Science and Mathematics Education Centre

Evaluation of a K-5 Mathematics Program which Integrates Children's Literature: Classroom Environment and Attitudes

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ABSTRACT

This thesis describes a one-year study of 120 fifth grade students whose teachers participated in a program entitled Project SMILE (**S**cience and **M**athematics **I**ntegrated with **L**iterary **E**xperiences). The purpose of the study was to investigate the extent to which the classroom implementation of Project SMILE positively influenced the classroom environment and student attitudes toward reading, writing and mathematics. This was accomplished by, first, facilitating a series of five professional development workshops with the teachers and, subsequently, asking these teachers to use the strategies with their students. Because Project CRISS (**CR**eating **I**ndependence through **S**tudent-owned **S**trategies), the foundation of SMILE, had already proven to be successful nationwide for secondary students, this study focused on elementary (K-5) school students and their teachers.

My evaluation of this unique program, that integrates children's literature and mathematics, focused on student attitudes and the nature of the classroom learning environment. My research represents one of the relatively few studies that have employed learning environment dimensions with students in the elementary school mathematics classroom as criteria of effectiveness in the evaluation of educational innovations. The My Class Inventory (MCI) and an adaptation of the 1988 NAEP (National Assessment of Educational Progress) Attitude Survey were administered to a sample of 120 Grade 5 students as measures of students' perceptions of the classroom learning environment and their attitudes. Qualitative data were composed of student and teacher interviews, classroom observations and work samples.

Methodologically, my study supports previous research that successfully combined qualitative and quantitative methods of data collection. The learning environment and attitude scales exhibited satisfactory internal consistency reliability and discriminant validity; additionally, the actual form of most learning environment scales was capable of differentiating between the perceptions of students in different classrooms.

The implementation of SMILE was found to have a positive impact on the students and classes of the teachers who participated in the inservice program. In particular, students' attitudes to mathematics and reading improved, and there was congruence between students' actual and preferred classroom environment on the scales of satisfaction and difficulty. Therefore, others can implement SMILE with confidence. As well, prior research was replicated in that students' satisfaction was greater in classrooms with a more positive learning environment, especially in terms of student cohesiveness.

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Chapter 1

INTRODUCTION AND OVERVIEW

Children's books are effective classroom vehicles
for motivating students to think and reason mathematically.
(Marilyn Burns, 1992)

As we begin the 21^{st} century, schools internationally are undergoing major transitions in their mathematics programs — transitions that involve fundamental changes in curricular content, modes of instruction, teacher education, professional development, methods of assessments and public attitudes (National Research Council, 1989).

Not only are calculators and computers displacing some of the computational drill that dominated the curriculum, but also their presence stimulates new approaches to understanding mathematics and to solving problems. All major components of mathematics education — curricula, teaching, teacher education, testing, textbooks, and software have changed significantly. The dramatic advances that have been made in mathematics over the past few decades are starting to be felt in the schools, in the form of new and exciting ways to help students to perceive and order the universe around them (National Research Council, 1989).

What factors are necessary for an educational program to become successful? Is instruction the only factor that makes a difference in a classroom? The answer to both of these questions is answered in the next few statements. Although research and evaluation have relied heavily on the assessment of academic achievement and other valued outcomes, these measures cannot give a complete picture of the educational process. Because students spend up to 15,000 hours at school by the time they finish senior high school (Rutter, Maughan, Mortimore, Ouston & Smith, 1979), they have a large stake in what happens to them at school and their reactions to and perceptions of their school experiences are important (Tobin & Fraser, 1998). Teachers, also seem to concentrate almost exclusively on the assessment of academic achievement, and devote little attention to factors which might be related to their students' performance.

In the last two decades, the field of classroom environment has progressed to the point where researchers and teachers can assess classroom environments and identify their effects on students. This research has given teachers an in-depth understanding into how individuals learn, the complexity of teaching, and the nature of classroom environment. A direct association between positive student attitudes and improved classroom environment has been established, and students achieve more when there is a positive classroom environment (Fraser, 1998a). My study, as reported in this thesis, is distinctive in that it adds to the small number of recent learning environment studies (e.g. Goh, Young & Fraser, 1995; Majeed, Aldridge & Fraser, 2002) that focus on the school subject of mathematics.

My thesis describes a one-year study of 120 fifth grade students whose teachers participated in a program entitled Project SMILE (Science and Mathematics Integrated with Literary Experiences). The main purpose of my study was to investigate whether integrating children's literature into this unique elementary (K-5) mathematics program would promote positive student attitudes toward mathematics and lead to improvement in the classroom learning environment.

I became intrigued with the study of learning environments when I observed that, at the beginning of each new school year when the children in my own classroom were asked what subject they liked best, most all of them responded 'reading'. When I asked them more in-depth questions, I found that they love mathematics **or** hate it. It was my quest to find out what classroom factors affect the attitudes of children toward mathematics. Was it the content, was it the way in which the teacher taught the content, was it the childrens' backgrounds in mathematics, or was it none of these?

At the end of the year, when I asked the children what subject they liked best, most of them responded that they like mathematics the best. Why was it that the children in my classroom love mathematics and children in other classrooms do not? Did the way in which I teach mathematics reflect my love for the subject or were there other factors involved? When I asked them why, several of the children responded that they understand mathematics better because the books that I use to introduce each mathematics lesson helped them to better understand the mathematical concepts.

Because I wanted to find out what classroom environment factors affect the attitudes of children in the elementary classroom, I decided to study classroom learning environments as they relate to the elementary (K-5) school mathematics classroom. The main purpose of my study was to discover whether integrating children's literature in the elementary school classroom, through a unique program entitled Project SMILE (Science and Mathematics Integrated with Literary Experiences) would promote positive attitudes toward mathematics and create a positive classroom environment.

The research reported in this thesis involved the evaluation of this unique program that integrates children's literature and mathematics in terms of learning environments and student attitudes. This study was significant in several ways. First, little research had been done on the strengths and weaknesses of the integration of mathematics and children's literature. Secondly, it was important to determine if SMILE would prove to be successful with elementary school students as Project CRISS (its predecessor) had been shown effective in secondary classrooms. Third, if SMILE showed merit in the fourth largest school system in the United States, its effectives could be explored further in other states. This chapter introduces the thesis using the following headings and section numbers:

1.1 Personal Background of SMILE

1.2 Historical Background of SMILE

- 1.2.1 Project CRISS
- 1.2.2 Adoption of CRISS in my District
- 1.2.3 A Summary of SMILE Thematic Units

1.3 Purposes and Significance of the Study

1.4 Specific Research Questions

1.5 Overview of Limitations

1.6 Overview of the Thesis

1.1 PERSONAL BACKGROUND OF SMILE

What would prompt a former public school music teacher to develop a program that integrates children's literature and mathematics? Too often, mathematics learning is relegated to practice with textbook and workbook exercises, which cannot spark children's imagination in the way that literature does (Burns, 1992). I learned mathematics with a workbook and textbook. After observing that my own children were forced into the drudgery of solving hours of mindless mathematical algorithms, I knew that I wanted to change the way in which mathematics was taught in my classroom. The expertise of constructivist mathematical masters (Reys, Lindquist, Lambdin, Smith & Suydam, 2001) and the classroom experiences of my own children were the inspiration behind the development of Project SMILE.

As an undergraduate music education major from a university in the Midwest, my goal was to be the best band director in the United States. Working as a band director for one year in the Midwest was a dream come true. However, my fiancée was teaching in Florida. I was recruited to teach music in Florida, married and accepted a general music position in an inner city school.

After teaching music for five years, the greatest frustration that I faced was that the children in the school were behind in reading. After much thought, I decided to earn a Master's degree in elementary education so that I could teach these children and other children to become better readers.

The focus of my Master's degree was teaching language-deficient children to read. I transferred to a new school to teach in a regular classroom setting. This move meant that I would be teaching children to read as well as to speak English. I taught in a classroom for ten years. I focused primarily on teaching the children to read, write and speak English. Why, then, did I switch to mathematics?

Growing up in a small town in Iowa, I always found mathematics was my favorite subject in school. As a fourth grader, I was working on the fifth grade mathematics book. The reason that I was ahead of the rest of my classmates was that I loved to please the teacher by working quickly. I was good at memorization — therefore, I was good at mathematics. I received high grades in mathematics throughout elementary, middle and high school. Again, I was good at memorizing.

Success in mathematics in college was not the same as in elementary and secondary school. In college, my one required mathematics class was taught by a professor lecturing to 500 students in an auditorium. I did not understand one thing that the professor taught. My small-group discussion class was taught by a graduate assistant, who barely spoke English. She wrote examples on the chalkboard and erased them just as quickly as we could copy. The homework assignments were applications of mathematical formulas. It was assumed that everyone in the class knew the correct formula for each problem. I could not apply the formulas because I had forgotten them. I remembered nothing from past mathematics classes. I now know that the reason that I did poorly was that I did not understand the concepts behind mathematics or *when* and *how* to apply formulas. Somehow, I did pass the course.

After ten years of teaching, I learned that a local university was offering an educational specialist degree program focusing on the teaching and learning of mathematics. Having a love for teaching mathematics, I applied for the MSRT (Mathematics and Science Resource Teacher) program. I was comfortable teaching mathematics to elementary school children but, when given the opportunity to enhance my background knowledge in mathematics, I immediately sent in my application.

When I was accepted into the program, my focus changed from teaching *just* reading to integrating mathematics into reading, writing and speaking. Though the children in my classroom spoke and read very little English, they were good at mathematics computation. Coming from other countries, they showed me strategies for mathematical problem solving that were different from the strategies in the textbook. The new-found knowledge from my university classes inspired me to integrate science, social studies and mathematics into the reading curriculum.

When I began the new university program, I jumped in wholeheartedly. One goal of the program was to increase background knowledge in mathematics. Some of the content courses offered were Algebra, Geometry, Calculus and History of Mathematics. I learned the content knowledge that I never attained in my other college courses.

The one course that changed the way in which I taught mathematics was the course, Methods of Teaching Elementary Mathematics. The professor taught us how to teach mathematics conceptually using a hands-on, activity-based approach. For the first time in my career, I understood the concepts behind the formulas. I began teaching my students using this approach. The most significant thing that I observed was that the children finally loved mathematics in the way that I did. They also felt that mathematics was fun. It is my opinion that this love for mathematics was brought about because the children finally *understood* the reasons behind the algorithms.

The professor of the methods course encouraged his students to meet other teachers by getting involved in presenting workshops at state and national conferences. The MSRT cadre attended conferences and gained insight into the teaching and learning of mathematics. Marilyn Burns, one of the leading authors and researchers in the area of elementary mathematics, presented research at these conferences. She not only is a researcher, but also teaches children at the elementary school level on a part-time basis. Because her workshops include work samples from the students in her classroom, her sessions are invaluable to the teachers/participants. After the first time I heard Marilyn Burns speak, I vowed that, when I did presentations, I would use only those activities that I had taught the children in my classroom. This philosophy continues today. If the activities don't work with children, why share them with others?

During summer recesses, I began attending inservice courses throughout the United States. I wanted to learn everything I could possibly learn about teaching elementary mathematics. Through one of these inservice courses, I was taught how to integrate mathematics with children's literature books. I spent the remainder of my summers writing mathematics lessons that integrated children's literature.

In my district, the emphasis is on achievement, particularly achievement test scores. My personal goals were helping children to learn and love mathematics *and* to have high achievement test scores. Our state gives monetary incentives to teachers whose students earn high test scores. The school-based administrators want the students in their school to earn high test scores. However, some were not informed of the latest trends in mathematics education. The administrator at my school bought an achievement test practice program. He was told that this program would *guarantee* high scores. As well as this practice program, we were also asked to use the textbook and its support material.

How was I supposed to use the textbook, the practice program *and* get the children to know, understand and love mathematics? That was the challenge before me. This challenge, along with my new graduate program and travel experiences, provided me with the incentive to begin developing my own lessons. SMILE began to take form.

Although I taught in the same school for 18 years, I had a range of experiences because I taught at different grade levels and under the leadership of four different principals. Each administrator had different strategies for fulfilling the district's goal of high achievement test scores.

Through the MSRT program, I met personnel from the district's Office of Professional Development. With the support of my university advisor and the director of professional development, I was given the opportunity to develop and conduct inservice courses for other teachers throughout the district. The title of the inservice course was Mathematics with Manipulatives. With the support of my school-based administrator, I maintained my classroom and taught a series of ongoing inservice workshops at elementary schools throughout the district.

During the summer, a group from the MSRT program taught workshops at the district's summer institute for mathematics and science. We were chosen because of our expertise in teaching mathematics to elementary school teachers. Our expertise was grounded on the fact that we were practicing classroom teachers and the lessons that we taught had been used with children of various grade levels.

At the completion of the educational specialist program, 11 out of the original 20 graduated with degrees in the teaching and learning of elementary mathematics. At this point, I was asked to move to the district Office of Professional Development and teach mathematics content and pedagogy to elementary school teachers. I took the new position with the understanding that I would be able to return to my former school to pilot new lessons and programs with children. The Director of the Office of Professional Development and the Principal agreed to the terms. I became a teacher-trainer in the Office of Human Resource and Development on a full-time basis.

My new administrator encouraged me to design lessons for the inservice courses. Each inservice course went for five full days over a ten-week period of time. The class of each teacher participating in the inservice course was covered by a substitute teacher paid by the Eisenhower Professional Development Program. This program is federally funded and provides teacher training through professional development activities in mathematics and science. Each teacher/ participant received $600 worth of materials to support the inservice activities. Four different inservice courses with approximately 120 participants were held during each week. By the end of the year, over 2000 teachers had participated in the Mathematics with Manipulatives inservice course. This program continued for four years.

At that point in time, the state began grading the schools. The administrators were looking for ways to raise and keep the achievement test scores rising. Research-based programs were sought. Project CRISS (Creating Independence through Student-owned Strategies) was chosen by my school district to be implemented. Teachers in the Miami-Dade County Public Schools were urged to participate in Project CRISS training. It is an outstanding research-based program for secondary (6-12) students (Santa, 1986). It was also available for upper elementary (4-5) students. However, due to the high reading levels, elementary teachers were having trouble adapting the materials for *all* elementary students.

My experience as a teacher trainer was such that I knew that in order for elementary teachers to buy into a program, they needed concrete materials that could be used immediately with their children. I requested permission from the mathematics and language arts departments to begin writing an adaptation of Project CRISS that would be sanctioned for use by all elementary teachers in the county.

The principles and strategies in Project CRISS were aligned with the philosophy behind the MSRT program. Meaning, teachers will be taught to teach mathematics combining procedures and concepts using a hands-on, activity-based approach. Project SMILE was designed to help elementary students to better understand the concepts of mathematics, using children's literature and hands-on, activity-based lessons as the foundation. In order to validate the teacher training, all SMILE lessons were field tested with children of various ability levels.

Funding for the current program will change at the end of the 2002 school year. Because of the success of SMILE, funding has been extended for the next three years. Though the funding has changed, the premise is the same---teachers are being taught to teach children how to conceptualize, have a positive attitude, and create a positive learning environment in the elementary mathematics classroom.

In conclusion, I did not start my teaching career teaching elementary mathematics. When I did begin teaching mathematics, I integrated all subjects into my mathematics lessons. My special interest was in integrating children's literature into mathematics. I was also curious to discover why the children in my classroom liked mathematics, while other students did not. I began investigating my classroom environment and how it related to student attitudes. I began writing thematic lessons that integrated children's literature. My children scored high on achievement tests. I wanted to undertake the present study to evaluate the integration of mathematics and children's literature in terms of classroom environment and students' attitudes.

The following section (1.2) describes in detail how and why Project CRISS was chosen to be the program to improve achievement test scores in Miami-Dade County.

1.2 HISTORICAL BACKGROUND OF SMILE

In mathematics education, what to teach and effective ways to teach the content have become more publicly and hotly debated in some areas of the United States in recent years. Teachers and parents are challenged to think about mathematics very differently from the school mathematics which they experienced. The demands of the new century require that all children acquire an understanding of concepts, proficiency in skills, and a positive attitude toward mathematics (Kennedy

& Tipps, 2000). According to the traditional view, students acquire mathematical skills by imitating demonstrations by the teacher and working on examples in the textbook (Battista, 1999). As today's students learn mathematics skills and concepts, they must apply, adapt, and extend old concepts to new tasks and existing ideas into new ideas (Kennedy & Tipps, 2000).

In 1989, the National Council of Teachers of Mathematics (NCTM) took a decisive step toward improving the teaching of mathematics with the publication of *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989b). This visionary document represents a major effort to create a set of guidelines or *standards* to guide the revision of the school mathematics curriculum and its associated evaluation (NCTM, 1989a). The standards-based curriculum in mathematics in essence is this: everything that is done with children needs to help them make sense of the mathematics that they are learning (Herrera, 2001). These national standards are the basis for the district and state curricula in Miami-Dade County, Florida. Each mathematics lesson plan must reflect the district standards which are, essentially, the national standards.

The Basics of School Improvement and Accountability in Florida GE356 (FDOE, 1997) changed the way in which mathematics is taught in the state of Florida. The change focused on a shift from rote acquisition of information to the understanding of underlying mathematical concepts. Research has consistently confirmed that isolated 'learnings' are not retained (Heibert & Carpenter, 1992). Mathematics can and must make sense. Writing, listening and discussing mathematics are now the norm in the elementary mathematics classroom (Burns, 1992).

To be successful in mathematics, a child needs to be able to think and reason. Being able to solve problems is the test of whether or not a child understands a concept (Herrera, 2001). A fundamental change is necessary in how mathematics is viewed – not as boring, sterile and difficult, but as an exciting exploration with practical uses every day for everyone (Reys, Suydam, Linquist & Smith, 1998). To accomplish the goal of increasing students' mathematical learning, school districts investigated a variety of instructional programs. Educators and leaders in Miami-Dade County felt that the instructional program that was selected must be firmly grounded on the results of past educational research (OEEMA, 1998). Thus Project CRISS was introduced in the Miami-Dade County School District. The evolution from Project CRISS to Project SMILE is described in sections 1.2.1 to 1.2.3, which are entitled Project CRISS, the Adoption of Project CRISS in my County and a Summary of the SMILE Thematic Units.

1.2.1 Project CRISS

Before the national standards were written, in the late 1970s, educators in the state of Montana were trying to help secondary students to improve their performance-based test scores (www.projectcriss.org, 2002). In 1979, a writing team under the direction of Dr Carol Santa, District Reading Coordinator, developed Project CRISS (**CR**eating **I**ndependence through **S**tudent-owned **S**trategies) for the Kalispell, Montana Public School District. Project CRISS was created to help students to better organize, understand and retain course information. In short, students receiving the CRISS method of instruction will *learn how to learn.*

In this quest for better test scores, students learn to become strategic when teachers teach the process of learning directly through explanation and modeling. Most students do not know how to learn. Teachers have to show them how. Teachers show, tell, model, demonstrate and explain, not only the content, but the process of activity-based learning. As the students' learning process begins, they are dependent on the teacher for all learning. As the process continues, the students take more and more responsibility for their own learning. In the end, the responsibility for learning is solely on the student. This is a gradual release of responsibility from the teacher to the student (www. projectcriss.org, 2002).

Project CRISS, which began as a local experiment in Kalispell, Montana, is now being implemented in 43 states and three countries. In 1982, Kalispell was an official state of Montana CRISS demonstration site for Grades 10-12. This means that this school district fulfilled all the criteria set by the state of Montana to have other school districts model their program. The program was nationally validated in 1985 (Santa, 1988). In 1993, the validation expanded to include Grades 4-12. The National Diffusion Network (NDN) provided funding for CRISS from 1985 to 1996. The NDN, part of the US Office of Educational Research and Improvement, provided validated projects with grants to support dissemination. NDN funding was eliminated by Congress in 1996 (Santa, 1996).

The project's basic underlying assumption is that poor student performance is due to the students' inability to read content area texts (Santa, 1988). CRISS strategies were designed to develop thoughtful and independent readers and learners. Project CRISS focuses on teaching secondary students how to learn content area subjects (mathematics, science and social studies) through reading, writing, speaking and listening. In its initial evaluation, students learned how to apply the CRISS principles to all subject areas (Santa, 1996). The following nine key principles drawn from cognitive and social learning research lay the foundation for Project CRISS (Santa, 1996, p. 1):

- Background knowledge is a powerful determinant of reading comprehension.
- Good readers are actively involved in making sense from their reading.
- Students need many opportunities to talk with one another about what they are learning.
- Good readers use metacognitive strategies to learn. They are goal directed and they know how to attack print to create meaning.
- Students need many opportunities to write about what they are learning.
- Good readers and writers have an intuitive understanding of the author's craft. (Students understand the author's style of writing.)
- Good readers know a variety of ways to organize information for learning.
- Students learn to become strategic learners when given opportunities by teachers through explanation and modeling.
- Students come to understand by doing a variety of thought-demanding activities with a topic.

After a ten-year implementation, Santa's research showed that students who attended schools where Project CRISS was put into practice had a higher success rate on standardized tests. The program was field tested in other states in the United States. Because of the success rate in Montana, the mathematics and science department of the Miami-Dade County Public Schools adopted Project CRISS at the beginning of the 1997-1998 school year.

1.2.2 Adoption of CRISS in my District

In 1998, the educational specialists assigned to the district's mathematics and science department were part of an intensive inservice training program for Project CRISS. These specialists were then able to begin training classroom teachers in the principles and strategies of Project CRISS. We felt that these principles and strategies would be of as much value to elementary (K-5) teachers as they are to secondary teachers. Research shows that exemplary teachers utilize strategies which encourage students to participate actively in learning activities (Fraser & Tobin, 1991, p. 287). Because the background of educational specialists is in teaching elementary school mathematics using a hands-on, conceptual approach, the principles and strategies of CRISS seemed a perfect match for the elementary school setting. As a result, this researcher was inspired to adapt the program for elementary (K-5) teachers. Many of the activities presented in the CRISS Manual were adapted for elementary school students using popular children's literature as the basis of thematic units. It was hoped that, after teachers used the CRISS strategies incorporating hands-on activities into their teaching, students would be better able to conceptualize mathematics, have more positive attitudes toward mathematics and create positive changes in classroom environment.

In May 1999, the Florida Department of Education declared Project CRISS the top-rated program for helping to improve performance-based standardized test scores at the secondary school level (FDOE, 1999). Hopefully, SMILE will one day be on the same list of successful elementary (K-5) mathematics programs.

1.2.3 A Summary of SMILE Thematic Units

The SMILE teaching materials were designed to infuse the principles and strategies of CRISS, and the national mathematics standards, into each lesson plan. The SMILE teaching materials consist of five thematic units which are presented to teachers during a five-day training session. Each unit focuses on one or more of the following foundational ideas in the NCTM standards: Number Sense and Operations, Measurement, Geometry, Data Analysis and Algebraic Thinking. Each unit spirals into the next and each contains built-in reviews and extension activities.

The first unit is entitled *The Greedy Triangle Meets the Attribute Block.* Organizational tools, including Venn diagrams, and critical thinking activities are infused into the objectives identified in the NCTM (National Council of Teachers of Mathematics) geometry content strand. Marilyn Burns' *The Greedy Triangle* serves as the literary context for children to learn how to differentiate between the attributes of geometric shapes. Students investigate what happens to a geometric shape when sides and angles are added to a polygon. Attribute blocks are used to illustrate the concepts.

The second unit, *Structures in Math, Science and Architecture,* addresses the NCTM content strand of Number Sense and Operations. The underlying concepts behind computation are taught through the use of linking cubes, color tiles and base-ten blocks. The students learn that each operational symbol has meaning. For example, the symbol for addition is the plus sign, which can represent the word 'combine' among other meanings. All four basic mathematical operations are discussed and conceptualized in this same manner.

The content strand of geometry is taught using *The Greedy Triangle.* In the story, the character of the Greedy Triangle adds one more side and one more angle each time that he becomes unhappy. Using eight basic two-dimensional polygons, the teachers investigate this principle by constructing geometric figures with straws. The culminating activity is the construction of a three-dimensional dodecahedron from 12 two-dimensional pentagons.

The third unit, *Rainbows and Fish,* uses *The Rainbow Fish* by Marcus Phister. This unit focuses on the NCTM content strand of Number Sense and Operations.

Addition and subtraction of fractions are taught using the strategy of *cross multiplication*. Children learn least common multiple, greatest common factor and fraction reduction using an Asian strategy called the *ski-slope method*, as illustrated below:

18/24 = 3/4	2	/18	24
GCF = 6	3	/ 9	12
LCM = 72		3	4

The numerator and denominator are divided by the smallest prime number that can be divided evenly into both of them. The Greatest Common Factor is found by multiplying all of the numbers to the left of the slope. The Least Common Multiple is found by multiplying all the way around the *slope* and the *ski*. The numbers under the *ski* are the original fraction's lowest terms.

Children explore geometric transformations by making a fish out of crackers. Students review Venn diagrams by discussing the attributes of the Rainbow Fish and the Greedy Triangle characters.

Bug Out on Math and Science, the fourth unit, deals with the NCTM content strands of Geometry, Data Analysis and Measurement. The focus of the unit is identifying angles, two- and three- dimensional objects, analyzing and collecting data, estimation and elapsed time. Students learn statistical vocabulary such as 'mean', 'median' and 'mode' through a trivia game. *The Hungry Caterpillar* and *The Grouchy Lady Bug,* both by Eric Carle, serve as the children's literature connections. These activities incorporate calculators to illustrate their importance in critical thinking.

The final unit in the SMILE manual incorporates all previously used CRISS principles and strategies as well as the NCTM content strands of Number Sense and Operations, Measurement, Geometry, Data Analysis and Algebraic Thinking. The teachers learn how to take any children's literature book and infuse all the principles and strategies of SMILE/CRISS. This final unit, *Math and Science for Chocolate Lovers,* addresses algebraic thinking using patterns of Hershey 'Kisses', single and double bar graphs using Hershey Miniatures, and data analysis using M&Ms. The book, *Chocolate by Hershey* by Betty Burford, provides the literature connection for the unit. This biography of Milton S. Hershey is also used to teach the importance of mathematics vocabulary.

In 1999, the adaptation of the CRISS materials was completed and renamed Project SMILE. SMILE focuses on teaching students reading, writing and mathematics through an integrated literature and activity-based (hands-on) mathematics program.

In conclusion, Project SMILE was initiated in the Miami-Dade County Public Schools because I felt that elementary school teachers needed to have usable materials for younger children. Subsections 1.2.1 to 1.2.3 discuss the history of Project CRISS, my county's adoption of Project CRISS and the SMILE teaching materials. These subsections add to the understanding of why SMILE was written and adopted in the county. In the following section, the purposes and significance of the study of SMILE are discussed.

1.3 PURPOSES AND SIGNIFICANCE OF THE STUDY

The purpose of the study was to determine the extent to which the classroom implementation of Project SMILE positively influenced the classroom environment and student attitudes toward reading, writing and mathematics. This was accomplished by, first, conducting a series of five professional development workshops for elementary school teachers and, subsequently, asking these teachers to use the strategies with their students. Because Project CRISS, the foundation of SMILE, had already proven to be successful for secondary students, this study focused on elementary school (K-5) students and their teachers. In particular, the focus of my research was the experiences of Project SMILE in terms of student attitudes and the classroom environment.

This study was significant in several ways. First, my research represents one of the relatively few studies that has employed learning environment dimensions as criteria of effectiveness in the evaluation of educational innovations in the elementary mathematics classroom. Secondly, it was also important to determine if SMILE would prove to be successful with elementary school students as Project CRISS (its predecessor) had been shown effective in secondary classrooms. Thirdly, the evaluation of this unique program is one of only a few studies that focuses on the strengths and weaknesses of integrating mathematics and children's literature and student attitudes and the nature of the classroom learning environment. Lastly, if SMILE showed merit in the fourth largest school system in the United States, it could possibly be implemented nationally.

1.4 SPECIFIC RESEARCH QUESTIONS

The following research questions were used to evaluate the experiences of Project SMILE in terms of changes that occur after the professional development program when teachers implement ideas in their classrooms:

1. What is the reliability and validity of the attitude and learning environment scales used with the sample elementary mathematics students?

2. After the teachers participate in the professional development activities for Project SMILE, are there changes in the attitudes of students regarding reading, writing and mathematics?

3. After the teachers participate in the professional development activities for Project SMILE, is there congruence between actual and preferred classroom learning environment?

4. Is there a relationship between students' perceptions of classroom environment and their attitudes?

1.5 OVERVIEW OF LIMITATIONS

Although my study's limitations are discussed more fully in the concluding chapter, a brief overview of limitations is also provided in this section. Of the 180 Grade 5 students who responded to the first questionnaire, only 120 students completed all aspects of the study because of student absences and student transfers. This relatively small sample presents a potential limitation because this sample was neither sizable nor representative of the full range of elementary schools and students. Therefore, it is unclear if my findings would apply to the full range of Grade 5 students. Also the power of the statistical analyses was limited by the smallness of the sample size in some cases.

Another limitation is that the original focus of my research (namely, the relationship between student attitudes, classroom environment and mathematics achievement) changed because I was unable to gain access to achievement test data.

Therefore, the focus changed exclusively to classroom learning environment and student attitudes.

A limitation in interpreting results stems from the fact that I did not administer the MCI on two different occasions to gauge changes in classroom environment over time. As an alternative, I compared actual and preferred learning environments after the implementation of SMILE as a way of furnishing evidence to inform my evaluation of SMILE.

Another limitation relates to the fact that the MCI is a somewhat outdated questionnaire. Therefore it does not capture all the dimensions of contemporary relevance that are assessed by contemporary instruments. (Nevertheless, the MCI has the advantage that its reading level is lower than for other existing classroom environment instruments.)

The final limitation is that the SMILE inservice program was not the only inservice workshop that some of the teachers were attending. Therefore, the results for attitudes and classroom environment perceptions might possible have been caused partly by teachers' experiences in other non-SMILE workshops.

1.6 OVERVIEW OF THE THESIS

The design, development, implementation and findings of this study are presented in five chapters. Chapter 1 introduces and provides a rationale for the study, poses the research questions, and provides personal and historical backgrounds related to the study. As well, the study's limitations are pre-empted in the first chapter.

A review of the literature pertinent to the present study is presented in Chapter 2. In this chapter, literature relevant to the teaching and learning of mathematics in the 21st century, the integration of mathematics and children's literature and the study of classroom environments and students' attitudes are examined. In particular, this chapter reviews literature related to past research undertaken in each of these fields.

The design of the study and the methods used in its implementation are outlined in Chapter 3. Also included in this chapter are descriptions of the stages of the study, the student sample, the data collection, the instruments used and the statistical procedures for analysing the data.

Chapter 4 provides the results of the study. The case study reports are presented and findings are described. Information pertaining to the reliability and validity of the learning environment and attitude instruments are provided. In addition, associations between students' attitudes and their perceptions of the learning environment are reported. In particular, analyses of data shed light on the effectiveness of SMILE in terms of changes in students' attitudes and the congruence between actual and preferred classroom learning environments.

Chapter 5 offers a summary of the thesis, together with a discussion of the limitations and implications of the study. In addition, recommendations for further research are suggested and personal reflections are made.

Chapter 2

REVIEW OF LITERATURE

There is but one correlation with success,
and that is attitude.
(Dr Harry Wong, 1998)

Mathematics gives learners a unique perspective on various domains of knowledge. In its origin and development, mathematics requires full association with all types of human activity, both mental and physical. Mathematics has drawn inspiration from business, religion, law, war, politics, ethics, gambling, metaphysics, mysticism, ritual and even play (e.g. the mathematics in the children's game of hopscotch) (Davis & Hersch, 1986).

One of the NCTM's (National Council of Teachers of Mathematics) goals for students is to explore the relationships between mathematics and the other disciplines that it serves, such as the physical and life sciences, the social sciences and the humanities. It seems that some teachers tend to leave mathematics outside the integrated whole (NCTM, 1989a).

Mathematics experts express concern that we tend to teach some parts of mathematics – arithmetic 'facts' and 'skills' – through meaningless drill so that learners lose the context and do not develop a sense of mathematical function. Except for counting and measurement in children's literature, mathematics has tended to be confined to arithmetic, taught from the book during a separate period (Whitin & Wilde, 1992). Ten percent of the mathematical content for the elementary school is computation and 90% is concepts (Reys, Lindquist, Lambdin, Smith & Suydam, 2001). In classrooms that I have observed, I have found that it is more likely that 90% of the mathematics that is being taught is computation and 10% is concepts.

Because mathematics is not being taught with a combination of conceptual knowledge and procedural knowledge, the experts are concerned that children do not connect mathematics to real-life experiences and that teachers who fear mathematics are producing learners who fear mathematics (Whitin & Wilde, 1992).

Traditionally, research and evaluation in classrooms have relied heavily on academic outcomes. While the measurement of outcomes is educationally important, research has indicated that the nature of the classroom environment also can affect students' affective and cognitive outcomes (Haertel, Walberg & Haertel, 1981). Over the past three decades, there has been considerable progress (Fraser, 1994, 1998a, 1998b; Fraser & Walberg, 1991) in the conceptualization and assessment of various aspects of the classroom environment, as well as the use of different approaches to study it (Fraser & Tobin, 1989; Fraser & Walberg, 1991).

Whiten and Wilde (1992) state: "Mathematics can be taught through the gift of story when it is integrated with children's literature". I was good at teaching reading. I love mathematics. Could integrating children's literature into the mathematics classroom positively affect childrens' attitudes toward mathematics and create a more positive learning environment? I found that there was little research into the integration of children's literature and mathematics.

My thesis describes a one-year study of 120 fifth grade students whose teachers participated in a program entitled Project SMILE. The purpose of the study was to determine the extent to which the classroom implementation of Project SMILE positively influenced the classroom environment and student attitudes toward reading, writing and mathematics. To inform this study, a literature review was conducted in various areas: elementary mathematics for the 21st century; teaching mathematics for understanding; the study of learning environments; and student attitudes. This chapter reports this literature review using the following headings:

2.1 Elementary Mathematics in the 21st Century

2.1.1 NCTM Standards

2.1.2 State and Local Standards

2.1.3 Project CRISS

2.1.4 Others Who Affect Mathematics in the 21st Century

2.2 Teaching Mathematics for Understanding

2.2.1 Procedural Knowledge Versus Conceptual Knowledge

2.2.2 Interdisciplinary Approach to Teaching

2.2.3 Integrating Mathematics and Children's Literature

2.3 The Study of Learning Environments

2.3.1 Historical Background of Learning Environments

2.3.2 Instruments for Assessing Classroom Environment

2.3.2.1 Learning Environment Inventory (LEI)

2.3.2.2 My Class Inventory (MCI)

2.3.2.3 Other Questionnaires

2.3.2.4 Moos' Scheme for Classifying Environment Scales

2.3.3 Applications of Classroom Environment Instruments

2.3.3.1 Past Studies that Combine Quantitative and Qualitative Information

2.3.3.2 Associations Between Student Outcomes and Environment

2.3.3.3 Evaluation of Educational Innovations

2.4 Student Attitudes

2.4.1 Definition of Student Attitudes

2.4.2 Evaluation of Student Attitudes

2.4.3 NAEP Attitude Survey

2.5 Chapter Summary

2.1 ELEMENTARY MATHEMATICS IN THE 21ST CENTURY

The study of mathematics has existed at least as long as recorded history. Mathematics has changed over the centuries, and its effect on culture has been profound and complex. During the last few centuries mathematics has progressed from its status as a somewhat static field of study to its current dynamic status. In fact, mathematics education as a separate field of scholarly endeavor is essentially a middle-twentieth-century phenomenon (Braddon, Hall & Taylor, 1993).

As we begin the 21st century, the nations' schools are undergoing major transition in their mathematics programs — transitions that involve fundamental changes in curricular content, modes of instruction, teacher education, professional development, methods of assessments and public attitudes (NRC, 1989).

Not only are calculators and computers displacing some of the computational drill that dominated the curriculum, but also their presence stimulate new approaches to understanding mathematics and to solving problems. All major components of mathematics education — curricula, teaching, teacher education, testing, textbooks, and software have changed significantly. The dramatic advances that have been made in mathematics over the past few decades are starting to be felt in the schools, in the form of new and exciting ways to help students to perceive and order the universe around them (NRC, 1989).

In mathematics education, what to teach and effective ways to teach the content have become more publicly and hotly debated in some areas of the United

States. Teachers and parents are challenged to think about mathematics very differently from the school mathematics which they experienced. The demands of the new century require that all children acquire an understanding of concepts, proficiency in skills, and a positive attitude toward mathematics (Kennedy & Tipps, 2000). According to the traditional view, students acquire mathematical skills by imitating demonstrations by the teacher and examples in the textbook (Battista, 1999). As today's students learn mathematics skills and concepts, they must apply, adapt, and extend old concepts to new tasks and existing ideas into new ideas (Kennedy & Tipps, 2000).

Many students see mathematics only as symbols on paper and believe that their job is to remember and follow the rules for the operation on the symbols (Kouba, Carpenter & Swafford, 1989). They believe that symbols and rules have little to do with their intuitions, their ideas of what makes sense, or their conceptual understanding (Heibert & Carpenter, 1992).

These beliefs are destructive because they take mathematics away from students. Mathematics becomes something that cannot be understood, a subject that is separated from real life and things outside the classroom that make sense. It is a subject for which they become completely dependent on someone else. Mathematics class is a time when the teacher gives students problems to solve or an assignment in the textbook that they don't entirely understand. The NCTM (National Council of Teachers of Mathematics) was one of the first groups to try to improve mathematics instruction in the US. Literature relevant to this group is reviewed in section 2.1.1.

2.1.1 NCTM Standards

The first step taken to improve mathematics education in the United States came about in 1989. The vision for the renewal of mathematics was formulated by the National Council of Teachers of Mathematics (NCTM). NCTM is a professional organization for persons who are concerned with the instruction of students in mathematics. With more than 100,000 members, teachers at all levels, school administrators, mathematics coordinators and consultants, and university professors of mathematics and teacher education participate in the development of information about trends and issues pertaining to mathematics. NCTM also provides extensive resources and information via journals, books and the Internet (Reys, et al., 2001).

In 1989, the NCTM took a decisive step toward improving the teaching of mathematics with the publication of *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989b). This visionary document represents a major effort to create a set of guidelines or *standards* to guide the revision of the school mathematics curriculum and its associated evaluation (NCTM, 1989b). The Standards were designed to establish a broad framework to guide reform in school mathematics in the 1990s. *The Curriculum and Evaluation Standards for School Mathematics* provided a vision of what the mathematics curriculum should include in terms of content priority and emphasis (NCTM, 1989b).

When the SMILE inservice course outline was being formulated, lessons were written that included the Standards for the K-4 curriculum. At each grade level, the NCTM Standards emphasize problem solving, communicating mathematics in a range of representational modes, mathematical reasoning, and mathematical connections. These reflect the assumptions from which the content-specific standards for each grade level were developed The authors of these standards wrote that Grade K—4 curriculum should:

- Be conceptually oriented
- Actively involve children in doing mathematics
- Emphasize the development of children's mathematical thinking and reasoning abilities
- Emphasize the application of mathematics
- Include a broad range of content
- Make appropriate and ongoing use of calculators and computers (NCTM, 1989b).

The Standards documents provide specifications for curriculum and instruction that call for significant change from current practice – both in content and pedagogy (Reys, Suydam, Lindquist & Smith, 1998) as well as recommendations that emphasize that all students should learn important mathematics. The documents also set forth standards by which local school districts can judge their own curricula. They call for curriculum and instruction that engage and challenge students and prepare them for continuous study and growth in mathematical skill and understanding (NCTM, 1989).

The intent of the Standards is to help students become mathematically literate, which includes being able to explore, to conjecture, to reason logically and to use a variety of mathematical methods to solve problems. The Standards-based curriculum in mathematics in essence is this: everything that is done with children needs to help them make sense of the mathematics that they are learning (Herrera, 2001). The bottom line is: Does a child need to think and reason in order to be successful? Or can a child be successful by repeating something that he or she learned by rote? If the first is true, the classroom is moving toward the Standards-based curriculum. If children can be successful without necessarily understanding, then it is violating the very essence of the Standards. Being able to solve problems is obviously the test of whether or not children understand something. The content of mathematics is important, but needs to be taught from the basic premise of problem solving (Herrera, 2001; NCTM, 1989a).

2.1.2 State and Local Standards

The National Standards are the basis for the district and state curricula in Miami-Dade County, Florida. Each mathematics lesson plan must reflect the district standards which are, essentially, the National Standards. *The Basics of School Improvement and Accountability in Florida GE356* (FDOE, 1997) changed the way in which mathematics is taught in the state of Florida. The change focused on a shift from rote acquisition of information to the understanding of underlying mathematical concepts. Research has consistently confirmed that isolated 'learnings' are not retained (Heibert & Carpenter, 1992).

To be successful in mathematics, a child needs to be able to think and reason. Being able to solve problems is the test of whether or not a child understands a concept (Herrera, 2001). A fundamental change is necessary in how mathematics is viewed – not as boring, sterile and difficult, but as an exciting exploration with practical uses every day for everyone (Reys, Suydam, Linquist & Smith, 1998). To accomplish the goal of increasing students' mathematical learning, school districts investigated a variety of instructional programs.

Beginning with the 1998-1999 school year, the School Improvement and Accountability in Florida Act of 1997, put into effect a mechanism to evaluate schools' performance on a high-stakes test. This is called 'The Florida A+ School Plan', (FDOE, 1997). Schools in Florida are given A-F ratings. Beginning in 1999-2000, in addition to a letter grade, each school receives an improvement rating of 'improved', 'remained the same', or 'declined'. Schools failing to make adequate progress for two years in a four-year period could experience possible state intervention (FDOE, 1997). Schools with improved scores receive monetary rewards. Each member of the staff of these improved schools is given a cash bonus.

All students in Grades 4, 5, 8 and 10 take the Florida Comprehensive Assessment Test (FCAT). For the FCAT 2000, the criteria are as follows: For a school to have 'passing status', fewer than 60% of students must score at or above Achievement Level 2 in the fourth grade FCAT reading; fewer than 60% of students must score at or above Achievement Level 2 in the fifth grade FCAT mathematics; and fewer than 50% of the students must score '3' or above in the fourth grade FCAT writing (OEEMA, 2001).

In Grades 4, 8 and 10, all students take the Florida writing examination. The results indicate the extent to which the student is fluent in writing either through a persuasive or expository essay. Responses are graded on a six-point rubric. Fifty percent of the students must score a '3' or above for the school to be deemed proficient in writing.

Educators and leaders in Miami-Dade County felt that in order to accomplish the goals of increasing student achievement, raising achievement test scores and school grades, they must investigate a variety of instructional programs. The instructional program that was selected must be firmly grounded on the results of past educational research (OEEMA, 1998). Thus Project CRISS was introduced in the

Miami-Dade County School District. Literature relevant to Project CRISS is reviewed in the following section (2.1.3).

2.1.3 Project CRISS

Before the National Standards were written, in the late 1970s, educators in the state of Montana were trying to help secondary students to improve their performance-based test scores (www.projectcriss.org, 2002). In 1979, a writing team under the direction of Dr Carol Santa, District Reading Coordinator, developed Project CRISS (**CR**eating **I**ndependence through **S**tudent-owned **S**trategies) for the Kalispell, Montana Public School District. Project CRISS was created to help students to better organize, understand and retain course information. In short, students receiving the CRISS method of instruction will *learn how to learn*.

In this quest for better test scores, students learn to become strategic when teachers teach the process of learning directly through explanation and modeling. Most students do not know how to learn. Teachers have to show them how. Teachers show, tell, model, demonstrate and explain, not only the content, but the process of activity-based learning. As the students' learning process begins, they are dependent on the teacher for all learning. As the process continues, the students take more and more responsibility for their own learning. In the end, the responsibility for learning is solely on the student. This is a gradual release of responsibility from the teacher to the student (www. projectcriss.org, 2002).

Project CRISS, which began as a local experiment in Kalispell, Montana, is now being implemented in 43 states and three countries. In 1982, Kalispell was an official state of Montana CRISS demonstration site for Grades 10-12. This means that this school district fulfilled all the criteria set by the state of Montana to have other school districts model their program. The program was nationally validated in 1985 (Santa, 1988). In 1993, the validation expanded to include Grades 4-12. The National Diffusion Network (NDN) provided funding for CRISS from 1985 to 1996. The NDN, part of the US Office of Educational Research and Improvement, provided validated projects with grants to support dissemination. NDN funding was eliminated by Congress in 1996 (Santa, 1996).

The basic underlying assumption of Project CRISS is that poor student performance is due to the students' inability to read content area texts (Santa, 1988). CRISS strategies were designed to develop thoughtful and independent readers and learners. Project CRISS focuses on teaching secondary students how to learn content area subjects (mathematics, science and social studies) through reading, writing, speaking and listening. In its initial evaluation, students learned how to apply the CRISS principles to all subject areas (Santa, 1996). The following nine key principles drawn from cognitive and social learning research lay the foundation for Project CRISS (Santa, 1996, p. 1):

- Background knowledge is a powerful determinant of reading comprehension.
- Good readers are actively involved in making sense from their reading.
- Students need many opportunities to talk with one another about what they are learning.
- Good readers use metacognitive strategies to learn. They are goal directed and they know how to attack print to create meaning.
- Students need many opportunities to write about what they are learning.
- Good readers and writers have an intuitive understanding of the author's craft. (Students understand the author's style of writing.)
- Good readers know a variety of ways to organize information for learning.

- Students learn to become strategic learners when given opportunities by teachers through explanation and modeling.
- Students come to understand by doing a variety of thought-demanding activities with a topic.

After a ten-year implementation, Santa's research showed that students who attended schools where Project CRISS was put into practice had a higher success rate on standardized tests. The program was field tested in other states in the United States. Because of the success rate in Montana, the mathematics and science department of the Miami-Dade County Public Schools adopted Project CRISS at the beginning of the 1997-1998 school year. Project CRISS and the implementation of the National, State and Local Standards were not the only programs that affect the learning of mathematics in the 21st century. Mathematics educators also play a role in raising standards in mathematics. In the following section (2.1.4) an interview with Marilyn Burns, researcher in elementary mathematics, is transcribed.

2.1.4 Others Who Affect Mathematics in the 21st Century

Marilyn Burns, one of the leading authors and researchers in the area of elementary mathematics, presents research at National and International conferences. She not only is a researcher, but also teaches children at the elementary school level on a part-time basis. Because her workshops include work samples from the students in her classroom, her sessions are invaluable to the teachers/participants. In an interview with Ms Burns by T. Herrera, Ms Burns discussed her philosophy of teaching elementary mathematics as it relates to support personnel (Herrera, 2001). Support personnel includes: school-site administrators, staff developers, preservice (students who are studying to become teachers) and practising classroom teachers.

The following excerpts from this interview help to verify the qualitative investigation in my study of the SMILE inservice course:

> I can tell in a minute when I go into a school if the Principal is one who pays attention to instruction or one who is so overwhelmed with the details of administration that he or she can't focus on the learning going on. Without the Principal's support, nothing is going to happen in a school. An individual teacher may be innovative, but a school community is necessary to improve learning. We, as mathematics educators, need to help our principals understand what the goals are for mathematics.
>
> I think we can't emphasize too much that you cannot teach what you don't know. Therefore, mathematics has to be the basis of all that you do and the vehicle through which staff developers talk about pedagogical issues. When you are working with preservice teachers, it is sort of hard because they have no classroom experience to ground their learning. The best you can do is strengthen their understanding of the mathematics that they have to teach. Because we know people teach as they were taught, you have to teach preservice teachers in a way that you want them to teach and you have to help strengthen their understanding of mathematics.
>
> In working with inservice teachers, everything should be tied to what the teachers can actually try and implement in their classes. They really should have a chance to experience what they are learning with their own students.
>
> We can't make changes by ourselves. Teachers need to talk to other teachers about their classroom. We are often isolated as teachers. Whatever teachers can do to break down the isolation – studying with another teacher or talking with the Principal about visiting other classrooms, or finding time to plan lessons together can help.
>
> One of the ways, teachers and administrators can take the first step in changing the curriculum is to find ways to teach mathematics so that students understand mathematical concepts. (Herrera, 2001, p. 18)

As we begin the 21st century, the nations' schools are undergoing major transition in their mathematics programs — transitions that involve fundamental changes in curricular content, modes of instruction, teacher education, professional development, methods of assessments and public attitudes (NRC, 1989).

Not only are calculators and computers displacing some of the computational drill that dominated the curriculum, but also their presence stimulate new approaches to understanding mathematics and to solving problems. All major components of mathematics education — curricula, teaching, teacher education, testing, textbooks, and software have changed significantly. The dramatic advances that have been made in mathematics over the past few decades are starting to be felt in the schools, in the form of new and exciting ways to help students to perceive and order the universe around them (NRC, 1989). For children in the 21st century to truly understand mathematics they must gain conceptual and procedural knowledge as well as apply mathematics concepts to the real world. Literature relevant to teaching mathematics for understanding is found in section 2.2.

2.2 TEACHING MATHEMATICS FOR UNDERSTANDING

One of NCTM's (National Council of Teachers of Mathematics) goals for students is to explore the relationships between mathematics and the other disciplines it serves, such as the physical and life sciences, the social sciences and the humanities. It seems that some teachers tend to leave mathematics outside the integrated whole (NCTM, 1991).

Separating academic disciplines for scholarly purposes probably makes sense. But for children who are still in the process of adapting and organizing their own learning styles, the separation of the subjects makes very little sense. It is easier for the child to make real-world applications if subjects are taught by connection (Ellis & Fouts, 1993).

Curriculum can be best understood by its dominant form — the textbook. Textbooks are written for a particular subject at a particular grade level. Integrating subjects represents a philosophy of student-centered learning. The student, not the subject, is placed at the center of learning. Activities and projects take precedence over academic disciplines (Ellis & Fouts,1993). Should children be taught mathematics activities and projects using procedures or concepts? The importance of teaching mathematics procedurally or conceptually has long been debated. The next few sections focus on this debate (2.2.1), as well as on teaching mathematics with an interdisciplinary/integrated approach (2.2.2) and infusing children's literature into mathematics (2.2.3).

2.2.1 Procedural Knowledge Versus Conceptual Knowledge

The importance of skills versus concepts in mathematics learning has long been debated. Such debate creates a false dichotomy that plays one against the other. The truth is that skills (Procedural knowledge) and concepts (Conceptual knowledge) are both necessary for expertise in mathematics (Reys, et al., 2001). When thinking about learning and teaching mathematics for young children, we believe it is useful to distinguish between *conceptual knowledge* and *procedural knowledge* (Hiebert & Lefevre, 1986).

Procedural knowledge is based on a sequence of actions, often involving rules and algorithms; conceptual knowledge is based on connected networks that link relationships and discrete pieces of information (Hiebert & Carpenter, 1992) Conceptual knowledge is knowledge that is rich in relationships. It can be thought of as a connected web, where every piece of information is related or connected to other pieces of information. Students acquire conceptual knowledge if they can fit a new piece of information with something they already know or if they suddenly recognize a connection between things that they previously learned as isolated pieces of information (Reys et al., 2001).

Lesh, Post and Behr (1987) suggest five ways in which mathematics ideas are commonly represented: (1) through language; (2) through real-life experiences that occur inside and outside of school; (3) by physical materials, such as base-ten blocks, craft sticks, and fraction bars; (4) by pictures; and (5) by written symbols. Often a particular mathematical concept can be presented in all five ways.

Procedural knowledge, in contrast, is made up of rules, procedures, or algorithms for performing mathematical tasks. Procedures are step-by-step prescriptions that generate correct answers for particular kinds of problems. Some procedures are simple one or two-steps and others are quite complicated (Reys, Suydam, Lindquist & Smith, 1998).

When children build connections between mathematical ideas and other topics, mathematics becomes more meaningful and understanding is enhanced. Both conceptual knowledge and procedural knowledge are important and both can be learned in school. The kind of knowledge that is acquired depends to a great extent on the kind of instructional activities that are provided. Instruction can be designed to help students build conceptual knowledge, or it can be designed to help students acquire procedures. We believe that instruction should do both. But more than that, instruction should be designed to help students see connections between the two kinds of knowledge (Reys et al., 2001).

The evidence from research reported in the past decade suggests that we are not doing enough to help students connect concepts with procedures. Most students acquire procedural knowledge separately from conceptual knowledge. Large-scale surveys and close-up analyses of individual topic areas converge toward the same conclusions: Many students learn rules and procedures for performing tasks with virtually no idea of what the problem means, why the procedure works, or whether the answer is reasonable (Kouba, Zawojewski & Strutchens, 1997).

Why should we worry if students memorize rules and procedures without connecting them to their conceptual knowledge? If students can apply a rule to solve a problem and get a correct answer, do they need to know why the rule works or what the rule is doing for them? It happens that learning rules and procedures without understanding them has many serious consequences. Many of these consequences are long-term and do not show up immediately. It might look as if students are doing well, but it is likely that they might experience undetected difficulties:

- **Isolated procedures do not transfer well** — If the rules are taught as prescriptions of manipulating symbols, with little discussion of their meaning or how they are alike, students will tend to link each rule to the specific kind of problem for which it was developed.
- **There are too many procedures to learn them individually** — There are simply too many different kinds of problems in mathematics for students to learn and remember different rules for each kind.
- **It is difficult to remember when to use which procedure** — If students remember the rule itself, they might have trouble deciding when to use it. If they have not established connections between a procedure and the concepts on which it is based, their conceptual knowledge is of no help.

- **Procedures are sometimes too powerful** — One reason that we teach students procedures and rules for manipulating symbols is that these techniques are very powerful. We can solve time-consuming and difficult real-world problems with relative ease by presenting the problem with symbols and manipulate them. Procedures can take students far beyond their level of understanding. Students can memorize rules for solving problems that they don't understand. The trouble is that if students do not understand the problem or exercise and why the rule they are using works or what it is doing for them, they have no way of knowing when to use the rule. They have no way of knowing whether their answer makes sense or of monitoring their own performance.
- **Destructive attitudes and beliefs are promoted** — Up to this point, we have been talking about the cognitive effects of separating conceptual and procedural knowledge. It appears that such a separation has important affective consequences as well. The kind of work that students do in classrooms determines how they think about the subject and what they recognize as being important. If students are asked to spend much of their time learning and practicing procedures for manipulating symbols, independent of conceptual considerations, we must expect students to believe that mathematics is a matter of remembering the right rules and checking the answer key. Apparently, this is exactly what many of them believe (Hiebert & Leevre, 1986).

Instruction can help students build their conceptual knowledge by considering the ways in which concepts should be presented in familiar real-life situations and with physical materials so students can connect the new ideas with things they already know. Concepts should then be developed by helping students think about the different representations, discuss their differences and similarities, and translate from one to the other.

Instruction can be designed to help students connect procedures and concepts. The instruction in mathematics should help students develop more powerful and efficient ways of representing and solving problems. The danger of teaching procedurally is that if new, more powerful and more efficient procedures are introduced apart from what is meaningful for children, the benefits are lost (Reys et al., 2001).

If a child learns the procedures for multiplying and dividing numbers on paper or on a calculator but does not see that these procedures can be used to solve everyday problems, the procedures are of no use. To be useful, children must understand what the procedures do for them. In other words, children must understand the concepts that lie behind the procedures and they must connect these concepts to the procedure. It is believed that activities that help students acquire conceptual and procedural knowledge in a tightly connected way are most beneficial.

Instruction can help students build their conceptual knowledge by considering the ways in which concepts are represented in instructional lessons. New concepts should be presented in familiar real-life situations and with physical materials so students can connect the new ideas with things they already know. Concepts should then be developed by representing them in different ways. Instruction should focus on helping students think about the different presentations, discuss their differences and similarities, and translate from one to the other. Such instruction takes more time than is usually allowed for presenting new concepts, but it has powerful consequences in the long run.

Both procedural and conceptual knowledge are important for children to learn and understand mathematics. The professional development activities in Project SMILE employed pedagogical skills in both areas. In the following section (2.2.2) literature relevant to teaching mathematics using an interdisciplinary approach is described.

2.2.2 Interdisciplinary Approach to Teaching

In the Miami-Dade County Schools, elementary (K-5) teachers have such a tight schedule that sometimes they are forced to integrate subjects or take an interdisciplinary approach to teaching in order to have enough time to teach each subject every day. Integration is a buzzword in education today. Interdisciplinary studies, interdisciplinary curriculum and integration are terms used somewhat interchangeably to indicate the bringing together of separate disciplines around common themes, issues or problems. Interdisciplinary studies involve teacher teaming, students working together, real-world applications and active learning (Ellis & Fouts, 1993).

Too often the meaning of integration seems to suggest that if the teacher throws any two subject areas together, something better will happen. With a little more purposeful thought, teachers can easily raise the interest, complexity, and success of some of their favorite activities. Some of the learning taxonomies one finds today suggest there are different levels of learning and that teachers should strive to help students achieve more complex learning skills. It has been suggested that learning complexity follows the pattern outlined below (in order from lowest from highest level):

- Restatement of fact
- Restatement of facts in child's own words
- Showing or doing, using information
- Breaking a whole into parts
- Building a new whole from parts
- Making judgments from the facts

By considering how teachers have traditionally taught each subject area in isolation, one can understand how activities with students have stayed largely at the lower levels of these taxonomies. In fact, many believe that at least 90% to 95% of classroom instruction time has traditionally been spent in the first two steps (Braddon, Hall & Taylor, 1993).

By combining subjects around themes, a certain economy is achieved because much of the repetitious material that occurs from subject to subject is eliminated. When subjects are connected, the students begin to see more meaningful relationships because the subject matter serves as a vehicle for learning rather than as an end in itself. These are among the primary claims of the advocates of interdisciplinary curriculum (Ellis & Fouts, 1993).

Using a thematic approach is one way to provide integration because it addresses not only basic skills, but also more open-ended and higher-level objectives. Individual interests and other individual differences may be more easily accommodated in a thematic unit. The cooperative learning approach lends itself to thematic units. They also provide opportunities to connect mathematics to real life through field trips and related activities (Cathcart, Pothier, Vance, & Bezuk, 2000).

Even without a thematic approach, however, many opportunities to integrate mathematics with other subjects are encountered daily. However, connections are not automatic. Teachers must provide experiences in which the connections are 'obvious' or at least where they can be made explicit. When children build connections between mathematical ideas and other topics, mathematics becomes more meaningful and understanding is enhanced. This will encourage children to look for other connections in other subjects (Cathcart, Pothier, Vance, & Bezuk, 2000).

Teachers who have become involved in interdisciplinary teaching have a greater opportunity to work together. Once left alone to plan and work only with their own students, those working in an interdisciplinary setting are meeting colleagues they have worked beside for years, but never really got to know (Ellis & Fouts, 1993).

The strands within mathematics, namely, number sense and operations, measurement, geometry, data analysis and algebraic thinking should also be integrated. Mathematics experts express concern that we tend to teach some parts of mathematics – arithmetic 'facts' and 'skills' – through meaningless drill so that learners lose the context and do not develop a sense of mathematics function. Except for counting and measurement infused into children's literature books, mathematics has tended to be confined to arithmetic, taught from the book during a separate period (Whitin & Wilde, 1992).

Ten percent (10%) of the mathematical content for the elementary school is computation and 90% is concepts (Reyes, et al., 2001). In classrooms that I have observed, I have found that it is more likely that 90% of the mathematics that is being taught is computation and 10% is concepts. Because mathematics is not being taught conceptually, the experts are concerned that children do not connect mathematics to real-life experiences and that teachers who fear mathematics are producing learners who fear mathematics (Whitin & Wilde, 1992). In the next section the literature relevant to the integration of mathematics and children's literature is described in detail.

2.2.3 Integrating Mathematics and Children's Literature

Mathematical ideas and concerns are present in literature of all kinds today, and indeed the purposes or functions of mathematics and literature are closer than might at first appear. One function of mathematics is to order the world around us. So does literature. Mathematics is concerned with classification. So is literature. Mathematics is concerned with problem solving. So is literature. Mathematics looks at relationships. So does literature. Mathematics involves patterns. So does literature. And mathematics and literature both have aesthetic appeal. Without taking this analogy too far, we contend that mathematics and literature have strong links, both in content and in structure, and that these links should be explored to make more effective the understanding of both mathematics and literature (Griffiths & Clyne, 1991).

Mathematics can be taught through the gift of story when it is integrated with children's literature. Fiction and nonfiction children's books provide rich, authentic explorations of time and place that make mathematical concepts vivid and relevant. (Whitin & Wilde, 1992). Children's literature promotes the understanding of mathematical concepts by putting numbers into situations and stories that relate to children. A good story encourages children to discuss mathematical concepts and connect mathematics with the real-world. Two ways that teachers may begin integrating children's literature into mathematics is to introduce a lesson so that students understand the textbook material more fully and/or to replace a mathematics textbook unit with a children's literature book and its correlated activities (Herrera, 2001).

The National Council of Teachers of Mathematics cites four reasons for giving children's literature a prominent place in the mathematics classroom. Children's literature:

- Furnishes a meaningful context for mathematics
- Celebrates mathematics as a language
- Integrates mathematics into current themes of study
- Supports the art of problem posing. (NCTM, 1989b)

The integration of mathematics into language arts through useful and creative problem-solving activities almost always raises the level of learning. Help in understanding the integration process may be found in the rather broad definitions of these two major areas of learning. Language arts may be considered as the curriculum area devoted to the study of the communication skills of speech, writing, hearing, reading, and sometimes touching. Mathematics may be considered the curriculum area devoted to the study of the communication skills of gathering and comparing data as well as to the study of patterns and order. The communication skills necessary for language arts and mathematics allow us to both receive and share information. Consider the difference that occurs when we attempt to develop our communication skills in mathematics and language arts in isolation, versus when those skills are practised by performing activities we see as important to our lives (Braddon, Hall & Taylor, 1993).

Elementary students who love good literature are often the same children who dislike completing worksheets filled with mathematics problems or who struggle with those troublesome word problems. Approaching mathematics through literature is often more palatable to many students and teachers who have found earlier experiences with mathematics unpleasant. With the thematic approach to language arts becoming more prevalent, it becomes evident that integrating mathematics and literature is not only exciting, but also a logical union (Braddon, Hall & Taylor, 1993).

Stories can show students how math is applied in the real-world in ways that textbooks rarely do. By integrating mathematics and literature, word problems can use familiar stories to allow students to address the mathematics functions rather than struggle needlessly with unfamiliar vocabulary. Mathematics activities that are stimulated by literature inspire students to explore and investigate concepts. The marriage of mathematics with quality literature fosters the realization that math is all around us (Griffiths & Clyne, 1991).

Historically, literature orders life experiences and human relationships. Whereas mathematics contains dry topics such as long multiplication, simultaneous equations and right-angles. This view is common among both children and adults; but to regard mathematics as a set of abstract concepts and skills is as narrow as regarding literature as a set of grammatical constructions and vocabulary. Rather, we should look on mathematics as a means of understanding the world around us; of dealing with information abut space, shape, time and quantity by grouping, ordering and transforming ideas (Griffiths & Clyne, 1991).

Children learn mathematics through using language. Children develop mathematical concepts through the use of informal language, and move gradually towards a formal terminology and symbolic method of recording. Bridging the gap between informal oral language and the formal symbolic code of mathematics is an important, but hazardous, area. For children to appreciate the purpose and usefulness of precise mathematical language they need to have a purpose for using that language. We do not offer any panacea for this problem, but we do believe that the context of stories and problems arising from literature provides a meaning and purpose for children's exploration of mathematical language. The combination of mathematics and literature, used in conjunction with opportunities for discussion, allows children to grapple with mathematics concepts in a meaningful context (Griffiths & Clyne, 1991).

Mathematics and literature have strong links and the benefits of using them together are many. Literature has an aesthetic and universal appeal to both adults and children. The magic of telling and reading stories should be offered to all children. Most children beginning school have already had some experience with books and this has assisted in shaping their perceptions of the world. Books extend and develop children's ideas of the world, but at the same time these ideas are bounded by the confines and constraints of the story. Activities will simultaneously allow for mathematical exploration and extend and develop the ideas in the story. At the same time the limits of the story can help children to focus on the mathematical ideas found in the text (Burns, 1991).

The familiarity of a book or story gives children a structure within which to explore mathematics. Such a structure provides children with a defined context within which they can manipulate and develop mathematics concepts. Within the various texts and illustrations (do not forget the illustrations as they often carry the mathematics ideas), there are opportunities to involve children in problem solving, pattern and order activities and classification, as well as other mathematics skills. Children are also provided with experiences which demonstrate that mathematics and literature are interrelated and not separate entities. Tying mathematics to stories humanizes the activity and still gives purpose and meaning to mathematics for both teachers and children (Griffiths & Clyne, 1987).

The language of mathematics is a stumbling block to many students. Children throughout their mathematical education need to be given time in situations which allow them to use language to describe, explain, report, investigate and question. Practice in using mathematical language assists children in developing and refining their understandings (Kennedy & Tipps, 2000).

Reading techniques valued in the language area are supported when teachers use literature to explore mathematics. In many books the children have to extract the mathematics from the text, which gives the teacher an opportunity to gauge their comprehension. Sequencing is another activity which supports children's reading development. Also, many activities demand detailed text reading and repeated readings, which gives reading practice with a purpose. Modeled writing by the teacher and the opportunity for innovative text and report writing all contribute to encouraging clarity of expression and the development of imaginative thinking in mathematics and writing.

Experience will assist in choosing appropriate texts for mathematical development as more books are used in these ways. Children's picture books have long been one of teachers' favorite tools for nurturing students' imaginations and helping them develop an appreciation of language and art. In the same way, children's books that have a connection to mathematics can help students develop an appreciation for mathematical thinking (Herrera, 2001). Using books, stories and rhymes to stimulate thinking about mathematics and develop and reinforce mathematical concepts enhances children's understanding of mathematics, promotes their enjoyment of the subject and develops their conception of mathematics as an integral part of human knowledge (Kennedy & Tipps, 2000).

Children's literature books when used in mathematics stimulate students to think and reason mathematically and help them experience the wonder possible in mathematical problem solving. Teachers might discover that children become keen observers of mathematical ideas and learn to identify areas suitable for mathematical investigation.

Integrating children's literature and mathematics has many positive aspects. However, mathematics should not be imposed upon a work of literature, as this would defeat the purpose of integrating the subject areas; but rather, the mathematics should flow from, and be a natural part of the book. Using literature in this way needs care, therefore we stress that the activities which may follow a reading or sharing of a book must be a natural development from the text (Whitin & Wilde, 1992).

In conclusion, teachers often use children's literature books to enhance lessons in language arts, social studies, science, music, art, dance and drama, but it is also easy, effective, and appropriate to use children's literature in mathematics lessons (Reys, et al., 2001). Stories provide children with a common starting point from which to share and discuss mathematical ideas. Mathematics and language skills develop hand-in hand as children talk about problems and read and write about mathematical ideas. Use of children's literature in mathematics lessons can enhance learning in many ways. Children's literature:

- Integrates mathematics into other curriculum areas
- Provides a meaningful context for mathematics
- Supports the art of problem posing
- Demonstrates that mathematics develops out of human experience

- Fosters the development of number sense
- Addresses humanistic, affective elements of mathematics
- Celebrates mathematics as a language
- Restores an aesthetic dimension to mathematical learning (Whitin & Wilde, 1992).

The implementation of various programs and instructional strategies does not necessarily mean that children have a good attitude toward the subject or that the classroom environment is conducive to learning. Because my study used learning environments as a framework for evaluating Project SMILE, the next section reviews literature relevant to the importance of the classroom learning environment.

2.3 THE STUDY OF LEARNING ENVIRONMENTS

The strongest tradition in past classroom learning environment research has involved investigation of associations between students' perceptions of psychosocial characteristics of their classrooms and their cognitive and affective learning outcomes. Fraser's (1994) tabulation of 40 past studies shows that associations between a variety of cognitive and affective outcome measures and classroom environment perceptions have been replicated using a variety of classroom environment instruments and samples ranging across numerous countries and grade levels (Majeed, Fraser & Aldridge, 2002).

In the last two decades, the field of classroom environment has progressed to the point where researchers and teachers can assess classroom environment and identify the effects on students. This research has given teachers an in-depth understanding into how individuals learn, the complexity of teaching, and the nature of classroom environment. The direct association between positive student attitudes and improved classroom environments has been established. Students achieve more when there is a positive classroom environment (Fraser, 1998a).

In the relatively new and rapidly growing field of classroom learning environments, studies involving qualitative methods have provided rich insights into classroom life (Rutter, Maughan, Mortimore, Ouston, & Smith, 1979; Stake & Easley, 1978). The use of quantitative methods have generated several widely-applicable questionnaires which have been used to replicate certain lines of research with large samples in a variety of countries (Fraser, 1986). It is desirable that researchers now combine qualitative and quantitative methods in learning environment research (Tobin & Fraser, 1998).

The sections below provide reviews of literature relevant to the history of the study of learning environments (section 2.3.1), to instruments for assessing classroom environment (section 2.3.2), and applications of classroom environment instruments (section 2.3.2).

2.3.1 Historical Background of Learning Environments

Over 30 years ago, Herbert Walberg and Rudolf Moos began independent programs of research which form the foundation of research into learning environments. Moos began developing the first of his social climate scales which, include those for use in psychiatric hospitals and correctional institutions. This research ultimately resulted in the development of the Classroom Environment Scale (CES). Walberg and Moos pioneered major research programs and spawned a lot of other research in the field of learning environments (Tobin & Fraser, 1998).

Kurt Lewin, the pioneer of the study of learning environments, is universally recognized as the founder of modern social psychology. He pioneered the use of theory, using experimentation to test hypothesis. He placed an everlasting significance on an entire discipline--group dynamics and action research.

In the early 1930s, Kurt Lewin (1936) recognized that the environment and the interaction of individuals were powerful determinants of behavior. Lewin introduced the formula, $B=f\ (P, E)$, to describe human behavior (B) as the result of two influences that are interdependent, the person (P) and the environment (E). This formula is known as the Lewinian formula.

H.A. Murray followed Lewin in 1938 by proposing a Needs-Press model of interaction. According to Murray, personal needs represent the tendency of individuals to move in the direction of goals, and the environmental press is the external situational counterpart that either supports or frustrates the expression of those needs. Murray also introduced the terms *alpha press*, which describes the environment perceived by a detached observer and *beta press* which describes the environment as perceived by the inhabitants (Fraser, 1998a).

Pace and Stern (1958) further developed Murray's Needs-Press model. Their model distinguished between 'private beta press' (the distinctive view of the environment by an individual) and "consensual beta press' (the shared view that members of a group hold about the environment). The personality (needs) and environment (press) measures, developed by Pace and Stern, permit research based on Murray's model. In classroom environment research this leads to a commonality between two units of analysis, the student and the class (Fraser, 1998a).

It is important to distinguish between classroom-level environment and school-level environment. School-level environment research can be distinguished from classroom-level environment research in that the school-level tends to be associated with educational administration and involve higher education institutions, whereas, the classroom-level deals with the students in elementary and secondary classrooms. Despite the fact that these two models were developed at relatively the same time and can be logically linked to each other, they have remained independent of each other (Tobin & Fraser, 1998).

There have also been investigations into associations between students' perceptions of classroom environments and student cognitive and affective outcomes (Fraser, 1986, 1991, 1994). Students are at a good vantage point to make judgments about classrooms because they have encountered many different learning environments and have enough time in a class to form acute impressions (Tobin & Fraser, 1998). Studies in the field of learning environments have led to the development of instruments which permit investigations of differences between actual and preferred classroom environments (Fisher & Fraser, 1983a). These tools have been the predominant means of data collection in the field of learning environments. Literature relevant to these data-collection tools is described in the subsection that follows (2.3.2).

2.3.2 Instruments for Assessing Classroom Environment

Considerable progress has been made over the past 30 years in the conceptualization, assessment and investigation of the concept of learning environment (Fraser, 1986, 1994, 1998a; Fraser & Walberg, 1991; McRobbie & Ellett, 1997; Wubbels & Levy, 1993). In the past decade, research has included the use of qualitative methods (Anstine Templeton & Nyberg, 1997; Tobin, Kahle & Fraser, 1990) and the combination of quantitative and qualitative methods (Fraser & Tobin, 1991; Tobin & Fraser, 1998). In this relatively new and rapidly-growing field, studies involving qualitative methods have provided rich insight into classroom life and the use of quantitative methods have generated several widely-applicable questionnaires (Fraser & Walberg, 1991).

Substantial research has also been done focusing on the development and validation of instruments used to measure students' perceptions of the different dimensions of classroom environment (Fraser, 1998b, 1999). Few fields of educational research can boast the existence of such a comprehensive variety of carefully developed and validated questionnaires that have been used to provide teachers and researchers with information on the nature of the classroom environment, the effects of innovations, the perceptions of individuals and subgroups, and whether students perform better in their preferred environment (Fraser, 2002).

The assumption that students perceive a common learning environment was subsequently challenged in the mid-1980s, when it was suggested that there were students within a class whom the teacher singled out during interaction more often than others. These students were known as 'target' students (Tobin, 1987; Tobin & Gallagher, 1987; Tobin & Malone, 1989). There emerged the insight that there could be differently-perceived environments within the one class.

Fraser, Giddings and McRobbie (1992) proposed a Personal form of a learning environment instrument which asked students for their personal perceptions of their role in the learning environment as opposed to the Class form which asks students for their perceptions of the learning environment in the class as a whole.

Even though the instruments developed for measuring classroom environments have been designed for different purposes, they share common characteristics. Each questionnaire is designed to draw out students' perceptions of their environment by indicating the extent to which they agree with a statement. One of the first classroom environment questionnaires to be used was the Learning

Environment Inventory (LEI). Both the LEI and its shortened version, the MCI (My Class Inventory) are described in the next two subsections (2.3.2.1 and 2.3.2.2) and six other questionnaires will be described in subsection 2.3.2.3.

2.3.2.1 Learning Environment Inventory (LEI)

As a part of the research and evaluation activities of the Harvard Project Physics, Anderson and Walberg (1968) developed the Learning Environment Inventory (LEI) (Anderson & Walberg, 1974; Fraser, Anderson & Walberg, 1982). The LEI is an expansion and improvement on Walberg's original instrument, the Classroom Climate Questionnaire (Fraser & Fisher, 1983a) The final version of the LEI contains 15 scales with seven items per scale, for a total 105 items.

The dimensions measured by the LEI can be classified according to Moos' (1974) scheme for classifying human environments. Moos identified three basic dimensions including: the *Relationship Dimension*, which measures the nature and intensity of personal relationships; the *Personal Development Dimension*, which measures the directions in which personal growth and self-enhancement occur; and the *System Maintenance and System Change Dimension*, which measures the extent to which the environment maintains clear objectives and control and responds to change. Under the three dimensions are these 15 scales: Cohesiveness, Diversity, Formality, Speed, Material Environment, Friction, Goal Direction, Favouritism, Difficulty, Apathy, Democracy, Cliqueness, Satisfaction, Disorganisation, and Competitiveness. Because of the readability level, the LEI is designed primarily for secondary students. The students respond to each item with 'Strongly Disagree', 'Disagree', 'Agree', or 'Strongly Agree' (Fraser, 1998b).

Many questionnaires were developed in separate Actual and Preferred forms. The 'actual' form measures experienced classroom environment, while the 'preferred' form measures students' perceptions of the ideal classroom environment. Although the wording is similar on both forms, slightly different instructions for answering each are used. For example, an item in the actual form may read: "There *is* a clear set of rules for students to follow". The preferred form would read: "There *would be* a clear set of rules for students to follow". (Fraser, 1998b) Prior research has suggested that relationships exist between class achievement and the degree of match between the actual classroom environment and that preferred by the class (Fraser & Fisher, 1983a, 1983b).

The LEI does have limitations. The length of the LEI, with its 105 items, was found to be too long. The factorial validity of the LEI was never established and many of the items are no longer pertinent in today's settings as they are more applicable to teacher-centered classrooms. At the request of some teachers and researchers, a shortened form of the LEI was developed (Fraser, 1982a; Fraser & Fisher, 1983a) for three reasons:

- The instrument contains less items to provide greater economy in testing and scoring
- It is easier to hand score
- It has adequate reliability for applications which involve averaging the perceptions of the students within a class.

This newer and shortened version of the LEI is called My Class Inventory (MCI). Literature relevant to the MCI is discussed in the following section (2.3.2.2).

2.3.2.2 My Class Inventory (MCI)

The My Class Inventory (MCI) is a simplified version of the LEI, suitable for students at the elementary (K-5) school level (Fisher & Fraser, 1981; Fraser, 1989; Fraser, Anderson & Walberg, 1982; Fraser & O'Brien, 1985; Goh & Fraser, 1998). The MCI is a one-page questionnaire that measures five scales, yet contains only 25 items (Fraser, 1989). All students in my study completed the short form of the MCI. One reason why this instrument was chosen as the measure of classroom environment for my study was my suspicion that some students could be language deficient because data collected during the 1997-1998 school year revealed that for 58% of the students in M-DCPS, English was not their home language (*M-DCPS Statistical Abstract 1997-1998).* Therefore, it was felt that the vocabulary in the MCI was appropriate for the sample of students in my study.

The MCI was initially developed for use among children aged 8-12 years (Fisher & Fraser, 1981; Fraser, Anderson & Walberg, 1982; Fraser & O'Brien, 1985). It also has been found useful at the middle (6-8) school level, especially for use with those with reading difficulties. To date, the MCI is possibly the best instrument available in terms of its low reading level.

The reliability of the MCI had been established in several previous research programs (Fisher & Fraser, 1981). The MCI provides a separate measure of student perceptions of actual and preferred classroom environment.

The scales used in the MCI are *Satisfaction, Friction, Competitiveness, Difficulty* and *Cohesiveness.* It is necessary to define what is meant by the five scales:

- **Satisfaction** – Extent of enjoyment of the class (Yarrow, Millwater & Fraser, 1997).

- **Friction** –the nature of children's relationships with one another, including in-fighting, being mean towards one another or attempts to control other members (Yarrow, Millwater & Fraser, 1997).
- **Competitiveness** – relating to, characterized by, or based on competition (Merriam-Webster, 1999).
- **Difficulty** – Children generally are comfortable with their learning activities and the difficulty level is close to ability levels. The teacher is aware of each child's capabilities and possible achievements (Yarrow, Millwater & Fraser, 1997).
- **Cohesiveness** – Extent to which students know, help and are supportive of one another (Fraser, Giddings & McRobbie, 1992).

The MCI can be distinguished from the LEI in several ways. First, it minimizes fatigue among the children because the MCI contains only five of the original 15 scales. Second, item wording has been simplified to enhance readability. Third, the LEI's four-point format has been 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, 1998b). However, the MCI does have several weaknesses:

- The factorial validity has not been established.
- The Yes-No rating scale suggests a correct answer to some students.
- The Satisfaction dimension is used as an environment dimension rather than an outcome.

In Singapore, Goh, Young and Fraser (1995) changed the MCI's original Yes-No response format to a three-point format (Seldom, Sometimes and Most of the Time) in a modified version of the MCI which includes a Task Orientations scale.

Goh et al. found the modified MCI to be valid and useful in research applications with primary mathematics students.

In a recent study done in Brunei Darussalam, the MCI was used for assessing perceptions of classroom learning environment among lower secondary school mathematics students. A revised factor structure was established that can be used in future studies. This is important because the factorial validity of the MCI had not been established in previous research (Majeed, Fraser & Aldridge, 2002). Therefore, it is unlikely that each scale in the LEI (the predecessor to the MCI) and MCI is empirically independent of all other scales in the same instrument. In fact, various studies involving the use of the MCI have found some scale intercorrelations (e.g. Fraser & O'Brien, 1985) that are relatively large and that therefore cast some doubt on the MCI's factor structure.

Data were collected using the items in the MCI's Satisfaction scale, but the Satisfaction scale score was used as an attitudinal outcome variable not as a measure of classroom environment. That is, Satisfaction items were omitted when exploring the factor structure of the MCI as a classroom environment measure, and Satisfaction was used as a dependent variable when investigating associations between student satisfaction and the nature of the classroom learning environment. Consequently, a major thrust of the study was to explore the factor structure of the remaining four scales of the MCI once Satisfaction had been omitted from consideration. The new refined MCI instrument, with the new factor structure and reduced number of items, was used for testing in the Brunei Darussalam research (Majeed, Fraser, & Aldridge, 2002).

When the Satisfaction scale was used as an attitudinal outcome variable, instead of as a measure of classroom environment, Majeed et al. found strong support for a three-factor structure for the MCI consisting of three of the four *a priori* scales, namely, Cohesiveness, Difficulty and Competitiveness (Fraser, 2002).

The original MCI was the tool used to measure the learning environment in my evaluation of Project SMILE. The purpose of the research was to investigate if implementing SMILE positively influenced the classroom environment and student attitudes. The next section provides a brief overview of other questionnaires that have been developed since the LEI and MCI first came into play (section 2.3.2.3).

2.3.2.3 Other Questionnaires

My study used the MCI as the instrument to assess perceptions of classroom environment. However, there are a variety of contemporary instruments that are valid and widely-applicable that have been developed since the MCI and LEI. This section describes six other classroom environment instruments: Questionnaire on Teacher Interaction (QTI), Classroom Environment Scale (CES), Individualised Classroom Environment Questionnaire (ICEQ), Science Laboratory Environment Inventory (SLEI), Constructivist Learning Environment Survey (CLES) and the What is Happening in this Class? (WIHIC).

- **Questionnaire on Teacher Interaction (QTI)**

The Questionnaire on Teacher Interaction (QTI) focuses purely on the nature and quality of interpersonal relationships between teachers and students (Wubbels & Brekelmans, 1998). The QTI originated in the Netherlands and examines students' perceptions of eight aspects of interpersonal teacher behaviour, namely, Leadership, Helpful/Friendly, Understanding, Student Responsibility/Freedom, Uncertain, Dissatisfied, Admonishing and Strict behaviour (Creton, Hermans & Wubbels, 1990; Wubbels, Brekelmans & Hoomayers, 1991; Wubbels & Levy, 1993). The original version was in Dutch but later was translated into English for an American study (Wubbels & Levy, 1991). An English version of the QTI has also been used in Australia (Fisher, Henderson & Fraser, 1997; Henderson, Fisher & Fraser, 1995a, Kent, Fisher & Fraser, 1995; Wubbels & Levy, 1993, 1995b), Singapore (Goh, 1994; Goh & Fraser, 1995, 1998; Quek, Fraser & Wong, 2001) and Brunei Darussalam (Riah & Fraser, 1998; Khine & Fisher, 2002; Scott and Fisher, 2001). In Korea, Kim, Fisher and Fraser (2000) validated a Korean-language version and Soerjaningsih, Fraser and Aldridge (2001b) translated the QTI into the Indonesian language.

The QTI allows graphic representation of interpersonal teacher behaviour, using two axes (proximity and influence). The scales of the QTI are theoretically related through this model and this can cause problems with the independence of the scales when the researcher attempts to relate interpersonal teacher behaviour to other variables (e.g., student outcomes). The original version of the QTI consisted of 72 items with approximately eight items in each scale. A short form of the QTI was developed consisting of 48 items with six items in each scale. Students respond using a five-point rating scale ranging from Never to Always.

- **Classroom Environment Scale (CES)**

The Classroom Environment Scale (CES) was developed as a result of a program of research that involved perceptual measures of nine different human environments, including hospital wards, work settings and families (Moos, 1974). The final version of the CES has a total of 90 items, with 10 items in each of the scales, namely, Involvement, Affiliation, Teacher Support, Task Orientation, Competition, Order and Organisation, Rule Clarity, Teacher Control and Innovation (Fisher & Fraser, 1983b; Moos & Trickett, 1987; Trickett & Moos, 1973). Scoring is reversed on almost half of the items to which students respond using a True-False format.

The CES measures some dimensions that are quite different from the LEI and includes the use of an ideal form. Although the CES is a useful instrument for measuring the learning environment, it has shortcomings associated with it. Like the LEI, the CES tends to be more suited to teacher-centred classes, making many of the items unsuitable in today's settings, and the factorial validity has not been demonstrated. In addition, there are issues associated with the use of a true-false response scale: whether a two-point response scale allows for sufficient discrimination; and whether a true-false response format suggests that there is a right or wrong answer.

- **Individualised Classroom Environment Questionnaire (ICEQ)**

The Individualised Classroom Environment Questionnaire (ICEQ) was developed by Rentoul and Fraser (1979). The instrument pioneered the measurement of the transition from a traditional to an individualized classroom. It was developed in various forms that allows the measurement of the teacher's and students' perceptions of the actual and preferred classroom environment. The ICEQ measures the dimensions of Personalisation, Participation, Independence, Investigation and Differentiation (Rentoul & Fraser, 1979; Fraser, 1990, 1999). Students respond using a five-point frequency response scale consisting of Almost Never, Seldom, Sometimes, Often and Very Often.

While the long form of the ICEQ contains 50 items with 10 items in each scale, there is also a short form containing 25 items, with five items in each scale. For the first time, this short version gave teachers an economical means of measuring the classroom environment, in terms of time and resources. The factorial validity of the ICEQ, however, was not established. The copyright arrangement gives permission to purchasers to make an unlimited number of copies of the questionnaires and response sheets.

- **Science Laboratory Environment Inventory (SLEI)**

The Science Laboratory Environment Inventory (SLEI) was developed by Fraser, Giddings and McRobbie (1992, 1995) to measure dimensions that relate specifically to the learning environment of science laboratory classes, namely, Student Cohesiveness, Open-Endedness, Integration, Rule Clarity and Material Environment. The initial version of the SLEI contained 72 items and eight scales, but extensive field testing and item and factor analysis led to a more valid and economical version. The final version has seven items in each of the five original scales, giving a total of 35 items which are responded to using a five-point frequency response scale of Almost Never, Seldom, Sometimes, Often and Almost Always.

The factor structure of the SLEI has been established in several countries including Australia, Canada, England, Israel, Nigeria and the USA. The SLEI has been developed in both Actual and Preferred forms and has pioneered the use of a Personal form in addition to the traditional Class form. This instrument is suited to assessing the environment of the science laboratory classes at the senior high school or higher education levels (Fraser et al., 1995; Fraser and McRobbie, 1995). The SLEI has been used successfully in Korea (Lee & Fraser, 2002), Singapore (Quek, Fraser, & Wong, 2001; Wong & Fraser, 1996), and Brunei (Riah & Fraser, 1998).

- **Constructivist Learning Environment Survey (CLES)**

The Constructivist Learning Environment Survey (CLES) was developed by Taylor, Dawson and Fraser (1995a, 1995b) and Taylor, Fraser and Fisher (1997) to enable teachers to measure the extent to which constructivist approaches are being adopted in their class. According to the constructivist view, meaningful learning is a cognitive process in which individuals make sense of the world in relation to the knowledge which they already have constructed, and this sense-making process involves active negotiation and consensus building (Fraser, 1998b).

The questionnaire contains a total of 30 items with six items in each of five scales specifically related to aspects of constructivism, namely, Personal Relevance, Student Negotiation, Shared Control, Critical Voice and Uncertainty. The CLES uses a five-point frequency response scale of Almost Always, Often, Sometimes, Seldom and Almost Never. The factor structure of the CLES has been established in several countries, including Australia and the USA (Dryden & Fraser, 1998), Korea (Kim, Fisher & Fraser, 1999; Lee & Fraser, 2001a), and Taiwan (Aldridge, Fraser, Taylor, & Chen, 2000). The CLES is the first instrument to arrange items consecutively rather than randomly or cyclically. This provides students with a questionnaire that is simpler and quicker to answer than most previous questionnaires.

- **What is Happening in this Class? (WIHIC) Questionnaire**

By combining some of the prominent dimensions from past instruments and as well as dimensions of contemporary relevance, Fraser, McRobbie and Fisher (1996) developed the What is Happening in this Class? (WIHIC) questionnaire to measure important aspects of the learning environment. This instrument consists of seven dimensions, namely, Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity.

The original version of the WIHIC questionnaire had 90 items with nine scales (Fraser, 1998b). The final version of the WIHIC questionnaire has 56 items with eight items in each scale, providing an economical measure of the learning environment.

Items in the questionnaire are arranged consecutively, as in the CLES, to provide contextual cues to the reader. Both the WIHIC and SLEI can be used to measure students' perceptions from a class and personal viewpoint. The WIHIC uses a five-point frequency response format of Almost Always, Often, Sometimes, Seldom and Almost Never. The factor structure of the WIHIC has been established in several countries, including Australia (Fraser, McRobbie & Fisher, 1996), Singapore (Chionh & Fraser, 1998) and Brunei (Riah & Fraser, 1998). There is also a Chinese version that was field-tested with a sample of over 1800 children from Taiwan (Aldridge & Fraser, 2000; Huang, Aldridge & Fraser, 1998), a Korean version (Kim, Fisher, & Fraser, 2000), and an Indonesian version (Margianti, Fraser, & Aldridge, 2001a).

2.3.2.4 Moos' Scheme for Classifying Environment Scales

The dimensions measured by individual instruments can be classified according to Moos' (1974) scheme for classifying human environments. Moos identified three basic dimensions including: the *Relationship Dimension*, which measures the nature and intensity of personal relationships; the *Personal Development Dimension*, which measures the directions in which personal growth and self-enhancement occur; and the *System Maintenance and System Change Dimension*, which measures the extent to which the environment maintains clear objectives and control and responds to change. Table 2.1 classifies the dimensions of the LEI, MCI and most of the learning environment instruments listed above according to Moos' scheme. The QTI has been omitted from Table 2.1 because, unlike the instruments, it focuses purely on the assessment of relationship dimensions.

TABLE 2.1 Overview of Scales Contained in Various Learning Environment Questionnaires

Instrument	Level	Scales Classified According to Moos' Scheme: Relationship Dimensions	Personal Development Dimensions	Systems Change & Maintenance Dimensions
Learning Environment Inventory (LEI)	Secondary	Cohesiveness Friction Favouritism Cliqueness Satisfaction Apathy	Speed Difficulty Competitiveness	Diversity Formality Material environment Goal direction Disorganisation Democracy
My Class Inventory (MCI)	Elementary	Cohesiveness Friction Satisfaction	Difficulty Competitiveness	
Classroom Environment Scale (CES)	Secondary	Involvement Affiliation Teacher support	Task orientation Competition	Order and organisation Rule clarity Teacher control Innovation
Individualised Classroom Environment Questionnaire (ICEQ)	Secondary	Personalisation Participation	Independence Investigation	Differentiation
Science Laboratory Environment Inventory (SLEI)	Senior secondary Higher ed.	Student cohesiveness	Open- endedness Integration	Rule clarity Material environment
Constructivist Learning Environment Survey (CLES)	Secondary	Personal relevance Uncertainty	Critical voice Shared control	Student negotiation
What is Happening in this Class? (WIHIC)	Secondary	Student cohesiveness Teacher support Cooperation Equity	Investigation	Task orientation Involvement

Adapted from Fraser (1994) with the permission of the author.

Although the instruments developed for measuring classroom environments have been designed for different purposes, they share common characteristics. Each questionnaire is designed to elicit students' perceptions of their environment by indicating the extent to which they agree with a statement.

The following section reviews the literature regarding applications of the classroom environment instruments that have been discussed in the previous sections.

2.3.3 Applications of Classroom Environment Instruments

Classroom environment instruments have been used as sources of predictor and criterion variables in a variety of research studies (Majeed, Fraser & Aldridge, 2002). Use of student perceptions of actual classroom environment as independent variables in several different countries has established consistent relationships between the nature of the classroom environment and various student cognitive and affective outcomes (Fraser, 1986, 1998a; Fraser & Fisher, 1982a). Studies involving use of the actual form of classroom environment scales as criterion variables have revealed that classroom psychosocial climate varies between different types of schools (Trickett, 1978) and between coeducational and single-gender schools (Trickett, Trickett, Castro & Schaffher, 1982).

Researchers and teachers have found it useful to employ classroom climate dimensions as process criteria of effectiveness in curriculum evaluation because they have differentiated revealingly between alternative curricula when student outcome measures have shown little sensitivity (Fraser, Williamson & Tobin, 1987). In promising small-scale applications, teachers have used assessments of their students' perceptions of their actual and preferred classroom environment as a basis for identification and discussion of actual-preferred discrepancies, followed by a systematic attempt to improve classrooms (Fraser & Fisher, 1986: Thorp, Burden & Fraser, 1994; Yarrow, Millwater & Fraser, 1997).

In order to illustrate some applications of classroom environment instruments, the next three sections review literature that considers three types of past research which focus on: past studies that combine quantitative and qualitative information (2.3.3.1); associations between student outcomes and environment (2.3.3.2); and evaluation of educational innovations (2.3.3.3).

2.3.3.1 Past Studies that Combine Quantitative and Qualitative Information

In the past, studies in the field of learning environments have combined qualitative and quantitative research methods. One study that used qualitative research methods involved the investigation of the types of learning environments that teachers can create to promote success in students with Attention Deficit Hyperactivity Disorder (ADHD; Anstine Templeton, 1994). This study used a variety of qualitative methods including intensive interviews with a child with ADHD and his mother, in addition to observations and discussions with his teachers, counselor and other adults involved in his education. The study suggested that, first, the learning environment needs to be structured in ways that will ensure success (such as routines with only a few steps) and, second, teachers need to be treated as professionals in order to provide them with a positive self image that will aid reform.

In another study that made use of qualitative research methods, Anstine Templeton and Nyberg (1997) did a case study in which they described and evaluated the learning environment that an exemplary teacher created. In this study, they suggested that the role of the teacher needs to be redefined so that it reflects the teacher as educational leader and informed decision maker. In doing so, teachers feel valued and rewarded for contributing beyond their classrooms.

Over the past decade, research within the field of learning environments has also successfully combined quantitative and qualitative methods (Fraser & Tobin, 1991; Tobin & Fraser, 1998). For example, a study which involved the intensive gathering of qualitative data from two Grade 10 classes over a 13-week period was complemented by the collection of quantitative data (Tobin, Kahle & Fraser, 1990). The qualitative data included daily interviews with two teachers and their students in addition to classroom observations. Quantitative data involving students' perceptions of the learning environment were found to be consistent with observers' field records of the patterns of learning activities and engagement in each class.

In an investigation into the performance of Chinese-Australian students in chemistry classes, Tobin and McRobbie (1996) followed a hermeneutic approach whereby their learning was informed by their own research, learning from the field and reading the literature. In this study, the researchers made intensive observations in a Grade 11 chemistry class and used the CES to survey the students' and teacher's perceptions of five dimensions of the learning environment. Students' and teacher's responses to the questionnaire served as focal points for interviews, to provide a general understanding of what the class was like.

In another study that combined qualitative and quantitative research methods, researchers examined the perceptions that exemplary teachers held of their school environment. Anstine Templeton and Jensen (1993) used the School-Level Environment Questionnaire (SLEQ) to provide information regarding students' perceptions of the learning environment, then used interpretative research methods to shed light on questions that surfaced during data analyses. This study suggested that exemplary teachers influenced their school climates in positive ways. It was also indicated that teachers facilitated positive school environments through empowering students to learn.

Fraser and Tobin (1989) combined qualitative and quantitative research methods in examining the classrooms of exemplary teachers and compared them with a group of non-exemplary teachers. In this study, the main data collection was based on interpretative research methods (such as observation, interviews with teachers and students and case studies). However, quantitative data were collected (in the form of questionnaires) to complement and enrich the qualitative data. The findings of this study suggested that, first, exemplary and non-exemplary teachers could be distinguished in terms of their students' perceptions of the learning environment that they created and, second, students' perceptions of the learning environment that the exemplary teachers created was more favourable than for students of non-exemplary teachers.

In an intensive study of 10 science classes (taught by the same teacher), researchers considered the notion of 'grain size' by focusing on different levels of intensity or extensiveness in their research (Fraser, 1999). In addition to qualitative information gathered from a variety of sources (including student diaries, interviews and videotapes of activities), the researchers administered a modified version of the Constructivist Learning Environment Survey (CLES) to three samples (a selection of students in the classes being studied; a selection of students from other teachers in the same school; and a larger representative group). These data were then used for comparisons to check the extent to which the teacher was typical with her school and the state. The overall pattern indicated differences between the perceptions of students in this teacher's class and the perceptions of students in the comparison group.

In my study of Project SMILE, both quantitative and qualitative methods were employed to gather data.

One of my study's research aims involved associations between student outcomes and the nature of the classroom environment. A review of past studies of associations between student outcomes and classroom environment is provided in the following section (2.3.3.2).

2.3.3.2 Associations Between Student Outcomes and Environment

Investigating associations between students' cognitive and affective learning outcomes and their perceptions of psychosocial characteristics of their classrooms has been the strongest tradition in past research into classroom learning environments (Fraser & Fisher, 1982a; Haertel, Walberg & Haertel 1981; McRobbie & Fraser, 1993). A tabulation of 40 past studies into classroom learning environments shows that associations between outcome measures and classroom environment perceptions have been replicated for a variety of cognitive and affective outcome measures, a variety of classroom environment instruments and a variety of samples. These international studies include samples of children from all grade levels (Fraser, 1994).

Using the SLEI (Science Laboratory Environment Inventory), associations with students' cognitive and affective outcomes have been established for samples in chemistry classes in Australia (Fisher, Henderson & Fraser, 1997; Fraser & McRobbie, 1995; McRobbie & Fraser, 1993) and in Singapore (Quek, Fraser, & Wong, 2001; Wong & Fraser, 1996).

Using the QTI (Questionnaire on Teacher Interaction), associations between student outcomes and perceived patterns of teacher-student interaction were reported for samples of high school biology, chemistry and mathematics students in Australia (Fisher, Fraser & Rickards, 1997; Fisher, Henderson & Fraser, 1995) and in Singapore with primary school mathematics students in Singapore (Goh, Young & Fraser, 1995) and high school chemistry students (Quek, Fraser, & Wong, 2001).

While some English-language versions of various learning environment questionnaires have been employed in Asian countries, researchers have undertaken the task of translating many of the most widely-used questionnaires into a variety of Asian Languages (Fraser, 2002). Some of the latest research that has established outcome-environment associations using translated versions of learning environment questionnaires is described below.

- In Brunei Darussalam, outcome-environment associations have been established for: satisfaction and scales of the MCI for a sample of mathematics students in 81 classes (Majeed, Fraser & Aldridge, 2002); for science attitudes and scales of the WIHIC and QTI for a sample of science classes (Khine, 2001; Khine & Fisher, 2001, 2002); achievement and attitudes and scales of the WIHIC, QTI and SLEI for a sample of secondary chemistry students (Riah & Fraser, 1998); and for enjoyment of science lessons with scales of a primary school version of the QTI that had been translated in Standard Malay and used with children in private schools (Scott & Fisher, 2001).
- In Korea, outcome-environment associations have been reported for students' attitude to science (using versions translated into Korean). Korean versions of the SLEI, CLES and QTI (Lee & Fraser, 2001a, 2001b, 2002) were used for a sample of Grade 10 and 11 science students and the CLES and WIHIC and QTI for a sample of science students (Kim, Fisher, & Fraser, 1999, 2000).
- In Taiwan, outcome-environment relationships have been found for student satisfaction and a Chinese-language version of scales for both the WIHIC and CLES for a sample of science students (Aldridge & Fraser, 2000; Aldridge, Fraser, & Huang, 1999; Aldridge, Fraser, Taylor, & Chen, 2000).

- In Indonesia, Margianti, Fraser, & Aldridge, 2001a, 2001b) reported associations between the outcomes of achievement and attitudes and students' perceptions on an Indonesian-language version of the WIHIC for a sample of university students. Soerjaningsih, Fraser, and Aldridge (2001a, 2001b) used Indonesian versions of the WIHIC and QTI to establish links with student outcomes (course achievement, leisure interest in computers, and attitude towards the internet) among university students.

Some research into outcome-environment associations has involved the use of more than one classroom environment questionnaire in the same study. In Singapore, Goh and Fraser (1998) used the MCI and QTI in a study involving the achievement and attitudes of primary mathematics students. The MCI and QTI each uniquely accounted for an appreciable proportion of the variance in achievement, but not in attitudes. A conclusion from this study is that it is useful to include the MCI and QTI together in a future study of achievement, but not of attitudes (Fraser, 2002).

Quek, Fraser and Wong (2001) used the SLEI and QTI together in a study of science students' attitudes in Singapore. Lee and Fraser (2001a, 2001b, 2002) used the Korean-language versions of the SLEI, QTI and CLES in a study of science students' attitudes in Korea. The results of both of these studies confirmed that each classroom environment instrument accounted for variance in student outcome measures that is independent of that accounted for by the other instrument. In the next section (2.3.3.3), the discussion focuses on the use of learning environment dimensions in the evaluation of educational innovations.

2.3.3.3 Evaluations of Educational Innovations

A major aim of my study was to evaluate the impact of the implementation of SMILE on the classroom environment. Classroom environment instruments can be used as a valuable source of process criteria in the evaluation of educational innovations (Fraser, Williamson & Tobin, 1987). An evaluation of the Australian Science Education Project (ASEP) revealed that, in comparison with a control group, ASEP students perceived their classrooms as being more satisfying and individualized and having a better material environment (Fraser, 1979). The significance of this evaluation is that classroom environment variables differentiated revealingly between curricula, even when various outcome measures showed negligible differences (Fraser, 1998a). In more recent studies, the incorporation of a classroom environment instrument within an evaluation of the use of a computerized database revealed that students perceived that their classes became more inquiry oriented during the use of the innovation (Maor & Fraser, 1996).

Only a small number of these evaluation studies have been carried out in Asia. However, in Singapore, Teh used his own classroom environment instrument (the Geography Classroom Environment Inventory) as a source of dependent variables in evaluating computer-assisted learning (Fraser & Teh, 1994; Teh & Fraser, 1994). Compared with a control group, a group of students using micro-PROLOG-based computer-assisted learning had much higher scores for achievement, attitudes and classroom environment (Fraser, 2002).

Khoo and Fraser (1998) used the WIHIC in evaluating computer application courses in Singapore. Overall, students perceived their computing classes as being relatively high in involvement, teacher support, task orientation and equity, but the course was differentially effective for students of different sexes and ages (Fraser, 2002).

An investigation of differences between the actual classroom environment and that preferred by students was reported by Fisher and Fraser (1983a). Students typically preferred a more positive classroom environment than was actually present for all environment dimensions. The pattern in which students prefer a more positive classroom learning environment than the one perceived as being currently present has been replicated using the WIHIC and QTI among high school students in Singapore (Fraser & Chionh, 2000; Wong & Fraser, 1996) and university students in Indonesia (Margianti, Fraser, & Aldridge, 2001b). In my study, I used the degree of congruence between actual and preferred classroom environment as an index of the effectiveness of Project SMILE.

Because students' attitudes also were assessed in my study, the next section includes a review of literature on student attitudes.

2.4 STUDENT ATTITUDES

In his book, *The First Days of School,* Harry Wong makes the statement that there is no correlation between success and family background, race, national origin, financial status, or even educational accomplishments. There is but one correlation with success, and this is attitude (Wong & Wong, 1998). Given there is a positive correlation between attitude and achievement in mathematics, it is important for the teacher to provide experiences and the kind of environment that will foster positive attitudes (Cathcart, Pothier, Vance, & Bezuk, 2000).

The development of positive students' attitudes towards their mathematics classroom was regarded as an important goal in my study. Attitudes are an important part of motivation. Children who feel good about mathematics and their ability to do mathematics will normally be motivated to learn. On the other hand, children who have negative attitudes about mathematics or their ability in mathematics often exhibit disinterest. Students' attitudes toward mathematics are a by-product of learning and are linked to both motivation and success in mathematics (Cathcart, Pothier, Vance, & Bezuk, 2000).

Students' values, including attitudes, are greatly influenced by teachers. Teachers who enjoy teaching mathematics and share their interest and enthusiasm for the subject tend to produce students who like mathematics (Reng & Dalla, 1993). Minimal stress, emphasis on meaning and understanding rather than memorization, successful experiences, meaningful use of manipulatives, relating mathematics to the real-world, and meaningful cooperative group work are some generalized guidelines for fostering the development of positive attitudes regarding mathematics (Cathcart, Pothier, Vance, & Bezuk, 2000).

Teacher expectations also greatly affect student performance (Koehler & Grouws, 1992). Establishing what is important and valued in every classroom greatly influences not only what is learned, but also students' attitudes toward mathematics. The definition of student attitudes (2.4.1) as well as literature related to the evaluation of student attitudes toward mathematics is discussed in terms of instruments used to assess attitudes (2.4.2), especially a NAEP (National Assessment of Educational Progress) attitude survey (2.4.3).

2.4.1 Definition of Student Attitudes

In the past, the study of students' affective outcomes has been the cause of definition problems, and terms associated with this domain, such as interests or attitudes, often have been used loosely and without clarification (Peterson & Carlson, 1979). In 1964, Krathwohl, Bloom and Masia (1964) went some way towards solving this difficulty when they developed a taxonomy in which various affective behaviours were placed along a hierarchical continuum which clarified some of the terms previously used to describe affective behaviours. They identified five major levels of internalisation in the structure of the affective domain taxonomy: receiving or attending; responding; valuing; organisation; and characterisation by a value or value complex (Aldridge & Fraser, 2000).

To this point, little literature is available regarding attitude toward mathematics. However, in 1975, Gardner suggested that there are two main categories related to attitudes concerned with science education: attitudes towards science; and scientific attitudes. Gardner (1975) defines attitudes towards science as:

> ... a learned disposition to evaluate in certain ways objects, people, actions, situations or propositions involved in learning science. (p. 2)

It is this learned disposition that is of concern and refers to the way in which students regard science, such as interesting, boring, dull or exciting. Positive student attitudes, then, are identified by the degree of motivation and interest reported by the student. The attitude scale used in the present study focuses on a survey based on the 1988 NAEP Attitude Survey in mathematics.

2.4.2 Evaluation of Student Attitudes

Students' attitudes towards a subject have been measured using a variety of techniques, including: interviews; open-ended questions; projective techniques; closed-item questionnaires (such as Likert scales); and preference rankings (Laforgia, 1988). A number of instruments have been designed to elicit the attitudes of students towards science (Fisher, 1973; Fraser, 1978, 1981; Mackay, 1971; Wubbels, Creton & Hoomayers, 1985). Many such instruments have been criticised on conceptual and empirical grounds (Gardner, 1975; Munby, 1980; Schibeci, 1984) and because of their inability to be used in different countries (Schibeci, 1986).

A review of literature revealed a large pool of science-related attitude scales. Of particular interest is the Test Of Science Related Attitudes (TOSRA) developed by Fraser (1978) to measure students' attitudes towards their science classes. Fraser based the subscales of his instrument on Klopfer's (1976) taxonomy of the affective domain related to science education. Modified versions of the TOSRA have been used in previous studies in non-Western countries with a high degree of reliability (Goh, 1994; Goh & Fraser, 1995).

Tobin and Fraser's (1989) study of student perceptions of the psychosocial environment in classrooms of exemplary teachers, using short forms of the My Class Inventory (MCI) and Classroom Environment Scale (CES), provided considerable evidence that exemplary teachers can be distinguished in terms of the classroom environments which they create. My study is significant in that it combined the MCI and an adaptation of the 1988 NAEP (National Assessment of Educational Progress) attitude survey to investigate if there is a correlation between students' attitudes and perceptions of their learning environment. This is first study to employ both of these questionnaires. A review of literature describing the NAEP questionnaire is found in the next section.

2.4.3 NAEP Attitude Survey

There are few instruments designed to draw out the attitudes of students toward mathematics. In my study, I chose to employ an attitude survey, based on the

1988 NAEP attitude survey. This survey was administered to six classes of Grade 5 students.

Since 1969, NAEP (National Assessment of Educational Progress) has been the sole, ongoing national indicator of what American students know and can do in major academic subjects. NAEP is a project of the National Center for Education Statistics (NCES) in the US Department of Education and is overseen by the National Assessment Governing Board (NAEP, 2000). The attitudes of students who took the NAEP mathematics assessment in Grade 4 were strongly related to their mathematics achievement. Students who agreed that they like mathematics and that mathematics is useful for solving problems scored higher than students who disagreed with these statements (NAEP, 2000).

The original NAEP survey of 1988 was adapted for elementary students and validated by Dr Okhee Lee for the Mathematics and Science Resource Teacher Program of the University of Miami (Lee & Cuevas, 1991). This adapted attitude survey was administered to the teachers and students participating in Project SMILE. The survey was designed to gauge their attitudes toward reading, writing and mathematics. The teachers responded to nearly the same survey as the students. For example, the students responded to the statement, "I like mathematics.", whereas the teachers responded to the statement, " I like TEACHING mathematics."

There are five questions in each of three different subject areas – reading, writing and mathematics. With the exception of the subject area, all statements in the attitude survey are exactly the same (See attitude surveys in Appendices B & C). The statements deal strictly with the attitudes of the individual regarding reading, writing and mathematics. The teachers and students respond 'agree', 'disagree' and 'not sure' to each item on the questionnaire.

The MCI (My Class Inventory) and the adaptation of the 1988 NAEP Attitude Survey served as the measures of attitude and classroom environment in my study. A sample of 120 Grade 5 students completed both surveys. These served as the quantitative data in the evaluation of Project SMILE.

2.5 CHAPTER SUMMARY

A summary of the literature relevant to the implementation of Project SMILE was described in Chapter 2. The review of literature included: elementary mathematics for the 21^{st} century, teaching mathematics for understanding and the study of learning environments and student attitudes. The NCTM Standards, Project CRISS, the Florida A+ Plan, procedural versus conceptual knowledge and methods of integrating mathematics into all subjects were described as they impacted on Project SMILE.

The history of the first two decades of learning environments research in Western countries shows a strong emphasis on the use of a variety of validated and robust questionnaires that assess students' perceptions of their classroom learning environment. In the past decade, Asian researchers have completed numerous impressive studies that have cross-validated the main contemporary classroom environment questionnaires and translated questionnaires that were originally developed in English. These researchers have laid a strong foundation for future learning environment research (Fraser, 2002). In my study, I decided to use one of these questionnaires (namely, the My Class Inventory).

We know that mathematics learning is influenced by factors specific to the individual student. We also know that mathematics learning is a slow process that requires years of development. In order for students to learn mathematics in the 21^{st}

century a fundamental change is necessary in how mathematics is viewed – not as boring, sterile and difficult, but as an exciting exploration with practical uses every day for everyone (Reyes, Suydam, Linquist & Smith, 1998).

Children who feel good about mathematics and their ability to do mathematics will normally be motivated to learn. On the other hand, children who have negative attitudes about mathematics or their ability in mathematics often exhibit disinterest (Cathcart, Pothier, Vance, & Bezuk, 2000). Teacher expectations also greatly affect student performance (Koehler and Grouws, 1992). Establishing what is important and valued in every classroom greatly influences not only what is learned, but also students' attitudes toward mathematics.

Past research reviewed in Chapter 2 shows that two applications of learning environment research have been in the evaluation of educational innovations and in investigations of associations between student outcomes and the nature of the classroom learning environment. The research questions in my study encompassed both of these applications.

Chapter 3

RESEARCH METHODS

> Students are not failing because of the curriculum.
> Students can learn almost any subject matter when
> they are taught with methods and approaches
> responsive to their learning style strengths.
> (Rita Dunn, 1990)

Traditionally research and evaluation in education have tended to rely heavily and sometimes exclusively on the assessment of academic achievement (Fraser, 1991). Teachers also seem to concentrate almost exclusively on the assessment of academic achievement, and devote little attention to factors which might be related to their students' performance. In the last two decades, the field of classroom environment has progressed to the point where researchers and teachers can assess classroom environments and identify their effects on students. This research has given teachers an in-depth understanding into how individuals learn, the complexity of teaching, and the nature of classroom environment. A consistent association between improved student attitudes and positive classroom environments has been established. Also students achieve more when there is a positive classroom environment (Fraser, 1998a).

In Chapter 2, it was noted that few fields in education can boast the existence of such a rich array of validated and robust instruments, which have been used in so many research applications, as the field of learning environments (Fraser, 1998a). A striking feature of this field is the availability of a variety of valid and widely-applicable questionnaires that have been developed and used for assessing students' perceptions of classroom environment (Fraser, 1998b). My study made use of one of these classroom environment instruments – namely, the My Class Inventory (MCI).

In addition, because students' attitudes toward mathematics are considered an important factor in mathematics classrooms, this study also included assessment of students' attitudes and investigated their association with the nature of the classroom learning environment. My evaluation of SMILE is distinctive in that it adds to the small number of recent learning environment studies (e.g. Goh, Young & Fraser, 1995; Majeed, Aldridge & Fraser, 2001) that focus on the school subject of mathematics.

As established in Chapter 1, four research questions were used to evaluate the experience of Project SMILE in terms of changes that occurred after the professional development program when teachers implemented ideas in their classrooms:

- What is the reliability and validity of the attitude and learning environment scales used with the sample elementary mathematics students?
- After teachers participate in the professional development activities for Project SMILE, are there changes in the attitudes of students regarding reading, writing and mathematics?
- After teachers participate in the professional development activities for Project SMILE, is there congruence between the actual and preferred classroom learning environment?
- Is there a relationship between students' perceptions of classroom environment and their attitudes?

This chapter describes the various research methods employed to generate information to answer the research questions. Discussion covers the data collection and the various instruments used to gather the data including surveys, classroom observations and case studies, the stages of the study, and a description of the sample. Also data analysis methods are outlined. The following headings and section numbers are used to organize my discussion of the research methods:

3.1 Combining Research Methods

3.2 Data Collection

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3.1 COMBINING RESEARCH METHODS

As recommended by Tobin and Fraser (1998) and Punch (1998), both qualitative and quantitative research methods were used in the evaluation of Project SMILE. For a number of years, workers in various areas of educational research, especially the field of educational evaluation, have claimed that there are merits in moving beyond the customary practice of choosing either qualitative or quantitative methods and instead of combining the two methods within the same study (Cook & Reichardt, 1979; Firestone, 1987; Fraser, Williamson & Lake, 1988; Howe, 1988). In recent years, significant progress has been made toward this desirable goal of combining both methods in research on classroom learning environments (Fraser & Tobin, 1991; Tobin & Fraser, 1998). The present evaluation of SMILE combined qualitative and quantitative research methods.

In the relatively new and rapidly-growing field of classroom learning environments, studies involving qualitative methods have provided rich insights into classroom life (Rutter et al., 1979; Stake & Easley, 1978). The use of quantitative methods have generated several widely-applicable questionnaires which have been used to replicate certain lines of research with large samples in a variety of countries (Fraser, 1986). It is desirable that researchers now combine qualitative and quantitative methods in learning environment research (Tobin & Fraser, 1998).

3.2 DATA COLLECTION

A range of quantitative and qualitative data were collected relevant to this evaluation. Quantitative data were gathered from two sources. First, an adaptation of the 1988 NAEP (National Assessment of Educational Progress) attitude survey (Appendices B & C) provided a measure of changes in student attitudes to reading, writing and mathematics. Second, Fraser and Fisher's (1983a) shortened form of My Class Inventory (Appendix D) was used to measure student perceptions of their classroom learning environment in classes taught by teachers who had attended the SMILE professional development course.

Qualitative data were gathered from six classroom observations, student and teacher interviews that were recorded and transcribed, working with students during class time, obtaining written responses to specific questions, and examining student notebooks and test papers. Feedback from the teachers on the written reports of the study was used as another data source. As soon as possible after each lesson, all data were compiled into written field notes. Student work samples were also utilized in the compilation of qualitative data.

My hypothesis was that the implementation of Project SMILE would promote improved attitudes toward the learning of mathematics and a positive classroom environment.

3.3 INSTRUMENTS USED FOR DATA COLLECTION

The instrument chosen as the measure of student attitude was an adaptation of the 1988 NAEP (National Assessment of Educational Progress) attitude survey (Lee & Cuevas, 1991). The My Class Inventory (MCI) was chosen as the instrument to measure classroom environment. These instruments are described in turn in the next two subsections (3.3.1 and 3.3.2).

3.3.1 Attitude Survey

An attitude survey, based on the 1988 NAEP attitude survey, was administered to six classes of Grade 5 students as both a pretest and posttest. Since 1969, NAEP has been the sole, ongoing national indicator of what American students know and can do in major academic subjects. NAEP is a project of the National Center for Education Statistics (NCES) in the US Department of Education and is overseen by the National Assessment Governing Board (NAEP, 2000). The attitudes of students who took the NAEP mathematics assessment in Grade 4 were strongly related to their mathematics achievement. Students who agreed that they like mathematics and that mathematics is useful for solving problems scored higher than students who disagreed with these statements (NAEP, 2000).

The original NAEP survey of 1988 was adapted for elementary school students and validated by Dr Okhee Lee for the Mathematics and Science Resource Teacher Program of the University of Miami, Miami, Florida (Lee & Cuevas, 1991). This adapted attitude survey was administered to the teachers and students participating in Project SMILE. The survey was designed to gauge their attitudes toward reading, writing and mathematics, which are separated on the survey because these academic disciplines are taught in isolation in most elementary classrooms. I wanted the teachers and students to respond honestly to the survey regarding their feelings toward these three subjects.

I administered the surveys to the children in their own classroom setting the week after the first SMILE inservice workshop. The teacher remained in the classroom. Because many of the students' reading ability was far below grade level, I read the survey aloud to the children and they responded. There are five statements in each of three different subject areas – reading, writing and mathematics. With the exception of the subject area, all statements in the attitude survey are exactly the same (a copy of the student attitude survey is found in Appendix B). The statements deal strictly with the attitudes of the individual regarding reading, writing and mathematics. The students respond 'agree', 'not sure' or 'disagree' to each item on the questionnaire. I chose to survey the students and teachers about their attitudes toward reading and writing, as well as toward mathematics, because the basic premise of both SMILE and Project CRISS is to teach reading and writing through content area subjects. Figure 3.1 shows an excerpt from the mathematics portion of the adapted NAEP attitude survey for students.

	Feelings about Mathematics	Agree	Not Sure	Disagree
1.	I like Mathematics.	1	2	3
2.	I am good at Mathematics.	1	2	3
3.	Everyone can do math well, if they try.	1	2	3
4.	Math is boring.	1	2	3
5.	Math is a hard subject.	1	2	3
6.	Math is mostly memorization and working from the textbook.	1	2	3

Figure 3.1 Mathematics Section of the NAEP Attitude Survey for Students Used in the Evaluation of SMILE

The teachers responded to the adapted NAEP Attitude Survey for Teachers during the first day of the SMILE inservice workshop (See Appendix C). They responded to nearly the same survey as the students. For example, the students responded to the statement "I like mathematics", whereas the teachers responded to the statement "I like TEACHING mathematics".

3.3.2 Classroom Environment Instrument

All of the students in the present study completed the My Class Inventory (MCI) as a measure of classroom environment (Fraser & Fisher, 1983b). The reason why I chose this particular instrument is that the vocabulary is well suited for the elementary school child, the responses are in a simple Yes-No format, and the answers are recorded on the questionnaire itself to avoid errors in transferring information from one place to another. The reliability of the MCI had been established in several previous research programs (Fisher & Fraser, 1981). The MCI (My Class Inventory) is a simplified version of the LEI (Learning Environment Inventory). The MCI may be found in its entirety in Appendix C.

It was noted in Chapter 2 that, as a part of the research and evaluation activities of Harvard Project Physics, Anderson and Walberg (1968) developed the LEI (Anderson & Walberg, 1974; Fraser, Anderson & Walberg, 1982). The LEI is an expansion and improvement on Walberg's original instrument, the Classroom Climate Questionnaire (Fraser & Fisher, 1983a). The final version of the LEI contains 15 scales with seven items per scale, for a total of 105 items.

The dimensions measured by the LEI can be classified according to Moos' (1974) scheme for classifying human environments. Moos identified three basic dimensions including: the *Relationship Dimension*, which measures the nature and intensity of personal relationships; the *Personal Development Dimension*, which measures the directions in which personal growth and self-enhancement occur; and the *System Maintenance and System Change Dimension*, which measures the extent to which the environment maintains clear objectives and control and responds to change. Under the three dimensions are these 15 scales: Cohesiveness, Diversity, Formality, Speed, Material Environment, Friction, Goal Direction, Favouritism, Difficulty, Apathy, Democracy, Cliqueness, Satisfaction, Disorganisation, and Competitiveness. Because of the readability level, the LEI is designed primarily for secondary school students. The students respond to each item with 'strongly disagree', 'disagree', 'agree', or 'strongly agree' (Fraser, 1998b).

Many questionnaires exist in separate Actual and Preferred forms. The 'actual' form measures experienced classroom environment, while the 'preferred' form measures students' perceptions of the ideal classroom environment. Although the wording is similar for both forms, slightly different instructions for answering each are used. For example, an item in the actual form could read: "There *is* a clear set of rules for students to follow." The preferred form would read: "There *would be* a clear set of rules for students to follow" (Fraser, 1998b). Prior research has suggested that relationships exist between class achievement and the degree of match between the actual classroom environment and that preferred by the class (Fraser & Fisher, 1983a, 1983b).

The LEI does have limitations. The length of the LEI, with its 105 items, is long. At the request of some teachers and researchers, a shortened form of the LEI was developed (Fraser 1982a; Fraser & Fisher, 1983a) for three reasons:

- The instrument contains less items to provide greater economy in testing and scoring.
- It is easy to hand score.
- It has adequate reliability for applications which involve averaging the perceptions of the students within a class.

The MCI can be distinguished from the LEI in several ways. First, it minimizes fatigue among younger children because it contains only five of the original 15 scales. Second, item wording has been simplified to enhance readability. Third, the LEI's four-point format has been 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, 1998a).

The MCI is a one-page questionnaire that measures five scales, yet contains only 25 questions (Fraser, 1989). The MCI's dimensions of *Satisfaction, Friction, Competitiveness, Difficulty* and *Cohesiveness* are defined below:

- **Satisfaction** – Extent of enjoyment of the class (Yarrow, Millwater & Fraser, 1997).
- **Friction** – Nature of children's relationships with one another. It manifests itself in fighting, being mean towards one another or attempts to control other members (Yarrow, Millwater & Fraser, 1997).

- **Competitiveness** – Relating to, characterized by, or based on competition. It involves striving for the same objective (Merriam-Webster, 1999)
- **Difficulty** – Children generally are comfortable with their learning activities and the difficulty level is close to ability levels (Yarrow, Millwater & Fraser, 1997).
- **Cohesiveness** – Extent to which students know, help and are supportive of one another (Fraser & Giddings, 1992).

The MCI was initially developed for use among children aged 8-12 years (Fisher & Fraser, 1981; Fraser, Anderson & Walberg, 1982; Fraser & O'Brien, 1985). Even though the MCI was originally developed for students at the primary level, it also has been found useful at the middle school level, especially for use with students with reading difficulties.

Data collected during the 1997—1998 school year revealed that 58% of the students in Miami-Dade County Public Schools were language deficient in that English is not their home language (OEEMA, 1998). Therefore, it was felt that the vocabulary in the MCI was appropriate for the sample of students in my study.

The MCI can also be used to provide a separate measure of student perceptions of actual and preferred classroom environment.

Adapted forms of the MCI have been used internationally. In Singapore, Goh, Young and Fraser (1995) modified the MCI's original Yes-No response format to a three-point response format (Seldom, Sometimes and Most of the Time). They also included a Task Orientation scale. Goh et al. found the modified MCI to be valid and useful in research applications with 1512 primary mathematics students in 39 classes (Fraser, 2002). In Brunei Darussalam, Majeed, Fraser and Aldridge (2002) used the original version of the MCI with 1565 mathematics students in 81 classes in 15 secondary schools. In this study, the Satisfaction scale was used as an attitudinal outcome variable, instead of as a measure of classroom environment. These recent studies increased my confidence about using the MCI.

In my study, the students responded to the MCI at the end of their teachers' SMILE inservice course. I had already observed and taught my SMILE lessons and the teachers had taught all of the SMILE units in their classrooms. I went into the individual classrooms and read both the Actual and Preferred forms aloud to the students on the same day. The next section (3.4) describes the stages of my evaluation of Project SMILE in detail.

3.4 STAGES OF THE STUDY

For my study, the combination of qualitative and quantitative methods capitalized on the strengths of the two approaches and compensated for the weaknesses of each (Punch, 1998; Tobin & Fraser, 1998). The study consisted of the three stages described below:

<u>Stage 1 – Pretesting.</u> An attitude questionnaire, based on the 1988 NAEP (National Assessment of Educational Progress) attitude survey, was administered to all students and teachers in the sample as a pretest. The teachers completed the survey on the first day of the SMILE inservice workshop. The students responded to the survey after the first day of the teachers' professional development activities. Six students and teachers were interviewed regarding their responses to the attitude survey.

<u>Stage 2 – Professional Development.</u> The SMILE inservice course began for the designated teachers. This inservice course went for five full days during a ten-week period. At the conclusion of each inservice day, the participants were asked to use the

lessons and materials with their students and to return with student work samples the following time.

Six hundred dollars worth of materials and supplies were given to each teacher-participant in SMILE. The funds for the materials and supplies came from the Title II Eisenhower Professional Development Program. This federally-funded grant program focuses on the professional development of teachers in mathematics and science.

Stage 3 – Attitude Posttest and Classroom Environment Assessment. The attitude survey was readministered as a posttest to the teachers and students in the sample at the completion of the SMILE professional development program. The MCI also was administered to the teachers and students around the same time in both its actual and preferred form.

3.5 THE SAMPLE

The sample covered mathematics classes at the elementary school (K–5) level. The teachers and students were selected to represent the diverse group of teachers and students found in the Miami-Dade County Public Schools. The teachers, designated by the school principal to attend the SMILE workshop, were asked to participate in the research. Preference was given to teachers who teach Grade 5. A sample of six teachers from two schools was involved. With each teacher having over 30 students in his/her class, the sample size approached 200 students. After all responses were collated, there were 120 students who had completed all surveys, inventories and achievement tests, and this reduced sample without any missing data was used for statistical analyses. Six classrooms of Grade 5 students participated in the SMILE pilot study.

The evaluation of SMILE began during the 2000–2001 school year. A major purpose of the study was to determine the extent to which the classroom implementation of Project SMILE positively influenced the classroom environment and student attitudes toward reading, writing and mathematics. Another of my goals in implementing SMILE was to improve the teaching and learning of mathematics concepts by integrating mathematics with children's literature and the principles and strategies of CRISS. From the first pilot group of 30 teachers, six teachers were asked to implement SMILE. These teachers were from Tulip and Daniel Elementary Schools. (Section 3.5.2 describes the demographics of these two schools.) In order to understand some of the terminology in the description of the sample schools, the school rating system under Florida's A+ School Plan (FDOE, 1997) is explained in the next subsection (3.5.1).

3.5.1 Sample Schools' Performance on the School Rating System

Beginning with the 1998–1999 school year, the School Improvement and Accountability in Florida Act of 1997 put into effect a mechanism to evaluate schools' performance on a high-stakes test. This is called the Florida A+ School Plan (FDOE, 1997). Schools in Florida are given A–F ratings. Beginning in 1999–2000, in addition to a letter grade, each school receives an improvement rating of 'improved', 'remained the same', or 'declined'. Schools failing to make adequate progress for two years in a four-year period could experience possible state intervention (FDOE, 1997). Schools with improved scores receive monetary rewards. Each member of the staff of these improved schools is given a cash bonus.

A short explanation of this school grading system follows. All students in Grades 4, 5, 8 and 10 take the Florida Comprehensive Assessment Test (FCAT). For the FCAT 2000, the criteria are as follows. For a school to have 'passing status', fewer than 60% of students must score at or above Achievement Level 2 in the fourth grade FCAT reading; fewer than 60% of students must score at or above Achievement Level 2 in the fifth grade FCAT mathematics; and fewer than 50% of the students must score '3' or above in the fourth grade FCAT writing (OEEMA, 2001).

In Grades 4, 8 and 10, all students take the Florida writing examination. The results indicate the extent to which the student is fluent in writing either through a persuasive or expository essay. Responses are graded on a six-point rubric. Fifty percent of the students must score a '3' or above for the school to be deemed proficient in writing.

With the background information on the school rating system in Florida, it is now easier to understand the description of each sample school in the following subsection (3.5.2).

3.5.2 Demographics of the Two Schools Involved

Tulip Elementary School is in a lower-income, African-American neighborhood. Ninety-eight percent of the students in this school are on a free lunch program (OEEMA, 2000) which the Federal government provides for students from low-income households. Tulip received a 'D' in Florida's school improvement plan because 35% of students scored below Achievement Level 2 in the fourth grade FCAT reading and 48% of students scored below Achievement Level 2 in the fifth grade FCAT mathematics (OEEMA, 2000).

One of the teachers from this school had been in the SMILE pilot project during the year before. The students in her classroom showed a 10-point gain on the Stanford Achievement Test (SAT 9th edition) (OEEMA, 1999). Because of this gain, the Principal wanted all the teachers in the school to be involved in my research project. He also allowed the use of the school as the site for the professional development workshops.

Daniel Elementary School is in a middle-class, multi-ethnic community. Two fifth grade mathematics teachers volunteered to be involved in the study. The Principal offered her school as a site for the professional development as well. At Daniel, 19% of the fourth grade students scored below Achievement Level 2 and 27% scored below Achievement Level 2 in mathematics (OEEMA, 1999). This school received a 'C' in Florida's A+ School Plan (FDOE, 1997).

3.6 QUANTITATIVE DATA ANALYSIS

As recommended by Tobin and Fraser (1998) and Punch (1998), both qualitative and a quantitative research methods were used in this evaluation of Project SMILE. In the following sections (3.6.1–3.6.4), the discussion focuses on the statistical analyses chosen to answer each of the four research questions.

3.6.1 Reliability and Validity of the Attitude and Environment Scales

1. What is the reliability and validity of the attitude and learning environment scales used with the sample elementary mathematics students?

The first research question involved the reliability and validity of the attitude scales and of the actual and preferred forms of the classroom environment instrument (i.e. the My Class Inventory, MCI). Fifteen items, focusing on three subjects (reading, writing and mathematics), of the NAEP attitude survey were administered both as a pretest and posttest to the sample of 120 students whose teachers were teaching the SMILE program. For each attitude scale, an estimate of scale internal consistency (the extent to which items in the same scale measure a common construct) and discriminant validity (the extent to which a scale measures a unique dimension not assessed by another scale) were assessed.

Internal consistency was assessed using Cronbach's alpha reliability coefficient, whereas discriminant validity was assessed using the correlation of a scale with the other scales as a convenient index. Data were analyzed separately for pretest and posttest responses.

In terms of the reliability and validity of the MCI, the same two indices of internal consistency and discriminant validity were reported separately for the actual and preferred form. As a convenient index of discriminant validity, use was made of the mean correlation of one scale with the other four MCI scales.

Ideally, students within the same class should perceive its environment relatively similarly, whereas mean class perceptions should vary from class to class. This characteristic was explored for the actual form of each MCI scale by performing a one-way ANOVA with class membership as the main effect.

3.6.2 Evaluation of Project SMILE in Terms of Student Attitudes

The second research question is:

2. After the teachers participate in the professional development activities for Project SMILE, are there changes in the attitudes of students regarding reading, writing and mathematics?

Teachers attended a series of five professional development workshops lasting five full days during a ten-week period. After the first day of the workshop, I went to each teacher's classroom and administered the NAEP attitude survey to the students. After the teachers completed the SMILE professional development course, I administered the attitude questionnaire again as a posttest. Changes in student attitudes between the pretest and posttest were used in evaluating the effectiveness of the SMILE inservice program.

When analyzing data from the pretest and posttest attitude surveys, the average item mean (the scale mean divided by the number of items in a scale) was used to provide a meaningful basis for comparing the means of scales containing differing numbers of items. The pretest and posttest scores were paired on each scale for each student. The average item mean, the average item standard deviation, the effect size (i.e. the difference between the mean values of the pretest and posttest, divided by the pooled standard deviation) and the results of a paired *t* test for the statistical significance of the difference between pretest and posttest were reported for attitude toward each of the three subject areas.

3.6.3 Comparing Actual and Preferred Learning Environments

The third research question is:

3. After the teachers participate in the professional development activities for Project SMILE, is there congruence between actual and preferred classroom learning environment?

Although the MCI was not administered as a pretest and posttest (cf. attitude scales), it still was possible to use the congruence between actual and preferred classroom environment as a basis for evaluating SMILE. At the end of the ten-week SMILE professional development series, I went into each classroom and administered both the actual and preferred forms of the MCI. The average item mean for the actual and preferred forms of each MCI scale was compared using the effect size and the result of a *t* test for paired samples.

3.6.4 Associations Between Attitudes and Learning Environment

The fourth research question is:

4. Is there a relationship between students' perceptions of classroom environment and their attitudes?

Associations between students' attitudinal outcomes (namely, Satisfaction from the MCI and the three scales assessing attitudes to reading, writing and mathematics) and students' perceptions on the four learning environment scales of the MCI (Friction, Competition, Difficulty and Cohesiveness) were investigated. For the purpose of analysis, the Satisfaction scale of the MCI was conceptualized and used as a dependent variable. Both simple correlation and multiple regression analyses were used.

Simple correlation analysis was used to provide information about the bivariate relationship between each attitude outcome and each classroom environment scale. The multiple correlation was used to describe the joint relationship between each attitude outcome and the set of four classroom environment scales. The regression coefficient was used to describe the association between an attitude scale and a particular environment scale when the other three environment scales are mutually controlled.

3.7 QUALITATIVE INVESTIGATION

In my study, qualitative information was used to support the patterns of results from the questionnaires and to provide richer insights into students' classroom environment and attitudes toward reading, writing and mathematics.

Before the SMILE professional development activities began, six students and six teachers were interviewed privately using questions based on the NAEP Attitude Survey. The interview questions were based on the 15 questions of the NAEP Attitude

Survey, but were expanded as the participants responded. The questions were read aloud to each participant and their responses were recorded and transcribed. The teachers collected work samples as proof that they were implementing the program in their classrooms. The collection of qualitative data is described below.

Collecting qualitative data in my study involved observing classrooms, interviewing teachers and students on a daily basis, working with students during class time, obtaining written responses to specific questions, and examining student notebooks and test papers (Erickson, 1986). Feedback from the teachers on the written reports of the study was used as another data source. From the six teachers interviewed, two teachers and their students were chosen for the case studies. As soon as possible after each lesson, observation or interview, all data were compiled into written field notes.

For the interview portion of the study, parental permission was obtained for the six students who were interviewed (See Appendix A). The Principals also gave permission for the students and teachers in their schools to be involved in my study. At both schools, the Principals requested that the schools be used as a pilot site in the study and offered to be the site for district-wide professional development. In this thesis, the schools' and students' names are not reported and any specific references to schools make use of pseudonyms.

3.8 CHAPTER SUMMARY

Chapter 3 discussed the methods necessary for the implementation of Project SMILE. A major purpose of the study was to determine the extent to which the classroom implementation of Project SMILE positively influenced the classroom environment and student attitudes toward reading, writing and mathematics. The present study combined qualitative and quantitative research methods to examine changes in attitude and learning environment among 120 fifth grade students whose teachers participated in the program.

The investigation was broken into three stages. Stage 1 deals with pre-testing both the teachers and students using the 1988 NAEP attitude survey. Stage 2 consists of the series of five professional development workshops and Stage 3 deals with posttesting the attitude survey and administering the actual and preferred forms of the MCI to the teachers and students.

Educational researchers claim that there are merits in moving beyond choosing between quantitative and qualitative methods, to combining quantitative and qualitative methods. In recent years, significant progress has been made towards the desirable goal of combining both methods within the same study in research on classroom learning environments (Tobin & Fraser, 1998). As recommended by Tobin and Fraser (1998) and Punch (1998), both qualitative and quantitative research methods were used in this evaluation of Project SMILE.

The quantitative probe was used to provide an overview of the learning environment. The MCI (Fraser & Fisher, 1983a) was used as the measure of learning environment and an adaptation of the 1988 NAEP attitude survey was used as the measure of student attitudes (Lee & Cuevas, 1991).

I chose the MCI as the measure of classroom environment (Fraser & Fisher, 1983a; Goh, Young & Fraser; Majeed, Fraser & Aldridge, 2002) because the vocabulary is well suited for the elementary school child, the responses are in a simple Yes-No format, and the answers are recorded on the questionnaire itself to avoid errors in transferring information from one place to another (Fraser, 1989).

The MCI is a one-page questionnaire that measures five scales, yet contains only 25 questions (Fraser, 1989). These scales are *Satisfaction, Friction, Competitiveness, Difficulty* and *Cohesiveness.* The MCI can also measure student perceptions of either *actual* or *preferred* classroom environment. The *preferred* form is concerned with goals and value orientations as it measures perceptions of the environment ideally liked or preferred. (Fraser, 1989) The *actual* form measures perceptions of the environment that are really happening in the classroom. Both forms were read aloud to the students in their own class setting.

Data were analyzed to shed light on the first research question concerning the reliability and validity of questionnaires. For each attitude scale, internal consistency was assessed using Cronbach's alpha reliability coefficient, whereas discriminant validity was assessed using the correlation of a scale with the other scales as a convenient index. For the actual and preferred forms of the MCI, the same two indices of internal consistency and discriminant validity were reported separately for the actual and preferred form. As a convenient index of discriminant validity, use was made of the mean correlation of one scale with the other four MCI scales. For the actual form of each MCI scale, a one-way ANOVA was performed, with class membership as the main effect, to assess the ability to differentiate between classrooms.

In order to evaluate Project SMILE in terms of its impact in the teachers' school classrooms, MANOVA and effect sizes were used in two ways. First, changes in attitudes were explored between pretest and posttest. Second, actual and preferred classroom environment was compared to see whether the teachers had achieved actual-preferred congruence in their classes in terms of dimensions of classroom environment.

One of my research questions involved associations between students' attitudinal outcomes (namely, Satisfaction from the MCI and the three scales assessing attitudes to reading, writing and mathematics) and students' perceptions on the four learning environment scales of the MCI (Friction, Competition, Difficulty and Cohesiveness). Simple correlation analysis was used to provide information about the bivariate relationship between each attitude outcome and each classroom environment scale. The multiple correlation was used to describe the joint relationship between each attitude outcome and the set of four classroom environment scales. The regression coefficient was used to describe the association between an attitude scale and a particular environment scale when the other three environment scales are mutually controlled.

Qualitative data-collection involved observing classrooms, interviewing teachers and students on a daily basis, working with students during class time, obtaining written responses to specific questions, and examining student notebooks and test papers. From six teachers interviewed, two teachers and their students were chosen to form the basis of the case studies. As soon as possible after each lesson, observation or interview field notes were written.

In conclusion, Chapter 3 described the various research methods employed to generate and analyze information to answer the research questions, the data collection, the instruments used to gather the data (including surveys, classroom observations and case studies), the stages of the study, the sample, and the qualitative investigation.

Chapter 4

RESULTS

Students achieve more when there is a
positive classroom environment.
(Barry Fraser, 1997)

This study drew on the field of learning environments (Fraser, 1994, 1998a) and was consistent with a long-standing tradition in the field of obtaining quantitative information through the administration of established questionnaires which assess students' perceptions of their classroom environment (Fraser, 1998b). Following recommendations made by Tobin and Fraser (1998), I also collected qualitative information based on observations and interviews and the interpretive techniques suggested by Erickson (1998).

This study is noteworthy because it included classroom environment variables (assessed using the My Class Inventory, MCI) as process criteria of effectiveness in evaluating SMILE. The evaluation also focused on changes in student attitudes using three five-item scales that assess Attitude to Reading, Attitude to Writing and Attitude to Mathematics, based on a National Assessment of Educational Progress (NAEP) Attitude Survey (1988). These 15 attitude items were administered both as a pretest and as a posttest to the sample of 120 elementary school students whose teachers were teaching the SMILE inservice program. The research tradition of investigating associations between student-perceived classroom environments and students' attitudinal outcomes was also implemented (McRobbie & Fraser, 1993).

This chapter discusses the results of my evaluation of SMILE using the following headings and section numbers:

4.1 Quantitative Investigation

4.1.1 Reliability and Validity of Attitude and Environment Scales

4.1.2 Changes in Student Attitudes

4.1.3 Comparing Actual and Preferred Learning Environments

4.1.4 Associations Between Attitudes and Learning Environment

4.1.5 Summary of Quantitative Research Results

4.2 Qualitative Investigation

4.2.1 Case of Tanya Robinette

4.2.1.1 Why Tanya Robinette was Chosen

4.2.1.2 Tanya Talks about her Class

4.2.1.3 How I Met Barbara

4.2.1.4 Working at Daniel Elementary School

4.2.1.5 Tanya's Concerns

4.2.1.6 The Lessons

4.2.1.7 Tanya's Perceptions

4.2.1.8 Barbara's Perspective

4.2.2 Case Study of Lisa Torrens

4.2.2.1 Why Lisa Torrens was Chosen

4.2.2.2 Lisa Talks about her Class

4.2.2.3 Observing Lisa Torrens

4.2.2.4 How I Met Mimi

4.2.2.5 Working at Tulip Elementary

4.2.2.6 Lisa Reflects on SMILE

4.2.3 Summary of Qualitative Research

4.2.3.1 Daniel Elementary

4.2.3.2 Tulip Elementary

4.3 Chapter Summary

4.1 QUANTITATIVE INVESTIGATION

As recommended by Tobin and Fraser (1998) and Punch (1998), both qualitative and quantitative research methods were used in this evaluation of Project SMILE. For a number of years, workers in various areas of educational research, especially the field of educational evaluation, have claimed that there are merits in moving beyond the customary practice of choosing either qualitative or quantitative methods and instead combining qualitative and quantitative methods within the same study (Cook & Reichardt, 1979; Firestone, 1987; Fraser, Williamson & Lake, 1988; Howe, 1988). My evaluation of the SMILE inservice program was based on four research questions, each of which is discussed in a separate section below.

4.1.1 Reliability and Validity of Attitude and Environment Scales

The first research question is as follows:

1. What is the reliability and validity of the attitude and learning environment scales used with the sample elementary mathematics students?

The attitude instrument used in the present study consists of five items that assess each of Attitude to Reading, Attitude to Writing and Attitude to Mathematics. These items were based on a NAEP Attitude Survey (1988). These 15 attitude items were administered both as a pretest and as a posttest to the sample of 120 elementary school students whose teachers were teaching the SMILE program.

Table 4.1 provides, for each attitude scale, an estimate of scale internal consistency (the extent to which items in the same scale measure a common construct) and discriminant validity (the extent to which a scale measures a unique dimension not assessed by another scale). Whereas internal consistency was assessed using Cronbach's alpha reliability coefficient, discriminant validity was assessed using the correlation of a scale with the other scales as a convenient index. Data were analyzed separately for pretest and posttest responses.

TABLE 4.1 Internal Consistency (Cronbach Alpha Reliability Coefficient) and Discriminant Validity (Correlation with Other Scales) for Attitude Scales at Pretest and Posttest

Scale	No. of Items	Form	Alpha Reliability	Correlation	
				Writing	Mathematics
Attitude to Reading	4[a]	Pre	0.54	0.00	0.74
		Post	0.42	-0.18	-0.14
Attitude to Writing	5	Pre	0.64		0.00
		Post	0.50		0.40
Attitude to Mathematics	5	Pre	0.51		
		Post	0.60		

The sample consisted of 120 students.
[a] Item 5 omitted.

When Item 5 was omitted from the Attitude to Reading scale, the alpha reliability coefficient rose from 0.54 to 0.64 for the pretest and from 0.42 to 0.60 for the posttest (Table 4.1). Although the reliability values in Table 4.1 are relatively low, they provide adequate support for the reliability of short attitude scales containing only four or five items each.

Table 4.1 shows too that, for most cases, the correlation of an attitude scale with the other two attitude scales is relatively small with the exception of Attitude to Reading with Attitude to Mathematics. This suggests that the three attitude scales are relatively independent of each other.

In terms of the reliability and validity of the MCI (My Class Inventory), the same two indices of internal consistency and discriminant validity are reported in Table 4.2 separately for the actual and preferred forms for the sample of 120 students. Alpha coefficients range from 0.51 to 0.77 for the actual form and from 0.51 to 0.89 for the preferred form. As a convenient index of discriminant validity, use was made of the mean correlation of a scale with the other four MCI scales. Discriminant validity indexes range form 0.15 to 0.28 for the actual form and from 0.06 to 0.47 for the preferred form. Overall, the data in Table 4.2 suggests that both the actual and preferred forms of MCI scales display adequate internal consistency and discriminant validity.

TABLE 4.2 Internal Consistency (Cronbach Alpha Reliability Coefficient), Discriminant Validity (Mean Correlation With Other Scales) for Actual and Preferred Forms and ANOVA Results for Ability to Differentiate Between Classrooms for each MCI Scale

MCI Scale	No. of Items	Form	Alpha Reliability	Mean Correlation	ANOVA Eta^2
Satisfaction	5	Actual	0.67	0.28	0.15**
		Preferred	0.70	0.46	
Friction	5	Actual	0.68	0.20	0.12**
		Preferred	0.70	0.46	
Competitiveness	5	Actual	0.64	0.25	0.06
		Preferred	0.74	0.42	
Difficulty	4[a]	Actual	0.51	0.15	0.13**
		Preferred	0.51	0.06	
Cohesiveness	5	Actual	0.77	0.20	0.08*
		Preferred	0.89	0.47	

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

[a] One item was omitted from the Difficulty scale.

The eta^2 statistic is the ratio of 'between' to 'total' sums of squares and represents the proportion of variance in MCI scores accounted for by class membership.

The last column of figures in Table 4.2 provides evidence about whether the actual form of each MCI scale is capable of differentiating between the perceptions of students in different classes. Ideally, students within the same class should perceive its environment relatively similarly, whereas mean class perceptions should vary from class to class. This characteristic was explored for each MCI scale by performing a one-way ANOVA with class membership as the main effect. Table 4.2 shows that all scales except Competitiveness were able to differentiate between classes. The eta^2 statistic, which represents the proportion of variance in an MCI scale accounted for by class membership, ranges from 0.06 for Competitiveness to 0.15 for Satisfaction.

4.1.2 Changes in Student Attitudes

The second research question reads as follows:

2. After the teachers participate in the professional development activities for Project SMILE, are there changes in the attitudes of students regarding reading, writing and mathematics?

Teachers attended a series of five professional development workshops lasting five full days during a ten-week period. After the first day of the workshop, I went to each teacher's classroom and administered the attitude survey to the students. After the teachers completed the SMILE professional development course, I administered the attitude questionnaire again as a posttest. Changes in student attitudes between the pretest and posttest were used in evaluating the effectiveness of the SMILE inservice program.

Table 4.3 shows the average item mean, the average item standard deviation, the effect size and the *t* test for the paired samples for differences between pretest and posttest scores on each of the attitude scales with the individual student as the unit of analysis. The average item mean (i.e. the scale mean divided by the number of items in a scale) was used to provide a meaningful basis for comparing the means of scales containing differing numbers of items.

TABLE 4.3 Average Item Mean, Average Item Standard Deviation and Difference Between Pretest and Posttest Scores (Effect Size and *t* Test for Paired Samples) for Attitude Scales for the Individual as the Unit of Analysis

Attitude Scale	Average Item Mean		Average Item Standard Deviation		Difference	
	Pre	Post	Pre	Post	Effect Size	*t*
Attitude to Reading	2.64	2.54	0.41	0.52	0.22	-1.69
Attitude to Writing	2.52	2.75	0.48	0.33	0.57	5.34**
Attitude to Mathematics	2.39	2.68	0.48	0.43	0.64	4.97**

N=120 students
** p <0.01

Whereas the results of the *t* tests provide information about the statistical significance of pre-post difference, effect sizes were calculated as a measure of the magnitude (or educational significance) of the differences. The effect size is simply the difference in means divided by the pooled standard deviation.

There were statistically significant differences (p<0.01) in student attitudes toward both writing and mathematics between pretest and posttest (Table 3). Attitude toward writing improved in its average item mean score from 2.52 to 2.75 (or an effect size of 0.57 standard deviations). Attitude toward mathematics changed from 2.39 to 2.68 (an effect size of 0.64). Attitude toward reading did not show a statistically significant change between pretest and posttest. The effect sizes of over half a standard deviation for the statistically significant changes suggest that the magnitudes of pre-post changes are educationally important.

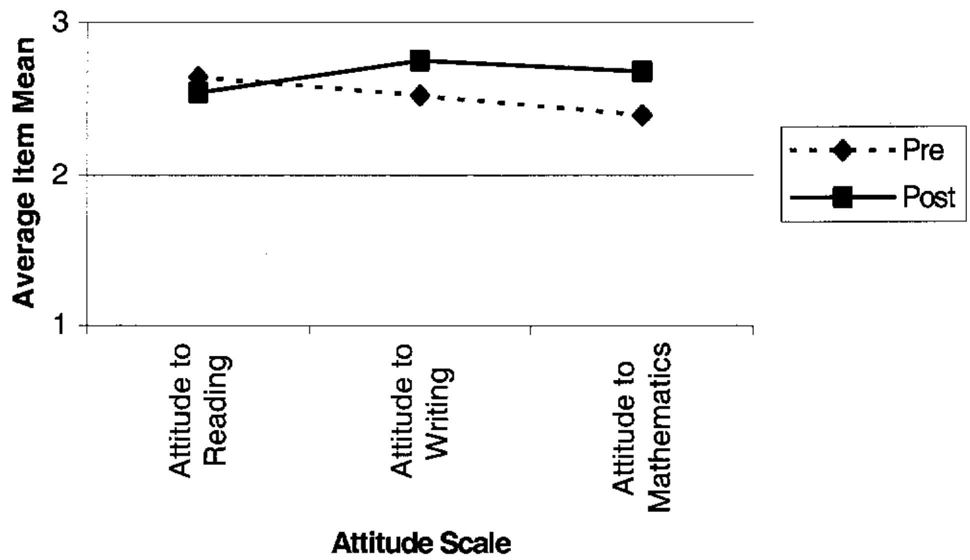

FIGURE 4.1 Changes in Student Attitudes Between Pretest and Posttest

Figure 4.1 provides a graphical representation of the means in Table 4.3 for the attitude scales. This figure illustrates how there was an improvement in attitudes to mathematics and writing between pretest to posttest, but a small and statistically nonsignificant decline in student attitudes toward reading between pretest and posttest. The positive change in student attitudes toward mathematics and writing after the implementation of SMILE was one of my goals for the program. It is my feeling that the attitude toward reading probably did not change appreciably because SMILE concentrates on weaving writing and mathematics into the reading. The children might not have known that, in essence, they were learning reading skills at the same time they were learning mathematics. Overall, the results support the effectiveness of SMILE in promoting positive student attitudes.

4.1.3 Comparing Actual and Preferred Learning Environments

The third research question is:

3. After the teachers participate in the professional development activities for Project SMILE, is there congruence between actual and preferred classroom learning environment?

In contrast to the attitude questionnaire which was administered as both a pretest and a posttest, the MCI was administered on only one occasion. However, because it was administered in both an actual version and a preferred version, it was possible to evaluate Project SMILE in terms of the degree of congruence between the actual environment present in these teachers' classrooms and that preferred by students.

Table 4.4 reports the average item mean for the actual and preferred forms of each MCI scale, together with the average item standard deviation and the difference between actual and preferred scores on each scale (effect size and results of a *t* test for paired samples). Mean scores also are graphed in Figure 4.2.

TABLE 4.4 Average Item Mean, Average Item Standard Deviation, and Difference Between Actual and Preferred Scores (Effect Size and *t* Test for Paired Samples) on each MCI Scale

MCI Scale	Average Item Mean		Average Item Standard Deviation		Difference	
	Actual	Preferred	Actual	Preferred	Effect Size	*t*
Satisfaction	2.66	2.67	0.30	0.15	0.24	0.11
Friction	2.43	2.19	0.28	0.26	0.89	-8.07**
Competitiveness	2.61	2.34	0.30	0.33	0.86	-8.08**
Difficulty	2.14	2.23	0.22	0.49	0.27	1.68
Cohesiveness	2.39	2.61	0.33	0.25	0.76	8.16**

N=120 students
** $p < 0.01$

Table 4.4 shows that students prefer a significantly more favorable classroom environment on the three scales of Friction, Competitiveness and Cohesiveness. That is, students prefer less Friction, less Competitiveness and more Cohesiveness. Effect sizes exceed three quarters of a standard deviation for these three scales. For the other two MCI scales of Satisfaction and Difficulty, differences between actual and preferred scores were statistically nonsignificant. This pattern, in which students prefer a more positive learning environment than the one perceived to be actually present, replicates prior research in other countries (Fisher & Fraser, 1983a; Fraser, 1998a).

In terms of evaluating the effectiveness of SMILE teachers in creating positive learning environments, it appears that the levels of classroom Satisfaction and the Difficulty of the work that are actually created by these teachers are very similar to the levels preferred by the students. These results provide some support for the effectiveness of SMILE.

However, relative to student preferences, the actual environment of the SMILE teachers' classrooms is perceived to have too much Friction and Competitiveness and too little Cohesiveness. One reason for this could be the high stakes testing that takes place in Grade 5 in the state of Florida. The children feel that, in order to do well on the FCAT (Florida Comprehensive Achievement Test), they must be in competition with the other students in the classroom. In turn, this competitiveness causes friction between the students. According to the results of the MCI, the children would like to be more cohesive, but perhaps this competition is causing friction between them. Overall, however, these results for Friction, Competitiveness and Cohesiveness provide some useful formative evaluative information about how to improve SMILE inservice programs by including an emphasis on the importance for teachers to increase cohesiveness and reduce friction and competition in their mathematics classrooms.

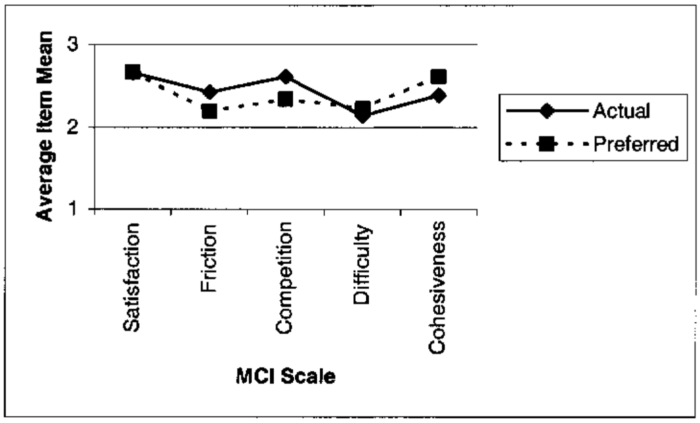

FIGURE 4.2 Average Item Mean for the Actual and Preferred Forms of MCI

4.1.4 Associations Between Attitudes and Learning Environment

The fourth research question is:

4. Is there a relationship between students' perceptions of classroom environment and their attitudes?

TABLE 4.5 Simple Correlation and Multiple Regression Analyses for Associations Between Student Attitudes and Four MCI Scales

MCI Scale	Outcome-Environment Association							
	Satisfaction		Attitude to Reading		Attitude to Writing		Attitude to Mathematics	
	r	β	r	β	r	β	r	β
Friction	-0.23*	-0.10	-0.15	-0.15	0.02	-0.15	-0.13	-0.02
Competitiveness	-0.21*	-0.06	0.01	0.11	0.07	0.01	0.10	0.01
Difficulty	-0.18*	-0.15	0.08	0.00	-0.05	0.06	0.04	-0.07
Cohesiveness	0.50**	0.44**	-0.00	-0.03	-0.08	-0.05	-0.01	-0.08
Multiple Correlation (*R*)		0.53**		0.17		0.16		0.12

*p<0.05 **p<0.01
N= 120 students.

In past learning environment research, many studies have investigated associations between students' outcomes and the nature of the classroom environment. My study followed this tradition by exploring associations between students' attitudinal outcomes (namely, Satisfaction from the MCI and the three scales assessing attitudes to reading, writing and mathematics) and students' perceptions on the other four learning environment scales of the MCI (Friction, Competitiveness, Difficulty and Cohesiveness). It should be noted that, for the purposes of these analyses, the Satisfaction scale from the MCI was conceptualized as an attitude outcome and used as a dependent variable as recommended by Majeed, Fraser and Aldridge (2002). The results are reported in Table 4.5.

The simple correlation analysis provides information about the bivariate relationship between each attitude outcome and each classroom environment scale. The multiple correlation describes the joint relationship between each attitude outcome and the set of four classroom environment scales. The regression coefficient describes the association between an attitude scale and a particular environment scale when the other three environment scales are mutually controlled.

Table 4.5 shows that there are no statistically significant associations between classroom environment and attitudes to reading, writing or mathematics. However, student Satisfaction is statistically significantly correlated with all four learning environment scales. As well, the multiple correlation between Satisfaction and the environment scales is 0.53 and is statistically significant. The regression coefficients show that Cohesiveness is a significant independent predictor of student Satisfaction when the other environment scales are mutually controlled.

Overall, the results in Table 4.5 suggest that student Satisfaction is higher in classes that have a more favorable classroom environment in terms of less Friction, less Competition and, especially, more Cohesiveness. However, Cohesiveness is the strongest independent predictor of student Satisfaction. In other words, the better the children feel that they get along with each other, the more satisfied they are with the classroom setting. Based on this finding, I surmise that children need to have a reasonable level of Cohesiveness in the learning environment in order to experience satisfaction.

4.1.5 Summary of Quantitative Research Results

The purpose of my research was to investigate if implementing SMILE positively influenced the classroom environment and student attitudes. Based on a sample of 120 elementary school students in Florida, classroom environment scales (based on the MCI) and attitude scales (based on the 1988 NAEP Attitude Survey), displayed adequate internal consistency reliability and discriminant validity for both the pretest and posttest for the attitude questionnaire and for both the actual and preferred versions of the MCI.

When pretest-posttest changes in students' attitudes were analyzed, statistically significant differences and appreciable effect sizes were obtained for attitudes to mathematics and reading. This finding supports the effectiveness of Project SMILE in promoting positive student attitudes.

For the purposes of evaluating the effectiveness of SMILE teachers in creating positive learning environments, I compared actual and preferred scores on the MCI. The levels of classroom Satisfaction and the Difficulty of the work that were actually created by these teachers was found to be very similar to the levels preferred by the students. Given that many studies internationally have established a pattern in which students' actual classroom environment falls short of their preferred environment

(Fraser, 1998a), the similarity of actual and preferred scores for Satisfaction and for Difficulty provides positive support for the effectiveness of SMILE.

However, relative to student preferences, the actual environment of the SMILE teachers' classrooms was perceived to have too much Friction and Competition and too little Cohesiveness. One reason for this could be the high stakes testing that takes place in Grade 5 in the state of Florida. That is, the children would like their classrooms to be more cohesive, but perhaps this competition is causing friction between them. These findings suggest the desirability in revising SMILE in ways that help teachers to create classroom environments that are more cohesive, less competitive and have less friction.

As in considerable prior research (e.g. Fraser, 1998a; McRobbie & Fraser, 1993), I explored associations between students' attitudes and their perceptions of actual classroom environment. As dependent variables, I used not only the three NAEP attitude scales for reading, writing and mathematics as dependent variables, but also the Satisfaction scales from the MCI as recommended by Majeed, Fraser and Aldridge (2002). The other four MCI scales were used as independent variables. Only student satisfaction was found to be significantly related to the student-perceived learning environment on the MCI. In particular, student satisfaction was high in cohesive classrooms.

Overall, the quantitative data provide relatively strong support for the effectiveness of the innovative SMILE program. However, in my opinion, the quantitative data alone were not enough to answer my research questions sufficiently. Therefore, I also employed qualitative data using case studies and interviews. The qualitative data are reported in the following section (4.2).

4.2 QUALITATIVE INVESTIGATION

Both quantitative and qualitative data were employed in the evaluation of Project SMILE. Significant progress has been made toward the desirable goal of combining methods in research on classroom learning environments (Fraser & Tobin, 1991; Tobin & Fraser, 1998). In the relatively new and rapidly-growing field of classroom learning environments, studies involving qualitative methods have provided rich insights into classroom life (Fraser & Tobin, 1991; Rutter et al., 1979; Stake & Easley, 1978; Tobin & Fraser, 1998).

Participant observer data-collecting strategies were employed to some extent in my study (Erickson, 1998). These involved observing classrooms, interviewing teachers and students on a daily basis, working with students during class time, obtaining written responses to specific questions, and examining student notebooks and test papers. Feedback from the teachers on the written reports of the study was used as another data source. As soon as possible after each lesson, all data were compiled into written field notes. Student work samples were also utilized in the compilation of qualitative data.

Six students and six teachers were interviewed privately using the NAEP Attitude Survey items used in the present study as a basis for designing interview questions. The teachers and students responded to nearly the same survey. For example, the students responded to the statement "I like mathematics", whereas the teachers responded to the statement "I like TEACHING mathematics". There were five statements for each of three different subjects – reading, writing and mathematics. I chose to survey the students and teachers about their attitudes toward reading and writing, as well as toward mathematics, because the basic premise of both SMILE and Project CRISS is to teach reading and writing through content area subjects. The statements were read aloud to the students and teachers individually and their responses were tape recorded and transcribed. The teachers collected student work samples as proof that the teachers were implementing the program in their classrooms. Findings based on qualitative information are summarized in the following sections using case study methods as described in Chapter 3.

In particular, the following case studies focus on Mrs Tanya Robinette and her student, Barbara, and Ms Lisa Torrens and her student, Mimi. Tanya teaches at Daniel Elementary and Barbara is a student in her homeroom class. Lisa teaches at Tulip Elementary and Mimi is in her homeroom class.

4.2.1 Case Study of Tanya Robinette

Section 4.2.1 concerns the case of Mrs Tanya Robinette and her student, Barbara. Mrs Robinette is a veteran teacher who loves to teach mathematics. Her student, Barbara, does not like mathematics and is not afraid to verbalize this fact to anyone she meets.

4.2.1.1 Why Tanya Robinette was Chosen

Upon the request of the Principal, I visited Daniel Elementary three times to help the faculty textbook committee select a new mathematics textbook. Tanya was a member of the textbook adoption committee. After viewing the 13 state-adopted textbooks, the Principal, Tanya and I were convinced that the research-based textbook would be the perfect book to implement. Tanya did not like to use a textbook, but she felt that other, less-experienced teachers, should have one. She was also interested in taking inservice courses to improve her teaching and willing for the students in her classroom to pilot mathematics lessons. Therefore, I asked Tanya if I could use the children in her classroom to test some of my SMILE lessons. She agreed. She also agreed to participate in the SMILE inservice workshop.

Tanya Robinette teaches Grade 5 mathematics at Daniel Elementary School located in a large, urban school district in the Southeast of the USA. The district has the highest percentage of Spanish and Haitian-Creole Limited English Proficient (LEP) students in the state. This is Tanya's 26^{th} year of teaching. She has been at Daniel for her entire teaching career. For the past two years, the school used a research-based mathematics program from the University of Chicago. That is not the sole program that Tanya uses. Experience has taught her that there is good in any program. She finds new lessons and strategies and uses them when teaching children. She attends at least two mathematics workshops per school year. She says that she is always looking for 'the program' to implement so that she won't have to write every lesson herself.

Tanya is not bilingual. When she began teaching at Daniel, this did not pose a problem, but now it is necessary for a translator to be present during parent conferences. Nearly half the parents do not speak English. She is also finding that children are bringing in other strategies for learning mathematics from their home countries. Tanya used to say: "My way is the right way and it's the only way." Now, she is learning other strategies to help her children.

I interviewed six teachers and six students before and after the inservice program. I also taught three lessons in each classroom. Each person was privately interviewed in the school setting. I took notes and tape-recorded each interview.

4.2.1.2 Tanya Talks about her Class

Tanya does not like to teach reading or writing, yet she feels that she is good at teaching reading and writing. She thinks that, if she tried, she **could** teach reading and writing well, but she has always loved teaching mathematics. She thinks that teaching writing is boring and difficult. She was thrilled when the Principal asked her if she would like to departmentalize the fifth grade (i.e. have each teacher teaching only one subject instead of all the subjects in the elementary curriculum). At Daniel Elementary, the students have four different teachers for the four subjects in the curriculum (mathematics, science, social studies and language arts/reading). Tanya now teaches mathematics to one half of the students at Daniel and lessons to the entire grade level once a week.

Tanya loves to teach mathematics and is good at teaching it. She believes that everyone can teach mathematics well if they try. Teaching mathematics is not boring or hard. She uses the required mathematics textbook as a reference. She is required to use the assessments from the research-based mathematics textbook. She said that it is difficult for some veteran teachers to use the new text, but she found it challenging and fun to teach. She felt that this text exemplifies the way in which mathematics should be taught. She did caution that she did not teach the textbook page by page. She uses the textbook about half of the time. For the rest of the lessons, she teaches material from a variety of other programs.

Tanya's classroom is aesthetically pleasing. She has mathematics-related bulletin boards, the manipulatives are easily accessible, children's work is displayed, and the children are engaged in learning activities. The 42 desks are in straight rows. I suggested that Tanya move the children into groups. She declined at this point because she said that this was the beginning of the year and that all of the children did not have self-control.

I observed Tanya teaching a lesson on the addition of fractions with unlike denominators. She demonstrated how to solve the algorithm procedurally. The children looked perplexed. Eleven of the children raised their hands for help. Using the blackboard, Tanya solved example after example in this same manner. One child asked if there was another way to do the problem. Tanya responded: "No, this is the only way. You must learn it this way because it is on the test." After doing 20 examples at the board, she gave the children a written assignment. "Open your books to page 221 and do numbers 1 to 25." The children all opened their books. They all attempted to do the first problem. Some of the children attempted to complete the assignment, while others called "Mrs Robinette" over and over again seeking help. Tanya walked around helping individual students. Most of the children did not understand how to begin, much less complete, the assignment.

4.2.1.3 How I Met Barbara

The first day I observed Tanya teaching mathematics, she introduced me to the students in her classroom. She explained that I was doing research and that I would be observing and teaching the class throughout the semester. The minute that Tanya was finished introducing me, a girl ran up to me, gave me a big hug and said: "My name is Barbara and I hate mathematics." She also said that she was the only one in the class who had a 'D'. The teacher later verified that fact. Barbara walked back to her seat in the back of the room and seemed to listen to Tanya attentively during the lesson. Upon receiving the assignment, Barbara immediately put her head down. I walked over to her and asked if I could help. She said: "I can't do this because I am the dumbest one in the class." I knew, at this point, that Barbara would be the subject in my case study.

Barbara, a fifth grade student at Daniel Elementary School, was excited about being interviewed. At the onset of the interview, she again told me how much she hated mathematics and how dumb she was in mathematics. I started the interview. She told me that she loves to read. She reads approximately seven books per week. She loves to read any kind of book. She believes that anyone can read well if they try. Reading is never boring to her and she says that, if reading is boring to other children, it is because they just don't want to read. Reading is not hard for Barbara. She usually gets a 'B'. She said that she gets a 'B' and not an 'A' because she doesn't hand in her written assignments.

Barbara also likes to write. She once wrote a story about ketchup falling in love. She thinks that she is good at writing. She also thinks that everyone can write well if they try. Writing is not boring for her and it is not hard. For fun at home, she writes stories on the computer. Her mother gave her a book of story starters and she loves to write and illustrate the stories on her computer.

Barbara has never liked mathematics. Because it was early in the year, she was not sure if she liked mathematics in fifth grade or not. She said that she had to find out how the teacher was before she could make up her mind. She remembers when she first started hating mathematics. It was in first grade. She said that, because she did not know her addition and subtraction facts, she was put in the "dumb class". Ever since then, she has hated mathematics, especially computation.

She thinks that she would like to do mathematics if she could relate it to things that she likes to do in real life --- like shopping!

After this initial observation day, the SMILE workshops began with Tanya Robinette in attendance.

4.2.1.4 Working at Daniel Elementary School

All fifth grade students at Daniel Elementary School spent one hour per week in a whole-group lesson. These classes were held in the cafeteria. Tanya Robinette taught one new mathematics concept per week to 150 students. The children sat at cafeteria tables using only paper and pencil. Tanya taught the lesson using an overhead projector while the children took notes. Three teachers and three paraprofessionals (teacher aides) served as monitors to assist children. The children worked diligently throughout the one-hour session. About every 10 minutes, Tanya would choose a child to come to the overhead projector and explain an answer to the rest. When Tanya was asked who decided to have these sessions, she told me that the teachers decided to do it this way because all the children would then get the same instruction on the most difficult topics of the FCAT (Florida Comprehensive Assessment Test). Because Tanya was the mathematics expert, she taught the group lessons and the other teachers taught follow up lessons in their own classrooms. These classes were held weekly from the first week of school until the week before the administration of the FCAT.

If these were the most important concepts on the FCAT, why weren't they being taught using hands-on activities? I hoped that this would change after Tanya had completed the SMILE training.

4.2.1.5 Tanya's Concerns

After observing the group lesson, Tanya and I spoke privately. The use of manipulatives and children's literature are the main emphases of the SMILE workshops. Mrs Robinette expressed the desire to use manipulatives, but found the children to be too disruptive and out of control. This is also the reason why she had the children put their desks in straight rows. She was also afraid to use children's literature as an introduction to a mathematics lesson. She said that the children thought that these books are "baby books". We discussed this problem and I told her that, after I taught three lessons in her classroom, I hoped that she would feel more confident and **try** to incorporate these activity-based strategies into her daily lesson plans.

4.2.1.6 The Lessons

The first lesson that I taught, *Data Analysis for Chocolate Lovers*, introduced the children to mean, median, mode, theoretical and actual probability, and the relationship between circle and bar graphs. I used M & Ms to help to illustrate the concepts. The first thing that I asked the children to do was to move their desks into groups of four. They were told that they must work with this group, and there would be no exceptions. I gave the students markers, scissors and glue to use. The children seemed surprised that they would use art supplies in mathematics class. I had to go over my rules for the use of these things.

I taught my lesson on *Mean, Median and Mode.* I read the story *Mrs Mean, the Math Teacher* by Gretel Mink. This story was written by Gretel to help her to remember the definitions of mean, median and mode. After I read the story, the children played a chocolate trivia game. The children read facts about chocolate.

They were asked to estimate the answers, analyze the responses and find the mean, median and mode of their set of numbers. We discussed the estimates and I gave the correct answers for this chocolate trivia.

The children were then given a cup of M & Ms to count and to make a bar graph of the frequencies of the different M & M colors. The bar graph is then turned into a circle graph. We then began to discuss theoretical and actual probability. The children experimented with replacement probability using ten M & Ms. The children recorded 100 trials of drawing the candy from a cup, recording the color and placing the candy back in the cup for the next draw. The results were recorded and conclusions were drawn. We discussed the findings. This lesson took two hours for the students to complete. There was not one discipline problem. I administered a written assessment the following week. The scores ranged from 92% to 100%.

I watched Barbara throughout the lesson. She seemed confident that she could complete the lesson. As I monitored the progress of the lesson, I kept my eye on Barbara. She did not ask questions. Her group worked well together. She got 99% on her assessment. She brought her test to me to see.

4.2.1.7 Tanya's Perception

After watching me teach the first lesson, Tanya wanted to try to use manipulatives. She "forced" herself to use manipulatives to teach a lesson once a week. She later told me that by the end of the year, she was using manipulatives at least two times per week.

Tanya had also been afraid to use a children's literature book as an introduction to a mathematics lesson. I introduced my third lesson with Eric Carle's *The Hungry Caterpillar.* Tanya observed how a primary (K-2) book could be used to teach higher-level mathematics. She saw how the children were engaged in the lesson. Not one child made 'a baby book' comment. She asked me to observe her teaching a lesson on the concept of elapsed time. She introduced the concept using Eric Carle's *The Grouchy Ladybug*. This, too, is a primary (K-2) book. Tanya thought that the children would laugh at her when she read *The Grouchy Ladybug*, but when the children realized they would get to make their own clock, they had a different attitude about the story. She saw that the children were actually learning something from 'the baby book'. Tanya said that she was now ready to incorporate children's literature and manipulatives into every concept that she taught.

4.2.1.8 Barbara's Perspective

I taught three lessons to Barbara's class. At the end of the ten-week period of time, I asked Barbara the same questions about mathematics again. I asked her if she liked mathematics and she said: "Yes, when you read the mathematics books and we get to do the activities that go along with the story." When asked if she was good at mathematics, she said that, as long as she didn't have to do fast computation, she was pretty good. She was good at figuring out problems if she had to do so. She said that she could still see her first grade teacher yelling at her because she was dumb, but she knew now that she wasn't dumb in mathematics. Mathematics was no longer boring when I was there doing a lesson. She said that her teacher was doing more and more fun things instead of lecturing. I asked if she was still getting a 'D' in mathematics and she said that she was now getting a 'B'. I followed Barbara's progress throughout the rest of the year. Her mathematics grades for each quarter of the year were 'D', 'B', 'B', and 'A'. I visited Barbara during the last week of school. She came running up to me again. She said: "Thank you for not letting me be dumb in mathematics.

You know, I still remember the M & M mathematics. I think my favorite subject in high school will be statistics." I said to myself: "Success". I felt that because Tanya and I had introduced Barbara to a new way of learning mathematics, we had made a positive change in her attitude toward the subject. In the following section (4.2.2), we find the case involving Ms Lisa Torrens, who was afraid to teach mathematics and her English language deficient student, Mimi.

4.2.2 Case of Lisa Torrens

Lisa Torrens is a beginning teacher who does not like to teach mathematics. This is due to the fact that she did not have a good background in mathematics. Mimi is her student. She is non-native English speaker. She grew up in South America. She **could** have been a good mathematics student. However, in South America, she learned to compute algorithms using different methods than her North American teachers. Therefore, she feels like she is not good at mathematics.

4.2.2.1 Why Lisa Torrens was Chosen

Lisa was a participant in the New Teacher Mathematics and Science Institute workshop that was held in the summer of 1999. (This institute is held for first-year and/or second-year teachers who would like to upgrade their content knowledge and pedagogical skills in mathematics and science.) She had just finished her second year of teaching. She was sullen and told the person sitting next to her that she was forced to attend the workshop by her Principal and that she needed the stipend to pay her property taxes. She appeared to be disinterested in mathematics, and she did not participate or volunteer answers. She seemed shy and reserved. Her attitude changed by the end of the institute. When evaluating the institute, she wrote: "I hated mathematics until I took this workshop. I wish that you had been my teacher in elementary school. Everyone in the United States should be required to take this workshop. Please include me in any workshops in the future." After reading her evaluation, I felt that her seemingly nasty attitude was in essence 'Math Phobia'. As I spoke to her individually, she seemed very confident about her teaching skills in the subjects of reading/language arts, but she avoided teaching mathematics at all costs. At this point, I concluded that Lisa would be the perfect candidate to attend the SMILE inservice course. I asked Lisa if she would be interested in the training. She seemed excited and said that she would ask her Principal. She attended the first series of SMILE inservice workshops.

Lisa Torrens teaches Grade 5 mathematics at Tulip Elementary School located in a large, urban school district in the Southeast of the USA. This is Lisa's third year of teaching. She has been at Tulip her entire teaching career. The teachers use a traditional textbook for mathematics instruction. This textbook is the sole mathematics program at Tulip. Lisa is required to use this textbook along with its teacher support materials (worksheets). She teaches from the textbook page by page. Her preservice (college) experience in mathematics consisted of one mathematics methods course.

Lisa is bilingual. She speaks both English and Spanish fluently. Because 58% of the children at Tulip are Black-American, it is not a necessity for the teachers there to be bilingual. Tulip is a Title 1 school. Title 1 schools are given extra Federal monies to help lower-income children to achieve by reducing class size and receiving more educational materials. Ninety-eight percent of the children in the school receive free lunch, which the Federal government provides for students from low-income households (OEEMA, 2000). All of the children in Lisa's class receive free lunch.

At Tulip Elementary, the parents leave the teaching to the teachers. Lisa gets support from home for discipline problems, but most of the parents do not have enough formal education to help the children with reading or mathematics homework.

4.2.2.2 Lisa Talks about her Class

Lisa likes to teach reading and writing and she feels that she is good at teaching reading and writing. She thinks that teaching reading and writing is not for everyone. She says that she had better preservice training in the methods of teaching reading and writing and that is why she feels more confident about teaching these two subjects. She thinks that teaching writing is never boring or difficult. She said that, even though about half of her children read at a second-grade level, she is confident that she can help the children to learn to read.

Lisa hates to teach mathematics, but she tries to do a good job at teaching this subject. She said that, if there were less time in the school day, she would skip mathematics. She would then concentrate on teaching reading and writing for the entire day. She believes that teaching mathematics is not easy for everyone. Teaching mathematics is not boring, but it is difficult to teach. She uses the required mathematics textbook because she knows no other way to teach mathematics. She explained that her mathematics methods class in college was terrible. It was not practical. The students in the class memorized everything. The college professor concentrated on computation and the content of mathematics, but not pedagogy.

When Lisa was in high school, she did poorly in mathematics. She attributes this to the fact that she did not like mathematics. It was too abstract for her. She had difficulty in memorizing all the formulas in Algebra. She felt stupid. The teacher reprimanded her for not memorizing the formulas. She liked geometry because the teacher respected her as a student. While taking geometry, she gained some confidence and an improved attitude toward mathematics. However, she feels that her experience in high school algebra affected the way she teaches mathematics in a positive way. She doesn't want any child in her classroom to feel stupid like she did.

Lisa feels comfortable teaching mathematics to children in Grades K-2. When the Principal asked her to teach fifth grade, she was horrified. She said that she panicked. She told me that she knew that she was not stupid, but just plain scared.

4.2.2.3 Observing Lisa Torrens

I began observing at Tulip in Lisa's Grade 5 classroom. During the first observation day, Lisa introduced me to the class. She explained that I was doing research and that I would be observing and teaching the class several days throughout the semester.

Lisa's portable classroom was aesthetically pleasing. Her room was separate from the main school building. She liked it that way because she didn't feel like there was anyone watching over her shoulder. She said that she could teach in the way in which she felt comfortable without worrying about a school administrator watching her every move.

The school is not as well maintained as Daniel Elementary. Lisa said that she wanted to keep her classroom looking nice because the children do not have beautiful things at home. She had one mathematics-related bulletin board. She had a number line. The majority of the room was decorated with reading materials. The 32 desks were placed in groups of four. Lisa teaches activities in cooperative groups at least twice a week.

Upon my arrival, Lisa was teaching a mathematics lesson on subtraction with regrouping. She demonstrated on the chalkboard how to solve the algorithm, procedurally. The children listened attentively. The children were asked to complete an assignment consisting of 30 subtraction problems. They complained that there were too many problems. Lisa responded: "But you need to practice these problems." One child asked Lisa if they had to regroup all of these problems. She responded: "I think you regroup most of the problems." The children began working. Lisa sat down at her desk. No one asked Lisa for help. I was curious to see what scores the children got on this assignment. Most of the children answered the 'regrouping' problems correctly, but tried to regroup the problems that did not need regrouping. Sixty-two percent of the children failed the written assignment.

4.2.2.4 How I Met Mimi

Mimi was a fifth grade student at Tulip Elementary in Lisa Torrens' class. She was a quiet, withdrawn child. As I did my first observation, I was intrigued by the fact that Mimi sat quietly during the entire lesson. She did not wiggle and squirm as did many of the children. She appeared to understand everything that she was being taught. When she was given the assignment, she began writing immediately. She worked by herself. There was no interaction with other children. I chose Mimi for this case study because she seemed to provide an interesting contrast with Barbara from Daniel Elementary. When I consulted with Lisa about which child would be the best to interview, she immediately suggested Mimi.

Lisa said that Mimi was good in mathematics, but rarely said anything in class. She was one of three Hispanic children in the class. As I looked at Mimi's portfolio, I found neat, well-written work. She seemed to be a perfectionist. Her mathematics papers received higher scores than did her reading/language arts. I approached Mimi and asked her if she would like to help me with my mathematics class. She seemed excited that I chose her. I gave her the parent permission slip and told her that I would return tomorrow to speak with her.

I returned the following day to interview Mimi, who was not sure if she liked to read. She was not sure if she was good at reading. She did not speak English until Grade 2. She did not feel that she could read well until she was in Grade 5. She believed that everyone can read well, if they try, and she thought that reading was boring **unless** the book is an adventure book. Reading was not difficult for her. She spoke English with a slight Spanish accent, but still felt that she was better at reading and writing English than speaking it.

Mimi was a confident writer. She got a '5' on last year's state writing test. She said that this was the highest in her class, but there were two '6s' in the other class. She was very proud of herself. She felt that she was a good writer. She didn't believe that everyone can write, even if they try. Writing was not boring or difficult and she says that, in order to write, kids must be able to read and have good handwriting. She liked Ms Torrens teaching reading and writing most of the day.

Mimi did not like mathematics and did not feel that she was good at mathematics (Ms Torrens disagreed with Mimi). She felt that mathematics was not for everyone. Sometimes mathematics was boring and hard. Homework is especially boring to Mimi. She was taught different ways to solve computation problems before she came to the United States and she didn't like that she now had to solve the problems in the teacher's way. In fourth grade, she solved a problem using a different method from the teacher's. She got the right answer and the teacher marked the answer wrong. That bothered her. She said she confronted the teacher and was told:

"In my class, you have to do it like it is in the book." Mimi said that she didn't like that teacher after that, but did not let her know.

Since first grade, she was good at computing but, because she did not speak English well, the teachers assumed that she could not solve algorithms. She did not think that mathematics should be from the book only. She said that she did not like doing so many problems from the mathematics book. Sometimes she wondered why she had to solve all of those problems when she already knew how to do them.

I asked Mimi if she had friends in the class. She said that she did now but, when she first arrived at this school, she sometimes could not get the English words right and the other children laughed at her. This was no longer a problem. Most of the kids knew that she was good at mathematics and would go to her for help. She said that, in Grade 4, the teacher did not let her help the others because she didn't always solve the problems using the teacher's procedures. The teacher told her that the right way was the way the problems were solved in the mathematics book.

A week after this first observation, Lisa Torrens began the SMILE inservice workshop.

4.2.2.5 Working at Tulip Elementary School

I began teaching lessons at Tulip Elementary three weeks after I started at Daniel Elementary. I told the Principal of Tulip about the group lessons being taught at Daniel Elementary. The Principal loved the idea, but he felt that the lessons should be hands-on and activity-based. It was important to him that the children interact with the teachers and other students. The Principal scheduled weekly group lessons to be held in the school cafeteria. Each teacher was asked to design two hands-on, activity-based lessons that they would teach to the entire group. There were 180 students in the cafeteria with four teachers and four paraprofessionals (paid teacher helpers). The Principal and/or Assistant Principal helped to supervise the children. The lessons were well-taught and well-received by the students. The teachers were asked to do follow-up lessons in their own classrooms. Lisa Torrens was the only teacher who did *documented* follow-up.

I taught the same lessons at Lisa Torrens' class as I did in Tanya Robinette's class. These lessons were part of the --*Math for Chocolate Lovers* and *Bug Out on Math* units from SMILE. At first the children thought that they could play around and not pay attention. They soon found that, if they paid attention, they could learn new things in mathematics, and it was fun. The children were not afraid to interact with me. I did not have to **train** the children to work with manipulatives because they were trained by the teachers during the group lessons.

When the lessons were taught in Lisa's class, Mimi ignored me. She did not volunteer answers but, when no-one else knew the answer, I called on Mimi. She knew the correct answer five times out of five. At first, she was hesitant to answer, but the other children began to admire her for her answers. One day, when no-one else could answer, a child interjected: "Ask Mimi, she'll never raise her hand, but I know that she knows." At the end of the third lesson, I saw Mimi starting to interact with the rest of the children.

Mimi was interviewed again at the end of the year. She told me that she liked mathematics and was good at it. She thought that **most** kids could do well if they tried. Mathematics was not boring if it was half computation and half fun. She did not like the group lessons because the other kids did not behave when the Principal was not in attendance. She said that she had always earned a good grade in mathematics, but finally she understood what mathematics was all about and thought that mathematics was fun. She said that the books that Ms Torrens read before each new lesson helped her to get interested in mathematics. Her favorite lesson was the chocolate trivia.

During the final interview, Mimi was proud to say that she had more friends than at the beginning of the year. She thought everyone in the class liked her now, even the boys! She attributed this to the fact that she helped them with their mathematics work. She thought that the other kids did not even know who she was until I started coming to the class. She said that she is proud that Ms. Torrens relies on her to help children who are having trouble in mathematics. She was proud of herself. Mimi's FCAT score in mathematics was level 5. This was the highest possible score. Her Grade 5 mathematics grades were consistently 'A's.

4.2.2.6 Lisa Reflects on SMILE

I went to Tulip Elementary and spoke with Lisa four weeks after the close of the SMILE inservice course. We discussed what was happening at the school. She said that the teachers continued to teach group lessons each week. This was because the Principal forced them to continue. Lisa said that she was trying to implement SMILE strategies. Lisa found that finding literature connections for her mathematics lessons was not as difficult as she originally thought. She said that the kids liked mathematics more now that she introduced each new concept with a book. She apologized for continuing to use the textbook almost every day, but that she was trying to wean herself away from it. Lisa was happy with the attitude of the children towards mathematics. They seemed much happier in her classroom. Some parents told her that they could see the difference in the attitude of their children toward school. She thanked me because she said that it was because she was teaching **children** now, not the textbook.

After she was shown the results from administering the My Class Inventory, she now understands how children learn and how the children perceived the *preferred* classroom. She was trying to change the classroom environment to meet the needs of the children.

Before SMILE, the only way Lisa knew how to teach mathematics was page by page from the textbook, and the first thing she eliminated from her daily schedule was mathematics. Now, she infused mathematics into her reading time and teaches longer periods of mathematics every day. She now had the confidence and knowledge to teach these fifth graders mathematics. The activities from SMILE helped her to infuse the principles and strategies into all mathematics lessons. She says that she forced herself to make one lesson a week hands-on. She now teaches two or three activity-based lessons per week. She opens each new concept lesson with a children's literature book. She said that activities from SMILE inspired the children and herself as well. She said that both she and the children were now "Mathematics Maniacs". She loved to teach mathematics and the children loved to learn.

I interviewed Ms Lisa Torrens again using the same questions from the NAEP attitude survey. Her responses regarding reading and writing remained the same. She always loved teaching these two subjects and she said that she always would. However, after the SMILE inservice program, she now finds that she teaches at least one third of her mathematics through reading and during her reading time. She felt that no matter what the outcome of the annual achievement tests were, she was pleased with her own change in attitude toward mathematics. She said that the children no longer felt that mathematics was boring.

Lisa was excited to tell me about an incident that had happened in her classroom recently. The children in Lisa's classroom were playing a mathematics game. The Principal came in to observe the students. He asked a child what he was doing. The child told him that they were playing a game and they were not doing any work. The Principal began laughing. He later told Lisa that the children were actually doing complicated multi-step computation problems and they thought they were only playing a game. He was amazed at this. She told the Principal that this is one of the games that she had learned in the SMILE inservice course. He told her that this was the only time he had seen children having so much fun doing higher level mathematics. He asked her to help the other teachers to reinforce the SMILE principles and strategies. She told him that all of the Grade 5 teachers were now excited about using the SMILE strategies in teaching mathematics.

She suggested to the Principal that the teachers be given a refresher class in the fall to get everyone to begin the new year the right way. At first, the Principal was apprehensive about Lisa's suggestion only because one teacher asked: "Will there be a SMILE 2? We are almost out of activities." He asked that his teachers have a refresher class and be instructed on **how** to infuse the principles and strategies of SMILE into their own lessons. The fifth grade teachers knew how to do this because they were forced to write the group lessons. The rest of the teachers were teaching the activities, but not designing new ones. He suggested that the fifth grade teachers act as mentors to the other teachers after the refresher training. He was assured that his teachers would get additional instruction during the next school year.

The Principal also decided to change Lisa Torrens from teaching Grade 5 to Grade 4 for the upcoming school year. He told Lisa that this was because the teaching emphasis in fourth grade is on reading, writing and mathematics and that he was aware that Lisa loved teaching reading and writing. He felt that her experience in SMILE would help her to write lessons that integrate reading and writing with mathematics. Another reason why he made the decision was that because he loved the lessons that she had designed for the Grade 5 group.

Lisa was looking forward to teaching mathematics for the first time in her career as an intermediate (Grade 3-5) teacher. She, too, was disappointed in the school-wide grade, but she was happy about her change in attitude toward mathematics. A summary of the qualitative research is found in the next section (4.2.3).

4.2.3 Summary of Qualitative Research

The qualitative information supported the patterns of results from the questionnaires and enhanced my understanding of how Project SMILE operated to enhance students' classroom environment and attitudes toward reading, writing and mathematics. Pretest-posttest changes in students' scores on an attitude questionnaire showed positive changes in student attitudes toward both writing and mathematics. Qualitatively, Lisa summed up how she and her students felt about Project SMILE: Activities from SMILE inspired the children and herself as well. Both she and the children were now 'Mathematics Maniacs'. She loved to teach mathematics and the children loved to learn.

A summary of the qualitative research is provided for Daniel Elementary in section 4.2.3.1 and for Tulip Elementary in section 4.2.3.2.

4.2.3.1 Daniel Elementary

I went back to Daniel at the end of the school year. The FCAT scores had just been announced. The school had gone from a 'C' to an 'A'. I asked Mrs Tanya Robinette the same questions that I had asked prior to the inservice program. She had a different attitude toward the teaching of reading and writing. She said that she would now like to teach reading and writing—but only through mathematics. She still thought that she would find it boring to teach reading and writing if she didn't integrate it into her mathematics, but that she would teach reading and writing if she was forced to do so. She said that, for next year, she would start using manipulatives for the group lessons. Her concern was that the Grade 4 teachers didn't really concentrate on mathematics because the children were tested only in writing and reading. They really didn't do much mathematics until *after* the FCAT was over at the end of March. She suggested to the Principal that all of the teachers take the SMILE inservice program during the next school year. I asked her if she thought that the SMILE inservice program was the main factor in raising test scores. She said that she thought that it was one of them: "SMILE, the new text, the group lessons and the departmentalization of the fifth grade all contributed to the achievement scores going up."

My quantitative data show that changes in attitude toward mathematics between pretest and posttest were statistically significant and positive. Tanya said that she felt that the most salient changes were in student attitudes toward learning mathematics and the classroom environment. This is a good example of the qualitative data supporting the findings of the quantitative data.

During the following year, all of the teachers at Daniel Elementary School took part in the SMILE inservice program. The next section (4.3.2) discusses the impact that SMILE had on the teachers and students of Tulip Elementary.

4.2.3.2 Tulip Elementary

The entire staff of Tulip Elementary were extremely disappointed when the FCAT scores were announced. Some gains were made in both reading and mathematics, but not enough to improve the letter grade of the school (OEEMA, 2001). The Principal felt sure that the grade would go up the following year because he had noticed a change in attitude in his teachers. They no longer were resistant to changing their teaching style. There was more critical thinking going on in the classrooms. They seemed to be enjoying the time which they spent teaching mathematics. He observed that the textbook was no longer the only source for teaching mathematics.

After speaking with Lisa and her Principal, observing and teaching the children in her classroom and administering the posttest of the attitude survey, I was pleased with the outcome. Before Lisa was enrolled in the SMILE inservice program, she hated teaching mathematics and the children hated learning mathematics. Lisa's teaching was rote and methodical. The children were instructed on a concept, did practice from the textbook, did countless computation problems and took an assessment over the concept. The same routine was followed day after day. Over half of the children failed each assessment. After Lisa had completed the SMILE inservice program, I observed Lisa and the students in her classroom enjoying mathematics. Sometimes the children did not realize that they were actually doing mathematics.

After looking at Lisa's student work samples and assessments in mathematics, we discovered that her children were doing better academically after implementing SMILE. Before implementing SMILE, only 35% of the students were attaining a score of over 80% on all mathematics assessments. After implementing the SMILE strategies, 85% of the students were attaining a score of over 80% on the assessments

After compiling the data from the interviews and work samples, I found a common thread beginning to take place at Tulip Elementary. Lisa Torrens, the children in her class and the Principal of the school all agree that SMILE helped promote positive changes in students' attitudes and in the classroom environment. In the words of every child in Lisa's classroom: "Math is Fun". Other positive changes seemed to be taking place at Tulip Elementary: Lisa learned how to infuse children's literature into every mathematics lesson, she was no longer afraid to teach mathematics, she began using the findings of the MCI to enhance the classroom environment, the children seemed excited about learning mathematics and the Principal wanted to expand SMILE program. A summary of Chapter 4 is discussed in the following section (4.3).

4.3 CHAPTER SUMMARY

This chapter reported the results of the study which used both quantitative and qualitative methods, as recommended by Tobin and Fraser (1998), in evaluating SMILE, especially in terms of its effectiveness in promoting positive student attitudes and a favorable classroom environment. Overall, the qualitative data, involving the use of teacher and student interviews, supported the results of the quantitative data and provided justified insights.

Quantitative data were gathered from two sources. First, an adaptation of the 1988 NAEP (National Assessment of Educational Progress) attitude inventory provided a measure of changes in student attitudes to reading, writing and mathematics. Second, Fraser and Fisher's (1983b) MCI (My Class Inventory) was used to provide a measure of student perceptions of their classroom learning environment. These questionnaires were administered to a sample of 120 elementary school students.

The first research question was:

1. What is the reliability and validity of the attitude and learning environment scales used with the sample elementary mathematics students?

Based on a sample of 120 students, the classroom environment scales (MCI) and the attitude scales (1988 NAEP Attitude Survey) displayed adequate internal consistency reliability and discriminant validity with this sample of elementary school students in Florida. Also the actual form of the MCI was capable of differentiating between students in different classrooms.

The second research question was:

2. After the teachers participate in the professional development activities for Project SMILE, are there changes in the attitudes of students regarding reading, writing and mathematics?

When pretest-posttest changes in students' attitudes were analyzed, statistically significant differences and appreciable effect sizes were obtained for student attitudes toward both writing and mathematics. The effect size was 0.7 standards deviations for attitude toward writing and 0.64 standard deviations for attitude toward mathematics. Attitude toward reading did not show a statistically significant change between pretest and posttest. The reason for this could be that students did not realize that they were actually reading when doing the hands-on SMILE activities. The effect sizes of over half a standard deviation for the statistically significant changes suggest that the magnitudes of pre-post changes in attitudes are educationally important.

The third research question was:

3. After the teachers participate in the professional development activities for Project SMILE, is there congruence between actual and preferred classroom learning environment?

In terms of evaluating the effectiveness of SMILE teachers in creating positive learning environments, the MCI was administered on one occasion only, but in both its actual and preferred versions. It was found that the levels of classroom Satisfaction and the Difficulty of the work that are actually created by these teachers are very similar to the levels preferred by the students. Given that many studies internationally have established a pattern in which students' actual classroom environment falls short of their preferred environment (Fraser, 1998a), the similarity of actual and preferred scores for Satisfaction and for Difficulty provides positive support for the effectiveness of SMILE.

However, relative to student preferences, the actual environment of the SMILE teachers' classrooms is perceived to have too much Friction and Competition and too little Cohesiveness. One reason for this could be that the children feel that, in order to do well on the FCAT (Florida Comprehensive Achievement Test), they must be in competition with the other students in the classroom. In turn, this competitiveness causes friction between the students. This finding provides formative evaluative information about the desirability in future SMILE inservice programs of guiding teachers in how to increase cohesiveness and reduce friction and competition in their classrooms.

The fourth research question was:

4. Is there a relationship between students' perceptions of classroom environment and their attitudes?

In prior learning environment research, many studies have investigated associations between students' outcomes and the nature of the classroom environment. My study follows this tradition by exploring associations between students' attitudinal outcomes (namely, Satisfaction from the MCI and the three scales assessing attitudes to reading, writing and mathematics) and students' perceptions on the other four learning environment scales of the MCI (Friction, Competition, Difficulty and Cohesiveness). In my study, for the purposes of analyses, the Satisfaction scale from the MCI was conceptualized as an attitude outcome and used as a dependent variable.

No statistically significant associations were found between classroom environment and attitudes to reading, writing or mathematics. However, student satisfaction was higher in the classes that have a more favorable classroom environment in terms of less Friction, less Competition and, especially, more Cohesiveness.

Qualitative data were also gathered from six classroom observations, student and teacher interviews that were recorded and transcribed, and student work samples that were collected by each teacher.

After attending the SMILE inservice course, the teachers involved in the study began writing mathematics lessons that employed children's literature. They no longer taught mathematics in a traditional way (following the book page by page). They were using hands-on, activity-based lessons. The teachers felt more secure with the mathematical content and encouraged other teachers to infuse children's literature into mathematics. The teachers also liked the fact the children seemed happier when mathematics time came around. Because of the results for the MCI, the teachers became aware that there was too much Friction and Competition in the classroom.

They felt that this could be due to the high stakes testing. They said that they would try different strategies to alleviate the problem in the upcoming year.

The children found that mathematics was no longer boring and that it was fun to do the activities. The children's literature books seemed to help the children to gain an interest and more confidence in learning mathematics. They made greater academic progress on teacher-made assessments as well. The children said: "Mathematics is fun."

One administrator saw growth in his teachers and in the mathematics program at his school. He wanted to investigate the possibility of having follow-up sessions for his teachers so that they could learn to integrate the SMILE strategies into all of their lesson plans. He was extremely happy with the new-found positive attitudes toward mathematics among both the teachers and the students.

Overall, both the quantitative and qualitative data provide strong support for the effectiveness of the innovative SMILE program. Statistically significant differences and appreciable effect sizes were found for changes in attitudes between pretest and posttest. A comparison of actual and preferred classroom environment showed that SMILE teachers' actual environment was congruent with that preferred by students in terms of levels or both satisfaction and difficulty. Similarly, student work samples and student and teacher interviews provided support for quantitative data concerning the positive attitudes and learning environment.

In conclusion, the combination of quantitative and qualitative information employed in the evaluation of Project SMILE did paint a picture of positive attitudes toward the learning of mathematics and positive student perceptions of some important aspects of classroom environment.

Chapter 5

DISCUSSIONS AND CONCLUSIONS

I love the fact that we were not just learning
new teaching strategies,
but we were also active participants.
(SMILE participant, 2001)

In this final chapter, I explore conclusions, limitations and implications associated with my research. I also propose future directions that are suggested by my study and its findings.

My interest in classroom learning environments stems from the fact that one of my personal goals is that every child in my classroom will learn. That goal has resulted in my questioning of which factors are necessary for every child to learn. Is instruction the only factor that makes a significant change in a classroom? While academic outcomes are educationally important, research has indicated that the nature of the classroom environment also affects student affective and cognitive outcomes (Haertel, Walberg & Haertel, 1981).

I feel that my job as a teacher is to search for innovative and research-based programs that have been proven successful, and to teach both conceptually and procedurally using as many pedagogical strategies as possible. Students must feel comfortable in their classroom learning environment so that they are able to reach their maximum academic potential. In my opinion, there are two keys to a successful classroom – student attitudes and classroom environment.

Ellis and Fouts (1993) have another philosophy regarding what makes a successful classroom. They claim that separating academic disciplines for scholarly purposes has its advantages. But, for children who are still in the process of adapting and organizing their own learning styles, the separation of the subjects makes very little sense. It is easier for children to make real-world applications if subjects are taught by connection.

Research on learning environments spanning the last 30 years reinforces the idea by identifying associations between students' perceptions of the classroom learning environment and a variety of cognitive and affective outcome measures. As well, the literature supports using classroom environment instruments as sources of criterion variables in a wide variety of applications (Fraser 1998a).

Taking research on learning environments and educational innovations into account, I chose to integrate reading, writing, mathematics and student attitudes and the classroom learning environment when I began writing my own innovative program. My decision to integrate three subjects was not based on 'learning styles'. It was based on the fact that I did not have enough time in the day to teach every subject. It was out of necessity that I started writing integrated lessons. I decided to incorporate attitudes and classroom learning environments because I wanted to find reasons why children in my classroom developed a love for mathematics while those in other classrooms did not. This was the beginning of Project SMILE (**S**cience and **M**athematics **I**ntegrated with **L**iterary **E**xperiences) and the beginning of my research.

The purpose of my study was to determine the extent to which the classroom implementation of Project SMILE positively influenced the classroom environment and student attitudes toward reading, writing and mathematics. The final chapter of this thesis is presented under the following headings:

5.1 Synopsis of Chapters

5.2 Summary of Research Methods

5.3 Summary of Quantitative Results

5.3.1 Summary of Findings for Research Question 1 –

Reliability and Validity of the Attitude and Environment Scales

5.3.2 Summary of Findings for Research Question 2 –

Evaluation of SMILE in Terms of Changes in Student Attitudes

5.3.3 Summary of Findings for Research Question 3 –

Evaluation of SMILE in Terms of Congruence Between Actual and Preferred Learning Environments

5.3.4 Summary of Findings for Research Question 4 –

Associations Between Attitudes and Learning Environment

5.4 Summary of Qualitative Results

5.5 Limitations of the Study

5.6 Contributions of the Study

5.7 Future Directions

5.1 SYNOPSIS OF CHAPTERS

The design, implementation and findings of this study have been presented in four chapters. Chapter 1 introduced and provided a rationale for the study, posed the research questions and provided personal and historical backgrounds related to the study.

A review of the literature pertinent to the present study was presented in Chapter 2. In this chapter, I reviewed literature relevant to the fields of the teaching and learning of mathematics in the 21st century, the integration of mathematics and children's literature, classroom environments, and students' attitudes. In particular, this chapter reviewed literature related to past research undertaken in each of these fields.

The design of the study and research methods regarding its implementation were outlined in Chapter 3. Also included in this chapter were descriptions of the stages of the study, the student sample and profile, the data-collection methods, the instruments used in the data collection, and the statistical procedures for analysing the data. Section 5.2 describes the research methods in greater detail.

Chapter 4 provided the results of the study. The case study reports were presented and findings were described. Data pertaining to the reliability and validity of the learning environment and attitude instruments were reported. In addition, associations between students' attitudes towards mathematics and their perceptions of the learning environment were reported. Finally, data were analysed to shed light on the evaluation of SMILE in terms of changes in attitudes and students' classroom environment perceptions. Sections 5.3 and 5.4 summarize the findings in considerable detail.

5.2 SUMMARY OF RESEARCH METHODS

The purpose of my study was to determine the extent to which the classroom implementation of Project SMILE positively influenced the classroom environment and student attitudes toward reading, writing and mathematics. In the implementation of Project SMILE, I combined qualitative and quantitative research methods to examine changes in attitudes and learning environment among 120 fifth grade students whose teachers participated in the program.

The investigation was broken into three stages. Stage 1 dealt with pretesting the students using an adaptation of the 1988 NAEP (National Assessment of Educational Progress) attitude survey. Stage 2 consisted of the series of five professional development workshops. Stage 3 involved students in responding to a posttest on attitudes and to the My Classroom Inventory in both its actual and preferred versions.

As recommended by Tobin and Fraser (1998) and Punch (1998), both qualitative and a quantitative research methods were used in this evaluation of Project SMILE. The quantitative probe was used to provide an overview of the learning environment. My Class Inventory (Fraser & Fisher, 1983b) was used as the measure of learning environment and an adaptation of the 1988 NAEP attitude survey was used as the measure of student attitudes (Lee & Cuevas, 1991).

I chose the My Class Inventory (MCI) as the measure of classroom environment (Fraser & Fisher, 1983b) because the vocabulary is well-suited for the elementary school child, the responses are in a simple Yes-No format, and the answers are recorded on the questionnaire itself to avoid errors in transferring information from one place to another (Fraser, 1989).

The MCI is a one-page questionnaire that measures five scales, yet contains only 25 questions (Fraser, 1989). These scales are *Satisfaction, Friction, Competitiveness, Difficulty* and *Cohesiveness.* The MCI can also measure student perceptions of actual and preferred classroom environment. The preferred form is concerned with goals and value orientations as it measures perceptions of the environment ideally liked or preferred (Fraser, 1989). The actual form measures perceptions of the environment that are really happening in the classroom. Both forms were read aloud to the students in their own class setting.

An adaptation of the 1988 NAEP attitude survey was chosen as the measure of student attitude. The original NAEP survey of 1988 was adapted for elementary school students and validated by Dr Okhee Lee for the Mathematics and Science Resource Teacher Program of the University of Miami, Florida (Lee & Cuevas, 1991). This adapted attitude survey was administered to the teachers and students participating in Project SMILE as a pretest and posttest to gauge changes in attitudes toward reading, writing and mathematics. The different subjects were separated on the survey because these three academic disciplines are taught in isolation in most elementary classrooms. I wanted the teachers and students to respond honestly to the survey regarding their feelings toward each of the three subjects.

Collecting qualitative data involved observing classrooms, interviewing teachers and students on a daily basis, working with students during class time, obtaining written responses to specific questions, and examining student notebooks and test papers. The interpretive methods adopted by Erickson (1986) guided the qualitative data collection. Feedback from the teachers on the written reports of the study was used as another data source. From the six teachers interviewed, two teachers and their students were chosen for the case studies. Data were compiled into written field notes at the completion of each lesson, observation and/or interview as recommended by Tobin, Kahle and Fraser (1990).

5.3 SUMMARY OF QUANTITATIVE RESULTS

The results from the analyses of the quantitative data answer the four research questions. These research questions involved the evaluation of the implementation of Project SMILE in terms of its effectiveness in enhancing the classroom learning environment and students' attitudes toward mathematics, reading and writing. The findings from the quantitative data are summarized below so that a separate subsection is devoted to the results as they relate to each of the four research questions.

5.3.1 Summary of Findings for Research Question 1 – Reliability and Validity of the Attitude and Environment Scales

1. What is the reliability and validity of the attitude and learning environment scales used with the sample elementary mathematics students?

The NAEP attitude instrument was administered as both as a pretest and posttest to the sample of 120 Grade 5 students. This survey consisted of five items that assess each of Attitude to Reading, Attitude to Writing and Attitude to Mathematics. For each attitude scale, an estimate of scale internal consistency and discriminant validity was made. Cronbach's alpha reliability coefficient was used to assess internal consistency. Discriminant validity was assessed using the correlation of a scale with the other scales as a convenient index. Data were analyzed separately for pretest and posttest responses. Although the reliability values are relatively low, still they provide support for the reliability of short attitude scales containing only four or five items each. The data also suggest that the correlation of an attitude scale with the other two attitude scales is relatively small with the exception of Attitude to Reading with Attitude to Mathematics. This suggests that the three attitude scales are relatively independent of each other.

In terms of the reliability and validity of the MCI (My Class Inventory), the same two indices of internal consistency and discriminant validity were reported separately for the actual and preferred forms. Internal consistency was assessed using Cronbach's alpha reliability coefficient, and discriminant validity was assessed using the mean correlation of a scale with the other scales as a convenient index. The findings suggest that both the actual and preferred forms of the MCI scales display adequate internal consistency and discriminant validity.

Ideally, students within the same class should perceive its environment relatively similarly, whereas mean class perceptions should vary from class to class.

This characteristic was explored for the actual form of each MCI scale by performing a one-way ANOVA with class membership as the main effect. The findings show that all scales except Competitiveness were able to differentiate between classes.

5.3.2 Summary of Findings for Research Question 2 – Evaluation of SMILE in Terms of Changes in Student Attitudes

The second research question reads as follows:

> 2. After the teachers participate in the professional development activities for Project SMILE, are there changes in the attitudes of students regarding reading, writing and mathematics?

Teachers attended a series of five professional development workshops lasting five full days during a ten-week period. After the first day of the workshop, I went to each teacher's classroom and administered the attitude survey to the students. After the teachers completed the SMILE professional development course, I administered the attitude questionnaire again to their students as a posttest. Changes in student attitudes between the pretest and posttest were used in evaluating the effectiveness of the SMILE inservice program.

There were statistically significant differences in student attitudes toward both writing and mathematics between the pretest and posttest. Attitude toward writing improved in its average item mean score from 2.52 to 2.75 (or an effect size of 0.57 standard deviations). Attitude toward mathematics changed from 2.39 to 2.68 (an effect size of 0.64). Attitude toward reading did not show a statistically significant change between pretest and posttest. The effect sizes of over half a standard deviation for the statistically significant changes suggest that the magnitudes of pre-post changes are educationally important.

The positive change in student attitudes toward mathematics and writing after the implementation of SMILE was one of my goals for the program. It is my feeling that the attitude toward reading probably did not change appreciably because SMILE concentrates on weaving writing and mathematics into the reading. The children might not have known that, in essence, they were learning reading skills at the same time they were learning mathematics. Overall, the results support the effectiveness of SMILE in promoting positive student attitudes.

5.3.3 Summary of Findings for Research Question 3 – Evaluation of SMILE in Terms of Congruence Between Actual and Preferred Learning Environment

The third research question is:

> 3. After the teachers participate in the professional development activities for Project SMILE, is there congruence between actual and preferred classroom learning environment?

Using the five scales of the MCI (My Class Inventory), I compared students' perceptions of actual and preferred classroom learning environment as another way of evaluating the effectiveness of Project SMILE. My findings showed that students prefer a significantly more favorable classroom environment on the three scales of Friction, Competition and Cohesiveness. That is, students prefer less Friction, less Competition and more Cohesiveness. This pattern, in which students prefer a more positive learning environment than the one perceived to be actually present, replicates considerable prior research in other countries (Fisher & Fraser, 1983; Fraser, 1998a). However, differences between actual and preferred scores on the other two MCI scales of Satisfaction and Difficulty were statistically nonsignificant.

In terms of evaluating the effectiveness of SMILE teachers in creating positive learning environments, it appears that the levels of classroom Satisfaction and the Difficulty of the work that are actually created by these teachers are very similar to the levels preferred by the students. These results provide some support for the effectiveness of SMILE.

It is noteworthy that, relative to student preferences, the actual environment for the SMILE teachers' classrooms is perceived to have too much Friction and Competition and too little Cohesiveness. One reason for this could be the high stakes testing that takes place in Grade 5 in the state of Florida. The children feel that, in order to do well on the FCAT (Florida Comprehensive Achievement Test), they must be in competition with the other students in the classroom. In turn, this competitiveness causes friction between the students. According to the results of the MCI, the children would like the class to be more cohesive, but perhaps this competition is causing friction between them. Overall, the results for Friction, Competition and Cohesiveness provide useful formative evaluative information to guide the modification of future SMILE workshops.

5.3.4 Summary of Findings for Research Question 4 – Associations Between Attitudes and Learning Environment

The fourth research question is:

4. Is there a relationship between students' perceptions of classroom environment and their attitudes?

Simple correlation and multiple regression analyses were used to explore associations between students' attitudes and their perceptions of their classroom environments. For these analyses, the MCI scale of Satisfaction was used as an attitudinal variable that was related to the other four MCI scales. No statistically significant associations were found between classroom environment and attitudes to reading, writing or mathematics. However, student Satisfaction was statistically significantly correlated with all four learning environment scales. In addition, the multiple correlation between Satisfaction and the environment scales was statistically significant. The regression coefficients show that Cohesiveness is the only significant independent predictor of student Satisfaction when the other environment scales are mutually controlled.

Overall, the results suggest that student Satisfaction is higher in classes that have a more favorable classroom environment in terms of less Friction, Competition and Difficulty are more Cohesiveness. However, Cohesiveness is the strongest independent predictor of student Satisfaction. In other words, the better the children feel that they get along, the more satisfied they are with the classroom setting.

5.4 SUMMARY OF QUALITATIVE RESULTS

Collecting qualitative data involved observing classrooms, interviewing teachers and students on a daily basis, working with students during class time, obtaining written responses to specific questions, and examining student notebooks and test papers (Erickson, 1986). Feedback from the teachers on the written reports of the study was used as another data source. From the six teachers interviewed, two teachers and their students were chosen for the case studies. All data were complied into written field notes following each lesson, observation or interview all data.

The qualitative information supported the patterns of results from the questionnaires and enhanced my understanding of how Project SMILE operated to enhance students' classroom environment and attitudes toward reading, writing and mathematics.

The qualitative results were based on two case studies, interviews with six teachers and six students, classroom observations and student work samples. After attending the SMILE inservice course, the teachers involved in the study began writing mathematics lessons that employed children's literature. They no longer taught mathematics in a traditional way (involving follow the book page by page). They were using hands-on activity-based lessons. The teachers felt more secure with the mathematical content. They liked the fact that the children seemed happier when studying mathematics.

The children found that mathematics was no longer boring and that it was fun to do the activities. The children's literature books seemed to help the children to gain an interest and more confidence in learning mathematics. They made greater academic progress on teacher-made assessments. The children said: "Mathematics is fun."

Both the quantitative and qualitative data supported the effectiveness of Project SMILE in terms of providing the elementary (K-5) mathematics classroom with a positive classroom learning environment and with positive attitudes.

5.5 LIMITATIONS OF THE STUDY

There are a number of limitations associated with my evaluation of Project SMILE. The first limitation is the sample size. Originally, 180 Grade 5 students from two schools responded to the first questionnaire. However, only 120 students completed all aspects of the study because of student absences and student transfers. This relatively small sample could present a limitation to this study because, compared to the general population of Grade 5 students in the county, the sample used were neither sizable nor representative of the full range of elementary schools and students. Therefore, it is unclear if my findings would apply to the full range of Grade 5 students. Also the power of the statistical analyses was limited by the sample size in some cases.

The second limitation of my study is that, because some of the children in the sample are language-deficient, it is possible that they misinterpreted some of the questionnaire items (despite the fact that the MCI has a very low reading level).

The third limitation is one of changing the focus of my research. Originally, the focus of my research was the relationship between student attitudes, classroom environment and mathematics achievement on performance-based tests. Because I was unable to gain access to achievement test data, the focus was changed exclusively to classroom learning environment and student attitudes.

The fourth limitation stems from the fact that I did not administer the MCI on two occasions to gauge changes in classroom environment over time. Results from a pretest of the MCI would have been helpful to the teachers and myself when trying to assess the impact of SMILE on changes in the classroom environment. Therefore I compared actual and preferred learning environments after the implementation of SMILE as a way of furnishing evidence to inform my evaluation of SMILE.

Another limitation related to the MCI is the fact that it is a somewhat outdated questionnaire. Therefore it does not capture all the dimensions of contemporary relevance that are assessed by contemporary instruments.

The final limitation was the fact that the SMILE inservice program was not the only inservice workshop in which some of the teachers were enrolled. Unfortunately, some teachers enrolled in more than one inservice program at a time. The attitudes of the students and classroom environment might have been changed because of teachers' experiences that were received from other workshops. However, the qualitative data helped to corroborate the fact that the teachers learned the strategies from the SMILE inservice program and that the positive attitudes and learning environments were subsequently fostered in these teachers' elementary school classrooms.

5.6 DISTINCTIVE CONTRIBUTIONS OF THE STUDY

The present study has made distinctive contributions to the field of learning environments. My research represents one of the relatively few studies that have employed learning environment dimensions as criteria of effectiveness in the evaluation of educational innovations (Maor & Fraser, 1996). It also is one of relatively few studies in the field of learning environments that has focused on elementary (K-5) school mathematics.

The purpose of this research was to investigate if implementing an integrated mathematics program positively influenced the classroom environment and students' attitudes. Overall, the data support the effectiveness of the innovative SMILE program. Therefore, in terms of classroom environment and student attitude, other educators can have a certain degree of confidence about implementing SMILE more widely.

My results did not come solely from the use of quantitative methods, but also from the use of qualitative methods. Methodologically, this shows me the importance of intertwining both methods of research (Tobin & Fraser, 1998).

The comments that the teachers provided were invaluable in terms of persuading others to implement this program. There was one common thread in the qualitative investigation—the classroom environment was considered conducive to learning and the children thought that mathematics was fun.

In summary, I feel that my study makes the following distinctive contributions to educational research:

- My study supports previous research that suggests that quantitative and quantitative data can be successfully intertwined.
- My study is one of the first to employ learning environment dimensions in the evaluation of elementary (K-5) mathematics programs.
- Because the implementation of Project SMILE promoted a positive impact on student attitudes towards mathematics and to the classroom learning environment, other educators can implement SMILE with confidence.

5.7 FUTURE RESEARCH DIRECTIONS

This study lends itself to at least three future directions:

- Extension of the research to include other classroom environment questionnaires and student achievement.
- Extension of the research to include a larger and broader sample.
- Replicating the evaluation of Project SMILE into other areas throughout the State.

As of June 2002, the evaluation department of the Miami-Dade County Public School System can track individual progress on the FCAT (i.e. the state-wide achievement test). This tracking can begin in Grade 3. This opens up the opportunity to expand the research on the evaluation of SMILE to include high-stakes student achievement measures. Once student achievement data are widely available, researchers can attempt to replicate the success of Project CRISS (Grades 6-12) in promoting achievement to include Project SMILE (Grades K-5).

Mathematics today is being continually created and adapted to meet new needs (NRC, 1989). Applying ideas and methods from the relatively new field of learning environments in investigating innovative mathematics programs could open up a variety of research opportunities. Mathematics is the key to opportunities, careers and everyday life. In the future, schools and colleges will need to meet goals that they now believe to be impossible (NRC, 1989). Children are the future. Everything we do is for them and everything that will be done, will be done by them. Without research into innovative programs such as Project SMILE, what future will our children have?

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Appendix A

PARENT PERMISSION LETTER

Dear Parent, ______________________

My name is Mrs. Debi Mink. I am presently working as a Mathematics Educational Specialist for the Miami-Dade County Public Schools in the Office of Human Resources and Development. I am writing to ask permission to have your child, ______________________ participate in a study that I will be conducting at both Hibiscus and Virginia Boone Highland Oaks Elementary Schools. The purpose of the study will be to find out the effects of integrating children's literature with hands-on mathematics activities.

I am conducting this study as part of my Doctoral Dissertation requirement by Curtin University of Technology, Perth, Australia. The course is being conducted through Intensive Mathematics Education courses and Distance Learning.

Your child will be answering a student attitude questionnaire in September and December (as a pretest and posttest) and classroom environment questionnaire at the conclusion of my study in December. These questionnaires will focus on his/her feelings toward mathematics, reading and writing.

Your child's name will not be used or published in any part of the study. If you have any questions or concerns, feel free to contact me at ______________ Please sign and return the bottom portion of this form and return it too your child's teacher as soon as possible.

Sincerely,

Deborah V. Mink

Child's ID# ____________________ Teacher's Name____________

________ **I give permission for my child to participate in the study.**

________ **I do not give permission for my child to participate in the study.**

Parent's Signature: _____________________ Date: ________

Appendix B

NAEP ATTITUDE SURVEY FOR STUDENTS

Name ____

School Name ________________Grade ____________

Date ____

Feelings about Reading, Writing and Mathematics

Feelings about Reading

	Agree	Not Sure	Disagree
1. I like to read.	3	2	1
2. I am good at reading	3	2	1
3. Everyone can read well, if they try.	3	2	1
4. Reading is boring.	3	2	1
5. Reading is a hard subject.	3	2	1

Feelings about Writing

	Agree	Not Sure	Disagree
1. I like to write.	3	2	1
2. I am good at writing	3	2	1
3. Everyone can write well, if they try.	3	2	1
4. Writing is boring.	3	2	1
5. Writing is a hard,	3	2	1

Feelings about Mathematics

	Agree	Not Sure	Disagree
1. I like math.	3	2	1
2. I am good at math.	3	2	1
3. Everyone can do math well, if they try.	3	2	1
4. Math is boring.	3	2	1
5. Math is a hard subject.	3	2	1
6. Math is mostly memorization and working from the textbook.	3	2	1

Appendix C

NAEP ATTITUDE SURVEY FOR TEACHERS

Name ______________________________________

School Name ________________Location # __________

Date ______________________________________

Feelings about Teaching Reading, Writing and Mathematics

Feelings about Teaching Reading

	Agree	Not Sure	Disagree
1. I like to teach reading.	3	2	1
2. I am good at teaching reading	3	2	1
3. Everyone can teach reading well, if they try.	3	2	1
4. Teaching reading is boring.	3	2	1
5. Reading is a hard subject to teach.	3	2	1

Feelings about Teaching Writing

	Agree	Not Sure	Disagree
1. I like to teach writing.	3	2	1
2. I am good at teaching writing	3	2	1
3. Everyone can teach writing well, if they try.	3	2	1
4. Teaching writing is boring.	3	2	1
5. Writing is a hard subject to teach.	3	2	1

Feelings about Teaching Mathematics

	Agree	Not Sure	Disagree
1. I like to teach math.	3	2	1
2. I am good at teaching math.	3	2	1
3. Everyone can teach math well, if they try.	3	2	1
4. Teaching math is boring.	3	2	1
5. Math is a hard subject to teach.	3	2	1
6. Teaching math is mostly memorization and working from the textbook.	3	2	1

Appendix D

MY CLASS INVENTORY

MY CLASS INVENTORY

STUDENT ACTUAL SHORT FORM

DIRECTIONS

This is not a test. The questions are to find out what your class is actually like.

Each sentence is meant to describe what your actual classroom is like. Draw a circle around

YES if you AGREE with the sentence
NO if you DON'T AGREE with the sentence.

EXAMPLE
27. Most pupils in our class are good friends.
If you agree that most pupils in the class actually are good friends, circle the Yes like this:
(Yes) No
If you don't agree that most pupils in the class actually are good friends, circle the No like this:
Yes (No)

Please answer all questions. If you change your mind about an answer, just cross it out and circle the new answer. Don't forget to write your name and other details below.

NAME ____________ SCHOOL ____________ CLASS ______

	Remember you are describing your actual classroom	Circle Your Answer	For Teacher's Use
1.	The pupils enjoy their schoolwork in my class.	Yes No	___
2.	Pupils are always fighting with each other.	Yes No	___
3.	Pupils often race to see who can finish first.	Yes No	___
4.	In my class the work is hard to do.	Yes No	___
5.	In my class everybody is my friend.	Yes No	___
6.	Some pupils are not happy in my class.	Yes No	R ___
7.	Some pupils in my class are mean.	Yes No	___
8.	Most pupils want their work to be better than their friend's work.	Yes No	___
9.	Most pupils can do their schoolwork without help.	Yes No	R ___
10.	Some pupils in my class are not my friends.	Yes No	R ___
11.	Pupils seem to like my class.	Yes No	___
12.	Many pupils in my class like to fight.	Yes No	___
13.	Some pupils feel bad when they don't do as well as the others.	Yes No	___
14.	Only the smart pupils can do their work.	Yes No	___
15.	All pupils in my class are close friends.	Yes No	___
16.	Some pupils don't like my class.	Yes No	R ___
17.	Certain pupils always want to have their own way.	Yes No	___
18.	Some pupils always try to do their work better than the others.	Yes No	___
19.	Schoolwork is hard to do.	Yes No	___
20.	All pupils in my class like one another.	Yes No	___
21.	My class is fun.	Yes No	___
22.	Pupils in my class fight a lot.	Yes No	___
23.	A few pupils in my class want to be first all of the time.	Yes No	___
24.	Most pupils in my class know how to do their work.	Yes No	R ___
25.	Pupils in my class like each other as friends.	Yes No	___

For Teacher's Use Only: S ____ F ____ Cm ____ D ____ Ch ____

This page is a supplement to a publication entitled *Assessing and Improving Classroom Environment* authored by Barry J. Fraser and published by the Key Centre for School Science and Mathematics at Curtin University.

MY CLASS INVENTORY

STUDENT PREFERRED SHORT FORM

DIRECTIONS

This is not a test. The questions are to find out what you would like or prefer your class to be like.

Each sentence is meant to describe what your preferred class is like. Draw a circle around

YES if you AGREE with the sentence
NO if you DONT AGREE with the sentence.

EXAMPLE
27. Most pupils in our class would be good friends.

If you agree that you'd prefer that most pupils in the class would be good friends, circle the Yes like this:

(Yes) No

If you don't agree that you would prefer that most pupils in the class would be good friends, circle the No like this:

Yes (No)

Please answer all questions. If you change your mind about an answer, just cross it out and circle the new answer. Don't forget to write your name and other details below.

NAME ______________________ SCHOOL ____________________ CLASS _____

	Remember you are describing your preferred classroom	Circle Your Answer	For Teacher's Use
1.	The pupils would enjoy their schoolwork in my class.	Yes No	___
2.	Pupils would be always fighting with each other.	Yes No	___
3.	Pupils often would race to see who can finish first.	Yes No	___
4.	In my class the work would be hard to do.	Yes No	___
5.	In my class everybody would be my friend.	Yes No	___
6.	Some pupils wouldn't be happy in my class.	Yes No	R ___
7.	Some pupils in my class would be mean.	Yes No	___
8.	Most pupils would want their work to be better than their friend's work.	Yes No	___
9.	Most pupils would be able to do their schoolwork without help.	Yes No	R ___
10.	Some pupils in my class would not be my friends.	Yes No	R ___
11.	Pupils would seem to like my class.	Yes No	___
12.	Many pupils in my class would like to fight.	Yes No	___
13.	Some pupils would feel bad when they didn't do as well as the others.	Yes No	___
14.	Only the smart pupils would be able to do their work.	Yes No	___
15.	All pupils in my class would be close friends.	Yes No	___
16.	Some pupils wouldn't like my class.	Yes No	R ___
17.	Certain pupils always would want to have their own way.	Yes No	___
18.	Some pupils always would try to do their work better than the others.	Yes No	___
19.	Schoolwork would be hard to do.	Yes No	___
20.	All pupils in my class would like one another.	Yes No	___
21.	My class would be fun.	Yes No	___
22.	Pupils in my class would fight a lot.	Yes No	___
23.	A few pupils in my class would want to be first all of the time.	Yes No	___
24.	Most pupils in my class would know how to do their work.	Yes No	R ___
25.	Pupils in my class would like each other as friends.	Yes No	___

For Teacher's Use Only: S F Cm ____ D ____ Ch ____

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