original reports of educational research (Keselman et al., 1998). This is despite the fact that measures of effect size have been available for at least 60 years (Huberty, 2002). In interpreting an effect size, it is important to know the reliability of the measurement from which it was calculated, which one reason why the reliability of any outcome measure used should be reported. Effect sizes were used to describe the magnitude of the differences between groups (e.g. students with specific learning disabilities vs. general-education students) in terms of perceived classroom environment and attitudes as suggested by Anderson and Arsenault (1998) and Thompson (1998). Cohen’s *d* effect size is calculated by dividing the difference between the mean of two groups by the pooled standard deviation.

4.3.1 Differences Between Students with Specific Learning Disabilities in Integrated and Self-Contained Classes

In order to investigate the differences between students with specific learning disabilities in integrated and self-contained classes, the average item mean was determined by dividing the scale mean by the number of items in a scale to allow easy comparison of the average scores on scales with different number of items. The average item mean for each learning environment and attitude scale in Table 4.3 suggests the existence of relatively small differences between students with specific learning disabilities in integrated and self-contained classes for most scales.

As noted above, I investigated differences between these two groups (students with specific learning disabilities in integrated and self-contained classes) in terms of statistical significance from MANOVA/ANOVA and Cohen's *d* effect size.

Table 4.3 shows that effect sizes ranged from 0.06 to 0.70 standard deviations. In fact, for Task Orientation and Enjoyment, a statistically-significant difference emerged between integrated and self-contained classes. The effect size was large for Task Orientation at 0.70 standard deviations. In this case, students with specific learning disabilities perceived a higher level of task orientation in integrated settings than in self-contained settings. The table also shows that there was a sizeable effect size for Enjoyment of Mathematics Lessons of 0.56 standard deviations. As with Task Orientation, students with specific learning disabilities perceived a higher level of enjoyment in their mathematics classes in integrated settings than in self-contained settings. The effect sizes for Enjoyment and Task Orientation are in the medium to large range according to Cohen (1988).

The small sample size of 70 students in separate classes was a drawback in terms of having adequate statistical power for detecting statistical significance. Such a small sample was inevitable because schools in this district have a very small number of students with learning disabilities placed in separate classes because of a policy of having more integrated classes.

TABLE 4.3 Average Item Mean, Average Item Standard Deviation, and Difference (Effect Size and MANOVA Results) Between Students with Specific Learning Disabilities in Integrated and Self-Contained Classes

Scale	Average Item Mean		Average Item SD		Difference	
	Integrated	Separate	Integrated	Separate	Effect Size	*F*
WIHIC						
Student Cohesiveness	3.99	3.74	0.78	1.38	0.22	0.72
Teacher Support	3.51	3.41	0.89	1.20	0.09	0.56
Involvement	3.09	2.84	0.95	1.50	0.20	0.50
Task Orientation	4.23	3.38	0.62	1.61	0.70	9.17**
Cooperation	3.48	3.06	0.82	1.37	0.37	1.81
TOMRA						
Adoption of Mathematical Attitudes	3.48	3.41	0.75	1.37	0.06	0.48
Enjoyment of Mathematics Lessons	3.26	2.60	1.16	1.14	0.56	2.68**

Sample consisted of 242 students in Broward County Florida
Effect sizes ranged from 0.06 to 0.70 standard deviations
N=70 ***p*<0.01

Figure 4.1 provides a graph that compares the average item means of students with specific learning disabilities in integrated and self-contained classes for each learning environment and attitude scale. This graph highlights an interesting pattern in which the scores of students with specific learning disabilities are somewhat higher in integrated settings than in self-contained settings for every WIHIC and TOMRA scale. That is, although between-group differences were small in magnitude and statistically nonsignificant for all scales except Task Orientation and Enjoyment, scores were somewhat higher for integrated settings for every scale.

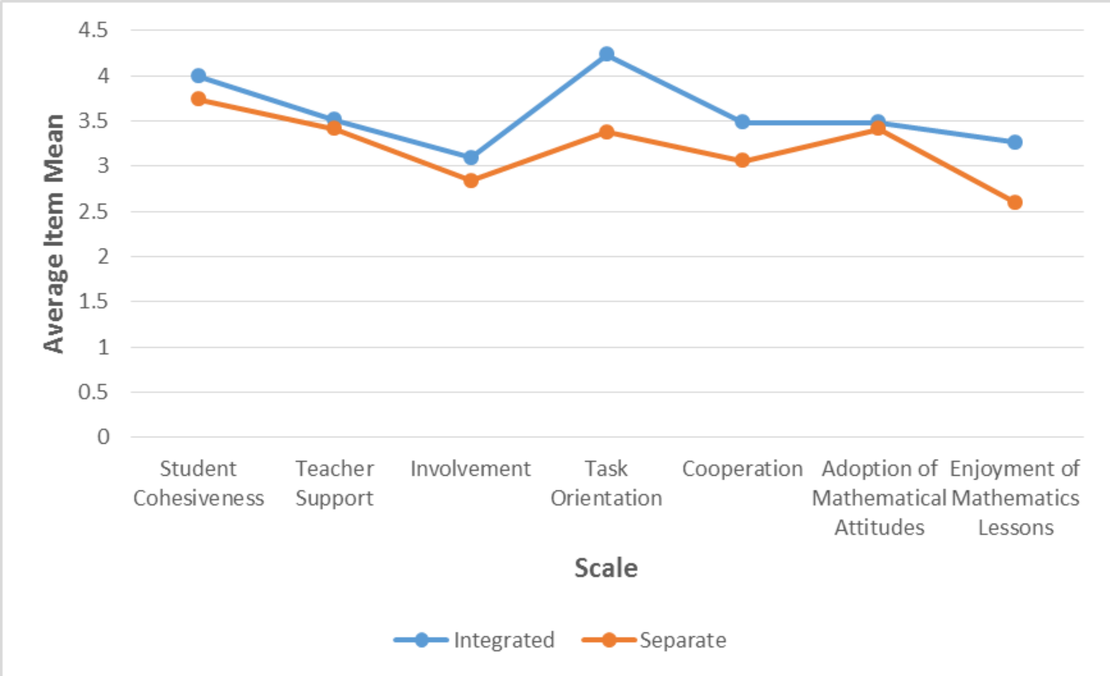

FIGURE 4.1 Comparison of Average Item Means Between Students with Specific Learning Disabilities in Integrated and Self-Contained Mathematics Classes

4.3.2 Differences Between Students with Specific Learning Disabilities and General-Education Students in Integrated Classes

This section reports differences between students with specific learning disabilities and general-education students in integrated classes in terms of attitudes and enjoyment of mathematics lessons. For each scale, Table 4.4 reports the average item mean, average item standard deviation, and difference between general-education students and those with learning disabilities in integrated classes. These between-group differences are reported in Table 4.4 in terms of both statistical significance from MANOVA/ANOVA and effect sizes using Cohen's *d*.

Table 4.4 shows that, for students in integrated classes, there were numerous statistically significant differences between general-education students and those with specific learning disabilities. In fact, differences were statistically significant for four of the five WIHIC scales (with the exception being Task Orientation) and for

Adoption of Mathematical Attitudes (but not the Enjoyment scale). For every scale except Enjoyment, general-education students had higher scores than students with learning disabilities. For the five scales for which differences between general-education students and those with learning disabilities were statistically significant (see Table 4.4), effect sizes ranged from 0.37 to 0.51 standard deviations and were of moderate size according to Cohen's (1988) criteria. There was also a significant difference for Adoption of Mathematical Attitudes with an effect size of 0.35 standard deviations (moderate magnitude).

TABLE 4.4 Average Item Mean, Average item Standard Deviation, and Difference (Effect Size and MANOVA Results) Between General-Education Students and Students with Specific Learning Disabilities in Integrated Classes

Scale	Average Item Mean		Average Item SD		Difference	
	General-Education	With Disabilities	General-Education	With Disabilities	Effect Size	*F*
WIHIC						
Student Cohesiveness	4.35	3.99	0.62	0.78	0.51	12.49**
Teacher Support	3.84	3.51	0.89	0.89	0.37	5.92*
Involvement	3.48	3.09	0.90	0.95	0.42	8.16*
Task Orientation	4.36	4.23	0.65	0.62	0.20	1.94
Cooperation	3.81	3.48	0.87	0.82	0.39	6.23*
TOMRA						
Adoption of Mathematical Attitudes	3.75	3.48	0.79	0.75	0.35	5.34*
Enjoyment of Mathematics Lessons	3.19	3.26	1.08	1.16	-0.06	0.17

N=232

Effect sizes ranged from 0.06 to 0.51

* $p<0.05$, ** $p<0.01$

The average item means for WIHIC and TOMRA scales in Table 4.4 are graphed in Figure 4.2 separately for general-education students and students with specific learning disabilities. This graph highlights the pattern in which means were higher for general-education students than for students with specific disabilities for all learning environment and attitude scales with the exception of Enjoyment of Mathematics Lessons. Interestingly, students with specific learning disabilities enjoyed these mathematics lessons at the same level as their general-education classmates.

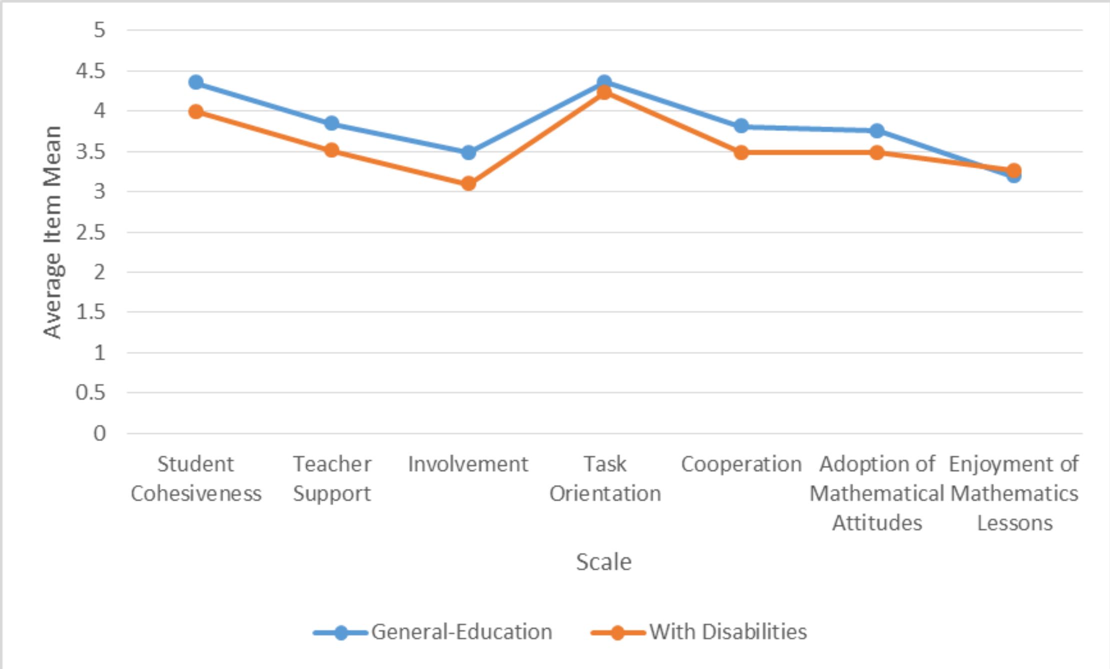

Figure 4.2 Comparison of Average Item Means Between General-Education Students and Students with Specific Learning Disabilities in Integrated Classes

4.4 Associations Between Student Attitudes and Classroom Environment

For the sample of 242 students, simple correlation and multiple regression analyses were used in exploring associations between each of the two TOMRA attitude scales and the set of five WIHIC learning environment scales. Simple correlation analysis is a suitable method for examining bivariate relationships between two specific variables. The multiple correlation provides information about the multivariate association between an attitude scale and the set of five environment scales. Regression weights were used to identify which specific environment scales were significantly related to an attitude scale when the other environment scales were mutually controlled. Neither regression nor correlation analysis can be interpreted as establishing cause-and-effect relationships; they can indicate only how or to what extent variables are associated with each other (Cohen, Cohen, West, & Aiken, 2003).

Table 4.5 shows that a statistically significant simple correlation (p<0.01) emerged between each attitude scale and each learning environment scale. Also the multiple correlation between each attitude scale and the set of five WIHIC scales was statistically significant.

Because the multiple correlation for the five WIHIC scales was statistically significant for each of the Adoption of Mathematical Attitudes and Enjoyment of Mathematics Lessons scales, standardized regression coefficients were examined. Table 4.5 indicates that four WIHIC scales (the exception being Student Cohesiveness) were significant independent predictors of each attitude scale (p<0.05) when the remaining four WIHIC sales were mutually controlled.

It is noteworthy that every statistically significant bivariate and multivariate attitude–environment association in Table 4.5 is positive. This replicates considerable past research (Fraser, 2007, 2012, 2014) that has established a positive link between a favorable classroom learning environment and positive students attitudes.

TABLE 4.5 Simple Correlation and Multiple Regression Analyses for Associations Between Student Attitude and Learning Environment Scales

Scale	Attitude−Environment Association			
	Adoption of Mathematical Attitudes		Enjoyment of Lessons	
	r	*β*	*r*	*β*
Student Cohesiveness	0.40**	-0.09	0.26**	-0.11
Teacher Support	0.52**	0.15*	0.44**	0.21**
Involvement	0.56**	0.24**	0.42**	0.16*
Task Orientation	0.50**	0.16*	0.45**	0.25**
Cooperation	0.58**	0.32**	0.42**	0.16*
Multiple Correlation, *R*		0.66**		0.54**

N=242

* $p<0.05$, **$p<0.01$

4.5 Conclusion

This chapter reported the findings of my study. Two instruments were modified and used in this study, the WIHIC (What Is Happening In this Class?) questionnaire and the TOMRA (Test of Mathematics Related Attitudes). The WIHIC questionnaire was used to assess students' perceptions of their classroom learning environment and the TOMRA questionnaire was used to assess students' attitudes to Mathematics. The data were collected from 242 eighth-grade students in Broward County.

The first research question involved the validity and reliability of the classroom environment and mathematics attitude scales. In order to check the factor structure of the learning environment and attitude scales, principal axis factor analysis with varimax rotation and Kaiser normalization was conducted. Although this study is unusual within the field of learning environments because of its focus on students with learning disabilities, the results revealed that the WIHIC and TOMRA scales were valid and reliable for assessing students' perceptions of classroom environment and their attitudes towards mathematics for this population of students. In the factor analyses, items were retained only if the factor loading was at least 0.40 on their *a* *priori* and less than 0.40 on all other scales. Based on these criteria, eight items were removed to form a refined version of the questionnaire with 48 items in the original seven scales. Together, the WIHIC and TOMRA scales accounted for 56% of the variance.

The second research question focused on the differences between groups (students with specific learning disabilities in self-contained vs. inclusion classes and students with specific learning disabilities vs. general-education students in inclusion classes) using a one-way MANOVA and ANOVAs. Students with specific learning disabilities in integrated settings had higher scores than students with disabilities in self-contained settings on every scale and that these differences were statistically significant for Task Orientation and Enjoyment. Effect sizes were 0.70 standard deviations for Task Orientation and 0.56 standard deviations for Enjoyment, which are in the moderate to large range.

Also, for students in integrated classes, there were significant differences between general-education students and those with specific learning disabilities for all of the five WIHIC scales and for Adoption of Mathematics Attitudes. In all cases, general-education students had higher scores than students with learning disabilities. Effect sizes for scales for which significant differences ranged from 0.35 to 0.51 standard deviations (moderate magnitudes). However, levels of Enjoyment were similar for general-education students and students with specific learning disabilities.

Associations between the nature of the classroom environment and students' attitudes towards mathematics were investigated using simple correlation and multiple regression analyses. The simple correlation analysis showed that all five WIHIC scales were significantly correlated with each attitude scale. The results of the multiple regression analysis were that every WIHIC scale except Student Cohesiveness was a significant independent predictor of each attitude scale when the other WIHIC scales were mutually controlled.

All bivariate and multivariate associations in Table 4.5 were positive. This replicates considerable past research into association between classroom environment and student attitudes reviewed by Fraser (2012, 2014).

Chapter 5 concludes this thesis with a summary of each chapter. This chapter also includes an overview of the significance and limitations of the study. Implications of the findings and recommendations for further research are also provided.

Chapter 5

DISCUSSION AND CONCLUSION

5.1 Introduction

The main purpose of this study was to examine the learning environments and attitudes of students with specific learning disabilities in inclusion and self-contained classrooms as part of the growing field of learning environments. The sample comprised 242 Grade 8 students in the Broward County Public Schools district. Specifically, I investigated the attitudes and classroom learning environment perceptions of general-education students in inclusion classes, students with specific learning disabilities in inclusion classes, and students with specific learning disabilities in self-contained special-education classes. The learning environment is very important for the success of students of all ages, especially those students with learning disabilities.

My study provides insights into the field of learning environments and offers useful information for guiding administrators and middle-school teachers in developing strategies for improving the learning environment and student attitudes in the mathematics classroom for students who have learning disabilities. This chapter provides an overview of some of the challenges faced by the education system in the state of Florida and specifically in the Broward County district at the middle-school level.

This thesis is summarized below using subheadings as follows: Background and rationale of the study is summarized in Section 5.2.1; Section 5.2.2 deals with the literature reviewed; and the research methodology is summarized in Section 5.2.3. Section 5.3 summarizes analyses and results of the study. In particular, Section 5.3.1 focuses on results for the first research question concerning the validity of my questionnaire; Section 5.3.2 summarizes findings concerning differences between students with learning disabilities and general-education in different settings; and Section 5.3.3 summarizes findings for association between classroom environment and student attitudes (Research question 3). Section 5.4 discusses the significance of the study, whereas Section 5.5 highlights the limitations of the study. Lastly, suggestion for future research are provided in Section 5.6.

5.2 Summary of the Chapters 1 – 3

5.2.1 Summary of Chapter 1: Background and Rationale

Chapter 1 provided a background to the study, including information about the field of learning environments and the education system in the state of Florida, particularly Broward County, at the middle-school level. This chapter also considered some of the potential implications of my study in relation to each research question. This chapter delineated three research questions:

4. Are the What Is Happening In this Class? (WIHIC) questionnaire and the Test of Mathematics Related Attitudes (TOMRA) valid and reliable when used with students with specific learning disabilities?

5. Are there differences between students with specific learning disabilities in self-contained classes, students with specific learning disabilities in inclusion classes, and general-education students in inclusion classes in terms of their perceptions of classroom environment and their attitudes to mathematics?

6. Are there associations between the nature of the classroom environment and students' attitudes to mathematics?

5.2.2 Summary of Chapter 2: Literature Review

A review of relevant literature that served as a foundation for gaining a better understanding of previous research relevant to my study was presented in Chapter 2. Literature related to the field of learning environment was reviewed, including a historical background to the field and a brief description of the conceptualization and measurement of the learning environment used in past studies. In particular, because my study utilized learning environment scales, a comprehensive review of existing learning environment instruments was provided in this chapter. Particular attention was given to the What Is Happening In this Class? (WIHIC) questionnaire that was used in my research. The remainder of the chapter included an overview of past studies related to the field of learning environments, including research on interpersonal teacher and the Questionnaire on Teacher Interaction. In particular, the two lines of past research most relevant to my study were reviewed in some detail: associations between the learning environment and student outcomes; and the use of learning environment criteria in evaluating educational programs.

A review of some literature related to students' attitudes was provided because students' attitudes to mathematics were investigated in my study. A particular focus of this review was the Test of Mathematics Related Attitudes (TOMRA) from which two scales were selected and adapted for my study.

Because my research involves students with specific learning disabilities, Section 2.4 reviewed literature concerning the definition of specific learning disabilities, the identification of students with specific learning disabilities, and special services for these students in inclusion and self-contained classes.

5.2.3 Summary of Chapter 3: Methodology

My Research methods, sample, procedures for collecting data, survey instruments, and data-analysis techniques were described in Chapter 3 of my thesis. An existing learning environment questionnaire was modified to make it suitable for assessing the learning environments of middle-school students in Broward County, where students' reading levels are mostly below grade level. The What Is Happening In this Class? (Aldridge, Fraser & Huang, 1999) was chosen for assessing five aspects of classroom environment (namely, Student Cohesiveness, Teacher Support, Involvement, Task Orientation, and Cooperation). In addition, student attitudes toward mathematics were assessed using modified items from two scales of the Test of Science-Related Attitudes (TOSRA, Fraser, 1981), namely, Enjoyment of Mathematics Lessons and Adoption of Mathematical Attitudes.

The sample consisted of 242 students in 8thgrade students in Broward County Public Schools, Florida. The sample was selected from the Exceptional Student Education Department in Middle Schools in Broward County Public Schools, which is one of the largest school districts in the USA with about 260,000 students from approximately 166 different countries. There are 42 are middle schools with about 53,520 students. The students in the Exceptional Student Education Department in Broward County Public Schools comprise about 10% of the school population.

Ethical issues (Section 3.3), questionnaire administration (Section 3.4), and specific details of the WIHIC and TOMRA (Section 3.5) were all considered in Chapter 3. Techniques for analyzing data were identified in Section 3.6 and are summarized in Section 5.2.

5.3 Summary of Major Findings

The major findings for my study are organized below into: Section 5.3.1 Validity of Classroom Environment and Attitude Scales; Section 5.3.2 Findings for Differences Between Students with Specific Learning Disabilities in Integrated and Separate Classes and Between Students with Specific Learning Disabilities and General-Education Students in Integrated Classes; and Section 5.3.3 Associations Between Student Outcomes Attitudes and Classroom Environment.

5.3.1 Validity of Classroom Environment and Attitude Scales

The first research question involved the validity and reliability of my questionnaire consisting of five scales from the What Is Happening In this Class? (WIHIC) questionnaire are two scales form the Test of Mathematics Related (TOMRA) when used with students with specific learning disabilities. Although the original version of the WIHIC consists of 56 items (Fraser, Fisher, & McRobbie, 1996) in seven scales, it was modified for use in my study with middle-school students in the eighth grade with specific learning disabilities in the Broward County Public Schools district. Only five of the seven original scales were utilized: Student Cohesiveness, Teacher Support, Involvement, Task Orientation, Cooperation, Investigation and Equity. The two scales chosen from the TOMRA and modified for use in my study were Enjoyment of Mathematics Lessons and Adoption of Mathematical Attitudes.

The data obtained from the sample of 242 8th grade students in the Broward County Public Schools (BCPS) district were analyzed to validate the WIHIC and TOMRA. Principal axis factor analysis with varimax rotation and Kaiser normalization supported the factorial validity of my questionnaire. After the removal of 8 of the 56 original items that did not satisfy criteria for retention (i.e. having a factor loading of at least 0.40 on their own scale and less than 0.40 on all other scales). The total proportion of variance accounted for was 56%.

Also the calculation of Cronbach's alpha coefficient for each scale supported the internal consistency reliability of every WIHIC and TOMRA scale (with scale reliabilities ranging from 0.83 to 0.94). As well, it was found that each WIHIC scale was capable of differentiating significantly between the perceptions of students in the classrooms of different teachers.

5.3.2 Findings for Differences Between Students with Specific Learning Disabilities in Integrated and Self-Contained Classes and Between Students with Specific Learning Disabilities and General-Education Students in Integrated Classes

The second research question focused on differences between students with specific learning disabilities in self-contained classes, students with specific learning disabilities in inclusion classes, and general-education students in inclusion classes in terms of their perceptions of classroom environment and their attitudes to mathematics. MANOVA was used to ascertain the statistical significance of differences between groups in terms of the set of seven WIHIC and TOMRA scales. When MANOVA revealed statistically significant differences between groups for the whole set of dependent variables using Wilks' lambda criterion, the univariate ANOVA was interpreted separately for each individual WIHIC and TOMRA scale. As well, effect sizes (Cohen's *d*) were used to portray the magnitude of differences between groups in standard deviation units.

My research showed that differences between students with specific learning disabilities in integrated and self-contained classes were statistically nonsignificant and small in magnitude for five scales. But, for Task Orientation and Enjoyment of Mathematics Lessons, differences were significant and of moderate to large magnitude (0.56 standard deviations for Enjoyment and 0.70 standard deviations for Task Orientation). For every learning environment and attitude scale, scores were higher for students in integrated classes than in self-contained classes.

There were statistically significant differences in inclusion classes between general-education students and those with specific learning disabilities for four of the five WIHIC scales and for Adoption of Mathematical Attitudes. For the five scales for which differences between general-education students and those with specific learning disabilities were statistically significant, effect sizes ranged from 0.35 to 0.51 standard deviations (small to moderate range). For all of these six scales, general-education students had higher scores than students with specific learning disabilities. However, levels of Enjoyment of Mathematics Lessons in inclusion classes were similar for general-education students and students with specific learning disabilities.

5.3.3 Findings for Associations Between Student Attitudes and Classroom Environment

For the sample of 242 students, simple correlation and multiple regression analyses were used in exploring associations between each of the two attitude scales and the set of five learning environment scales. The findings showed that a statistically significant simple correlation emerged between each attitude scale and each learning environment scale. Because the multiple correlation for the five WIHIC scales was statistically significant for each of Adoption of Mathematical Attitudes and Enjoyment of Mathematics Lessons, standardized regression coefficients were examined. The results indicated that four WIHIC scales (the exception being Student Cohesiveness) were significant independent predictors of each attitude scale when the remaining four WIHIC sales were mutually controlled.

For every statistically significant bivariate and multivariate association between attitudes and classroom environment, the relationship was positive, suggesting that positive learning environments are linked with positive student attitudes. This pattern replicates considerable past research (see reviews of Fraser, 2012, 2014).

5.4 Significance of the Study

This study contributes to the field of learning environments because its focus on students with specific learning disabilities has been rare in previous research, as well as to the field of special education because research in that field seldom has involved learning environment assessments. Therefore, my pioneering but exploratory study lays a foundation on which future research on learning environments and special education can build.

A methodological contribution of this research is that it has made available to teachers and researchers validated scales for use among students with specific learning disabilities for assessing classroom environment and attitudes to mathematics. These scales could be used in evaluating educational programs for students with specific learning disabilities or in attempts to improve classroom environments.

This study is practically significant for educators, especially those who are responsible for students with specific learning disabilities. There is a need for research to assist educators to better understand how to create for students with specific learning disabilities learning environments that could lead to improvements in their attitudes to mathematics. Information from this study might assist curriculum developers, administrators and teachers in developing programs for the special-education population that create and maintain learning environments that facilitate improved attitudes among students. The results of my research could be used by state or county education departments to determine whether inclusion classes meet the needs of students with learning disabilities and provide a basis for implementing strategies for improving the learning environment to better suit their needs.

5.5 Limitations to the Study

As with all educational research, a number of limitations were encountered in my study. Because the population of students with specific learning disabilities is typically very small, inevitably my sample was of limited size. My total sample of 242 students came from 70 eighth grade mathematics classes across middle schools in the Broward County School District. The sizes of classes with students who have any type of learning disability are usually small in relation to general-education classes because of the trend of facilitating greater access to learning opportunities. The statistical power of my analyses was limited because of the relatively small sample size.

Another limitation of my study is that questionnaires were somewhat difficult to read for some of the students with specific learning disabilities. Because some students with specific learning disabilities have low reading levels, they experienced difficulty with reading the questions even though some of them had been modified.

There is a possibility that some of the students chose answers without carefully reading the questions and understanding them.

Obtaining the cooperation of teachers was sometimes difficult, which led to a limitation in the number students who were available to take part in this research. Some teachers felt that they did not have the time to administer the questionnaires in their classrooms or to allow the researcher to administer it in their classrooms. Some teachers considered that the study could be an inconvenience to them and their students, as well as a disruption to the curriculum.

Originally, the researcher had intended to include students' mathematics achievement, but this proved impossible because a large number of students did not return their parent consent forms giving the researcher access to their standardized state test scores. In the state of Florida, eighth grade students take the Florida Comprehensive Assessment Test (FCAT) to determine proficiency on the Sunshine State Standards. In order for the researcher to gain access to these FCAT scores, parents had to give consent. The researcher's plan to include achievement was abandoned because the sample size of students with parental consent was too small to yield meaningful results.

The location of Broward County as a much sought-after residential area by immigrants from the Caribbean, Central and South America and other parts of the world led to another limitation faced by the researcher. The population of students is very diverse and the number of students who speak other languages, especially Spanish and Haitian Creole, is very high. The schools therefore have the problem of dealing with these multicultural students who find it difficult to read and understand English. The wording of some questionnaire items had to be changed to make them more suitable. For example, 'pupil' was changed to 'student', which is a more familiar word for these students.

The types of statistical analysis used in my study were adequate for its purpose, but perhaps more sophisticated techniques might have been employed. For example, confirmatory factor analysis could have been used in addition to exploratory factor analysis. The somewhat limited sample size made it impractical to conduct powerful statistical analysis using the class mean as the unit of analysis or to use multilevel analyses.

My study was limited to quantitative data based on students' responses to a questionnaire assessing learning environment and attitudes. Practical considerations prevented the collection of qualitative information based on observations and interviews. However, the use of qualitative information could have helped to explain the reasons for the differences and associations found (Tobin & Fraser, 1998).

5.6 Suggestions for Future Research

When one study is completed, avenues for future research usually grow from it. Classroom environment research in the state of Florida, particularly in Broward County, has not been very prevalent. The present study utilized and cross-validated the Test of Mathematics-Related Attitude (TOMRA) and the What Is Happening In this Class? instrument among middle-school students with specific learning disabilities. Therefore, one suggestion is that these instruments be used to pursue further research with students with specific learning disabilities in other school districts with student populations that are different from the Broward County Public Schools (BCPS) district.

Further use of these instruments in different middle schools and with a larger sample size of students with specific learning disabilities would be most beneficial. Because my study was undertaken in only four middle schools, it would be desirable to replicate the study in other middle schools. In particular, the sample size in my study turned out to be smaller than planned because of the reading levels and cultural background of the students, the low number of parent consent forms that were returned to the researcher, and the small proportion of the population of students with specific learning disabilities. It would be interesting to see if the findings of the study could be replicated in other less-diverse school communities and with larger samples. The main focus of this study was on investigating students' perceptions of the learning environment. However, it would be desirable for future research also to include the perceptions of the teachers of these students with specific learning disabilities.

In future research, it would be desirable to broaden the student outcomes included from my study's focus on attitudes also to include a range of other outcomes, especially student achievement in mathematics.

Numerous researchers recommended mixed-methods approaches involving both quantitative and qualitative data in order to provide deeper insights and enhance the credibility of results (Aldridge, Fraser, & Huang, 1999; Cresswell & Plano Clark, 2011; Tobin & Fraser, 1998). When replicating my study in the future, it is recommended that qualitative data such as observation and interviews be used to augment quantitative data collected from questionnaires.

5.7 Conclusion

Chapter 5 was devoted to summarizing this thesis, especially the methods and findings for my study. In particular, findings were summarized according to the study's three research questions involving, first, the validation of learning environment and attitude scales, second, differences between students with specific learning disabilities in integrated and self-contained classes and between students with specific learning disabilities and general-education students in integrated classes and, third, associations between student attitudes and classroom environment.

The present study has made several contributions to the fields of learning environment and special education at the middle-school level. The study provides modified and validated versions of two instruments for researchers and teachers to use to measure classroom environment and students' attitudes to mathematics. The results of this study supported the factorial validity and internal consistency reliability (using Cronbach's alpha coefficient) of the five classroom environment and two attitude scales. Past research (Fraser, 2014) was replicated in that statistically significant associations were found between student attitudes and the classroom environment. An important finding for the field of special education is that students with specific learning disabilities had somewhat more favorable learning environment perceptions and attitudes to mathematics on all scales in integrated settings than in self-contained classes (and these differences were sizeable for Task Orientation and Enjoyment of Mathematics Lessons).

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Appendix A

What Is Happening In this Class? (WIHIC)

and

Test Of Mathematics-Related Attitudes (TOMRA)

Items 1–45 in this appendix are based on the What Is Happening In this Class? (WIHIC) developed by Fraser, Fisher and McRobbie (1996). The WIHIC is discussed in Sections 2.2.2.8 and 3.5.2. Items 46–61 are based on the Test Of Science-Related Attitudes (TOSRA) developed by Fraser (1981). The TOMRA is discussed in Section 3.5.1. These questionnaires were used in my study and are included in this thesis with the permission of the author.

What is your opinion of this class?

Directions:
This questionnaire contains statements about this mathematics class. You will be asked how often each statement is true. There are no 'right' or 'wrong' answers. Your opinion is what is needed. Think about how well each statement describes what this class is like for you. Be sure to answer all questions.

For each statement draw a circle around:

SA if you **STRONGLY AGREE** with the statement;
A if you **AGREE** with the statement;
N if you are **NOT SURE**;
D if you **DISAGREE** with the statement;
SD if you **STRONGLY DISAGREE** with the statement.

Practice Item

1. It would be interesting to learn about fishing.

Suppose you **AGREE** with this statement, then you would circle A on the sheet like this:

SA A N D SD

If you change your mind about an answer, erase completely or cross it out and circle the correct one. Some questions are fairly similar to others. Don't worry about this. Simply give your opinion about all statements.

---

1. Name: ____

2. Gender: O Male O Female

3. Grade: O 6th O 7th O 8th

4. Student ID: ____

Student Cohesiveness

	Almost Never	Seldom	Sometimes	Often	Almost Always
6. I make friends among students in this class.	O	O	O	O	O
7. I know other students in this class.	O	O	O	O	O
8. I am friendly to students of this class.	O	O	O	O	O
9. Students of this class are my friends.	O	O	O	O	O
10. I work well with other students in this class.	O	O	O	O	O
11. I help other students who are having trouble with their work.	O	O	O	O	O
12. Students in this class like me.	O	O	O	O	O
13. In this class I get help from other students.	O	O	O	O	O

Teacher Support

	Almost Never	Seldom	Sometimes	Often	Almost Always
14. The teacher takes a personal interest in me.	O	O	O	O	O
15. The teacher goes out of her way to help me.	O	O	O	O	O
16. The teacher considers my feelings.	O	O	O	O	O
17. The teacher helps me when I have trouble with my work.	O	O	O	O	O
18. The teacher talks with me.	O	O	O	O	O
19. The teacher is interested in my problems.	O	O	O	O	O
20. The teacher moves about the class to talk with me.	O	O	O	O	O
21. The teacher's questions help me to understand.	O	O	O	O	O

Involvement

	Almost Never	Seldom	Sometimes	Often	Almost Always
22. I discuss ideas in this class.	O	O	O	O	O
23. I give my opinions during class discussions.	O	O	O	O	O
24. The teacher asks me questions.	O	O	O	O	O
25. My ideas and suggestions are used during classroom discussions.	O	O	O	O	O
26. I ask the teacher questions.	O	O	O	O	O
27. I explain my ideas to other students.	O	O	O	O	O
28. Students discuss with me how to go about solving problems.	O	O	O	O	O
29. I am asked to explain how I solve problems.	O	O	O	O	O

Task Orientation

	Almost Never	Seldom	Sometimes	Often	Almost Always
30. Getting a certain amount of work done is important to me.	O	O	O	O	O
31. I do as much as I set out to do.	O	O	O	O	O
32. I know the goals of this class.	O	O	O	O	O
33. I am ready to start this class on time.	O	O	O	O	O
34. I know what I am trying to accomplish in this class.	O	O	O	O	O
35. I pay attention during this class.	O	O	O	O	O
36. I try to understand the work in this class.	O	O	O	O	O
37. I know how much work I have to do.	O	O	O	O	O

Cooperation

	Almost Never	Seldom	Sometimes	Often	Almost Always
38. I cooperate with other students when doing assigned work.	O	O	O	O	O
39. I share my books and resources with other students when doing assignments.	O	O	O	O	O
40. When I work in groups in this class, there is teamwork.	O	O	O	O	O
41. I work with other students on projects in this class.	O	O	O	O	O
42. I learn from other students in this class.	O	O	O	O	O
43. I work with other students in this class.	O	O	O	O	O
44. I cooperate with other students on class goals.	O	O	O	O	O
45. Students work with me to achieve class goals.	O	O	O	O	O

Adoption of Mathematics Attitudes

	Almost Never	Seldom	Sometimes	Often	Almost Always
46. I enjoy reading about things which disagree with my previous ideas.	O	O	O	O	O
47. I like repeating mathematics problems to check that I get the same results.	O	O	O	O	O
48. I am curious about the world in which we live.	O	O	O	O	O
49. I like to listen to people whose opinions are different from mine.	O	O	O	O	O
50. I find it interesting to hear about new ideas.	O	O	O	O	O
51. In doing mathematics, I like to use new methods which I have not used before.	O	O	O	O	O
52. I am willing to change my ideas when evidence shows that the ideas are poor.	O	O	O	O	O
53. I like listening to other people’s ideas.	O	O	O	O	O

Enjoyment of Mathematics Lessons

	Almost Never	**Seldom**	**Sometimes**	**Often**	**Almost Always**
54. Mathematics Lessons are fun.	O	O	O	O	O
55. I like Mathematics lessons.	O	O	O	O	O
56. Schools should have longer Mathematics lesson periods.	O	O	O	O	O
57. Mathematics lessons interest me.	O	O	O	O	O
58. Mathematics is one of the most interesting subjects.	O	O	O	O	O
59. I enjoy Mathematics lessons.	O	O	O	O	O
60. The activities done in Mathematics class are interesting.	O	O	O	O	O
61. I look forward to Mathematics classes.	O	O	O	O	O

Appendix B

Research Subject Informed Consent Form

English

Curtin
University of Technology

RESEARCH SUBJECT INFORMED CONSENT FORM

Prospective research subject – Read this consent form carefully and ask as many questions as you like before you decide whether you want to participate in this research project.

Project Title: Proposed Doctoral Dissertation – Learning Environment, Achievement, and Attitudes among Mathematics Students with Specific Learning Disabilities in Self-Contained and Inclusion Classes.

Principal Investigator: Christine G. Thomas
University Affiliation: Curtin University of Technology – Graduate Student
Key Centre for School Science and Mathematics
Perth, Western Australia
Professional Affiliation: Broward County Public Schools – Teacher
Fort Lauderdale, Florida USA

Voice mail: (754) 323-3800 x 3011
Mobile: (954) 249-4693
Email address: Christine.G.Thomas@browardschools.net

Distance Supervisor: Dr. Barry J. Fraser
University Affiliation: Curtin University of Technology – National Key Centre for School Science and Mathematics
Perth, Western Australia
Fax: (+61) 8 9266 2503
Email: B.Fraser@curtin.edu.au

PURPOSE OF THE RESEARCH STUDY

The overall purpose of the study is to determine if there are differences between students with specific learning disabilities in self-contained classes, in inclusion classes, and general education students in inclusion classes in terms of their perceptions of classroom learning environment, achievement, and attitudes to mathematics.

PROCEDURES

Students and parents will be asked to allow the principal investigator to administer pre/post attitude tests using learning environment questionnaires. To measure students' attitude learning environment instruments will also be administered, the What is happening in this class? (WIHIC), and the Test Of Mathematics-Related Attitude (TOMRA) modified from the Test Of Science-Related Attitude. The scales were modified, item wording was simplified to enhance readability, and scales shortened to suit the readability of students who are of Hispanic and Haitian heritage and those who are learning English as a second language. FCAT scores will be used to measure student achievement.

The analysis and interpretation of data and written reports will take place during the fourth grading period of the school year. The estimated engagement in administering these questionnaires should be approximately one hour of students' class time.

POSSIBLE RISKS OR DISCOMFORTS

There are no known possible or reasonably foreseeable risks or discomforts to the participants.

POSSIBLE BENEFITS

There are several implications for students, teachers, administrators and the various stake-holders in education in the state of Florida arising from the results of the present study. In the first place, two widely applicable instruments will be utilized in the Broward County Public Schools district, in schools that replicate the majority of students within the district. These instruments, namely, the What is happening in this class? (WIHIC) and the Test Of Science-Related Attitude (TOSRA) which was modified for use in the mathematics classroom, the Test Of Mathematics-Related Attitude (TOMRA), to provide a means by which teachers can collect more data and use it to help motivate their students learning, monitor the learning environments, and measure the logical thinking, motivation and attitude of the students.

COMPENSATION

There is no financial compensation for your participation in this research project.

POSSIBLE COSTS TO YOU

There are no anticipated financial costs associated with this study for the participants.

CONFIDENTIALITY

Your identity in this study will be treated as confidential. The results of the study may be published for educational purposes but will not include your name or any identifiable references to you.

TERMINATION OF RESEARCH STUDY

If for any reason you decide your student should not participate in this study please notify Christine Thomas of your decision to terminate your child's participation in the study.

AVAILABLE SOURCES OF INFORMATION

Any questions you may have about this study will be answered by the Principal Investigator:

Christine G. Thomas
Telephone Number: 754-323-3800, extn. 3011
Email: Christine.G.Thomas@browardschools.net

AUTHORIZATION

I have read and understood this consent form, and I volunteer my child to participate in this research study. I voluntarily choose that my child participates, but I understand that my consent does not take away any legal rights in the case of negligence or other legal fault of anyone who is involved in this study. I further understand that nothing in this consent form is intended to preempt any applicable federal, state, or local laws regarding informed consent.

SUBJECT VOLUNTEERS

1. ________________________________
Name of student Participant (Printed)

____
Signature of student Date Time

2. ________________________________
Name of Parent or Guardian Participant (Printed)

____
Signature of Parent or Guardian Date Time

I, ___________________ (Print Parent's or Guardian's Name) verify that I have discussed this research

study, its objectives, methods, associated risks, and benefits with my child, _______________

(Print Child's Name), who will be a subject volunteer.

____
Signature of Parent Who is Informing Child of Research Study Date Time

Parental Consent

I, _____________________ (Print Parent or Guardian's name) give my parental consent for my child,

_____________________ (Print Child's Name) to participate in this research study.

____

Parent's or Guardian's Signature Date Time

I, ________________________ (Print Parent or Guardian's name) **do not** give consent for my

child, _____________________(Print Child's Name) to participate in this research study.

____

Parent's or Guardian's Signature Date Time

Appendix C

Research Subject Informed Consent Form

Spanish

FORMULARIO DE CONSENTIMIENTO QUE DECLARA ESTAR INFORMADO SOBRE EL TEMA DE LA INVESTIGACIÓN

Posible tema de investigación – Lea este formulario de consentimiento cuidadosamente y formule las preguntas que considere necesarias antes de decidir si usted quiere participar en este proyecto de investigación.

Título del Proyecto: *Disertación Doctoral Propuesta* – Ambiente de Aprendizaje, Realización y Actitudes entre Alumnos de Matemáticas con Específicos Problemas de Aprendizaje en Clases Autosuficientes y de Inclusión.

Principal Investigador: Christine G. Thomas
Afiliación Universitaria: Curtin University of Technology (Universidad de Tecnología Curtin) – Estudiante Graduada
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Perth, Western Australia
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Afiliación Universitaria: Curtin University of Technology (Universidad de Tecnología Curtin) – Centro Principal para Ciencia y Matemáticas en Colegios
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Correo Electrónico: B.Fraser@curtin.edu.au

PROPÓSITO DEL ESTUDIO DE INVESTIGACIÓN

El propósito general de esta investigación es determinar si existen diferencias entre los alumnos con específicos problemas de aprendizaje en clases autosuficientes, en clases de inclusión y los alumnos en general en clases de inclusión en términos de sus percepciones del ambiente de aprendizaje en el salón de clases, realización y sus actitudes para con las matemáticas.

PROCEDIMIENTOS

Se les pedirá a los estudiantes y a los padres de los estudiantes permitir al principal investigador administrar exámenes de actitud de entrada y salida (antes y después) utilizando cuestionarios de ambiente de aprendizaje. Para medir los instrumentos del ambiente de aprendizaje de los alumnos, también será administrado el ¿Qué está sucediendo en esta clase? (WIHIC), y el Examen de Matemáticas y Actitud Relacionadas (TOMRA) modificación tomada del Examen de Ciencia y Actitud Relacionadas. Las escalas fueron modificadas, la formulación de los temas simplificada para mejorar la lectura y las escalas fueron reducidas para satisfacer la lectura de estudiantes de procedencia hispana o haitiana y de aquellos alumnos que estén aprendiendo el idioma inglés como segunda lengua.

El análisis e interpretación de los datos obtenidos y de reportes escritos serán llevados a cabo durante el segundo período de calificación del año escolar. El compromiso estimado para la administración de estos cuestionarios aproximadamente deberá durar una hora de clase para los estudiantes.

POSIBLES RIESGOS O INCOMODIDADES

No existen riesgos posibles o previstos o incomodidades para los participantes de esta investigación.

POSSIBLES BENEFICIOS

Existen varias implicaciones que están surgiendo de los resultados del presente estudio en las que se ven involucrados los estudiantes, profesores, administradores y todas las personas que toman parte del proceso educativo del estado de Florida. En primer lugar, dos instrumentos ampliamente aplicables serán utilizados en las escuelas públicas del distrito de Broward County, en escuelas que reúnan la mayoría de estudiantes dentro del distrito. Estos instrumentos, anteriormente nombrados, ¿Qué está sucediendo en esta clase? (WIHIC) y el Examen de Ciencia y Actitud Relacionadas (TOSRA) que fue modificada para ser utilizada en una clase matemáticas, el Examen de Matemáticas y Actitud Relacionadas (TOMRA), proveen un medio por el cual los profesores podrán recolectar mayor información y utilizar la misma apara ayudar a motivar el aprendizaje de sus alumnos.

COMPENSACIÓN

No hay compensación financiera por su participación en este proyecto.

POSIBLES GASTOS PARA USTED

No existe ningún tipo de gasto financiero previsto, asociado a este estudio por parte de los participantes.

CONFIDENCIALIDAD

Su identidad en este estudio será tratada con reserva, confidencial. Los resultados de este estudio podrían ser publicados por razones educativas pero no incluirán de ningún modo su nombre o cualquier referencia que lo pudiese identificar a usted.

TERMINACIÓN DE SU PARTICIPACIÓN EN EL ESTUDIO DE INVESTIGACIÓN

Si por alguna razón, usted decidiera que su alumno no debería participar en este estudio, por favor notifique a Christine Thomas acerca de su decisión de concluir la participación de su hijo(a) en este estudio.

FUENTES DISPONIBLES DE INFORMACIÓN

Cualquier pregunta que usted tenga sobre el mencionado estudio será respondida por el Principal Investigador:

Christine G. Thomas
Número Telefónico: 754-323-3800
Correo Electrónico: Christine.G.Thomas@browardschools.net

AUTORIZACIÓN

He leído y entendido plenamente este formulario de consentimiento, y deseo que mi hijo(a) participe voluntariamente en este estudio de investigación. Yo voluntariamente elijo que mi hijo (a) participe, pero también entiendo que mi consentimiento no resta ningún derecho legal en el caso de negligencia u otra falta legal cometida por cualquiera que esté involucrado en este estudio. También entiendo que nada en este formulario de consentimiento tiene la intención de violar ninguna ley federal, estatal o local con respecto al consentimiento informado.

SUJETOS VOLUNTARIOS

1. _______________________________
Nombre del estudiante participante (Impreso)

____
Firma del Estudiante Fecha Hora

2. _______________________________
Nombre del Padre o del Guardián del Participante (Impreso)

____
Firma del Padre o del Guardián Fecha Hora

Yo, ___________________ (Imprimir el nombre del padre o del Guardián) verifico que he discutido este estudio de investigación, sus objetivos, métodos, riesgos asociados y beneficios con mi hijo (a), _______________ (Imprimir el nombre de su hijo (a)), quién será un sujeto voluntario.

____
Firma del Padre quién está informando al alumno (a) sobre el Estudio de Investigación Fecha Hora

Consentimiento del Padre

Yo, _____________________ (Imprimir el nombre del padre o del Guardián) otorgo mi consentimiento

paternal para que mi hijo, _____________________ (Imprimir el nombre de su hijo (a)) participe en este

estudio de investigación.

____

Firma del Padre o del Guardián Fecha Hora

Yo, _______________________(Imprimir el nombre del padre o del Guardián) **no otorgo** mi

consentimiento para que mi hijo (a), ____________________(Imprimir el nombre de su hijo (a))

participe en este estudio de investigación.

____

Firma del Padre o del Guardián	Fecha	Hora

Appendix D

Research Subject Informed Consent Form

Haitian Creole

FÒM KONSANTMAN EKLERE POU RECHÈCH

Rechèch pwospektif – Li fòm konsantman sa a byen epi poze tout kesyon ou genyen anvan ou deside si ou vle patisipe nan pwojè rechèch sa a.

Tit Pwojè a:Tèz Doktora Propoze – Milye aprantisaj, Reyalizasyon, ak Konpòtman Elèv Matematik ki gen pwoblèm Aprantisaj Espesifik nan Klas Entegrasyon Eskolè Timoun ki gen difikilte.

Anketè Prensipal: Christine G. Thomas
Inivèsite Afilye: Curtin University of Technology – Etidyan Diplome
Key Centre for School Science and Mathematics
Perth, Ostrali Wès
Afilyasyon Pwofesyonèl: Broward County Public Schools – Pwofesè
Fort Lauderdale, Florid, Etazini

Mail vokal: (754) 323-3800 x 3011
Adrès Email: Christine.G.Thomas@browardschools.net

Sipèvizè adistans: Dr. Barry J. Fraser
Inivèsite Afilye: Curtin University of Technology – National Key Centre for School Science and Mathematics
Perth, Ostrali Wès
Fax: (+61) 8 9266 2503
Email: B.Fraser@curtin.edu.au

OBJEKTIF RECHÈH LA

Objektif jeneral etid la se detèmine si gen diferans ant elèv gi genyen pwoblèm aprantisaj espesifik nan klas espesyal ak nan klas entegrasyon, ak elèv ansèyman jeneral nan klas entegrasyon sou pèsepsyon yo sou anviwònnman sal klas yo, reyalizasyon yo, ak konpòtman yo nan matematik.

PWOSEDI

Elèv ak paran yo pral pèmèt anketè prensipal la itilize kesyonè Anviwònnman Aprantisaj pou bay tès konpòtman avan/apre. Pou mezire konpòtman elèv yo, ya p bay tèks sou anviwònman Aprantisaj, *What is happening in this class*? (WIHIC), ak *Test Of Mathematics-Related Attitude (TOMRA*) modiye pa $ apò ak *Test Of Science-Related Attitude*. Echèl yo modifye, mo yo senplifye pou fasilite lekti a, epi echèl yo diminye pou matche kapasite lekti elèv dorijin ispanik ak ayisyen yo ak sila yo kap aprann angle kòm yon dezyèm lang.

Analiz ak entèpretasyon done ak rapò ekri yo pral fèt pandan dezyèm period klasman nan lane eskolè a. Angajman yo estime pou administre kesyonè sa yo dwe apeprè inè nan lè klas elèv yo.

RISK OU ENKONVENYAN

Pa gen okenn risk ou enkonvenyan koni oubyen rezonableman previzib pou patisipan yo.

AVANTAJ

Gen anpil enplikasyon pou elèv, pwofesè, administratè ak anpil entèvenan nan domèn edikasyon nan leta Florid la kap sòti nan rezilta etid sa a. Premyeman, yo pral itilize de enstriman aplicab anpil nan distri *Broward County Public Schools* lan, nan lekòl ki replike majorite elèv nan distri a. Enstriman sa yo, a savwa, *What is happening in this class? (WIHIC*) ak *Test Of Science-Related Attitude (TOSRAv) yo* te modifye pou itilizasyon yo nan klas matematik, *Test Of Mathematics-Related Attitude (TOMRA*), pèmèt pwofesè yo kolekte plis done epi itilize yo pou ede ankouraje elèv yo aprann, kontwole anviwònnman aprantisaj yo, epi mezire refleksyon lojik, motivasyon ak konpòtman elèv yo.

COMPANSASYON

Pa gen okenn konpansayon finansyè pou patisipan yo nan pwojè rechèch sa a.

LAJAN SA KA KOUTE OU

Pa gen depans previzib patisipan yo pral fè pou etid sa a.

KONFIDANSYALITE

Idantite ou nan etid sa ap rete konfidansyèl. Rezilta etid la ka vinn piblik pou rezon ledikasyon men yo pap genyen non ou byen nenpòt referans ki ka idantifye ou.

FEN RECHÈCH LA

Si pou yon rezon kèlkonk ou deside elèv ou a pa dwe patisipe nan etid sa, tanpri enfòme Christine Thomas de desizyon ou pou mete fen a patisipasyon pitit ou nan etid la.

SOUS ENFÒMASYON DISPONIB

Anketè Prensipal la kapab reponn tout kesyon ou genyen sou etid sa:

Christine G. Thomas
Nimewo Telefòn: 754-323-3800
Email: Christine.G.Thomas@browardschools.net

OTORIZASYON

Mwen li e mwen konprann fòm konsantman sa a, mwen vle pitit mwen patisipe nan pwojè rechèch la. Mwen chwazi de pwòp mwen menm pou pitit mwen patisipe, men mwen konprann konsantman mwen an pa retire dwa legal yo nan ka neglijans ou lòt fòt legal yon moun ki enplike nan etid la. Mwen konprann ankò anyen nan fòm konsantman sa a pa ka ranplase lwa federal, leta ou lokal yo sou sa ki gen rapò ak konsantman.

SIJÈ VOLONTÈ

1. ______________________________
Non elèv Patisipan (enprime)

____
Siyati elèv la Dat Lè

2. ______________________________
Non paran ou responsab Patisipan lan (enprime)

____
Siyati Paran ou Responsab Dat Lè

Mwen, __________________ (non Paran ou Responsab lan) ateste mwen diskite sou pwojè rechèch la,

Objektif li, method li, risk ak avantaj li gen ladan li ak pitit mwen, _______________

(non Timoun lan), ki pral yon sijè volontè.

____
Siyati Paran ki pale ak Timoun lan sou Etid Rechèch la Dat Lè

Konsantman paran

Mwen, ____________________ (non Paran ou Responsab lan) dakò pou pitit mwen,

____________________ (Non Timoun lan) patisipe nan rechèch sa-a.

____

Siyati paran ou moun responsab Dat Lè

Mwen, _______________________ (non Paran ou Responsabl lan) **pa** dakò pou pitit mwen, ____________________(Non Timoun lan) patisipe nan etid rechèch sa-a.

____

Siyati paran ou moun responsab Dat Lè

Appendix E

Approval for Research

Curtin University Human Research Ethics Committee

Protocol Approval Number SMEC 20060036

MINUTE

Curtin
UNIVERSITY OF TECHNOLOGY

To	Christine Thomas
From	Dr Tony Rickards, Coordinator Human Research Ethics Science and Mathematics Education Centre.
Subject	Protocol Approval **Number** SMEC 20060036
Date	Form B submission date September 24th, 2007
Copy	Prof. Barry Fraser

For and on behalf of:
Office of Research and Development

Human Research Ethics Committee

TELEPHONE 9266 2784
FACSIMILE 9266 3793
EMAIL l.teasdale@curtin.edu.au

Thank you for your Form C Application for Approval of Research with Minimal Risk (Ethical Requirements) for the project entitled "LEARNING ENVIRONMENT, ACHIEVEMENT AND ATTITUDES AMONG MEDIC STUDENTS WITH SPECIFIC LEARNING DISABILITIES IN SELF-CONTAINED AND INCLUSION CLASSES." On behalf of the Human Research Ethics Committee I am authorised to inform you that the project is approved.

Approval of this project is for a period of twelve months from Sept 25th, 2006 to Sept 24th, 2007.

If at any time during the twelve months changes/amendments occur, or if a serious or unexpected adverse event occurs, please advise me immediately. The approval number for your project is **SMEC 20060036**. *Please quote this number in any future correspondence.*

A. Rickards

Tony Rickards PhD.
Coordinator for Human Research Ethics
Science and Mathematics Education Centre

Please Note: The following standard statement must be included in the information sheet to participants:
This study has been approved by the Curtin University Human Research Ethics Committee. If needed, verification of approval can be obtained either by writing to the Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University of Technology, GPO Box U1987, Perth, 6845 or by telephoning 9266 2784.

A "Form B" is to be completed and returned to the Secretary, Human Research Ethics Committee C/- Office of Research & Development, **twelve months** following initial project approval ie,prior to the expiry date. If any alterations or changes to the study apply prior to the expiry date, this "Form B" should be submitted to the Committee at that time. An application for renewal may be made with a Form B three years running, after which a new application form (Form A), providing comprehensive details, must be submitted.

The form is available at: http://research.curtin.edu.au/ethics

Appendix F

Permission to Conduct Research

The School Board of Broward County, Florida

Research Services

THE SCHOOL BOARD OF BROWARD COUNTY, FLORIDA
RESEARCH SERVICES

CARY SUTTON, Ed.D., DIRECTOR
DEPARTMENT OF RESEARCH SERVICES

Telephone: 754-321-2500 Facsimile: 754-321-2722

Approval Expires Wednesday, February 28, 2007

January 18, 2007

TO: Principals

FROM: Cary Sutton, Ed.D., Director
Research Services

VIA: Verda Farrow, Ed.D.
South Central Area Superintendent

SUBJECT: **PRINCIPAL APPROVAL MEMORANDUM FOR RESEARCH PROPOSAL #441** – *LEARNING ENVIRONMENT, ACHIEVEMENT, & ATTITUDES AMONG MATHEMATICS STUDENTS WITH SPECIFIC LEARNING DISABILITIES IN SELF-CONTAINED & INCLUSION CLASSES*

Staff has reviewed the research request ***Learning Environment, Achievement, & Attitudes Among Mathematics Students with Specific Learning Disabilities in Self-Contained & Inclusion Classes*** and approval has been granted for the researcher or research group to contact you requesting participation. The recently completed review of the proposed research involved school- and district-based staff, Institutional Review Board (IRB) approvals, and a review of the proposed research methods. These steps were taken to determine if the proposed methods demonstrated reasonable promise of generating data/analyses that will accurately answer the main research questions of interest.

Your participation in this research project is voluntary. To aid in your decision, the researcher or research group has been instructed to share with each selected District office and/or school a complete description of research activities as well as the **"Approval Documentation"**. Based upon this information, each District office and/or school would then be asked to make a decision to participate or not and inform the requesting research parties of their decision.

VF/COS:bt