Science and Mathematics Education Centre

Parent and Student Perceptions of the Science Learning Environment and Its Influence on Student Outcomes

Debra Allen

This thesis is presented as part of the requirements for the award of the Degree of Doctor of Philosophy of the Curtin University of Technology

January 2003
ACKNOWLEDGEMENTS

I would like to thank the following people for their assistance toward the completion of this thesis:

Professor Barry Fraser, my supervisor, whose encouragement and kind guidance enabled me to complete my study. Without Professor Fraser’s keen insights, I could not have finished this mammoth task called a thesis.

Jill Aldridge for computing my survey results and for always being willing to offer any help I asked for throughout this process.

The teachers, students and parents who volunteered and participate in my study.

My husband whose constant support and encouragement made it possible for me to pursue this study.
ABSTRACT

This thesis reports on the modification, validation and application of a classroom learning environment questionnaire. This thesis is distinctive in that parents’ perceptions were utilised in conjunction with students’ perceptions in investigating science classroom learning environments among Grade 4 and 5 students in South Florida. The *What is Happening in this Class?* (WIHIC) questionnaire was modified for young students and their parents. Data from samples of students and parents were analysed to check the reliability and validity of the modified questionnaires and to examine similarities and differences between parents’ and students’ perceptions of the learning environment. Associations between parents’ and students’ perceptions of the science learning environment and student outcomes (attitude and achievement) were also investigated in this study. Parents and students were interviewed to check further the validity and reliability of questionnaires and to enhance the richness of the quantitative findings. Interviews with parents and students, along with classroom observations, offered some insights into the quantitative findings.

Data analyses supported the WIHIC’s factorial validity, internal consistency reliability and ability to differentiate between the perceptions of students in different classrooms. Both students and parents preferred a more positive classroom environment than the one perceived to be actually present, but effect sizes for actual-preferred differences were larger for parents than for students. Associations were found between some learning environment dimensions (especially Task Orientation) and student outcomes (especially attitudes). Qualitative methods suggest that students and parents were generally satisfied with the classroom environment, but that students would prefer more investigation while parents would prefer more teacher support. The study provides a pioneering look at how parents and students perceive the science learning environment and opens the way for further learning environment studies involving parents and students.
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Chapter 1

INTRODUCTION AND OVERVIEW

As part of the professional dialogue at my school, a group of eight teachers meet once a month. These meetings are voluntary and informal. Professional articles brought by members, strategies used in instruction, and children’s work are shared and examined. Problems at the individual student, classroom and school levels are discussed.

One morning, the group was discussing a problem that a teacher had with a parent. The teacher related how one of her parents was irate over the way in which the teacher was instructing and interacting with her child. Many of the allegations from the parent did not fit with the perspective that the teacher had of her class. All of the teachers echoed this experience. It seemed that many of the parents’ perceptions of what was going on in the class did not match the teachers’ perceptions. The seed for this research study was germinated: What do parents think is going on in their children’s classroom? And, what would parents like to be going on in their children’s classroom?

The field of learning environments, with its wide variety of valid questionnaires (Fraser, 1998a, 2002), seemed to offer an appropriate framework for assessing and investigating students’ and parents’ perceptions of the science learning environment in my study. Much of the past research on family and school environments has concentrated on family environmental factors that promote or limit student achievement (see Chapter 2). The present study looked at students’, along with their parents’, perceptions of the science learning environment, examined differences between these perceptions, and explored associations between student outcomes (attitude and achievement) and the learning environment as perceived by students or parents.

This chapter provides an overview of this thesis using the following sections:

1.1 Rationale for the Study
1.2 Research Questions
1.3 Research Design
1.4 Significance
1.5 Limitations
1.6 Science Education
1.7 Overview of the Thesis

1.1 Rationale for the Study

Transforming a schools' climate involves all key stakeholders (Johnson, 1996). Often change at the school level is initiated by a district or by state mandates. This ignores the need to create a dialogue between parents, students, teachers, administrators and community members, who all contribute to the climate of a school. Numerous studies link parental involvement to the overall success of the school (Borger, Lo, Oh, & Walberg, 1985; Phi Delta Kappa, 1980; Steven & Sanchez, 1999). Parental involvement could be a key factor in preventing or reducing school failure (Epstein, 2001).

How should families be involved at their child’s school? As part of the involvement in decision making, should parents be involved in the evaluation of the classroom learning environments? What perspective would parents bring to these evaluations? Research suggests that parents and principals have some similar and some different views of what makes a good teacher (Epstein, 1987), which suggests that parents can contribute important perspectives as to what should be going on in their children’s school. An integral part of my research was the consideration of not only students’ perceptions of the learning environment but also their parents’ perspectives of the learning environment. By looking at parents perceptions in this study, what parents think is going on in their children’s science class and what parents would like to happen in their children’s science class were explored and analysed.

Individuals are deeply influenced by the social matrix in which they are embedded (Moos, 1991). “Our task is to formulate an integrated conceptual framework and develop assessment procedures that reflect the complex interplay of real-life processes. Thus we must place learning environment in context and consider how the
characteristics and influences of schools and classrooms are altered by other factors in the lives of students and educators…” (p. 29).

Student achievement is likely to be enhanced when there is similarity between actual classroom environment and students’ preferred environment (Fraser, 1998b). Similarly, students achieve better in classrooms with interaction rules that are similar to those that they have experienced in their families (Moos, 1991). Any effort to enhance children’s learning should take into account the context in which it is implemented as well as parents’ needs and wishes (Kellaghan, Sloane, Alvarez, & Bloom, 1993).

Much of the past research on learning environments has focused on the students’ perceptions of the classroom environment and its effect on student outcomes (Fraser, 1986, 1994, 1998a; Fraser & Walberg, 1991). Numerous research studies have shown that students’ perceptions account for appreciable amounts of variance in learning outcomes, often beyond that attributable to background student characteristics (Fraser, 1994; Fraser, Walberg, Welch, & Hattie, 1987; Haertel, Walberg, & Haertel, 1981). Learning environment questionnaires have been shown to be widely applicable in various classroom settings and in countries around the world. Chapter 2 provides an overview of the learning environment research.

Past research has compared students and teachers in terms of their perceptions of the learning environment and their teacher interpersonal behaviour (Brekelmans, Wubbels & Levy, 1993; Wubbels & Brekelmans, 1998) and important differences have been found between teachers’ and students’ perceptions of the learning environment (Moos, 1979a; Hofstein & Lazarowitz, 1986; Wubbels, 1993). Learning environment research has shown that teachers can improve classroom environments by introducing an intervention that addresses any discrepancies between students’ actual and preferred classroom learning environment (Fisher, Fraser & Bassett, 1995; Fraser, 1998b). My study is distinctive in that it assessed both students’ perceptions of the learning environment and their parents’ perceptions of the learning environment. The practical implications are that student outcomes might be improved by taking into account parents’ and students’ perspectives and attempting to create classroom environments found empirically to be correlated with student outcomes.
1.2 Research Questions

The research questions proposed in this study were designed to assess the science learning environment of 9-11 year-olds as perceived by parents and students, to identify differences between parents and students, and to explore associations between student outcomes and the learning environment.

The first research question was developed to determine whether the instruments that were modified and designed to assess parents’ and students’ perceptions of the learning environment were valid and reliable:

*Research Question #1: Is it possible to develop valid questionnaires to assess:*
- 9-11 year-old students’ perceptions of the actual and preferred science learning environment?
- parents’ perceptions of the actual and preferred science learning environment for their children?
- 9-11 year-old students’ attitudes towards science?

The second research question was designed to explore differences between students’ and parents’ perceptions of the learning environment:

*Research Question #2: Are there differences between parents and students in their preferred classroom environment and in their perceptions of the same actual classroom environment?*

The third research questions was designed to examine associations between student outcomes (achievement and attitudes) and the perceptions of the science learning environment held by students as well as their parents.

*Research Question #3: Are there associations between the student outcomes of achievement and attitudes and:*
- students’ perceptions of the science learning environment?
- parents’ perceptions of their children’s science learning environment?
1.3 Research Design

The study for this thesis began with the belief that distinct classroom environments exist and these characteristics can determine human behaviour (Lewin, 1936). Additionally, Walberg's (1981) nine-factor model of educational productivity, in which student outcomes are co-determined by three student aptitude variables including psychosocial environments of the school/class and the home, also framed the design of this study. And finally, Murray's (1938) distinction between an environment as perceived by an external observer (parents) and an environment perceived by milieu inhabitants (students) added to the conceptual framework for this study.

This study used a mixed-method design. Parents' and students' perceptions of the science learning environment in this study were assessed by administration of a survey, namely, a modified version of the What is Happening in this Class? (WIHIC) questionnaire (Fraser, McRobbie, & Fisher, 1996). Four forms were used in this study. Two forms measured students' and parents' preferred classroom environment, while the other two forms measured students' and parents' perceptions of the actual classroom environment. Information about the modifications made to this questionnaire, its administration, and samples involved can be found in Chapter 3.

The analyses of the quantitative information from the questionnaires started with an investigation of validity and reliability of the instruments. Next parents and students were compared to provide information about differences between parents' actual and preferred perceptions, differences between students' actual and preferred perceptions, and differences between students' and parents' in their actual and preferred perceptions of the learning environment. Finally, associations between students' and parents' perceptions of the science learning environment and student outcomes (attitudes and achievement) were determined. The findings of these analyses are reported in Chapter 4.

After the quantitative data had been gathered, qualitative data based on interviews and classroom observations were collected to offer plausible explanations and augment
the richness of the quantitative findings. Through triangulation of quantitative data with qualitative information, greater credibility can be placed on the findings (Fraser & Tobin, 1991; Tobin & Fraser, 1998).

The interpretive methods of Erickson (1998) guided the collection of the qualitative data (interviews and classroom observations). Using a recursive process, the interviews and observations were examined for patterns and the qualitative findings were reconciled with the quantitative findings. The methods chosen for the quantitative and qualitative design are presented in further detail in Chapter 3.

1.4 Significance

Considerable past research (Fraser, 1998a) has involved the assessment of students' perceptions of their classroom learning environment and has explored associations between students' perceptions of the learning environment and their attitudes and achievement. My study is pioneering because, as well as considering students' perceptions, it also involved assessing parents' perceptions of their children's science learning environment. An existing learning environment questionnaire (WHIC) was modified, administered and validated for use with young children. The instrument was constructed in two forms to measure actual and preferred science learning environment.

Parallel forms of the student learning environment questionnaires were designed, administered and validated for use with parents of these young children. The questionnaires, that have been so widely and successfully used to assess students' perceptions of the classroom learning environment, had not previously been adapted and used among parents. Therefore, this study makes a distinctive contribution by validating and using a widely-applicable questionnaire to assess parents' perceptions of their children's learning environment.

The four science learning environment questionnaires (student actual and preferred; parent actual and preferred), together with another questionnaire that assessed attitudes towards science, were translated and back translated into Spanish and Haitian Creole. Although these forms were not utilised in this study because students opted to respond to the English version, their development still represents a worthwhile
contribution to the field because they are available for other researchers. Chapter 3 provides more details on the creation of these translated questionnaires.

1.5 Limitations

The age of the students is a limitation of this study. With students aged nine to 11 years, two main limiting factors emerged. The first limiting factor was the possibility that students faked answers to please their teachers. The second limiting factor could be the readability of the questionnaire. Because students completed the learning environment questionnaire independently, some students might have had difficulties reading the questionnaire.

Parents' participation in the study constrained the sample size and sample selection. While most of the parents of the researcher's students readily participated, the participation of parents of other classes was far less forthcoming. Future research involving a larger sample of parents is desirable.

While learning environment questionnaires have a long history of being valid and reliable to ascertain students' and teachers' perceptions of the learning environment, no research has been done using questionnaires to ascertain parents' perceptions of their children's learning environment. Therefore the parent questionnaires used in my study need further validation attempts to increase confidence in these instruments. The limitations of the study are discussed further in Chapters 3 and 5.

1.6 Science Education

To help place the study in context, a brief overview of the science curriculum is provided for the state in which my study was conducted. The Sunshine State Standards are the centrepiece of the educational reform effort in Florida to align science curriculum, instruction and assessment. They identify what students should know and be able to do in the 21st century. School districts in Florida are mandated to incorporate provisions for instruction of the Sunshine State Standards (Department of Education, 2002).
Because the trend in the United States is towards standards-based reform, Florida created Grade Level Expectations for science in January 1999. The standards are structured into benchmarks clustered by grade levels (K-2, 3-5, 6-8 and 9-12), with specific Grade Level Expectations within the benchmarks. The Science Sunshine State Standards are organized into eight strands with two to three benchmarks per strand. The strands and benchmarks for Science K-12 are presented in Chapter 2.

While the benchmarks delineate what students should know and be able to do in science, decisions about which materials, strategies and evaluations are used for these benchmarks are made at the school or classroom level. Because there was no uniformity in classroom assessment, it was decided to use two achievement measures, the final grade in science (determined by the students' teachers) and the stanine score from the Stanford Science Achievement Subtest (a nationally normed test).

1.7 Overview of the Thesis

The conceptualisation, design, implementation and findings of this study are presented in five chapters. Chapter 1 provides the background, rationale, and significance of the study.

Chapter 2 reviews the literature pertinent to the study. The literature review incorporates three main relevant fields. The first section of the review examines the social matrix of family and schools and the second section considers literature related to the science curriculum currently being taught. Importantly Chapter 2 reviews the literature from the field of classroom learning environments, including research into associations between classroom environment and students' outcomes.

Chapter 3 details the design and implementation of the study. Methods used for the modifications and validation of the What is Happening in this Class? (WHIC) questionnaire are given in Chapter 3. Also included are descriptions of the research methods used in the implementation and the analyses. Both the quantitative and qualitative methods that were employed in this study are described in this chapter.
Analyses and results are reported in Chapter 4. The reliability and validity of the questionnaires are presented to answer the first research question. Differences between parents' and students' perceptions of the science learning environment are also examined. Next, associations between parents' and students' perceptions of the environment and student outcomes (achievement and attitudes) are considered. Finally, the findings from the qualitative interviews and classroom observations are presented.

Chapter 5 concludes the thesis with a summary of the main findings based on quantitative and qualitative data-collection methods. The chapter continues by detailing the significance of the study, along with the limitations of the study. The chapter concludes with recommendations for further research, implications of the findings and concluding comments.
Chapter 2

REVIEW OF RELATED LITERATURE

2.1 Introduction and Overview

This study looked at students’ and parents’ perceptions of the science learning environment, differences between these perceptions, and associations between classroom environment and student outcomes (attitude and achievement). Guided by the purposes of this study, three main areas of literature were reviewed to help guide and frame the design of the study. Because parents’ along with students’ perceptions of the learning environment were examined, the first area considered in this chapter is research relevant to the social matrix of families and schools (Section 2.2). The second area considered is the current science curriculum (Section 2.3). And the last area considered is the field of learning environments (Section 2.4).

The literature review on the social matrix of families and schools (Section 2.2) includes the follow sections:

- an overview of parental involvement in education (Section 2.2.1)
- current national and state goals encouraging parental involvement (Section 2.2.2)
- a review of the growing field of study involving the family (Section 2.2.3)
- links between home and school settings and student outcomes (Sections 2.2.4 & 2.2.5)
- past research on parental perceptions (Section 2.2.6)
- a summary of the research on families discussed in Section 2.2 (Section 2.2.7).

The literature on science education (Section 2.3) highlights:

- national educational goals (Section 2.3.1)
- current curriculum mandates (Section 2.3.2)
- classroom practices that affect achievement and attitudes in science (Section 2.3.3).
The related research on learning environments (Section 2.4) includes:

- the historical foundations of learning environments research (Section 2.4.1)
- school-wide, classroom or personal levels of research on learning environments (Section 2.4.2)
- actual and preferred forms (Section 2.4.3)
- teacher and student perceptions of the same learning environment (Section 2.4.4)
- different learning environment questionnaires (Section 2.4.5)
- the What is Happening in this Class? (WHIC) questionnaire (Section 2.4.6)
- associations between the learning environment and student achievement and attitudes (Section 2.4.7)
- the advantages of combining qualitative and quantitative research methods in assessing the learning environment (Section 2.4.8).

A summary of the literature review is provided in Section 2.5.

2.2 Families and Schools: A Social Matrix

As previously stated, this study examined not only students’ perceptions of the learning environment but also their parents’ perceptions of the science learning environment. Researchers recognize that education takes place within the context of the community and family (Kellaghan, Sloane, Alvarez & Bloom, 1993; Majoribanks, 1999; McCaleb, 1997; Moos, 1991). Families should be involved in this learning process and invited to share their own values and life goals with their children and the schools (McCaleb, 1997). The family remains central to the preparation of children for academic learning (Families & Schools, 1995).

School learning and the home environment are highly linked (Kellaghan et al., 1993). Kellaghan et al. have proposed that it would be desirable to extend the traditions of learning environment research involving students to also involve their parents. While past learning environment research (see Section 2.4) has focused on students’ perceptions of their learning environment, my study attempted simultaneously to determine the perceptions of parents and students as advocated by Majoribanks (1991) and Kellaghan et al. (1993).
2.2.1 Parental Involvement

The term 'parental involvement' used in education contains a wide variety of systems and/or activities through which parents can contribute to the school and their own child's academic progress. Parental involvement goes back to a time when most mothers did not work outside the home and were available to meet the schedules and needs of the child and school (McCaleb, 1997). The schools of the 1990s have attempted to create supportive climates for parents. Comprehensive parental involvement policies, with nationwide and state networking capabilities, are evolving. Parental involvement programs have changed over the decades in response to changing social values and economic pressures (Lopez, 1992).

Epstein (2001) found that teachers would like families to assist, guide, and influence their children to do their school work. Some educators expect parents to become involved in their children's education on their own. On the other hand, some parents expect the school to tell parents what to do and parents simply to respond. Research (Epstein, 2001) suggests that 'partnership' is a better approach. Partnerships, involve educators, families, and community members working together to share information, guide students, solve problems, and celebrate success. Partnerships involve sharing responsibilities of home, school and community for children's learning and development. Students must remain central for successful partnerships.

Carey, Lewis and Farris (1998), in reviewing educational statistics on parental input, found that schools did not consider parental input to a great extent in making decisions on school issues. However, the schools reported giving the most consideration on the issue that directly relates to parents—the development of parent involvement activities. Approximately one-third (31 percent) of schools considered parent input to a great extent on this issue, and 37 percent considered it to a moderate extent. And interestingly, as noted by Carey et al. (1998), consideration of parent input did not vary across school characteristics.

Parental involvement programs display variety as exemplified by the many types of strategies that have been developed to promote such involvement. Kellaghan et al. (1993) suggest that one way to categorise these strategies is by the extent to which
they focus on formal learning and teaching. Proximal activities focus on teaching and learning. An example of proximal activities would be parents’ involvement in learning activities at home or parental involvement in instruction at school (for example, as a teacher aide). Intermediate activities would include communication between schools and parents regarding school programs and children’s school progress. And distal activities would include activities encompassing basic provision for the health, nutrition, safety, and general well-being of children or parental involvement in parent-teacher associations (Kellaghan et al., 1993).

Auerbach (1990) observes that many of the existing family education programs follow a ‘transmission of school practices model’ (p. 17) in which knowledge is transmitted from teachers to children and from the schools to parents to children. The following practices were noted as the most prevalent in this transmission model program:

- giving parents guidelines, materials, and training to carry out school-like activities in the home
- training parents in effective parenting
- teaching parents about the culture of schooling
- developing parent language and literacy through skills, grammar, and behavioural approaches.

Carey et al. (1998) found that the majority of public elementary schools (79 percent) reported having an advisory group or policy council that included parents. Inclusion of parents in such an advisory group was related to the size of the school and the percentage of minority students enrolled in the school. Small schools were less likely than moderately-sized or large schools to report including parents on such councils (66 versus 83-85 percent), whereas schools with minority enrolments of 20 percent or more were more likely to report having an advisory group that includes parents than were schools with minority enrolments of under 5 percent (86-89 versus 70 percent).

The findings reported by Carey et al. look quite different when examined by poverty and minority enrolment in the school. Specifically, Carey et al. (1998) report that more schools with poverty concentrations and minority enrolments of 50 percent or
more perceived the following issues to be barriers than did schools low on these characteristics:

- lack of parent education to help with school work
- cultural or socioeconomic differences
- language differences between parents and staff
- parent attitudes about the school
- staff attitudes toward parents
- concerns about safety in the area after school hours.

DeCarbalho (2001) perceives that the current policy framework considers parental involvement as a resource for school success. Traditionally schools and teacher have depended on and requested family or parental collaboration. Parental involvement in schooling has been identified as a main factor of educational achievement. Because of this belief, policies regarding parental involvement have turned previously informal and limited parental involvement into a mandate. As families, schools and communities have changed and grown in diversity and complexity, so too should the role of educational policy.

As described in this section, parental involvement is recognized as an essential component for a successful school. While past policies have focused on informing parents about the appropriate way in which to help their children with school, Epstein (2001) proposes a partnership approach instead. My study embraced this concept of partnership by asking parents what they want for their children in terms of the classroom learning environment.

### 2.2.2 Educational Goals

During the 1980s and 1990s, the field of school, family, and community partnerships was awakened by activities in research, policy, and practice. In 1994, United States Congress added a new national educational goal for school and family partnerships to the major federal legislation called Goals 2000: Educate America Act (Epstein, 2001). Other federal, state, and local policies have been and are being developed that mandate and encourage partnerships between the home and school (Carey et al., 1998). Along with curriculum, instruction, evaluation, and staff development, a
program of school, family, and community connections is now viewed as one of the factors that help to promote success in school (Epstein, 2001).

With the passage of the Goals 2000: Educate America Act, there has been a renewed commitment to improve the education of all students. Preparing students for the challenges of the future is not the sole responsibility of schools. Discussions about how to improve the quality of education in America have focused attention on the roles of family and community, and research supports the belief that high-quality education cannot be successfully accomplished without the active involvement of parents (Carey et al., 1998). Studies have shown that parent involvement in children’s learning can have a positive effect on students’ achievement and reduce the school dropout rate (U.S. Department of Education, 1994).

Goal 8 of the National Education Goals stipulates that schools will actively engage parents and families in a partnership that supports the academic work of children at home and shared educational decision making at school (Carey et al., 1998). Increasingly, leaders in school districts and state departments of education are writing policies and setting goals to improve school, family, and community partnerships (Epstein, Williams & Lewis, 2002).

My study not only looked at what parents believed was happening in their children’s science classroom (science learning environment), but also looked at what parents would like to happen in their children’s science classroom. The questionnaires used in my study offer a practical way for schools to assess what parents think about their children’s classroom environment, thereby offering one way to engage parents and families in a partnership as described in Goal 8 of the National Educational Goals.

2.2.3 Family Research: A Growing Field of Study

The distant cultural origin of the current appeal to the family seems to be found during the colonial era of the common school when parents initiated the hiring of teachers in order to teach their children within rural communities (Church & Sedlak, 1976; Guest & Tolnay, 1985; Kaestel, 1983). Increasing rates of student failure and
dropout in the last 20 years have sparked renewed interest in the family and the importance of parental involvement in the child's ability to learn (McCaleb, 1997).

In the late 1960s and 1970s, researchers argued heatedly about whether schools or families were more important (Epstein, 2001). The joint contributions of schools and families were summarily acknowledged. The debate changed, as it became increasingly clear that neither schools nor families alone could do the job of educating and socialising children and preparing them for life. Schools, families, and communities share responsibilities for children and influence them at the same time. In the 1960s, the topic of parent involvement gained prominence with the implementation of Federal Head Start and Follow-Through programs in preschool and early elementary grades. These programs legislated the involvement of low-income parents in the education of their young children in an attempt to prepare them for successful entry into school.

In the 1980s, studies began to clarify the term ‘parent involvement’ and recast the emphasis from parent involvement (left up to the parent) to school and family partnerships. Researchers collected data to identify separable components of involvement and began to focus more rigorously on measuring results of involvement for students, parents, and educators (Epstein, 2001). The shared responsibility removed from parents part of the burden of figuring out on their own how to become or stay involved in their children’s education.

Epstein (2001) asserts that the interest and action in this field of study are evident by the growth of research papers presented at annual meetings of the American Educational Research Association (AERA). In the late 1980s, few papers at the AERA focused on topics concerning families. Now, Epstein points out that multiple labels are needed to index presentations on family involvement, school partnerships, parent participation, fathers, mothers and other related terms. As expected, in a growing field, researchers debate assumptions, definitions and interpretations of results (Coleman, 1987; Lareau, 1989, 1996).

Individuals are deeply affected by the social matrix in which they are established. New assessment procedures are available to identify the most salient aspects of school
and classroom setting (Moos, 1991). Such methods can be used to describe distinctive types of learning environments. These methods can also be used to examine how learning environments influence student moral and academic performance and to understand why some classrooms and schools are much more cohesive and task oriented than others. With this information, educators can create more satisfying and effective educational settings.

With Moos’ (1991) research in mind, my study examined how perceptions of the learning environments were associated with student achievement and attitudes. And furthermore, recognizing that individuals are deeply affected by the social matrix of their families, parents’ perceptions of the learning environment also were examined for their association with student outcomes.

2.2.4 Home and School Settings

Children live their lives in two worlds: the home and the school. When these two worlds fail to know, respect, and celebrate each other, children are placed in a difficult position (McCaleb, 1997). All schools serve children and families. Without exception, teachers and administrators have explicit or implicit contact with their students’ families every day (Epstein, 2001).

Many educators enter schools without adequately understanding the backgrounds, languages, religions, cultures, histories, structures, races, social classes or other characteristics of their students or families (Epstein, 2001). The children of new immigrants make up a growing percentage of students in United States public schools today. Across the country, teachers are challenged to teach this diverse population of students, who bring to school a wide variety of cultural practices and languages. The parents of these students, like most parents everywhere, have high aspirations for their children (McCaleb, 1997). School and home appear to be becoming more distant from each other. Schools have been slow to adjust to the changing environments in families from which many of their children come. Increasingly, teachers are strangers in the community; it is becoming rare for families and children to feel a sense of belonging to a particular community, let alone a school (Families and Schools, 1995).
With increased fragmentation of responsibility for child rearing, the family still remains central to the guidance of children for academic learning. While earlier research focused primarily on the relationship between family status and family structure on scholastic performance, more recent studies have examined the family as a support system (Families and Schools, 1995).

Researchers recognize that various characteristics of the individuals inhabiting a particular environment – average age, ability level, socioeconomic background, educational attainment, and the like – can be considered as situational variables in that they partially define relevant characteristics of the environment. The approach implies that the character of an environment is dependent on the nature of its members, and its dominant features on their typical characteristics (Moos & Insel, 1974).

Walberg has proposed a nine-factor model of educational productivity in which student outcomes are co-determined by three student aptitude variables, the quantity and quality of instruction, and the psychosocial environments of the school/class, the home, the peer group and the mass media (Fraser, Walberg, Welch, & Hattie, 1987; Walberg, 1981). The model holds that no single factor alone has a huge impact on learning and, to increase achievement, several factors need to be aligned and raised simultaneously (Walberg, 1981). Only a few studies have attempted to establish the joint influence of the school/class, home and peer environments on students’ achievement and attitudes. My study attempted to determine the influence of both parents’ and students’ perceptions of the science learning environment on student outcomes.

In a secondary analysis of a national data base, the environments of the class and home were found to be significant independent predictors of achievement and attitude (Walberg, Fraser, & Welch, 1986). Using this model, Fraser, Kahle, Scantlebury and Meece (1999) analysed data from a questionnaire that had been administered to science and mathematics students at the middle school level. Part of the questionnaire assessed student perceptions of their class, home and peer environments. The sample consisted of 34 classes in 1995, 97 classes in 1996 and 60 classes in 1997. This study confirmed a strong and consistent factor structure for measures of student perceptions of their class, home and peer environments. All three environments accounted for
statistically significant amounts of unique variances in student attitude, but only the environment of the class accounted for statistically significant amounts of variance in student achievement scores. Walberg’s model of educational productivity suggests that improvements in student attitudes are likely to be obtained by aligning and optimising all three environments of the class, home and peer group.

While past analyses of the home, school and peer environments are not precisely parallel to my study, it was hypothesised that parents’ and students’ perceptions of the science learning environment each would be significant predictors of student achievement and attitudes in my study.

Individuals are affected profoundly by the social matrix in which they are embedded. School, work, and family settings can be described in terms of a set of conceptually-related dimensions that appear to have common influences. Educational researchers have pursued ways to conceptualise and measure learning environments and their determinants and impacts.

For this purpose, three social climate scales were developed to characterise the three types of settings: the Classroom Environment Scale (CES; Moos & Trickett, 1987), the Work Environment Scale (WES; Moos, 1981) and the Family Environment Scale (FES; Moos & Moos, 1986). Each of these three instruments measures Moos’ (1974) three underlying sets of dimensions: relationship dimensions, personal growth or goal orientation dimensions, and system maintenance and change dimensions. The three sets of dimensions have been linked to indexes of moral constructs, self-confidence, and well being, as well as to academic performance and school behaviour. Some emphasis on each of the three areas facilitates positive social and performance outcomes, but too much focus on any one area can raise problems.

Academic self-concepts are closely related to school learning. Measures of academic self-concept (an individual’s perception of himself/herself as a learner) account for up to 25 percent of the variation in achievement (Families and Schools, 1995). Moos (1991) found that, compared to indexes of academic achievement, the distal criteria of intrinsic motivation to learn, family and other contextual factors probably affect general self-confidence and a sense of personal efficacy more strongly.
How Moos' (1987) three social climate domains characterise the three types of settings of classroom, work, and family are outlined in Table 2.1.

<table>
<thead>
<tr>
<th>Type of Setting</th>
<th>Social Climate Domain</th>
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<tbody>
<tr>
<td>Classroom</td>
<td>Involvement</td>
<td>Task Orientation</td>
<td>Organization</td>
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<tr>
<td></td>
<td>Affiliation</td>
<td>Competition</td>
<td>Clarity</td>
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<td></td>
<td>Teacher Support</td>
<td></td>
<td>Teacher Control</td>
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<tr>
<td>Work</td>
<td>Involvement</td>
<td>Autonomy</td>
<td>Clarity</td>
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<tr>
<td></td>
<td>Peer Cohesion</td>
<td>Task Orientation</td>
<td>Control</td>
</tr>
<tr>
<td></td>
<td>Supervisor Support</td>
<td>Work Pressure</td>
<td>Innovation</td>
</tr>
<tr>
<td>Family</td>
<td>Cohesion</td>
<td>Independence</td>
<td>Organization</td>
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<tr>
<td></td>
<td>Expressiveness</td>
<td>Achievement</td>
<td>Control</td>
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<td></td>
<td>Conflict</td>
<td>Intellectual-Cultural</td>
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<td></td>
<td></td>
<td>Active-Recreational</td>
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<tr>
<td></td>
<td></td>
<td>Moral-Religious</td>
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</table>

a Classroom Environment Scale (Moos & Trickett, 1987)
b Work Environment Scale (Moos, 1981)
c Family Environment Scale (Moos & Moos, 1986)

By considering the dynamic interactions among these three primary institutions (school, work, and family settings), behavioural and social scientists can make important new contributions toward understanding the broader implications of educational processes (Moos, 1991). Classroom teachers have the ability as well as the responsibility to facilitate and help to strengthen the relationships of students with their families and communities. The strength of this relationship affects a student’s positive self-identity (Auerback, 1990). The social climate dimensions that were assessed in my study are involvement, teacher support, peer cohesion and task orientation.

2.2.5 Family Environments and Educational Outcomes

Research from around the world confirms the strong relationship between home environments and children’s school learning. As schools seek to improve their
programs, they cannot ignore the powerful influences on learning that lie outside their walls. The development of children takes place in the context of both the family and school (Families and Schools, 1995).

The belief that parent involvement in education is related to children’s learning and school performance is supported by a growing body of research (Epstein, 1991). For example, the report *Strong Families, Strong Schools* (U.S. Department of Education, 1994), concludes that, when parents are involved in their children’s learning, children earn higher grades and test scores, and they stay in school longer. Additionally, when parents are involved in a variety of ways at school, the performance of all children in the school tends to improve. Increasing family involvement in children’s learning has become a special focus in school reform efforts.

Many studies have linked aspects of the family environment to children’s cognitive and intellectual ability. Children in cohesive, stimulating, and intellectually-oriented families tend to show more rapid mental development and to perform better on visual memory, verbal communication, and reading achievement tasks (Gottfried & Gottfried, 1984). In general, adolescent development is promoted in families that encourage independence and provide modeling for instrumental and social skills, while it could be hampered by a family that emphasises achievement in the context of conflict and accommodation to restrictive rules (Moos & Moos, 1986). Conversely, children in poorly-organized families that are deficient in stimulation tend to be more maladjusted and impulsive (Gottfried & Gottfried, 1984).

There are some important connections between the family environment and school-related attitudes and performance. Academically competent children are more likely to be reared in cohesive homes that encourage independent thinking within a reasonably structured context. Students who are in family and classroom settings, both of which are high in support and structure, have the highest scholastic self-concepts. Thus some aspects of family and classroom environment can amplify each other in promoting students’ personal growth (Moos, 1987).

Marjoribanks (1986) examined connections between family and school characteristics and children’s outcomes. He found that boys who had the support of an academically-
oriented family, and who saw their high school environment as more intellectual and permissive, had a better academic self-concept and showed more enthusiasm for school.

Studies indicate that children who do well in school come from families that provide a supportive and enriched environment for learning in the home. Likewise, Walberg et al. (1986) have shown that more stimulating classroom environments and home environments that are more oriented toward learning each independently help to predict more positive attitudes toward science and better science achievement. Conversely, children who do less well in school often come from families in which support for school learning is limited or in which there are serious differences and discontinuities between what is taught at home and how it is taught, and what is expected at school (Families and Schools, 1995).

Joint school and family effects are likely to be most powerful when there is psychological continuity between the home and the school. Hansen (1981), by focusing on the rules guiding interpersonal interactions in families and schools, defined three types of families and three types of classrooms. Cohesive settings are strong in communal and exchange rules. Coercive settings are strong in exchange rules but weak in communal rules. Laissez-faire settings are weak in both communal and exchange rules. Children from cohesive families tend to obtain higher grades than children from the other two types of families. As one would expect, children achieve better in classrooms with interaction rules that are similar to those that they experience in their families (Hansen, 1981).

Children of well-educated parents learn, in their homes, to master teaching and learning processes that are similar to those that occur in school, thus giving these children an advantage over children who do not (Laosa, 1982). Conversely, the academic underachievement and high dropout rates of children from families of low socioeconomic status could be due to an abrupt discontinuity or mismatch between their home and school environments (Laosa, 1984; Lightfoot, 1978).

Kellaghan et al. (1993) propose that the idea of regarding the problems of all children from non-Western cultures in Western schools as similar becomes questionable when
we consider the vast range of cultures. Because of these variations, our understanding of the problems experienced by children from non-Western backgrounds in Western schools remains limited.

Parent-child interactions in the average white home have been found to look a lot like the types of interaction that one would expect to find in a school than do parent-child interactions in the average Hispanic family (Kellaghan et al., 1993). As a result, the Hispanic child is more likely to experience discontinuity between the teaching practices and styles of home and school. The discontinuity hypothesis is based on the premise that an environment fosters the development of the particular knowledge, skills, learning styles, and values that have adaptive value for individuals living in it.

One can apply this reasoning to children making the transition from home to school and conclude that, because homes and schools differ in the demands that they make on individuals, all children will experience some problems with discontinuity when they go to school (Kellaghan et al., 1993). Laosa (1984) believes that the academic underachievement and high dropout rates of children from families of low socioeconomic status might be due to an abrupt discontinuity or mismatch between their home and school environments. However, the cultural discontinuity hypothesis cannot account for all of the variance in school achievement (Kellaghan et al., 1993).

Academic indicators such as grades and test scores explain an average of less than three percent of the variance in indices of adult occupational performance (Samson, Graue, Weinstein, & Walberg, 1984). Thus we need to consider such educational goals as the development of social competence, academic and general self-efficacy, and intrinsic motivation to learn. Compared to grades and other indices of academic achievement, these distal criteria probably are affected more strongly by family and contextual factors. According to Rich (1997), all parents can and should teach qualities such as motivation, perseverance, initiative and effort that help children to think positively and respect themselves.

The family practices that prepare a child for school are influenced by parents' educational and occupational backgrounds, as well as by the social-psychological aspects of their work. In turn, schools educate children for broader family and social
roles that will affect their values and attitudes as they mature. Extending the family research that says school and family effects are likely to be most powerful when there is psychological continuity between the home and the school (Hansen, 1981), my study offers a convenient way to assess students’ and parents’ perceptions. While there is no way to change the educational and occupational backgrounds of students, educators could open a dialogue with parents. This dialogue could create a common starting place to examine classroom learning environments.

2.2.6 Perceptions of Parents

Parental characteristics, such as their attitudes toward education, their interest in their children’s education, and their belief in the value of schooling, account for more of the variation in children’s school achievement than either the parents’ material circumstances or various school circumstances (Families and Schools, 1995). The perceptions of students, parents, and the neighbouring community are key components in creating an atmosphere where teachers can teach, students can learn, parents can take an active role in the education of their children, and excellence can be achieved. Many school districts have based their measure of school climate on the perceptions of teachers, principals, and sometimes students (Stevens & Sanchez, 1999).

Epstein (2001) found that parents in general had positive attitudes about their public elementary schools teachers. Parents of 1,269 students in 82 first, third, and fifth grade classrooms in Maryland completed and returned by mail questionnaires about parent involvement practices of their children’s teachers. Despite generally positive attitudes, parents believed that the schools could do more to involve them in learning activities in an attempt to help their children at home.

Borger, Lo, Oh, and Walberg (1985) identified, through a review of 205 research studies, eight factors characterising effective schools: leadership, school climate, teacher/student relations, curriculum instruction, finance, physical environment, evaluation, and parent/community. Of the 205 studies reviewed in Borger et al. (1985), 96 percent found that school climate is positively associated with academic effectiveness. Coleman (1984) emphasised the importance of parent perceptions, as
well as teacher perceptions, both in ascertaining the climate of a school and in determining how to improve it.

Stevens and Sanchez (1999) constructed and administered a parent survey with the following constructs of school climate: Instructional Environment, Instructional Process, Communication, and Administration. The student/parent/community surveys were part of the Houston Public School district’s effort to evaluate and improve their effectiveness. An analysis of the parental survey results showed that the highest levels of positive parental feedback concerned the Instructional Environment and Instructional Process. The Instructional Process construct concerns activities and planning by teachers that directly impact on student learning in the classroom. The Instructional Environment construct focuses on issues of academic expectations, fairness, assistance to achieve at the highest level, and resources.

The home and school share responsibility for the education of the young, but this relationship is far from spontaneous. Instead, it is contrived, shaped and directed by differing perspectives, even when the milieu inhabitants possess the same expectations, values, and goals (Cutler, 2000). Distinct and yet necessarily interdependent, parents and teachers have a symbiotic relationship. The challenge facing parents and teachers might be different today, but it is not unprecedented.

Communication is the key to reaffirm the interdependence of the school and the home. Each has a related task to perform than can only be achieved through collaboration (Cutler, 2000). By asking parents and community members to express their views and expand their involvement, school districts provide these stakeholders with a definite role, predisposing them toward a more positive attitude about their children’s education (Stevens & Sanchez, 1999). Past research has shown that parents’ attitudes towards education and beliefs about school climate are positively associated with student academic achievement (Borger et al.; Coleman, 1984; Families and Schools, 1995). My study makes an original contribution by using a learning environment questionnaire that examined associations between parent perceptions of the learning environment and student outcomes (achievement and attitudes).
2.2.7 Summary of the Research on Families and Schools

Families and schools are linked in their mutual aspirations for children. Many researchers (Kellaghan, Sloane, Alvarez & Bloom, 1993; Marjoribanks, 1999; McCaleb, 1997; Moos, 1991) acknowledge that education takes place within the context of community and family and that the school learning and home environment are highly linked (Kellaghan et al., 1993). Many of these researchers have advocated extending the traditions of learning environment research involving students also to involve their parents. That is precisely the thrust of this study: an examination of perceptions of parents and students of the science learning environment.

As described in this section, parental involvement is recognized as an essential component for a successful school (Epstein, 1991, 2001; U.S. Department of Education, 1994). My study embraced this concept of partnership by asking parents what they want for their children in terms of the classroom learning environment.

With Moos’ (1991) research in mind, my study examined how perceptions of the learning environments influenced student academic and attitudinal outcomes. And furthermore, recognizing that individuals are deeply affected by the social matrix of their families, parents’ perceptions of the learning environment were examined for associations with student outcomes. Past research has shown that parental attitudes towards education and beliefs about school climate are positively associated with student academic achievement (Borger et al.; Coleman, 1984; Families and Schools, 1995). My study pioneers the use of a learning environment questionnaire in examining associations between parent perceptions of the learning environment and student outcomes (achievement and attitudes).

As schools seek to improve their programs, they cannot ignore the strong relationship between home environment and children’s school learning. Research (Hansen, 1981) confirms that joint school and family effects are likely to be most powerful when there is psychological continuity between the home and the school. Extending the concept of psychological continuity to the present study, it is hypothesised that students will display higher achievement and have more positive attitudes towards science when there is congruence between the actual and preferred environment.
An examination of past studies involving families shows that schools tend to dictate to parents how they should help their child. Instead of this model, Epstein (2001) proposes that a ‘partnership’ approach in which families and schools work together to share information. It is the intent of this study to honour Epstein’s ‘partnership’ approach by asking students and parents not only what is happening in the science class, but also asking them to identify their ideal science class.

2.3 Science Education

Because this study examines the science learning environment of 9-11 year-old students, an overview of science education in the United States (Section 2.3.1), current curriculum mandates (Sunshine State Standards) (Section 2.3.2) and classroom practices (Section 2.3.3) that affect achievement and attitudes in science are provided in this section.

2.3.1 Science Education in the United States

The years 1955-1974 have been called the Golden Age in Education because of the prominent position which education held in the United States. The Sputnik crises in 1957, in which the United States believed that it was losing a competitive edge in science and technology to Russia, and criticisms by scientists levied against science education for not mirroring the nature of science, helped to fuel this era. Shifts in the role of the student and the teacher needed to occur for the new curricula to be successful. The student had to change from a passive consumer of authoritative knowledge to an active producer of concepts and generalisations (Krajcik, Mamlik, & Hug, 2001).

Currently, support for reform is unprecedented in the history of American education. By the early 1990s, more than 300 reports admonished those within the educational system to reform science education (Bybee, 1995). Scientific and technological literacy was the main purpose of science education in K-12 since the 1960s.

Significant differences exist between the 1960s and 1990s reforms. The 1960s reform began at the secondary level and progressed to the elementary level. In the 1990s,
reforms generally addressed all levels, but the specific curriculum reform began at the elementary school level. A second difference in the 1990s reform is that there were fewer curriculum projects at the national level. Reform efforts were initiated through state-level frameworks. And a final difference is the influence of national standards and benchmarks in the 1990s (Bybee, 1995).

2.3.2 Sunshine State Standards

The Sunshine State Standards are the centrepiece of a reform effort in Florida aimed at aligning curriculum, instruction and assessment. They identify what students should know and be able to do in the 21st century. School districts are required to incorporate provisions for instruction in the Sunshine State Standards (Sunshine State Standards, 2002).

Originally the standards were structured into benchmarks clustered by grade levels: K-2, 3-5, 6-8 and 9-12. However, the expanding national trend toward standards-based reform and accountability resulted in the State of Florida's decision to produce statewide Grade Level Expectations in January 1999. The Science Sunshine State Standards are organized into eight strands with two to three benchmarks per strand.

The Grade Level Expectations are not intended to take the place of a curriculum guide, but rather to serve as the basis for curriculum development to ensure that the curriculum is rich in content and delivered through effective instructional activities.

Miami-Dade County Public School System's science curriculum is outlined in the Competencies Based Curriculum (Dade County Public Schools, 1995). These Competencies are based on the content standards of the National Science Education Standards and are related to Florida's Sunshine State Standards for Science. The CBC (1995) states that learning is an active process and something that students do, not something that is done to them. Furthermore 'hands on' activities are not enough. Students must have 'minds-on' experiences as well.

During the twentieth century, scientists and educators have been concerned that school science reflects the actual practice of science, with respect both to the content
that students learn and to the actual way in which scientists work. Because experimenting involves ‘learning by doing’, there can be no substitute. Pupil experimentation is an essential part of good science education. In every course of science offered at any level, opportunities should be provided for the pupils to perform experiments (Krajeck et al., 2001). Given that experimenting, minds-on and hands-on investigations are a major thrust of the science curriculum, it is noteworthy that this aspect of the curriculum is assessed by numerous scales of the WIHIC (see Section 2.4.6).

2.3.3 Classroom Practices that Affect Achievement and Attitudes in Science

O’Sullivan and Weiss (1999) reported classroom practices that relate directly to students’ performance in science and to school climate based on survey data collected from the National Assessment of Educational Progress (NAEP) Science Assessment in 1996. The results showed that eighth grade teachers who reported placing a heavy emphasis on developing laboratory skills had students who were more likely to perform at or above the Proficient level when compared to teachers who reported placing less emphasis on developing laboratory skills. Other research supports the importance of including hands-on investigations in terms of the students’ transition from concrete thinking to more formal operation thinking (Saunders & Shepardson, 1987). Research shows that misconceptions are most likely formed when new concepts are presented in a narrow context, such as a classroom lecture and that this is true even for teachers (Stepans, Dyche, & Beiswenger, 1988).

O’Sullivan and Weiss (1999) found that 67 percent of the fourth grade students surveyed liked science and that those who said that they liked science outperformed those who said that they did not like science. Similarly an international assessment of nine to thirteen year-old students in 20 countries (IAEP, 1992) revealed that attitudes associated with science affect student participation and performance in science.

Two other aspects that the IAEP (1992) revealed could influence science achievement and attitudes towards science are race and ethnicity. Mickelson (1990) reported that, despite low levels of achievement in science, minority students, especially African-Americans, paradoxically indicated positive attitudes toward science.
Studies on gender show that females avoid additional science courses (Archer & McDonald, 1991; Maple & Stage, 1991) and become less confident about their academic skills (Linn & Hyde, 1989). Kahle and Damnjanovich (1997) report that, while boys' and girls' interest in a science as a career are the same in the seventh grade, most girls lose interest by the eleventh grade. One study, involving fourth and fifth grade students' attitudes following a week-long hands-on electricity unit, showed that the girls displayed significantly improved attitudes towards doing electrical activities. This finding suggests that some negative attitudes might be based on lack of experience (Kahle & Damnjanovich, 1997).

Equity in the classroom has concerned educators for the past 20 years (Kahle & Damnjanovich, 1997). As in past research, my study examined the connection between equity, investigation and other classroom learning dimensions and student outcomes (attitudes and achievement).

In summary, Section 2.3 has helped to set the scene for my study of science classroom environments in South Florida. In particular, this section considers salient aspects of the current state of science education in the United States (Section 2.3.1), the current standards for science education adopted in the state of Florida (Section 2.3.2), and some past research into classroom practices that influence students' outcomes in science.

2.4 Learning Environments

My study draws on and contributes to the field of learning environments research, which provides the framework for assessing students' and parents' perceptions of the science learning environment.

Traditionally, many educators have focused their attention exclusively on student achievement. The quality of school and classroom life, however, also is important and deserves the serious attention of researchers and educators (Fraser, 1998a). Much of the past research in the field of learning environments has focused on the students' perceptions of the learning environment and its effects on student outcomes (Fraser,

There is a wide variety of economical and valid questionnaires that have been used for the past 25 years to assess students' perceptions of the learning environment (Fraser, 1998a) (see Section 2.4.5). A highlight in the use of these questionnaires includes the investigation of differences between actual and preferred classroom environment (Fisher & Fraser, 1983) (see Section 2.4.3). Additionally, qualitative methods for assessing the learning environment have been combined with the quantitative methods to provide additional support for the validity of questionnaires and plausible explanations for the findings from questionnaire data (Fraser & Tobin, 1991; Tobin, Kahle & Fraser, 1990; Tobin & Fraser, 1998) (see Section 2.4.8).

This section (2.4) first looks at the historical foundations of the field of learning environment (Section 2.4.1). Next, school, class and personal levels of learning environment research are explored (Section 2.4.2) and actual and preferred forms are discussed (Section 2.4.3). The use of learning environment questionnaires to compare teacher and student perceptions is presented in Section 2.4.4. An overview of learning environment questionnaires (Section 2.4.5), along with a more detailed description of the questionnaire used in this study (the WIHIC), is provided in Section 2.4.6. Associations between student outcomes and the learning environment are explored in Section 2.4.7. This section concludes with a review of the advantages of combining qualitative and quantitative research methods (Section 2.4.8).

2.4.1 Foundations of the Field of Learning Environments

Learning environment research has been influenced by the notable theoretical, conceptual, and measurement foundations set over 50 years ago by pioneers like Lewin (1936) and Murray (1938) and their followers, such as Pace and Stern (1958). Lewin formulated his idea in the form of an equation, $B=f(P,E)$. Behaviour $B$ is a function $f$ of the person $P$ and the environment $E$. Murray proposed a needs-press model to explain an individual's behaviour within an environment as the result of the interaction between a person's needs and the external environment. Murray also introduced the terms alpha press and beta press. Alpha press refers to an environment
as perceived by an external observer and \textit{beta press} is what is perceived by milieu inhabitants.

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

Using Lewin's, Murray's and Stern et al.'s pioneering research into home, work and school settings, Walberg and Moos began the new field of research focused on classroom learning environments over 30 years ago (see Section 2.2.4 on home and school settings). Walberg developed the Learning Environment Inventory (LEI) as part of the research and evaluation activities of Harvard Physics Project (Walberg, 1979; Walberg & Anderson, 1968). Simultaneously, Moos developed social climate scales for varying human environments including the Classroom Environment Scale (CES) (Moos, 1979a; Moos & Trickett, 1987).

\subsection*{2.4.2 School, Class and Personal Levels in Environmental Research}

School climate is the heart and soul of a school. (Freiberg & Stein, 1999)

Freiberg and Stein propose that school climate should be measured from multiple perspectives, and throughout the school year. Additionally, continuous improvement requires continuous information about the learner and the learning environment.

The fields of classroom-level and school-level environment have remained remarkably independent. One feature of school-level environment work, which distinguishes it from classroom-level environment research, is that the former has tended to be associated with the field of educational administration and to rest on the assumption that schools can be viewed as organizations. It is useful to distinguish between classroom or classroom-level environment and school or school-level environment, which involves psychosocial aspects of the climate of whole schools.
(Anderson, 1982; Fraser & Rentoul, 1982; Genn, 1984). This study investigated the science learning environment at the class level.

Fraser and Tobin (1991) proposed that, at that time, there was a problem with the existing classroom environment instruments when using them to differentiate between subgroups within a classroom or in the construction of case studies of individual students. The problem was that the items were worded to obtain an individual student’s perception of the class as a whole rather than a student’s perception of his/her own role within the classroom. For example, an item in the traditional class form seeks students’ opinions about whether “the work of the class is difficult”. The personal form of the same item would ask whether “I find the work of the class difficult”.

Other studies have found that there could be different learning environments within one classroom (Tobin, 1987; Tobin & Gallagher, 1987). For example, classroom observations and interviews involving teachers and students in one study (Fraser & Tobin, 1991) suggested that there were groups of students termed ‘target’ students who were more involved in classroom discussions than other students. These ‘target’ students were found to have more favourable perceptions of the learning environment than those students less involved (Tobin, 1987; Tobin & Gallagher, 1987).

This distinction between class and personal forms allows researchers to investigate differences between the class means for the two forms and between the magnitudes of associations between achievement and environment for the two forms. The distinction between personal and class forms is consistent with Stern, Stein and Bloom’s (1956) terms of private beta press, the individualised view that each person has of the environment, and consensual beta press, the shared view that members of a group hold of the environment (Fraser, 1998a). The personal form of a classroom environment instrument was utilised in this study and was useful for integrating the questionnaire findings with the qualitative findings.
2.4.3 Actual and Preferred Forms

A distinctive feature of most learning environment questionnaires is that they not only have a form to measure the 'actual' classroom environment, but they also have a form to measure 'preferred' classroom environment (Fraser, 1998a). The preferred forms are focused on the classroom environment ideally liked or preferred. Although the wording is similar for actual and preferred forms, different instructions for how to answer each are used. For example, an item in the actual form would be changed from the wording "There is a clear set of rules for students to follow" to the wording "There would be a clear set of rules for students to follow" in the preferred form.

In a practical attempt to improve classroom environment, Fraser and Fisher (1986) used the actual and preferred forms of the CES (Classroom Environment Scale) developed by Rudolf Moos at Stanford University (Moos, 1974). The procedure incorporated to improve the classroom environment followed five steps. First, the CES's actual and preferred forms were administered to all students. Second, the teacher was provided with feedback information derived from student responses. Third, the teacher engaged in reflection and discussion about the results in order to provide a basis for a decision about whether an attempt would be made to change the environment. Fourth, the teacher introduced an intervention of approximately two months in duration in an attempt to change identified areas of the learning environment. And finally, the student actual form of the scale was re-administered at the end of the intervention to assess changes.

Examination of pretest-posttest difference revealed significant differences for the learning environment dimensions of Teacher Support, Task Orientation, and Order and Organization. Two of the three dimensions on which appreciable changes were noted were those on which the teacher had attempted to promote change. Other examples of the use of actual and preferred forms of classroom environment questionnaires in attempts to improve the learning environment are Yarrow, Millwater and Fraser (1997), Thorp, Burden and Fraser (1994) and Sinclair and Fraser (2002).

Research has indicated that an actual-preferred match could be as important as the actual classroom environment in predicting student achievement of important
affective and cognitive aims (Fraser, 1998a). Having both actual and preferred forms of classroom environment instruments permits exploration of whether students achieve better when there is a higher similarity between the actual classroom environment and that preferred by students (Fraser, 1998a). The practical implication of these findings is that changing the actual classroom environment to be more congruent with that preferred by the class might enhance class achievement of certain outcomes (Fraser 1994; Fraser & Fisher, 1983).

My study utilised the actual and preferred forms of the What is Happening in this Class? (WHIC) questionnaire (see Section 2.4.6) to investigate the differences between students and parents in their perceptions of the science classroom learning environment.

2.4.4 Teacher and Student Perceptions of the Learning Environment

The separate actual and preferred forms allows investigations of differences between students and teachers in their perceptions of the same actual classroom environment and of differences between the actual environment and that preferred by students or teachers (Fraser, 1998a).

Fisher and Fraser (1983) used a sample of 116 classes of students in Tasmania in comparing the student actual with the student preferred learning environments. Also comparisons were made between students and teachers in their perceptions of the actual learning environment. Students preferred a more positive classroom environment than was present for all five learning environment dimensions. Additionally, teachers generally perceived a more positive classroom environment than did their students in the same classroom.

These results replicate patterns emerging in other studies in school classrooms in the USA (Moos, 1979a), Indonesia (Margianti, Fraser & Aldridge, 2002), Israel (Raviv, Raviv, & Reisel, 1990), Canada (Raaflaub & Fraser, 2002) and Australia (Aldridge, Fraser, Fisher & Wood, 2002; Fraser, 1982, 1985), as well as in other settings such as hospital wards and work milieus (Moos, 1974, 1979b). These studies inform educators that students and teachers are likely to differ in the way in which they
perceive the actual environment of the same classrooms, and that the environment preferred by students commonly differs from that actually present in classrooms.

Based on the past research, for which differences were found between teachers 'and students' perceptions of the learning environment, my study examined whether parents and students would also differ in their perceptions of the science learning environment.

2.4.5 Learning Environment Questionnaires

The field of learning environments over the past three decades has displayed a wide variety of economical, valid and widely-applicable questionnaires for assessing student perceptions of classroom learning environments (Fraser, 1998a, 1998b).

Initial development and validation of the Learning Environment Inventory (LEI) began in the 1960s in conjunction with evaluation and research related to Harvard Project Physics (Fraser, Anderson & Walberg, 1982; Walberg & Anderson, 1968). The final version contains 15 scales with 7 items each, making a total of 105 statements descriptive of the then typical school classroom. The LEI was simplified to create the My Class Inventory (MCI) for use with children aged 8-12 years (Fisher & Fraser, 1981; Fraser et al., 1982; Fraser & O'Brien, 1985). Although the MCI was developed for use with elementary school children, it also has been found useful for students at the junior high school level, especially those students with limited reading skills. The number of scales was reduced from 15 to 5 and the wording was simplified to enhance readability. The final form of the MCI contains 38 items, although Fraser and O'Brien (1985) developed a shorter 25-item version. Recently, Goh and Fraser (1998) and Majeed, Fraser and Aldridge (2002) utilised the MCI to assess the classroom learning environment.

The Classroom Environment Scale (CES) (Fisher & Fraser, 1983b; Moos, 1979a; Moos & Trickett, 1987) was developed out of comprehensive research at Stanford University involving perceptual measures of human environments including psychiatric hospitals, prisons, university residences and work milieus (Moos, 1974). The final version contains nine scales with 10 items each.
The Individualised Classroom Environment Questionnaire’s (ICEQ) development was guided by literature on individualised, open and inquiry based education. The final published version (Fraser, 1990) contains 50 items with 10 items belonging to each of the 5 scales. The ICEQ differ from other classroom environment instruments in that it assesses those dimensions that distinguish individualised classrooms from conventional ones (Fraser, 1998b).

The Constructivist Learning Environment Survey (CLES) was developed to assess the degree to which constructivist teaching and learning approaches are established in the classroom (Aldridge, Fraser, Taylor & Chen, 2000; Taylor, Fraser & Fisher, 1997). While the CLES was developed to assist researchers and teachers to assess the degree to which a particular classroom’s environment is consistent with epistemological assumptions, it also provides feedback to teachers to help them to reshape their teaching practices. Recently the CLES has been used in Korea to assess classroom learning environments (Kim, Fisher & Fraser, 1999; Lee & Fraser 2001a). The final version of the CLES contains 50 items on five scales (Fraser, 1990).

Because laboratory settings in science are a unique learning environment, the Science Laboratory Environment Inventory (SLEI) was developed to assess science laboratory classes at the senior high school or higher education levels. The SLEI was simultaneously field tested and validated in six countries (the USA, Canada, England, Israel, Australia, and Nigeria) (Fisher, Henderson & Fraser, 1997). Since then, the questionnaire has also been used in Singapore (Wong & Fraser, 1996; Quek, Fraser & Wong, 2001), Brunei (Riah & Fraser, 1998), and Korea (Lee & Fraser, 2001b). The questionnaire contains 5 scales containing 7 items each (Fraser, 1998b).

Because the What is Happening in This Class? (WIHIC) questionnaire was selected for use in my study, literature related to the WIHIC is reviewed in a separate section below (Section 1.4.6).

2.4.6 What is Happening in this Class? (WIHIC) Questionnaire

The recent What is Happening in this Class? (WIHIC) questionnaire (Fraser, McRobbie & Fisher, 1996) combines modified versions of the most salient scales
from a wide range of existing questionnaires with additional scales that accommodate contemporary educational concerns (Fraser, 1998b). Because the WIHIC has a class form and a personal form, the instrument can assess a students’ perceptions of the class as a whole or assess a student’s personal perceptions of his or her role in a classroom (Fraser, 1998a). The original nine-scale 90-item version was refined by statistical analysis of data and extensive interviews of students about their views of their classroom (Fraser et al., 1996).

The final version of the WIHIC contains 8 items and 7 scales which have been used successfully in many countries: Australia (Fraser 1998b; Aldridge & Fraser, 2000), Taiwan (Aldridge & Fraser, 2000), Singapore (Fraser & Chionh, 2000), Brunei (Khine & Fisher, 2001; Riah & Fraser, 1998), Indonesia (Margianti, Fraser & Aldridge, 2002; Soerjaningsih, Fraser & Aldridge, 2001), Canada (Raaflaub & Fraser, 2002; Zandvliet & Fraser, 1999) and Korea (Kim et al., 2000). The seven scales are Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity. Within these countries, the WIHIC has been used to assess a variety of subjects including high school science (Aldridge & Fraser, 2000; Aldridge, Fraser & Huang, 1999; Moss & Fraser, 2001; Riah & Fraser, 1998), mathematics and science (Raaflaub & Fraser, 2002) and mathematics and geography (Chionh & Fraser, 1998; Fraser & Chionh, 2000). The classification of each WIHIC scale according to Moos’ scheme (see Section 2.2.4) is provided in Table 2.2.

Table 2.2 Classification of WIHIC Scales According to Moos’ Scheme

<table>
<thead>
<tr>
<th>Moos’ Climate Dimensions</th>
<th>WIHIC Scales</th>
</tr>
</thead>
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<tr>
<td>Relationship dimensions</td>
<td>Student Cohesiveness</td>
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<tr>
<td></td>
<td>Teacher Support</td>
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<td></td>
<td>Involvement</td>
</tr>
<tr>
<td>Personal development dimensions</td>
<td>Investigation</td>
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<tr>
<td></td>
<td>Task Orientation</td>
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<td></td>
<td>Cooperation</td>
</tr>
<tr>
<td>System maintenance and change dimension</td>
<td>Equity</td>
</tr>
</tbody>
</table>
Aldridge and Fraser (2000) and Aldridge, Fraser and Huang (1999) investigated the learning environments in science classes in Taiwan and Australia using the WIHIC. A Mandarin version of the personal form of the (WIHIC) questionnaire was developed for the Taiwanese students. The procedure for developing the questionnaire started with the English version of the WIHIC questionnaire being translated into Mandarin by educators in Taiwan. Afterward, the Mandarin version was back translated into English by an independent third party. The back translations were analysed to ensure that the Mandarin version retained the original meanings and concepts in the original English version. Modifications were made to the original English version of the WIHIC to create parallel questionnaires, one in English and one in Mandarin.

Recently the WIHIC was used to investigate the learning environment in Canadian mathematics and science classrooms in which laptop computers were used (Raaflaub & Fraser, 2002) and to assess students perceptions in a technology-rich learning environment in Australia (Aldridge, Fraser, Fisher, & Wood, 2002). Additionally, the WIHIC was used in the United States in evaluating an innovative science program (Lightburn & Fraser, 2002).

Because of the wide applicability of the WIHIC and impressive reliability and validity found in varying studies around the world, the What is Happening in this Class? (WIHIC) questionnaire was selected for this study. The actual and preferred versions of the WIHIC were chosen to assess students’ and parents’ perceptions of the learning environment. The learning environment scales of Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation and Equity were particularly relevant to the present study.

Translations of the actual and preferred forms of the WIHIC in my study involved the same methods as those used by Aldridge and Fraser (2000) and Aldridge, Fraser and Huang (1999) (see Section 3.3.4). Chapter 3 details the modifications that were required to make the WIHIC more appropriate for young children and their parents (see Section 3.3.1) in my study.
2.4.7 Associations between the Learning Environment and Student Achievement and Attitudes

Research has shown that there are associations between student outcomes and dimension of the learning environment (Fraser 1994; Fraser et al., 1987). Findings from prior research (Haertel, Walberg, & Haertel, 1981) are highlighted in the results of a meta-analysis involving 734 correlations from a collection of 12 studies of 10 data sets from 823 classes in eight subject areas containing 17,805 students in four nations. Learning posttest scores and regression-adjusted gains were found consistently and strongly to be associated with cognitive and affective learning outcomes. Correlations generally were higher in samples of older students and in studies employing collectivities such as classes and schools (in contrast to individual students) as the unit of statistical analysis.

The association between student perceptions of learning environment variables and student outcomes has provided a particular rationale for the use of learning environment instruments. Numerous research studies have shown that student perceptions account for appreciable amounts of variance in learning outcomes, often beyond that attributable to background student characteristics (Fraser, 1994; Fraser et al., 1987; Haertel et al., 1981). Some recent studies that have found that the psychosocial climate of classrooms is an important determinant of student outcomes include technology-rich settings (Aldridge, Fraser, Fisher, & Wood, 2002; Raaflaub & Fraser, 2002), university classes (Margianti, Fraser, & Aldridge, 2002; Soerjaningsih, Fraser & Aldridge, 2001), biology classes (Henderson, Fisher & Fraser, 1995) and chemistry classes (Wong & Fraser, 1996; Riah & Fraser, 1998). Each of these studies replicates previous studies which have shown a consistent association between classroom environments and student outcomes. The practical implication from this research is that student outcomes might be improved by creating classroom environments found empirically to be beneficial to learning.

As in past research, my study examined the association between students’ perceptions of the learning environment and students’ outcomes. Additionally, my research is the first to use the WIHIC to examine associations between parents’ perceptions of the learning environment and students’ outcomes.

40
2.4.8 Combining Qualitative and Quantitative Methods

The field of learning environments, while offering a wide variety of valid quantitative instruments from which to choose, also includes many fine studies that have used qualitative or interpretative methods (Fraser, 1998a). These studies include research on exemplary science teachers (Fraser & Tobin, 1989), a study of higher-level learning (Tobin, Kahle & Fraser, 1990), a study of a teacher-researcher teaching science in a challenging school setting (Fraser, 1999), and a cross-cultural study of learning environments in Taiwan and Australia (Aldridge, & Fraser, 2000).

Aldridge and Fraser (2000) conducted a study that used multiple research methods. The study compared classroom environments in Taiwan and Australia. Learning environment and attitude surveys were administered to a large sample to provide an economical overview of the learning environment in both countries. This quantitative data guided further data collection, which included observations, interviews, and narrative stories. “This data collected using the different methodologies complemented each other and together they formed a more complete and coherent picture of the learning environment in each country” (Aldridge & Fraser, 1999, p. 8). Aldridge and Fraser (2000) used interpretative procedures (Erickson, 1986, 1998) to guide the qualitative inquiry.

Roth (1998), in his research design to facilitate reform of science teaching, combined quantitative and qualitative results. The quantitative results expressed the overall trends, while the qualitative results helped the researchers to gain further understanding of the relationship between students’ perceptions of the learning environment and achievement.

Roth (1998) used a fine ‘grained’ analysis of individual student data to create a link to the quantitative results. Fraser (1999) states that qualitative and quantitative methods can be appropriately used with differing ‘grain sizes’. A fine ‘grain size’, involving a comparison between two teachers or between students, can best be analysed using intensive qualitative interpretive methods. On the other hand, a coarse ‘grain size’
involving an evaluation of a school system would be analysed using quantitative methods.

In one interpretive study of two science teachers, Tobin, Kahle, and Fraser’s (1990) use of a classroom environment questionnaire showed that the student-perceived classroom environment was related to the teachers’ knowledge and beliefs. Additionally these differences in teacher expectations and attitudes toward individual students were reflected in differences in individual students’ perceptions of the learning environment. By drawing on a qualitative data base, the teacher-researcher was able to provide an account of why the results are consistent and plausible. For example, the high level of perceived Personal Relevance in one class was consistent with this teacher’s practice of devoting one science period per week to things that were of personal interest to her students.

Bricolage can be applied to the use of multiple methods in research (Denzin, 1997), including the use of qualitative and quantitative information together in a study. In learning environment research, considerable progress has been made in realising the benefits of combining qualitative and quantitative methods (Dorman, Fraser & McRobbie 1994; Fraser & Tobin. 1991; Tobin, Kahle & Fraser, 1990). When a study using quantitative methods has been completed, its main findings can be contextualised with thick description consisting of observations and verbal accounts from participants (Fraser, 1998a).

Quantitative research is thought to be more concerned with the deductive testing of hypotheses, while qualitative research is more concerned with exploring a topic and with inductively generating hypotheses and theories. While this is often true, those stereotypes can be overdone. As Miles and Huberman (1994) say: “Both types of data can be productive for descriptive, reconnoitring, exploratory, confirmatory, hypothesis-testing purposes” (p. 42).

Miles and Huberman (1994) point out that there are strengths and advantages to each approach. Quantitative data enable standardised, objective comparisons to be made, and permit overall descriptions of situations or phenomena in a systematic and comparable way. Procedures for the analysis of quantitative data, being well developed and codified, bring ‘objectivity’ to the research, in the sense that they
increase the chances that the results of the analysis do not depend on the researcher doing the analysis.

There are important strengths and advantages to the qualitative approach (Miles & Huberman, 1994). Qualitative methods are flexible, more so than quantitative methods. Qualitative methods are the best way that we have of getting the insider’s perspective, the ‘actor’s definition of the situation’, the meanings that people attach to things and events. Qualitative data are well able to deal with the complexity of social phenomena.

When a study using quantitative methods has been completed, the main findings can be contextualised through observations and verbal accounts from participants (Tobin & Fraser, 1998). Through triangulation of quantitative data and qualitative information, greater credibility can be placed in the findings (Fraser & Tobin, 1991; Tobin & Fraser, 1998). In order to maximise the strengths inherent in each approach (quantitative and qualitative methods), a mixed-method design was employed in my study (see Section 3.2). The quantitative findings along with the qualitative findings are presented in Chapter 4.

In summary, Section 2.4 has reviewed literature in the field of learning environments (which is the field on which my study drew and to which it contributes). The first three sections of the chapter covers background issues, namely, the historical foundations of the field (Section 2.4.1), the distinction between personal and class forms of assessment instruments (Section 2.4.2), the distinction between actual and preferred forms of questionnaires (Section 2.4.3) and differences between students’ and their teachers’ perceptions of the same classroom environments (Section 2.4.4). Because my study involved the use of learning environment questionnaires, Section 2.4.5 overviews a range of instruments that have been used commonly in past research; whereas Section 2.4.6 provides a particular focus on the instrument selected for my study, namely, the What is Happening in this Class? (WIHIC) questionnaire. The final two subsections review literature on two areas of central relevance to my study’s aims and methods: past research into associations between learning environments and student outcomes (Section 2.4.7); and studies that have combined quantitative and qualitative data-gathering methods (Section 2.4.8).
2.5 Summary of Literature Review Chapter

Families should be involved and invited to share their own values and life goals with the schools (McCaleb, 1997). A ‘partnership’ approach in which educators and families work together to share information and guide students seems to be the best approach in involving parents (Epstein, 2001). Based on the related research about families and schools, it is believed that the social matrix in which people are embedded profoundly affects these individuals. This belief helped me to conceptualise the present study. Not only were students’ perceptions of the science learning environment examined, but parents’ perceptions of their children’s science learning environment also were assessed and investigated in my study.

The idea that distinct classroom environments exist and that these characteristics can determine human behaviour (Lewin, 1936) guided the direction of this study. Additionally, Walberg’s (1981) nine-factor model of educational productivity in which student outcomes are co-determined by three student aptitude variables, including the psychosocial environments of the school/class and the home, also helped to frame the conceptual design of the study. And finally, Murray’s (1938) distinction between an environment as perceived by an external observer (parents) and an environment perceived by milieu inhabitants (students) provided an additional framework for this study.

After a review of the related literature, the What is Happening in the Class (WIHIC) questionnaire (Fraser, McRobbie & Fisher, 1996) was selected as the most appropriate instrument for assessing parents’ and students’ perceptions of the science learning environment in the present study. Because two of my research questions involved investigation of differences between students’ and parents’ perceptions of actual and preferred environment and of associations between student outcomes and the learning environment, this chapter also reviewed past studies into these two questions.

A mixed-method design, combining quantitative and qualitative methods, was chosen to help to minimise the inherent weaknesses of each method as recommended by Tobin and Fraser (1998).
While this chapter reviewed related research for this study, the next chapter describes the research methods employed in the study. The methods chosen combined a large-scale student quantitative learning environment probe (WIHIC), involving administration of a learning environment survey, with a ‘fine grain’ qualitative investigation involving a small sample of students and parents. The ‘fine grain’ samples of students and parents were interviewed and classroom observations were conducted during the students’ science classes.
Chapter 3

RESEARCH METHODS

3.1 Introduction and Overview

One of the main aims of this study was to develop and validate classroom learning environment questionnaires that assess not only students' perceptions of the learning environment, but also their parents' perceptions of the same science learning environment. Additionally this study investigated differences between parents and students in their preferred classroom environment and in their perceptions of the same actual classroom environment. And, finally, this study examined possible associations between student outcomes (achievement and attitudes in science) and either parents' perceptions of their children's learning environment or students' perceptions of the learning environment.

How does one go about assessing perceptions of the learning environment? While there are multiple methods available, a researcher must delineate which model is the most appropriate for the study at hand. Questionnaires offer an economical way to gather information for a large sample, but they fail to provide the explanations behind those responses. Interviews can provide some of these missing details, but they are time consuming (Morgan, 1997). Observations put the researcher into the actual learning environment, but they are clouded by the personal perceptions of the observer (Denzin, 1994). The methodology chosen for this study combined questionnaires, interviews and observations. By using multiple methods as data sources, the strengths of each method could be capitalised upon and their weaknesses could be partially overcome; as well, a more complete picture of the learning environment could be provided (Aldridge & Fraser, 2000; Aldridge, Fraser & Huang, 1999; Creemers & Reezigt, 1999; Fraser, 1999; Roth, 1998).

This chapter details the methods used to gather and analyse the data for this study. The chapter begins by discussing the merits of combining qualitative and quantitative data (Section 3.2). Next, the selection and modification of the questionnaires are
described (Section 3.3), and this is followed by a description of the interviews and observations (Section 3.4). The chapter continues with a discussion of the achievement measures used (3.5), and a description of the sample selected for the study (Section 3.6). The chapter concludes with a description of the methods of analysis used for the questionnaire, interview and observational data (Section 3.7), limitations of the study (Section 3.8) and a summary of the chapter (Section 3.9).

3.2 Combining Qualitative and Quantitative Methods

The learning environment has shown a strong and consistent link with student achievement and attitudes (Aldridge, Fraser, Fisher, & Wood, 2002; Fraser 1998a; Fraser & Walberg, 1991; Raafflaub & Fraser, 2002). As discussed in Chapter 2, the field of learning environments offers a wide variety of economical and valid questionnaires developed to quantify students’ perceptions of classroom environment (Fraser, 1998a). Similarly there is a vast array of qualitative methods for studying the learning environment, including interviews, discussions, and observations (Freiberg & Stein, 1999).

Each method, quantitative and qualitative, makes a distinct contribution to the assessment of the classroom environment (Fraser, 1986; Tobin & Fraser, 1998). Any method of research provides just one possible window into educational environments (Fraser, 1998a). There are strengths and advantages to each approach. Quantitative data enable standardised, objective comparisons and permit overall descriptions of situations in a systematic and comparable way (Punch, 1998). When a study using quantitative methods has been completed, the main findings can be contextualised through observations and verbal accounts from participants (Tobin & Fraser, 1998).

Qualitative data, collected by looking and asking, enable researchers to document the conduct of everyday events and to identify the meanings of those events (Erickson, 1998). Insights gained by one method are followed up by using other methods. Qualitative methods are the best way that we have of getting the insider’s perspective and of providing ‘thick’ descriptions of the data (Punch, 1998).
Fraser (1999) explains that qualitative and quantitative methods can be appropriately used with differing 'grain sizes'. A small 'grain size' sample, perhaps involving a contrast between two teachers or several students, calls for qualitative interpretive methods. In contrast, an evaluation of a system-wide reform would require a 'coarse grain' sample size and require economical quantitative survey methods (Fraser, 1999). Additionally, differing 'grain sizes' will be relevant at different times and for different purposes throughout a particular study. A design that features recursive relationships between the data sources can be referred to as a multi-level study (Fraser, 1998a).

Many researchers concur on the advantages in combining qualitative and quantitative methods (Aldridge & Fraser, 2000; Creemers & Reezigt, 1999; Fraser, 1999; Roth, 1998; Tobin & Fraser, 1998). For these reasons, the research design for my study combined quantitative and qualitative methods. While questionnaires offered an economical way to access perceptions of the learning environment for a relatively large 'grain size' sample of students and parents (Aldridge & Fraser, 2000), interviews and classroom observations provide plausible explanations and additional validity for a 'fine grain' size sample. Through triangulation of quantitative data and qualitative information, greater credibility can be placed on the findings of the study (Fraser & Tobin, 1991).

3.3 Questionnaires

Two questionnaires were used in this study. Modified versions of the What is Happening in this Class? (WIHIC) were used to assess students' and parents' perceptions of the science learning environment. A modified version of the Test of Science Related Attitudes (TOSRA) was selected for measuring students' attitudes towards science class so that attitude-environment relationships could be investigated.

3.3.1 Learning Environment Questionnaire

The WIHIC, modified for this study, was developed originally by Fraser, McRobbie and Fisher (1996) to provide a good spread of the most relevant scales for assessing student and parent perceptions of the science learning environment (see Chapter 2,
Section 2.4.6). Since its creation, the WIHIC has been used for many different purposes. For example, the WIHIC has been used in investigations of associations between student outcomes and classroom environment (McRobbie & Fraser, 1993), teachers’ practical attempts to improve the classroom environment (Thorp, Burden & Fraser, 1994), assessing students’ perceptions of outcomes-focused technology-rich learning environments (Aldridge, Fraser, Fisher, & Wood, 2002), evaluating an innovative science program in high school science (Lightburn & Fraser, 2002), and investigating the learning environment in classrooms in which laptop computers are used (Raaflaub & Fraser, 2002).

Recently the WIHIC has been used to assess the learning environment in Australia (Aldridge, Fraser, Fisher & Wood, 2002), Singapore (Fraser & Chionh, 2000), Canada (Raaflaub & Fraser, 2002) and America (Lightburn & Fraser, 2002). In addition the WIHIC has been translated and validated in Korea (Kim, Fisher & Fraser, 2000), Taiwan (Aldridge & Fraser, 2000), and Indonesia (Margianti, Fraser & Aldridge, 2002). The WIHIC was selected for this study because of the impressive reliability and validity found in varying settings, languages and studies around the world (see Section 2.4).

Tobin and Fraser (1998) recognized that some learning environment dimensions are more salient than others in a particular classroom, and that the specific learning environment scales for a particular study should ideally be chosen after researchers have had some experience in the classes. The learning environment scales chosen for this study were guided by past research, personal experience as a classroom teacher and discussions with fellow researchers in the learning environment field. For these reasons, six of the original seven scales were selected for this study (for descriptions of the original scales see Section 2.4.6). My study assessed the following six classroom learning environment dimensions: Student Cohesiveness, Teacher Support, Involvement, Task Orientation, Equity, and Investigation. (The original Cooperation scale was omitted.)

The wording of the items in the original WIHIC was simplified and the number of items was reduced from 56 (7 scales with 8 items each) to 48 items (6 scales with 8
items each) to improve appropriateness for 9-11 year-olds. The number of items was reduced from 48 to 39 items as a result of statistical analyses and additionally some items were lost during translation into other languages (see Section 3.3.4). The student actual and preferred versions of the WIHIC were field tested with ten 9-11 year-olds students. These students completed the questionnaires and were subsequently interviewed about the wording, meaning, and readability of the items. As a result of the student interviews, some of the items were eliminated while other items were rewritten for clarity. For example, the first question on the original WIHIC states: “I make friendships among students in this class.” The modified version of the question for this study states: “I have friends in this class.” Additionally some words like ‘investigation’ on the original form were changed to ‘experiments’ on the modified version.

Because the research questions focused on the actual and preferred science learning environment of parents and students, four forms of the WIHIC were constructed. Two forms measure students’ and parents’ preferred classroom environment (Appendixes A & B), while the other two forms measure students’ and parents’ perceptions of the actual science classroom (Appendixes C & D). The actual forms assess the perceptions of the science learning environment actually present in the classroom, while the preferred forms assess the ideal or preferred learning environment for students.

The response alternatives in the original WIHIC are Almost Never, Seldom, Sometimes, Often, and Almost Always. As previously indicated, the TOSRA (see Section 3.3.3) also was administered to students to determine their attitudes towards science. In order to provided consistency between the WIHIC and TOSRA response formats, and therefore to reduce confusion among students, the response format for the WIHIC used in this study was changed to Strongly Disagree, Disagree, Not Sure, Agree, and Strongly Agree. The questionnaires were worded in the personal form (see Section 2.4.2) to elicit the view that a parent or a student has of the science learning environment as it applies to that student. An example of an item from a class form would be “The teacher gives students extra help when needed” while the personal form would be “The teacher gives me extra help when needed”. Table 3.1 provides a
scale description and a sample question used in the actual version of the WIHIC for parents and students.

Table 3.1  Scale Descriptions and Sample Item for the Actual Version of each WIHIC Scale for Parents and Students

<table>
<thead>
<tr>
<th>Scale</th>
<th>Description</th>
<th>Sample Item Student</th>
<th>Sample Item Parent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Cohesiveness</td>
<td>How helpful and supportive are students of each other?</td>
<td>I have friends in this class.</td>
<td>My child has friends in this class.</td>
</tr>
<tr>
<td>Teacher Support</td>
<td>How helpful, friendly, trustful and interested is the teacher in students?</td>
<td>The teacher gives me extra help when needed.</td>
<td>The teacher gives my child extra help when needed.</td>
</tr>
<tr>
<td>Involvement</td>
<td>To what extent are students interested, involved, doing additional work and enjoying science class?</td>
<td>I say what I think during class talks about science.</td>
<td>My child says what he/she thinks during class talks about science.</td>
</tr>
<tr>
<td>Task Orientation</td>
<td>How important is it to complete activities and stay on subject matter?</td>
<td>Getting my work done in science is important to me.</td>
<td>Getting work done in science is important to my child.</td>
</tr>
<tr>
<td>Equity</td>
<td>Are all students treated equally in the classroom?</td>
<td>The teacher treats me the same as the other students.</td>
<td>The teacher treats my child the same as the other students.</td>
</tr>
<tr>
<td>Investigation</td>
<td>To what extent is there an emphasis on inquiry learning and problem solving?</td>
<td>I do experiments to answer questions that I have.</td>
<td>My child does experiments that answer questions that he/she has.</td>
</tr>
</tbody>
</table>

Once modifications were completed for the student actual and preferred forms, parallel forms were created for parents. For example, the original questionnaire determining students' perception of the actual science classroom states: "The teacher gives me extra help when needed." The parallel parent questionnaire was reworded to state: "The teacher gives my child extra help when needed."

3.3.2  Administration of the WIHIC Questionnaire

Fourth and fifth grade teachers at the three schools were asked to volunteer to participate in the study. Twenty-two out of the 28 teachers agreed to administer the actual and preferred questionnaires to their students. The teachers who declined stated they were afraid that the information generated could be used against them in some way. For two of the 22 classrooms, teachers administered the actual form but not the preferred form. See Section 3.6 for a description of the schools and student sample.
The researcher visited the schools and provided guidance to the teachers on how to administer the WIHIC questionnaires. The 22 teachers who volunteered were asked to administer the actual and preferred questionnaires on separate days with the preferred version being administered first. The directions were to be read aloud to the students and the teacher should provide clarification to students as needed. Teachers were asked not to read the questionnaire to the students but instead to allow students to read and respond to the questionnaire on their own. If students asked a procedural question, teachers were instructed to answer. On the other hand, if the students asked what an item meant, teachers were instructed to ask the student what they thought it meant and respond with a nod along with encouragement that the students respond to the questionnaire as best they could.

A letter was sent home with the fifth grade students from the researcher's school inviting their parents to participate in the study. If the parents responded in the affirmative, the parent WIHIC questionnaires were sent home with the child. Students then returned the completed questionnaires to the school.

3.3.3 Attitudes in Science Questionnaire

To permit investigation of associations between student perceptions of the science learning environment and student attitudes in science, a modified version of the Test of Science-Related Attitudes (TOSRA) was administered (Appendix E). The TOSRA originally was designed to test science-related attitudes among secondary school students (Fraser, 1981). Because this study assessed the attitudes of relatively young children, the original seven scales (70 questions) were reduced to include 30 questions evaluating three conceptual categories: Attitude to Scientific Inquiry, Adoption of Scientific Attitudes, and Enjoyment of Science Lessons.

Klopfer (1971) provides a classification scheme for science educational aims in which six categories of attitudinal aims are distinguished. The three conceptual categories chosen for this study were determined to be the most appropriate attitudinal aims for elementary science students. Attitude to Scientific Inquiry measures attitude to
scientific experimentation and inquiry as ways of obtaining information about the natural world. Adoption of Scientific Attitudes measures 'scientific attitudes' such as open-mindedness and willingness to revise opinions after obtaining new information. Enjoyment of Science Lessons measures satisfaction with science learning experiences at school. Table 3.2 provides Klopfer's classification and a sample item from each of the three attitude scales in this study.

Table 3.2 Name, Classification and Sample Question for Each Scale in TOSRA

<table>
<thead>
<tr>
<th>Scale Name</th>
<th>Klopfer (1971) classification</th>
<th>Sample statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude to Scientific Inquiry</td>
<td>Scientific inquiry as a way of thought</td>
<td>Doing experiments is not as good as finding out information from teachers. (-)</td>
</tr>
<tr>
<td>Adoption of Scientific Attitudes</td>
<td>Adoption of 'scientific attitudes'</td>
<td>I dislike repeating experiments to check that I get the same results. (-)</td>
</tr>
<tr>
<td>Enjoyment of Science Lessons</td>
<td>Enjoysment of science learning experiments</td>
<td>Science lessons are fun. (+)</td>
</tr>
</tbody>
</table>

(+) Scored 5, 4, 3, 2, and 1, respectively; for the responses SA, A, N, D, and SD.  
(-) Scored in the reverse manner.

Students responded to the statements on a five-point Likert response scale (Strongly Agree, Agree, Not Sure, Disagree, and Strongly Disagree). Many items received a score of 5, 4, 3, 2, 1, respectively, for these five response alternatives. However, items 4-6, 10-12, 16-18, 22-24, and 28-30 were scored in the reverse direction (see Appendix M).

The TOSRA was administered to 161 fifth grade students at the researcher's school. Because the TOSRA was originally administered to and validated with students in grades 7-10 (Fraser, 1981), this survey was read aloud to students to help to reduce any reading difficulties. Additionally, given that some of the items were reverse scored, teachers were told that they could call attention to this as they administered the survey. While the teacher read each item on the TOSRA aloud to the students, some students followed along and marked their responses. However, other students completed the questionnaire at their own rate (some faster and some slower).
3.3.4 Translations of the WIHIC and TOSRA

Because the three schools participating in this study have a diverse ethnic population, it was thought that it would be advisable to offer the questionnaires not only in English, but also in Spanish and Creole. The four WIHIC questionnaires (student actual and preferred; parent actual and preferred) and TOSRA were translated by educators into Spanish and Creole. Independent third parties then back translated the Spanish and English versions into English as described by Aldridge and Fraser (2000) and as recommended by Brislin (1970).

The back translations were checked to see if they retained the original meanings. While the Spanish back translations of the questionnaires revealed no major problems, the Creole versions revealed that many of the words and phrases in English could not be translated in a way that maintained their original meaning. One of the main problems was that, in Creole, there are eight ways to say 'I would'. Because the preferred form uses this tense of the verb, many of items were not precise in their meaning. Additionally, the Creole spoken by the immigrants living in South Florida is a relatively new written language (approximately 50 years) and, therefore, disagreements arose between the two translators. Even though a third Creole translator was consulted about the forms (and she independently consulted other speakers of Creole), no agreement could be reached on the Creole translation of some of the items. Therefore the original modified version of the WIHIC containing 48 items was ultimately reduced to 39 (see Section 3.3.1) by retaining only the items that survived back translations in Spanish and Creole (Appendixes F-O).

The TOSRA, which was used to investigate associations between student perceptions of the learning environment and student attitudes in science, was translated and back translated using the same methods as those utilised for translation of the WIHIC. All 30 items of the modified TOSRA survived translation and back translation.

The letter that was sent home inviting the fifth grade parents to participate in the study was also translated into Spanish and Creole. Parents were provided the option of completing the questionnaire in English, Spanish, or Creole. Surprisingly only four
parents chose to complete the questionnaire in Spanish and only one completed the questionnaire in Creole. Additionally, students whose second language is English were provided the option of completing the questionnaire in their home language. Only five students chose to complete the questionnaire in Spanish and none of the students chose to complete the questionnaire in Creole.

Therefore, the responses from the translated versions of the questionnaires are not included in the results of this study. However, in terms of future research, these Spanish and Creole versions of the WIHIC and TOSRA are likely to be useful to other researchers for their studies.

3.4 Interviews and Observations

Interviews are one of the most powerful ways that we use to try to understand our fellow human beings (Fontana & Frey, 1998). Additionally, observation of teacher-student interaction in the classroom has a long tradition (Wubbels & Brekelmans, 1998). Combining interviews, observations, and questionnaires provides more depth and breadth to our understanding of classroom environments.

There are basically two types of interviews: normative and key informant (Anderson & Arsenault, 1998). Normative interviews are used to collect data which are classified and analysed statistically, while key informant interviews probe the views of a small number of individuals. For this study, key informant interviews were used.

Ten students were interviewed three times: individually, in peer groups of 4-6 students, and with their parents. Parents were interviewed with their children and these interviews were scheduled as focus group interviews which were intended to have 8-10 participants (Krueger, 1994). Some parent-child interviews had two participants because the other parents and children did not attend the scheduled interviews. All interviews were tape recorded and transcribed.

Because the intent of the interviews was to augment the quantitative data and provide plausible explanations for the quantitative data (Aldridge & Fraser, 2000; Erickson,
1998), the interviews of parents and students were conducted after the questionnaires had been completed. The interview questions were guided by the research questions and were intended to supplement the data previously collected from the surveys (Morgan, 1997). The two main interview questions were:

**Parent questions:**
- What would you like your child to be doing during science class?
- What do you think your child is doing during science class?

**Student questions:**
- What would you like to do during science class?
- What do you do in science class?

These questions were followed up with prompts for respondents to give specific examples and instances (Morgan, 1997). Particular care was given to asking parents and students for specific responses which reflected the dimensions assessed on the WIHIC and TOSRA. For example, one of the areas assessed by the WIHIC was *Equity*, but often parents did not freely offer their perceptions in this area unless asked specifically.

Parents were asked to tell how they came to know what was going on in the science class. An oral summary of the major points was provided by the researcher at the halfway point and at the end of each interview. Parents and students were asked if this was an accurate summary of what had been shared in the interview. The summary questions played a critical role in the analysis of the interviews (Krueger, 1994).

Ten students in six different classes were observed during a classroom science lesson. The observations were recorded as field notes in an unstructured approach and were recorded as the actions and events unfolded in the classroom. After the observations, the notes were organized to reflect the scales assessed on the WIHIC and TOSRA to facilitate analysis. It should be noted that these classroom observations were focused on what the students were doing and not on what the teacher was doing.

### 3.5 Achievement

Because my study involved investigating associations between student achievement and classroom environment, the achievement levels of students were obtained from
the nationally-normed Stanford 9 multiple-choice Achievement science subtest. The 50-item Science subtest assesses understanding in the domains of life, physical, and earth sciences and is administered by the Miami-Dade County Public school district in April of the school year. The National Science Education Standards (Harcourt, 2000) were used in developing Stanford 9 test items. The test items allow students to use what they know to apply information and data, interpret data, draw conclusions, and predict events (Harcourt, 2000). In June, the individual students’ test results are provided to the school in percentages and stanine scores.

Additionally, student achievement was obtained by examining final grades in science for the school year. The final grade is assigned by the teacher and includes teacher-made assessments, unit tests, and homework assignments for the school year. Although the curriculum is the same for all students, teachers may assess their students at their discretion. There are no uniform assessment procedures. Therefore, achievement scores are not strictly comparable across schools and teachers in the sample.

3.6 Sample

A sample of 520 9-11 year-olds students completed the actual and preferred student version of the WIHIC. The 520 students were from 22 classes in three schools in a large urban school district in South Florida. Six of the classes in the sample were at the researcher’s school and were taught by three teachers (with the researcher teaching two of these classes). The other classes were in the same school district. The class sizes ranged from 20 to 35 students, with boys and girls being approximately equally represented. The ethnicity of the students reflected the diversity of the school district (US Census, 1990). Students in this study and their families come from a variety of backgrounds, with many immigrating from the Caribbean Islands, Central America, and South America.

Teachers at the researcher’s school gladly administered the WIHIC to students. The return rate for teachers at the researcher’s school was 100 percent for a total of approximately 360 students in 11 classes. The other 160 students were in 11 classes
from two schools from the same school district. Because the class rosters of these schools were not provided to the researcher, there is no way to know the completion rates for these two schools.

The parent sample was limited to the researcher’s school and grade level because of the anticipated difficulty in obtaining cooperation from parents. Additionally the school district requires parental approval before academic records can be released. Out of the 200 parents who were sent letters home requesting their participation in this study, along with permission to access their children’s academic records, only 161 responded affirmatively and only 120 parents completed the actual and preferred versions of the WIHIC for parents.

Because permission was obtained from only 161 parents to access students records, this group became a subsample of 161 students who responded to the Test of Science Related Attitudes (TOSRA) (Fraser, 1981) to assess attitudinal outcomes. Additionally, achievement outcomes for these 161 students were obtained through their final report card grades and stanine scores on the Stanford 9 standardised achievement test.

A sample of 120 parents corresponding to the subsample of 161 students completed the learning environment questionnaire. Of the 120 parents, 10 parents participated in follow-up interviews. These 10 parents and their children were interviewed using varied techniques. Focus group, paired (parent and child), and individual interviews were conducted with this ‘fine grain’ sample (Fraser, 1999).

3.7 Methods of Data Analysis

Statistical analyses were performed to examine the reliability and validity of the questionnaires used in this study, to investigate differences between student and parent perceptions of the learning environment, and to examine associations between students’ outcomes and the scales assessing the classroom learning environment. The SPSS (version 6.1) statistical software program was used to analyse student and parent responses (Coakes, 2001).
After administering the questionnaires, the interviews provided an opportunity for students and parents to explain in detail the reasons for their responses. The interpretative methods of Erickson (1998) guided the qualitative data collection and analysis. In this process, concepts are developed inductively from the data and raised to a higher level of abstraction, so that their interrelationships then can be explored (Punch, 1998).

3.7.1 Validating the Questionnaires

Research Question #1: Is it possible to develop valid questionnaires to assess:
- 9-11 year-old students' actual and preferred science learning environment?
- parents' actual and preferred science learning environments for their children?
- 9-11 year-old students' attitudes towards science?

Simply stated, validity is the extent to which what we measure reflects what we expect to measure (Anderson & Arsenault, 1998). Factor analysis with varimax rotation was used with students' and parents' responses for the actual version of the WIHIC and for the TOSRA. Factor loadings obtained from this analysis identified whether each scale measured a distinct aspect of the learning environment and whether the a priori scale structure of each instrument could be replicated with 9-11 year-olds in South Florida. Additionally, this analysis identified faulty questionnaire items, which were removed to improve the factorial validity. Details of the results of the factor analyses are provided in Chapter 4 in Sections 4.1.1 for the student versions and in Section 4.1.2 for the parent versions.

Reliability refers to consistency in measurement (Anderson & Arsenault, 1998). The internal consistency reliability (alpha coefficient) is necessary to establish that each item in a scale assesses a common construct. The internal consistency of each scale was determined for the two units of analysis (the individual and class) using Cronbach's alpha coefficient.
Discriminant validity of scales involves empirical independence of the raw scores on different scales within a questionnaire. While the factor analysis provides support that factor scores on each scale of the WIHIC or TOSRA measures distinct aspects, discriminant validity assesses the extent to which raw scores on each scale are unique in the dimension that they cover. The mean magnitude of the correlation of one scale with other scales in the WIHIC was calculated using two units of analysis (individual and class) to provide a convenient index of the discriminant validity. Because the TOSRA contained only two scales, the discriminant validity was determined by using the correlation of one scale with the other scale using two units of analysis (individual and class).

To determine the ability of the actual form of each WIHIC scale to differentiate between classrooms, a one-way analysis of variance (ANOVA) was conducted for each scale. ANOVA determines the degree to which a questionnaire’s scale can differentiate between the perceptions of students, or the parents of students, in different classes. These analyses were performed with class membership as the factor or independent variable for each scale. If the variance between the groups is larger than the variance within the groups, we can conclude the groups differ. The \( \eta^2 \) provides statistical information about the proportion of variance in scale scores accounted for by class membership.

### 3.7.2 Exploring Differences Between Parents’ and Students’ Perceptions

In the present study, the following differences were explored:

**Research Question #2:** Are there differences between parents and students in their preferred classroom environment and in their perceptions of the same actual classroom environment?

A separate one-way MANOVA (multivariate analysis of variance) for repeated measures with the set of WIHIC scales as the dependent variables was used to investigate each of the following pairs of perceptions of the science learning environment on the WIHIC:
• differences between parents’ actual and preferred perceptions on the WIHIC
• differences between students’ actual and preferred perceptions on the WIHIC
• differences between students’ and parents’ in their actual and preferred perceptions on the WIHIC.

Because the multivariate test using Wilks’ lambda criterion was statistically significant, results for the ANOVA for each individual WIHIC scale were interpreted. The average item mean, or the scale mean divided by the number of items in a scale, was determined using the individual as the unit of analyses. This allowed comparison between scales with differing numbers of items. The standard deviation provides a measure of the extent to which the scores deviate from their mean. The average item mean provides descriptive statistics, which can be portrayed in graphs and used to compare the perceptions of the learning environment. Also, effect sizes were calculated to determine magnitude of differences as suggested by Anderson and Arsenault (1998) and Thompson (1998).

3.7.3 Associations Between Outcomes and Environment

Research Question #3: Are there associations between the student outcomes of achievement and attitudes and:
• students’ perception of the science learning environment?
• parents’ perceptions of their children’s science learning environment?

Simple correlation and multiple regression analyses for associations between student outcomes and dimensions of the actual version of the WIHIC were calculated separately for students and for parents.

The outcomes studied were academic achievement (Stanford 9 science subtest and final grade) and those attitudinal scales (Attitude to Scientific Inquiry and Enjoyment of Science Lessons) which were measured by the TOSRA and survived the factor analyses described later in Chapter 4.
Correlation analysis provides a way of describing in quantitative terms the degree to which variables are related (Anderson & Arsenault, 1998). The correlation coefficient indicates both the direction and strength of a relationship. With simple correlation, we are concerned with the bivariate relationship between two continuous variables. The closer numerically the coefficient is to 1.0, the stronger the relationship (Punch, 1998).

Although simple correlation analysis can provide interesting information about associations between a particular outcome and a particular environment scale, calculating numerous simple correlations gives rise to Type I errors. Multiple regression analysis, therefore, was used to provide a more parsimonious picture of the joint influence of correlated environment scales on student outcomes. In this study, multiple correlation analysis was used to provide information about which scales contributed to the variance in students' attitudes or achievement when the other WIHIC scales were mutually controlled.

3.7.4 Analysing Information from Interviews and Observations

Analyses of the interviews and observations began by focusing on the intent of the study (Kreuger, 1994). The intent of the interviews and observations in this study was to provide plausible explanations and additional validity for the results of the questionnaires. As such, the interviews were fairly structured and the interview questions were designed to augment the results obtained using the WIHIC questionnaire.

In the design of the study, it was determined that interviews would be transcribed and field notes would be generated from the classroom observations. Field notes and transcripts were coded into categories by highlighting with coloured markers portions of text indicating where relevant information was located and the content of these data (Erickson, 1998). This process of analysis brings order to the data by organizing the raw data into patterns, categories, and basic descriptive units. The next step involved interpretation by systematic examination of similarities and differences between student and parent responses (Punch, 1998). Using interpretative procedures as
described by Erickson (1998), these working assertions were reviewed and revised in light of the evidence.

3.8 Limitations

Two measures of achievement were chosen to minimize the weaknesses inherent in each. Because the SAT-9 Science subtest is nationally normed, some of the concepts tested are not part of the school district’s curriculum. While the final grade for each student is based on the mandated curriculum, the assessment procedures varies from class to class. Therefore, achievement scores of different students based on classroom final grade are not strictly comparable.

One of the limitations of using surveys is the possibility of students and/or parents faking answers to please their teacher. To limit this possibility, students and parents were assured that there were no wrong or right answers. Additionally the students were guaranteed that the questionnaire would have no impact on their grades. Students were informed that only the researcher would have access to the names and no names would be revealed.

Although the WIHIC was simplified to make the questionnaire easier for students to read, it is recognized that some students still might have had problems reading the questionnaire either because of poor reading skills or language barriers. Anticipating the language barrier, the questionnaires were translated into Spanish and Creole. However, almost all the students elected to take the test in English even if Spanish or Creole was their first language.

Another limitation of the study is its pioneering use of surveys to ascertain parents’ perceptions of the learning environment. Therefore, the parents’ questionnaires were not known to be valid and reliable at the time of my data collection.

Additionally there were constraints on the sample size and sample selection (see Section 3.6). Of the 200 parents at the researcher’s school who received letters inviting them to participate, only 120 responded. With a sample of 120 parents,
confidence in the statistical analysis is not as strong as it would be for a larger sample. Also, while 120 parents filled out the questionnaire, only 10 volunteered to be interviewed. Most of the parents who volunteered to be interviewed were from the researcher’s classroom. Personal telephone calls and additional letters sent to their homes helped to increase participation from other classes.

Qualitative research holds the possibility of lacking objectivity (Kvale, 1996). Even a slight rewording of an interview question can influence the answer. The interviewer’s own verbal and bodily responses following an answer can act as a positive or negative reinforcer for the answer given and thereby influence the respondents’ subsequent answers (Morgan, 1997). Because of the time-consuming nature of interviewing, it is only practically possible to interview a small sample. The important issue is to recognize these limitations and to structure the interviews and observations to lead to and produce new and interesting knowledge (Kvale, 1996).

In order to capitalise upon the strengths and minimise weaknesses of each method, this study combined quantitative data and qualitative information. By using multiple methods, greater credibility can be placed on the findings (Fraser & Tobin, 1991; Tobin & Fraser, 1998). Triangulation of data provides additional support for the validity of questionnaires and plausible explanations for the findings from questionnaire data.

3.9 Summary of Methods Chapter

Chapter 3 discussed the research design and the methods used to frame the design of the study. One of the aims of the study was to develop valid questionnaires to assess 9-11 year-old students’ perceptions of the actual and preferred learning environment, as well as their parent’s perceptions of the actual and preferred learning environment for their children. Additionally, a questionnaire to determine student attitudes in science was developed and utilised. The second aim was to investigate differences between parents and students in their preferred classroom environment and in their perceptions of the same actual classroom environment. And the third aim was to examine associations between the student outcomes of achievement and attitudes and
students' perceptions of their learning environment and parents' perceptions of their children's learning environment.

This study combined quantitative and qualitative probes as recommended by Creemers and Reezigt (1999), Fraser (1999), Roth (1998) and Tobin and Fraser (1998). The What is Happening in this Class? (WIHIC) questionnaire assessed students' and parents' perceptions of the science learning environment and the Test of Science Related Attitudes (TOSRA) assessed student attitudes in science. The WIHIC questionnaire was modified from the original version created by Fraser, McRobbie and Fisher (1996) and the TOSRA questionnaire was modified from the original version created by Fraser (1981). The version of the WIHIC used in my study assessed six classroom learning environment dimension (Student Cohesiveness, Teacher Support, Involvement, Task Orientation, Equity, and Investigation) while the version of the Test of Science Related Attitudes (TOSRA) evaluated three attitudinal conceptual categories (Attitude to Scientific Inquiry, Adoption of Scientific Attitudes and Enjoyment of Science Lessons). The modifications included rewording of items and a reduction in the number of items to make the questionnaire more appropriate for 9-11 year-olds and their parents. Additionally, the questionnaires were translated and back translated into Spanish and Creole.

The validity and reliability of the modified WIHIC questionnaire and TOSRA were investigated using four methods of statistical analysis. First the a priori factor structure of the questionnaires was checked using principal components analysis with varimax rotation for the four forms of the WIHIC (student actual, student preferred, parent actual and parent preferred) and the TOSRA. Second, the internal consistency reliability of each WIHIC and TOSRA scale was checked using Cronbach's alpha coefficient. Third, the independence of raw scores on different scales was checked by exploring discriminant validity, using the mean correlation of a scale with the other scales for the WIHIC and using the correlation between the two scales for TOSRA. Fourth, the ability of the actual form of each WIHIC scale to differentiate between the perceptions of students in different classrooms (or between the perceptions of the parents of students in different classrooms) was explored by conducting an ANOVA with the class membership as the independent variable.
Differences were investigated between three pairs of perceptions on the WIHIC: between students' actual and preferred scores; between parents' actual and preferred scores; and between students and their parents in terms of all actual and preferred scales. In each case, a MANOVA with repeated measures was used with the WIHIC scales as the dependent variables. When the multivariate test using Wilks' lambda criterion yielded a significant result, the individual ANOVA for each individual WIHIC scale was interpreted. Also effect sizes (i.e. the difference between scales means expressed in standard deviation units) was used to provide information about the magnitudes of differences, in addition to their statistical significance.

Simple correlation and multiple regression analyses were used to explore the associations between student attitudes and achievement in science and dimensions of the WIHIC questionnaires as perceived by either students or their parents.

Key informant interviews (Anderson & Arsenault, 1998) were used to probe the views of a small number of individuals (10 students and their parents). The students were interviewed individually, in peer groups of eight or less, and with their parents. Additionally observations were conducted in the students' science classes and field notes were kept.

The field notes and interviews were coded and then systematically examined for similarities and differences between student and parent responses (Erickson, 1998). These working assumptions were reviewed and revised in the light of evidence using the interpretive procedures described by Erickson (1998).

While this chapter detailed the methods chosen for the design and implementation of this study, the next chapter describes the analyses of the data and the results of the study.
Chapter 4

QUANTITATIVE AND QUALITATIVE RESULTS

This chapter details the analyses and results of the quantitative and qualitative probes used in this study. Data were collected using two student versions (actual and preferred) and two parent versions (actual and preferred) of the What is Happening in This Class? (WIHIC) questionnaire to determine students’ and parents’ perceptions of the learning environment. As outlined in Chapter 3, the student questionnaires were administered to 520 students in 22 classes and to 120 parents of students in 6 classes in South Florida. Follow-up interviews and classroom observations were conducted with 10 parents and their children to provide further evidence for the validity of the WIHIC and plausible explanations for the quantitative results. The similarities and differences between students and parents in their preferred classroom environment and in their perceptions of the same actual classroom environment were analysed. And, finally, possible associations between parents’ perceptions of their children’s learning environment or students’ perceptions of the learning environment and student outcomes (achievement and attitudes in science) were analysed. The Test of Science-Related Attitudes (TOSRA) was used to assess student attitudes.

Analyses of the data collected helped to answer the research questions:

Research Question #1: Is it possible to develop valid questionnaires to assess:
- 9-11 year-old students’ perceptions of the actual and preferred science learning environment?
- parents’ perceptions of the actual and preferred science learning environment for their children?
- 9-11 year-old students’ attitudes towards science?

Research Question #2: Are there differences between parents and students in their preferred classroom environment and in their perceptions of the same actual classroom environment?
Research Question #3: Are there associations between the student outcomes of achievement and attitudes and:

- students’ perceptions of the science learning environment?
- parents’ perceptions of their children’s science learning environment?

The findings for the validity and reliability of the WIHIC and TOSRA questionnaires are found in Section 4.1. Differences between parents’ and students’ perceptions of the science learning environment are presented in Section 4.2. Associations between students’ and parents’ perceptions of the learning environment and outcomes (achievement and attitude) are presented in Section 4.3. And, finally, the results of the student and parent interviews and classroom observations are presented in Section 4.4.

4.1 Validity and Reliability of the WIHIC and TOSRA

Research Question #1: Is it possible to develop valid questionnaires to assess:

- 9-11 year-old students’ perceptions of the actual and preferred learning environment?
- parents’ perceptions of the actual and preferred learning environment for their children?
- 9-11 year-old students’ attitudes towards science?

To explore the validity and reliability of the What is Happening in this Class? (WIHIC) and Test of Science Related Attitudes (TOSRA), some or all of the following characteristics were investigated through statistical analyses of the data for 520 students in 22 classes and 120 parents of students in 6 classes: factor structure, internal consistency reliability, discriminant validity and ability to differentiate between classes (using ANOVA). Section 4.1.1 describes the factor structure for the student version of the WIHIC. Section 4.1.2 describes the factor structure for the parent version of the WIHIC. Section 4.1.3 describes factor analysis results for the TOSRA. Alpha reliability, discriminant validity and the ANOVA results are reported in Section 4.1.4 for the student version of the WIHIC, and in Section 4.1.5 for the parent version of the WIHIC. Section 4.1.6 reports reliability and discriminant validity for the TOSRA.
4.1.1 Factor Analysis for Student WIHIC

The What is Happening in this Class? (WIHIC), developed by Fraser, McRobbie and Fisher (1996), was modified for use with young children aged 9-11 years for this study. Six of the seven original learning environment dimensions (see Section 2.4.5) were utilised in this study: Student Cohesiveness, Teacher Support, Involvement, Task Orientation, Equity and Investigation. Before translation, the English version contained 48 questions. Because nine items did not survive translation and back translation into Spanish and Creole (see Section 3.3.4), the version of the WIHIC used in this study contained 39 items.

To determine the factorial validity of the student WIHIC questionnaire, principal components factor analysis with varimax rotation was carried out. Table 4.1 provides the factor loadings for the student WIHIC actual form. The student sample consisted of 520 students in 22 classes in South Florida. The students' ages ranged from 9 to 11 years.

Factor and item analyses were used to identify faulty questionnaire items on the student actual version of the WIHIC whose removal improved the internal consistency reliability and factorial validity. Thirty-seven (37) of the original 39 items were retained in the same six-factor structure of Student Cohesiveness, Teacher Support, Involvement, Task Orientation, Equity and Investigation. (Items 5 and 6 were the ones that were omitted because of their low factor loadings on their a priori scale.)

The remaining 37 items all had a factor loading of at least 0.30 on their a priori scale. The exceptions are items 3 and 17. Item 26 is the only item which has a loading greater than 0.30 on a scale other than its own scale. Thirty-two out of the remaining 37 items have a factor loading of at least 0.30 on their a priori scale.

The percentage of variance ranged from 3.51% to 23.83% for different scales, with the total variance being 49.45%. The results of the factor analysis with varimax
The factor loadings shown in Table 4.1 support the factorial validity of the actual form of the WIHIC for the student sample of 520 students.

### Table 4.1  Factor Loadings for the WIHIC Items (Actual Form) for Students

<table>
<thead>
<tr>
<th>Item No</th>
<th>Student Cohesiveness</th>
<th>Teacher Support</th>
<th>Involvement</th>
<th>Task Orientation</th>
<th>Equity</th>
<th>Investigation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td></td>
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<td>4</td>
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<td>11</td>
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<tr>
<td>39</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.53</td>
</tr>
</tbody>
</table>

| %Variance | 4.06 | 8.02 | 3.51 | 4.66 | 5.37 | 23.83 |
| Eigenvalue | 1.5  | 3.0  | 1.3  | 1.7  | 2.0  | 8.8   |

Factor loadings smaller than 0.30 have been omitted.
The sample consisted of 520 students in 22 classes in South Florida.
While factor and item analyses also were carried out for the preferred version, satisfactory results were not obtained and therefore are not reported here. It is unclear why scales, which proved to be factorially distinct for responses to the actual form of the WIHIC, did not also prove to be factorially distinct for the preferred form. The reason could be related to idiosyncrasies of my sample or to the relative smallness of the sample size. Clearly, in future research, it will be important to investigate further the factorial validity of the preferred form of the WIHIC using a variety of different and large samples.

Finding 1: The student actual WIHIC had satisfactory factorial validity. The preferred version did not display satisfactory factorial validity.

4.1.2 Factor Analysis for Parent WIHIC

As with the student version of the WIHIC, the parent version of the WIHIC was analysed for factorial validity. Table 4.2 provides the factor loadings for the parent WIHIC actual form. The parent sample consisted of only 120 parents of students in 6 classes in South Florida. For an explanation of the differing samples, refer to Section 3.7 in Chapter 3.

A note should be made on the difficulty in obtaining the parent sample. Parents of students in the researcher’s class readily completed the questionnaires, with a 97% return rate. Parents of students in the other four classes averaged a return rate of only 43%. Because of the small sample of parent responses (N=120), replicating the a priori factor structure of the WIHIC was unlikely.

As for the student WIHIC, a principal components factor analysis with varimax rotation was carried out for the same 37 WIHIC items. The most striking feature of these factor analysis results (see Table 4.2) is the collapsing of the originally-separate scales of Student Cohesiveness and Equity into one factor for the parent sample. The items for these two originally-separate scales loaded on the same factor (Table 4.2).
Table 4.2  Factor Loadings for the WIHIC Items (Actual Form) for Parents

<table>
<thead>
<tr>
<th>Item No</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Student Cohesiveness</td>
</tr>
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<td>1</td>
<td>.75</td>
</tr>
<tr>
<td>2</td>
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<td></td>
</tr>
<tr>
<td>39</td>
<td></td>
</tr>
<tr>
<td>%Variance</td>
<td>7.06</td>
</tr>
<tr>
<td>Eigenvalue</td>
<td>2.6</td>
</tr>
</tbody>
</table>

Factor loadings smaller than 0.40 have been omitted.
The sample consisted of 120 parents of students in 6 classes in South Florida.
All of the items in the other scales of *Student Cohesiveness, Involvement, Task Orientation* and *Investigation* loaded at least 0.40 on their *a priori* scale with the exception of item 17 (*Involvement*). Also, item 17 loaded at least 0.40 on the *Teacher Support* scale. All other items in Table 4.2 have a factor loading of at least 0.40 on their *a priori* scale. The percentage of variance ranged from 4.13% to 29.88% with the total variance being 54.21%. Satisfactory results were not obtained for the preferred version of the parent WIHIC.

These findings suggest a need for replication with a larger sample. Additionally, findings suggest that parents might not distinguish between *Student Cohesiveness* and *Equity* in the same way that students do. Overall the factor analysis supports a five-scale structure (with *Student Cohesiveness* and *Equity* forming a single factor) rather than the *a priori* six-scale structure for the actual parent WIHIC. (Because the student version and a large student sample supports the six-scale factor structure, the six-scale factor structure was adopted also for the parent data for analyses and comparison with student sample.)

*Finding 2:* Factor analysis supports a five-scale structure (with Student Cohesiveness and Equity forming a single factor) rather than the *a priori* six-scale structure for the actual parent WIHIC. Findings indicate a need for replication with a larger sample. The preferred version did not display satisfactory factorial validity.

### 4.1.3 Factor Analysis for TOSRA

The Test of Science Related Attitudes (TOSRA), developed by Fraser (1981), was modified for use in my study. The original seven scales with 70 items was reduced to three scales with 30 items to improve appropriateness for administration to young children aged 9 to 11 years. The three conceptual categories assessed for this study were *Attitude to Scientific Inquiry, Adoption of Scientific Attitudes* and *Enjoyment of Science Lessons* (see Section 3.3.3).

To determine the factorial validity of the Test of Science Related Attitudes (TOSRA), factor analysis with varimax rotation was carried out. Table 4.3 provides the factor
loadings for the TOSRA. The student sample consisted of 161 students in 6 classes in South Florida. The students' ages ranged from 9-11 years.

Factor and item analyses were used to identify faulty questionnaire items on the student TOSRA whose removal improved the internal consistency reliability and factorial validity. Twenty of the original 30 items were retained in a two-factor structure of Attitude to Scientific Inquiry and Enjoyment of Science Lessons. All items (N=10) assessing Adoption of Scientific Attitudes were removed after factor and item analyses were performed. The remaining 20 items had a factor loading of at least 0.30 on their a priori scale. The percentage of variance was 14.1% and 27.33% for the two scales, with the total variance being 41.43%.

Table 4.3 Factor Loadings for the TOSRA Items

<table>
<thead>
<tr>
<th>Item No</th>
<th>Attitude to Scientific Inquiry</th>
<th>Enjoyment of Science Lessons</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.49</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>.54</td>
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<td>.80</td>
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<tr>
<td>30</td>
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<td>.52</td>
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</tbody>
</table>

% Variance 14.1 27.33
Eigenvalue 2.8 5.5

Factor loadings smaller than 0.30 have been omitted.
The sample consisted of 161 students in 6 classes in Miami-Dade County, Florida

Finding 3: Factor analysis supports a two-scale structure (Attitude to Scientific
Inquiry and Enjoyment of Science Lessons, rather than the a priori three-scale structure, for the TOSRA. The smallness of the sample size suggests the desirability of replication with a larger sample.

4.1.4 Internal Consistency Reliability, Discriminant Validity and Ability to Differentiate Between Classrooms for the Student WIHIC

The internal consistency reliability (Cronbach alpha coefficient) of the actual form of each WIHIC scale was determined for the student sample of 520 students. The discriminant validity (using the mean correlation of a scale with the other scales) was also calculated. Both the individual and class were used as the unit of analysis. The ability of each scale of the actual form of the instrument to differentiate between the perceptions of students in different classrooms was determined using an ANOVA with class membership as the main effect. Table 4.4 reports the results of these analyses.

The internal consistency reliability (alpha coefficient) for different WIHIC scales ranged from 0.67 to 0.86 with the individual as the unit of analysis and from 0.73 to 0.90 with the class as the unit of analysis. As expected, reliability is higher when the class mean is used as the unit of analysis (Fraser, 1994). These results are similar to those found using the WIHIC in Australia (Aldridge & Fraser, 2000).

The discriminant validity results indicate that most scales were fairly unique in the dimension that each assessed. The mean correlation of a scale with the other scales varied between 0.37 and 0.46 with the individual as the unit of analysis and between 0.66 and 0.77 with the class mean as the unit of analysis (see Table 4.4). Although there is some overlap between raw scores, the factor analysis results support the independence of factor scores.

The last column in Table 4.4 reports the ANOVA results concerning whether students in the same class perceive the classroom environment relatively similarly, while mean class perceptions vary from class to class. This analysis revealed statistically significant differences between students' perceptions in different classes for Involvement, Equity, and Investigation but not for Student Cohesiveness, Teacher
Support and Task Orientation. The $\eta^2$ statistic (which represents the proportion of variance in scale scores accounted for by class membership) ranged from 0.06 to 0.11 for different WIHIC scales.

Table 4.4  Internal Consistency Reliability (Cronbach Alpha Coefficient), Discriminant Validity (Mean Correlation With Other Scales) and Ability to Differentiate Between Classrooms (ANOVA Results) for Two Units of Analysis for the WIHIC for Students

<table>
<thead>
<tr>
<th>Scale</th>
<th>Number of Items</th>
<th>Unit of Analysis</th>
<th>Alpha Reliability</th>
<th>Mean Correlation with other Scales</th>
<th>ANOVA $\eta^2$</th>
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</thead>
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<tr>
<td>Student Cohesiveness</td>
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<td>Individual</td>
<td>.67</td>
<td>.38</td>
<td>.06</td>
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<tr>
<td></td>
<td></td>
<td>Class Mean</td>
<td>.73</td>
<td>.69</td>
<td></td>
</tr>
<tr>
<td>Teacher Support</td>
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<td>Individual</td>
<td>.80</td>
<td>.42</td>
<td>.10</td>
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<td></td>
<td>Class Mean</td>
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</tr>
<tr>
<td>Involvement</td>
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<td>.74</td>
<td>.46</td>
<td>.09 **</td>
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<td></td>
<td></td>
<td>Class Mean</td>
<td>.86</td>
<td>.73</td>
<td></td>
</tr>
<tr>
<td>Task Orientation</td>
<td>6</td>
<td>Individual</td>
<td>.71</td>
<td>.41</td>
<td>.09</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class Mean</td>
<td>.85</td>
<td>.77</td>
<td></td>
</tr>
<tr>
<td>Equity</td>
<td>6</td>
<td>Individual</td>
<td>.82</td>
<td>.39</td>
<td>.11 **</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class Mean</td>
<td>.92</td>
<td>.70</td>
<td></td>
</tr>
<tr>
<td>Investigation</td>
<td>6</td>
<td>Individual</td>
<td>.86</td>
<td>.37</td>
<td>.07 **</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class Mean</td>
<td>.90</td>
<td>.66</td>
<td></td>
</tr>
</tbody>
</table>

** $p<0.01$

The sample consisted of 520 students in 22 classes in South Florida. The $\eta^2$ statistic (which is the ratio of 'between' to 'total' sums of squares) represents the proportion of variance explained by class membership.

Finding 4: The actual version of the student WIHIC demonstrates satisfactory reliability and discriminant validity for two units of analysis (student and class mean), and most scales can differentiate between the perceptions of students in different classes.

4.1.5  Internal Consistency Reliability, Discriminant Validity and Ability to Differentiate Between Classrooms for the Parent WIHIC

Whereas Table 4.4 presents the results for the student version, Table 4.5 presents parallel results for the actual form of the parent version of the WIHIC. The sample
consisted of 120 parents whose students were in six classes.

As with the student version, the Cronbach alpha coefficient was used to indicate the internal consistency reliability of the scales and the mean correlation of a scale with the other scales was used as a convenient index of the discriminant validity. Both the individual and class were used as the unit of analysis. Additionally an ANOVA was used to ascertain each WIHIC scale’s ability to differentiate between classes. Table 4.5 reports the results of these analyses.

Table 4.5 Internal Consistency Reliability (Cronbach Alpha Coefficient), Discriminant Validity (Mean Correlation With Other Scales) and Ability to Differentiate Between Classrooms (ANOVA Results) for the Two Units of Analysis for the WIHIC for Parents

<table>
<thead>
<tr>
<th>Scale</th>
<th>Number of Items</th>
<th>Unit of Analysis</th>
<th>Alpha Reliability</th>
<th>Mean Correlation with other Scales</th>
<th>ANOVA Eta²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student Cohesiveness</td>
<td>5</td>
<td>Individual</td>
<td>.78</td>
<td>.33</td>
<td>.01</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class</td>
<td>.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher Support</td>
<td>7</td>
<td>Individual</td>
<td>.89</td>
<td>.51</td>
<td>.11**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class</td>
<td>.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Involvement</td>
<td>6</td>
<td>Individual</td>
<td>.77</td>
<td>.45</td>
<td>.11**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class</td>
<td>.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task Orientation</td>
<td>6</td>
<td>Individual</td>
<td>.81</td>
<td>.41</td>
<td>.11**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class</td>
<td>.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equity</td>
<td>6</td>
<td>Individual</td>
<td>.88</td>
<td>.44</td>
<td>.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class</td>
<td>.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investigation</td>
<td>6</td>
<td>Individual</td>
<td>.87</td>
<td>.39</td>
<td>.06</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class</td>
<td>.80</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**p<0.01

The sample consisted of 120 parents of students from 6 classes in South Florida.
The eta² statistic (which is the ratio of ‘between’ to ‘total’ sums of squares) represents the proportion of variance explained by class membership.

The reliability of different scales (alpha coefficient) ranged from 0.77 to 0.89 with the individual as the unit of analysis and from 0.80 to 0.95 with the class as the unit of analysis. However, the reliability of class means clearly is unsatisfactory for Student Cohesiveness (0.29), possibly because of the small sample size. When the scale of Student Cohesiveness is excluded, the reliability ranges from 0.80 to 0.95 with the class as the unit of analysis. As expected, the reliability is higher when the class mean was used as the unit of analysis.

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The discriminant validity results indicate whether each scale is unique in the aspect which it assesses. The mean correlation of a scale with the other scales varied between 0.33 and 0.51 with the individual as the unit of analysis and between 0.26 and 0.53 with the class mean as the unit of analysis. While there is some overlap between raw scores, factor analysis results support the independence of factor scores (except for Student Cohesiveness and Equity).

The last column in Table 4.5 reports the ANOVA results. Parents with students in the same class should perceive the classroom environment relatively similarly, while mean class parent perceptions should vary from class to class. This analysis shows there were statistically significant differences between the perceptions of parents with students in different classes for the Teacher Support, Involvement, and Task Orientation scales. The Student Cohesiveness, Equity, and Investigation scales did not show significant differences between classes. The proportion of variance accounted for by class membership (eta$^2$) ranged from 0.01 to 0.10 for different WIHIC scales.

**Finding 5:** The actual version of the parent WIHIC generally demonstrates satisfactory reliability and discriminant validity for two units of analysis (individual and class mean), and most scales are able to differentiate between the perceptions of parents whose children are in different classes. Nevertheless, the results suggest the desirability of replication with a larger sample.

### 4.1.6 Internal Consistency Reliability and Discriminant Validity for the TOSRA

The Cronbach alpha coefficient was calculated to establish the internal consistency reliability of the two scales of the TOSRA. The discriminant validity of the TOSRA was calculated using the correlation between the two scales. Both the individual and class were used as the unit of analysis.

The reliabilities (alpha coefficients) for the two scales were 0.74 and 0.88 with the individual as the unit of analysis and 0.81 and 0.91 with the class as the unit of
analysis. As expected, the reliability is higher when the class mean was used as the unit of analysis. The discriminant validity results (correlation with the other scale) was 0.22 with the individual as the unit of analysis and 0.29 with the class mean as the unit of analysis as reported in Table 4.6.

Table 4.6 Internal Consistency Reliability (Cronbach Alpha Coefficient) and Discriminant Validity (Correlation with other Scale) for Two Units of Analysis for the TOSRA

<table>
<thead>
<tr>
<th>Scale</th>
<th>Unit of Analysis</th>
<th>Alpha Reliability</th>
<th>Correlation with other Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude to Scientific Inquiry</td>
<td>Individual</td>
<td>.74</td>
<td>.22</td>
</tr>
<tr>
<td></td>
<td>Class</td>
<td>.81</td>
<td>.29</td>
</tr>
<tr>
<td>Enjoyment of Science Lessons</td>
<td>Individual</td>
<td>.88</td>
<td>.22</td>
</tr>
<tr>
<td></td>
<td>Class</td>
<td>.91</td>
<td>.29</td>
</tr>
</tbody>
</table>

The sample consisted of 161 students in 6 classes in Miami-Dade County, Florida. The eta² statistic (which is the ratio of 'between' to 'total' sums of squares) represents the proportion of variance explained by class membership.

Finding 6: The TOSRA's two scales demonstrate satisfactory reliability and discriminant validity for two units of analysis (individual and class mean). Nevertheless, the results suggest the desirability of replication with a larger sample.

4.2 Differences Between Parents and Students in Terms of Preferred Classroom Environment and Perceptions of the Actual Classroom Environment

Research Question #2: Are there differences between parents and students in their preferred classroom environment and in their perceptions of the same actual classroom environment?

In order to investigate differences in parents' and students' actual and preferred perceptions of the science learning environment, a series of MANOVAs with repeated measures was used. When the multivariate test using Wilks' lambda criterion yielded significant results, the individual ANOVA for each individual WHIC scales was
interpreted and effect sizes were calculated. Section 4.2.1 reports the differences between students’ perceptions of the actual and preferred learning environment. Differences between parent perceptions of the actual and preferred science learning environment for their children are reported in Section 4.2.2. And, finally, Section 4.2.3 reports the differences between students and parents in their actual and preferred perceptions of the learning environment.

4.2.1 Differences Between Students’ Perceptions of Actual and Preferred Learning Environment

To explore the differences between students’ perceptions of the actual environment compared to the students’ preferred environment, the average item mean was determined. The average item mean is simply the scale mean divided by the number of items in a scale, and it was used to enable easy comparison of the average scores on scales with different number of items. Using the individual as the unit of analysis, effect sizes were calculated to determine the magnitude (in contrast to the statistical significance) of the difference between actual and preferred perceptions as suggested by Anderson and Arsenault (1998) and Thompson (1998). The effect size is simply the difference between means expressed in standard deviation units. Table 4.7 shows the results of these analyses.

The first analysis involved a one-way MANOVA (multivariate analysis of variance) for repeated measures with the set of WIHIC scales as the dependent variables and with the form of the instruments (student actual versus student preferred) as the independent variable. Because the multivariate test using Wilk’s lambda criterion yielded significant differences, the univariate ANOVA was interpreted for each scale.

Table 4.7 shows that students prefer statistically significantly higher levels of Involvement (effect size 0.18), Equity (effect size 0.17), and Investigation (effect size 0.27) in their science classrooms. For Teacher Support and Task Orientation, there were only small differences between actual and preferred scores (effect size of 0.07 and 0.02, respectively), and these differences were not statistically significant. Students desired less Student Cohesiveness (effect size 0.07), but this difference
wasn’t statistically significant. Figure 4.1 graphically represents the differences between actual and preferred environment scores for students.

Table 4.7  Average Item Mean, Average Item Standard Deviation and Differences between Student Actual and Preferred Scores on the WIHIC (Effect Size and MANOVA for Repeated Measures) with the Individual as the Unit of Analysis

<table>
<thead>
<tr>
<th>Scale</th>
<th>Average Item Mean</th>
<th>Average Item Standard Deviation</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>Preferred</td>
<td>Actual</td>
</tr>
<tr>
<td>Student Cohesiveness</td>
<td>4.12</td>
<td>4.08</td>
<td>.58</td>
</tr>
<tr>
<td>Teacher Support</td>
<td>3.94</td>
<td>3.99</td>
<td>.68</td>
</tr>
<tr>
<td>Involvement</td>
<td>3.80</td>
<td>3.93</td>
<td>.70</td>
</tr>
<tr>
<td>Task Orientation</td>
<td>4.22</td>
<td>4.21</td>
<td>.57</td>
</tr>
<tr>
<td>Equity</td>
<td>3.91</td>
<td>4.05</td>
<td>.86</td>
</tr>
<tr>
<td>Investigation</td>
<td>3.84</td>
<td>4.05</td>
<td>.86</td>
</tr>
</tbody>
</table>

**p<0.01

The sample consisted of 453 students in 22 classes in South Florida.

Overall students perceive lower levels of most WIHIC dimensions for the actual classroom environment when compared to their preferred classroom environment. While the effect sizes were relatively small, overall the findings indicate that students prefer a classroom environment that is more favourable than the one that they perceive as actually being present. These findings are consistent with studies conducted throughout the world (Fraser, 1998a; Henderson, Fisher & Fraser, 2000).
Finding 7: Students generally prefer a more favourable learning environment in their science classrooms than what they perceive is actually present.

4.2.2 Differences Between Parents’ Perceptions of the Actual and Preferred Learning Environment for Their Children

In exploring differences between actual and preferred environment scores for parents, the same statistical analyses were utilised for the parent responses on the WIHIC as were used for the student responses on the WIHIC (see Section 4.2.1). That is, when a MANOVA revealed statistically significant results overall, univariate ANOVA for repeated measures were interpreted for each scale. Table 4.8 is parallel to Table 4.7 except that parents’ responses rather than students’ responses were analysed in Table 4.8.
Table 4.8 shows the differences in parents’ perceptions of the actual and preferred science learning environment for their children. On all six scales, parents consistently indicated a lower item mean average for the actual classroom environment when compared to the parents’ preferred science learning environment for their children. Figure 4.2 graphically depicts the sizeable differences between parents’ views of their children’s science learning environment and their preferred or ideal science learning environment for their children.

Table 4.8  Average Item Mean, Average Item Standard Deviation and Differences Between Parent Actual and Preferred Scores on the WIHIC (Effect Size and MANOVA for Repeated Measures) with the Individual as the Unit of Analysis

<table>
<thead>
<tr>
<th>Scale</th>
<th>Average Item Mean</th>
<th>Average Item Standard Deviation</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual</td>
<td>Preferred</td>
<td>Actual</td>
</tr>
<tr>
<td>Student Cohesiveness</td>
<td>4.23</td>
<td>4.33</td>
<td>.48</td>
</tr>
<tr>
<td>Teacher Support</td>
<td>3.95</td>
<td>4.32</td>
<td>.68</td>
</tr>
<tr>
<td>Involvement</td>
<td>3.75</td>
<td>4.30</td>
<td>.59</td>
</tr>
<tr>
<td>Task Orientation</td>
<td>4.19</td>
<td>4.43</td>
<td>.54</td>
</tr>
<tr>
<td>Equity</td>
<td>3.93</td>
<td>4.34</td>
<td>.66</td>
</tr>
<tr>
<td>Investigation</td>
<td>3.80</td>
<td>4.30</td>
<td>.70</td>
</tr>
</tbody>
</table>

**p<0.01

The sample consisted of 120 parents of students from 6 classes in South Florida.

MANOVA revealed statistically significant differences on all scales (Table 4.8). The greatest differences between actual and preferred means can be found for Involvement (effect size 0.89) and Investigation (effect size 0.76). Additionally Teacher Support, Equity and Task Orientation show sizeable effect sizes of 0.58, 0.65 and 0.46, respectively. The smallest effect size was found for Student Cohesiveness (0.20).
Of particular note are the large effect sizes for parents (see Table 4.8) when compared to the smaller effect sizes for students (see Table 4.7). The effect size for parents on five of the six scales ranged between approximately a half of a standard deviation (0.46) and over three-quarters of a standard deviation (0.89). These effect sizes indicate a substantial difference between parents preferred learning environment for their children and the perceived actual learning environment.

Finding 8: Parents prefer a more favourable learning environment for their children than what they perceive is actually present. Parents' effect sizes for actual-preferred differences were notably larger than the corresponding students' effect sizes.
4.2.3 Differences Between Students and Parents in Terms of Actual and Preferred Scores on the WIHIC

To explore differences between students’ and parents’ perceptions of their actual environment and their preferred environment, the average item mean was calculated for each WIHIC scale. Using the individual as the unit of analysis, effect sizes were calculated to determine the magnitude of the difference between parents’ and students’ scores as suggested by Anderson and Arsenault (1998) and Thompson (1998). The effect size expresses the difference between two means in standard deviation units. The sample consisted of 120 parents and students in six classes. (For the majority of students in the main sample, corresponding parent questionnaire responses were not available.)

In order to determine the statistical significance of differences, a one-way MANOVA (multivariate analysis of variance) for repeated measures was performed with the set of WIHIC scales as the dependent variables and with the group responding to the instrument (students versus parents) as the independent variable. Because the multivariate test using Wilks’ lambda criterion yielded significant differences, the univariate ANOVA was interpreted separately for each scale. All analyses were performed separately for the actual and the preferred forms of the WIHIC.

Table 4.9 shows that parents perceive the actual classroom environment less favourably than their children do, but the effect sizes are generally small. Using the average item mean as the basis of comparison, parents perceive that there is less actual Teacher Support (effect size 0.09), Involvement (effect size 0.17), Task Orientation (effect size 0.28), and Investigation (effect size 0.18) than their children. A negligible difference was found between parents’ and students’ perceptions of the amount of Student Cohesiveness (0.04 difference) present in the classroom learning environment. Students and parents indicate agreement on the level of Equity in the classroom. Task Orientation is the only scale for which differences between students and parents were statistically significant for the actual form of the WIHIC.

In contrast, the differences between what parents would prefer happening in their children’s science classroom and what their children prefer happening are large.
Parents prefer greater levels of *Student Cohesiveness* (effect size 0.40), *Teacher Support* (effect size 0.44), *Involvement* (effect size 0.59), *Equity* (effect size 0.36), and *Investigation* (effect size 0.30). All of these effect sizes suggest an educationally important difference between students' and parents' preferences. The only area parents indicate a slightly lower preference than students is *Task Orientation* (effect size 0.08). Relative to their students, parents consistently indicated a preference for a more favourable learning environment. ANOVA results confirmed the statistical significance of these differences between students' preferred and parents' preferred learning environment for five of the six scales (see Table 4.9). *Task Orientation* was the only scale that did not reveal a statistically significant difference (effect size 0.08).

Table 4.9  Average Item Mean, Average Standard Deviation and Differences Between Student and Parent Actual and Preferred Scores on the WIHIC: (Effect Size and MANOVA for repeated measures) with the Individual as the Unit of Analysis

<table>
<thead>
<tr>
<th>Scale</th>
<th>Form</th>
<th>Average Item Mean</th>
<th>Average Item Standard Deviation</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Student</td>
<td>Parent</td>
<td>Effect Size</td>
</tr>
<tr>
<td><strong>Student Cohesiveness</strong></td>
<td>Actual</td>
<td>4.21</td>
<td>4.23</td>
<td>.49</td>
</tr>
<tr>
<td></td>
<td>Preferred</td>
<td>4.14</td>
<td>4.34</td>
<td>.48</td>
</tr>
<tr>
<td><strong>Teacher Support</strong></td>
<td>Actual</td>
<td>4.00</td>
<td>3.94</td>
<td>.69</td>
</tr>
<tr>
<td></td>
<td>Preferred</td>
<td>4.04</td>
<td>4.31</td>
<td>.60</td>
</tr>
<tr>
<td><strong>Involvement</strong></td>
<td>Actual</td>
<td>3.89</td>
<td>3.78</td>
<td>.69</td>
</tr>
<tr>
<td></td>
<td>Preferred</td>
<td>3.88</td>
<td>4.30</td>
<td>.65</td>
</tr>
<tr>
<td><strong>Task Orientation</strong></td>
<td>Actual</td>
<td>4.32</td>
<td>4.17</td>
<td>.53</td>
</tr>
<tr>
<td></td>
<td>Preferred</td>
<td>4.36</td>
<td>4.40</td>
<td>.50</td>
</tr>
<tr>
<td><strong>Equity</strong></td>
<td>Actual</td>
<td>3.93</td>
<td>3.93</td>
<td>.88</td>
</tr>
<tr>
<td></td>
<td>Preferred</td>
<td>4.11</td>
<td>4.35</td>
<td>.73</td>
</tr>
<tr>
<td><strong>Investigation</strong></td>
<td>Actual</td>
<td>3.94</td>
<td>3.81</td>
<td>.81</td>
</tr>
<tr>
<td></td>
<td>Preferred</td>
<td>4.09</td>
<td>4.29</td>
<td>.68</td>
</tr>
</tbody>
</table>

**p<0.01**
The sample consisted of 120 parents and students in 6 classes in South Florida

Figure 4.3 graphically illustrates the item mean averages for the differences between students and parents in their actual and preferred WIHIC scores. Overall parents perceive a somewhat less favourable actual science classroom environment than students, but parents prefer a much more favourable science classroom environment
than students do. Figure 4.3 also shows that students prefer a classroom environment that is more favourable than the one which they perceive as actually being present, a finding that is consistent with previous studies conducted throughout the world (Fraser, 1998b; Henderson, Fisher & Fraser, 2000). Moreover, Figure 4.3 illustrates that the differences between actual and preferred scores are considerably larger for parents than students.

Figure 4.3 Comparison of Average Item Means for Students and Parents in their Actual and Preferred WIHIC scores

![Graph showing comparison of average item means for students and parents in their actual and preferred WIHIC scores.]

Finding 9: Parents perceive a somewhat less favourable actual science classroom environment than students, but parents prefer a much more favourable science classroom environment than students do.

4.3 Associations between Student Outcomes and Students' and Parents' Perceptions of the Learning Environment

Research Question #3:
Are there associations between the student outcomes of achievement and attitudes and:

- students' perception of the science learning environment?
To examine associations either between students' or parents' perceptions of the learning environment and student outcomes (achievement and attitudes), simple correlation and multiple regression analyses were carried out. Section 4.3.1 reports the results of these analyses for the student version of the actual form of the WIHIC and Section 4.3.2 reports the results of these analyses for the parent version.

4.3.1 Simple Correlation and Multiple Regression Analyses for Student WIHIC

Simple correlation was used to examine the bivariate relationship between each student outcome and a particular environment scale, while multiple regression analyses were carried out to determine which scales contributed to variance in students' attitudes or achievement when the other WIHIC scales are mutually controlled. Attitudes were assessed by student responses to the TOSRA (Enjoyment of Science Lessons and Attitude to Scientific Inquiry) and achievement (stanine score on the Stanford-9 science subtest (SAT-9) and final grade in science).

Table 4.10 shows the relative strength of the associations between student outcomes (attitude and achievement) and the six scales of the WIHIC. The sample consisted of 161 students in 6 classes in South Florida. This sample was comprised of the students whose parents had signed a release form required by the school district before academic information can be released. This samples size permitted analyses to be carried out only at the student level.

The results of the simple correlational analysis reported in Table 4.10 show that 4 out of 24 simple correlations are statistically significant, which is three times that expected by chance. The results show that Investigation is significantly correlated with Attitude to Scientific Inquiry, and that the learning environment scales of Involvement, Task Orientation, and Investigation are significantly correlated with Enjoyment of Science. All of these statistically significant correlations are positive. The students' final grade and SAT-9 scores are not significantly related to any of the environmental scales.
The multiple correlation between an outcome measure and the set of six environment scales was 0.25 for *Attitude to Scientific Inquiry*, 0.39 for *Enjoyment of Science Lessons*, 0.21 for Final Grade, and 0.26 for SAT-9 scores (see Table 4.10). The multiple correlation is statistically significant only for *Enjoyment of Science Lessons*.

Table 4.10 Simple Correlation and Multiple Regression Analyses for Associations Between Student Attitudes, Academic Achievement and Dimensions of the WIHIC for Students

<table>
<thead>
<tr>
<th>Scale</th>
<th>Attitude to Scientific Inquiry</th>
<th>Enjoyment of Science Lessons</th>
<th>Final Grade</th>
<th>SAT-9 Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( r )</td>
<td>( \beta )</td>
<td>( r )</td>
<td>( \beta )</td>
</tr>
<tr>
<td>Student Cohesiveness</td>
<td>.05</td>
<td>-.01</td>
<td>.05</td>
<td>.12</td>
</tr>
<tr>
<td>Teacher Support</td>
<td>.06</td>
<td>.08</td>
<td>.00</td>
<td>-.04</td>
</tr>
<tr>
<td>Involvement</td>
<td>.08</td>
<td>-.02</td>
<td>.24**</td>
<td>.16</td>
</tr>
<tr>
<td>Task Orientation</td>
<td>.09</td>
<td>.03</td>
<td>.33**</td>
<td>.33**</td>
</tr>
<tr>
<td>Equity</td>
<td>-.03</td>
<td>-.11</td>
<td>.03</td>
<td>-.07</td>
</tr>
<tr>
<td>Investigation</td>
<td>.23**</td>
<td>.23**</td>
<td>.20**</td>
<td>.07</td>
</tr>
<tr>
<td>Multiple Correlation (R)</td>
<td>.25</td>
<td></td>
<td>.39**</td>
<td></td>
</tr>
</tbody>
</table>

** \( p < 0.01 \)

The sample consisted of 161 students in 6 classes in South Florida.

Standardized regression coefficients were used to identify which of the six WIHIC scales contributed uniquely to the variance in student outcomes (*Attitude to Scientific Inquiry*, *Enjoyment of Science Lessons*, *Grades* and *SAT-9 Scores*) when other environment scales were mutually controlled. Because the multiple correlation is statistically significant only for *Enjoyment of Science Lessons*, regression weights were only examined for this outcome. Table 4.8 shows that Task Orientation is a significant independent predictor of *Enjoyment of Science Lessons*.

*Finding 10: Positive but relatively weak relationship exists between student outcomes (especially Enjoyment of Science Lessons) and the learning perceived by students (especially Task Orientation).*

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4.3.2 Simple Correlation and Multiple Regression Analyses for the Parent WIHIC

As with the student version, simple correlation and multiple regression analyses were carried out to determine associations between the student outcomes of attitudes and academic achievement and dimensions on the actual form of the parent WIHIC. Table 4.11 shows the relative strength of the associations between student outcomes and parent perceptions on the six scales of the WIHIC. The sample consisted of 120 students and their parents.

Table 4.11 Simple Correlation and Multiple Regression Analyses for Associations Between Student Attitudes, Academic Achievement and Dimensions of the WIHIC for Parents

<table>
<thead>
<tr>
<th>Scale</th>
<th>Attitude to Scientific Inquiry</th>
<th>Enjoyment of Science Lessons</th>
<th>Final Grade</th>
<th>SAT-9 Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( r )</td>
<td>( \beta )</td>
<td>( r )</td>
<td>( \beta )</td>
</tr>
<tr>
<td>Student Cohesiveness</td>
<td>.12</td>
<td>.08</td>
<td>.20*</td>
<td>.12</td>
</tr>
<tr>
<td>Teacher Support</td>
<td>.11</td>
<td>.20</td>
<td>.21*</td>
<td>.28</td>
</tr>
<tr>
<td>Involvement</td>
<td>.15</td>
<td>.06</td>
<td>.08</td>
<td>-.21</td>
</tr>
<tr>
<td>Task Orientation</td>
<td>.04</td>
<td>.04</td>
<td>.24*</td>
<td>.28**</td>
</tr>
<tr>
<td>Equity</td>
<td>-.07</td>
<td>.32**</td>
<td>.11</td>
<td>-.16</td>
</tr>
<tr>
<td>Investigation</td>
<td>.22*</td>
<td>.20</td>
<td>.11</td>
<td>-.03</td>
</tr>
<tr>
<td>Multiple Correlation (( R ))</td>
<td>.33</td>
<td>.33</td>
<td>.42**</td>
<td>.21</td>
</tr>
</tbody>
</table>

** \( p < 0.01 \)

The sample consists of 112 parents of students in 6 classes in South Florida.

The results of the simple correlational analysis reported in Table 4.11 show that 6 out of 24 simple correlations are statistically significant, which is 7 times that expected by chance. Results show that Investigation is significantly correlated with Attitude to Scientific Inquiry. This is consistent with the student results (see Table 4.10). Student Cohesiveness, Teacher Support, and Task Orientation also are significantly correlated with Enjoyment of Science Lessons. Additionally, Student Cohesiveness, Involvement, Task Orientation, and Equity are significantly correlated with the students’ final grade. As with the students’ results, all significant relationships are positive. There
were no significant correlations between the SAT-9 scores received on the standardised science achievement test and any of the six environmental scales.

The multiple correlation between an outcome measure and the set of six environment scales was 0.33 for *Attitude to Scientific Inquiry*, 0.33 for *Enjoyment of Science Lessons*, 0.42 for Final Grade, and 0.21 for SAT-9 scores. The multiple correlation was statistically significant only for the *Final Grade* outcome (see Table 4.11).

As with the student version, standardized regression coefficients were used to identify which of the six WIHIC scales contributed uniquely to the variance in student outcomes (*Attitude to Scientific Inquiry, Enjoyment of Science Lessons, Final Grade* and SAT-9 scores) when other environmental scales were mutually controlled. Although the analysis revealed that four regression coefficients were statistically significant, results were interpreted only for Final Grade because it is the only outcome for which the multiple correlation was statistically significant. *Task Orientation* was a significant independent predictor of Final Grade.

*Finding 11:* Generally positive but relatively weak relationships exist between student outcomes (especially Final Grade) and the learning environment as perceived by parents (especially Task Orientation).

*Finding 12:* Overall the strengths of outcome-environment associations are similar for students and parents as suggested by multiple correlations.

### 4.4 Interviews and Observations

After the questionnaires were administered to the 520 students and 120 parents, follow-up interviews and observations were conducted. Ten students and their parents were interviewed (see Chapter 3 for details on the selection of parents and students). The main interview questions sought information about what the science learning environment was like in the current classroom and what type of science learning environment would be preferred in an ideal classroom (see Appendix P for the interview questions). Additionally, the 10 students interviewed were observed once in their science classrooms.
Generally the quantitative probes indicated that parents perceived the actual classroom learning environment less favourably than their children did. Additionally, statistically significant differences existed between parents’ perception of the actual science learning environment and the preferred learning environment for their children. While this might indicate dissatisfaction with the classroom environment, the overall impression from the interviews was exactly the opposite. All parents during interviews expressed the belief that teachers were doing the best that they could under the constraints of mandated testing, overcrowding and discipline problems created because of the overcrowding. Parents felt that these three issues all negatively impacted the learning environment of their children. Even so, parents generally considered that these issues as being beyond the control of the classroom teacher and was an issue better addressed at the district or even state level.

While quantitative findings indicated that students generally prefer a more favourable learning environment in their science classrooms, all the students interviewed were relatively happy with their teachers and classrooms. Involvement, Equity, and Investigation were the three specific areas for which there were statistically significant differences between students’ actual and preferred perceptions of the science learning environment. The results from the interviews helped to provide possible explanations for these differences.

One of the interview questions asked parents how they came to know what was going on in their children’s classrooms. Two of the ten parents said that they did not really know what their children did in science class. Three of the parents said that they knew what their children were doing in science class by what their children talked about when they came home from school. And, half the parents indicated that homework was the way in which they came to know what their child was doing in school. In fact, every parent referred to the science fair project that was currently being completed at home by students.

The qualitative probes were designed to augment the quantitative probes and offer plausible explanations for the results. The findings from the student and parent interviews, along with relevant classroom observations, are presented in the following sections which use the names of the WIHIC scales as organizing themes: Student
Cohesiveness (Section 4.4.1), Teacher Support (Section 4.4.2), Involvement (Section 4.4.3), Task Orientation (Section 4.4.4), Equity (Section 4.4.5), and Investigation (Section 4.4.6).

Finding 13: Generally, the students interviewed were satisfied with their science classrooms learning environments.

Finding 14: Generally, parents were satisfied with the science learning environments of their children’s classrooms, and they suggest that most of the problems (the number of students in each class, the physical structure of the classroom, and discipline) were outside the control of the teacher.

Finding 15: Parents indicated that they knew what was going on in their children’s science classroom mainly through their children’s homework assignments and what their children talked about when they come home from school.

4.4.1 Student Cohesiveness

The quantitative probe of the learning environment suggests that students would prefer slightly less Student Cohesiveness in the classroom (see Figure 4.1). During interviews, students consistently commented on the advantages and disadvantages of having friends in classroom. One student stated: “Having friends is good and bad. They might distract you; and then you get into trouble.”

Another student said: “I try to ignore my friends in class. Like if I am doing something hard, I ignore them and concentrate on my work. Like they say something – I’m like yeah [gestures with hand like ‘go away’] whatever.”

While students saw the necessity of getting along to accomplish group work, it was always presented with a caution about not being too friendly in class. The general attitude towards student cohesiveness is summed up in this student’s response: “We have to get along in the group but not too much. So, if we get along and work together as a team, we will get the work done.”
The quantitative findings for parents indicate a preference for greater level of *Student Cohesiveness* (see Figure 4.2). While parents echoed their children’s caution of not being too friendly in class, they emphasised the importance of children getting along with their peers. During interviews, all the parents asserted that positive interactions between students in the classroom are likely to foster greater enjoyment of science lessons and academic achievement. This is consistent with the quantitative findings in Table 4.11 showing that associations between parents’ perceptions of *Student Cohesiveness* in the classroom were significantly correlated with their children’s *Enjoyment of Science Lessons* and academic achievement (Final Grade).

One parent stated: “The teacher should be able to pair someone up – I won’t say friends – who could be serious with him or her.” Another parent affirmed: “It is always good to have friends in class. You are more relaxed. I think it helps because you want to be as good or ‘up there’ with the level [of the class] proving that you are in the same class.” A third parent concurred: “We want our children to have an environment that’s pleasant and where they get long. But, on the other hand, you know that all the talking and not focussing on what is going on in class could keep them from learning.”

The advantages and disadvantages of having friends in the classroom were evident during classroom observations. During one classroom observation, students were being instructed on how to make a cheek cell slide to view under a microscope. The directions involved many steps, which were modelled and orally presented by the teacher. Some students became confused and asked their classmates for clarification. One student asked: “Do I slide it on the bigger one? I don’t get it.” A student next to him demonstrated how to slide the cover slip on the slide. After about 10 minutes of viewing the cheek cell under the microscope, several students alternated between following directions and talking about ‘who likes who’ and ‘play fighting’ with friends. While friends did help with clarifying directions and completing the task, they also provided a distraction during group work.

*Finding 16: Students generally reported both advantages and disadvantages of having friends in the classroom* (Student Cohesiveness).
Finding 17: Parents generally felt that positive interactions between students in the classroom were likely to foster greater enjoyment of science lessons and academic achievement.

4.4.2 Teacher Support

The quantitative findings for students indicated almost no difference (see Figure 4.1 and Table 4.7) between the amount of Teacher Support that the students perceive that they actually receive in the classroom and the amount of Teacher Support that they would prefer. Although students indicated that the teacher might not walk around the classroom and talk individually to them about their problems, they did not perceive this in a negative manner.

When I walked into Mrs L’s classroom, she was sitting on a stool with her science manual open and the students had their book open on their desks. The students were all sitting in rows facing the front of the room.

Mrs L: What are the cells doing?
Student 1: They can die.
Student 2: Divide.
Mrs L: Okay and repair.
Student 1: A scab is cells repairing.
Mrs L: What are the function of cells?

The discussion continues and most students appear interested and attentive. The conclusion of the lesson required students to fill in a graphic organizer provided by the teacher.

After the observation, one student interviewed states: “We raise our hand when we need help and then we get help.” A student from another class agrees that the teacher can offer support without coming to his desk: “The teacher doesn’t have to walk around the whole class. She has the whole class to deal with. If the teacher stays at the front, we can raise our hands.”
Unlike their children, parents indicated a preference for greater Teacher Support (see Figure 4.2 and Table 4.8). During every parent interview, Teacher Support was cited as the most important variable in an ideal science class. One parent states: “The relationship between the student and teacher is number one. If my son has a good relationship with his teacher, he will learn.”

Another parent agrees: “Undoubtedly relationship is the core. The fact is that the teacher is the ombudsman between the subject; and, if there is going to be enthusiasm, it is coming from the teacher.” The quantitative findings are consistent with this statement (see Table 4.11) in that Enjoyment of Science was positively and significantly correlated to Teacher Support.

Finding 18: Students were generally happy with the amount of Teacher Support provided in their classrooms.

Finding 19: During every interview, parents identified Teacher Support as being the most important variable in an ideal science classroom for their children.

4.4.3 Involvement

Most students indicated embarrassment as the main reason for not being more involved in the classroom. The quantitative probe found that students preferred statistically significantly greater levels of Involvement in the classroom (see Table 4.7). Students expressed a fear of being laughed at by their peers if they asked questions or expressed their opinions in class. One student said: “I get embarrassed. I’ll say that I like go all 'blushy'.” Another student stated: “I don’t explain my thoughts about science to other students because they might think it’s silly.”

For students, higher levels of Involvement in the classroom were positively and significantly correlated with greater Enjoyment of Science Lessons (see Table 4.10). During interviews, students indicated that an ideal science classroom would be one in which students would be able to share ideas and comments: “I think that it would be a better science class if the children in the classroom – students – could have more comments and questions.”

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As with the student quantitative findings, parents indicate a statistically significant preference for greater levels of *Involvement* in the classroom (see Figure 4.2). One parent proposes: "Eighty-five percent of students are saying to themselves that they hope that the teacher doesn’t call on them. It would seem germane to take this 85 percent kicking and screaming into the enclosure and get them involved anyways."

Another parent emphasises the importance of the teacher getting all kids involved in the classroom: "I think it is up to the teacher to be aggressive and to be dynamic, and that will make the children listen. Something along the line of making kids get involved even if they are not doing too well. I know for the most part that my child is involved and she’ll ask if she is lost."

Additionally parents felt that this was a maturity issue: "Really this is what defines us as human beings. Those things that we care enough about to risk embarrassment."

Finding 20: Students indicated fear of being embarrassed as the main reason for not being more involved in the classroom (Involvement).

Finding 21: Parents indicated that it was up to teachers to involve all students in the classroom, even if they resisted (Involvement).

4.4.4 Task Orientation

As with *Student Cohesiveness and Teacher Support*, the quantitative findings for students indicate almost no difference (see Figure 4.1) between the level of *Task Orientation* perceived in the classroom and the level preferred in the classroom. All students maintained that completing their work and knowing what to do in science was important. "I know that I’m supposed to take out my notebook and write down notes when my teacher writes on the board," a student explains.

Students stressed the importance of asking questions to clarify what needed to be accomplished in the classroom. In response to why students in classes might not be receiving good grades, one student proposes: "Probably the teacher doesn’t inform them about the activities as to what to do. They probably have questions and the
teacher won't even answer them.” During classroom observations, most questions from students were used to clarify directions on completing a task assigned by the teacher. These clarifying questions were addressed to the teacher and to their peers.

The findings from the parent quantitative probe indicated a statistically significant preference for greater levels of *Task Orientation* in the classroom (Table 4.8). *Task Orientation* was significantly correlated to student *Enjoyment of Science Lessons* and the student’s final grade in science (Table 4.11). Most parents identified *Task Orientation* as something parents instilled in their children. One parent proposes: “One of the most important areas in the science achievement of my child is outside the teacher’s control. Does the child have the capacity and desire? The teacher has 30 to 40 students. It is intrinsic into the child as to whether they do well or not.”

Two parents stated that the American public school policy of not physically punishing children in class contributed to lower task orientation by their children. One parent says: “My child was beaten by a teacher when he was 5. He was attending private school. He always brought the homework because the teacher beat him. So he was crying, ‘Mommy, I forgot my homework. I got to go back or the teacher is going to beat me.’ Now he doesn’t care.”

*Finding 22:* *All students maintained that completing their work and knowing what to do in science was important* (*Task Orientation*).

*Finding 23:* *Parents generally felt that they instilled the importance of Task Orientation in their children.*

### 4.4.5 Equity

Students preferred significant greater levels of *Equity* in the classroom (see Figure 4.1). Students indicated that teachers treated students differently because of student behaviour and level of academic achievement. One student said: “Sometimes the teacher doesn’t see my hand and she’ll pick the kids with good grades.”
Another student states: "The teacher always makes me answer the questions and that isn’t fair to the other students. She doesn’t pay attention to some students like the LD [Learning Disabled Students].”

A student summarised his feelings about Equity in the classroom: "I think that it is very important for the whole class to be treated equally because you won’t have problems. If he’s a ‘goody two shoes’ or a ‘teacher’s pet’, then he gets picked more or she gets picked more. We would have people calling each other names like ‘teacher’s pet’. Everyone gets the same opportunity to answer a question thoroughly or ask a question, because they get treated equally in class. They get as much attention as the other students do. I think that it’s very important.”

Parents also indicated a statistically significant preference for greater levels of Equity in the classroom (see Table 4.8). Parent perceptions of higher levels of Equity in the classroom were significantly related to the student’s final grade in science (See Table 4.11).

The quantitative findings indicated that parents and students did not view equity in the same way. Factor analysis indicated that Student Cohesiveness and Equity loaded on the same scale (see Table 4.2). When asked about Student Cohesiveness and Equity during the interviews, parents felt these two areas were interrelated. Parents indicated that equitable treatment in the classroom would lead to cohesive relations between students. Students, on the other hand, perceived these areas as two separate issues when interviewed.

Although parents did not express a specific problem with equity in the classroom, the manner in which the teacher treated their child in the classroom was an important issue. Parents stated that equitable treatment in the classroom provided motivation for all students to succeed. One parent suggests: "Because kids’ hearts are pure, they can really tell if someone is caring. So I think it [Equity] is very important, because students will work harder if they feel that way. It helps them to want to learn more.”

Finding 24: Students indicated that teachers treated students differently because of student behaviour and academic achievement (Equity).
Finding 25: For parents, the manner in which the teacher treated their children in the classroom was an important issue. Parents felt that the concept of Equity in the classroom was intertwined with Student Cohesiveness.

4.4.6 Investigation

The quantitative findings indicate that students prefer statistically significantly greater levels of *Investigation* in their classrooms (see Figure 4.1) and perceptions of higher levels of *Investigation* were significantly correlated with higher *Attitudes to Scientific Inquiry and Enjoyment of Science Lessons* scores (see Table 4.10). During interviews, students stressed the importance of investigation in science especially performing ‘hands-on’ experiments. During classroom observations four out of the six classes conducted ‘hands-on’ experiments and two used the textbook. All of the teachers interviewed stated that experiments were used in the classroom to either introduce a new concept or reinforce previous learning. No matter what level of investigation was present in the classroom, the students wanted more hands-on opportunities in the science classroom.

One student suggests: “A lot of people like science because of the experiments; and I especially like the experiments. I think that people wouldn’t like science that much if there weren’t experiments or hands-on experiments.”

Another student proposes: “If there were no hands-on projects, I’d be mad because there is some information that you can only get from hands-on projects, such as the thing that we were mixing up with the ammonia and the cleaner stuff. It got hotter. It [being able to classify the change] came out of information about physical and chemical change. It’s not the same out of a book.”

Parents also indicated a statistically significant preference for greater levels of *Investigation* in the classroom (see Figure 4.2) and parent perceptions of higher levels of *Investigation* were significantly correlated to greater student *Attitudes to Scientific Inquiry* (see Table 4.11). Parents indicated the teacher’s use of hands-on experiences was constrained by the class size and physical structure of the rooms. “I don’t know
how much hands-on things they do, especially in these rooms. We used to put the plants by the windows so that the sun would come in and let them grow. And in the portables, some portables have no windows at all.” Another parent explains, “My impression is that teachers have 30 to 35 kids. That makes it very hard to do hands-on.”

Parents also expressed the opinion that hands-on experiences were different from book learning. One parent explains: “It is a learning tool. It is just very effective. I mean that you don’t learn the same thing by just reading it. And, with children, it should be that much better because they don’t have the development mentally.” Another parent elaborates: “It is different when you read about something or do hands-on. They are two different things: doing the subject and talking about it. Doing it is key. The hands-on ties everything [together].”

During observations, it was noted that four out of the six classes did not have a sink or running water available. Additionally, two out of the six classes were housed in rooms that were half size. The original design of these rooms was for kindergarten classes with a spill-out area in the middle of the two classes. Because the school was overcrowded, these rooms were used for two fifth grade classes with 32 and 34 kids each. There was no extra space in the room to set up additional tables. All materials had to be taken out of cabinets, used at the students’ desks, collected and returned to the cabinet. These rooms also did not have windows. The other four classes that were observed also had between 30 and 35 students, but the rooms were larger. But, with 30-35 students, the desk and the students took up most of the space available in the classroom. These four classes were held in relocatables that sometimes are called portable classrooms. Overall the rooms were not conducive to hands-on investigations in science.

Finding 26: No matter what level of Investigation was present in the classroom, students wanted more hands-on investigations (Investigation).

Finding 27: While parents indicated that hands-on experiences in the science classroom were an important learning tool, parents felt teachers were constrained from the use of hands-on experiments because of the physical structure of the classrooms and number of students in the classroom (Investigation).
4.5 Summary of Results Chapter

Chapter 4 reported the results and analyses of the quantitative and qualitative findings. To determine parents’ and students’ perceptions of the learning environment, a modified version of the *What is Happening in this Class?* (WIHIC) questionnaire was administered to 520 students and 120 parents. As well, a questionnaire was used to survey students’ attitudes to science. Follow-up interviews and observations offered further validity and plausible explanations for the findings. This section summarizes the results separately for each research question.

4.5.1 Research Question #1

My study’s first research question is as follows:

*Is it possible to develop valid questionnaires to assess:*

- 9-11 year-old students’ actual and preferred learning environment?
- parents’ actual and preferred science learning environment for their children?
- 9-11 year-old students’ attitudes towards science?

In order to answer the above research question, student and parent data bases for the *What is Happening in this Class?* (WIHIC) questionnaire and Test of Science Related Attitudes (TOSRA) were analysed in four ways. First the *a priori* factor structure of the questionnaires was checked using principal components analysis with varimax rotation for the four forms of the WIHIC (student actual, student preferred, parent actual and parent preferred) and the TOSRA. Second, the internal consistency reliability of each WIHIC and TOSRA scale was checked using Cronbach’s alpha coefficient. Third, the independence of raw scores on different scales was checked by exploring discriminant validity, using the mean correlation of a scale with the other scales for the WIHIC and using the correlation between the two scales for TOSRA. Fourth, the ability of the actual form of each WIHIC scale to differentiate between the perceptions of students in different classrooms (or between the perceptions of the parents of students in different classrooms) was explored by conducting an ANOVA with class membership as the independent variable.
Finding 1: The student actual WIHIC had satisfactory factorial validity. The preferred version did not display satisfactory factorial validity (see Section 4.1.1).

Finding 2: Factor analysis supports a five-scale structure (with Student Cohesiveness and Equity forming a single factor) rather than the a priori six-scale structure for the actual parent WIHIC. Findings indicate a need for replication with a larger sample. The preferred version did not display satisfactory factorial validity (see Section 4.1.2).

Finding 3: Factor analysis supports a two-scale structure (Attitude to Scientific Inquiry and Enjoyment of Science Lessons) rather than the a priori three-scale structure for the TOSRA. The smallness of the sample size suggests the desirability of replication with a larger sample (see Section 4.1.3).

Finding 4: The actual version of the student WIHIC demonstrates satisfactory reliability and discriminant validity for two units of analysis (student and class mean), and most scales can differentiate between the perceptions of students in different classes (see Section 4.1.4).

Finding 5: The actual version of the parent WIHIC generally demonstrates satisfactory reliability and discriminant validity for two units of analysis (individual and class mean), and most scales are able to differentiate between the perceptions of parents whose children are in different classes. Nevertheless, the results suggest the desirability of replication with a larger sample (see Section 4.1.5).

Finding 6: The TOSRA's two scales demonstrate satisfactory reliability and discriminant validity for two units of analysis (individual and class mean). Nevertheless, the results suggest the desirability of replication with a larger sample (see Section 4.1.6).

4.5.2 Research Question #2

Are there differences between parents and students in their preferred classroom environment and in their perceptions of the same actual classroom environment?
To answer the above research question, differences were investigated between three pairs of perceptions on the WIHIC: between students’ actual and preferred scores; between parents’ actual and preferred scores; and between students and their parents in terms of all actual and preferred scales. In each case, a MANOVA with repeated measures was used with the WIHIC scales as the dependent variables. When the multivariate test using Wilks’ lambda criterion yielded a significant result, the individual ANOVA for each individual WIHIC scale was interpreted. Also effect sizes (i.e. the difference between scales means expressed in standard deviation units) was used to provide information about the magnitudes of difference, in addition to their statistical significance.

Finding 7: Students generally prefer a more favourable learning environment in their science classrooms than what they perceive is actually present (see Section 4.2.1).

Finding 8: Parents prefer a more favourable learning environment for their children than what they perceive is actually present. Parents’ effect sizes for actual-preferred differences were notably larger than the corresponding students’ effect sizes (see Section 4.2.2).

Finding 9: Parents perceive a somewhat less favourable actual science classroom environment than students, but parents prefer a much more favourable science classroom environment than students do (see Section 4.2.3).

4.5.3 Research Question #3

The third research question reads as follows:

Are there associations between the student outcomes of achievement and attitudes and:

- students’ perception of the science learning environment?
- parents’ perceptions of their children’s science learning environment?

Simple correlation and multiple regression analyses for associations between student outcomes and dimension of the actual version of the WIHIC were calculated
separately for students and for parents. Simple correlation analysis provided information about associations between a particular outcome and a particular environment scale. On the other hand, multiple regression analysis provided a more parsimonious picture of the joint influence of correlated environment scales on student outcomes. In this study, multiple correlation analysis provided information about which scales contributed to the variance in students’ attitudes or achievement when the other WIHIC scales were mutually controlled. The outcomes studied were academic achievement (Stanford 9 science subtest and final grade) and two attitudinal scales (Attitude to Scientific Inquiry and Enjoyment of Science Lessons) measured by the TOSRA.

Finding 10: Positive but relatively weak relationship exist between student outcomes (especially Enjoyment of Science Lessons) and the learning environment perceived by students (especially Task Orientation) (see Section 4.3.1).

Finding 11: Generally positive but relatively weak relationships exist between student outcomes (especially Final Grade) and the learning environment as perceived by parents (especially Task Orientation) (see Section 4.3.2).

Finding 12: Overall the strengths of student outcome-environment associations are similar for students and parents as suggested by the multiple correlations (see Section 4.3.1 and 4.3.2).

4.5.4 Interviews and Observations

Interviews and observations in this study were intended to provide plausible explanations and additional validity for the results of the questionnaires. Ten students and their parents participated in follow-up interviews and these same ten students were observed in their science classrooms. Field notes and transcripts were systematically examined for similarities and differences between student and parent responses. Using interpretative procedures, these working assertions were reviewed and revised in light of the evidence as suggested by Erickson (1998).
Finding 13: Generally, the students interviewed were satisfied with their science classroom learning environments (see Section 4.4).

Finding 14: Generally, parents were satisfied with the science learning environments of their children's classrooms, and they suggest that most of the problems (the number of students in each class, the physical structure of the classroom, and discipline) were outside the control of the teacher (see Section 4.4).

Finding 15: Parents indicated that they knew what was going on in their children's science classroom mainly through their children's homework assignments and what their children talked about when they come home from school (see Section 4.4).

Finding 16: Students generally reported both advantages and disadvantages of having friends in the classroom. (see Section 4.4.1).

Finding 17: Parents generally felt that positive interactions between students in the classroom were likely to foster greater enjoyment of science lessons and academic achievement (see Section 4.4.1).

Finding 18: Students were generally happy with the amount of Teacher Support provided in their classrooms (see Section 4.4.2).

Finding 19: During every interview, parents cited Teacher Support as being the most important variable in an ideal science classroom for their children (see Section 4.4.2).

Finding 20: Students indicated fear of being embarrassed as the main reason for not being more involved in the classroom (Involvement) (see Section 4.4.3).

Finding 21: Parents indicated that it was up to teachers to involve all students in the classroom, even if they resisted (Involvement) (see Section 4.4.3).

Finding 22: All students maintained that completing their work and knowing what to do in science was important (see Section 4.4.4).
Finding 23: Parents generally felt that they instilled the importance of Task Orientation in their children (see Section 4.4.4).

Finding 24: Students indicated that teachers treated students differently because of student behaviour and academic achievement (see Section 4.4.5).

Finding 25: For parents, the manner in which the teacher treated their children in the classroom was an important issue. Parents felt that the concept of Equity in the classroom was intertwined with Student Cohesiveness (see Section 4.4.5).

Finding 26: No matter what level of Investigation was present in the classroom, students wanted more hands-on investigations (see Section 4.4.6).

Finding 27: While parents indicated hands-on experiences in the science classroom were an important learning tool, parents felt that teachers were constrained from the use of hands-on experiments because of the physical structure of the classrooms and number of students in the classroom (see Section 4.4.6).

A unique aspect of this study was in the construction and validation of a learning environment questionnaire that could assess the perceptions of young students, along with their parents. An economical and widely-applicable student and parent learning environment questionnaire was found to have satisfactory validity and reliability.

Overall, the quantitative and qualitative findings reported in this chapter indicate that students and parents perceive the actual classroom environment somewhat similarly, while there are sizeable differences between students’ and parents’ preferred classroom environment. As with numerous past learning environment research studies, associations were found between the nature of the classroom environment as perceived by students and student outcomes (academic and attitude) (Fraser, 1986, 1994; McRobbie, Fisher, & Wong, 1998). A key finding is that, not only were associations found between the nature of the classroom environment as perceived by students and student outcomes, but associations were also found between parent perceptions and student outcomes.
Chapter 5 concludes the thesis with a summary of the research methods and the main quantitative and qualitative findings. Next, the significance of the study and its limitations are examined. This chapter also provides recommendations for further research and implications of the findings. The chapter closes with possible implications of the findings and concluding remarks.
Chapter 5

DISCUSSION AND CONCLUSIONS

Much of the past research on family and school environments has concentrated on family environmental factors that promote or inhibit student achievement (see Sections 2.2.4 and 2.2.5). The field of classroom learning environment is well established in science education (Aldridge & Fraser, 2000) and has been used as a framework for a variety of different research purposes, in different countries and in different languages (see Section 2.3.4). But, in past research, it as been quite rare to involve both students and their parents within the same study of the nature and effects of classroom environment. Therefore, this study looked at students' and parents' perceptions of the science learning environment, examined differences between these perceptions, and investigated associations between perceptions and student outcomes (attitude and achievement).

This chapter begins with a summary of this thesis (Section 5.1), including the introductory chapters (Section 5.1.1), the research methods (Section 5.1.2) and the findings (Section 5.1.3). Next, the significance of the study (Section 5.2) and its limitations (Section 5.3) are examined. The chapter concludes with recommendations for further research (Section 5.4), implications of the findings (5.5) and conclusions (5.6).

5.1 Summary of Thesis

Parents' as well as students' perceptions of the science learning environment were investigated in this study. In the following sections, a summary of the research methods and main findings are presented.

5.1.1 Summary of Introductory Chapters

In Chapter 1, the following research questions were delineated to provide an overview of the science learning environment of 9-11 year-olds as perceived by parents and students, to explore differences between parents' and students' perceptions of the
learning environment, and to examine associations between student outcomes and perceptions of the science learning environment:

Research Question #1: Is it possible to develop valid questionnaires to assess:
- 9-11 year-old students’ actual and preferred science learning environment?
- parents’ actual and preferred science learning environments for their children?
- 9-11 year-old students’ attitudes towards science?

Research Question #2: Are there differences between parents and students in their preferred classroom environment and in their perceptions of the same actual classroom environment?

Research Question #3: Are there associations between the student outcomes of achievement and attitudes and:
- students’ perception of the science learning environment?
- parents’ perceptions of their children’s science learning environment?

5.1.2 Summary of Research Methods

To assess parents’ and students’ perceptions of the science learning environment, the What is Happening in this Class? (WIHIC) was modified for use with parents and young children (aged 9-11 years) (see Chapter 3). Four forms were created: two forms to assess parents’ perceptions of the science learning environment (actual vs. preferred); and two forms to assess students’ perceptions of the science learning environment (actual vs. preferred). The modified WIHIC assesses the scales of Student Cohesiveness, Teacher Support, Involvement, Task Orientation, Equity and Investigation. A modified version of the Test of Science Related Attitudes (TOSRA) was utilised to determine student attitudes towards science.

To analyse the differences between students’ and parents’ perceptions of the learning environment, a one-way MANOVA for repeated measures was used to explore: differences between students’ actual and preferred scores; differences between parents actual and preferred scores; and differences between students and parents in terms of
both their actual and preferred scores. Because the Wilks’ lambda criterion indicated overall significant differences in each case, the ANOVA was interpreted for each scale. Effect sizes (i.e. the differences between means expressed in standard deviation units) were used to provide information about the magnitudes of differences.

Final grades and stanine results on the Stanford-9 science subtest were utilised to determine student achievement in science. Simple correlation and multiple regression analyses were employed in exploring outcome-environment associations separately for students and parents for each achievement and attitude measure.

In order to offer plausible explanations for the quantitative findings, qualitative probes were utilised. The adoption of multiple methods was intended to further substantiate the validity, reliability, and richness of the quantitative findings. Interviews with parents and students, along with classroom observations, offered some specific insights into the quantitative findings.

5.1.3 Summary of Findings

The sample sizes for the student versions of the questionnaires were 520 students for the What is Happening in this Class? (WIHIC) and a sub-sample of 161 students for the Test of Science Related Attitudes (TOSRA). First the a priori factor structure of the questionnaires was checked using principal components analysis with varimax rotation for the four forms of the WIHIC (student actual, student preferred, parent actual and parent preferred) and the TOSRA. Second, the internal consistency reliability of each WIHIC and TOSRA scale was checked using Cronbach’s alpha coefficient. Third, the independence of raw scores on different scales was checked by exploring discriminant validity, using the mean correlation of a scale with the other scales for the WIHIC and using the correlation between the two scales for TOSRA. Fourth, the ability of the actual form of each WIHIC scale to differentiate between the perceptions of students in different classrooms (or between the perceptions of the parents of students in different classrooms) was explored by conducting an ANOVA with the class membership as the independent variable.
Validity and Reliability of the Student Questionnaire

The key findings of the validity and reliability for the two student questionnaires (the WIHIC an TOSRA) are as follows:

- The student actual WIHIC had satisfactory factorial validity. The preferred version did not display satisfactory factorial validity.

- Factor analysis supported a two-scale structure (*Attitude to Scientific Inquiry* and *Enjoyment of Science Lessons*) rather than the *a priori* three-scale structure for the TOSRA. The smallness of the sample suggests the desirability for further research involving a larger sample.

- The actual version of the student WIHIC demonstrated satisfactory reliability and discriminant validity for two units of analysis (student and class mean) and most scales could differentiate between the perceptions of students in different classes.

- The TOSRA’s two scales demonstrated satisfactory reliability and discriminant validity for two units of analysis (individual and class mean).

As in past research, the TOSRA and WIHIC (Aldridge & Fraser, 2000; Aldridge, Fraser, Fisher & Wood, 2002; Fraser, 1981, 1998b; Fraser, McRobbie & Fisher, 1996) demonstrated strong validity and reliability.

Validity and Reliability of the Parent Questionnaires

The sample consisted of 161 parents of children in six classes. Because of the small parent samples, research involving a larger sample is desirable to further confidence in the following findings:

- Factor analysis supports a five-scale structure (with *Student Cohesiveness* and *Equity* forming a single factor) rather than the *a priori* six-scale structure for the
actual parent WIHIC. The preferred version did not display satisfactory factorial validity.

- The actual version of the parent WIHIC generally demonstrated satisfactory reliability and discriminant validity for two units of analysis (individual and class mean), and most scales were able to differentiate between the perceptions of parents whose children are in different classes.

The findings suggest that parents do have important perspectives about their children’s learning environment. It is hoped that creating and validating a parent version of the WIHIC will offer an important contribution to the field of learning environments.

*Differences Between Parents’ and Students’ Perceptions of the Learning Environment*

To investigate differences between parents’ and students’ perceptions of the science learning environment and between actual and preferred scores, a series of one-way MANOVAs for repeated measures were undertaken to reveal the following patterns:

- Students generally preferred a more favourable learning environment in their science classrooms than what they perceived as actually present.

- Parents preferred a more favourable learning environment for their children than what they perceived as actually present. Parents’ effect sizes for actual-preferred differences were notably larger than the corresponding students’ effect sizes.

- Parents perceived a somewhat less favourable actual science classroom environment than students, but parents preferred a much more favourable science classroom environment than students did.

Of particular note are the large differences between what parents perceive is happening in their children’s science class and what they would like to be happening in their children’s science class. Consistently parents wanted more for their children. Overall students perceive lower levels of most WIHIC dimensions for the actual
classroom environment when compared to their preferred classroom environment. Patterns in which students prefer a more favourable classroom environment than what is perceived to be actually present are consistent with studies conducted throughout the world (Fraser, 1998a; Henderson, Fisher & Fraser, 2000).

*Associations Between Students’ Outcomes and the Learning Environment as Perceived by Students and Parents.*

Simple correlation and multiple regression analyses were carried out to determine the relative strength of associations between the student outcomes of attitudes and academic achievement and dimensions on the actual form of the WIHIC for parents and for students. Analyses revealed:

- Positive but relatively weak relationship existed between student outcomes (especially *Enjoyment of Science Lessons*) and the learning environment as perceived by students (especially *Task Orientation*).

- Generally positive but relatively weak relationships existed between student outcomes (especially Final Grade) and the learning environment as perceived by parents (especially *Task Orientation*).

- Overall the strengths of outcomes-environment associations were similar for students and parents as suggested by the multiple correlations.

As with previous research, this study has shown associations between learning environment variables and student outcomes (Fraser, 1994; Fraser, Walberg, Welch, & Hattie, 1987; Henderson, Fisher & Fraser, 2000). Of note is the similarity in the strength of outcome-environment associations for parents and students.

*Qualitative Findings for Students*

Ten students were interviewed about the science learning environment in their classrooms. Overall students were relatively happy in their science classrooms. Nevertheless, the quantitative probe had indicated that students generally prefer a
more favourable learning environment than what they perceive is actually present. The interviews led to the following patterns which are organized using the dimensions contained in the WIHIC:

- Generally, the students interviewed were satisfied with their science classroom learning environments.

- Student Cohesiveness: Students generally reported both advantages and disadvantages of having friends in the classroom.

- Teacher Support: Students were generally happy with the amount of teacher support provided in the their classrooms.

- Involvement: Students indicated fear of being embarrassed as the main reason for not being more involved in the classroom.

- Task Orientation: All students maintained that completing their work and knowing what to do in science was important.

- Equity: Students indicated that teachers treated students differently because of student behaviour and academic achievement.

- Investigation: No matter what level of investigation was present in the classroom, students wanted more hands-on investigations.

While students were relatively happy in their science class, they all wanted more hands-on investigation. Peer interactions were also a factor in students' perceptions of the learning environment. Students feared being made fun of if they asked questions in class, and students reported advantages and disadvantages on having friends in the classroom.
Qualitative Findings for Parents

Ten parents were interviewed about the science learning environment of their children. While the quantitative findings had indicated that parents perceived the classroom learning environment less favourably than their children did, parents' interviews indicated that they were generally happy with their children's classroom learning environment. The following findings help to provide possible explanations for this contradiction:

- Generally, parents were satisfied with the science learning environments of their children's classroom and suggested that most of the problems (the number of students in each class, the physical structure of the classroom, and discipline) were outside the control of the teacher.

- Parents indicated that they knew what was going on in their children's science classroom mainly through their children's homework assignments and what their children talked about when they came home from school.

- Student Cohesiveness: Parents generally felt that positive interactions between students in the classroom were likely to foster greater enjoyment of science lessons and academic achievement.

- Teacher Support: During every interview, parents cited teacher support as being the most important variable in an ideal science classroom for their children.

- Involvement: Parents indicated that it was up to teachers to involve all students in the classroom, even if they resisted.

- Task Orientation: Parents generally felt that they instilled the importance of task orientation in their children.

- Equity: The manner in which the teacher treated their children in the classroom was an important issue. Parents felt that the concept of equity in the classroom was intertwined with student cohesiveness.
• *Investigation:* While parents indicated that hands-on experiences in the science classroom are an important learning tool, parents felt teachers are constrained in the use of hands-on experiments because of the physical structure of the classrooms and number of students in the classroom.

During interviews, parents indicated that *Equity* and *Student Cohesiveness* are related. Parents indicated that one cannot have *Student Cohesiveness* without equitable treatment. Parents also stated that their children’s teachers were doing their best under the constraints with which teachers had to deal (number of students in the classroom, discipline and the physical structure of the classrooms).

### 5.2 Significance

This study is pioneering in that it examined parents’ and young students’ perceptions of the learning environment. Much of the past learning environment research has focused on students at the secondary level of education. Very little learning environment research has involved young children’s perceptions (9-11 year-olds) of the science learning environment, especially in conjunction with their parents’ perceptions of the science learning environment.

What parents actually think is happening in their children’s classrooms, and what parents would like to be happening in their children’s classrooms, were determined using an actual and a preferred form of the WIHIC. Rather than the school telling parents what should be going on in their children’s science classroom, parents were provided a voice for their beliefs about the classroom learning environment for their children through these questionnaires. In family-school relations, most families are powerless (de Carvalho, 2001). Schools need to listen to and respect the diverse views that parents bring to their children’s school. This study offers one possible practical and economical tool to give a voice to parents.

One of the major thrusts of this study was to create science learning environment questionnaires that could assess the perceptions of young students (aged 9-11 years). While the preferred form did not demonstrate satisfactory validity, the actual form
proved to be reliable and valid for this study (see Section 4.1.1). These young children completed the WIHIC independently after their teachers provided directions. Therefore, this study provides teachers with an instrument that can be easily administered in classrooms to ascertain the overall science learning environment as perceived by the students. Because the student version of the WIHIC takes only 15 to 20 minutes to administer, it provides an economical and practical manner in which to ascertain the classroom learning environment of young children.

Another aspect of this study that is groundbreaking is the translation of the parent and student forms of the WIHIC into Spanish and Hatian Creole. Despite the fact that these forms ultimately were not used in this study because parents and students elected to use the English versions, they are available for other researchers (see Section 3.3.3). However, because few students or parents responded to the translated version in my study, their validity and reliability have not yet been established. Language barriers between parents and teachers impede the equal participation of these families in the education of their children. If parents cannot understand communications from the school, then parents cannot effectively guide their children or act as advocates for their children (Epstein, 2001).

5.3 Limitations

The main limitations this study include the young age of the students and the associated potential problems with readability of the questionnaires by young children, the possibility of faked answers to please the teacher, the smallness of the parent and student samples, and the limited scope of the achievement outcome measures. Additionally, there is no prior research base which involves parents’ perceptions of classroom learning environments and upon which this study could build.

Because young students (9-11 year olds) have had only five to six years of classroom experience, this does not afford them a wide variety of classroom learning environments and experiences. Additionally, science is a subject that is sometimes neglected in the elementary classrooms. Therefore, young students might not have
enough prior experiences and/or maturity to provide meaningful responses about what they would like to happen in their science classes.

The student actual and preferred WIHIC were read independently by the students (9-11 year-olds). The student sample included all ability levels of students. Different students read above the grade level, at the grade level or below the grade level as indicated by their teachers. Therefore, some students might have had difficulties reading the questionnaires and possibly did not ask for help or clarification.

Students, as well as parents, could fake answers deliberately to please or displease the teacher. While every effort was made to assure parents and students that there were no wrong or right answers, it is recognized that some parents and/or students might not have completed the questionnaire completely truthfully.

The student sample was of a reasonable size but the difficulties in getting the cooperation of parents led to a sample too small for some analyses. The generalizability of this study is limited because all the parents who participated in the study were from the researcher’s school. Additionally, the preferred forms did not display satisfactory validity. The small sample might be one plausible explanation for this anomalous result.

The district’s policy of requiring parental approval before accessing student records constrained the size of the sample of students for some measures. The student sample size that was used to explore associations between outcomes and perceptions of the learning environment was limited to those students whose parents returned the permission forms. Even though 161 out of 200 parents granted permission for their children to participate, only 120 parents completed the parent WIHIC questionnaires. Therefore, further research of a more expansive scope is desirable.

The two outcomes measures used to assess achievement were the Stanford-9 science subtest stanine scores and the school’s end-of-year final grade in science. While the stanine scores are nationally normed in the United States, the students in this study might not have been taught the national science curriculum which this test assesses.
The science curriculum taught in South Florida is mandated through the state's Sunshine State Standards (see Section 2.3).

For this study, the teacher determined the final grade for each student. Although the Sunshine State Standards are the same for all students, teachers may assess their students at their discretion; and there are no uniform assessment procedures. Therefore, the achievement outcome of final grades is not strictly comparable across students in the sample.

While this study makes a distinctive contribution by being the first to validate and use a widely-applicable questionnaire to assess parents’ perceptions of their children’s learning environment, the study could not benefit by building on past research. Consequently, the questionnaires need additional administrations to further increase confidence in them.

5.4 Recommendations for Further Research

Despite the limitations above, the study has provided some possible new directions in assessing learning environments. Determining young students’ and their parents’ perceptions of the learning environment by itself is only a starting point. And, as mentioned previously, further administrations of the learning environment questionnaire are necessary to enhance confidence in the findings.

Although the three schools in this study were of an ethnically-diverse make-up, they were relatively similar in socioeconomic status, ethnic origins and cultural make-up. Subsequent administrations of the learning environment questionnaire should involve larger samples from a broader range of schools, students, and parents than was present in this study. Additionally, future research should investigate relationships between students’ and parents’ perceptions of the learning environment and a broader range of student outcomes (in addition to attitudes and achievement).

Although not used in this study, the Spanish and Haitian Creole versions of the questionnaires should be utilised and validated in future research. Parents should not be excluded from expressing their beliefs about their children’s education because of
language barriers. Schools have an obligation to include all students and parents in discussions about their children's teachers, classroom programs and curricula. Because South Florida has a relatively large Spanish and Haitian Creole population, it is foreseen that other researchers will be able to take advantage of the translated questionnaires.

Feedback on the results of the classroom learning environment surveys should be provided to the teachers, students, and parents. This offers a starting point for discussions. Teachers, students and parents can create a dialogue about the changes that each would like to see implemented in the classroom learning environment. As in past research studies (Fisher, Fraser & Bassett, 1995; Yarrow, Millwater & Fraser, 1997), these agreed changes could be implemented and, after a period of time, the learning environment questionnaires can be used to re-assess the learning environment and gauge the effectiveness of the change attempts.

In this study, homework was cited as the main way in which parents knew what was going on in the science classroom. Sometimes homework is the only form of serious communication about school and learning between parents and school-aged children (Epstein, 2001). This makes homework a powerful communication tool between home and school. It is recommended that teachers consider the importance of homework not just as a tool for practising and maintaining skills, but also in terms of the message that homework sends home to the parents. Homework enables parents to know what topics are being taught and how their children are progressing. Future research should investigate the effect that homework has on parents' perceptions of their children's learning environment.

5.5 Implications

Some educators and parents expect the school to tell parents what to do. This approach is not effective for informing or involving all families (Epstein, 2001). A better approach involves partnerships that recognize the integral relationship between home and school, with students central to the success of this partnership. Classroom learning environment questionnaires can offer one way to provide a voice for students and parents in the educational processes of their schools.
Research involving secondary analysis of a large data bases has shown that there are associations between student outcomes and classroom, home and peer environments, but that only the environment of the classroom accounted for statistically significant amounts of variance in student achievement scores (Fraser, Kahle, Scantlebury & Meece, 1999). This suggests that researchers or individual teachers attempting to improve science learning environments should put students’ perceptions of the learning environment to the forefront. The WIHIC student questionnaires used in this study offer an economical and practical way to assess students’ perceptions of the learning environment.

Similarly, there is much research to show that some aspects of family and classroom environments can amplify each other in promoting students’ personal growth (Moos, 1987), and that joint school and family effects are likely to be most powerful when there is continuity between the home and the school (Hansen, 1981). The WIHIC parent questionnaires utilised in this study offer an economical and practical way to assess parents’ perceptions of their children’s classroom learning environments.

By taking into account parents’ wants and wishes for their children’s education, educators could create a more harmonious interplay between home and school. The ultimate beneficiaries of this dialogue would be all the stakeholders: parents, students and teachers. Each stakeholder is linked by a common desire for the best education possible.

5.6 Conclusion

It was felt that there was much to learn from the both parents’ and young students’ perceptions of the science learning environment. After finding that the parent and student versions of the What is Happening in this Class? (WIHIC) questionnaire were reliable and valid for the present study, similarities and differences in perceptions of students and parents were explored. While students were generally satisfied with the learning environment, parents wanted more for their children. The questionnaires used in this study allow researchers, teachers, students and parents to identify perceptions of the science learning environment in an economical and practical manner.
This study also identified associations between students' attitudes towards science and achievement in science and the science learning environment as perceived by parents and students. While the relationships between achievement and the learning environment as perceived by students were generally weak, a somewhat stronger relationship was found between student attitudes and the student-perceived learning environment scales of Task Orientation and Investigation. Similarly the relationship between students’ attitudes and parents’ perceptions of the learning environment was relatively weak, except for the learning environment scale of Task Orientation. These results suggest that there are some links between parents’ and students’ perceptions of the learning environment and students’ attitudes towards science; and these results replicate prior research (Fraser, 1998a; Wong & Fraser, 1996).

The analyses of associations in this study might have implications for improving student attitudes and achievement by utilising both parents’ and students’ perceptions of the learning environment. The differentiation between students’ and parents’ perceptions could be used by teachers in a three-way discussion (teachers, parents and students) aimed at guiding improvements.

Modifying the science learning environment to accommodate parents’ and students’ perceptions holds promise for generating new insights into the home-school connection and for the field of learning environments.
REFERENCES


Erickson, F. (1986). Qualitative research on teaching. In M.C. Wittrock (Ed.), *Handbook on research on teaching (3rd ed., pp. 119-161).* New York: Macmillan.


graduate students. Washington, DC: Office of Bilingual Education and Minority Languages Affairs.


Appendix A

WHAT SHOULD BE HAPPENING IN THIS SCIENCE CLASS?
STUDENT PREFERRED FORM

NAME ____________________________ SCHOOL ________________________ CLASS ______________________

Directions: Think about the ideal SCIENCE CLASS. Draw a circle around
1 if you STRONGLY DISAGREE that this should happen in your science class
2 if you DISAGREE that this should happen in your science class
3 if you are NOT SURE that this should happen in your science class
4 if you AGREE that this should happen in your science class
5 if you STRONGLY AGREE that this should happen in your science class

Remember you are describing your ideal science classroom.

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<tr>
<td>1. I would have friends in this class.</td>
<td>1</td>
<td>2</td>
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<td>4</td>
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<td>2. I would know students in this class.</td>
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<td>3. I would be friendly to other students in this class.</td>
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<td>4. Some students in this class would be my friends.</td>
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<td>5. I would work well with other students in this class.</td>
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<td>6. I would help other students in this class when they have trouble with their work.</td>
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<td>7. Some students in this class would like me.</td>
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<tr>
<td>8. Other students would help me when I have trouble doing my work.</td>
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<td>9. The teacher would give me extra help when needed.</td>
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<td>10. The teacher would care about my feelings.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<td>11. The teacher would help me if I have trouble doing my classwork.</td>
<td>1</td>
<td>2</td>
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<td>12. The teacher would talk with me.</td>
<td>1</td>
<td>2</td>
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<td>13. The teacher would care about my problems.</td>
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<td>2</td>
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<td>4</td>
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<td>14. The teacher would walk around the class to talk with me.</td>
<td>1</td>
<td>2</td>
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<td>15. The teacher's questions would help me to understand.</td>
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<td>16. I would say what I think during class talks about science.</td>
<td>1</td>
<td>2</td>
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<td>17. The teacher would ask me questions.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>18. I would ask the teacher questions.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>19. I would explain my thoughts about science to other students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>20. Other students and I would talk about how to solve science problems.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>5</td>
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<tr>
<td>21. I would explain how I solve problems.</td>
<td>1</td>
<td>2</td>
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<td>22. Getting my work done in science would be important to me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>23. I would know what I need to do for science class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>24. I would be ready to start class on time.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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<tr>
<td>25. I would know what I am supposed to do in science class.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>26. I would try to understand the work in this class.</td>
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<tr>
<td>27. I would know how much work I have to do for this class.</td>
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<td>2</td>
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<tr>
<td>28. My questions would get as much attention as other students' questions.</td>
<td>1</td>
<td>2</td>
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<td>5</td>
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<tr>
<td>29. The teacher would treat me the same as other students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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<tr>
<td>30. My ideas would be treated as being just as important in this class as other students' ideas.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>31. I would get the same amount of help from the teacher as other students do.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<td>32. I would get the same chance to talk in class as other students do.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>33. I would get the same chance to answer questions as other students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>34. I would work on experiments to see if what I think would happen, does happen.</td>
<td>1</td>
<td>2</td>
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<td>35. I would do experiments to answer questions the class has.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>36. I would do experiments to answer questions that I have.</td>
<td>1</td>
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<tr>
<td>37. I would do experiments that answer questions the teacher gave me.</td>
<td>1</td>
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<tr>
<td>38. I would find out answers to questions by doing experiments.</td>
<td>1</td>
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<td>39. I would find out my own answers by using information from an experiment.</td>
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Appendix B

WHAT SHOULD BE HAPPENING IN YOUR CHILD’S SCIENCE CLASS?

PARENT PREFERRED FORM

STUDENT’S NAME ___________________________ SCHOOL __________________

PARENT’S NAME _______________________________ CLASS __________________

Directions: Think about the ideal SCIENCE CLASS for your child. Draw a circle around

1. if you STRONGLY DISAGREE that this should happen in your child’s science class
2. if you DISAGREE that this should happen in your child’s science class
3. if you are NOT SURE that this should happen in your child’s science class
4. if you AGREE that this should happen in your child’s science class
5. if you STRONGLY AGREE that this should happen in your child’s science class

Remember you are describing your child’s ideal science classroom.

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<tbody>
<tr>
<td>1. My child would have friends in this class.</td>
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<tr>
<td>2. My child would know students in this class.</td>
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<td>3. My child would be friendly to other students in this class.</td>
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<td>4. Some students in this class would be my child’s friends.</td>
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<td>18. My child would ask the teacher questions.</td>
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<td>21. My child would get to explain how he/she solves problems.</td>
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<td>2</td>
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<td>22. Getting work done in science would be important to my child.</td>
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<td>2</td>
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<td>23. My child would know what he/she needed to do for this class.</td>
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<td>24. My child would be ready to start class on time.</td>
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<td>25. My child would know what he/she is supposed to do in this class.</td>
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<td>26. My child would try to understand the work in this class.</td>
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<td>28. My child’s questions would get as much attention as other students’ questions.</td>
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<td>29. The teacher would treat my child the same as other students.</td>
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<td>30. My child’s ideas would be treated as being just as important in this class as other students’ ideas.</td>
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<td>31. My child would get the same amount of help from the teacher as other students.</td>
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<td>32. My child would get the same chance to talk in class as other students do.</td>
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<td>2</td>
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<td>33. My child would get the same chance to answer questions as other students.</td>
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<td>2</td>
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<td>34. My child would work on experiments to see if what he/she thought would happen, did happen.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>35. My child would do experiments to answer questions the class has.</td>
<td>1</td>
<td>2</td>
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<tr>
<td>36. My child would do experiments to answer questions that he/she has about science.</td>
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<tr>
<td>37. My child would do experiments that answer questions the teacher gave him/her.</td>
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<td>2</td>
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<td>38. My child would find out answers to questions by doing experiments.</td>
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<tr>
<td>39. My child would find out his/her own answers by using information from an experiment.</td>
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</tbody>
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Appendix C

WHAT IS HAPPENING IN THIS SCIENCE CLASS?
STUDENT ACTUAL FORM

NAME ___________________ SCHOOL __________________ CLASS ___________________

Directions: Think about your SCIENCE CLASS. Draw a circle around

1 if you STRONGLY DISAGREE that this happens in your science class
2 if you DISAGREE that this happens in your science class
3 if you are NOT SURE that this happens in your science class
4 if you AGREE that this happens in your science class
5 if you STRONGLY AGREE that this happens in your science class

Remember you are describing your actual science classroom.

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</thead>
<tbody>
<tr>
<td>1</td>
<td>I have friends in this class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>I know students in this class</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>I am friendly to other students in this class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Some students in this class are my friends.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>I work well with other students in this class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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</tr>
<tr>
<td>6</td>
<td>I help other students in this class when they have trouble with their work.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Some students in this class like me.</td>
<td>1</td>
<td>2</td>
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</tr>
<tr>
<td>8</td>
<td>Other students help me when I have trouble doing work.</td>
<td>1</td>
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<tr>
<td>9</td>
<td>The teacher gives me extra help when needed.</td>
<td>1</td>
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<tr>
<td>10</td>
<td>The teacher cares about my feelings.</td>
<td>1</td>
<td>2</td>
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<td>4</td>
</tr>
<tr>
<td>11</td>
<td>The teacher helps me if I am having trouble doing my classwork.</td>
<td>1</td>
<td>2</td>
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</tr>
<tr>
<td>12</td>
<td>The teacher talks with me.</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>13</td>
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<td>2</td>
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<td>14</td>
<td>The teacher walks around the class to talk with me.</td>
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<tr>
<td>15</td>
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<tr>
<td>16. I say what I think during class talks about science.</td>
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<td>18. I ask the teacher questions.</td>
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<tr>
<td>19. I explain my thoughts about science to other students.</td>
<td>1</td>
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<tr>
<td>20. Other students and I talk about how to solve science problems.</td>
<td>1</td>
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</tr>
<tr>
<td>21. I explain how I solve problems.</td>
<td>1</td>
<td>2</td>
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</tr>
<tr>
<td>22. Getting my work done in science is important to me.</td>
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<tr>
<td>23. I know what I need to do for this class.</td>
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<td>25. I know what I am supposed to do in this class.</td>
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<td>28. My questions get as much attention as other students' questions.</td>
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<td>29. The teacher treats me the same as the other students.</td>
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<td>30. My ideas are treated as being just as important in this class as other students' ideas.</td>
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<td>31. I get the same amount of help from the teacher as other students do.</td>
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<td>32. I get the same chance to talk in class as other students do.</td>
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<td>35. I do experiments to answer questions that the class has.</td>
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Appendix D

WHAT IS HAPPENING IN YOUR CHILD’S SCIENCE CLASS?
PARENT ACTUAL FORM

STUDENT’S NAME ________________________________ SCHOOL __________________________

PARENT’S NAME ________________________________ CLASS __________________________

Directions: Think about your child’s SCIENCE CLASS. Draw a circle around

1 if you STRONGLY DISAGREE that this happens in your child’s science class

2 if you DISAGREE that this happens in your child’s science class

3 if you are NOT SURE that this happens in your child’s science class

4 if you AGREE that this happens in your child’s science class

5 if you STRONGLY AGREE that this happens in your child’s science class

Remember you are describing your child’s actual science classroom.

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<td>2. My child knows students in this class.</td>
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<tr>
<td>3. My child is friendly to other students in this class.</td>
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<td>4. Some students in this class are my child’s friends.</td>
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<td>5. My child works well with other students in this class.</td>
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<td>6. My child helps other students in this class when they have trouble with their work.</td>
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<td>7. Some students in this class like my child.</td>
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<td>8. Other students help my child when he/she has trouble doing work.</td>
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<td>9. The teacher gives my child extra help when needed.</td>
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<td>11. The teacher helps my child if he/she has trouble doing class work.</td>
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<td>12. The teacher talks with my child.</td>
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<td>13. The teacher cares about my child’s problems.</td>
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<td>15. The teacher’s questions help my child to understand.</td>
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<td>17</td>
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<td>My child asks the teacher questions.</td>
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<tr>
<td>19</td>
<td>My child explains his/her thoughts about science to other students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>20</td>
<td>Other students and my child talk about how to solve science problems.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>21</td>
<td>My child explains how he/she solves problems.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>22</td>
<td>Getting work done in science is important to my child.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>23</td>
<td>My child knows what he/she needs to do in this class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>24</td>
<td>My child is ready to start class on time.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>25</td>
<td>My child knows what is supposed to be done in this class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>26</td>
<td>My child tries to understand the work in this class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>27</td>
<td>My child knows how much work he/she has to do for this class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>28</td>
<td>My child's questions get as much attention as other students' questions.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>29</td>
<td>The teacher treats my child the same as the other students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>30</td>
<td>My child's ideas are treated as being just as important in this class as other students' ideas.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>31</td>
<td>My child gets the same amount of help from the teacher as other students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>32</td>
<td>My child gets the same chance to talk in class as other students do.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>33</td>
<td>My child gets the same chance to answer questions as other students.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>34</td>
<td>My child works on experiments to see if what he/she thinks would happen, does happen.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>35</td>
<td>My child does experiments to answer questions the class has.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>36</td>
<td>My child does experiments to answer questions that he/she has.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>37</td>
<td>My child does experiments that answer questions the teacher gives him/her.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>38</td>
<td>My child finds out answers to questions by doing experiments.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>39</td>
<td>My child finds out his/her own answers by using information from an experiment.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
Appendix E

TEST OF SCIENCE-RELATED ATTITUDES

STUDENT'S NAME: ___________________ SCHOOL: _______________ CLASS: ____________

DIRECTIONS: This test contains a number of statements about science. You will be asked to think about these statements. There are no 'right' or 'wrong' answers. Your opinion is what is wanted.

For each statement, draw a circle around

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1. I would prefer to find out why something happens by doing the experiment rather than by being told.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>2. I enjoy reading about things which disagree with my first ideas.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>3. Science lessons are fun.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>4. Doing experiments is not as good as finding out information from the teachers.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>5. I dislike repeating experiments to check that I get the same results.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>6. I dislike science lessons.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>7. I would prefer to do experiments than to read about them.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>8. I am curious about the world in which we live.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>9. School should have more science lessons each week.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>10. I would rather agree with other people than do an experiment to find out for myself.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
</tbody>
</table>

146
<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Finding out about new things is unimportant.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>12. Science lessons bore me.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>13. I would prefer to do my own experiments than to find out information from a teacher.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>14. I like to listen to people whose opinions are different from mine.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>15. Science is one of the most interesting school subjects.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>16. I would rather find out about things by asking an expert than by doing an experiment.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>17. I find it boring to hear about new ideas.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>18. Science lessons are a waste of time.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>19. I would rather solve a problem by doing an experiment than be told the answer.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>20. In science experiments, I like to use new methods which I have not used before.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>21. I really enjoy going to science lessons.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>22. It is better to ask the teacher the answer than to find it out by doing experiments.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>23. I am unwilling to change my ideas when evidence shows that the ideas are poor.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>24. The material presented in science lessons is not interesting.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>25. I would prefer to do an experiment on a topic than to read about it in science magazines.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>26. In science experiments, I report unexpected results as well as expected ones.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>27. I look forward to science lessons.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>28. It is better to be told scientific facts than to find them out from experiments.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>29. I dislike listening to other people's opinion.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
<tr>
<td>30. I would enjoy school more if there were no science lessons.</td>
<td>SA</td>
<td>A</td>
<td>NS</td>
<td>D</td>
</tr>
</tbody>
</table>
Appendix F

SPANISH VERSION – WHAT SHOULD BE HAPPENING IN THIS SCIENCE CLASS? STUDENT PREFERRED FORM

Note: For copyright reasons Appendix F has not been reproduced.

(Co-ordinator, ADT Program (Bibliographic Services), Curtin University of Technology, 4/12/2003)
Appendix G

SPANISH VERSION – WHAT IS HAPPENING IN YOUR CHILD’S SCIENCE CLASS? PARENT PREFERRED FORM

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(Co-ordinator, ADT Program (Bibliographic Services), Curtin University of Technology, 4/12/2003)
SPANISH VERSION – WHAT IS HAPPENING IN THIS SCIENCE CLASS? STUDENT ACTUAL FORM

Note: For copyright reasons Appendix H has not been reproduced.

(Co-ordinator, ADT Program (Bibliographic Services), Curtin University of Technology, 4/12/2003)
Appendix I

SPANISH VERSION – WHAT IS HAPPENING IN YOUR CHILD’S SCIENCE CLASS? PARENT ACTUAL FORM

Note: For copyright reasons Appendix I has not been reproduced.

(Co-ordinator, ADT Program (Bibliographic Services), Curtin University of Technology, 4/12/2003)
Appendix J

SPANISH VERSION – TEST OF SCIENCE-RELATED ATTITUDES

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(Co-ordinator, ADT Program (Bibliographic Services), Curtin University of Technology, 4/12/2003)
Appendix K

CREOLE VERSION – WHAT SHOULD BE HAPPENING IN THIS SCIENCE CLASS? STUDENT PREFERRED FORM

Note: For copyright reasons Appendix K has not been reproduced.

(Co-ordinator, ADT Program (Bibliographic Services), Curtin University of Technology, 4/12/2003)
Appendix L

CREOLE VERSION – WHAT SHOULD BE HAPPENING IN YOUR CHILD’S SCIENCE CLASS? PARENT PREFERRED FORM

Note: For copyright reasons Appendix L has not been reproduced.

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Appendix M

CREOLE VERSION – WHAT IS HAPPENING IN THIS SCIENCE CLASS? STUDENT ACTUAL FORM

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Appendix N

CREOLE VERSION – WHAT IS HAPPENING IN YOUR CHILD’S SCIENCE CLASS? PARENT ACTUAL FORM

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Appendix O

CREOLE VERSION – TEST OF SCIENCE-RELATED ATTITUDES

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Appendix P
FOCUS GROUPS INTERVIEW QUESTION GUIDE
(PARENTS AND STUDENTS)

Discussion Starter and Question: “You have a pad and pencil in front of you. I’d like you to think about your (your child’s) science class. Write some notes down on what is happening in this science class.” Have parents and students share responses; then probe more with following questions:

- What are the other students doing? (talking, helping others, discussing experiments, asking and answering questions, writing, reading....)
- What is the teacher doing? (helping students, standing in front of the room, sitting at the desk, walking around the room, asking questions...)
- What activities are taking place? (talking, asking & answering questions, hands on experiments, reading, writing, testing)
- How do you know what is going on in your child’s science class? (ask for specific examples)

Question: “You’ve described your (your child’s) science class. What would be different/same in the ideal science class for you (your child?)” Share responses; then probe:

- Give examples or instances of what the students would be doing and how that would be different or the same from actual science class
- Give examples or instances of what the teacher would be doing
- Give examples or instances of what activities are taking place in the class
- Clarify -- Would this be the same or different from what is already happening in the science class?

Question: “As I listened to the discussion I heard ______.” (Give brief summary of the main ideas generated.)

- Is this an adequate summary?
- Have we missed anything?

Questions: “Everyone has already completed a learning environment questionnaire about your (your child’s) science class. You might have noticed there were six areas that were surveyed. Let’s look at each area and talk about what you think the effect
would be on achievement (grades and test scores) in science and attitude (enjoyment) in science."

Do you think that each of the following (see below) helps you (your child) get better grades in science and like science better?

- (having friends)
- (having a supportive/caring teacher)
- (being able to answer questions and explain ideas)
- (knowing what needs to be done in class and doing it)
- (being treated the same as everyone else in the class)
- (doing hands-on science experiments)

Probe previous responses with the following questions:

- How does it help?
- How does it hinder?
- How does it affect attitude?
- Give examples

**Question:** "As I listened to the discussion I heard _______." (Give brief summary on the main ideas generated.)

- Is this an adequate summary?
- Have we missed anything?