Science and Mathematics Education Centre

# The Relationship of Teacher-Student Interpersonal Behaviour With Student Sex, Cultural Background and Student Outcomes

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## ABSTRACT

The major purposes of this study were to provide validation data for the *Questionnaire on Teacher Interaction* (QTI) with a large Australian sample and examine the relationship of teacher-student interpersonal behaviour with student sex, cultural background and student outcomes. The sample from lower secondary science classrooms in Australia consisted of 3,215 students in 158 classes in 43 schools in two Australian states, namely Tasmania and Western Australia. The sample was chosen carefully so as to be representative, though only co-educational classes were used in order to permit an unconfounded test of sex differences. Students and teachers completed a questionnaire which included the QTI, an attitude to class scale based on the *Test of Science Related Attitudes* (TOSRA), a cognitive achievement measure based on items from the *Test of Enquiry Skills* (TOES) and a five-item cultural background survey. The study follows the current trend in the field of classroom environment research of combining qualitative and quantitative methods. The qualitative component of the study involved about 100 interviews. This study is unique in that it provides a very large database of teacher-student interaction data in science classrooms and provides new insights into the relationships between teacher-student interpersonal behaviour with student sex, cultural background and student outcomes. The study found that there were associations between teacher student interpersonal behaviour and student sex and that there were differences in the way that students from different cultural backgrounds perceived their learning environments. Student achievement and student attitude to class were also found to be positively associated with teacher-student interpersonal behaviour. As a practical outcome of this study, the 48-item QTI has been shown to be useful to Australian lower secondary science teachers as an initiator of self reflection on teaching practice.

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# CHAPTER 1

"Interpersonal behaviour defines the most important dimension of personality." Timothy Leary (1957, p. 12.)

## 1.1 Origin of this Thesis

This thesis represents an opportunity for me to examine, explore and research some of the thoughts and interests that as a classroom teacher enabled me to love my job and interact in a positive way with my students. The catalyst for all of this work was my undergraduate study of social psychology and teaching at Deakin University in Geelong; then self reflection on the interpersonal behaviour that occurred between my students and myself over a period of 12 years as a primary, secondary and tertiary teacher. I found in my teaching career that I was able to get typically non-productive and troublesome students to be academically productive and have a positive attitude and an interest in their subjects. Replication of my interaction style seemed to support a continued pattern of positive interpersonal behaviour and attitude to class as well as improved academic standards over time for the students that I taught. I wondered why. Why did students enjoy our classes together and want to work well for me and not for some other teachers? I was not the only teacher to experience this but those of us who did were in some way different from other teachers. Why?

As a school teacher I recognise that the group of students assigned to me by the principal each year, are not just students to be taught. They are people with whom I am going to interact during many days of the year and for many hours. It has been suggested that by the end of secondary schooling a student will have spent as much as 15,000 hours in school (Rutter, Maughan, Mortimore, Ouston, & Smith, 1979), 7,000 of these

hours having been spent during primary school years (Jackson, 1968). Teachers on the other hand have been estimated to spend more than 40,000 hours in the classroom during a professional career (Hargreaves, 1972, p. 130). Typically, students are at school for more waking hours than they are at home with their parents during school days. Students then have a large exposure to school and their perceptions and reactions to what happens in the classroom are significant. The way the teacher and their students interact will evolve until they both establish and stabilise an agreed interpersonal culture and rules for their class group that will last long after the year together has passed.

Interactions between teachers and their students go far beyond the classroom alone and extend to the school camps, sports days and other school community events. The personal interactions between the teacher and the students, as individuals and as a group, constitute a large part of what happens in the learning environment that a school provides. The relationship typically lasts for one year at least, though the interactions with particularly memorable students or events can be remembered through a school career and beyond. It seems important then to investigate the nature of these teacher-student interactions and try to identify factors that may contribute to making the interpersonal behaviours more positive and productive for students and to examine if making the journey more enjoyable translates into better student outcomes.

The question investigated in this study was, are there associations between teacher-student interpersonal behaviour and student sex, student cultural background and student outcomes in science classrooms in Australia. The study is unique in that it focuses on Australian lower secondary science classrooms in two states of Australia, namely, Tasmania and Western Australia. This study is also unique in that it involved a very large sample of students in secondary science classrooms and resulted in a very large Australian database of

information. In keeping with recent trends in classroom learning environment, the study utilised both qualitative and quantitative methods. Though the use of these two approaches in the one study is not new; (e.g. Kounin, 1970, p. 42), it is generally accepted that any survey of the classroom environment can be enhanced by including a combination of both quantitative and qualitative measures (Fraser & Tobin, 1991; Tobin & Fraser, 1998).

It is necessary to make a clear distinction between sex, biological "maleness" or "femaleness", and gender as recently there has been some debate on the use of the term gender when describing student membership of either male or female groupings (Anderson, 1998; Freedman, 1993). It has been reported that there are no pronouns that describe a gender that is neither male nor female (Anderson, 1998) and that the term gender refers to a "more broad behavioural complex of which one specific aspect is sexual orientation" (Freedman, 1993). Some people consider themselves as neither male nor female. Others may have Kleinfelder's syndrome, (i.e., a 47XXY chromosome arrangement) or be hermaphrodites or androgynous people (Anderson, 1998). This study uses the terms student sex in preference to student gender to describe the sexuality of groups of students that are either male or female.

A feature of this study that made it different from previous studies was that the teachers participating in the study were provided with a certificate of participation and a very prompt report on the results for their class. A special effort was made to recognise the time that teachers contributed to the study and ensure feedback to them was as quick as practicably possible, typically three to four weeks. This is consistent with the obligation as a researcher to give back something to those in the classroom that make research possible.

## 1.2 Background to this Study

The social, historical and other antecedents that acted as major motivating factors for this study of learning environments evolved over time and were partly a result of my direct experiences and observations in a classroom as a teacher and student in three states of Australia. I had noticed an increasing association between the relationship that I had as a teacher with the students in my classrooms and their achievement in those classes. What fascinated me most was that the relationship that I had with these students seemed different from the relationship that these students had with other teachers. This was based on casual reports from both teachers and students. This, my students reported, was a major factor in their minds when they were determining how positive they felt toward a given subject and how hard they were prepared to work in those subjects. Students typically had to apportion homework time to subjects that they deemed "more important" than others in an increasingly long school day. Sporting commitments and cultural events began demanding a greater share of a student's day during my years as a teacher.

Another aspect of teacher-student interpersonal behaviour that is rarely reported in studies of learning environments is that students do not choose to be at school as a part of these interactions (Hargreaves, 1972). Students are there because they are required by law to be in school and are nominated teachers with whom to interact. In wider society, and with the benefit of having completed the "schooling process", most people are able to make choices about this. If they do not enjoy the interaction they are able to move on. This issue of choice is not unique to schools. As Moos (1968), Moos and Houts (1968) and Hargreaves (1972) report, mental hospitals, prisons and the armed services put people in the same situation. There is also a great difference in the relative social power of the participants in teacher-student interaction and in the decision making process in classrooms as well as the privacy

of students and teachers. A teacher is able to invade the privacy of a students' work or personal space at will. Again this is not unique to schools. These factors have a role in defining the interactions and the learning environment to the point where the "dice are loaded in the teachers' favour" (Hargreaves, 1972, p. 139). It has been suggested that the nature of teacher-student interpersonal behaviour becomes skewed toward the teacher behaviour, ie., the behaviour of the students are a product of, and respond to, the perceived role and teaching style of the teacher (Hargreaves, 1972). However this is not consistent with the systems theory of communication, referred to later in this thesis, where teaching style in turn is a product of, and responds to, the interactions that teachers have with their students. This is another premise that supports the recording of perceptions of teacher behaviours as perceived by the teacher and students in a classroom.

I had to ask myself, was there in fact a relationship between student cognitive achievement, attitude to a subject and the nature of the teacher-student interactions that took place in a classroom? Keeping in mind that never before in Australian history have Australian schools been so culturally diverse (Giles & Franklyn-Stokes, 1989), was there a difference in the way students from different cultural backgrounds perceived the classroom? In the high school that I attended as a student 20 years ago, I had the one Asian student that attended as a friend, he had Singaporean parents. In that same school today over half of the student population has at least one Asian parent. The realisation that schools need to take into account the diversity among children attending schools in Western Australia has recently been recognised with the release of a new K-12 Curriculum framework (Curriculum Council, 1998). What about student sex? Do boys and girls perceive the classroom learning environment in the same way? Thus began my self-motivated research which to me was to be "an objective, unbiased quest for replicable findings" (Gay, 1992, p. 7).

### 1.3 Theoretical Framework

The instruments that have been used in studies of learning environments often are related to the theoretical framework for human environments proposed independently by Moos (1968) and Walberg (1968) and are usually scored on a five point numeric Likert scale, (Likert, 1932).

Walberg began his pioneering efforts in the use of classroom environment assessments over 30 years ago during the quest for a better way to evaluate curriculum innovations whilst working on the Harvard Project Physics (Anderson & Walberg, 1968; Walberg, 1968; Walberg & Anderson, 1968). Harvard Project Physics (HPP) was a project involving about 80 physicists and teachers and was established to produce a one-year junior high school and college physics course (Collette, 1973, p. 113). This work by ultimately led to the development of the *Learning Environment Inventory*, (LEI). Following the development of the (LEI) (Anderson & Walberg, 1968; Fraser, Anderson, & Walberg, 1982; Walberg & Anderson, 1968), research has investigated the learning environment more closely from the perspective of the students that make up a classroom.

At the same time, in his research on human environments, Moos (Moos, 1974; Moos, 1979a; Moos, 1979b; Moos, 1979c; Moos & Houts, 1968; Moos, Insel, & Humphrey, 1974; Moos & Trickett, 1974; Moos & Trickett, 1987) found that three general categories can be used in characterising diverse learning environments. This finding emerged from Moos's work in a variety of environments (Moos, 1968; Moos & Houts, 1968) including psychiatric hospital wards school classrooms, correctional institutions, military companies, university residences and work place environments (Fraser & Walberg, 1991; Moos, 1979a). The three dimensions are: *relationship dimensions* which identify the nature and intensity of personal relationships within the environment

and assess the extent to which people are involved in the environment and support and help each other; *personal development* dimensions which assess personal growth and self enhancement; and *system maintenance and system change* dimensions which involve the extent to which the environment is orderly, clear in expectations, maintains control, and is responsive to change (Moos, Insel, & Humphrey, 1974). This research resulted in the development and validation of the *Classroom Environment Scale* (CES) (Moos & Trickett, 1974; 1987). During the early 1980's much more attention was devoted to research on teachers than had been the case in the 1950's and 60's, (Wubbels & Levy, 1993). Research in the field of teacher-student interpersonal behaviour experienced a surge of research interest, particularly in The Netherlands, which resulted in the development of a useful questionnaire based on a circumplex model to assess teacher-student interpersonal behaviour (Wubbels & Levy, 1991; 1993).

The interactional and interpersonal behaviour between teachers and their students provides an example of an important relationship dimension that forms the focus of this study.

Leary devised a system for measuring and representing specific relationship dimensions using a two dimensional model (Leary, 1957). This was later adapted by Wubbels, Créton, Levy and Hooymayers, (1993) into an eight sectored model which retained the two dimensions of Proximity and Influence.

It was not until the early instruments that have been used in studies of learning environments, that the circumplex nature of the Leary model was utilised (Leary, 1957). This study extends and builds upon the work in learning environment research that has taken place over nearly three decades inspired by Moos and Walberg.

Previous research has indicated that a key to improving student achievement and attitudes is to create learning environments which emphasise those characteristics which have been found to be linked empirically with achievement and attitude, (e.g., Brekelmans, Wubbels, & Créton, 1990; Germann, 1994; Henderson, Fisher, & Fraser, 1995; Rawnsley, 1997; Wubbels, Brekelmans, & Hooymayers, 1991). In addition to this it has been reported that student motivation, and hence positive attitude, is influenced by the teacher's ability to make the subject interesting and explain concepts well (Kounin, 1970, p. 42). As well, the use of appropriate classroom environment scales are likely to contribute to our understanding of whether science classes typically provide greater success and enjoyment for males or for females, and whether students from different cultural backgrounds perceive the classroom learning environment differently. This socio-cultural aspect of classroom environment has "been theorised to have potential influence on students' learning" (Jegede & Okebukola, 1992).

Previous studies have also reported associations between the sex of students in science classes and the student perceptions of the psychosocial learning environment (Fisher, Fraser, & Rickards, 1997; Fraser, Giddings, & McRobbie, 1991; Fraser, Giddings, & McRobbie, 1992; Lawrenz, 1987). Sex differences in student perceptions have also been reported in students' ideal or preferred learning environment (Byrne, Hattie, & Fraser, 1986). With regard to cognitive outcomes and attitudinal outcomes, previous research has reported sex differences in achievement (Husén, Fägerlind, & Liljefors, 1974; Keeves & Kotte, 1995) and in student attitudes (Friedler & Tamir, 1990; Schibeci & Riley, 1986; Wareing, 1990). Previous research has not examined a combination of these variables with student cultural background as an indicator factor. This study is unique in that it combines all of these elements with a large Australian sample.

Though it has been stated in this introduction that the teacher-student interpersonal relationship extends beyond the science classroom and out onto the sports field and other school community events, this study will focus on interactions between teachers and their students during a single school academic year in science classrooms. This study examines teachers and their whole class interactions rather than focussing on individual teacher and single student interactions. Individual person to person interactions, such as teacher to a single student interaction, have a more private nature. Goffman (1959) described these as "off the floor" interactions and they may be important in students forming a perception of the teacher as a person but not for the perception of his or her role as a teacher.

Student perceptions of teacher communication style are formed or confirmed by the interactions going on around them in the classroom (van Tartwijk, Brekelmans, & Wubbels, 1993) as the teacher tries to maintain 'order', or 'hold the floor' (Capella, 1985), in the classroom. This command aspect of behaviour becomes more predictable the longer individuals interact (van Tartwijk, Brekelmans, & Wubbels, 1993, p. 2).

It is interesting to note that Lewin considered the nature of the teacher-student interaction from the perspective of who is more likely to change over time, the teacher or the student. In a benchmark study Lewin, Lippitt, and White (1939) examined leadership styles in a group of boys in a club atmosphere and concluded that democratic styles produced more student interest in the work and authoritarian styles produced apathy and even aggressive responses.

This study was conducted with science teachers during regular class time and after the settling period of two months or more of teacher-student interaction. This study will seek to extend previous research by examining the nature of the relationship of teacher-student

interpersonal behaviour with student sex, cultural background, student attitude and achievement in lower secondary science classrooms.

### 1.4 Objectives

The QTI has not been administered previously to a large sample of lower secondary Australian science classrooms therefore, this study provides a large sample of validation data and the first research objective is based upon this.

The objectives of this thesis were to:

1. provide further validation information about the QTI in terms of reliability and ability to differentiate between classrooms when used with a large Australian sample of lower secondary science classes.

2. investigate associations between student perceptions of teacher interpersonal behaviour and student sex.

3. investigate cultural background differences in student perceptions of teacher interpersonal behaviour.

4. investigate associations between interpersonal teacher behaviour and student enquiry skills.

5. investigate whether the nature of interpersonal teacher behaviour affects student attitude to science classes.

6. to confirm the construct validity of the QTI through the use of student interviews.

7. determine the suitability of the QTI as a source of self reflection for Australian science teachers.

### 1.5 Significance of the Study

In order for Australia to work effectively toward becoming the 'clever country' and gain the competitive edge needed for Australia's economic well being, it is essential that more young people successfully complete a high quality education in science (Australian Education Council and Curriculum Corporation, 1992). Australia needs all of the skill and talent of the population to continue strong economic growth and innovation and improve participation rates in the workforce (Australian Education Council and Curriculum Corporation, 1994), particularly in science. Education should also work toward improving the life chances of students and reduce the disadvantage suffered by some students (Australian Education Council and Curriculum Corporation, 1994). It is unfortunate that at a time when so much depends on science education, it has been found wanting both in Australia and overseas in terms of low participation rates (Dekkers, de Laeter, & Malone, 1991), inappropriate curricula (Prime Minister's Science Council, 1990) and failure to emphasise higher level learning (Tobin, Kahle, & Fraser, 1990).

The Schools Council of the National Board of Employment Education and Training in Australia has been concerned for some time with issues concerning the quality of teaching as evidenced through its reports on *Teacher Quality: An Issues Paper* (1989) and *Australia's Teachers - An Agenda for the Next Decade* (1990). These reports and others highlight the need for teachers to examine continually what they do in classrooms. Teacher quality and the need for continual professional development and reflection on the teaching practice of teachers has been the subject material of a ministerial statement (Beazley, 1993) which makes teachers responsible for effective

implementation of change in curriculum and teaching practice. This study is noteworthy because it focuses on a technique which teachers can and have used for examining what is occurring in their own classrooms and use the information provided as a starting point for reflection on their own teaching practice. Indeed, this very reflective process is what originally acted as a catalyst for this dissertation.

At no other time in history has there been such an awareness around the world of the importance of ensuring that girls receive an equitable education. In Australia, the *National Action Plan for the Education of Girls 1993-97* (Australian Education Council and Curriculum Corporation, 1993) highlights this concern. Of all school subjects, probably the greatest inequity between the sexes in enrolments, achievement and attitudes occurs for science (Parker, Rennie, & Fraser, 1996; Young & Fraser, 1994). This study enhances our understanding of differences between boys and girls by examining the nature of the interactions between teachers and their students. The effect of student sex, poverty, cultural and linguistic difference, disability, geographic and social isolation on educational opportunities and outcomes has also been the subject of a national strategy to improve student learning outcomes (Australian Education Council and Curriculum Corporation, 1994).

Furthermore, there is an awareness that Australian classrooms are becoming increasingly multi-cultural and that the way in which people communicate and perceive communication is culturally influenced (Levy, Wubbels, Brekelmans, & Morganfield, 1994; Levy, Wubbels, & Morganfield, 1994). The need for inclusion of the perspectives of all students and the provision of non-violent, non-discriminatory learning environments has been recognised (Australian Education Council and Curriculum Corporation, 1994).

This study looked at differences in the perceptions of the way in which teachers interact with students from different cultural backgrounds. Though there are instruments available to sample the socio-cultural environment of a classroom, for example the 30-item *Socio-Cultural Environment Scale* (SCES) (Jegede & Okebukola, 1988), this study was conducted with an Australian sample and for the purpose of this study, cultural background was determined by asking students for the birthplace of each parent and what language is normally spoken at home.

Although the QTI has been used to investigate teacher student interactions before, this study is unique in that it examines cultural background and sex differences in these relationships. In addition the effects of these teacher student interactions on student attitude to science and achievement in science are considered. This study is also different from previous research in the area but consistent with an emerging trend toward the use of both quantitative and qualitative methods of data collection and analysis, utilising both traditional and computerised methods for analysis and reporting of results.

Previous large scale studies have been conducted using the questionnaire employed in this study (Brekelmans & Wubbels, 1992; Brekelmans, Wubbels, & Créton, 1990; Fraser, 1991; Fraser & Tobin, 1998) however these studies have been conducted primarily overseas (Fisher, Fraser, & Rickards, 1997; Fisher, Henderson, & Fraser, 1995; Levy, Rodriguez, & Wubbels, 1992; Wubbels, Brekelmans, & Hermans, 1987; Wubbels, Brekelmans, & Hooymayers, 1991; Wubbels, Créton, & Hooymayers, 1985; Wubbels & Levy, 1991; Wubbels & Levy, 1993). None have combined the variables that this study has with a large Australian cohort of lower secondary science students.

This study is unique and seeks to contribute to a better understanding of some the key variables that might be influencing student attitude

and cognitive achievement and hence participation rates in school science. The study contributes significantly to the study of teacher-student interpersonal behaviour in science classrooms by providing validation data for the QTI from a large data base of responses. Secondly this study provides timely and unique combination of qualitative and quantitative information on associations between teacher-student interpersonal behaviour, sex, cultural background, cognitive achievement and attitudes in science classes. This has not been presented before and provides a benchmark Australian sample for other researchers to compare data with in the future. A key result of this research is to provide teachers with a practical means by which they can monitor and evaluate what is happening in their classrooms to better serve the needs of their students and science education in general to improve the quality of teaching and learning.

### 1.6 Limitations of the Study

In examining the limitations of this study it is acknowledged that the sample was comprised of only coeducational schools in two states of Australia. Though rural, inner city, independent and government schools were represented in the study, single sex schools were not due to the need to assess sex differences within classes.

The large sample size enhanced the unique nature of this study but did present limitations in the qualitative data collection process. Due to the large number of questionnaires returned, the initial estimates of how many of the quantitative sample should be interviewed had to be revised due to budget, time and resource limitations. Despite these limitations over 100 students were able to be interviewed by the researcher in two states of Australia. Though their comments provided valuable insights and information about the variables examined, caution should be exercised in extrapolating the comments to the total sample.

## 1.7 Overview of the Methodology

This study follows the recent trend in science education research to combine qualitative and quantitative methods of data collection and analysis (Cohen & Manion, 1996; Merriam, 1988; Patton, 1990) as recommended by Fraser and Tobin (Fraser & Tobin, 1991; Tobin & Fraser, 1998). Student questionnaires were only one of the sources of information for this study as it would be wrong to use only one source alone to gather perceptions from the classroom environment (Eley & Thomson, 1993). The 48-item short form of the QTI (Wubbels, 1993) was used to collect data on student and teacher perceptions of teacher-student interpersonal behaviour in lower secondary science classes in two states of Australia. In addition interviews were conducted to gather a more in depth response from students.

A large sample of lower secondary school students was involved for the quantitative aspects of the study in order to generate dependable validation data and permit powerful statistical tests. Because of the intensive nature of the qualitative component of the study, only a relatively small sub-sample of classes was involved.

The survey also included items to elicit student information on the birthplace of their mother and father as well as the primary language spoken at home.

Student attitude to science was measured by using one adapted attitude scale from the *Test of Science Related Attitudes* (TOSRA) (Fraser, 1978; Fraser, 1981b). Data on student cognitive achievement was provided by utilising items from a standardised item bank, the *Test of Enquiry Skills* (TOES) (Fraser, 1979)

Data analysis was completed using both manual and computerised methods to address the objectives for this study. Quantitative data were examined using Microsoft Excel Version 5 (Microsoft Corporation, 1993) and SPSS (Norusis, 1993). Qualitative data were examined manually and by using the NUDIST (Richards, Richards, McGalliard, & Sharrock, 1992) software package. These data were reported using the scales of the model for interpersonal teacher behaviour and the outcome variables as a guide. The use of qualitative data analysis software is relatively new in the field of classroom environment research. The unique nature of this study has been enhanced by using computerised data analysis software packages to analyse more deeply the large amount of data that has been collected and provide reliable comparisons with previous research.

The qualitative data was primarily provided as an alternative perspective and to act as a means to cross validate and further enrich the quantitative findings (Cohen & Manion, 1996; Merriam, 1988; Patton, 1990). The software packages utilised in this study permitted a greater level of analysis than would have been possible using manual methods alone.

### 1.8 Overview of this Thesis

This thesis consists of eight chapters and six appendices. This first chapter has introduced and summarised the purpose of this study and outlines the objectives, provides a brief overview of the methodology and discusses the significance of the study.

Chapter 2 is used to review the supporting literature describing learning environment research, interpersonal behaviour research and the Questionnaire on Teacher Interaction.

Chapter 3 describes the methodology used in this study and outlines the research questions, sample and measures used. Qualitative and quantitative methodologies are detailed.

Chapter 4 details the validation of the QTI and provides data on the three versions used in this study.

Chapter 5 provides data from the other measures used in this study. These included the attitude scale, the cognitive achievement measure and information on student sex and cultural background.

Chapter 6 provides teacher data and information on how the teacher profiles were used for reflection and self-directed action research by some teachers involved in this study.

Chapter 7 reports the qualitative student data collected and its use in supporting the validation of the QTI.

Finally, Chapter 8 reports the major findings with reference to the research questions proposed. It also clarifies associations between students' perceptions of the classroom learning environment, attitude, achievement and student outcomes. The relationships between the qualitative and quantitative findings are also discussed. This chapter provides the implications, limitations and conclusions of this study. Future directions for research based upon the findings of this study are suggested.

Following the references there are several appendices consisting of technical and statistical notes. These appendices provide a full set of questionnaires as used in this study. Also included is a copy of the report materials provided to teachers participating in this study and letters of consent.

## 1.9 Chapter Summary

This first chapter has outlined the personal motivations that led to the origin of this thesis. The next four sections detailed the background and rationale for this study along with the objectives and significance of the study. The limitations of this research were introduced here and will be concluded with the section covering future directions and further research in the final chapter of this thesis. Chapter One also provided an overview of the methodologies used in this study and presented an overview of the contents of each chapter contained in this thesis.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction and Overview

The primary aim of this study was to examine associations between teacher-student interpersonal behaviour, student sex and student cultural background in lower secondary science learning environments in Australia. The study also collected data on student outcomes for cognitive achievement and attitude to subject. The first objective of this chapter is to establish a conceptual framework for this study by reviewing the literature on which studies of learning environments are based. An historical perspective on learning environment instrument development up to the QTI is also presented. The second objective is to review completed research in the areas of teacher-student interpersonal behaviour which reports associations between teacher-student interpersonal behaviour, student sex and student cultural background, cognitive achievement and attitude to subject in lower secondary science. The chapter concludes with a summary drawing on the presented literature in these areas. Further literature supporting the validation of the QTI is reviewed in Chapter 3.

## 2.2 Conceptual Framework for Research on Learning Environments

During the collection of data for this study there were many discussions with teachers about their views on what was occurring in their classrooms. Teachers and students alike were quick to grasp the concepts of the study and related positively to the representation of their data. Many however, were impressed with the simplicity of the

data representations but were not aware of where this interesting research originated.

An examination of past reviews of research (Anderson, 1982; Fraser, 1991; Fraser, 1998a; Fraser, 1998b; Fraser & Walberg, 1981a; Templeton & Johnston, 1998; Wubbels, Créton, & Hooymayers, 1992) shows that international research efforts over the last three decades involving the conceptualisation, assessment and investigation of perceptions of various aspects of the classroom learning environment have firmly established classroom environment research as a thriving field of study. Furthermore, science education researchers have led the world in the field of classroom environment over the last two decades, and this field has contributed much to understanding and improvement of science education (Anderson, 1982; Fraser, 1991; Fraser, 1998b; Fraser & Walberg, 1981a; Wubbels, Créton, & Hooymayers, 1992). For example, classroom environment assessments provide a means of monitoring, evaluating and improving science teaching and curriculum.

One of the earliest attempts to categorise and observe interaction in the classroom with the use of trained observers who recorded verbal elements of interaction in the classroom was carried out by Withall (1949). Withall (1949) characterised interaction behaviour into seven categories, learner-supportive statements, acceptance and clarifying statements, problem-structuring statements, neutral statements, directive or authoritative statements, reproving or deprecating remarks and teacher self-supporting remarks. The first three categories were classified as learner centred and the final three categories were teacher centred, the middle category being neutral (cited in Hargreaves, 1972, p. 132). Though there are similarities between the work initiated by Withall and others such as Flanders (1960) these approaches typically had a linear approach or linked elements to represent teacher-student interaction (Hargreaves, 1972).

However, as Fraser (Fraser & Walberg, 1991, p. 4) and Chavez (1984) indicate, the key theoretical influence of the work of Walberg and Moos of other researchers including Lewin (Lewin, 1935; 1936) and his field theory, and Murray's beta press or Needs-Press Model (1938) should be noted.

### *2.2.1 The Lewinian Formula*

A key advance in thinking that contributed greatly to the study of learning environments was the Lewinian formula proposed by an exile from Nazi Germany, Kurt Lewin (1936). It is a key to the human interaction focus of the current study in that it proposed that the environment and the personal characteristics of an individual determined human behaviour. This theory was expressed in the formula that human behaviour (B) is a function of both the personality of the individual (P) and the environment (E).

$$B = f(P,E)$$

This formula was to provide a motivating force for new research strategies (Fraser, 1994; Stern, 1970).

### *2.2.2 Murray's Needs-Press Model*

Murray (1938) developed a theory to describe an individual's personal needs and environmental press. He defined needs as those specific, innate and personal requirements of an individual such as personal goals. An individual's need to achieve these goals, or their drive to attain them is also a factor in an individual's personality. The environmental factors that were beyond an individual's control that either enhanced or retarded the individual's achievement of their personal goals and needs were defined as the press. Murray used the term *alpha press* to refer to an external observer's perceptions of the learning environment and *beta press* to refer to observations by the

constituent members of the environment under observation (Murray, 1938).

Stern, Stein, and Bloom, (1956) built on Murray's discrimination between *alpha press* and *beta press*. They suggested that *beta press* can further be discriminated by the individual view and experience of the environment that each student, for example, has of the learning environment versus the shared view that the students have as a group of participants in the learning environment. They used *private beta press* to represent the idiosyncratic view a student may have of the classroom environment and *consensual beta press* for the shared view of the students' perceptions. This study utilises the student *consensual beta-press* perspective for student data and the *private beta-press* perspective for teacher data.

Classroom research methods about three decades ago were centred on observation techniques where trained observers would categorise classroom activities and interactions between members of the class. Along with an improvement in observation procedures and techniques (Brophy & Good, 1986) came a categorisation of observations as either high or low inference measures (Rosenshine & Furst, 1973). Low-inference measures were defined as the specific items that were recorded during classroom observation sessions. High-inference measures were observations that had required the observer to make an inference about the teacher's behaviour in terms of warmth, clarity or overall effectiveness. High-inference observations could be made by either a member of the classroom environment or an outside observer.

Murray's needs-press model was utilised and extended (Pace & Stern, 1958) to report on high inference measures in educational learning environments. A problem with outside observers is that they must make judgements on observations that are based on experiences external to the learning environment.

Further to this, Pace and Stern (1958) suggested that an assessment of the relationships between the environmental press and a student's needs may be useful in predicting personal achievement.

### 2.3 The Development of Learning Environment Instruments

Typically there is a dichotomy in learning environment research that centres on either the school-level environment or the classroom-level environment (Anderson, 1982; Fraser & Rentoul, 1982b; Fraser & Walberg, 1991). The theoretical and conceptual frameworks for these two levels of learning environment research share some commonality but are generally different and evolved separately. Fraser (1994) suggested that there was little knowledge of each area's work despite the similarities in research. In this study the classroom was selected as the level of learning environment to be studied.

This section describes many of the instruments that have been used to assess the quality and nature of classroom learning environment over the last three decades. As discussed in Chapter One, Moos' work (1974) has influenced the development and use of many instruments used to assess the qualities of the classroom learning environment from the perspective of the student. As the scales of all of the instruments mentioned in this section can be categorised into one of the dimensions of Moos' scheme for classifying human environments, there is some commonality in the underlying conceptual frameworks for assessment of classroom environment.

The classroom environment instruments briefly discussed here are:

- Learning Environment Inventory (LEI)
- My Class Inventory (MCI)

- College and University Classroom Environment Inventory (CUCEI)
- Classroom Environment Scale (CES)
- Individualised Classroom Environment Questionnaire (ICEQ)
- Science Laboratory Environment Inventory (SLEI)
- Constructivist Learning Environment Survey (CLES)
- Modified Geography Classroom Environment Inventory (GCEI)
- Computer Classroom Environment Inventory (CCEI)
- What is Happening In This Classroom (WIHIC)
- Cultural Learning Environment Questionnaire (CLEQ)
- Distance and Open Learning Environment Survey (DOLES)
- Socio-Cultural Environment Scale (SCES)

### *2.3.1 The Learning Environment Inventory (LEI)*

Fraser and Walberg (1981a, p. 68) suggested that at that time, "the most widely used perceptual measure of psychosocial environment in science education" was the *Learning Environment Inventory (LEI)* (Anderson & Walberg, 1968). This instrument measures student perceptions of 15 environment dimensions of secondary school classrooms and was developed in the late 1960's (Fraser, Anderson, & Walberg, 1982). Following the development of the Learning Environment Inventory (LEI) by Anderson and Walberg (1968), and the development of means to assist in the evaluation of a new college physics course, Harvard Project Physics research studies have investigated the learning environment more closely from the

perspective of the students who make up a classroom rather than from the perspective of trained observers.

The LEI has seven items per scale with a total of 105 items. The items are scored on a four point Likert scale (Likert, 1932) with some items reversed. The LEI evolved from the 18-scale *Classroom Climate Questionnaire* developed by Walberg (1968). The LEI utilised 15 dimensions of climate which had previously been identified as good predictors of learning and were relevant to social psychological theory of the time (Fraser & Walberg, 1991, p. 8).

### *2.3.2 The My Class Inventory (MCI)*

The *My Class Inventory (MCI)* (Anderson & Walberg, 1968; Fraser, Anderson, & Walberg, 1982; Walberg & Anderson, 1968) is essentially a simplified version of the LEI that has 38 items, rather than the 105 items in the LEI. The LEI was modified to improve comprehension by children in the 8-12 years age range (Fisher & Fraser, 1981; Fraser, Anderson, & Walberg, 1982; Fraser & O'Brien, 1985). The MCI has also been found to be useful for use with students who have difficulty reading the lengthy LEI (Fraser & Walberg, 1995, p. 124). Another difference in the MCI from the LEI is the reduction from 15 scales to five scales. This made it a more manageable instrument for younger children and reduced student fatigue (Fraser & Walberg, 1991, p. 9). Furthermore, the MCI has a simpler response format of yes or no and is scored directly on the questionnaire rather than on a separate response sheet. The original version of the MCI had 45 items but it was reduced to 38 items (Fisher & Fraser, 1981) to improve scale reliabilities.

### *2.3.3 The College and University Classroom Environment Inventory (CUCEI)*

Up until the development of the *College and University Classroom Environment Inventory (CUCEI)* (Fraser, Treagust, Williamson, & Tobin, 1987) there had not been a suitable instrument for use in tertiary

education settings (Fraser & Walberg, 1991, p. 9). The development of the CUCEI was influenced by four initial criteria. They were, economy of response time and data processing, selection of meaningful items that were relevant to and understood by university or college teachers and students, association of scales to the three general dimensions formulated by Moos (1974) and an examination of previous instruments to determine relevant scales at this time. What resulted was an instrument that enabled learning environments in university or college classroom settings to be examined (Fraser, Treagust, Williamson, & Tobin, 1987). The CUCEI has also recently been successfully used in hospital-based nursing education classroom environments in Australia (Fisher & Parkinson, 1998). The CUCEI has seven scales each with seven items scored on a four point Likert scale with about half of the items reversed. As with some other questionnaires, the CUCEI has been adapted to form instruments that are specific to particular studies. One example is the *Secondary Colleges Classroom Environment Inventory* (SCCEI) (Kent & Fisher, 1997, p. 3) which was adapted from both the LEI and the CUCEI.

### *2.3.4 The Classroom Environment Scale (CES)*

The *Classroom Environment Scale (CES)* was developed at Stanford University by Moos (Moos, 1974; Moos, 1979a; Moos, 1979b; Moos & Trickett, 1987; Trickett & Moos, 1973) and was inspired by Moos' research in a number of work milieus including psychiatric hospital wards, school classrooms, correctional institutions, military companies, university residences and work place environments. The current version contains nine scales for use in secondary school classrooms with ten items per scale. The scales are all scored using a true/false response with about half of the items being reversed. The process used to construct the CES involved a review of the literature and a process of structured interviews to determine item content. The CES was primarily developed to examine the psychosocial environment of school classrooms from the perspective of participant interaction

(Raviv, Raviv, & Reisel, 1990). This included behaviour exhibited by the teacher, teacher-student interaction and student-student interaction (Moos & Trickett, 1974; Moos & Trickett, 1987).

*2.3.5 The Individualised Classroom Environment Questionnaire (ICEQ)*

The *Individualised Classroom Environment Questionnaire (ICEQ)* assesses those dimensions which distinguish individualised classrooms from conventional ones and it was developed by Rentoul and Fraser (1979). The original version of the ICEQ had five scales with 15 items per scale. The final version of the ICEQ reduced each scale to 10 items to give a total of 50 items. Each item has a 5 point Likert-type response scale with some items reversed.

The three criteria that were adhered to during the development of the ICEQ were: the scales should characterise the learning environment upheld in inquiry based classrooms, scales should conform to the dimensions outlined by Moos (1979a) for conceptualising learning environments; and individual items should be salient to teachers and their students (Rentoul & Fraser, 1981).

A feature of the ICEQ is that there is also a short form of the questionnaire (Fraser, 1990) that retains the five scales with 25 items. These items are equally divided among the scales and retain the same representation of positively and negatively worded items.

*2.3.6 The Science Laboratory Environment Inventory (SLEI)*

The *Science Laboratory Environment Inventory (SLEI)* (Fraser, Giddings, & McRobbie, 1991) was developed specifically to assess the learning environments of science laboratory classes at the senior secondary or tertiary levels. The SLEI consists of five scales with 34 items in total. Responses are scored on a five point Likert-type scale and approximately half of the items are reversed. The SLEI also conforms to the dimensions outlined by Moos (Fraser, Giddings, &

McRobbie, 1992). The SLEI was validated in six countries simultaneously with a sample of approximately 5,500 students in 270 classrooms (Hofstein & Lunetta, 1982).

The SLEI has also been modified to produce a variant known as the *Environmental Science Learning Environment Inventory* (ESLEI) (Henderson, Fisher, & Fraser, 1998b) which was first used with 100 Environmental Science students in senior high schools in Tasmania, Australia.

*2.3.7 The Constructivist Learning Environment Survey (CLES)*

The constructivist view of learning suggests that meaningful learning is a cognitive process in which individuals make sense of the world by associating and negotiating what they already have constructed for themselves with the contributions of significant others that they interact with as they travel through life to reach a personal consensus (Fraser, 1998b, p. 534; Fraser & Walberg, 1991, p. 20). The *Constructivist Learning Environment Survey* (CLES) (Taylor, Fraser, & Fisher, 1997) is designed to assist researchers and teachers assess the degree to which a particular classroom's environment is consistent with a constructivist epistemology. The initial development of the CLES was guided by four criteria (Taylor, Fraser, & Fisher, 1993, p. 5) which were that the CLES had to be consistent with current literature, have a personalised response format, be economical to use and have a high level of salience to teachers, researchers and students for whom it was intended. The original version of the CLES had 58 items with four scales that ranged from nine to twenty items. After a further validation process the CLES was reduced to five, six item scales giving a total of 30 items with only item 6 reversed. In their use of the CLES, Taylor, Fraser, & White (1994) arranged the items in groups of like items. This resulted in all of the items for a particular scale being in the same group which was a different approach to the more traditional cyclic arrangement of scale items in many other similar questionnaires.

*2.3.8 Geography Classroom Environment Inventory (GCEI)*

Though the title of this instrument, the *Geography Classroom Environment Inventory (GCEI)*, suggests that it is for Geography classes this was not the primary focus of the instrument. This instrument was specifically designed to assess innovation and gender equity in computer assisted learning environments in Singapore (Teh & Fraser, 1993; 1995). The original form of the instrument had eight scales but these were reduced to four scales following factor and item analysis. Each unique scale has eight items that are scored on a five point Likert-type scale. Almost half of the 32 items are reverse scored items. The gender equity scale was a new scale developed by Teh and Fraser while the other scales were adapted from other existing classroom environment instruments and modified to better suit the computer assisted learning environment. The development of the GCEI was guided by four criteria. Consistency with the literature on computer assisted learning, consistency with the dimensions set out by Moos, salience to classroom environment researchers, teachers and students and finally salience to computer education experts.

*2.3.9 Computer Classroom Environment Inventory (CCEI)*

The *Computer Classroom Environment Inventory (CCEI)* was developed specifically to assess student perceptions of learning environments which involve both inquiry learning methods and the use of computer-assisted instruction (Maor & Fraser, 1993; 1996). The initial version of the CCEI had 40 items which were later refined to five scales with 30 items in total. Responses are scored on a five point Likert-type scale with some of the items reversed. The CCEI conforms to the dimensions outlined by Moos. Other criteria used to constrain the development of the CCEI were, firstly, the existing literature on inquiry learning was to serve as a basis for scale selection as were existing learning environment instrument scales and secondly the CCEI

should be quick and efficient to complete and hand score as well as being salient to teachers and students in the target audience.

*2.3.10. Cultural Learning Environment Questionnaire (CLEQ)*

The *Cultural Learning Environment Questionnaire* (CLEQ) (Waldrip & Fisher, 1997a) was developed as there was no currently available instrument designed to assess the culturally-sensitive factors of the classroom learning environment. Research on dimensions of culture (Hofstede, 1984) served as a guide in the development of the CLEQ as did Moos' dimensions. Six criteria use in construction of this instrument. They included a need for consistency with previous learning environment research and literature, consistency with Hofstede's and Moos's dimensions, salience for teachers and students in the target audience and economy of operational requirements. The resultant questionnaire has eight scales with five items in each scale giving an economical total of 40 items. An impressive factor analysis of the eight scales using the student as the unit of analysis (Waldrip & Fisher, 1997b, p. 171) resulted in the 40 items in eight scales being retained.

*2.3.11 What is Happening In This Classroom (WIHIC)*

This is a relatively new questionnaire and as such is able to make use of scales from past instruments to enhance its coverage of contemporary educational thought. The *What is Happening in This Classroom (WIHIC)* (Fraser, Fisher, & McRobbie, 1996) has both a class and personal form. The class form examines student perceptions of the class as a whole group and the personal form assesses the student's perceptions of his or her role in the classroom. The reduction of the WIHIC from the original 90-item nine scale version was refined using interviews and statistical analysis. In the final version, 56 items remained in seven scales.

The WIHIC has recently been used in a cross-national study in Australia and Taiwan in 50 junior high school classes in each country (Aldridge, Fraser, & Huang, 1998; Huang & Fraser, 1997). There were 1,879 Taiwanese students and 1,081 Australian students involved in the study. Among the conclusions from this study was the need for caution to be exercised when interpreting data from questionnaires from cross-national studies where there are cultural differences even if questionnaires have been back translated.

*2.3.12 Distance and Open Learning Environment Survey (DOLES)*

The *Distance and Open Learning Environment Survey (DOLES)* (1998a; Jegede, Fraser, & Fisher, 1998b) is an unique instrument developed from a growing need for research into university distance education settings particularly in science (Jegede, 1992). The initial version of the DOLES had 60 items. These were reduced in the final version to 52 items arranged into five core scales and two optional scales containing varying numbers of items. The optional scales are designed to be used for specific purposes or by students for whom these aspects are relevant. The DOLES is an unique instrument from this perspective. Responses are scored on a five point Likert-type scale.

The criteria used in the development of the DOLES were as follows. Consistency with existing literature on learning environments, consistency with previously constructed instruments for face-to-face learning environments, coverage of distance and open learning characteristics, economy in administration time and scoring responses and finally salience to teachers and students in the target distance and open education audience.

*2.3.13 Socio-Cultural Environment Scale (SCES)*

The 30-item *Socio-Cultural Environment Scale* (SCES) (Jegede & Okebukola, 1988) was developed to assess student perceptions of the socio-cultural environment of their classrooms. It consists of five

subscales with six items for each scale that are scored on a three point Likert type response scale. The development of the instrument was facilitated by a panel of experts versed in African studies comprising of science educators, science teachers, sociologists and anthropologists (Jegede & Okebukola, 1992).

### 2.4 Actual and Preferred Forms

An important aspect in the use of many of these questionnaires is the development of the preferred or ideal forms. In addition to a form measuring student perceptions of the actual environment, the questionnaires have an additional form measuring the preferred learning environment. The preferred form is concerned with goals and value orientations as it measures perceptions of the environment preferred by students and teachers (Fraser & Walberg, 1991). Although the wording of items in the actual and preferred forms is almost identical, the directions for answering the two forms instruct students clearly as to whether they are rating what their class is actually like or what they would prefer it to be like. For example, an item such as, "This teacher explains things clearly", in the actual form would appear as, "This teacher would explain things clearly", in the preferred form.

The availability of the preferred form allows teachers to identify discrepancies between the actual environment and that preferred by students. This serves as a useful starting point for reflecting on teaching practice and enables teachers and researchers to quickly identify perceptual differences in the learning environment. Fraser (Fraser & Walberg, 1981a) summarised the basic logic underlying this approach partly in terms of person-environment fit research (Hunt, 1975). A number of other studies (Fraser & Fisher, 1983a; Fraser & Fisher, 1983b; Rentoul & Fraser, 1980) have taken up the suggestion that researchers were reluctant to include the environment and the person in their research (Fraser & Fisher, 1983a). Using the ICEQ with 116

classes (Fraser & Fisher, 1983a; Fraser & Fisher, 1983b) suggested that students achieve better when they are operating in their preferred environment. This is also supported by a Singaporean study of school types, learning styles and gender using the ICEQ with 1,733 secondary students who preferred a more positive and favourable classroom environment than was actually present (Lim, 1995). Fraser & Walberg (1991), suggested that the achievement of goals and set outcomes for a particular class is enhanced if the learning environment for that class is enhanced to make it more consistent to that which is preferred by the class.

## 2.5 Short and Long Forms of the CES, ICEQ and MCI.

With an ever increasing burden on teachers' time from a more diversified curriculum and greater number of tasks to complete in a day, the need for researchers to be able to rapidly make assessments of learning environments is growing. The ability to "dip a thermometer" into a learning environment and quickly assess the perceptions of the participants with little disruption is a very valuable feature of any instrument. Particularly if it seeks to become popular, and therefore gain larger acceptance from teachers. As with a thermometer used for temperature measurements, some "energy" in the events of the class is absorbed when a "reading" is made in a learning environment with a questionnaire. It is this loss of energy and time from having to administer questionnaires in the classroom that was a factor that all teachers considered when deciding whether or not to participate in this study. The acceptance by teachers of the economical instrument used in this study was valuable and contributed to the unique and large sample size. A precaution for researchers wishing to shorten any instrument is that it is necessary to immerse an instrument into a learning environment long enough to gather an accurate reading. The reliability and validity of short forms is crucial in the developmental stages of the shortened instrument to maintain valid outcomes.

The short forms of the CES, MCI and ICEQ were primarily developed to meet the needs of teachers and researchers to save time, by reducing the number of items to complete, by making the results of the questionnaires hand scorable to reduce data preparation time and to ensure a satisfactory reliability for the assessment of class mean scores (Fraser, 1982; Fraser, 1994).

## 2.6 Summary of Learning Environment Instruments

During the last three decades of classroom environment research there has been a variety of instruments introduced to examine different learning environments. More recently, some classroom environment research has focused on teacher interpersonal behaviour (Wubbels, 1993; Wubbels, Créton, Levy, & Hooymayers, 1993; Wubbels & Levy, 1993), science laboratory classroom environments (McRobbie & Fraser, 1993), constructivist classroom environments (Taylor, Dawson, & Fisher, 1995; Taylor, Dawson, & Fraser, 1995), cross national studies (Aldridge, Fraser, & Huang, 1998; Fisher, Goh, Wong, & Rickards, 1996; Fisher, Rickards, Goh, & Wong, 1997; Riah, Fraser, & Rickards, 1997), computer-assisted instruction classrooms (Fisher & Stolarchuk, 1997; Teh & Fraser, 1994), the effects of internet usage on learning environments (Churach & Fisher, 1998) and physical factors of the learning environment combined with psychosocial environments (Zandvleit, 1998).

There are now some learning environment instruments designed to achieve a particular task. For example, the CLES is designed specifically for constructivist classrooms. Results from research utilising these instruments has enabled associations between the classroom learning environment and other factors to be examined. It is clear that there are many instruments to choose from for research in this area, and equally clear that they are all suited to particular emphases of research.

To help to summarise the learning environment instruments presented in this section, an overview outlining the major features and scales for the instruments is presented in Table 2.1. Also presented is a classification of scales for each instrument and how these relate to Moos' dimensions (Moos, 1974; Moos, Insel, & Humphrey, 1974). It should be noted that the table includes the QTI for comparison. The QTI is described in more detail in section 2.10.

Table 2.1
*Overview of Scales in 13 Classroom Environment Instruments*

| Instrument | Level | Items Per Scale | Scales Classified According to Moos's Scheme | | |
|---|---|---|---|---|---|
| | | | Relationship Dimensions | Personal Development Dimensions | System Maintenance & Change Dimensions |
| Learning Environment Inventory (LEI) | Secondary | 7 | Cohesiveness, Apathy Friction, Favouritism, Cliqueness, Satisfaction. | Speed, Difficulty, Competitiveness. | Diversity, Formality, Goal Direction, Disorganisation, Material Environment, Democracy. |
| My Class Inventory (MCI) | Elementary | 6-9 | Cohesiveness, Friction, Satisfaction. | Difficulty, Competitiveness | |
| College and University Classroom Environment Inventory (CUCEI) | Higher Education | 7 | Personalisation Involvement Cohesiveness Satisfaction | Task Orientation | Innovation Individualisation |
| Classroom Environment Scale (CES) | Secondary | 10 | Involvement, Affiliation, Teacher Support. | Task Orientation, Competition. | Order & Organisation, Rule Clarity, Teacher Control, Innovation. |

Table 2.1 *(Continued).*

| Instrument | Level | Items Per Scale | Scales Classified According to Moos's Scheme | | |
|---|---|---|---|---|---|
| | | | Relationship Dimensions | Personal Development Dimensions | System Maintenance & Change Dimensions |
| Individualised Classroom Environment Questionnaire (ICEQ) | Secondary | 10 | Personalisation<br>Participation | Independence<br>Investigation | Differentiation. |
| Science Laboratory Environment Inventory (SLEI) | Upper Secondary | 7 | Cohesiveness | Open Endedness<br>Integration | Rule Clarity<br>Material Environment |
| Constructivist Learning Environment Survey (CLES) | Secondary | 7 | Personal Relevance,<br>Scientific Uncertainty. | Critical Voice,<br>Shared Control. | Student Negotiation. |
| Geography Classroom Environment Inventory (GCEI) | Secondary | 4 | Gender Equity | Investigation<br>Resource Adequacy | Innovation |
| Computer Classroom Environment Inventory (CCEI) | Secondary | 5 | Satisfaction. | Investigation<br>Open Endedness | Material Environment<br>Organisation |

Table 2.1 *(Continued).*

| Instrument | Level | Items Per Scale | Scales Classified According to Moos's Scheme | | |
|---|---|---|---|---|---|
| | | | Relationship Dimensions | Personal Development Dimensions | System Maintenance & Change Dimensions |
| Questionnaire on Teacher Interaction (QTI) | Secondary Elementary | 8-10 | Helpful/Friendly, Understanding, Dissatisfied, Admonishing. | | Leadership, Uncertain, Strict, Student Responsibility & Freedom. |
| Cultural Learning Environment Questionnaire (CLEQ) | Secondary | 8-10 | Gender Equity Collaboration Risk Involvement | Competition Congruence | Teacher Authority Modelling Communication |
| What is Happening In This Classroom (WIHIC) | Secondary | 8 | Student Cohesiveness Teacher Support Involvement | Investigation Task Orientation Cooperation | Equity |
| Distance and Open Learning Environment Scale (DOLES) | Tertiary | 4-12 | Student Cohesiveness Teacher Support Personal Involvement & Flexibility | Task Orientation & Material Environment, Technology Resources | Student Centre Environment, Home Environment |

Table 2.1 *(Continued).*

| Instrument | Level | Items Per Scale | Scales Classified According to Moos's Scheme | | |
|---|---|---|---|---|---|
| | | | Relationship Dimensions | Personal Development Dimensions | System Maintenance & Change Dimensions |
| Socio-Cultural Environment Scale (SCES) | Secondary Elementary | 6 | African World View | Societal Expectation | Authoritarianism, Goal Structure Sacredness of Science |

(Developed from Fraser, 1998)

## 2.7 Conceptual Framework for Interpersonal Behaviour

This next section deals with the origins and foundations of the assessment of teacher-student interpersonal behaviour. A long term research project during the 1970s called "Education for teachers" (Wubbels, Créton, & Hooymayers, 1987) at Utrecht University in The Netherlands served as the origin and catalyst for teacher-student interpersonal behaviour research work (Wubbels & Levy, 1993). The primary and practical goal of this project was to apply the results of research findings, in the form of a school induction programme, to the experiences of pre-service teachers. An early finding based on "observations, analysis of interviews, conferences and action research activities" (Wubbels, Créton, & Hooymayers, 1992, p. 2) was that a key factor in beginning teachers with discipline problems was interpersonal teacher behaviour. Thus, researchers in The Netherlands provided a basis for this current research by focussing specifically on the interpersonal behaviour between teachers and their students.

### *2.7.1 Systems Theory of Communication Model*

This study is inspired by the work of Wubbels, Créton, & Holvast (1988). They have investigated teacher behaviour in classrooms from a systems perspective. The Dutch researchers investigated what they called "the interactional aspect of teacher behaviour" (Wubbels, Créton, & Hooymayers, 1985, p. 3) in a classroom from a systems perspective, adapting a theory on communication processes developed by the Palo Alto group which included Waltzlawick, Beavin, and Jackson (1967). The notion of circularity is a central concept in the systems theory of communication that suggests that "changes in one part of the system lead to changes in other parts of the system, which influence the first part, and so on" (Wubbels, Créton, & Holvast, 1988, p. 26). Within the systems perspective of communication, it is assumed that the behaviours of participants mutually influence each other. The behaviour of the teacher is influenced by the behaviour of the students

and in turn influences the student behaviour. Créton, Wubbels, and Hoomayers (1993) refer to this as circularity and change, and argue that "a circular communication process develops which not only consists of behaviour, but determines behaviour as well" (p. 2).

With this systems perspective in mind, Wubbels, Créton, and Hooymayers (1985) developed a model to map interpersonal teacher behaviour using an adaptation of the work of Leary (1957). This model has been used in the development of an instrument, the QTI, to gather students' and teachers' perceptions of interpersonal teacher behaviour (Wubbels, Brekelmans, & Hooymayers, 1991; Wubbels & Levy, 1993).

*2.7.2 Leary's Model For Interpersonal Behaviour*

The Leary Model for interpersonal behaviour originates from research carried out by Leary and his colleagues, working on the Kaiser Foundation research project (Leary, 1957, p. 62). They suggested a 16-dimensional model with two levels of behaviour. The dimensions of level one behaviour were classified in terms if interpersonal mechanisms, gestures or reflexes and involved two-way interpersonal codes (p. 134), see Figure 2.1. Level two behaviours are classified in terms of interpersonal attributes or traits, (p. 134), see Figure 2.2. Leary asserted that "every discernible or rateable interpersonal theme in the content of an individual's verbalisations defines a unit of Level two behaviour" (p. 135).

The model assumes that interpersonal behaviour is motivated by an individual's needs to reduce anxiety and maintain self esteem (Leary, 1957). Leary, (p. 8) suggests that the "motivating principle of behaviour" for individuals is "the avoidance of the greater anxiety and the selection of the lesser anxiety". If an individual repeats interpersonal behaviours that reduce anxiety and increase or maintain self esteem, then a pattern of communication behaviour is established. This premise enhances the link with the systems perspective that

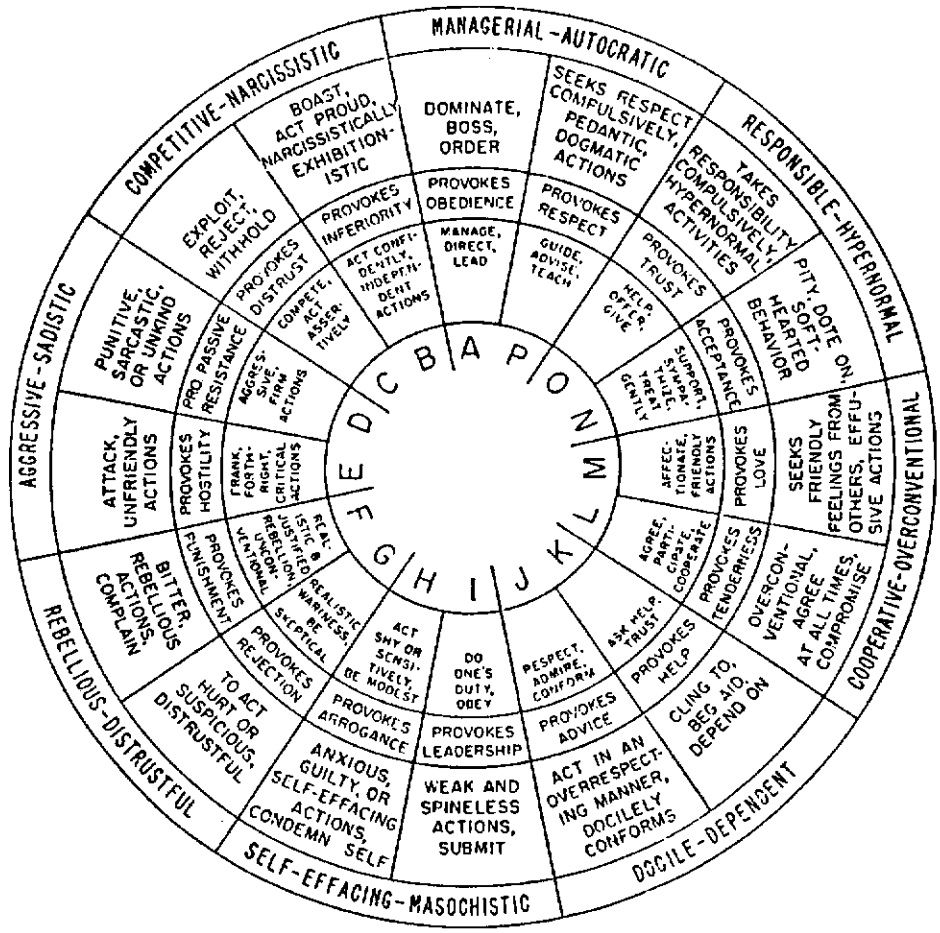


*Figure 2.1.* Classification of interpersonal behaviour into sixteen mechanisms or reflexes.

(Source: Leary, 1957, p. 65)

suggests that circular communication processes develop which not only consist of behaviour, but determine behaviour as well (Créton, Wubbels, & Hooymayers, 1993). The 16 mechanisms developed by Leary and his colleagues were later reduced to eight categories (Wubbels, Créton, Levy, & Hooymayers, 1993) of interpersonal behaviour which are plotted on a two-dimensional coordinate system, see Figure 2.4.

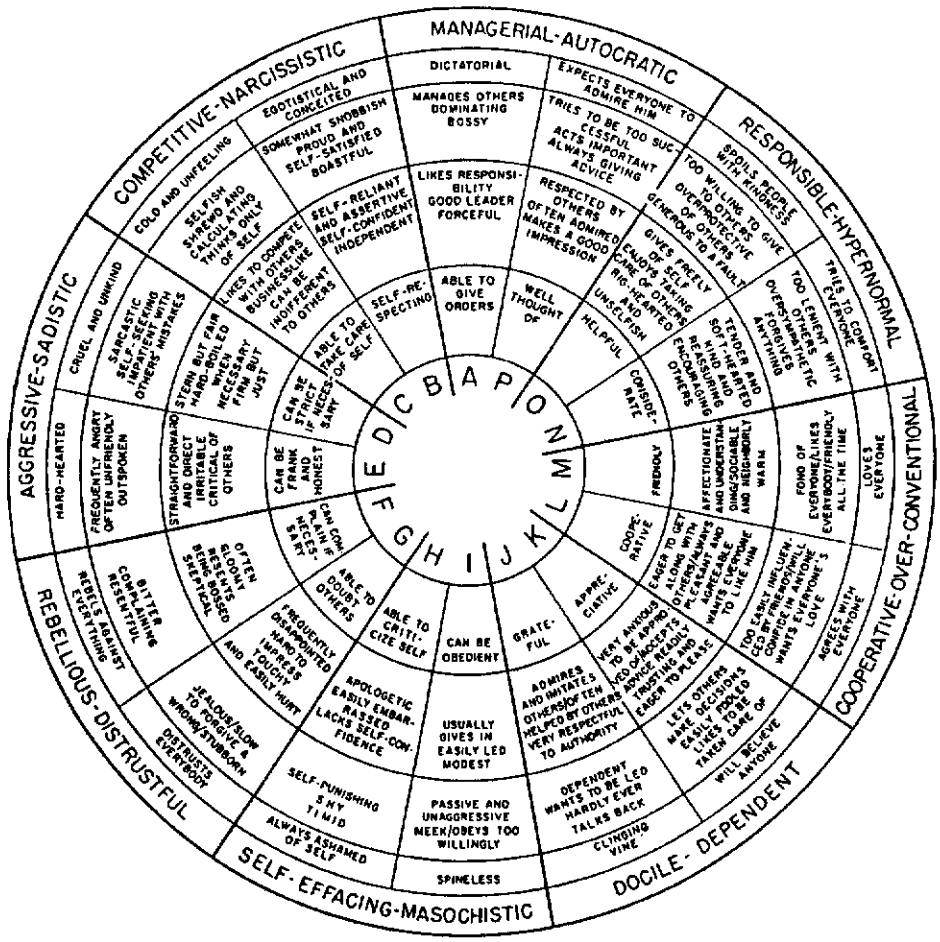


*Figure* 2.2. Level two classification of interpersonal behaviours into sixteen variable categories.

(Source: Leary, 1957, p. 135)

This two-dimensional coordinate system of representing interpersonal behaviour mapped the degree cooperation between the individuals communicating on the horizontal axis and the degree of control or influence over the communication process of the communicator being observed. Leary originally labelled the Cooperation-Opposition axis the "Affection-Hostility" continuum (Wubbels, Créton, Levy, & Hooymayers, 1993).

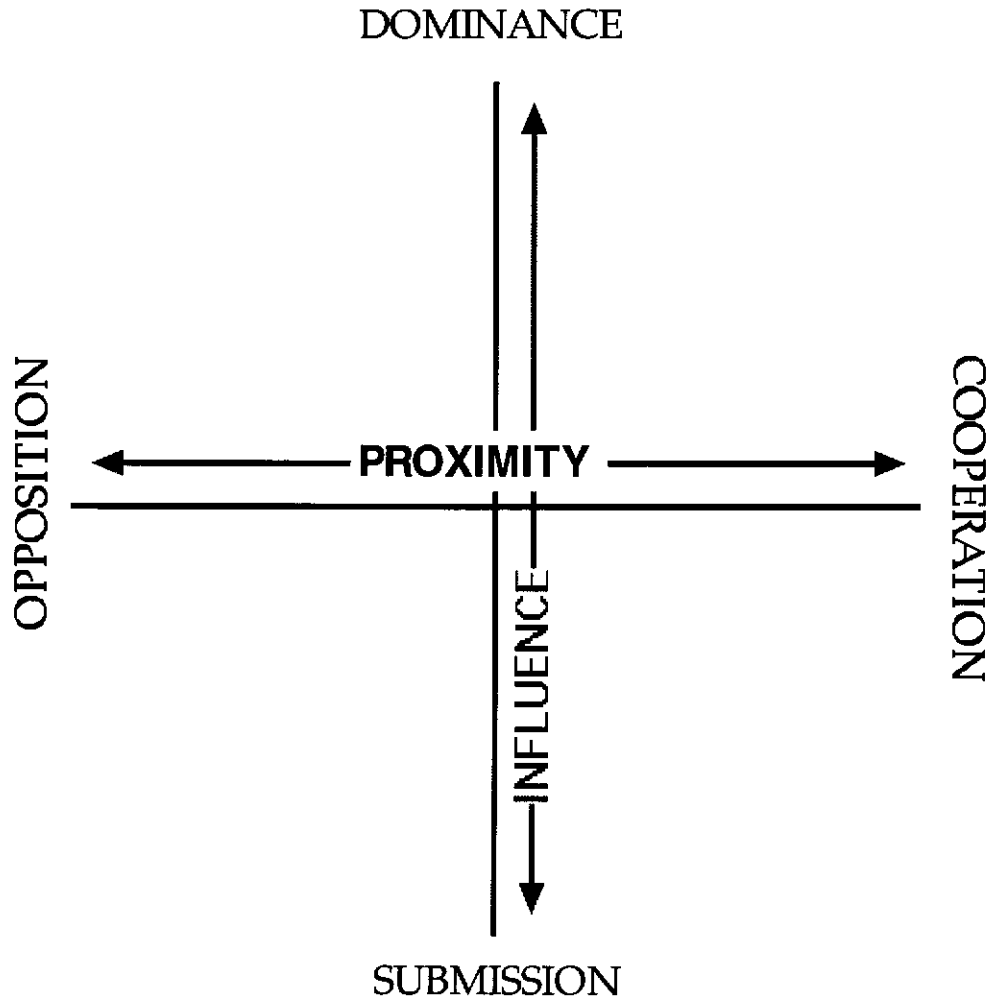


*Figure* 2.3. The two-dimensional coordinate system of the Leary model (Source: Wubbels, Créton, Levy, & Hooymayers 1993, p. 15).

This two-dimensional model based on the work of Leary (Wubbels, Créton, & Hooymayers, 1985) has been used widely in educational settings (Wubbels, Créton, Levy, & Hooymayers, 1993), see Figure 2.3. Furthermore, cross national validation of the Leary model has shown it to be culturally universal (Lonner, 1980; Wubbels & Levy, 1991).

The Leary model was not however, the only model suggesting titles for the types of human interaction it measured at its inception. For example others have adopted the terms Status and Solidarity (Brown, 1965, p. 52; 1985), Warmth and Directivity (Dunkin & Biddle, 1974), and

Dominance and Affiliation (Foa, 1961; Gough, 1957), however the Leary terms of Influence and Proximity "have generally been accepted as universal descriptors of human interaction" (Wubbels, Créton, Levy, & Hooymayers, 1993, p. 14).

## 2.8 The Development of the Model for Interpersonal Teacher Behaviour

If Figure 2.4 is examined it can be seen that the dot representing DC, where dominance prevails over cooperative behaviour, is plotted in the same quadrant as the dot representing CD, where cooperative behaviour prevails over dominant behaviour as exhibited by the teacher in a classroom. A difficulty with this two-dimensional model was that two behaviours that vary in, for example, the amount of dominant behaviour that is exhibited, can in fact be plotted in the same quadrant. This may have been what motivated the adaptation of the two-dimensional Leary model to a more comprehensive model.

In the adaptation of the Leary model, the model for interpersonal teacher behaviour teacher behaviour is mapped with the Proximity dimension (Cooperation, C, - Opposition, O) and the Influence dimension (Dominance, D, - Submission, S) to form eight sectors, each describing different behaviour aspects, as illustrated in Figure 2.5. The sections in the model for interpersonal teacher behaviour are labelled DC, CD, CS, SC, SO, OS, OD and DO according to their position in the coordinate system. For example, the two sectors DC and CD are both characterised by Dominance and Cooperation. In the DC sector, however, the Dominance aspect predominates over the Cooperation aspect, whereas the adjacent sector CD Cooperation predominates over the Dominance aspect.

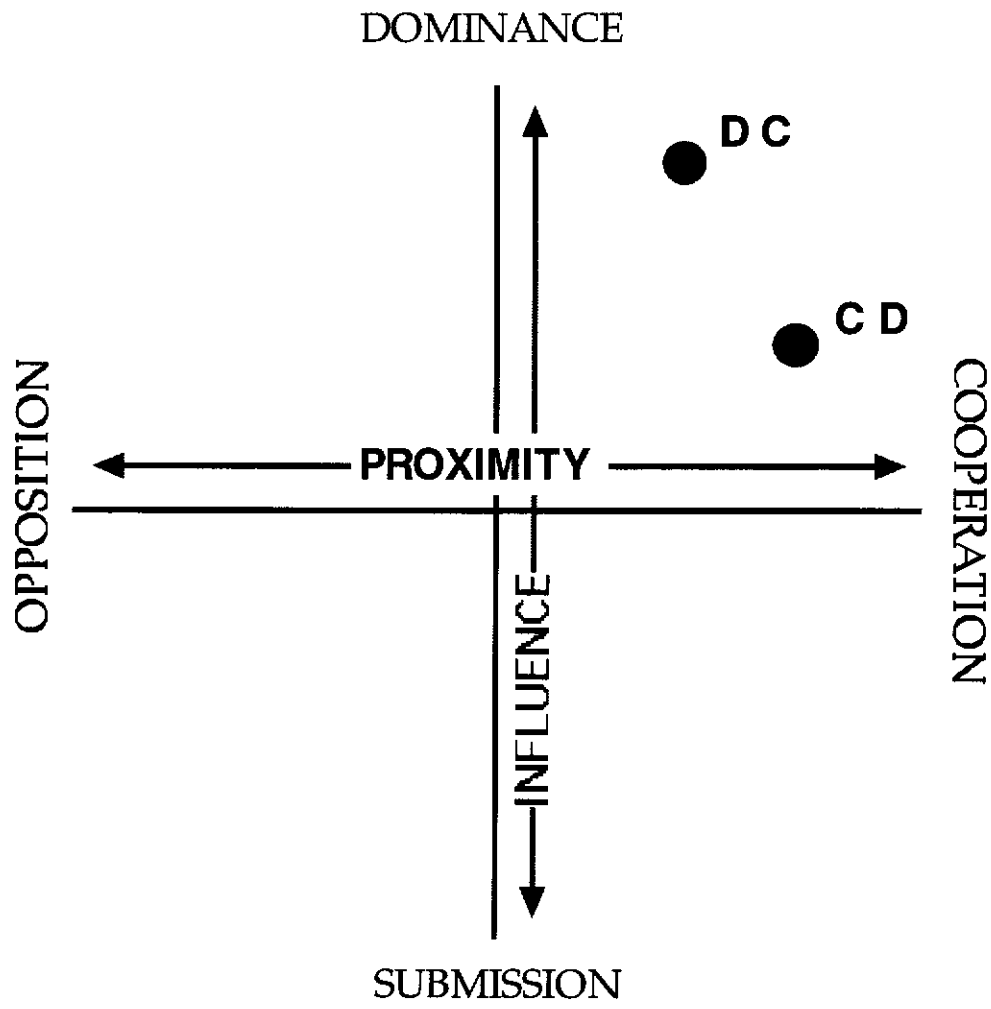


*Figure 2.4.* The two-dimensional coordinate system of the Leary model (Source: Wubbels, Créton, Levy, & Hooymayers, 1993, p. 15).

These behavioural aspects were labelled Leadership, Helping/Friendly, Understanding, Student Responsibility and Freedom, Uncertain, Dissatisfied, Admonishing and Strict behaviour.

Whilst the Leary model was an appropriate model to represent interaction behaviour and withstood testing in psychological research settings, (Wubbels, Créton, Levy, & Hooymayers, 1993, p. 14) the 128-item *Interpersonal Adjective Checklist* (ICL) that Leary used to gather his data about four levels of behavioural intensity was cumbersome in

an educational setting, (Wubbels, Créton, Levy, & Hooymayers, 1993, p. 18) and contained many items that were not pertinent to teachers.

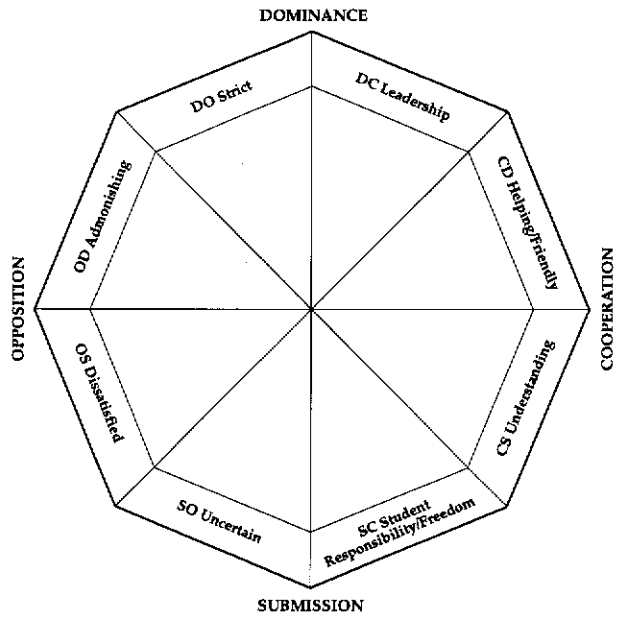


*Figure 2.5.* The model for interpersonal teacher behaviour (Source: Fisher, Fraser, & Wubbels, 1993).

It was this that led to the development of the *Questionnaire for Interactional Teacher-behaviour* (Wubbels, Créton, & Hooymayers, 1985) and later the *Questionnaire on Teacher Interaction* (QTI) (Wubbels & Levy, 1993).

## 2.9 The Development of Questionnaire on Teacher Interaction (QTI)

International research projects utilising the *Questionnaire on Teacher Interaction* (QTI), are well established in the literature (Brekelmans, Wubbels, & Créton, 1990; Fisher, Fraser, & Rickards, 1997; Fisher, Henderson, & Fraser, 1995; Levy, Rodriguez, & Wubbels, 1992; Wubbels, Brekelmans, & Hermans, 1987; Wubbels, Brekelmans, & Hooymayers, 1991; Wubbels, Créton, & Hooymayers, 1985; Wubbels & Levy, 1991; Wubbels & Levy, 1993).

Studies that have utilised the QTI as an instrument have shown that the nature of the relationship between the teacher and his or her students is an important aspect of the learning environment (Fraser & Walberg, 1991) and that despite the influences of primacy and recency effects (Brown, 1965; Brown, 1985; Luchins, 1957) the behaviour patterns that are established in a classroom learning environment are relatively stable over time (Brekelmans, Holvast, & van Tartwijk, 1990; Fraser & Walberg, 1991, p. 158). Créton, Wubbels and Hooymayers (1993), Wubbels, Créton and Holvast, (1988) and Fraser (1991) suggest that the circular communication processes that consist of behaviour as well as determine behaviour develop early in the year in a classroom. Once this has resulted in stability being achieved in the classroom both teachers and students are more resistant to change.

As the items of the QTI ask about the teacher's behaviour over a long period of time, not just during the current lesson, it has been suggested that teachers and students should interact for a period of two to three months prior to administration of the instrument (Brekelmans, 1989; van Tartwijk, Brekelmans, & Wubbels, 1993). It has also been suggested that the nature and patterns of the teacher-student interpersonal behaviour that are established during this time are very likely to remain relatively stable for the remainder of the year (Fraser & Walberg, 1991, p. 158). This suggests that it does not matter when questionnaires are administered so long as the initial two or more months of settling in have taken place (Brekelmans, 1989).

In order to examine teacher-student interpersonal behaviour in lower secondary school science classes, a multi-scale instrument that has good internal consistency within scales and is able to differentiate between student perceptions in different classrooms was required. The purpose of this section is to outline the history and development of the teacher-student interpersonal behaviour questionnaire, the QTI. In particular, this section describes the various forms of the QTI and reviews its use

in past research. Validation data for the QTI obtained in this study are presented in Chapter 4.

The QTI (Wubbels & Levy, 1991; 1993) was designed to assess teacher-student interpersonal behaviour in the lower secondary classroom and developed out of a need to measure secondary students' and teachers' perceptions of teacher behaviour. The original version of the QTI in the Dutch language was developed after four trials (Wubbels, Créton, Levy, & Hooymayers, 1993) in the early 1980s in The Netherlands and had 77 items arranged into eight scales. The number of items in each scale varied from nine to eleven items. The 77-item version of the QTI was a result of a modification, re-wording and reduction of the 128 items from the ICL (Wubbels, Créton, & Hooymayers, 1992). The other significant change was to modify the response format from a "yes" or "no" response in the ICL to a five point Likert-type response. The items were arranged into the eight scales corresponding to the eight sections of the model for interpersonal teacher behaviour. Later, an American version of the QTI was developed in the English language which had 64 items (Wubbels & Levy, 1991). Items were deleted from the Dutch version following correlational analysis of the 77-item version to result in the 64 items used in the American version.

Following these two pioneering versions of the QTI, a shorter 48-item Australian version of the QTI was constructed (Fisher, Fraser, & Wubbels, 1992). In this version, the eight scales consist of six items each.

Table 2.2, on the next page, clarifies further the nature of the QTI by providing a scale description and a sample item for each of the eight scales. It is this 48-item, economical, Australian version that has been used in this study.

All versions of the QTI require responses to items which are presented using a five-point Likert-type response scale are scored from 0 (Never) to 4 (Always) on the questionnaire, rather than on a separate response sheet. This assists in reducing the time for responding. Thus the QTI can be administered quickly so that teachers and students can complete it easily within one lesson.

Table 2.2
*Description of Scales and Sample Items for each Scale of the QTI*

| Scale name | Description of scale (The extent to which the teacher...) | Sample item |
|---|---|---|
| Leadership | ...leads, organises, gives orders, determines procedure and structures the classroom situation. | This teacher talks enthusiastically about his/her subject. |
| Helping/Friendly | ...shows interest, behaves in a friendly or considerate manner and inspires confidence and trust. | This teacher helps us with our work. |
| Understanding | ...listens with interest, empathises, shows confidence and understanding and is open with students. | This teacher trusts us. |
| Student Resp/ Freedom | ...gives opportunity for independent work, gives freedom and responsibility to students. | We can decide some things in this teachers class. |
| Uncertain | ...behaves in an uncertain manner and keeps a low profile. | This teacher seems uncertain. |
| Dissatisfied | ...expresses dissatisfaction, looks unhappy, criticises and waits for silence. | This teacher thinks that we cheat. |
| Admonishing | ...gets angry, express irritation and anger, forbids & punishes. | This teacher gets angry unexpectedly. |
| Strict | ...checks, maintains silence and strictly enforces the rules. | This teacher is strict. |

* Items are scored 0, 1, 2, 3, and 4, respectively, for the responses Almost Never, Seldom, Sometimes, Often, Very Often. Missing or invalid responses are scored 2, the midrange value. (Table based on the descriptions provided by Wubbels, 1993)

When the QTI is administered to students, information is provided about the perceptions of teachers and the perceptions of their students of the interpersonal behaviour of that teacher. Similarly, teachers can

be asked for their perceptions of their own behaviour or the behaviour that they consider to be ideal. The wording of the questionnaire is varied slightly when used to obtain teachers' self-perceptions and ideal perceptions. For example the item "This teacher talks enthusiastically about his/her subject", becomes "I talk enthusiastically about my subject" in the teacher self-perception version, and "The teacher would talk enthusiastically about his/her subject" in the Teacher Ideal version. Appendix A contains the Teacher Ideal Version of the QTI, Appendix B contains the Teacher Actual Version of the QTI and Appendix C contains the Student Version of the QTI.

An examination of the items in Appendix D indicates that the items are arranged in cyclic order and in blocks of four. This is consistent for all of the 48-item Australian versions of the QTI. Items 1 to 24 assess the four scales called Leadership behaviour, Understanding behaviour, Uncertain behaviour and Admonishing behaviour, whereas Items 25 to 48 assess the scales Helping/Friendly behaviour, Students Responsibility and Freedom behaviour, Dissatisfied behaviour and Strict behaviour.

By using these three separate forms of the QTI it is possible to collect data on students' perceptions of teacher-student interpersonal behaviour, teachers' perceptions of their actual teacher-student interpersonal behaviour in the classroom and what they perceive to be ideal. For example, Figure 2.6 depicts the information that was provided to a science teacher and visually indicates differences between the teacher's self perceptions, perceptions of an ideal teacher and how he/she was perceived by their students.

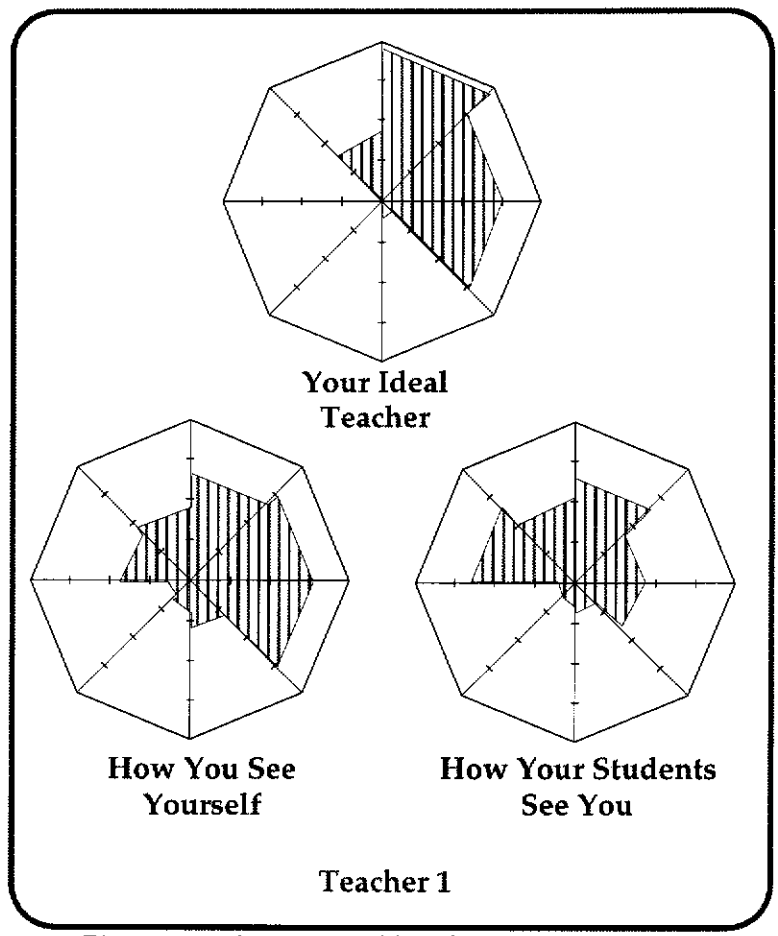


*Figure 2.6.* Sector profile of a science teacher.

Recently a primary school level version of the QTI was developed, trialed and validated in Singapore (Goh & Fraser, 1995; Goh & Fraser, 1996; Goh, Young, & Fraser, 1995). This version has been adapted from the 48-item QTI in order to be more readable for the younger target audience and has a revised three point response format. Further to this another modification of the QTI has resulted in the *Principal Interaction Questionnaire* (PIQ) (Cresswell & Fisher, 1997). This questionnaire assesses the teachers' or school principals' perceptions of principal interpersonal behaviour using the same eight scales as the QTI.

## 2.10 Review of Past Studies Using the QTI

### *2.10.1 Overseas Studies*

The QTI has been shown to be a valid and reliable instrument when used in The Netherlands (Wubbels & Levy, 1993). When the 64-item USA version of the QTI was used with 1,606 students and 66 teachers in the USA, the cross-cultural validity and usefulness of the QTI were confirmed (Wubbels & Levy, 1991).

Studies in Singapore (Goh & Fraser, 1995), Israel (Kremer-Hayon & Wubbels, 1992) and Brunei (Riah, Fraser, & Rickards, 1997; Rickards, Riah, & Fisher, 1997) have also confirmed the reliability and validity of the QTI. Using the Cronbach alpha coefficient (Cronbach, 1951) as a measure of how closely items in each of the QTI scales measured the same behaviour, Wubbels and Levy (Wubbels & Levy, 1991, p. 9) reported acceptable internal consistency reliabilities for the QTI scales ranging from 0.76 to 0.88 for student responses and from 0.74 to 0. 84 for teacher responses in the USA. The Dutch data from the study (Wubbels & Levy, 1991) also contained internal consistency reliabilities for the QTI scales ranging from 0.74 to 0.90 for student responses and from 0.61 to 0.83 for teacher responses. The test and re-test reliabilities have been found to be above 0.80 (Wubbels, Brekelmans, & Hooymayers, 1991).

An examination of the literature reveals very few longitudinal studies carried out using the QTI to investigate changes in interpersonal teacher behaviour during a teaching career. The results of one study (Créton, Hermans, & Wubbels, 1990) suggested there was an increase in dominance behaviour and a corresponding decrease in uncertain behaviour and disorder in the classroom over time. These results are also detailed in a report on teacher interpersonal behaviour and the same changes in leadership and uncertain behaviours were evident as the teachers became more experienced up to about ten years of teaching experience (Brekelmans, Holvast, & van Tartwijk, 1990). Teacher

interpersonal behaviour for leadership and uncertain behaviour then stabilises and there is no increase in cooperative behaviour as teacher experience increases (Brekelmans, Holvast, & van Tartwijk, 1990). In fact, teachers have been found to become less helpful, friendly and understanding and more admonishing and dissatisfied as experience develops further (Créton, Hermans, & Wubbels, 1990).

Differences in the perceptions of teachers and students of the teacher interpersonal behaviour in the same learning environment has been carried out in The Netherlands using different school subjects (Brekelmans & Wubbels, 1992). This study found that teachers and students tended not to agree about their perceptions of the interpersonal behaviour.

Levy, Créton and Wubbels (1993) analysed data from studies in The Netherlands, the USA and Australia involving students being asked to use the QTI to rate their best and worst teachers. Students rated their best teachers as being strong leaders and as friendly and understanding. The characteristics of the worst teachers were that they were more admonishing and dissatisfied. It is interesting to note that an investigation into the characteristics of teachers (Wubbels & Levy, 1991) that compared Dutch and American teachers, found very few differences, although American teachers were perceived as stricter and Dutch teachers as giving their students more responsibility and freedom.

Another use of the QTI in The Netherlands involved investigation of relationships between perceptions on the QTI scales and student outcomes (Wubbels, Brekelmans, & Hooymayers, 1991). Regarding students' cognitive outcomes, the more that teachers demonstrated strict, leadership and helping/friendly behaviour, then the higher were cognitive outcomes scores. Conversely, student responsibility and

freedom, uncertain and dissatisfied behaviours were related negatively to student cognitive outcomes, see Figure 2.7.

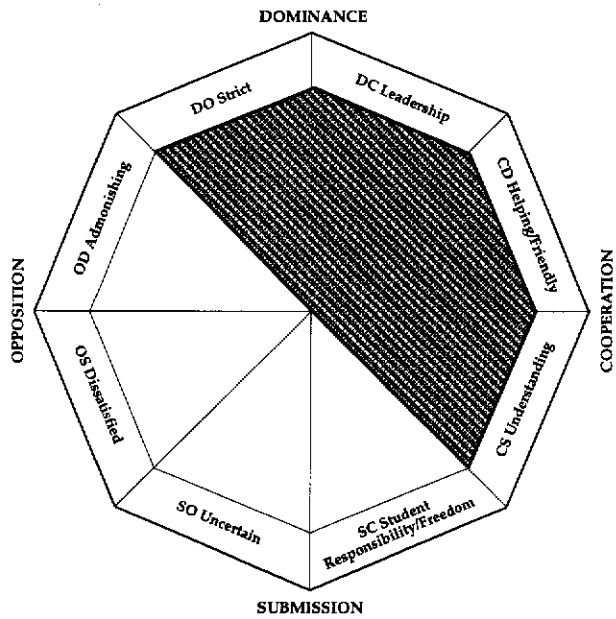


*Figure 2.7.* Associations between QTI scales and student cognitive outcomes.

One study in Physics classes (Créton, Hermans, & Wubbels, 1990, p. 88) examined teachers and students to see what associations there were between the teacher-student interpersonal behaviour in the classroom and the students' affective outcomes. It was apparent from this research that there were positive associations between the more cooperative behaviours in the model for interpersonal behaviour, namely the scales of Student Responsibility and Freedom, Understanding, Helpful and Friendly and Leadership. The more prominently that these behaviours exhibited in the classroom the higher were the student affective outcomes, see Figure 2.8.

These results suggest that the proximity dimension rather than the influence dimension was more closely associated with student

enjoyment of their physics class. These findings are further supported by research with secondary school students in 1990 and university

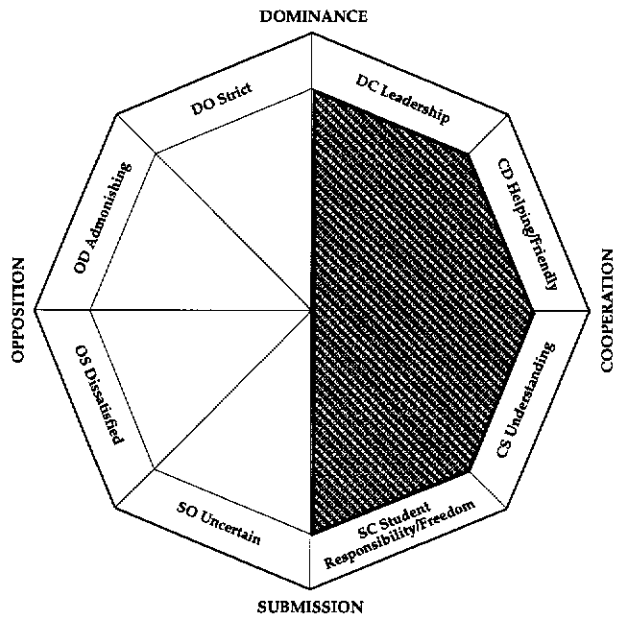


*Figure 2.8.* Associations between QTI scales and student attitudinal outcomes.

students in 1991 that concluded effective teachers were those who had been nominated by the students, that had proceeded into post compulsory education, as being especially helpful and encouraging (Holloway, 1994).

Variations in the students' appreciation of the subject and the lessons have been characterised on the basis of the proximity dimension: the more cooperative the behaviour displayed, the higher the affective outcome scores (Wubbels, Brekelmans, & Hooymayers, 1991). That is, student responsibility and freedom, understanding, helping/friendly and leadership behaviours were related positively to student attitudes. Uncertain, dissatisfied, admonishing and strict behaviours were related negatively to student attitudes. Overall, previous studies have

indicated that interpersonal teacher behaviour is an important aspect of the learning environment and that it is related strongly to student outcomes.

The QTI also has been used to develop typologies of teacher interpersonal behaviour in The Netherlands (Wubbels, Brekelmans, Créton, & Hooymayers, 1990). Using cluster analysis, eight types were distinguished. The behavioural patterns on the eight teacher types were characterised as directive, authoritative, tolerant/authoritative, tolerant, uncertain/tolerant, uncertain/aggressive, repressive, and drudging. Teacher types of profiles from all American and Dutch studies can be associated with one of the typologies that have been identified above (Brekelmans, Levy, & Rodriguez, 1993). Teacher types associated with the greatest student cognitive and affective gains were directive (characterised by a well structured task oriented learning environment) and tolerant/authoritative (characterised by a pleasant well structured environment in which the teacher has a good relationship with students). Uncertain/aggressive (characterised by an aggressive kind of disorder) and uncertain/tolerant teacher types were associated with the lowest student gains.

The next section will consider Australian studies that have utilised the QTI.

*2.10.2 Australian Studies*

In one of the first uses of the QTI in Australia (Fisher, Fraser, & Wubbels, 1993), associations were investigated between teachers' perceptions of their work environment, using the *School Level Environment Questionnaire (SLEQ)*, (Fisher & Fraser, 1990) and students' and teachers' perceptions of their classroom interactions, using the QTI. Results from this study indicated that relationships between SLEQ and QTI scores generally were weak. This suggests that teachers believed that they had considerable autonomy and freedom to

shape their own classrooms regardless of their school environment. Perhaps a case of teachers thinking "when the door is shut in my class, it is my class".

One Australian study in Western Australia and Tasmania (Fisher, Fraser, & Wubbels, 1993; Fisher, Fraser, Wubbels, & Brekelmans, 1993) used the QTI with a sample of 792 students and 46 teachers. The results of this study were similar to previous Dutch and American research referred to earlier in that, generally, teachers did not reach their ideal and differed from the best teachers as perceived by students. It is noteworthy that the best teachers, according to students, are stronger leaders, more friendly and understanding, and less uncertain, dissatisfied and admonishing than teachers on average. This pilot study strongly supported the validity and the potential usefulness of the QTI within the Australian context, and suggested the desirability of conducting of further and more comprehensive research involving the QTI. Furthermore, following past research (e.g., Fraser, 1992; Fraser & Fisher, 1982) it is important to establish how teacher-student interpersonal behaviour affects student outcomes.

A team of researchers in Australia completed the first use of the 48-item QTI in senior biology classes with a sample of 489 students in 28 biology classes (Fisher, Henderson, & Fraser, 1995). Although past studies have examined associations between student perceptions of the learning environment in science classes and student outcomes, this Australian study was unique in that it examined student outcomes in three distinct areas, namely, student attitude, achievement in a written examination, and performance on practical tests.

This study confirmed the validity and reliability of the QTI when used in senior secondary biology classes. The alpha reliability figures for the different QTI scales ranged from 0.63 to 0.83 when the individual student was used as the unit of analysis (Fisher, Henderson, & Fraser,

1995). As expected, the reliability figures were higher when the class mean was used as the unit of analysis and ranged from 0.74 to 0.95. Generally, the dimensions of the QTI were found to be associated significantly with student attitude scores. In particular, students' attitude scores were higher in classrooms in which students perceived greater leadership, helping/friendly, and understanding in their teachers' interpersonal behaviours. Conversely, students' attitude scores were lower in classrooms in which students perceived greater uncertainty, dissatisfaction, admonishing, and strictness in their teachers' interpersonal behaviours. It was concluded that, if biology teachers want to promote favourable student attitudes in their class and laboratory work, they should ensure the presence of these interpersonal behaviours.

Another early use of the QTI in Australia examined student attitudes to mathematics and teacher-student interpersonal behaviour in mathematics classrooms (Fisher & Rickards, 1998). This study confirmed the reliability of the QTI when used with a sample of 405 students in nine schools together with their 21 grade 8, 9, and 10 Mathematics teachers. Student attitude scores were consistent with those found in science classrooms and were higher in classrooms in which students perceived greater leadership and, helping/friendly behaviours in their teachers' interpersonal behaviours and lower in classrooms in which students perceived greater dissatisfaction, admonishing, and strictness in their teachers' interpersonal behaviours.

Much of the work that is presented in classroom environment research is inspired by the Lewinian formula $B = f(P.E)$, with the focus primarily on the "E" or environment element. One study of 1,883 grade 11 and 12 students in 108 classes completed in Tasmania (Fisher, Kent, & Fraser, 1997; Fisher, Kent, & Fraser, 1998; Kent & Fisher, 1997; Kent, Fisher, & Fraser, 1995) examined the "P" or personality element of this formula

using the QTI and the *Myers-Briggs Type Indicator* (MBTI) (Myers & McCaulley, 1985). Application of the MBTI is particularly suited to teaching and learning settings (McCaulley, 1987). The study examined the teacher perceptions of interpersonal behaviour, the relationship between teacher-student interpersonal behaviour, measured with the QTI, and teacher personality type, measured by the MBTI; and the percentages of each personality type in the sample. The study reported Cronbach alpha reliabilities for the scales of the QTI ranging from 0.66 to 0.83 when the individual student was used as the unit of analysis. When the more conservative class mean score was used as the unit of analysis reliabilities ranged from 0.83 to 0.93. The study reported that there was a moderate association between teacher-student interpersonal behaviour and teacher personality. A greater association was found between teacher self perception and teacher personality than between student perceptions of teacher interpersonal behaviour and teacher personality.

*2.10.3 Cross-National Studies*

There has been a great deal of expansion and internationalisation in the presentation of science education research findings in the period 1990 to 1995 (Fraser, 1997). A review of past education environment research reveals that international learning environment research efforts have been undertaken at least since the 1970's. Current interest in cross national studies in Science Education (Aldridge, Fraser, & Huang, 1998; Fisher, Goh, Wong, & Rickards, 1996; Fisher, Rickards, Goh, & Wong, 1997; Riah, Fraser, & Rickards, 1997) and new international conferences such as the one recently in Vietnam (Fisher & Rickards, 1997) further support the international growth and dissemination of research findings in this area. The renewed attention may be due in part to the mass media interest generated by publication of the results of the Third International Mathematics and Science Study (TIMSS) (Lokan, Ford, & Greenwood, 1996) and the inevitable country rankings that result (Jacobsen, 1996). It is also due to the increased participation of an

international audience at conferences which may enhance cross-national research links (Fraser, 1997).

The first cross-national use of the QTI between Singapore and Australia was carried out in 1997 (Fisher, Goh, Wong, & Rickards, 1996; Fisher, Rickards, Goh, & Wong, 1997). The study involved 720 students in 20 grades 8 and 9 science classes in Singapore and 705 students in 29 grades 8 and 9 science classes in Australia. In Singapore, the alpha reliability figures for different QTI scales ranged from 0.50 to 0.88 when the individual student was used as the unit of analysis, and from 0.60 to 0.98 when the class mean was used as the unit of analysis. For the Australian sample, the corresponding values were 0.60 to 0.88 and 0. 64 to 0.96 respectively (Fisher, Rickards, Goh, & Wong, 1997). The results for this sample generally provided further cross-validation information supporting the internal consistency of the QTI with either the individual student or the class mean as the unit of analysis. The Student Responsibility/Freedom scale had reliability figures less than the other scales, particularly in Singapore, and it was suggested that this scale requires examination and revision before using the questionnaire in that country.

A cross-national study conducted in Brunei found that QTI to be a valid and reliable instrument (Rickards, Riah, & Fisher, 1997) as did a concurrent study of Chemistry classes in Brunei (Riah, Fraser, & Rickards, 1997). Reliabilities for the scales of the QTI when used in Brunei were found to be acceptable and ranged from 0.58 to 0.80 when the individual student was used as the unit of analysis and 0.75 to 0.93 when the class mean score was used as the unit of analysis. These data were then applied to a cross-national study which provided an Australian sample of secondary science classrooms. Reliabilities for the QTI scales ranged from 0.60 to 0.88 for the student as the unit of analysis and 0.64 to 0.96 for the class mean as the unit of analysis.

One early study of interpersonal behaviour from a cross-national perspective (Wubbels & Levy, 1991) used data from The Netherlands and the USA. This study sought to validate the English version of the QTI, investigate if the Dutch and English versions of the questionnaire were equivalent and examine any differences in the students' or teachers' perceptions of interpersonal teacher behaviour in these two countries. The study found that teacher behaviours were similar in many ways but that American teachers saw strictness as being more important whereas Dutch teachers emphasised student responsibility and freedom. In concluding, Wubbels and Levy suggested that their work on this study was a first step for cross-national research with the QTI and that comparisons with other variables such as student cultural background with teacher-student interpersonal behaviour would be enhanced by the availability of this new instrument. Though the primary focus of this study was to develop an English language version of the Dutch QTI for use in an American setting it served as an excellent precursor to future development of the Australian 48-item version of the QTI (Wubbels, 1993).

## 2.11 Associations Between Students Perceptions of the Classroom Environment and Student Outcomes.

Associations between teacher-student interaction and student attitudes and achievement, have been suggested as a worthy area for research (Hargreaves, 1972, p. 136). Early in the 1960's Flanders (1964) suggested that student achievement and attitude would be better in classrooms that were learner-centred as opposed to teacher-centred. This next section examines a number of studies that have reported associations between student perceptions of the teacher-student interpersonal behaviour, the sex of the student, and the outcome variables of attitude and achievement.

It has been reported in the United States that "student achievement is not a direct consequence of social background or school attendance" (Green, Dugoni, Ingels, & Camburn, 1995) and that one indicator is student effort in class. One review of predominantly low inference measure classroom environment studies (Rosenshine, 1971) found consistent but not strong correlations between teacher behaviours and student achievement. The pattern of courses taken also has an impact (Green, Dugoni, Ingels, & Camburn, 1995, p. 69). Following a need for more research into associations between teacher behaviours and student achievement (Brophy & Good, 1986), it has been demonstrated internationally that students' perceptions of the science classroom learning environment have been positively associated with student cognitive measures and student attitude to class (Fraser, 1991; Fraser, 1994; Fraser, Walberg, Welch, & Hattie, 1987; Haertel, Walberg, & Haertel, 1979; Haertel, Walberg, & Haertel, 1981; McRobbie & Fraser, 1993). If education is to improve student outcomes and increase the positive interest of students in science these factors should be considered.

### *2.11.1 Sex Differences in Student Perceptions of Teacher Interpersonal Behaviour*

Differences attributable to student sex have been reported in many studies (Friedler & Tamir, 1990; Husén, Fägerlind, & Liljefors, 1974; Jegede & Okebukola, 1992; Lawrenz, 1987; Parker, Rennie, & Fraser, 1996). One study examining differences in student achievement in Israel found that statistically significant differences in achievement scores favoured males (Friedler & Tamir, 1990). Other studies, such as Young and Fraser (1990) , found that there were differences in student responses to different types of multiple-choice questions. Males performed better on questions with a diagrammatic representation of data and females performed better where there were descriptive items with a biological content. Others have considered student sex related learning differences from the point of view of student emotions such as

hope, fear, pride and shame in a learning environment (Ingleton, 1995) and suggested team based learning is a preferred approach to learning. Student self confidence has been linked to student achievement in science, particularly for female students who were perceived as being disadvantaged by the dominant groups of boys in science classes (Stanley, 1996). Jones and Wheatley (1990) found that teachers engaged in large-group discussions in science classrooms tended to elaborate more on male responses that to female responses of scientific concepts.

Sex related differences in students' perception of the classroom psychosocial learning environment have been found to become more conspicuous as student age increased (Lawrenz, 1987). This finding is confirmed in the results of an international secondary analysis study of patterns of science achievement which drew on the findings of the First and Second IEA science study (Keeves & Aikenhead, 1995; Keeves & Kotte, 1995). This study reported that it was girls, without exception, that held more favourable attitudes to schooling and that the average effect size decreased with student age (Keeves & Kotte, 1995, p. 82). Some suggest that student sex differences are most influential on perceptions of the actual learning environment (Lim, 1995, p. 168). Males perceived that they had greater opportunities for working at their own pace and in their own time whereas the female students perceived that they were able to participate and have control over their own learning (Lim, 1995).

Moos has found that there are significant differences in the perceptions of boys and girls in single sex schools (Moos, 1979a). This study considers only co-educational schools to permit an unconfounded test of student sex differences. Students were asked to report their sex as either male or female on the questionnaire but were not asked to report on their perceptions of sex differences for the variables under investigation. This was partly due to considerations of economy when designing the questionnaire and partly due to previous research

findings which report that most often the male students in co-educational classes do not perceive inequities such as the sex related disparity in classroom discussions and activity (Guzzetti & Williams, 1996).

The inclusion of gender-neutral language and more female representations in illustrations in science textbooks has also been noted as an important factor encouraging positive interest towards science from girls (Potter & Rosser, 1992). Student attitude toward the subject of science is an important outcome variable. The promotion of positive student attitude toward science is an essential element in encouraging the increased participation of females in science and science related subjects (Henderson, Fisher, & Fraser, 1998b), particularly as students get older.

### *2.11.2 Cultural Differences in Student Perceptions of Teacher Interpersonal Behaviour*

Australian Schools are becoming increasingly culturally diverse and the way in which people communicate and perceive communication is influenced by their cultural background, (Giles & Franklyn-Stokes, 1989; Segall, Dasen, Berry, & Poortinga, 1990). Considerable research into cultural background factors is evident in the literature (Hofstede, 1980; Hui & Villareal, 1989; Jegede & Okebukola, 1988; Lonner, 1980; Riah, Fraser, & Rickards, 1997; Waldrip & Taylor, 1995), though little research reflects associations with teacher-student interpersonal behaviour as measured by the QTI in an Australian context.

An example from within Australia that combines these elements (Fisher, Fraser, & Rickards, 1997; Waldrip & Fisher, 1996b) found that there are associations between student cultural background and teacher-student interpersonal behaviour. This study seeks to enhance our understanding of the differences in students' perceptions of the

classroom learning environment that are attributable to differing student cultural backgrounds.

There are notable studies that do make associations with teacher-student interpersonal behaviour from overseas (Wubbels & Levy, 1991). Levy, Wubbels, Brekelmans, and Morganfield (1997), investigated a sample of 550 high school students in 38 classes comprised of three primary investigation groups, namely 117 Latinos, 111 Asians and 322 from the United States. The primary focus was the language and cultural factors in students' perceptions of teacher communication style. This study focused on identifying ways in which the students' culture relates to student perceptions of their teachers. The results from this study suggested that the students' cultural background is indeed significantly related to the perceptions that they had of their teachers' interaction behaviour. The study also concluded that teachers did not seem to be aware of cultural differences in their interactions with students in their classes in the same way as their students were, despite altering their behaviour in classes with different cultural compositions.

### 2.13 Chapter Summary

This chapter has discussed the historical development of the QTI and reported several studies that have utilised the QTI to examine teacher-student interpersonal behaviour. This study builds on these previous studies and goes on to contribute vital additional information on important contemporary aspects of education in science classrooms and has practical application for teachers today. The inclusion of student sex and cultural background provides a more diverse look into the science classroom of multi-cultural Australia than has been attempted before. Previous studies that have examined associations between these variables were also presented in this chapter.

This study is also distinctive in that it combines this large QTI response database of teacher-student interpersonal behaviour with assessment of student attitude to their science subject and a measure of cognitive outcomes. This is a unique study of associations between interpersonal behaviour and student outcomes in lower secondary science classes in Australia which, it is intended, can have practical application in the classroom. The decision to examine associations between teacher-student interpersonal behaviour and cognitive achievement in this study was prompted by previous research findings that suggest that there is a strong association between these variables.

The next chapter describes the methodology used in the study including details about how the study was conducted.

# CHAPTER 3

# METHODOLOGY

## 3.1 Introduction

The previous chapter provided a review of the literature and indicated the theoretical basis upon which studies into learning environment research and interpersonal behaviour research have been based. Particular attention to the historical development and past uses of learning environment instruments over the last three decades as well as their associated short, long, actual and preferred forms was discussed. The development of the model for interpersonal behaviour and later the QTI as well as a review of past studies that have used the QTI was presented. The chapter concluded by presenting associations between student perceptions of the classroom environment and student outcomes. This chapter contains a detailed description of the methodology used in the current study and the rationale that prompted this research.

In keeping with recent developments in research on science learning environments, qualitative and quantitative methods are combined in this study. The purpose of this is to validate more clearly and accurately what is happening in the learning environments being examined. This is the first time this has been done with a large Australian sample of QTI data. This combination of methods has been described as a desirable goal and serves to enrich and enhance the data that have been collected (Fraser, 1992; Fraser & Fisher, 1994; Fraser & Tobin, 1991).

### 3.2 Preparation for the study

Following the initial motivation, described in the introduction to this thesis, an examination of the research literature was carried out. It revealed that no research had been completed in Australia using the variables of this study, and none had involved a comprehensive sample in two states of Australia. Most previous studies involved subsets of the variables examined in this study.

It was decided that the psychosocial aspects of classroom environment would be central to this study. The perceptions of the milieu inhabitants who were directly engaged in the interpersonal interactions under observation formed the target audience. This followed the findings of Fraser and Walberg, (1991) who suggested that the "subjective" perceptions of the students in the learning environment were preferable to the "objective" observation and interpretation of the learning environment interactions by researchers. Further to this, a "paper and pencil" test, particularly for a large sample in two states, was more economical and efficient to administer to teachers and students than observational methods. Recording student perceptions also enabled a representation of student perceptions of interactions over time, rather than isolated events observers may experience, and were an aggregation of the perceptions of all of the students in the class. With the systems approach to communication processes in mind, the students were selected as a data source because they are part of the process and would be reporting from a first hand perspective. Using the working description of learning environments that was developed in Chapter 2 the following research questions were proposed.

### 3.3 Research Questions

The purpose of this section is to convert the objectives presented earlier in section 1.4 into research questions for this study. The QTI has not

been validated with a large Australian study of lower secondary science classes in Tasmania and Western Australia before. The validation of the QTI with this target group was considered valuable not only for this research, but for other researchers with smaller samples working in the area of learning environments to use for comparison. Thus, the first research question was formulated as follows:

> Research Question 1.
> Are the three forms of the QTI used in this study reliable, valid and able to differentiate between classrooms when used with a large Australian sample of lower secondary science classes?

As discussed in Chapters 1 and 2, previous studies have described associations between student sex and perceptions of the teacher-student interpersonal behaviour in a classroom. The results of these previous studies prompted research question 2.

> Research Question 2.
> What associations are there between science student perceptions of teacher-student interpersonal behaviour and student sex?

The rationale for research question 3 stemmed from an awareness that Australian classrooms are becoming increasingly multi-cultural and that the way in which people communicate and perceive communication is culturally influenced. This study sought to focus on teacher-student interactions and student cultural background to examine cultural differences and hence research question 3 evolved.

Research Question 3.

How do science student perceptions of teacher-student interpersonal behaviour differ with student cultural background?

Previous research indicating associations between student perceptions of teacher-student interpersonal behaviour and student cognitive outcomes, or enquiry skills, provided the rationale for research question 4. Identifying any variables that may enhance the maximisation of student outcomes in a classroom environment utilising existing resources and without capital investment must surely be of interest to all teachers and students.

Research Question 4.

What associations are evident between students' perceptions of teacher-student interpersonal behaviour and student enquiry skills?

Student attitude to a subject has been linked to student choice of future subjects and equity issues, in terms of the number of girls and boys choosing science as a field of endeavour and study in later life. An examination of associations between teacher-student interpersonal behaviour and attitude seemed valuable in determining another variable that teachers could utilise in improving the enjoyment of science for their students. Research question 5 evolved from this.

Research Question 5.

What associations are evident between students' perceptions of teacher-student interpersonal behaviour and student attitude to science classes?

In an effort to further validate and confirm what students were reporting in their questionnaire results, it was decided that two methodologies would be preferable. Results from this study could also support the construct validity of the QTI when used with a large Australian cohort. Research question six emerged from the use of this qualitative approach.

> Research Question 6.
> Are student comments about their teachers' interpersonal behaviours similar to those resulting from the use of the QTI thus supporting the construct validity of the QTI?

As this study has been motivated by events and reflections from real occurrences in classrooms, this study seeks to have practical outcomes that are able to be utilised by teachers in any classroom. An examination of how teachers can use the primary instrument from this study as a catalyst for self reflection prompted the final research question.

> Research Question 7.
> Can the QTI be used as a source of information to establish a suitable feedback process of use to teachers in science classrooms causing them to reflect on their teaching?

With the research questions clarified, suitable instruments and methods had to be considered. The next section examines instrument selection and construction of the final questionnaire as used in this study.

### 3.4 Instrument Selection

An examination of currently available instruments that are commonly used to examine learning environments, and teacher-student interpersonal behaviour in particular, resulted in the preliminary selection of the QTI. Further examination of the history and development of this instrument, its rapid acceptance by teachers and its results from concurrent research projects was encouraging. Following a more detailed literature review and discussions with supervisors and classroom teachers, the QTI and a modified scale from each of the TOSRA and the TOES were selected for inclusion in the final survey form. The final survey instrument was comprised of the following elements. An unaltered 48-item short version of the QTI, one scale from the TOSRA to measure attitude to class, some additional items to identify teacher, student, class, cultural background and a modified set of items from the TOES.

*3.4.1 Development of the Test of Science Related Attitudes* (TOSRA)

This study has chosen to report on the student's attitude to subject, however there are other dimensions of attitude that were considered. These were outlined in the early 1970's by Klopfer (1971) who devised six categories of student attitude: attitude to science and scientists; attitude to enquiry; adoption of scientific attitudes; enjoyment of science learning experiences; interest in science and interest in a career in science. These six categories served as a basis for the later construction and development of the Test of Science Related Attitudes (TOSRA) (Fraser, 1978; Fraser, 1981b).

There are limitations with all standardised tests (Mehrens & Lehmann, 1991, p. 380), the purpose here was to find one that had minimum limitations and maximum advantages for the purposes of this study. For example an adaptation of a multi-dimensional Q sort technique presented a technique for scoring student attitude in a form suitable for

classroom use (Humphreys, 1975). This however was a cumbersome rather than economical method of data collection and was discounted as was another version of this method of attitude data collection developed by Aitken (1988)

Another instrument, the *Questionnaire of Chemistry-Related Attitudes* (QOCRA) (Wong & Fraser, 1994), that had been validated with a sample 1592 students in Chemistry laboratory learning environments from Singapore was considered. This instrument is a shortened and modified form of the *Test of Science Related Attitudes* (TOSRA). This instrument has 30 items with half of the items being scored in reverse. It was considered that 30 items were too many to add to an economical survey instrument as not all scales were necessary for this study.

Fraser (1981b) developed an instrument to specifically measure secondary school science students' attitudes, the TOSRA. The seven attitude scales supported by Klopfer's (1971) rationale of science attitude were: Social Implications of Science, Normality of Scientists, Attitude to Scientific Enquiry, Adoption of Scientific Attitudes, Enjoyment of Science Lessons, Leisure Interest in Science and Career Interest in Science. The full instrument contains 70 items, 10 items for each scale. Each item is scored on a 5 point Likert Scale (Likert, 1932) with responses ranging from Strongly Agree to Strongly Disagree.

Henderson, Fisher, and Fraser (1995) constructed from the TOSRA a seven-item scale that was less time consuming than others to administer. A major advantage of this seven-item attitude scale is that the format of the questions is the same as the QTI, therefore, adding it to the questionnaire used in this study did not visually distract the respondents. It was also quick to complete and economical on time and resources to score.

In an interesting study of attitude instrument response methods Schibeci (1982) compared the responses of students to the TOSRA, which uses a Likert scale, to a Semantic Differential technique where students were asked to respond to bipolar adjective pairs of responses. This study concluded that the Likert response format of the TOSRA was found to be more sensitive in measuring student attitudes than the bipolar adjective pair responses format of the Semantic Differential technique.

Thus, to measure student attitude to science class in this study, a seven-item *Attitude to this Class* scale was adopted from previous research in this area (Henderson, Fisher, & Fraser, 1995; Waldrip & Fisher, 1997b), see Appendix C. More recent studies have also utilised this instrument to examine associations between learning environments and student attitude to environmental science (Henderson, Fisher, & Fraser, 1998a; Henderson, Fisher, & Fraser, 1998b). The reliability for this scale has been reported to be 0.68 for the student as the unit of analysis and 0.74 for the class mean score (Henderson, 1995). Another study that examined associations with the CLEQ and the TOSRA reported a Cronbach alpha reliability of 0.79 (Waldrip & Fisher, 1997a; 1997b).

*3.4.2 Test of Enquiry Skills* (TOES)

As this study was not confined to one state with a uniform procedure for recording student grades, a suitable means by which to compare data from the two states was required. In order to achieve this, data was collected using selected items from the *Test of Enquiry Skills* (Fraser, 1979). This test was ideal as it was non-content specific and had been designed for students in grades 7 to 10, and it provided a common test to use across two states of Australia. This is an economical measure of cognitive ability and has been used in a recent study of 3,785 science students in 186 classes in 67 Australian schools where the alpha reliability was found to be 0.69 (Waldrip & Fisher, 1997a; 1997b). This

was similar to the scale reliabilities reported by Fraser (1979) of 0.59 to 0.72, using the student as the unit of analysis.

*3.4.3 The Cultural Background Items*

Teaching in the past was a practical process of passing on skills for survival and procreation as well as preserving the cultural identity of a group. It may have involved communicating complex information such as coastal navigation, as was the case with the Polynesian sailors of old, or vital information regarding safe sources of food and the location of water holes in desert environments, as is the case with Australian Aborigines.

In the educational context of a secondary science classroom there is a growing awareness that Australian classrooms are becoming increasingly multicultural and that the way in which people communicate (Giles & Franklyn-Stokes, 1989) and perceive communication (Segall, Dasen, Berry, & Poortinga, 1990) is culturally influenced. One previous study has suggested that the dichotomy between a students' own world view and that same students' perception of the school view of the natural world results in little positive influence of the school view on the students' traditional world views in developing countries (Waldrip & Taylor, 1995). Other studies have concluded that, particularly in science classes, the subject content may have less effect on education than the cultural background of the learner (Jegede & Okebukola, 1991; Okebukola, 1986). This study investigates differences in the way in which teachers interact with students from different cultures. For the purposes of this study, cultural background was identified by asking students to record the birthplace of each of their parents and the primary language spoken at home. Students were also asked two questions to indicate whether their mother or father was born in Australia. These variables were selected to act as indicators of cultural background.

The relationship between student cultural background and teacher student interpersonal behaviour will have increasing importance and implications for Australian teachers as Australia becomes even more multi-cultural. It has been estimated by the United Nations (Australian Bureau of Statistics, 1998b) that the population of the world will increase by 72% between 1995 and 2051. The last census that was conducted in Australia in 1996 counted 18.31 million people in Australia (Australian Bureau of Statistics, 1998a), this is estimated to rise to between 23.5 and 26.4 million people by 2051. This population was shown to be made up of people from many different cultural backgrounds and origins and is set to be under increasing pressure to allow increased migration, especially from countries in the South East Asian region. The gap between Australia's population and that of it's neighbours is set to increase dramatically in the next 5 decades. Indonesia, for example, already has ten times the population of Australia and this is set to rise to over twelve times the population of Australia by the year 2051 (Australian Bureau of Statistics, 1998b). Malaysia currently has a population that is similar to Australia, but by the year 2051 is set to double and become 53% larger than that of Australia (Australian Bureau of Statistics, 1998b). The representation of many cultures in our society influences the composition of school science classes.

### 3.5 Validity and Reliability of the QTI

Chapter 2 details the conceptual model for teacher-student interpersonal behaviour and the development of the QTI and the model for interpersonal behaviour upon which the QTI is based. The following section outlines reliability and validity information for the QTI from various key studies.

Table 3.1 presents internal consistencies (alpha reliability coefficients) for QTI scales for student perceptions of teacher-student interpersonal

behaviour in three countries. The table shows the results of calculations using the student as the unit of analysis as well as the class mean as the unit of analysis as recommended by Sirotnik (1980). The alpha reliability when the student was the unit of analysis ranged from 0.68 in the Student Responsibility and Freedom scale to 0.90 for both the Helping/Friendly and Understanding scales (Wubbels & Levy, 1993, p. 166).

Table 3.1

*Internal Consistency (Alpha Reliability Coefficient) for QTI Scales for Student Perceptions of Teacher-Student Interpersonal Behaviour in Three Countries*

| Scale | Unit of Analysis | Alpha Reliability | | |
|---|---|---|---|---|
| | | USA | Australia | Netherlands |
| DC Leadership | Individual | 0.80 | 0.83 | 0.83 |
| | Class Mean | 0.94 | 0.94 | 0.94 |
| CD Helpful/Friendly | Individual | 0.88 | 0.85 | 0.90 |
| | Class Mean | 0.95 | 0.95 | 0.95 |
| CS Understanding | Individual | 0.88 | 0.82 | 0.90 |
| | Class Mean | 0.94 | 0.94 | 0.96 |
| SC Student Resp/ | Individual | 0.76 | 0.68 | 0.74 |
| Freedom | Class Mean | 0.86 | 0.80 | 0.85 |
| SO Uncertain | Individual | 0.79 | 0.78 | 0.79 |
| | Class Mean | 0.96 | 0.92 | 0.92 |
| OS Dissatisfied | Individual | 0.83 | 0.78 | 0.86 |
| | Class Mean | 0.90 | 0.93 | 0.92 |
| OD Admonishing | Individual | 0.84 | 0.80 | 0.81 |
| | Class Mean | 0.92 | 0.92 | 0.90 |
| DO Strict | Individual | 0.80 | 0.72 | 0.78 |
| | Class Mean | 0.95 | 0.90 | 0.89 |
| | Students | n = 1,606 | n=792 | n=1,105 |
| | Classes | n = 66 | n = 46 | n = 66 |

Source Wubbels & Levy (1993, p. 166)

As expected the alpha coefficients for the class mean scores were higher than those for the student as the unit of analysis where they ranged from 0.80 for the Student Responsibility and Freedom scale to 0.96 for the Uncertain and Understanding scales (Wubbels & Levy, 1993). These reliability figures are all above the 0.60 level suggested by Nunnally (Nunnally, 1967; 1978) and the 0.65, "suggested acceptable level for research purposes" used by Wubbels, Créton, Levy and Hooymayers, (1993, p. 21).

If any instrument that measures a classroom learning environment is to be effective, then it should be sensitive enough to differentiate between classrooms. The instrument should be able to do this for each of the scales that it is measuring. Horst's (1949) general coefficient, the ANOVA $eta^2$ statistic, is one measure of the ability of the QTI to discriminate between classes and "is large if the difference between classes is larger than the difference between students from one class," (cited in Wubbels & Levy, 1993, p. 21).

When the intra-class correlations for each scale of the QTI were examined in one study by Wubbels, Créton, Brekelmans, and Hooymayers, cited in Wubbels and Levy, 1993, p. 21, they were generally found to be above 0.80 for each scale.

Table 3.2 shows that the proportion of variance in the scales of the QTI which can be accounted for by class membership ranged from 0.19 to 0.59 and that all scales differentiated significantly *($p<0.01$)* between the perceptions of students in different classrooms. These data are consistent with Australian student data, (Henderson, Fisher, & Fraser, 1995) for students in secondary Biology classes.

Table 3.2
*The Amount of Variance Accounted for by Class Membership (Eta$^2$) in Three Countries.*

| Scale | Eta$^2$ | | |
|---|---|---|---|
| | USA(a) n = 1,606 | Australia(b) n = 489 | Netherlands(c) n = 1,105 |
| DC Leadership | 0.41* | 0.48** | 0.59* |
| CD Helpful/Friendly | 0.22* | 0.33** | 0.48* |
| CS Understanding | 0.28* | 0.29** | 0.43* |
| SC Student Resp/ Freedom | 0.29* | 0.28** | 0.36* |
| SO Uncertain | 0.38* | 0.38** | 0.59* |
| OS Dissatisfied | 0.19* | 0.20** | 0.39* |
| OD Admonishing | 0.25* | 0.25** | 0.39* |
| DO Strict | 0.43* | 0.30** | 0.45* |

*$p<0.01$ **$p<0.001$
(a & c ) Source Wubbels & Levy (1991, p. 10)
(b) Source Henderson, Fisher, and Fraser, (1995, p. 7)

The QTI is a rather different instrument with which to examine inter-scale correlations in that is based on a two-dimensional circumplex model for interpersonal behaviour. It assumes that each scale correlates more highly with the scales that are adjacent to it than opposite it. As you move away from any given scale the correlations decrease until you reach the opposing scale, where the correlation is the most negative; ie. the most unlike the scale opposite, (Wubbels, Créton, Levy, & Hooymayers, 1993, p. 21). For example, the scale for Leadership behaviour is least like the Uncertain scale, see Table 3.3.

Table 3.3
*Interscale Correlations for the QTI.*

| Scale | Unit of Analysis | DC | CD | CS | SC | SO | OS | OD | DO |
|---|---|---|---|---|---|---|---|---|---|
| DC Leadership | Student | 1.00 | 0.61 | 0.50 | -0.12 | -0.72 | -0.48 | -0.33 | 0.02 |
| | Teacher | 1.00 | 0.48 | 0.35 | -0.41 | -0.72 | -0.40 | -0.17 | 0.34 |
| CD Helping/ Friendly | Student | | 1.00 | 0.86 | 0.38 | -0.34 | -0.68 | -0.60 | -0.42 |
| | Teacher | | 1.00 | 0.76 | 0.09 | -0.37 | -0.47 | -0.44 | -0.19 |
| CS Understanding | Student | | | 1.00 | 0.44 | -0.23 | -0.69 | -0.63 | -0.49 |
| | Teacher | | | 1.00 | 0.30 | -0.15 | -0.45 | -0.57 | -0.29 |
| SC Student Resp / Freedom | Student | | | | 1.00 | 0.34 | -0.24 | -0.33 | -0.48 |
| | Teacher | | | | 1.00 | 0.52 | -0.08 | -0.40 | -0.64 |
| SO Uncertain | Student | | | | | 1.00 | 0.44 | 0.29 | -0.03 |
| | Teacher | | | | | 1.00 | 0.49 | 0.15 | -0.19 |
| OS Dissatisfied | Student | | | | | | 1.00 | 0.76 | 0.53 |
| | Teacher | | | | | | 1.00 | 0.60 | 0.44 |
| OD Admonishing | Student | | | | | | | 1.00 | 0.58 |
| | Teacher | | | | | | | 1.00 | 0.54 |
| DO Strict | Student | | | | | | | | 1.00 |
| | Teacher | | | | | | | | 1.00 |

Student n = 2,407
Teacher n = 91
(Source: Wubbels, Créton, & Hooymayers, 1985, p. 6; Créton and Wubbels, 1984 cited in Wubbels and Levy, 1991, p. 167.)

The pattern of between scale correlations is most clearly demonstrated if a single scale is selected and the scale correlations are plotted on a sector profile chart. For example, the figures for the leadership scale presented in Table 3.3 are plotted onto Figure 3.1.

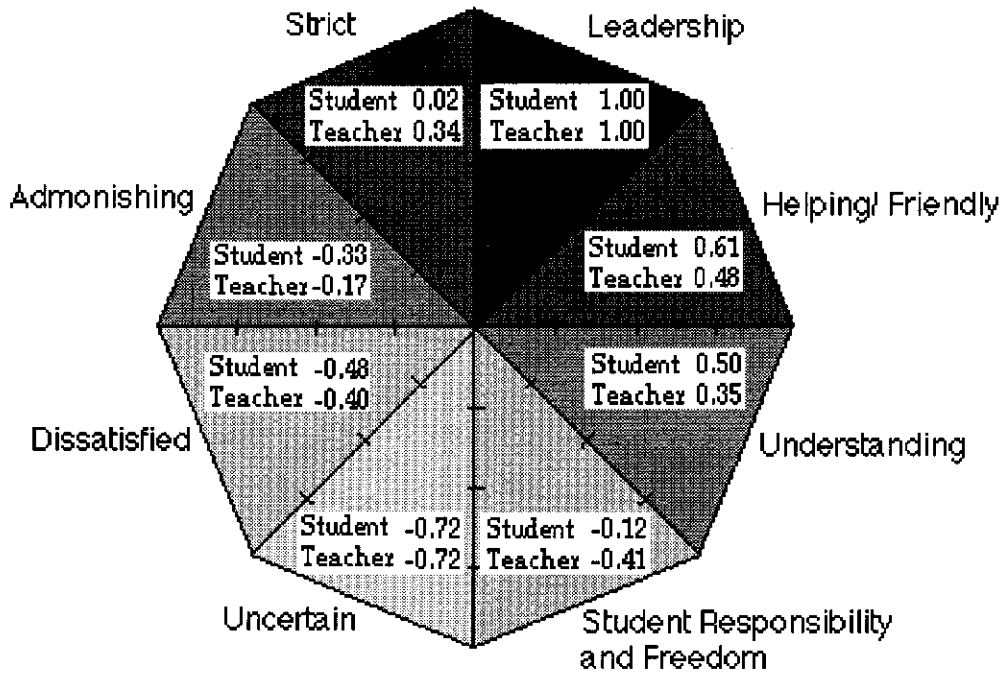


*Figure 3.1.* Circumplexity and Interscale Correlations for the Scale of Leadership in the QTI.

It can be seen that the correlation between scales decreases as you move away from the Leadership scale to the point where the scale opposite, in this case the Uncertain scale, is the most highly negatively correlated scale with Leadership. This is a clear demonstration of the circumplex nature of the scales of the QTI.

### 3.6 Selection and Description of the Sample

The purpose of this study was to investigate the relationship of teacher-student interpersonal behaviour with student sex, cultural background and student outcomes in lower secondary science classes in two states of Australia, namely Western Australia and Tasmania. The selection of two states made it more favourable to find enough schools willing to participate in the study, and it removed any state bias that would occur if only one state was used. These two states were also chosen because the researcher and supervisor had direct experiences in each of them.

Lower secondary students were selected as this cohort of school aged students all take part in science classes. It was considered that the older secondary students, as opposed to primary level students, have greater school experience and attend more classes each week and may be more discerning in their perceptions of the classroom learning environment teacher-student interpersonal behaviour. It is also noteworthy that many of the previous studies using the QTI were with senior secondary students in Physics and Biology so the selection of lower secondary general science students added to our knowledge in this area.

In an effort to decide on the preferred minimum sample size required to analyse the ordinal data using the weighted least squares technique in Lisrel the following formula was used:

Minimum sample size = $k(k+1)/2$
where k = the number of variables, (Jöreskog & Sörbom, 1996).

In this study there were 74 variables. It follows then that the minimum sample size should be 2,775 students. The final sample size was 3,215 students and the validity is enhanced by this large sample size.

During the latter half of 1995, the names of all schools in Western Australia and Tasmania were collected and entered into a FileMaker Pro database (Claris Corporation, 1992). These were sourced from phone books, online databases and various education authorities and contacts in both states. In order to permit an unconfounded test of sex differences, a particular focus of this study, the sample was checked carefully to ensure that only co-educational classes were selected.

Prior to the end of 1995 an initial mailout to schools occurred. Included in the mailout was an invitation to participate in the survey, a sample of QTI items, an acceptance form with a return fax number, a

prepaid/pre-addressed envelope, a sample teacher report and an example letter to parents. The invitation letter was addressed to the principal of each school and marked "Attention: Head Science Teacher" in an effort to reduce the chances of the letter being discarded at this early stage. The sample of QTI items that was included had the words "Example Only" printed across them to prevent schools from copying and using this sample version prior to the complete mailout package arriving in schools.

An acceptance form was included and return of this was made either by facsimile or by posting the form back to the researcher in a pre-addressed and reply-paid envelope. This reduced the time and effort for teachers to return acceptance forms.

The sample of the report for each participating teacher included a copy of the overall results of a previous study for comparison plus an explanation of the scales of the QTI.

Approval of education authorities was sought and granted. A letter of consent for parents was also included for those teachers and/or schools who wished to use them. The inclusion of this letter was designed to comply with the ethics in research policy of Curtin University of Technology as outlined in the Handbook of Guidelines and Regulations for Higher Degrees by Research (1995). A selection of these materials is provided in Appendix E at the end of this thesis.

Initially school postal addresses and contact details were entered into a data base from telephone books and school lists etc, as described above. When the acceptance forms were returned the data recorded on these forms had been checked for any errors or out of date information and added to by the teacher participants. Schools often have a different postal and street address and have been known to change their preferred postal address so this was an important step in ensuring that

the questionnaires arrived where they were supposed to go. The final database of contact details constructed from these returned acceptance forms acted as a central source of information for logging each school. It provided a source for mail merging of teacher names, classes and subjects for personalised reports, certificates, questionnaire bundle labels.

Questionnaires were printed for the second mailout to each of the teachers and students that had been identified as participants from the acceptance forms. A letter to thank teacher participants for agreeing to participate was included, see Appendix I. Each bundle was individually counted, named and coded for the class, subject level and teacher for whom they were intended and the two teacher questionnaires were added. Subject Teachers and their Heads of Department were asked by telephone to complete the questionnaires in one lesson and return the responses to Curtin University by mail or in person as soon as possible. A return address label and sturdy return envelopes had been included with the Questionnaires for this purpose. Teachers often commented that they liked the personal interaction of a call from the researcher as it enabled them to ask questions and clear up any procedural problems immediately. Most schools obliged and had returned the questionnaires within two weeks. Teachers were asked to complete their questionnaires at the same time as their students and think about the class in front of them when recording perceptions on interactions. This was important as some teachers had agreed to provide data on more than one class. All questionnaires had been returned to Curtin University in time to have responses mailed to teachers prior to the end of their school year.

In all there were 50 schools who received the questionnaire materials. Of these there were seven schools that were unable to complete the surveys due to school closure, staff problems, a change in headmaster, a student accident, a fire and a school move. Follow-up telephone

contact established in each case that the school was indeed unable to complete the surveys due to these factors though all suggested that they would be willing to participate in future research.

Data were able to be collected and entered into a spreadsheet program for both states so that a prompt and individualised report of teacher and student QTI data could be sent to all participating teachers before the close of the school year. Reporting results to teachers participating in the study quickly after they had completed the questionnaires was a priority in this study. Rapid reporting was considered to enhance the chances of participants taking part in subsequent research by providing relevant and timely reporting of the data collected. This was typically within three weeks from the receipt of their questionnaire data. In addition a personally prepared and signed certificate of participation was sent to each teacher.

Following the coding and analysis of all of the returned questionnaires the final sample consisted of 3,215 lower secondary science students spread approximately equally between grade 8, 9 and 10 students in 158 classrooms in 43 schools.

### 3.7 Data Collection

In the design stage of questionnaire construction the data preparation team at Curtin University was consulted on preferred, economical and ergonomically cooperative questionnaire layout and design. This served to engage the data-entry staff in the design process and positively associate the questionnaire with them. This proved beneficial during the data entry stages of research.

The qualitative component of the study involved about 100 students. Both subjective impressions and responses to the QTI were used to guide the selection of classes for the qualitative aspects of the study in

order to achieve a range of contrasting styles of teacher interpersonal behaviour. Following selection of the interview schools the contact people in each school were again contacted by phone to arrange suitable times for students to be interviewed and to identify the students required for interview. A letter of consent was also posted to the school contact people so that parent consent could be obtained, see Appendix F. The school contact people then arranged a schedule that was best suited to their individual timetables and teacher requests.

During the formal interviews students were presented with sector profile diagrams representing responses to the QTI from the students in their class and asked to respond to questions about each of the scales. The sector profiles had been prepared from a preliminary data analysis required to produce information for the individual teacher reports that were given to teachers who participated.

Students were given information on what the sector profile diagrams were and how they represented their perceptions and the perceptions of the students in their class. For example, when explaining what the shading in each sector represented students were told that, "If this area is shaded in all the way, this would suggest that a teacher demonstrates this behaviour a lot in class, if this area is shaded only a little bit, then this teacher would demonstrate this behaviour only sometimes". They were then asked to comment on what was recorded for their class on the sector profiles. For example, "The students in your class suggested that your teacher is a good leader, what do you mean when you say your teacher is a good leader?" This resulted in students being able to present their own descriptions of teacher-student interpersonal behaviour as well as being able to interpret the data represented on sector profile diagrams for their own class data. In addition, students were asked if the data represented on the sector profiles for each scale seemed to represent fairly how often those behaviours are exhibited in their classroom.

## 3.8 Data Analysis

### *3.8.1 Quantitative Data*

As this study set out to have a large representative sample, consistent and accurate methods of data entry and error checking had to be put into place. A standardised series of codes for countries of origin and primary language spoken at home had to be established so that future coding of data would be consistent. This was done by recording a numeric value for each country or language from the self-reported student data as they presented themselves during coding of the questionnaire. The primary language spoken at home variable characterises the primary language used in the home by a students' family (Hafner, Ingels, Schneider, & Stevenson, 1990). It differentiates between English and other non-English languages by asking for the most frequently used language. Where several languages may have been spoken in the home, the first listed was taken as the primary language. This allowed questionnaires to be checked for completeness and inconsistencies prior to data entry. The raw data for the location of countries was then examined against standard geographic areas of the world as presented in the Times Atlas of the World (1995).

When questionnaires were returned to the researcher they were coded for country, language, attitude and cognitive achievement by the researcher. Any questionnaires that were incomplete or defaced were removed from the sample. Recording which schools and classes within schools had returned data was done directly into the central database. Questionnaire response data was entered into a Microsoft Excel spreadsheet (Microsoft Corporation, 1993) which is the data format for all archived data. During data entry a random sample of student questionnaire data that had been entered was manually checked again by the researcher. Each student was allocated a unique code.

Initially the data path and procedures for accurate data entry processing and reporting had been guided by looking at the requirements of output, namely the teacher report, sector profiles and output format from data entry. The next consideration was based on what input formats were required by the software that was to be used, ie. SPSS (Norusis, 1993), Microsoft Excel (Microsoft Corporation, 1993), and NUDIST (Richards, Richards, McGalliard, & Sharrock, 1992). After some trials, a data path was set and a procedures manual started with standard operating procedures for data entry. This resulted in a standardised and consistent method for data handling and another unique feature of this study. The preparation of sector profiles and merging of personalised reports for participants in a very short time, usually two to three weeks, as opposed to months was a priority in this study.

Data for the QTI were entered directly off the questionnaire as were the researcher entered codes for school, teacher, class and student number. Where there were only a few QTI values missing for any one student missing or invalid scores were scored two, the mid-range score. In cases where there were more than two missing values for any one scale of the QTI for a single teacher or student, that person's questionnaire was removed. The same procedure was followed for the TOSRA. A proprietary software package was used to plot data onto sector profile or web diagrams (see Figure 2.6), to reveal diagrammatically the degree to which participants perceive each behaviour of the model is exhibited.

The cognitive achievement items on each questionnaire were manually scored by the researcher prior to data analysis and a total calculated so that only the final score was recorded. Any missing responses were coded as incorrect.

Class means, standard deviations, maximum and minimum scores were calculated for each scale of the QTI and the attitude items using the spreadsheet program. Error checking parental place of birth was carried out to confirm, for example, that there were no entries that recorded that the student's mother was born in Australia and a country had also been entered in the alternative country space.

Advances in research methodology in the last decade or so now make it readily possible to employ the individual student's perceptions on a questionnaire as the unit of analysis and still fully acknowledge the 'nested' nature of students in classes (Sirotnik, 1980). Thus, simple and multiple correlational analyses were used with two different units of analysis (the student and the class mean scores) in estimating the strength of the outcome environment associations. It has been suggested by Fraser (1991, p. 5) that "the choice of the unit of analysis is of key importance". The use of the student as the unit of analysis or the use of the class, or perhaps the school leads to differing significance levels and certainly different sample perceptions.

Student sex and cultural differences in teacher-student interaction were examined using a two-way MANOVA with the eight QTI scales as dependant variables. Statistics for QTI scale reliability, discriminant validity and ability to differentiate between classrooms were completed using the individual and the class mean as the unit of analysis. The methods for this aspect of the research drew on previous classroom environment studies of sex differences (Fisher, Fraser, & Rickards, 1997; Lawrenz, 1987; Young & Fraser, 1994) and cultural differences (Hofstede, 1980; Jegede & Okebukola, 1992; Levy, Wubbels, & Morganfield, 1994; Waldrip & Fisher, 1996b) in student perceptions.

*3.8.2 Qualitative Data*

All student responses were recorded on standard size audio tapes which were labelled. Each interview began by identifying the school, teacher,

student and class. They were later transcribed into a word processor file and coded in preparation for data analysis using both traditional methods and the NUDIST software package. This software package enabled the data to be categorised and sorted more efficiently than by traditional methods and proved useful in enhancing data analysis and interpretation. The use of qualitative data analysis software is relatively new in the field of classroom environment research and supplemented rather than replaced other methods of analysis.

### 3.9 Chapter Summary

This chapter has provided a description of the methodology used to complete the current study and the rationale that prompted the use of both qualitative and quantitative research methods. The chapter presented the seven research questions that guided the study and justified the initial selection of teacher interpersonal behaviour as a central focus of this study. The rationale for selecting the data collection instruments and a description of the development, validation and descriptive information for each was presented. In particular, the QTI as the primary research instrument, was shown to have satisfactory internal consistency and the ability to differentiate between the perceptions of students with different teachers in different classrooms. The circumplex nature of the QTI was also presented. This was an important characteristic to explore as the QTI is one of the few instruments that has interscale correlations presented in this circumplex manner. The chapter concluded with the procedures for data collection and data analysis for the qualitative and quantitative data collected in this study.

The next chapter presents the validation and descriptive information for the 48-item version of the QTI used in this study.

# CHAPTER 4

# VALIDATION AND DESCRIPTIVE INFORMATION FOR THE QTI

## 4.1 Introduction

The previous chapter discussed and described the preparation for the study and outlined the research questions. The selection of the instruments, and their reliability reported in previous research studies was presented. This chapter presents results to support the validity and reliability of the QTI when used with a large Australian sample of science classrooms. The actual perceptions of the students and the actual and ideal perceptions of the teachers is reported.

## 4.2 Student Data

This section presents results of statistics calculated from the large Australian QTI database consisting of the responses of 3,215 students and 158 teachers in 158 classes in 43 schools to the 48-item Australian version of the QTI used in this study. The results provide further validation data on the instrument when used specifically in lower secondary science classes in two states of Australia. The representation of students from government schools (2,054 students) was about 2 to 1 when compared with independent schools (1,161 students).

Table 4.1 provides reliability and validity information for the QTI when used in the present sample. To determine the degree to which items in the same scale measure the same aspect of teacher-student interpersonal behaviour, a measure of internal consistency, the

Cronbach alpha reliability coefficient (Cronbach, 1951) was used. In order to provide results that are comparable with previous studies statistics are reported for two units of analysis, namely, the individual student's score and the class mean score for each scale of the QTI. As expected, reliabilities for class means were higher than those where the individual student was used as the unit of analysis. Table 4.1 shows that the alpha reliability figures for different QTI scales ranged from 0.62 to 0.86 when the individual student was used as the unit of analysis, and from 0.72 to 0.92 when the class mean was used as the unit of analysis. These values support the internal consistency of the QTI, using either the individual student or the class mean as the unit of analysis, for a large Australian sample.

Another desirable characteristic of any instrument like the QTI is that it is capable of differentiating between the perceptions of students in different classrooms. That is, students within the same class should perceive it relatively similarly, while mean within-class perceptions should vary from class to class. This characteristic was explored for each scale of the Student Actual version of the QTI using a one-way ANOVA, with class membership as the main effect. The individual student was used as the unit of analysis. It was found that each of the eight QTI scales differentiated significantly ($p<0.001$) between classes and that the $eta^2$ statistic, representing the proportion of variance explained by class membership, ranged from 0.16 to 0.31 for different scales. These data suggest that the QTI is capable of differentiating between the perceptions of students in different classrooms.

Table 4.1
*Internal Consistency (Cronbach Alpha Coefficient) and Ability to Differentiate Between Classrooms for the QTI*

| Scale | Unit of Analysis | Alpha Reliability | ANOVA Results (eta$^2$) |
|---|---|---|---|
| Leadership | Individual | 0.81 | .29* |
| | Class Mean | 0.88 | |
| Helping/ Friendly | Individual | 0.86 | .31* |
| | Class Mean | 0.92 | |
| Understanding | Individual | 0.83 | .26* |
| | Class Mean | 0.88 | |
| Student Resp/ Freedom | Individual | 0.65 | .26* |
| | Class Mean | 0.79 | |
| Uncertain | Individual | 0.69 | .21* |
| | Class Mean | 0.78 | |
| Dissatisfied | Individual | 0.78 | .16* |
| | Class Mean | 0.84 | |
| Admonishing | Individual | 0.75 | .25* |
| | Class Mean | 0.79 | |
| Strict | Individual | 0.62 | .24* |
| | Class Mean | 0.72 | |

*$p<0.001$ n = 3,215 students in 158 classes.

The reliability results for both the student as the unit of analysis and the class mean were consistently greater for the more positive scales of the QTI. This suggests that the items in these scales tend to measure the same dimension more consistently than the other scales.

The results from the validation of the student data are consistent with data reported in other studies (Fisher, Fraser, & Wubbels, 1993; Fisher, Fraser, Wubbels, & Brekelmans, 1993) and provide further evidence that the QTI is an internationally valid and reliable instrument with which to measure teacher-student interpersonal behaviour.

As indicated in section 3.5, Table 3.3 and Figure 3.1, the QTI is unusual in that it is based on a two-dimensional circumplex model for interpersonal behaviour. Table 4.2 reports inter-scale correlations from this study as another measure of the validity of the circumplex nature of the QTI.

Table 4.2
*QTI Interscale Correlations for two Units of Analysis .*

| Scale | Unit of Analysis | DC | CD | CS | SC | SO | OS | OD | DO |
|---|---|---|---|---|---|---|---|---|---|
| DC Leadership | Student | 1.00 | 0.70 | 0.74 | 0.05 | -0.50 | -0.54 | -0.49 | -0.11 |
| | Class Mean | 1.00 | 0.67 | 0.63 | 0.08 | -0.52 | -0.48 | -0.33 | -0.00 |
| | Teacher | 1.00 | 0.49 | 0.31 | -0.10 | -0.35 | -0.29 | -0.13 | 0.16 |
| CD Helping/ Friendly | Student | | 1.00 | 0.78 | 0.30 | -0.39 | -0.59 | -0.55 | -0.32 |
| | Class Mean | | 1.00 | 0.77 | 0.33 | -0.32 | -0.52 | -0.53 | -0.33 |
| | Teacher | | 1.00 | 0.56 | 0.15 | -0.22 | -0.34 | -0.23 | -0.07 |
| CS Understanding | Student | | | 1.00 | 0.24 | -0.39 | -0.59 | -0.59 | -0.29 |
| | Class Mean | | | 1.00 | 0.22 | -0.37 | -0.51 | -0.55 | -0.32 |
| | Teacher | | | 1.00 | 0.24 | -0.16 | -0.35 | -0.31 | -0.01 |
| SC Student Resp / Freedom | Student | | | | 1.00 | 0.27 | 0.02 | -0.05 | -0.27 |
| | Class Mean | | | | 1.00 | 0.17 | -0.04 | -0.15 | -0.37 |
| | Teacher | | | | 1.00 | 0.30 | 0.21 | 0.04 | -0.13 |
| SO Uncertain | Student | | | | | 1.00 | 0.53 | 0.49 | 0.12 |
| | Class Mean | | | | | 1.00 | 0.51 | 0.19 | 0.11 |
| | Teacher | | | | | 1.00 | 0.37 | 0.24 | -0.06 |
| OS Dissatisfied | Student | | | | | | 1.00 | 0.63 | 0.44 |
| | Class Mean | | | | | | 1.00 | 0.50 | 0.26 |
| | Teacher | | | | | | 1.00 | 0.34 | 0.03 |
| OD Admonishing | Student | | | | | | | 1.00 | 0.45 |
| | Class Mean | | | | | | | 1.00 | 0.44 |
| | Teacher | | | | | | | 1.00 | 0.11 |
| DO Strict | Student | | | | | | | | 1.00 |
| | Class Mean | | | | | | | | 1.00 |
| | Teacher | | | | | | | | 1.00 |

Student n = 3,215
Classes n = 158
Teachers n = 158

The circumplex nature of the model is supported if the interscale correlations are highest between adjacent scales and lowest, in fact negatively correlated, with scales that are opposite. The data from this study support the circumplex nature of the QTI. For example, the scale of Helping/Friendly, is correlated closely and positively with Leadership and Understanding and this correlation decreases as you move around the model. The scale most unlike Helping/Friendly is the Dissatisfied scale, which has the highest negative correlation, see Figure 4.1.

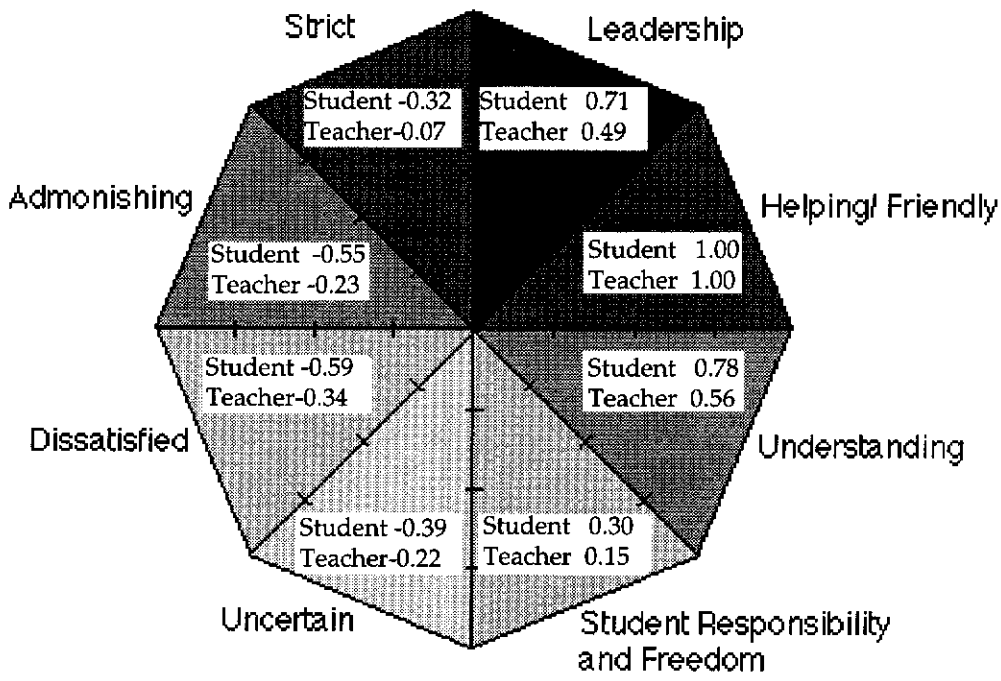


*Figure 4.1.* Circumplexity and interscale correlations for the scale of Leadership in the QTI for this study.

The data from this study are generally consistent with other studies that have reported interscale correlations (Rickards & Fisher, 1997, p. 440).

### 4.3 Teacher Data

Data in the sample of teacher participants represented the responses of 158 teachers in two states of Australia. Females represented about 66 percent of the sample and males about 33 percent. This is similar to the figures for the total population of teachers. Table 4.3 shows the alpha reliability for each of the two teacher versions.

Table 4.3
*Internal Consistency (Cronbach Alpha Coefficient) for the Teacher Versions of the QTI*

| Scale | Unit of Analysis | Alpha Reliability |
|---|---|---|
| Leadership | Teacher Ideal | 0.81 |
| | Teacher Actual | 0.88 |
| Helping/ Friendly | Teacher Ideal | 0.86 |
| | Teacher Actual | 0.92 |
| Understanding | Teacher Ideal | 0.83 |
| | Teacher Actual | 0.88 |
| Student Resp/ Freedom | Teacher Ideal | 0.65 |
| | Teacher Actual | 0.79 |
| Uncertain | Teacher Ideal | 0.69 |
| | Teacher Actual | 0.78 |
| Dissatisfied | Teacher Ideal | 0.78 |
| | Teacher Actual | 0.84 |
| Admonishing | Teacher Ideal | 0.75 |
| | Teacher Actual | 0.79 |
| Strict | Teacher Ideal | 0.62 |
| | Teacher Actual | 0.72 |

*$p < 0.001$ n = 156 teachers.

Statistics are reported for only one unit of analysis, namely, the individual teacher's score as there were too few teachers in many of the schools to examine school means. The reliabilities for the Teacher

Actual form of the QTI were all above the 0.6 value discussed previously though they were lower than expected for the Strict scale. Table 4.3 shows that the alpha reliability figures for Teacher Actual scores on different QTI scales ranged from 0.72 to 0.92 supporting the internal consistency of the QTI for the Teacher Actual version of the QTI.

The data presented in Table 4.3 also reports the individual teacher scores for the Teacher Ideal version of the QTI. The reliability values for the Teacher Ideal version of the QTI ranged from 0.62 to 0.86. The scores for the scales of Student Responsibility and Freedom and Strict behaviour were lower than expected though scores for all scales of the QTI were above the acceptable 0.6 level. The values presented in Table 4.3 support the internal consistency of the QTI for the Teacher Ideal version of the QTI.

## 4.4 Chapter Summary

This chapter has presented descriptive statistics to support the validity and reliability of the two teacher versions and the student version of the 48-item QTI as used in this study. The next chapter examines the student outcome variables and other outcome measures.

# CHAPTER 5

# STUDENT OUTCOME VARIABLES AND OTHER MEASURES

## 5.1 Introduction

The previous chapter presented validation and descriptive information for the QTI, as used in this study. This chapter presents data describing sex differences in interpersonal behaviour, associations between teacher-student interpersonal behaviour and attitude and teacher-student interpersonal behaviour and cognitive achievement. The following chapter provides data for the teacher versions of the QTI.

## 5.2 Sex Differences in Interpersonal Behaviour

Sex differences in student-teacher interactions were examined using a two-way MANOVA with the eight QTI scales as dependent variables. It should be noted that males (n=1,592 or 49.5%) and females (n=1,623 or 50.5%) were represented almost equally in the study. The percentage rates for sex representation for students in all schools in Australia as at February 1998 (males, n = 1.600 million or 50.9% of the sample; females, n = 1.542 million or 49.1% of the sample) were similar to those in percentage terms represented in this study (Australian Bureau of Statistics, 1998c). The calculation of *F* values reported in the tables in this chapter involved a one-way ANOVA means comparison where the dependant variables were the eight scales of the QTI.

Table 5.1 presents the scale means and standard deviations for male and female students' scores on the eight scales of the QTI. Statistically

significant sex differences in students' mean scores were apparent in responses to seven of the eight scales of the QTI, with females perceiving greater helping/friendly and understanding behaviours in their teachers and males perceiving their teachers as being more uncertain, dissatisfied, admonishing and strict and as giving more student responsibility and freedom. The magnitude of these differences is not large but the differences generally indicate that females perceive their teachers in a more positive way than did males.

Table 5.1
*Scale Means and Standard Deviations for Male and Female Science Students' Scores on the Eight Scales of the QTI*

| | Scale Mean | | Difference | Standard Deviation | | F Value |
|---|---|---|---|---|---|---|
| Scale | Male | Female | (Female - Male) | Male | Female | |
| Leadership | 2.72 | 2.75 | 0.03 | 0.74 | 0.73 | 1.68 |
| Helping/Friendly | 2.75 | 2.88 | 0.13 | 0.89 | 0.83 | 16.28 ** |
| Understanding | 2.77 | 2.86 | 0.09 | 0.80 | 0.78 | 10.95 ** |
| Student Resp/ Freedom | 1.76 | 1.71 | - 0.05 | 0.66 | 0.64 | 5.12 * |
| Uncertain | 1.10 | 0.92 | - 0.18 | 0.72 | 0.67 | 55.53 ** |
| Dissatisfied | 1.24 | 0.98 | - 0.26 | 0.81 | 0.74 | 87.56 ** |
| Admonishing | 1.49 | 1.33 | - 0.16 | 0.81 | 0.80 | 29.93 ** |
| Strict | 1.83 | 1.75 | - 0.08 | 0.67 | 0.62 | 13.20 ** |

* $p<0.05$ males n = 1,592
** $p<0.01$ females n = 1,623

In an effort to explore the educational effect of these sex differences each scale of the QTI was examined separately for effect size of sex (Cohen, 1988). The usual method used to calculate effect size is divide the difference of two groups by the standard deviation of the whole group (Cohen, 1988). Effect sizes are generally not expected to be large in the

behavioural sciences (Cohen, 1988, p. 284). They are differentiated as small (0.10), medium (0.25) and large (0.40) (Cohen, 1988, p. 355). In this study, the method used to calculate the effect size was female student mean score less male student mean scale score divided by the pooled standard deviation.

Table 5.2
*Effect Sizes for Sex in Student QTI Scale Mean Scores*

| Scale | Scale Mean | | Pooled Standard Deviation | Effect Size |
|---|---|---|---|---|
| | Female | Male | | |
| Leadership | 2.75 | 2.72 | 0.73 | 0.04 |
| Helping/Friendly | 2.88 | 2.75 | 0.86 | 0.15 |
| Understanding | 2.86 | 2.77 | 0.79 | 0.11 |
| Student Resp/ Freedom | 1.71 | 1.76 | 0.65 | 0.07 |
| Uncertain | 0.92 | 1.10 | 0.70 | 0.26 |
| Dissatisfied | 0.98 | 1.24 | 0.79 | 0.33 |
| Admonishing | 1.33 | 1.49 | 0.81 | 0.20 |
| Strict | 1.75 | 1.83 | 0.65 | 0.12 |

* $p<0.05$ males n = 1,592
** $p<0.01$ females n = 1,623 in 43 classes

Table 5.2 shows that when using the student as the unit of analysis the scales of Uncertain and Dissatisfied have effect sizes that are medium as they are greater than 0.25 and that the scales of Helping/Friendly, Understanding, Admonishing and Strict have small effect sizes as they are less than 0.25 but greater than 0.10. The effect sizes, though not large, do confirm that there are educationally significant sex differences in teacher-student interpersonal behaviour and that these are most evident in the less positive behaviours.

The effect sizes presented in Table 5.2 provide an alternative but consistent way to examine sex differences. When effect size results are compared with the data presented in Table 5.1 the pattern that emerged from the statistical significance calculations, that the scales of Helping/Friendly, Understanding, Uncertain, Dissatisfied, Admonishing and Strict were statistically most significant, is consistent with the effect size results.

## 5.3 Cultural Differences in Interpersonal Behaviour

It should be noted for this section of the data analysis that the students for whom the mothers' and/or fathers' birthplaces were recorded as coming from an American cultural background were removed from the sample. When these students are combined with missing data for this field, they account for the small reduction in student sample size. They were removed because there were so few students from the many countries that could be coded as American, including both South American and North American countries and they did not form a representative group because of the variation in cultures within these country groups. This procedure is consistent with other studies in the area that have encountered small non-representative groups within a sample, (e.g., Levy, Wubbels, Brekelmans, & Morganfield, 1994, p. 125).

### *5.3.1 Father's Birthplace*

Table 5.2 presents the student scale mean scores for the QTI differentiated by father's birthplace by geographic area. Oceania consisted of New Zealand, Australia, New Guinea and the Pacific Islands south of the equator.

Statistically significant differences were apparent in students' responses to seven of the eight scales of the QTI. Mean scores were highest, for

Table 5.3
*Scale Means for each Scale of the QTI for Fathers' Birthplace.*

| Scale | Mean Scores | | | | | F Value |
|---|---|---|---|---|---|---|
| | Europe | SE Asia | Asia | Oceania | Africa | |
| Leadership | 2.72 | 2.90 | 2.86 | 2.72 | 2.89 | 4.08** |
| Helping/ Friendly | 2.75 | 3.08 | 2.92 | 2.82 | 2.81 | 4.98** |
| Understanding | 2.79 | 2.98 | 2.93 | 2.81 | 2.88 | 2.50* |
| Student Resp/ Freedom | 1.70 | 1.77 | 1.83 | 1.75 | 1.51 | 3.90** |
| Uncertain | 0.96 | 1.00 | 0.96 | 1.03 | 0.81 | 3.05* |
| Dissatisfied | 1.11 | 0.99 | 1.08 | 1.12 | 1.07 | 1.02 |
| Admonishing | 1.44 | 1.21 | 1.43 | 1.42 | 1.27 | 3.53** |
| Strict | 1.81 | 1.76 | 1.85 | 1.78 | 1.99 | 2.60* |
| | n=673 | n=161 | n=87 | n=2,177 | n=84 | |

* $p<0.05$ Total n=3,182
** $p<0.01$

the positive scales of the model for interpersonal teacher behaviour, for students from a South-East Asian cultural background on the QTI scales of Leadership, Helping/Friendly and Understanding. This suggests that students from a South-East Asian background perceived their teachers significantly more positively on these three dimensions than did those from the other cultural groups used in this analysis. Given the small sample size, students who had fathers from an African cultural background had very similar scale mean scores for leadership behaviour, and rated their teachers almost as highly, as students whose father was from a South-East Asian cultural background. Students from Asia rated their teachers in a manner that was very similar to South-East Asian students but scored higher on the scale of Student Responsibility and Freedom. Students with an African paternal birthplace scored highest for the Strict scale. Students for who father's birthplace was Oceania had the highest scale mean scores for the less positive scales of Uncertain and Dissatisfied.

The effect size was calculated for father born in Australia versus father not born in Australia for each scale of the QTI but were all less than 0.10, which is a small effect size (Cohen, 1988).

### 5.3.2 *Mother's Birthplace*

Table 5.3 presents the mean scale scores of the QTI for mother's birthplace. Statistically significant differences were apparent in students' responses to six of the eight scales of the QTI.

Table 5.4
*Scale Means for each Scale of the QTI for Mothers' Birthplace.*

| Scale | Mean Scores | | | | | F Value |
|---|---|---|---|---|---|---|
| | Europe | SE Asia | Asia | Oceania | Africa | |
| Leadership | 2.74 | 2.89 | 2.69 | 2.72 | 2.94 | 4.09** |
| Helping/ Friendly | 2.74 | 3.07 | 2.78 | 2.82 | 2.90 | 5.86** |
| Understanding | 2.80 | 2.99 | 2.83 | 2.80 | 2.98 | 3.63** |
| Student Resp/ Freedom | 1.66 | 1.81 | 1.83 | 1.75 | 1.58 | 5.11** |
| Uncertain | 0.96 | 1.05 | 1.02 | 1.03 | 0.75 | 4.11** |
| Dissatisfied | 1.10 | 1.01 | 1.18 | 1.12 | 0.95 | 1.83 |
| Admonishing | 1.41 | 1.26 | 1.41 | 1.43 | 1.26 | 2.71* |
| Strict | 1.85 | 1.72 | 1.78 | 1.78 | 1.95 | 2.51** |
| | n=609 | n=200 | n=97 | n=2,187 | n=84 | |

* $p<0.05$ Total n=3,182
** $p<0.01$

Mean scores were highest for students from an Asian cultural background on the QTI scales of Helping/Friendly and Student Responsibility/Freedom. This suggests that students from an Asian maternal background perceived their teachers significantly more positively on these two dimensions than did those from the other cultural groups used in this analysis.

The effect size for mother born in Australia versus mother not born in Australia for each scale of the QTI were less than 0.10, the level for small effect size (Cohen, 1988).

*5.3.3 Primary language spoken at home.*

As shown in Table 5.5, when primary language spoken at home was used as the cultural background variable, it was found that children from homes where Asian-based languages were dominant had statistically significant higher mean scores on the scales of Leadership, Helping/Friendly, and Understanding, the scales on the right side of the model for interpersonal behaviour, (see Figure 2.3 in Chapter 2).

Table 5.5
*Scale Means for each Scale of the QTI for Primary Language Spoken at Home*

| | Mean scores | | | F Value |
|---|---|---|---|---|
| Scale | English | Other European | Asian | |
| Leadership | 2.73 | 2.71 | 2.96 | 4.42* |
| Helping/Friendly | 2.81 | 2.73 | 3.13 | 6.94** |
| Understanding | 2.81 | 2.79 | 3.12 | 7.52** |
| Student Resp/ Freedom | 1.73 | 1.72 | 1.87 | 2.15 |
| Uncertain | 1.01 | 1.08 | 1.09 | 1.19 |
| Dissatisfied | 1.11 | 1.12 | 0.99 | 1.19 |
| Admonishing | 1.42 | 1.37 | 1.15 | 5.29** |
| Strict | 1.79 | 1.81 | 1.70 | 1.11 |
| | n=3,016 | n=103 | n=96 | |

* $p<0.05$ n = 3,215
** $p<0.01$

Apparently, students with an Asian background perceived interactions with their teachers more positively than did students with other cultural backgrounds.

The differences in the student perceptions of interpersonal behaviour can be more clearly seen if the data is presented as a chart. Figure 5.1 shows the similarity of the perceptions of all students from English and other European languages when compared to Asian based languages for all scales of the QTI.

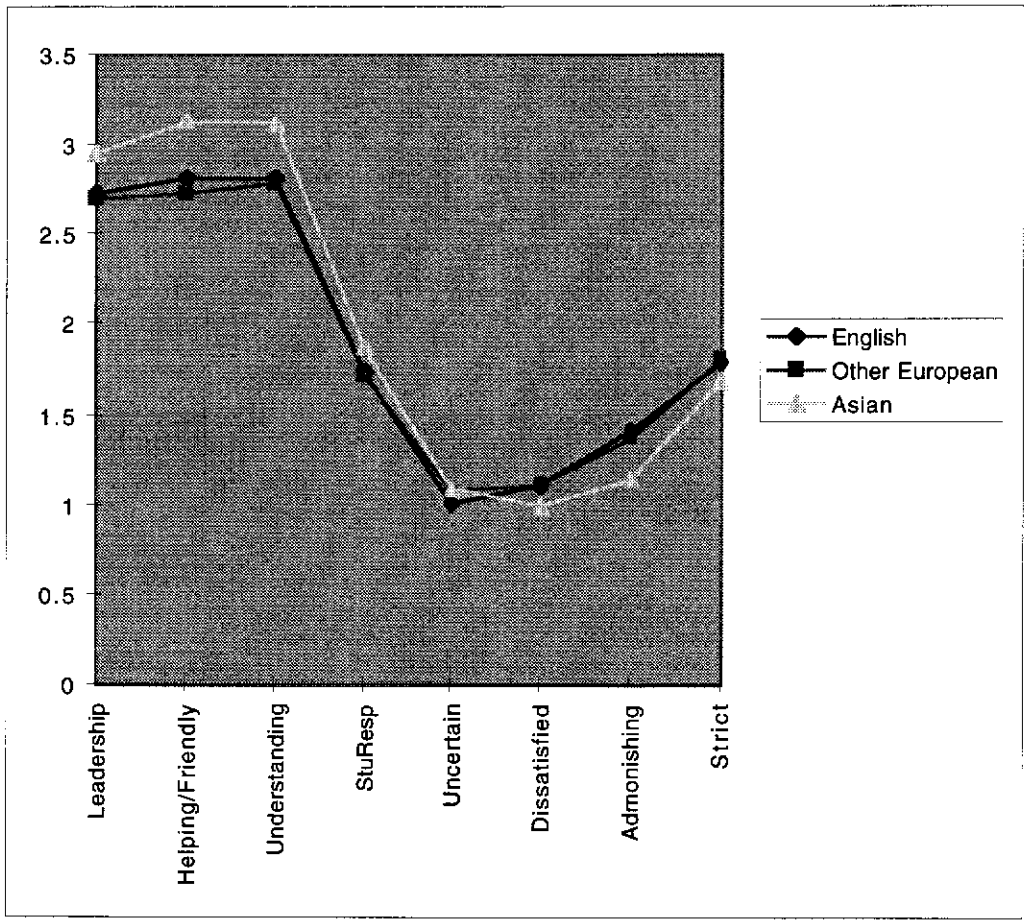


*Figure 5.1.* Differences in mean student scores for each scale of the QTI for different primary language spoken at home.

The data represented in Figure 5.1 is from Table 5.5 and clearly shows the extent to which the students from an Asian cultural background differ in their perceptions of teacher-student interpersonal behaviour. It is also clear that their scale mean scores are higher for the more positive scales of Leadership, Helping Friendly and Understanding, and lower on the less positive scale of Admonishing.

For all students, the effect size for English as the primary language of the students' home versus non-English as the primary language of the students' home for each scale of the QTI were less than 0.10, the level for small effect size (Cohen, 1988). Caution should be exercised due to the differences in the number of students in each language group. In particular, there were a greater number of students for whom English was their primary home language.

Other studies have observed differences in perceptions of learning environment in students from diverse cultural backgrounds (Fisher, Fraser, & Rickards, 1997; Levy, Wubbels, & Morganfield, 1994; Waldrip & Fisher, 1997b). It has also been found that students from an Asian background prefer their teachers to exhibit more strict behaviour in teacher-student interactions (Aldridge, Fraser, & Huang, 1998; Fisher, Goh, Wong, & Rickards, 1996; Fisher, Rickards, Goh, & Wong, 1997; Riah, Fraser, & Rickards, 1997) and would prefer to complete just those teacher-set tasks that are required and assessable for credit with little or no student input (Aldridge, Fraser, & Huang, 1998).

## 5.4 Associations Between Interpersonal Behaviour and Attitude

Table 5.6 reports the results for associations between students' perceptions of student-teacher interaction and students' attitudinal outcomes when the data were analysed using both simple and multiple correlations. Whereas the simple correlation ($r$) describes the bivariate association between an outcome and a QTI scale, the standardised regression weight ($\beta$) characterises the association between an outcome and a particular QTI scale when all other QTI dimensions are controlled.

Table 5.6
*Associations Between QTI Scales and Students Attitudinal Outcomes in Terms of Simple Correlations (r) and Standardised Regression Coefficients (ß)*

| | Attitude to class | |
|---|---|---|
| Scale | *r* | *ß* |
| Leadership | 0.51** | 0.21** |
| Helping/ Friendly | 0.57** | 0.26** |
| Understanding | 0.53** | 0.30 |
| Student Resp/ Freedom | 0.13** | - 0.01 |
| Uncertain | - 0.31** | 0.02 |
| Dissatisfied | - 0.48** | - 0.09** |
| Admonishing | - 0.46** | - 0.09** |
| Strict | - 0.33** | - 0.13** |
| Multiple *R* Correlation | | 0.63** |
| $R^2$ | | 0.40 |

* $p<0.05$ n = 3,215
**$p<0.01$

The *r* values were calculated using bivariate Pearson correlation coefficients with a two-tailed test of significance that excluded pairs pairwise. The enter method of linear regression was carried out using sex as the dependant variable and the QTI scales as the independent variables. The probability of *F* was set at 0.5 and removal was set at the 0.1 level for cases that were excluded list wise.

An examination of the simple correlation (*r*) figures in Table 5.6 indicates that there were eight significant relationships ($p<0.05$), out of eight possible, between student/teacher interactions and student outcome variables. Assuming that the significance level of chance is 0.05 and that there are eight possible simple correlation (*r*) figures in the table, then the eight significant relationships are represented 20 times

that expected by chance alone. An examination of the $R^2$ figure suggests that 40% of the variance in student attitude was due to teacher-student interpersonal behaviour. These associations were positive for the scales of Leadership, Helping/Friendly and Understanding for attitude to class. The scales of Uncertain, Dissatisfied, Admonishing and Strict displayed significant negative associations for attitude to class.

An examination of the beta weights for attitude to class reveals five out of eight significant relationships ($p<0.05$), which is 12.5 times that expected by chance alone. The more conservative multiple regression analysis indicated that it was the Dissatisfied, Admonishing and Strict scales that were negatively associated with attitude and the Leadership and Helping/Friendly scales that were significantly positively associated with attitude.

## 5.5 Associations Between Interpersonal Behaviour and Cognitive Achievement

Table 5.7 reports the simple correlation ($r$) and the standardised regression weight ($\beta$) between cognitive achievement and each individual QTI scale when all other QTI dimensions are controlled. Statistically significant associations were found with cognitive achievement, however, it should be noted that these were consistently smaller than those found for attitude to class.

The simple correlation ($r$) figures in Table 5.7 indicate that there were seven significant relationships ($p<0.05$), out of the eight possible, between teacher-student interactions and cognitive achievement which is 17.5 times that expected by chance alone. These associations were positive for the scales of Leadership, Helping/Friendly and Understanding for student cognitive achievement. The scales of Uncertain, Dissatisfied, Admonishing and Strict displayed significant negative associations for cognitive achievement.

Table 5.7
*Associations Between QTI Scales and Students Cognitive Outcomes in Terms of Simple Correlations (r) and Standardised Regression Coefficients (ß)*

| Scale | Achievement score | |
|---|---|---|
| | *r* | *ß* |
| Leadership | 0.11** | 0.08 |
| Helping/ Friendly | 0.15** | - 0.00 |
| Understanding | 0.15** | 0.06 |
| Student Resp/Freedom | 0.01 | 0.05 |
| Uncertain | - 0.25** | - 0.23** |
| Dissatisfied | - 0.19** | - 0.23 |
| Admonishing | - 0.20** | - 0.04 |
| Strict | - 0.14** | - 0.06 |
| Multiple *R* Correlation | | 0.28** |
| $R^2$ | | 0.08 |

* $p<0.05$ n = 1,297
**$p<0.01$

Cognitive achievement was higher where the teachers demonstrated more leadership, helping/friendly and understanding behaviours and less strict, dissatisfied and admonishing behaviours.

An examination of the beta weights reveals one out of eight significant relationships ($p<0.05$), which is 2.5 times that expected by chance alone. The more conservative multiple regression analysis indicated that it was the Uncertain scale that was negatively associated with cognitive achievement. The $R^2$ figure in Table 5.7 suggests that 8% of the variance in student cognitive achievement is attributable to teacher-student interpersonal behaviour.

The Cronbach alpha reliability for the TOES instrument used in this study was calculated and found to be 0.81. This is consistent with the findings of other studies described in section 3.4.2. on page 75 of this thesis. Inter-item reliability was not a problem in this study due to the nature of the TOES, ie. there was only one correct response for each question.

## 5.6 Chapter Summary

The quantitative data that were reported in this chapter represented sex and cultural background differences in interpersonal behaviour, associations between interpersonal behaviour and attitude, and interpersonal behaviour and cognitive achievement.

The results suggest that there are differences in students' perceptions of teacher-student interpersonal behaviour that are associated with student sex and also with student cultural background for the two indicator variables used in this study. Sex differences generally indicated that females perceived their teachers in a more positive way than did males. For the cultural background indicator variables, students from an Asian background perceived their teachers significantly more positively than did those from the other cultural groups used in this analysis. In terms of student attitude to class, the greatest contribution to attitude occurred when teachers exhibited more leadership and helping/friendly behaviours in their classrooms and were less strict, dissatisfied and admonishing. Though the associations for cognitive achievement were consistently smaller than those found for attitude to class, they displayed significant positive associations for the scales of Leadership, Helping/Friendly and Understanding and negative associations for the scales of Uncertain, Dissatisfied, Admonishing and Strict.

The next chapter reports results for the use of teacher versions of the QTI collected at the same time as the student data and describes a practical way to which the research data may be applied.

# CHAPTER 6

# TEACHER VERSIONS OF THE QTI

## 6.1 Introduction and Overview

Chapter Five presented data for the student outcome variables and other measures. This chapter reports data for the two teacher versions of the 48-item version of the QTI, namely the Teacher Ideal version and the Teacher Actual version. In consideration of research question seven, the practical applications of the research using the QTI are discussed.

## 6.2 Teacher Data

Teacher data was collected using two separate versions of the QTI described earlier in the methodology chapter. Table 6.1, on the next page, shows scale mean scores for Teacher Actual and Teacher Ideal versions of the QTI. For comparison, data from the student version of the QTI has been included.

Table 6.1.
*Mean Item Scores for Teachers on Teacher Actual, Teacher Ideal and Student Actual Forms of QTI*

| Scale | QTI Type | Mean Item Score: Scale Mean | Mean Item Score: Standard Deviation |
|---|---|---|---|
| DC Leadership | Teacher Actual | 3.04 | .34 |
| | Teacher Ideal | 3.75 | .25 |
| | Student Actual | 2.74 | .73 |
| CD Helping/ Friendly | Teacher Actual | 3.32 | .41 |
| | Teacher Ideal | 3.71 | .33 |
| | Student Actual | 2.82 | .86 |
| CS Understanding | Teacher Actual | 3.21 | .36 |
| | Teacher Ideal | 3.64 | .33 |
| | Student Actual | 2.82 | .79 |
| SC Student Resp/ Freedom | Teacher Actual | 1.35 | .46 |
| | Teacher Ideal | 1.42 | .42 |
| | Student Actual | 1.74 | .65 |
| SO Uncertain | Teacher Actual | 0.82 | .48 |
| | Teacher Ideal | 0.45 | .49 |
| | Student Actual | 1.01 | .69 |
| OS Dissatisfied | Teacher Actual | 0.83 | .44 |
| | Teacher Ideal | 0.58 | .49 |
| | Student Actual | 1.11 | .78 |
| OD Admonishing | Teacher Actual | 0.93 | .44 |
| | Teacher Ideal | 0.43 | .46 |
| | Student Actual | 1.41 | .80 |
| DO Strict | Teacher Actual | 2.01 | .43 |
| | Teacher Ideal | 1.97 | .47 |
| | Student Actual | 1.79 | .65 |

| | |
|---|---|
| Student | n = 3,215 |
| Teacher Ideal QTI | n = 158 |
| Teacher Actual QTI | n = 158 |

*6.1.1 Teacher Actual Data*

When teachers described their perceptions of their own behaviours, they tended to see them a little more favourably than did their students. The scale mean scores for the total sample indicate that teachers rated the scales of Leadership, Helping/Friendly and Understanding higher than other scales on Teacher Ideal. This suggests that they perceive that they exhibit these behaviours more frequently than do their students. Teacher actual mean scores for the scales of Student Responsibility and Freedom, Uncertain, Dissatisfied and Admonishing are scored lower indicating that teachers perceive these behaviours less than their students. Strict behaviour is scored at about the mid-way point on the scale used to score these behaviours. This indicates that teachers see themselves as exhibiting strict behaviours about half of the time that they are interacting with a class of students.

*6.1.2 Teacher Ideal Data*

Generally, when teachers reported their ideal perceptions for teacher-student interpersonal behaviour, they tended to see the behaviours of Leadership, Helping/Friendly and Understanding as being more frequently exhibited by an ideal teacher for their students and therefore desirable behaviours to exhibit. Teachers also rated student responsibility and freedom as a behaviour that could be exhibited more frequently, but continued to score it below the mid-point score of two.

For the less positive behaviours of uncertain, dissatisfied, admonishing and strict, teachers saw the ideal teacher exhibiting less of these behaviours than they currently perceived that they exhibited in their interactions with students. It is interesting to note that the teacher data suggests that teachers would prefer to be a little less strict and giving more student responsibility and freedom in their interpersonal behaviour.

Generally, the teachers' actual perceptions for all scales were between the students' perceptions of actual behaviour and the teachers' ideal behaviour. The differences in these mean scores indicate that teachers think that they behave closer to their ideal than their students think that they do, see Figure 6.1.

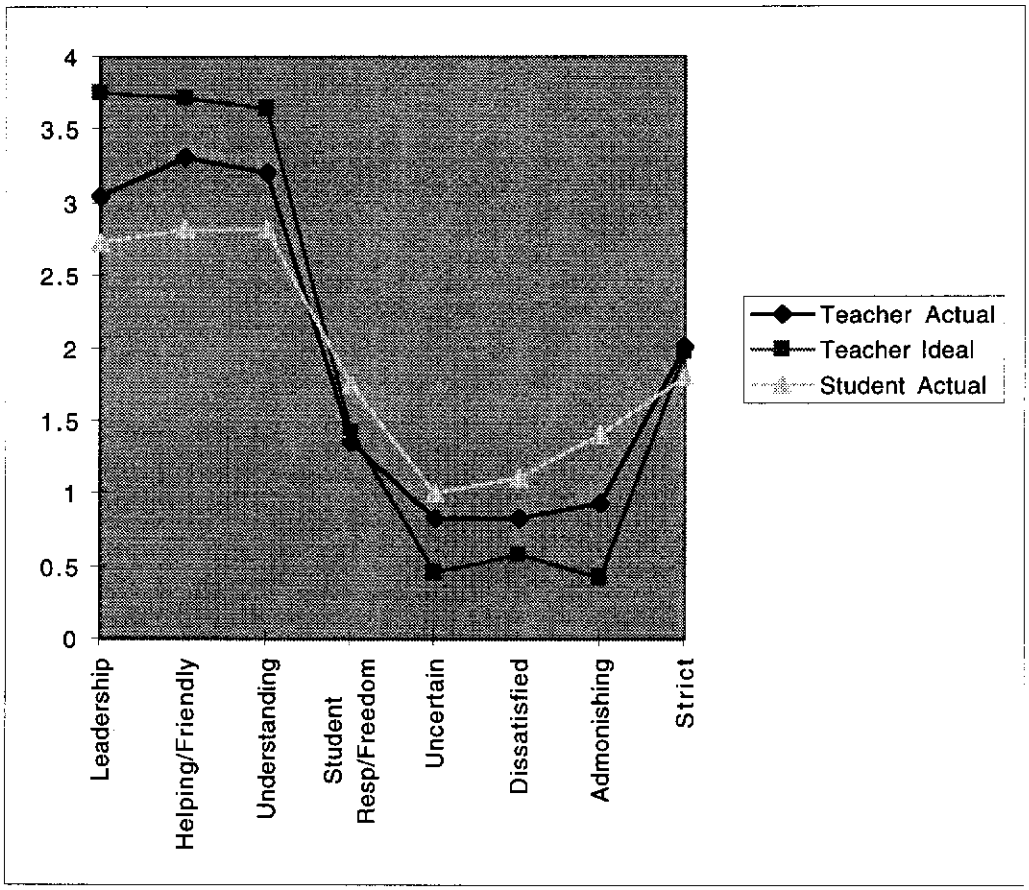


*Figure 6.1.* Differences in mean scores for each scale of the QTI for three versions of the QTI.

## 6.3 The Practical Application of Research Data

A major implication for school improvement resulting from curriculum research and development studies over three decades ago was the idea that classroom teachers could act as researchers in their own classrooms (Stenhouse, 1975, p. 142). Since this time, there has been an increased acceptance of research reports and a small number of

conference presentations that have been co-authored by researchers and teacher-researchers (Fraser, 1996). Though this study did not set out to engage teachers as researchers, it does provide a means by which they may engage in self-directed research in their classroom learning environment.

A number of science teachers have used the QTI as a basis for self reflection and have participated with the researcher in professional development activities using the QTI. These teachers are provided with a report that provides the results from using the QTI in their classrooms. The report begins with a brief description of the model for interpersonal teacher behaviour, on which the QTI is based. The next section contains a quick guide to interpreting the charts and an explanation of the sector characteristics. The average profile of a sample of 50 Australian science teachers is included to allow teachers to make comparisons with their own results. The final page presents the teacher with their personal and student sector profile results in a readily-interpretable and diagrammatic form. The scores for the teachers' perception of their ideal teacher, how they see themselves, and the mean scores for how their students see them are presented on the same page for ease of comparison. Although the results for teacher and student responses to the questionnaire could be shown in tabular form the graphical presentation is considered more useful and easier to interpret by teachers and results can readily be compared with the model for interpersonal teacher behaviour. For example, Figure 6.2 and Figure 6.3 depict the profiles recently provided by the authors to two science teachers who participated in a recent data collection.

Both teachers could use the data provided by the sector profile diagrams to reflect on their classroom behaviours and use the results as a basis for modifying their behaviour when interacting with students. For example, Teacher 2 may decide to exhibit more leadership behaviour in

the classroom whilst trying to be more cooperative with students and give them more assistance while they are working.

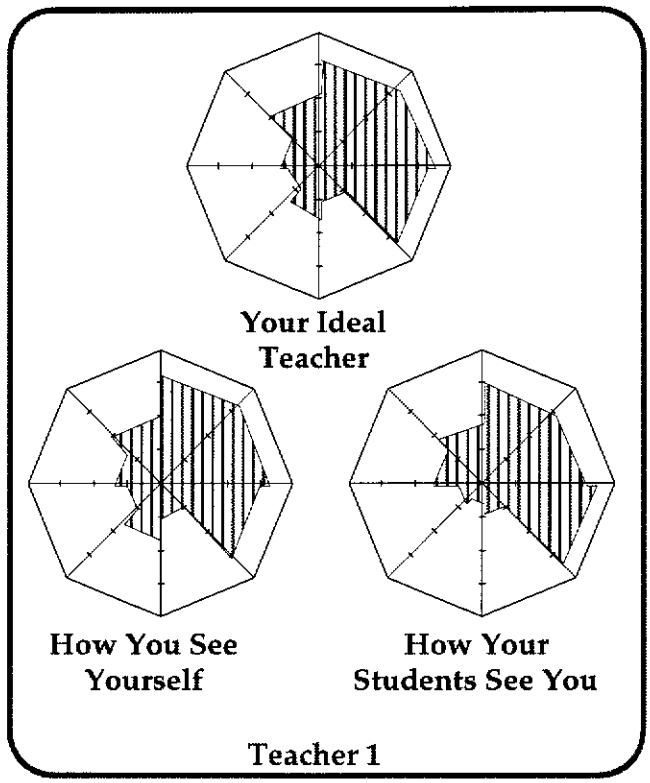


*Figure 6.2.* Science teacher sector profile 1.

The sector profile diagrams were considered a very useful way of interpreting the current classroom environment. One teacher, who had recently returned to teaching full-time after an absence from teaching of 14 years, found the information provided by the sector profiles particularly useful in comparing the perceptions of her students with her own. It was interesting for her to note that the perceptions that the students held were very similar to her own. This proved to be a reassuring and reinforcing finding because it suggested that she was meeting the individual needs of the students without compromising her own standards.

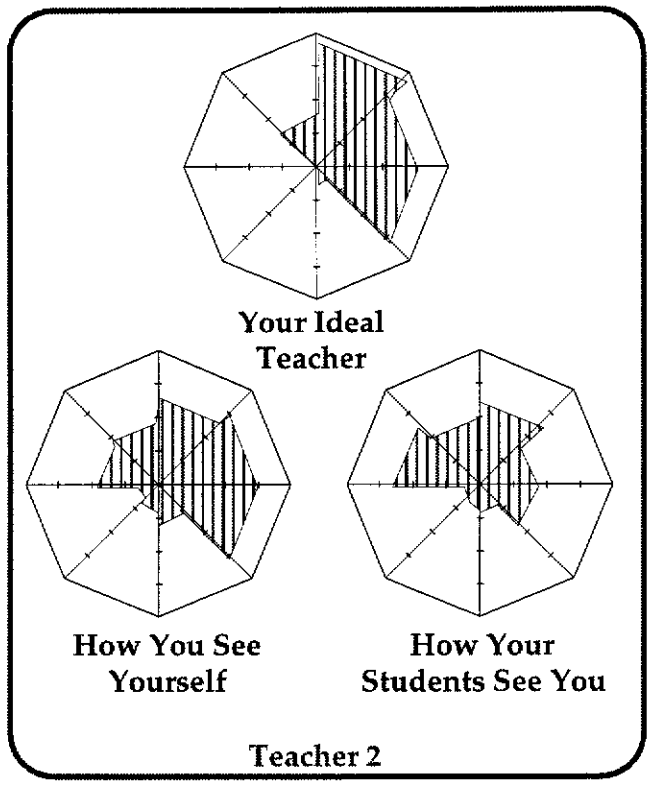


*Figure 6.3.* Science teacher sector profile 2.

Though teachers agreed with the results for their classroom, they raised further questions relating to their individual teaching practice. For example, the dimension of Helping/Friendly on the QTI produced a surprise for one teacher in that students' perceived a lower level of teacher helpful/friendly behaviour than did the teacher. This suggested to the teacher that the students either needed more help than the teacher was able to give, or perhaps that the students really "lapped up" the nurturing and wanted more.

Some teachers reported that students often saw them as being more confident and better leaders than they perceived themselves to be. Other teachers suggested that it would be useful to respond to the QTI again after some time had elapsed so that any trends and changes in teacher-student interpersonal behaviour could be monitored.

It is apparent that the three versions of the QTI do provide the teacher with valuable information that can be used as a basis for self reflection on their own teaching performance. Based on this information, teachers might decide to change the way they behave in an attempt to create a more desirable classroom environment.

## 6.4 Chapter Summary

This chapter has presented data collected from the Teacher Actual and Teacher Ideal versions of the QTI. The data suggested that teachers perceived their classrooms more favourably than did their students. The data also suggested that the teacher actual perceptions were generally between the students' perceptions and the teachers' ideal perceptions. A means by which teachers are able to use the QTI for self reflection was also outlined.

The next chapter presents qualitative data collected from around 100 students who participated in this study. The first section provides construct validity for the QTI and a summary of validation data for the QTI. Teacher-student interpersonal behaviour and other variables examined in this study is then be presented.

# CHAPTER 7

# QUALITATIVE DATA FROM STUDENTS

## 7.1 Introduction

This chapter presents the qualitative data resulting from student interviews in two states in Australia, namely Tasmania and Western Australia in an effort to examine the construct validity of the QTI. The method used to collect the interview data is detailed in Chapter Three.

The combination of qualitative and quantitative methods in science and mathematics education research has provided a new direction to the way we examine schools and classrooms today. Though it is not a new concept to combine these two methods (Fisher, Waldrip, Harrison, & Venville, 1996; Waldrip & Fisher, 1996a), this study is unique in that it provides the results of the first large-scale Australian survey of science classes combining both quantitative and qualitative data collection using the QTI.

The interview data for this chapter have been grouped by each scale of the QTI, as the primary data gathering instrument, followed by the other outcome variables. The construct validity of the QTI scales is presented more clearly if the data are grouped in this way. Construct validity is "the degree to which a test measures an intended hypothetical construct" (Gay, 1992, p. 157).

During the interviews, students were asked to comment on whether they agreed with the average student perception of the teacher-student interaction, as represented by a sector profile diagram, in their classroom. These sector profile diagrams were explained to students, as

outlined earlier in this thesis, at the beginning of each interview. Students were informed that the results on the sector profile diagrams were a representation of behaviour over time and not just for the last lesson that they had with this particular teacher. When asked about the scales students were very cooperative. They listened with interest to the instructions on how to interpret the results from the sector profile diagrams.

A description of each scale and sample items was provided in Table 2.2 and Table 5.1 provided the QTI scale means and standard deviations.

## 7.2 Construct Validation of the QTI Scales

Each scale's mean score from the QTI for the total student sample is provided in the title of each of the following sub-sections.

### *7.2.1 The Leadership scale (Mean = 2.74)*

Students were able to relate to this scale as they understood quite well the description of the scale. When students were asked, "What do you mean when you say your teacher is a good leader?" they were generally supportive of the terms used in the items of this scale and in the description of the Leadership scale in the model for interpersonal teacher behaviour (see Figure 2.4). The following examples typify student responses when they had given a high class mean response on this scale, ie., the students reported that their teacher was a good leader.

> **Jaqueline: Well compared to other teachers, she controls the students well and I can tell that because everyone is listening to her and if someone is doing something wrong she wont yell at them. She will just say it softly, but everyone does what she says.*

> **( It should be noted that in the interests of student privacy all names given in the following transcript excerpts are fictional.)*

*Paul: Oh well she controls us and she is good at teaching what she does and she leads us along the right line and that, you know, what we are meant to be doing.*

*Graeme: Well, he sort of explains things to us and lets us, he leads the class and that sort of thing, and keeps control of the class.*

*Kristen: Um, he manages to keep the class under control when we are a bit rowdy and he shows us the way. He sets good examples, like when we come to class he will give us these pep talks.*

*Kelly: He's like very good at teaching and explains everything well so you understand everything instead of having to go home and ask them what the teacher was talking about and he knows how to control the children without letting them get too out of control but we still muck around a lot and goss. (Gossip).*

*Emily: Um, she was able to keep everybody under control and she was like even if they were naughty she was still nice when she got them to work or showed them what to do. She just had a way with people. She was just great.*

*David: Well, he sort of explains things to us. He is a good influence on us, like he will have fun and stuff but then he will show you that you have to get on with your work and things like that.*

*Kate: Like she teaches us well, she controls the class, she leads us well there is never any mischief in the class kind of thing. When there is she sorts it out.*

*Bill: Um, he is able to lead us in the right direction and show us the right way of things and he sort of if he has got a question like about the future he will be able to answer it and point us in the right direction.*

*Caitlin: He expresses himself, like he doesn't let us take control of him.*

*Simon: Our teacher is a good leader because he never lets the class get on top of him and he makes us want to work. He is in control and is good at organising his lessons.*

*Serena: He's like very good at teaching, and explains everything well so you understand everything instead of having to go home and ask them what the teacher was talking*

*about... and he knows how to control the children without letting them get out of control.*

Students seemed to equate the teachers' leadership behaviour with a sense of fairness. This sense of fairness was also present in the scales of Strict and Admonishing. For example, where students deemed they were unfairly or inconsistently reprimanded, the teacher was perceived as unfair and as exhibiting greater admonishing behaviour.

It is interesting to note that the comments from students for whom the teacher scored lower on the scale of leadership were consistently less positive and reflected their lower scores on that scale. However, it should be noted that the vast majority of students had positive comments about the leadership of their teachers. One exception was, Alison, in a grade 8 science class who said about her teacher;

*I don't think our teacher is a good leader but, yeah, he just lets us get away with too much I think. I don't think he is a good leader. Some kids are able to muck about too much and we don't get so much work done.*

Alison was provided with a definition of leadership behaviour from the QTI, then she was asked if she still agreed with her first comment. Her response was:

*Yes I do. Well, his directions aren't very good and he is not always in control but yes I guess some of the rest is ok I suppose. I think he would be a little lower on the leadership score.*

Other students who had low mean scores for this scale offered the following comments about their teachers' leadership behaviour when asked if they considered their teacher to be a good leader;

*Lynne: Well he gives out our assignments and he doesn't force you or make you, he tells you but you are just having to do it because he is so organised. He says, "I'm not going to do it for you know".*

*Steve: He doesn't make sure the class is really noisy or throws spitballs or something around the class. He lets us muck around and doesn't really tell us off so long as we are not too noisy.*

Some students offered an interesting interpretation of a teacher who scored lower for the scale of Leadership. They suggested that they were in a higher achieving class and that they had chosen to be there. This meant that they were less in need of leadership from the teacher as they were self-motivated to do the work required in that class. Damien's comment summarises the situation well when he says the following:

*No, he really doesn't tell us off very much so that is good. We don't muck around for him much, we don't have any idiots in our class, so he doesn't really need to. We do the work because we chose to do the subject and we chose to be in that class, so we all sort of get on well.*

Students in another class, who liked science also commented on lower leadership behaviour that they perceived in their teacher.

*Kieran: No, not really because I get on with my work well because I like Science. Well teachers which are in control of the class seem to work well when the class is controlled. I think it's good, its really good because we all like science and we all do the work, mostly. We still need to be told to get on with it sometimes though.*

*Sarah: Oh yeh Mr Smith is kind of an easy going teacher and he leads casually, like everyone responds to what he says to do because they like him and because it is laid back.*

However, there were very few students who made comments about a low level of leadership behaviour exhibited by the teachers in their classrooms which was consistent with the results from the quantitative data. Student comments throughout the interviews confirmed that a student's QTI score for the scale of Leadership, was consistent with the comments that those same students made about their teacher in interviews, i.e., a high scoring student for the scale of Leadership

generally had reported that their teacher exhibited high levels of leadership behaviour. This was generally consistent and agreeable with what the QTI sector profiles reported for their class.

*7.2.2 The Helping/Friendly scale (Mean = 2.82)*

The students that were interviewed generally perceived their teachers as helping and friendly in the classroom. Students made comments about the positive relationship between teachers who either had an enthusiastic personality or were enthusiastic about their subject and their high level of helping and friendly behaviour. The students generally used terms that were consistent with the descriptions in the model for interpersonal teacher behaviour.

Melanie when asked about what she thought about the high level of helping/friendly behaviour that was recorded for her class suggested;

> *Um, I think it's like that because I think she is really interested in what she is teaching and so is quite enthusiastic about what she teaches so she is usually helpful in answering our questions.*

Some other student comments that were consistent with a high class mean score for this scale made mention of the ability of the teacher to relax and joke around a little in class. Students suggested that this was sometimes a large factor in their appreciation of the subject.

> *Bronwyn: Um, yeh he has sometimes, he helps you with stuff, he doesn't tell you to go read the books or anything, he helps you personally. I think that he is very friendly which makes it easier to communicate with him and yes he helps you he doesn't sort of expect you to know everything. He doesn't mind joking around with us sometimes so long as we get the work done.*
>
> *Courtney: I'm someone who likes a fair bit of freedom in class. I like to try things my way or try different methods of doing things, like projects and things like that. As well as having the leadership that she's got she lets me, like... do*

*things my own way sometimes or go at my own pace without having the pressure of doing everything the way she wants you to do it.*

*Maxine: Yes that is right she is always helping us and always nice and cheerful and stuff. She just comes around and helps you all the time if you need help.*

*Samantha: Yes. He is a good friendly teacher, helpful, helps us sometimes with extra stuff as well.*

*Keefer: Oh, he is great, yes, he is always looking after us and seeing that we are always up with everything and he knows what he is talking about too. You get teachers who don't but no he is excellent.*

Some students presented information on their teacher's helping and friendly behaviour by relating it to approachability:

*Jacinta: Yes, he is very friendly, if we need help we can ask him anything, he is nice to talk to and so we are not scared of him.*

*Alison: You can approach him and ask for help if you want help or I don't know.*

*Rosalie: Being friendly is really important. Where you have got a strict teacher and everybody is scared of them, they do the work but they don't really like it. I'm not sure, I think being able to have a teacher that can realise that we are actually only 13 or 14 year olds not 43 or what have you.*

When Doug was asked about his high scale score he related it to the nature of the interpersonal relationship between him and his female teacher. The use of the word fairness by other students was common and perceived as an important characteristic of the student-teacher interaction. Doug said:

*....Yeah, she is always willing to help us but she is only willing to help if like you have got to be paying attention all the time. If you don't then she is not willing to help so*

*much, so basically if you don't give your half she wont do hers. I guess that's fair.*

Some students scored a lower than average scale mean score for this scale. Their comments were reflected in the following:

*Barry: He helps us most of the time but sort of if there is a lot of people, he sort of forgets who wants help and then you usually have to ask him again, but sometimes you just don't get a chance because he has to get on with the next section of work.*

*Darcy: Yes, I think if you have got a teacher which has something against you and you have something against your teacher the relationship doesn't really help you learn from the teacher. You tend not to listen to them and you are definitely not friendly.*

*Debbie: Yes, well if you did put up your hand he will come and help you but not all the time.*

*Sarah: Maybe he needs to explain things a bit more or help people a bit more maybe.*

*Murray: Yes, because he is that old so he is kind of like so we are afraid to ask him questions and stuff. He is grumpy a lot of the time but he is head teacher and we have to have him next year as well so we don't complain, we just do what we have to do.*

The student comments for this scale suggest that the QTI is reflecting the perceptions of students well in that they agree with what has been scored for helping and friendly behaviour exhibited by the teacher in their class and the student comments are associated with their QTI scores. A high scale mean score generally results in a positive comment regarding teacher behaviour. The construct validity for this scale is generally supported by student comments.

*7.2.3 The Understanding scale (Mean = 2.82)*

Many students who perceived their teachers as understanding and many used terms to describe the teacher-student interpersonal

behaviour that were consistent with terms in the questionnaire. Some typical comments from students with a high scale mean score were:

> *Sarah: Our teacher does not interrupt you if you are talking and if someone else does he gives them a bit of trouble.*
>
> *Bob: Well if we don't understanding something, he explains it to us and he goes through things with the class if the class doesn't understand.*
>
> *Sam: Well he like, he goes through things that we don't understand as a class again and stuff like that.*
>
> *Sarah: Um, I don't know Mr Smith is really nice, just as long as the teacher is nice and understands you like he does, I can work well.*
>
> *Jack: It is true, yes he is great, everyone likes science because we can understand it, because if we don't understand it the first time, he explains it a different way so we understand it the next. He understands us, we understand science.*
>
> *Brian: Yes.... he understands us and understands our problems because he has children and always relates back to them to tell us about what he is talking about. He takes his time and doesn't rush.*

Students appeared to particularly appreciate it when teachers were patient and interested in their individual concerns. This was most evident when students described times when they were uncertain and in need of explanation of terms or concepts that they did not understand.

> *I think that my teacher is understanding of us as he often is interested in what we are doing and trusts us to do it by ourselves. You can come up to him and question. You kind of feel pretty stupid about asking it, but he says no it's fine and if you don't understand it once he will go over and over it until you do so he is very understanding.*

One female student asked to have the definition of the term "Understanding" given to her. The description given was; "Understanding behaviour is when the teacher listens with interest,

empathises, shows trust, is accepting, looks for ways to settle differences, is patient and open."

> *Sally replied: Yeah, just like everyone she has her days I guess but she is pretty understanding... eh. She is pretty much patient, not so much open as Ms Timsky. We have basically a teacher/student relationship and nothing more but if you ask a question she is willing to help and she is quite understanding too. Like she will hear you out and if she thinks..... like if you hand in an assignment in late and she thinks it is a reasonable reason she is willing to make some sort of compromise.*

The students displayed a good grasp of the terms for the Understanding scale. Many provided examples from personal experiences in the classroom to help to clarify their responses.

Students who had perceived their teacher behaviour as less understanding offered comments such as the following:

> *Darren: Yes, it is lower because he is not so willing to help us if we don't understand it and stuff. He says we should know this stuff and should listen more and stuff. It doesn't really help because some of the time it is just so boring you can't listen and he doesn't really care.*
>
> *Sally: Yes, he does think that he is understanding. He understands what he is talking about, but I don't think he expresses it in the way that kids understand it.*
>
> *Ben: Like he uses all these big words, no one understands and stuff, not using our terms.*
>
> *Robert: I think that the uncertain picture is about the same as what happens I reckon, because there are a lot of people that didn't understand chemistry or physics this year and yeh, its because I think I didn't go very well because I found it so boring and were just not interested in it. So I just can't sit there and learn about it.*

Students commented that they preferred to have a teacher that demonstrated that they were understanding when they had difficulties and that this showed them that the teacher cared about them. Generally, the comments from students supported the answers that they gave on the questionnaires and the scale does appear to be assessing the understanding behaviour of the teacher.

*7.2.4 The Student Responsibility and Freedom scale (Mean = 1.73)*

When students with favourable class mean scores for the scale of Student Responsibility and Freedom were interviewed students reported that they perceived the teacher in a manner consistent with the data from their questionnaires. For example, Brian was concerned for the well-being of students and understood the need for some strictness, the opposing scale to student responsibility and freedom. He balanced the need for strict behaviour in a science class with the students' need for freedom when he made the following comments:

> *Well science is a pretty dangerous class so you can understand why people just can't run around mixing chemicals and all that kind of stuff so it is understandable why you have to have some restrictions. He allows us to go at our own pace, but he is not very lenient with us, he keeps us on track but that is science I suppose.*

Similarly, students who had a low scale-mean score in the questionnaire were consistent in their less positive comments about their teacher's interpersonal behaviour and were able to verify this feeling. Students recognised the need for a lesser degree of freedom and a greater level of control by the teacher during dangerous experiments or practical demonstrations. For example, some students commented:

> *Melissa: Oh, you can talk but not in like the experiment time, you can talk pretty loudly in normal classes and sometimes he yells or tells us off a little bit but he doesn't give really bad punishments or anything.*

*Kyle: Yeh, well when we do like experiments and that, he kind of makes, he does what any teacher would do... make sure everything is under control, make sure all the Bunsen burners are off and like so nothing would happen and that no one would get hurt. I can see why but I still like to play with fire.*

*Jane: We get a lot more because we are an extended class because we chose to do another subject of science. We get a lot more prac so I think we are more than that. We do get more responsibility and if he needs to go grab some stuff we can be trusted in the prac classroom so we have got a lot of responsibility which we really enjoy as well and no one ever abuses it.*

*Alex: Um, yeh he gives, he lets us take responsibility of if we are doing an experiment like we have to take responsibility but yeh so I agree with what is on the chart.*

*Dylan: I think it should be higher, because we can have time to work on our science projects and stuff. We have two classes with them, investigations which is an extension science class and we have heaps of time to work by ourselves on that, so he trusts us like that.*

Though not common amongst student reports, there was one interesting tale of lack of student responsibility and freedom given. No doubt, this sort of mistake has happened to many a teacher but, the way it is handled probably differs greatly dependant on the teacher's confidence and sense of control in the classroom. Sally recounts her horror afternoon:

*Yes, she doesn't seem to trust us or give us responsibility. Like for instance we built something and a magnet went missing and we couldn't find it anywhere and she wouldn't let anyone out. We were all kept in the whole lunch hour and then she found it on her desk and she was blaming it on us. We got a big lecture about stealing and things like that. It didn't make me feel good about science that day but overall I like science, especially the experiments.*

Donna's class reported in their questionnaires that her teacher scored low on the student responsibility and freedom scale. When asked about whether the students are given the opportunity for independent work

in her class Donna said

> *She just got us to write down notes from the board and stuff like that. Weren't allowed to talk or anything if you had finished your work and you have to catch up on some other science work then she just wont let you go and finish that. You have to just put down your pens and just stop.*

There were different degrees of student freedom and responsibility perceived in classes in this study. Other students who scored the scale mean score low commented that:

> *Barry: If the teacher was not so good at controlling the class then she would time the classes and give us set tasks for each few minutes to keep everyone on track. This made that classes really boring and did not give us a chance to say much.*
>
> *Vincent: Oh, we didn't really get much responsibility because he did most of the experiments.*
>
> *Wendy: Well like we don't get much of a chance to talk. Like we do when we are working but when we start getting a bit noisy well we are not allowed to leave our seats or nothing like that, so when we are disturbing other people I suppose that is when we get into trouble most of the time so we don't have a lot of freedom in that sense when we muck around.*

Students commented generally that they preferred a class where there was some control but where they could have some say in deciding some things in the class. Students suggested in an informal discussion after an interview session, that they recognised that they could not have it all their way but liked teachers who were able to make them feel a part of what was going on in their classes.

In classes where individual students scored this scale with a high scale mean score student comments were generally more positive. Some examples are:

*Sonja: Well she always puts us to work and enjoys, keeps the class quiet and happy and everything and she always makes sure that everyone is being responsible and if anyone isn't she will deal with them in an appropriate way.*

*Patrick: Um, I don't think it is that low, really. I think he probably gives us a bit more freedom and responsibility than that. Hmmm. He makes us feel quite responsible but maybe gives us not that much freedom.*

*Melinda: Well it depends what we are working on. At the moment we are working on surveys and we have to be responsible for that because we have to hand them in at the end of the term and he is trusting us to do all the work and everything. But if we are doing sort of normal maths he expects us to do all the answers. Um, probably we didn't really have much freedom then because we were sort of in the middle of a unit and he was trying to teach us everything so we get the hang of everything.*

*Gillian: Yes, we did get a fair bit of responsibility, like doing activities by ourselves and he trusts us to do that, pracs and stuff.*

*Lee: Um, he does give us freedom in class. I suppose I am not quite sure why, they do in a way but they don't think we are responsible enough to do stuff we want to do all the time.*

*Naomi: We get a lot more freedom in class to have a say in what happens because we are an extended class and because we chose to do another subject of science. We get a lot more prac so I think we are more responsible and that. We do get more responsibility and if he needs to go grab some stuff while we are in only prac sessions, we can be trusted in the classroom so we have got a lot of responsibility which we really enjoy as well and no one ever abuses it.*

Where students recognised a danger in experimental sessions, the need for the teacher to exercise more caution and allow less freedom was commented on and supported by students. Generally the student comments concurred with their QTI scores and supported the construct validity for the scale of Student Responsibility and Freedom.

*7.2.5 The Uncertain scale (Mean = 1.01)*

This was an interesting scale to discuss with students as most looked upon their teachers as having high levels of confidence and consistently low levels of uncertain behaviour. When students had low scale-mean scores they were prepared to support their teachers confident behaviour in class and typically reported comments such as the following:

> *Carol: She knows what she is doing, so I don't think that she lacks confidence. She is usually pretty sure of what she is teaching and doesn't have any problems answering our questions. If it was another teacher in this school which I know, the answer would be yes he is uncertain, but not this teacher.*
>
> *Shanti: Yes, what is on the chart is good, she is very confident.*
>
> *Kelly: She always knew what she was talking about but listened to us if we had other ideas. Sometime we were right and she was wrong but this did not phase her much.*
>
> *Ben: No, he is not uncertain, not really. He is pretty confident, he is usually happy with us and happy with the way we are going. He doesn't put us down or anything and he is a good leader so we listen to him.*
>
> *Brydie: Well I think he is not that timid he knows what he has to do in the class. If he does something wrong he apologises and restates what he was supposed to say and stuff like that so.*
>
> *Darren: Yes, I don't think Mr P is like that, no he is not unhappy or timid at all. If he has had a bad weekend like he went to an expedition and things went bad he tells the class what he did and stuff so we are interested. I guess it is nice to see that he makes mistakes too.*
>
> *Thomas: Well Mr W isn't that glum but if he thinks something is wrong he questions like are you feeling all right etc. But I mean if we are doing a science test or experiment and he said well why did that happen? That's appropriate I think.*

*Beverley: She knows what she is doing, so I don't think that she is uncertain. She is usually pretty sure of what she is teaching and doesn't have any problems at all answering questions.*

*George: No, he is not uncertain. He knows exactly what he wants to do each lesson and we get to do what he wants. He knows what he is doing and always knows what he is talking about.*

It was difficult to find examples of students who scored teacher behaviour as uncertain. Some students who did have a higher than average mean score suggested that:

*Cheryll: When the teacher is not really confident in a class it is possible to do what you like by talking to the teacher about other things.*

*Kelly: I really hate the fact that his favourite word is sorry. we should be saying this.*

*Kyle: Well I think he is not that timid. He knows what he has to do. If he does something wrong he apologises and restates what he was supposed to say.*

*Madeline: She seems to watch the clock all the time like she is just waiting to get out at lunch. We often get out early when we are noisy and she just gives us book work to do a lot of the time.*

Some students did not agree that these teachers were easy to make a fool out of, they laughed at this idea, but thought that it was possible to get what they wanted by being nice and talking about things that the teacher liked.

The uncertain teacher in this case was at the end of her career and in a position to get out of teaching soon. She was aware that the students were able to manipulate her but she was happy that they were occupied in her classes.

It should be noted that the majority of teachers were perceived by their students as being highly confident and low in uncertain behaviour during the interviews. This was consistent with the data from the QTI which reported the lowest scale mean of all the scales, (1.01), for all students. The scale does indeed appear to assess uncertain behaviour in the teacher.

*7.2.6 The Dissatisfied scale (Mean = 1.11)*

General student opinion on this scale was that their teachers were not dissatisfied as exemplified by the low scale mean for dissatisfied behaviour.

An example from one class where a student scored her teacher higher on the dissatisfied scale than the class mean follows.

> *Jacqui: Yeah, she always sort of doesn't really smile much when you say hello, she will just say oh. It is nice when someone says hello and then your name. She doesn't use our names and things like that.*

Among other students who scored higher scale-mean scores were:

> *Val: Well she didn't ream it out on the class if something was wrong but she never seems happy.*
>
> *Eddy: We always seem to spend a lot of time getting quiet in class at the start of a lesson and she never says anything.*
>
> *Mike: Oh, he did have a bit. He was a bit dissatisfied this term but we are a hard class.*

Generally, the trend for students who scored low levels of dissatisfied behaviour was for students to make comments like:

> *Samantha: No, she is not very unhappy, in fact I think that she has a lower level of dissatisfied behaviour than the chart shows.*

*Erica: Um. Sometimes he is but maybe that is just me. But no he is not that much, he doesn't have that much dissatisfied. No he doesn't criticise us and he doesn't look unhappy.*

*Trevor: Well I think he is not dissatisfied at all. He doesn't get angry and he pretty much lets us do what we want.*

*William: No, I don't think he is dissatisfied in any way, he gets along with everybody and everyone gets along with him and he never ever seems to be angry or anything like that.*

*Lyn: No. He just, he's normally happy in the class. Doesn't really make us copy a lot of notes, he just shares his thoughts with us and we listen.*

*Bob: He's very satisfied with what we do and if you don't do well in your test he has a friendly talk to you and he sort of explains it and after that he keeps an eye out and sees if you understand everything so you can do well.*

*Simon: Oh she never really criticises us at all so, I reckon that is a fair indication and she like, whenever we need a question or whenever we have a problem she is always the first one to help us.*

When students were asked to comment on how much dissatisfied behaviour they thought their teacher exhibited their comments were generally consistent with what had been reported by them on the QTI and supported the construct validity for the Dissatisfied scale.

*7.2.7 The Admonishing scale (Mean = 1.41)*

Students were able to identify well with the terms used in the Admonishing scale, such as "this teacher gets angry unexpectedly", and generally suggested that their teachers did not frequently display admonishing behaviour. Students often related teacher behaviour on this scale with a sense of what they considered fair punishment for their actions and some added that they sometimes deserved the anger that they got. For example, the following comments where students recorded the teacher as having a low scale mean score for admonishing behaviour were common and reflect general student opinion.

*Hamish: Well she really only punishes you or gets angry when you deserve it so I reckon that this is right.*

*Amelia: Yes, he only ever gets angry when he needs to get angry. He doesn't take out his bad moods on us.*

*Sophie: He doesn't get angry over little things. He will get angry over, it takes a lot for him to get angry and when he does get angry, he really does hit the roof.*

*Justin: Yeah, he doesn't get angry often but when he does it is because we have asked for it. That is about right for us, there on the chart.*

*Alex: The way she hands out punishment means that it doesn't feel like you have just had punishment. It feels like you are actually learning something. She does it in a pleasant way so you listen to her instead of feel bad.*

*Phu: Okay, yeh, because he doesn't really get angry, he just moves you away from everyone like sit over there so you don't talk much.*

*Kim: Yeh, he doesn't lose his temper very much but when he does it is reasonable for him to, like if someone is really naughty then you know he is going to get angry because it is quite reasonable.*

*Edwina: She never gets angry just for no reason, she usually has a good reason if there is something.*

*Graham: He doesn't get angry over little things that we do. and it takes a lot for him to get angry. When he does get angry, he really flies off the handle.*

*Peter: Well he doesn't get angry really fast, he waits for a while and gives warnings and then if you acting not very well he sends you out of the class or something.*

*David: He doesn't get angry, like if someone does wrong he just tells them to be quiet and sit down.*

A small number of students who perceived their teacher as exhibiting higher levels of admonishing behaviour related this perception to their feelings of what was fair behaviour in their view. The sense of fairness was related then to self concept. In

one case where the student had scored the admonishing scale higher than the mean for the scale she just said of her teacher that:

> *I think he is sarcastic.*

When asked "What do you mean when you say sarcastic?" Alicia said:

> *He makes stupid jokes and stuff and makes me feel bad. He gives us lots of theory and very little practical work and is impatient when I ask questions.*

Students generally commented that they really disliked it when the teacher got angry for no reason but were happy that this seemed to happened very infrequently. Some students who recorded a scale mean score that was higher than the mean for their class made the following comments;

> *Brydie: She is sometimes in a bad mood and bites our heads off for no reason but it usually passes and the next time we see her she is fine. She really likes us most of the time.*
>
> *Alice: Yeh he doesn't get angry that easily. I suppose every teacher has got to be angry some time but they should have a good reason.*
>
> *Beatrice: I like it when he doesn't get very angry very often? I hate it when the teacher gets angry for no reason.*
>
> *Bob: I don't know, I suppose occasionally he gets a bit angry but I don't know, I wouldn't say he has too many days like this.*
>
> *Kelly: She doesn't take any excuses that is it, even if they are real ones!*

The low mean scale score, (1.41), for this behaviour would suggest that the students do not see their teachers as admonishing. This view was supported by the student interview data presented in this section and further supports the construct validity for this scale.

*7.2.8 The Strict scale (Mean = 1.79)*

Students were able to readily identify what was meant by the term strict. They generally scored their teachers with a low to mid-range score on this scale, as the scale means would suggest.

The type of activity that was being undertaken seemed to have an effect on the students willingness to accept higher levels of strict behaviour. This is consistent with the findings for the opposing scale of student responsibility and freedom reported earlier in section 7.2.4. For example, one female student on a laboratory session in science commented;

> *Sharon: We don't like her to be strict but when we are doing dangerous things like mixing chemicals we need her to be strict or we might burn ourselves or something. We saw on a science day that just because a chemical is clear it doesn't mean you can drink it. Oh well in some way I guess teachers have to be strict or we wouldn't get any work done but only when necessary. We like to have a friendly, strict and good leader as a teacher.*

Another girl added:

> *Jane: Um, yes he is strict. Most teachers are strict but he is probably more strict than most because of what we are doing in Science because it is dangerous. We don't know what all these chemicals do so I guess he has to control us a lot.*

Another female student echoed this and added an interesting juxtaposition with the scale of helping and friendly behaviour. She reflected the general feeling of the students interviewed when she offered the following insightful comment.

> *Yes. He is not very strict, because like some teachers will sit you down and make you do your work, whereas he is like I can't make you do it, if you want to learn then you can and I*

*will help you but if you don't want to then it is your problem. This gave us a choice, we didn't feel afraid of this teacher. He doesn't push you, so if you don't want to know anything about physics then you just don't do it, so long as you don't disturb others in the class. We would want to do it because we had a say in what we could do. Most of the time when we did experiments in that class a few kids would stuff it all up for everyone else and then we weren't allowed to do it so we like it when he is strict in Labs.*

The relationship between strictness and student responsibility and freedom is clear from these comments. The circumplex nature of the model for interpersonal behaviour, (see Figure 3.1) suggests that there is a negative correlation between the scales that are opposite, in this case Strict and Student Responsibility and Freedom. These student comments about the balance between the need for strict and orderly behaviour and the need to feel that students have some freedom and a say in what is going on support the circumplex nature of the model.

Generally students had comments such as the ones following for high scale mean scores:

*Joel: Yeah, our teacher is strict alright...Well, like when people didn't hand things in on time, they were kept in and things?*

*William: He doesn't let us muck around, he is not real strict or anything but he knows, he doesn't let us muck around and so we do well in maths.*

*Anita: Oh, she is fairly strict with homework and things and we have a lot of class rules but at least we all know what the rules are so we can follow them.*

*Andrew: Um, she's strict, um yeh. That's probably all I can say.*

*Talitha: Yes. She was strict but fair. Oh well being rather strict is good because she has more control over the class?*

*Mark: Yeah, She is strict but she is not overly strict. Just right.*

*Darren: With some students he is strict more than others because they play, they muck around, play up and be naughty; but yeh he is pretty happy with when you get things done on time and things like that. I suppose every teacher has got to be strict to a certain extent. He's fair when he is strict.*

*Damien: He is pretty strict, not yelling all the time, just fairly strict. Yeh, he makes us keep on the job.*

Student comments for students who had scored lower scale mean scores were in the spirit of the following comments:

*Ravin: with a less strict kind of teacher you are less inclined to work hard and have low standards. You don't really worry about it that much. A strict teacher would be pretty good, because you sort of learn a lot more. Probably wouldn't be as fun, but still its not the most important thing.*

*Tony: Strict? Um, Mr Smith isn't really that strict. He really doesn't need to be because he gets it through the ways of just understanding kids basically. Because once you see that you don't really have to go overboard and understand his rules, so he is not really that strict.*

*Mike: Well he is not really strict. Like as long as you pass in your work and everything it is okay but otherwise though you can basically do what you like.*

*Selisha: Yes. He is not very strict, because unlike some teachers who will sit you down and make you do your work, whereas he is like, I can't make you do it. If you want to learn then you can and I will help you but if you don't want to then it is your problem. He doesn't push you, so if you don't want to know anything about physics then you just don't do it.*

*Bill: Yes. He wasn't really that strict at all. He is pretty much, if you want to work it is up to you, not too bad.*

*Peter: Um, well we have a very good class, it is very good so he doesn't really need to be that strict because people are very good in it.*

*Jacinta: Ms J is a bit too friendly. I don't work because usually for me teachers have got to be a bit strict to get me doing work. But I like it pretty much if they are not strict like Ms J.*

*Herbert: I'm not sure. Well yeh, he is not strict. I probably think he could be a little bit stricter than he is, not quite as much free time as he lets us have.*

*Jeremy: He is sort of strict. He is good at sort of getting what we have to do across and um, and he is not terribly strict so he lets us muck around a bit, yes I would agree with what is scored on the picture.... Because we are sort of his and he always allows us to talk a bit and muck around a bit and make it a bit more fun but yes. I would just say he is just a bit lenient.*

Comments offered by and elicited from students for teacher strict behaviour generally supported the construct validity for the QTI.

### 7.3 Summary of the QTI Construct Validation Data

This pattern from the qualitative data was consistent with the view expressed through the questionnaire data. The Construct validity for the QTI was supported by the Qualitative data presented in this chapter. Those students that reported during interviews that their teacher was perceived as a good leader were in fact the same students that scored high scale mean scores on the QTI scale of Leadership. This was consistent for all scales of the QTI and suggests that the QTI is measuring what it sets out to measure.

Students were able to quickly associate the sector profile diagrams that represented scale mean scores for each of the scales of the QTI for their classes. Students in this study were generally in agreement with the representations of the quantitative class data for each of the scales of the QTI represented on the sector profiles. This also reinforced the notion that the QTI is a reliable, valid and useful instrument that teachers can use to gather data upon which to reflect on their teacher-student interpersonal behaviour. The next chapter presents a summary of conclusions for this study.

# CHAPTER 8

# CONCLUSIONS

## 8.1 Introduction

This chapter provides a synthesis of the material presented in the preceding chapters with the aim of answering the research questions outlined in Chapter 3. Conclusions are then drawn from this information, the significance of the study noted, directions for future research indicated and concluding remarks are made.

Chapter 1 introduced the origins of this thesis and presented an overview of the thesis. Chapter 2 established the conceptual framework for this study by reviewing the literature on which studies of learning environments are based and provided an historical perspective on learning environment instrument development to the QTI. Chapter 3 presented the research questions and gave a detailed description of the methodology and rationale that prompted the use of both qualitative and quantitative research methods. Chapter 4 presented descriptive statistics to support the validity and reliability of the QTI when used with a large Australian sample of teachers and their students. Chapter 5 presented data describing sex differences in student perceptions of teacher interpersonal behaviour, associations between teacher interpersonal behaviour with attitude and cognitive achievement. The chapter included information on effect size calculations for primary variables. Chapter 6 reported data for the two teacher versions of the 48-item version of the QTI, namely the Teacher Ideal version and the Teacher Actual version and discussed the practical applications that can

be made from using the QTI in classrooms. The construct validity for the QTI was supported by the qualitative data presented in Chapter 7.

The current study provides validation data for the 48-item QTI when used with the largest Australian sample of lower secondary science students collected to date. The sample consisted of 3,215 lower secondary science students in 158 classes in 43 schools in two states of Australia, namely Tasmania and Western Australia. This study is the first to provide a unique and distinct examination of the relationship between teacher interpersonal behaviour in lower secondary science learning environments and student sex, cultural background, student attitude to science and student enquiry skills in two Australian states.

## 8.2 Major Findings of the Study

There were seven research questions proposed in this study and each is addresses in terms of the results.

> Are the three forms of the QTI used in this study reliable, valid and able to differentiate between classrooms when used with a large Australian sample of lower secondary Science classes?

The results from this study, presented in Chapters 4 and 7 show that the QTI is a valid and reliable instrument for use with lower secondary science classes in Australia. The alpha reliability figures for different QTI scales ranged from 0.62 to 0.86 when the individual student was used as the unit of analysis, and from 0.72 to 0.92 when the class mean was used as the unit of analysis. It was found that each of the eight QTI scales differentiated significantly ($p<0.001$) between classes and that the $eta^2$ statistic, representing the proportion of variance explained by class membership, ranged from 0.16 to 0.31 for different scales. Thus, this study provides further evidence that the QTI is an internationally valid

and reliable instrument with which to measure teacher-student interpersonal behaviour.

The teacher data provided alpha reliability figures for different QTI scales which ranged from 0.72 to 0.92 for Teacher Actual scores and 0.62 to 0.86 for the Teacher Ideal scores of the QTI. This data supports the internal consistency of the teacher versions of the QTI.

The construct validity for the QTI was supported by the qualitative data and the quantitative data. Those students who reported that their teacher was perceived as a good leader were in fact the same students that scored high scale mean scores on the QTI scale of Leadership. This pattern or response was generally consistent for all scales of the QTI and suggests that the QTI is measuring what it sets out to measure. Student comments about the balance between the need for strict and orderly behaviour and the need to feel that students have some freedom and a say in what is going on in the teacher-student interaction in a classroom support the circumplex nature of the model for interpersonal teacher behaviour.

The second research question was:

> What associations are there between science student perceptions of teacher-student interpersonal behaviour and student sex?

The results from this study suggest that there are statistically significant sex differences in students' perceptions of teacher-student interpersonal behaviour for seven of the eight scales of the QTI. The magnitude of these differences is not large but the differences generally indicated that females perceived their teachers in a more positive way than did males. It was found that females perceived greater helping/friendly and understanding behaviours in their teachers. Males perceived their

teachers as being more uncertain, dissatisfied, admonishing and strict and as exhibiting more student responsibility and freedom behaviours. It should be noted that there were no in-class comparisons made and as such caution should be exercised if generalizing beyond the sample used in this study.

The third research question that was proposed for this study was:

> How do science student perceptions of teacher-student interpersonal behaviour differ with student cultural background?

The results from this study found that there are differences in student's perceptions of teacher-student interpersonal behaviour that are associated with student cultural background for the two indicator variables used in this study, namely the parental birthplace and the primary language spoken in the home. For both of these variables students from an Asian background perceived their teachers significantly more positively than did those from the other cultural groups used in this analysis.

It is interesting to note that when compared with males from other cultures, Asian male students had the highest scale mean scores for all four behaviours on the right hand side of the model for teacher interpersonal behaviour. This was consistent with the female data findings, where Asian females had the highest scale mean scores for all four behaviours on the right hand side of the model. This suggests that whether the sample be comprised of males, females or both, Asian students perceive the learning environment more positively than do students from other cultural groups.

Chapter 5 provided results for the next two research questions. The fourth research question proposed in this thesis was:

> What associations are evident between students' perceptions of teacher-student interpersonal behaviour and student enquiry skills?

The results from this study indicate that there were seven significant relationships ($p<0.05$), out of the eight possible, between teacher-student interactions and cognitive achievement. Though the percentage of the variance in student cognitive achievement attributable to teacher-student interpersonal behaviour was only about 8% there were positive associations found. These associations were positive for the scales of Leadership, Helping/Friendly and Understanding. The scales of Uncertain, Dissatisfied, Admonishing and Strict displayed significant negative associations for cognitive achievement. From this information, this study concluded that cognitive achievement was higher where the teachers demonstrated more leadership, helping/friendly and understanding behaviours and less strict, dissatisfied and admonishing behaviours.

The fifth research question proposed was:

> What associations are evident between students' perceptions of teacher-student interpersonal behaviour and student attitude to science classes?

This study found that there were eight significant associations between teacher-student interpersonal behaviour and student attitude to class. These associations were positive for the scales of Leadership, Helping/Friendly, Understanding and Student Responsibility and Freedom for attitude to class. The scales of Uncertain, Dissatisfied, Admonishing and Strict displayed significant negative associations for attitude to class. The greatest contribution to attitude occurred when teachers exhibited more leadership and helping/friendly behaviours in their classrooms and were less strict, dissatisfied and admonishing.

Data from this study suggests that 40% of the variance in student attitude was due to teacher-student interpersonal behaviour.

The sixth research question proposed in this study was:

> Are student comments about their teachers' interpersonal behaviours similar to those resulting from the use of the QTI thus supporting the construct validity of the QTI?

This study found that the qualitative data was consistent with the view expressed through the questionnaire data and reinforced the construct validity of the QTI. Students in this study were also generally in agreement with the representations of the quantitative class data for each of the scales of the QTI represented on the sector profiles.

The final research question proposed in this thesis was:

> Can the QTI be used as a source of information to establish a suitable feedback process of use to teachers in science classrooms causing them to reflect on their teaching?

What this study has shown is that when teachers described the perceptions of their own behaviours, they tended to see them a little more favourably than did their students. On average, the teachers' perceptions for all scales were between the students' perceptions of actual behaviour and the teachers' ideal behaviour. The differences in these mean scores indicate that teachers think that they behave closer to their ideal than their students think that they do. Teachers could apply much of this research in their teaching. These differences provide the impetus and the direction for individual teachers to examine their learning environments more closely. In particular, based on this

information, teachers might decide to change the way they behave in an attempt to create a more desirable classroom environment. They may choose to work toward ensuring those behaviours that have been found to be associated with positive student outcomes are present in their interactions with students.

This study reinforces the notion that the three versions of the QTI do provide the Australian lower secondary science classroom teacher with valuable information that can be used as a basis for self reflection on their own teaching performance.

## 8.2 Implications of this Study

This study has made a significant contribution to the validation data for the QTI in particular with a large Australian sample. Studies that follow now have a large sample set of data with which to make comparisons.

The data collected in this study demonstrates that Australian science classes already represent a multi-cultural society. The data from the Australian Bureau of Statistics serves to demonstrate that the implications of this study will become increasingly important as time progresses in terms of the cultural background of students in our schools. The question of whether there are any effects on student-teacher interpersonal relationships or student outcomes due to cultural differences seems to be one that is likely to have increasing value for Australia.

The different cultural backgrounds of students in a class has been shown to have an influence on how students perceive the learning environment. Teachers with students of different cultural backgrounds in their classrooms should not interact with students as a homogeneous group but take these factors into account when

interacting with different students. It is clear that the need for more regular feedback from students would help teachers understand better how students perceive those interpersonal behaviours that have been shown to be linked to student achievement and attitude to science. Furthermore, teachers who are sympathetic to differences in student sex and cultural background factors of their students reduce the uncertainty and risks of providing interaction behaviours that are detrimental to students of particular sex or cultural background groups.

This study suggests that if teachers wish to improve the achievement and attitudes of their students then they should ensure that those behaviours that have been found to be empirically linked to these variables should be present in their classes. The interpersonal behaviours that are more positively associated with enquiry skills, or cognitive achievement in class, are leadership, helping/friendly and understanding behaviours. For a more positive student attitude to class, the behaviours of leadership, helping/friendly, understanding and student responsibility and freedom were positively associated to attitude to class.

It has been said that incorporating learning environment ideas into teacher education programs could lead to an improvement in those programs (Fisher & Fraser, 1992). A key result of this research is to provide teachers with a practical means by which they can monitor and evaluate what is happening in their classrooms to better serve the needs of their students and science education in general to improve the quality of teaching and learning.

With the increasing accountability of performance indicators and school comparisons, the direct implications of associations between student attitude and achievement become important factors for any school wishing to improve its performance against competitors.

The interview data were found to support the construct validity of the QTI and was consistent with the findings of the quantitative data. Based on this association between the two methods of data collection and their positive association, teachers may choose to use discussions with students as a preliminary indicator of the nature of the teacher student interpersonal behaviour in their classrooms. This could then be used to prompt the introduction of the QTI to gather quantitative data from the whole class and encourage teacher self reflection on teaching practice.

## 8.3 Future Directions and Further Research

The wider application of the findings of this study prompts some other future directions for research into classroom learning environments.

As this study has progressed over the past three years, the idea that it would have a start and a distinct end have diminished. The possibilities for continuing research based on what this study has discovered in science education prompts questions about what may be happening in other areas of education. For example, are there parallels in mathematics education and what of the technology classroom? Can we make associations between the physical learning environment and what we now know about the psychosocial learning environment?

The real world implications from this study return now to the theoretical framework for human environments proposed independently by Moos (1968) and Walberg (1968) and the origins of learning environment research. Three decades on from the development of the first learning environment instruments, to 1998 and the year of submission for this thesis, is after all but a small fragment of time in terms of how long people have been interacting with each other. The findings from this study have broad and global implications for teachers, teacher educators and in fact any person that

experiences teacher/learner types of interactions. These interactions may take place in learning environments such as psychiatric hospital wards, school classrooms, correctional institutions, military companies, university residences or work place environments as identified by Moos and others all those years ago. In these environments however, the interactions take place and the feedback is immediate. These synchronous interactions allow the communication patterns between participants to evolve relatively quickly, due to the immediate and public nature of the communications, such as in a classroom where all students can hear what is going on in the class. But what of the plethora of learning environments where the nature of the interaction is asynchronous and more private? These interactions may take place in locations such as an internet based university course or a distance education situation such as Australia's famous school of the air which may use a combination of Flying doctor HF radio, fax machines, satellite telephones and computers in very remote and rural locations. Here the interactions may be of a much more impersonal and asynchronous nature where feedback is delayed for the participants. Future research could divest itself from science classrooms alone and re-examine these other learning environments for new developments and associations with the variables identified in this study and interpersonal behaviour from a systems perspective.

Further studies could be carried out to determine if there are differences in the perceptions of primary, lower level and upper level secondary school students' perceptions of teacher-student interpersonal behaviour. The development of a suitable lower primary level instrument may allow a longitudinal study that follows student perceptions of teacher-student interpersonal behaviour through a students' school career would be very interesting. It may seek to determine the long term effects of schooling and the importance of the teacher-student relationship on the students' perceptions of life long learning and motivation to participate in higher education.

The development and modification of the QTI to become an even leaner instrument, with fewer than the present 48-items. It could be used more frequently by teachers to assess the nature of the teacher-student relationship at critical points in the school year which would result in a dynamic and longitudinal profile for teachers of their interactions with students over time. This could be linked to student outcome measures used by that teacher to examine associations between selected variables and provide a useful benchmark for examining curriculum innovations as they are introduced to a class.

It would be particularly interesting and exciting to identify a set of Australian teacher typologies as has been identified in studies in The Netherlands (Brekelmans, Levy, & Rodriguez, 1993; Brekelmans & Wubbels, 1992) utilising data from the United States and The Netherlands. No study to date has identified Australian typologies. If this research were completed it could help us to understand better if the teacher typologies previously identified can bee applied in the same way to an Australian sample of teachers and indeed if the same typologies exist in Australia.

Another key element of research that could be carried out to build on the research in this study would be to investigate more deeply the nature of the differences between student and teacher versions of interpersonal behaviour. For example, the sex differences in teacher perceptions and student perceptions of interpersonal behaviour. Do students prefer to have same sex or opposite sex teachers? Does this affect student outcomes such as attitude and achievement? Do students prefer classes with the same or opposite sex teachers? Do students who share the same culture as the teacher respond differently than teachers who don't?

An interesting aspect of future studies that could take advantage of a limitation of this study would be to investigate a larger sample of students who have parents born in countries located in North and South America. For this study, the limitation of having such a small representation of students from this group resulted in these students being removed for analysis of the cultural background data.

There is much in human interaction that is non-verbal and remains beyond the "threshold of language" (Hernadi, 1995, p. 38) and yet contributes to interpersonal behaviours and communication. These non-verbal elements are important as they may both initiate and sustain communication by providing feedback to the interactors (Hargie, Saunders, & Dickson, 1981, p. 22). An integration of the findings from this study with an examination of the non-verbal elements of classroom interaction and communication patterns that may take place would be a unique and interesting contribution to the knowledge base of classroom learning environment research.

## 8.6 Chapter Summary and Concluding Remarks

This thesis provides the first study of associations between teacher-student interpersonal behaviour, sex, cultural background, attitude and achievement in Australian lower secondary science classes in two states of Australia. The study identified associations between student's perceptions of their teacher's interpersonal behaviour and their sex, cultural background and cognitive and attitudinal outcomes. As a result it has provided the first large scale validation data for the QTI in Australian science classes in Tasmania and Western Australia and one of the first uses of both quantitative and qualitative data for construct validity of the QTI in Australia. It is also one of the first QTI studies in Australia to include effect size data.

The results from this study have implications for science teachers who are interested in developing more positive and productive learning environments for their students. The conclusions are designed to be specifically applicable to science learning environments but in principle are broadly applicable to learning environments in other areas where similar interpersonal interactions take place. The findings from this study add to the maturing global knowledge base of teacher-student interpersonal behaviour and science learning environment research.

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# APPENDICES

# APPENDIX A.

## Teacher Ideal Version of the Questionnaire on Teacher Interaction (QTI)

Office Use only

| ___ | _ | __ | 00 | 1 |
|---|---|---|---|---|
| SCH | TCHR | CLS | STU | QTI |

# Questionnaire on Teacher Interaction

## Your Ideal Teacher Questionnaire

The following questionnaire asks for your view of an ideal teacher's behaviour. Think about your ideal teacher and keep this ideal teacher in mind as you respond to these sentences.

The questionnaire has 48 sentences about the ideal teacher. For each sentence, circle the number corresponding to your response. For example:

| | Never | | | | Always |
|---|---|---|---|---|---|
| The teacher would express herself/himself clearly. | 0 | 1 | 2 | 3 | 4 |

If you think that ideal teachers always express themselves clearly, circle the 4. If you think ideal teachers never express themselves clearly, circle the 0. You also can choose the numbers 1, 2 and 3 which are in-between. If you want to change your answer, cross it out and circle a new number. Thank you for your cooperation.

**In order for us to provide you with a report of the results, please write your name and other details at the top of the reverse side of this page.**

DF:TR:BF 1996/QTI 1 Modified by T. Rickards

Name_____ Class_____ School_____

Please circle the appropriate response: Gender: male female

Years of teaching: 1--5 6--10 > 10

| | Never | | | | Always |
|---|---|---|---|---|---|
| 1. The teacher would talk enthusiastically about her/his subject. | 0 | 1 | 2 | 3 | 4 |
| 2. The teacher would trust students. | 0 | 1 | 2 | 3 | 4 |
| 3. The teacher would seem uncertain. | 0 | 1 | 2 | 3 | 4 |
| 4. The teacher would get angry unexpectedly. | 0 | 1 | 2 | 3 | 4 |
| 5. The teacher would explains things clearly. | 0 | 1 | 2 | 3 | 4 |
| 6. If students did not agree with the teacher, they could talk about it. | 0 | 1 | 2 | 3 | 4 |
| 7. The teacher would be hesitant. | 0 | 1 | 2 | 3 | 4 |
| 8. The teacher would get angry quickly. | 0 | 1 | 2 | 3 | 4 |
| 9. The teacher would hold the students' attention. | 0 | 1 | 2 | 3 | 4 |
| 10. The teacher would be willing to explain things again. | 0 | 1 | 2 | 3 | 4 |
| 11. The teacher would act as if she/he did not know what to do. | 0 | 1 | 2 | 3 | 4 |
| 12. The teacher would be too quick to correct students when they broke a rule. | 0 | 1 | 2 | 3 | 4 |
| 13. The teacher would know everything that goes on in the classroom. | 0 | 1 | 2 | 3 | 4 |
| 14. If students had something to say, the teacher would listen. | 0 | 1 | 2 | 3 | 4 |
| 15. The teacher would let students boss her/him around. | 0 | 1 | 2 | 3 | 4 |
| 16. The teacher would be impatient. | 0 | 1 | 2 | 3 | 4 |
| 17. The teacher would be a good leader. | 0 | 1 | 2 | 3 | 4 |
| 18. The teacher would realise when students did not understand. | 0 | 1 | 2 | 3 | 4 |
| 19. The teacher would not be sure what to do when students fooled around. | 0 | 1 | 2 | 3 | 4 |
| 20. It would be easy to pick a fight with the teacher. | 0 | 1 | 2 | 3 | 4 |
| 21. The teacher would act confidently. | 0 | 1 | 2 | 3 | 4 |
| 22. The teacher would be patient. | 0 | 1 | 2 | 3 | 4 |
| 23. It would be easy to make a fool out of the teacher. | 0 | 1 | 2 | 3 | 4 |
| 24. The teacher would be sarcastic. | 0 | 1 | 2 | 3 | 4 |
| 25. The teacher would help students with their work. | 0 | 1 | 2 | 3 | 4 |
| 26. Students could decide some things in the teacher's class. | 0 | 1 | 2 | 3 | 4 |
| 27. The teacher would think that students cheat. | 0 | 1 | 2 | 3 | 4 |
| 28. The teacher would be strict. | 0 | 1 | 2 | 3 | 4 |
| 29. The teacher would be friendly. | 0 | 1 | 2 | 3 | 4 |
| 30. Students could influence the teacher. | 0 | 1 | 2 | 3 | 4 |
| 31. The teacher would think that students did not know anything. | 0 | 1 | 2 | 3 | 4 |
| 32. Students would have to be silent in the teacher 's class. | 0 | 1 | 2 | 3 | 4 |
| 33. The teacher would be someone students can depend on. | 0 | 1 | 2 | 3 | 4 |
| 34. The teacher would let students fool around in class. | 0 | 1 | 2 | 3 | 4 |
| 35. The teacher would put students down. | 0 | 1 | 2 | 3 | 4 |
| 36. The teacher's tests would be hard. | 0 | 1 | 2 | 3 | 4 |
| 37. The teacher would have a sense of humour. | 0 | 1 | 2 | 3 | 4 |
| 38. The teacher would let students get away with a lot in class. | 0 | 1 | 2 | 3 | 4 |
| 39. The teacher would think that students can't do things well. | 0 | 1 | 2 | 3 | 4 |
| 40. The teacher's standards would be very high. | 0 | 1 | 2 | 3 | 4 |
| 41. The teacher could take a joke. | 0 | 1 | 2 | 3 | 4 |
| 42. The teacher would give students a lot of free time in class. | 0 | 1 | 2 | 3 | 4 |
| 43. The teacher would seem dissatisfied. | 0 | 1 | 2 | 3 | 4 |
| 44. The teacher would be severe when marking papers. | 0 | 1 | 2 | 3 | 4 |
| 45. The teacher 's class would be pleasant. | 0 | 1 | 2 | 3 | 4 |
| 46. The teacher would be lenient. | 0 | 1 | 2 | 3 | 4 |
| 47. The teacher would be suspicious. | 0 | 1 | 2 | 3 | 4 |
| 48. Students would be afraid of the teacher. | 0 | 1 | 2 | 3 | 4 |

# APPENDIX B.

## Teacher Actual Version of the Questionnaire on Teacher Interaction (QTI)

Office Use only

| ___ | _ | __ | 00 | 2 |
|---|---|---|---|---|
| SCH | TCHR | CLS | STU | QTI |

# Questionnaire on Teacher Interaction

## Teacher Self Questionnaire

This questionnaire has 48 sentences about your behaviour in a particular class.

For each sentence, circle the number corresponding to your response. For example:

| | Never | | | | Always |
|---|---|---|---|---|---|
| I express myself clearly. | 0 | 1 | 2 | 3 | 4 |

If you think that you always express yourself clearly, circle the 4. If you think you never express yourself clearly, circle the 0. You also can choose the numbers 1, 2 and 3 which are in-between. If you want to change your answer, cross it out and circle a new number.

Thank you for your cooperation.

**In order for us to provide you with a report of the results, please write your name and other details at the top of the reverse side of this page.**

DF:TR:BF 1996/QTI 2 Modified by T. Rickards

Name_____ Class_____ School_____

Please circle the appropriate response: Gender: male female

Years of teaching: 1--5 6--10 > 10

| | | Never | | | | Always |
|---|---|---|---|---|---|---|
| 1. | I talk enthusiastically about my subject. | 0 | 1 | 2 | 3 | 4 |
| 2. | I trust the students. | 0 | 1 | 2 | 3 | 4 |
| 3. | I seem uncertain. | 0 | 1 | 2 | 3 | 4 |
| 4. | I get angry unexpectedly. | 0 | 1 | 2 | 3 | 4 |
| 5. | I explain things clearly. | 0 | 1 | 2 | 3 | 4 |
| 6. | If students don't agree with me, they can talk about it. | 0 | 1 | 2 | 3 | 4 |
| 7. | I am hesitant. | 0 | 1 | 2 | 3 | 4 |
| 8. | I get angry quickly. | 0 | 1 | 2 | 3 | 4 |
| 9. | I hold the students' attention. | 0 | 1 | 2 | 3 | 4 |
| 10. | I am willing to explain things again. | 0 | 1 | 2 | 3 | 4 |
| 11. | I act as if I do not know what to do. | 0 | 1 | 2 | 3 | 4 |
| 12. | I am too quick to correct students when they break a rule. | 0 | 1 | 2 | 3 | 4 |
| 13. | I know everything that goes on in the classroom. | 0 | 1 | 2 | 3 | 4 |
| 14. | If students have something to say, I will listen. | 0 | 1 | 2 | 3 | 4 |
| 15. | I let students boss me around. | 0 | 1 | 2 | 3 | 4 |
| 16. | I am impatient. | 0 | 1 | 2 | 3 | 4 |
| 17. | I am a good leader. | 0 | 1 | 2 | 3 | 4 |
| 18. | I realise when students don't understand. | 0 | 1 | 2 | 3 | 4 |
| 19. | I am not sure what to do when students fool around. | 0 | 1 | 2 | 3 | 4 |
| 20. | It is easy for students to pick a fight with me. | 0 | 1 | 2 | 3 | 4 |
| 21. | I act confidently. | 0 | 1 | 2 | 3 | 4 |
| 22. | I am patient. | 0 | 1 | 2 | 3 | 4 |
| 23. | It's easy to make a fool out of me. | 0 | 1 | 2 | 3 | 4 |
| 24. | I am sarcastic. | 0 | 1 | 2 | 3 | 4 |
| 25. | I help students with their work. | 0 | 1 | 2 | 3 | 4 |
| 26. | Students can decide some things in my class. | 0 | 1 | 2 | 3 | 4 |
| 27. | I think that students cheat. | 0 | 1 | 2 | 3 | 4 |
| 28. | I am strict. | 0 | 1 | 2 | 3 | 4 |
| 29. | I am friendly. | 0 | 1 | 2 | 3 | 4 |
| 30. | Students can influence me. | 0 | 1 | 2 | 3 | 4 |
| 31. | I think that students don't know anything. | 0 | 1 | 2 | 3 | 4 |
| 32. | Students have to be silent in my class. | 0 | 1 | 2 | 3 | 4 |
| 33. | I am someone students can depend on. | 0 | 1 | 2 | 3 | 4 |
| 34. | I let students fool around in class. | 0 | 1 | 2 | 3 | 4 |
| 35. | I put students down. | 0 | 1 | 2 | 3 | 4 |
| 36. | My tests are hard. | 0 | 1 | 2 | 3 | 4 |
| 37. | I have a sense of humour. | 0 | 1 | 2 | 3 | 4 |
| 38. | I let students get away with a lot in class. | 0 | 1 | 2 | 3 | 4 |
| 39. | I think that students can't do things well. | 0 | 1 | 2 | 3 | 4 |
| 40. | My standards are very high. | 0 | 1 | 2 | 3 | 4 |
| 41. | I can take a joke. | 0 | 1 | 2 | 3 | 4 |
| 42. | I give students a lot of free time in class. | 0 | 1 | 2 | 3 | 4 |
| 43. | I seem dissatisfied. | 0 | 1 | 2 | 3 | 4 |
| 44. | I am severe when marking papers. | 0 | 1 | 2 | 3 | 4 |
| 45. | My class is pleasant. | 0 | 1 | 2 | 3 | 4 |
| 46. | I am lenient. | 0 | 1 | 2 | 3 | 4 |
| 47. | I am suspicious. | 0 | 1 | 2 | 3 | 4 |
| 48. | Students are afraid of me. | 0 | 1 | 2 | 3 | 4 |

# APPENDIX C

**Complete Student Version of the Questionnaire including the Questionnaire on Teacher Interaction (QTI) and other items.**

Office Use only

| ___ | _ | __ | __ | 3 |
|---|---|---|---|---|
| SCH | TCHR | CLS | STU | QTI |

# Questionnaire on Teacher Interaction

## Student Questionnaire

This questionnaire asks you to describe the behaviour of your teacher.

This is NOT a test.

Your opinion is what is wanted.

This questionnaire has 48 sentences about the teacher. For each sentence, circle the number corresponding to your response. For example:

| | Never | | | | Always |
|---|---|---|---|---|---|
| This teacher expresses himself/herself clearly. | 0 | 1 | 2 | 3 | 4 |

If you think that your teacher always expresses himself/herself clearly, circle the 4. If you think your teacher never expresses himself/herself clearly, circle the 0. You also can choose the numbers 1, 2 and 3 which are in-between. If you want to change your answer, cross it out and circle a new number. Please answer all questions. Thank you for your cooperation.

Don't forget to write the name of the teacher and other details at the top of the reverse side of this page.

My last mark or grade for this subject was

(Please put your mark or grade in the box, if you can't remember, please ask your teacher to help you.)

Please write your name at the top of the next page so that we can identify you for interviews if necessary.

**My Name** _____ Class _____ School _____

| **Teacher's Name** _____ | | Never | | | | Always |
|---|---|---|---|---|---|---|
| 1. | This teacher talks enthusiastically about her/his subject. | 0 | 1 | 2 | 3 | 4 |
| 2. | This teacher trusts us. | 0 | 1 | 2 | 3 | 4 |
| 3. | This teacher seems uncertain. | 0 | 1 | 2 | 3 | 4 |
| 4. | This teacher gets angry unexpectedly. | 0 | 1 | 2 | 3 | 4 |
| 5. | This teacher explains things clearly. | 0 | 1 | 2 | 3 | 4 |
| 6. | If we don't agree with this teacher, we can talk about it. | 0 | 1 | 2 | 3 | 4 |
| 7. | This teacher is hesitant. | 0 | 1 | 2 | 3 | 4 |
| 8. | This teacher gets angry quickly. | 0 | 1 | 2 | 3 | 4 |
| 9. | This teacher holds our attention. | 0 | 1 | 2 | 3 | 4 |
| 10. | This teacher is willing to explain things again. | 0 | 1 | 2 | 3 | 4 |
| 11. | This teacher acts as if she/he does not know what to do. | 0 | 1 | 2 | 3 | 4 |
| 12. | This teacher is too quick to correct us when we break a rule. | 0 | 1 | 2 | 3 | 4 |
| 13. | This teacher knows everything that goes on in the classroom. | 0 | 1 | 2 | 3 | 4 |
| 14. | If we have something to say, this teacher will listen. | 0 | 1 | 2 | 3 | 4 |
| 15. | This teacher lets us boss her/him around. | 0 | 1 | 2 | 3 | 4 |
| 16. | This teacher is impatient. | 0 | 1 | 2 | 3 | 4 |
| 17. | This teacher is a good leader. | 0 | 1 | 2 | 3 | 4 |
| 18. | This teacher realises when we don't understand. | 0 | 1 | 2 | 3 | 4 |
| 19. | This teacher is not sure what to do when we fool around. | 0 | 1 | 2 | 3 | 4 |
| 20. | It is easy to pick a fight with this teacher. | 0 | 1 | 2 | 3 | 4 |
| 21. | This teacher acts confidently. | 0 | 1 | 2 | 3 | 4 |
| 22. | This teacher is patient. | 0 | 1 | 2 | 3 | 4 |
| 23. | It's easy to make a fool out of this teacher. | 0 | 1 | 2 | 3 | 4 |
| 24. | This teacher is sarcastic. | 0 | 1 | 2 | 3 | 4 |
| 25. | This teacher helps us with our work. | 0 | 1 | 2 | 3 | 4 |
| 26. | We can decide some things in this teacher's class. | 0 | 1 | 2 | 3 | 4 |
| 27. | This teacher thinks that we cheat. | 0 | 1 | 2 | 3 | 4 |
| 28. | This teacher is strict. | 0 | 1 | 2 | 3 | 4 |
| 29. | This teacher is friendly. | 0 | 1 | 2 | 3 | 4 |
| 30. | We can influence this teacher. | 0 | 1 | 2 | 3 | 4 |
| 31. | This teacher thinks that we don't know anything. | 0 | 1 | 2 | 3 | 4 |
| 32. | We have to be silent in this teacher's class. | 0 | 1 | 2 | 3 | 4 |
| 33. | This teacher is someone we can depend on. | 0 | 1 | 2 | 3 | 4 |
| 34. | This teacher lets us fool around in class. | 0 | 1 | 2 | 3 | 4 |
| 35. | This teacher puts us down. | 0 | 1 | 2 | 3 | 4 |
| 36. | This teacher's tests are hard. | 0 | 1 | 2 | 3 | 4 |
| 37. | This teacher has a sense of humour. | 0 | 1 | 2 | 3 | 4 |
| 38. | This teacher lets us get away with a lot in class. | 0 | 1 | 2 | 3 | 4 |
| 39. | This teacher thinks that we can't do things well. | 0 | 1 | 2 | 3 | 4 |
| 40. | This teacher's standards are very high. | 0 | 1 | 2 | 3 | 4 |
| 41. | This teacher can take a joke. | 0 | 1 | 2 | 3 | 4 |
| 42. | This teacher gives us a lot of free time in class. | 0 | 1 | 2 | 3 | 4 |
| 43. | This teacher seems dissatisfied. | 0 | 1 | 2 | 3 | 4 |
| 44. | This teacher is severe when marking papers. | 0 | 1 | 2 | 3 | 4 |
| 45. | This teacher's class is pleasant. | 0 | 1 | 2 | 3 | 4 |
| 46. | This teacher is lenient. | 0 | 1 | 2 | 3 | 4 |
| 47. | This teacher is suspicious. | 0 | 1 | 2 | 3 | 4 |
| 48. | We are afraid of this teacher. | 0 | 1 | 2 | 3 | 4 |

**Now some questions about you, your parents and your home.**

| | | | |
|---|---|---|---|
| 49. | Are you a: | ☐Female | ☐Male |
| 50. | What language does your family speak at home most of the time? | | |
| 51. | Was your **mother** born in Australia?<br>If not, which country was she born in? | ☐Yes | ☐No |
| 52. | Was your **father** born in Australia?<br>If not, which country was he born in? | ☐Yes | ☐No |

**Now some questions about yourself.**

Items 1-7 below consist of a number of statements about the class which you are in right now. You will be asked what you think about these statements. There are no 'right' or 'wrong' answers. Your opinion is what is wanted.

For each statement, draw a circle around

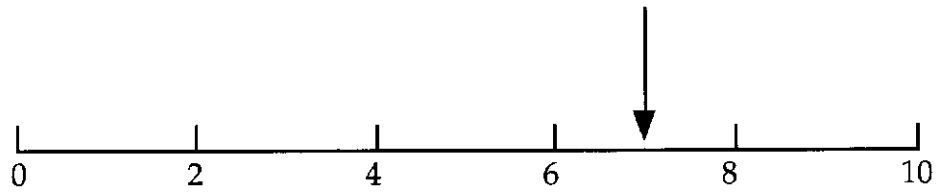
5 if you STRONGLY AGREE with the statement;
4 if you AGREE with the statement;
3 if you are NOT SURE;
2 if you DISAGREE with the statement;
1 if you STRONGLY DISAGREE with the statement.

| | | | | | |
|---|---|---|---|---|---|
| 53. I look forward to this class | 1 | 2 | 3 | 4 | 5 |
| 54. I feel confused during this class | 1 | 2 | 3 | 4 | 5 |
| 55. The class is a waste of time | 1 | 2 | 3 | 4 | 5 |
| 56. This class is among the most interesting at this school | 1 | 2 | 3 | 4 | 5 |
| 57. The work is hard in this class | 1 | 2 | 3 | 4 | 5 |
| 58. The thought of this class makes me tense. | 1 | 2 | 3 | 4 | 5 |
| 59. I enjoy this class. | 1 | 2 | 3 | 4 | 5 |

Please continue.....

**In the following items, select the best answer.**

**60.** The Diagram below represents some of the distance posts along a country road.



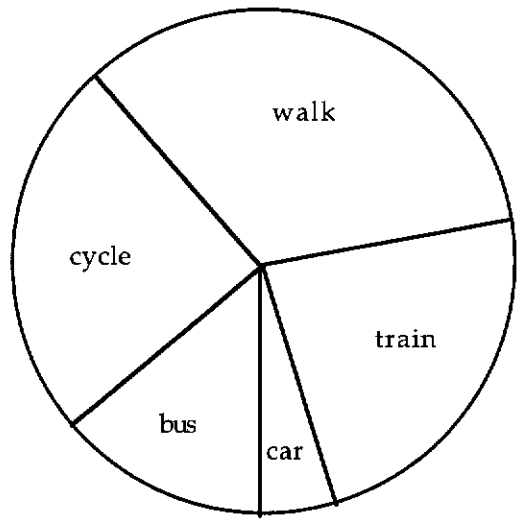

A motorist runs out of petrol at the point marked by the arrow.

If there was a distance post at this point, it would show a reading of:

**A.** 6 **B.** 6.5 **C.** 7 **D.** 7.5 **E.** 8

**Questions 61-62.**

At Bunyip High School there are 36 students in Year 12A. These students either walk to school or travel by train, car, bus or cycle. The following diagram shows the number of students using each of these methods of travel. Use the diagram to answer Questions **61-62.**




**61.** The two methods of travel which are used by approximately the same number of students are:

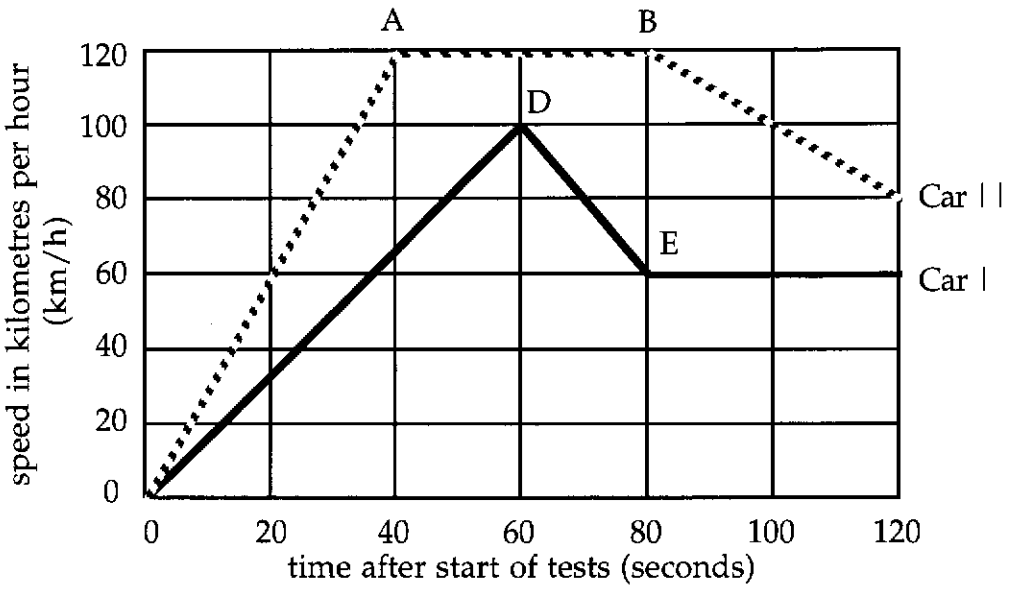
**A.** train and walk **B.** bus and train **C.** cycle and train **D.** walk and cycle **E.** bus and car

**62.** Which one of the following statements is supported by the information in the diagram?

**A.** No students in Year 12A use a train to come to school.
**B.** Some students cycle some days but walk on other days.
**C.** The students coming by car have their own licences.
**D.** The students who come by train also come by bus.
**E.** There are few busses that pass the school.

**Questions 63-64.**

The graph below has been drawn from the information obtained during a series of car tests. It shows the speeds of two cars at different times. Use the graph to answer Questions **63-64.**




**Q 63.** In the time interval 40 seconds - 60 seconds, the speed of Car II:

**A.** was zero.
**B.** increased.
**C.** decreased.
**D.** increased then decreased.
**E.** stayed the same.

**Q 64.** The time taken by Car II to reach 60 km/h is:

**A.** 140 seconds.
**B.** 40 seconds.
**C.** 5 seconds.
**D.** 20 seconds.
**E.** not obtainable from the information on the graph.

**Q 65.** Ninety-two different chemical elements can be found on the earth. The following table provides information about some of these elements.

| Name of Element | Appearance when pure | Common way the element occurs |
|---|---|---|
| Aluminium | light grey shiny metal | combined with oxygen in clay |
| Carbon | shiny black solid | by itself as coal |
| Oxygen | colourless gas | by itself in air or combined with hydrogen in water |
| Chlorine | greenish yellow gas | combined with sodium in table salt |
| Platinum | heavy white metal | by itself |
| Silicon | brown powder | combined with oxygen in clay |
| Iodine | bluish grey solid | by itself as particles in sea-water |
| Nitrogen | colourless | by itself in air |

**Q 65.** The element silicon could be obtained from:

**A.** the air.
**B.** a packet of kitchen salt.
**C.** clay in the garden.
**D.** rain-water.
**E.** sea-water.

**Q 66.** When Harry was at the beach, he wondered if sound could travel through water. To test that idea, Harry decided to hit two stones together.

Which one of the following is **NOT** a suitable method for testing if sound can travel through water?

**A.** Hit two stones together in the water with the ears in the air
**B.** Hit two stones together in the air with the ears in the air
**C.** Hit two stones together in the water with the ears in the water
**D.** Hit two stones together in the air with the ears in the water

**Q 67.** Mary and Jane each bought the same kind of rubber ball. Mary said, " my ball bounces higher than yours." Jane replied, "I'd like to see you prove that."

Mary should:

**A.** throw both balls against a wall and see how far each ball bounces off the wall.
**B.** drop the two balls from different heights and notice which bounces higher.
**C.** throw the balls down against the floor and see how high they bounce.
**D.** feel the balls by hand to find which is harder.
**E.** drop both balls from the same height and notice which bounces higher.

**Q 68.** Dr R. Choo believes that he has developed a vaccine that will help prevent mumps. At his hospital Dr Choo has 30 people who are willing to test the vaccine. He decides to give the vaccine to 15 of these people.

In order to test if the vaccine works, Dr Choo should expose to the mumps disease:

**A.** none of the 30 people
**B.** only the 15 people who received the vaccine
**C.** only the 15 people who did not receive the vaccine
**D.** all of the 30 people

**Q 69.** Lying on the beach was a box containing an assortment of metal and non-metal rods. Tom's teacher asked him to find out whether the metal rods were better heat conductors than non-metal rods. Tom chose a steel rod and held up the tip of the rod in the flame of a Bunsen burner. After a short time, the rod was too hot to hold.

Before Tom could tell his teacher that he believed all metal rods were better heat conductors than non-metal rods, he should:

**A.** heat another steel rod.
**B.** heat all the metal rods but none of the non-metal rods.
**C.** heat all the non-metal rods but none of the metal rods.
**D.** heat all of the metal rods and all of the non-metal rods.

The End

Thank you for completing this questionnaire.

Office use only

# APPENDIX D

## Allocation of items based on the Leary Model for each Scale of the QTI.

**Scales for the Influence Dimensions**

**Dominance**

*Leadership*

1. This teacher talks enthusiastically about her/his subject.
5. This teacher explains things clearly.
9. This teacher holds our attention.
13. This teacher knows everything that goes on in the classroom.
17. This teacher is a good leader.
21. This teacher acts confidently.

*Strict*

28. This teacher is strict.
32. We have to be silent in this teacher's class.
36. This teacher's tests are hard.
40. This teacher's standards are very high.
44. This teacher is severe when marking papers.
48. We are afraid of this teacher

**Submission**

*Uncertain*

3. This teacher seems uncertain.
7. This teacher is hesitant.
11. This teacher acts as if she/he does not know what to do.
15. This teacher lets us boss her/him around.
19. This teacher is not sure what to do when we fool around.
23. It's easy to make a fool out of this teacher

*Student Responsibility/Freedom*

26. We can decide some things in this teacher's class.
30. We can influence this teacher.
34. This teacher lets us fool around in class.
38. This teacher lets us get away with a lot in class.
42. This teacher gives us a lot of free time in class.
46. This teacher is lenient.

**Scales for the Proximity Dimensions**

**Cooperation**

*Helping/Friendly*

25. This teacher helps us with our work.
29. This teacher is friendly.
33. This teacher is someone we can depend on.
37. This teacher has a sense of humour.
41. This teacher can take a joke.
45. This teacher's class is pleasant.

*Understanding*

2. This teacher trusts us.
6. If we don't agree with this teacher, we can talk about it.
10. This teacher is willing to explain things again.
14. If we have something to say, this teacher will listen.
18. This teacher realises when we don't understand.
22. This teacher is patient.

**Opposition**

*Dissatisfied*

27. This teacher thinks that we cheat.
31. This teacher thinks that we don't know anything.
35. This teacher puts us down.
39. This teacher thinks that we can't do things well.
43. This teacher seems dissatisfied.
47. This teacher is suspicious.

*Admonishing*

4. This teacher gets angry unexpectedly.
8. This teacher gets angry quickly.
12. This teacher is too quick to correct us when we break a rule.
16. This teacher is impatient.
20. It is easy to pick a fight with this teacher.
24. This teacher is sarcastic.

## APPENDIX E

**Copy of Inclusions in first mailout: Invitation to Participate in this Study Letter; Sample Teacher Report and a Letter to Parents.**

**(letterhead here)**

«Principal»
«School Name»
«Postal Address»
«Postal Suburb»
«State» «Post Code»

<<Date>>

Dear «Principal G/Name»,

Attention: Head Science Teacher

**A Study of Gender and Cultural Differences in Teacher-Student Interpersonal Behaviour**

We invite you to participate in this study which is being conducted by Associate Professor Darrell Fisher, Tony Rickards and Professor Barry Fraser from the National Key Centre for School Science and Mathematics, Curtin University of Technology.

The Key centre sponsors extensive educational research, publication and teacher professional development programs. It aims to improve the quality of, and participation in, school science and mathematics.

This study is unique in that it focuses on a technique which teachers can use for examining what is occurring in their own classrooms and will help them establish how teacher-student interpersonal behaviour affects student outcomes.

We anticipate that at least 100 Australian schools including government and non-government schools (country and metropolitan) will be participating in the study.

Within the participating schools, a set of about six Science and/or Mathematics classes, taught by different teachers, will be asked to respond to the Questionnaire on Teacher Interaction (QTI) and a few questions about their background. Completion of this questionnaire will take about 30 minutes per class. Each of the six teachers also will be asked to complete two teacher forms of the QTI.

The anonymity of individual schools, teachers and students will be preserved throughout as identification numbers will be used for all the

data analyses. No school or teacher will be identified in any reporting of the study.

In return for your co-operation, we will furnish each participating teacher with a report, including a copy of the overall results plus their individual QTI profiles. A letter acknowledging participation in the study as well as a certificate of participation also will be provided. This information could be a valuable resource for use by individual teachers reflecting on their practice and possibly be used for credit towards professional development activities.

For your information we have enclosed a copy of the QTI plus a sample report. The individual teacher reports will be in the form of sector diagrams (pp. 1 & 3, QTI Report). To save you some time we have also included a consent form for parents to sign prior to the questionnaire being administered.

If you are willing to participate in this study, please complete the **Acceptance Form** accompanying this letter and return it by fax or in the prepaid envelope as soon as possible.

Should you require further information, do not hesitate to contact :

Darrell Fisher (09) - 351 3110
Tony Rickards (09) - 351 3593

If either phone is unattended, please leave a message following the tone and we will return your call as soon as possible.

Alternatively you can contact us by fax on 09 351 2503.

Thank you for considering our request and we look forward to working with you and your staff if this proposal is acceptable.

Yours sincerely

Associate Professor Darrell Fisher  Tony Rickards  Professor Barry Fraser

NATIONAL KEY CENTRE FOR SCHOOL SCIENCE AND MATHEMATICS
(Especially for Women)

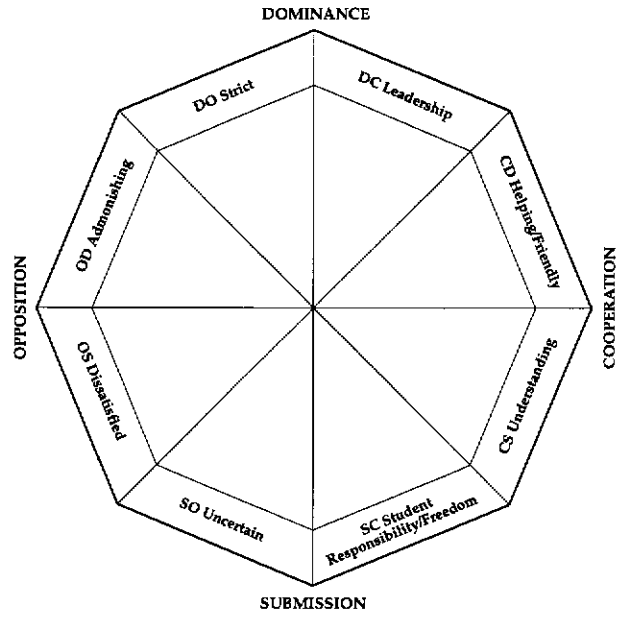
# Teacher Student Interpersonal Behaviour

**Personally prepared report for «Merge Teacher Name» of «Merge School Name».**

As you remember, both you and your students completed a 48-item questionnaire on classroom interaction. This report includes scores for how your students see you, how you see yourself and your ideal teacher. Your personal results are presented in sector profile diagrams at the end of this report. Within each profile the sector scores are represented by shaded figures.

The scores range from 0 to 4 for each of the 48 items. The higher the score the more significantly or frequently you and your students believe that you exhibit the behaviour described with that item.

A summary of these 48 scores is presented in a figure which describes how a teacher interacts with his/her students. The figure uses two dimensions to map teacher behaviour: Dominance-Submission and Cooperation-Opposition. The dimensions are the represented in a pie chart divided into eight sectors. The chart is presented below.




As can be seen, the sectors are labelled DC, CD etc. according to their position in the circle. In the DC, or Leadership sector the Dominance aspect prevails over the Cooperation aspect, though both are characteristics of leadership.

## A quick guide to interpreting your chart.

When looking at your charts note that each shaded area represents a measure of a particular behaviour. The further from the centre of the chart a sector is shaded the more significantly or frequently you and your students believe you exhibit the behaviour described with that item. The items for each sector are described on the next page.

**Leadership (DC)**-organises, gives directions, sets tasks determines procedures, is aware of what's happening, structures classroom situations, explains, makes intentions clear, holds class attention.

**Helpful/Friendly (CD)**-assists, shows interest, show concern, is able to take a joke, inspires confidence and trust.

**Understanding (CS)**-Listens with interest, empathises, shows trust, is accepting, looks for ways to settle differences, is patient, is open.

**Student responsibility/freedom (SC)**-gives opportunity for independent work, is lenient, allows students to go at their own pace, waits for class to settle down, approves of student activity.

**Uncertain (SO)**-acts hesitant, apologises, has "wait and see" attitude, is timid.

**Dissatisfied (OS)**-is disapproving, questions suspiciously, looks unhappy or glum, criticises.

**Admonishing (OD)**-gets angry, is sarcastic, expresses irritation, forbids, admonishes, punishes

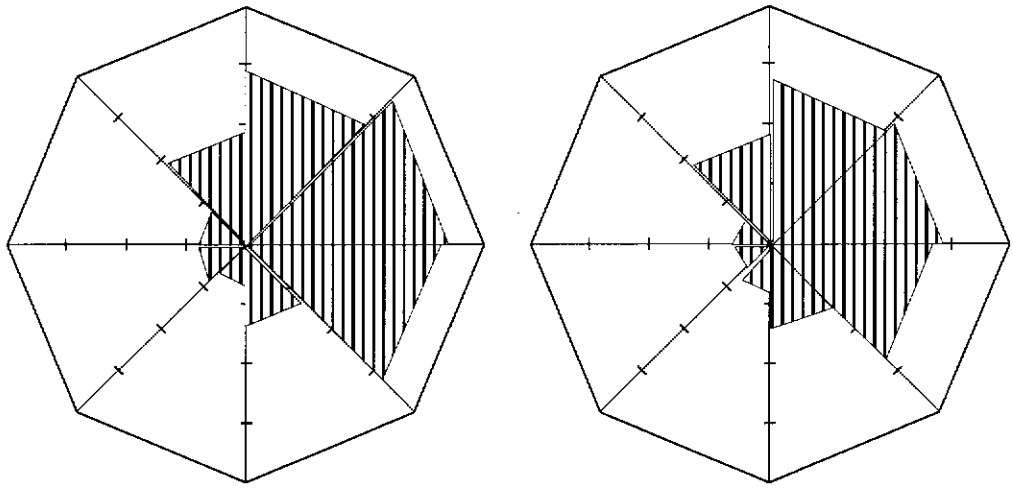
**Strict (DO)**-keeps a tight rein, checks, judges, demands silence, sets rules, gives hard tests.

The boundaries between sectors are not strict, as there is overlap between neighbouring categories. For example, a behaviour such as "We can talk with this teacher" has both Helping/Friendly and Understanding characteristics. On the other hand, sectors opposite each other on the chart describe opposite behaviour, e.g.(Student Responsibility/Freedom vs. Strict).

It is important to note that teachers can exhibit acceptable behaviour in each sector. There are situations in which it is appropriate for a teacher to be dissatisfied, or uncertain, or admonishing (or any other category). It appears that most teachers show behaviours in every category. For this reason, the profile contains scores in each category.

For your information, the next page shows two additional profiles. The two profiles depict the average of self perceptions of 46 science and mathematics teachers and the average of the 46 teachers as perceived by their 792 students. These two profiles are included in the report for comparison purposes only.

## Comparison Profiles



Average Teacher
(Self Perceptions)

Average Teacher
(Student Perceptions)

**An Australian sample of 792 students and their 46 science and mathematics teachers.**

Should you wish any further information on the questionnaire or the report please feel free to contact us. Thank you for your cooperation.


Associate Professor Darrell Fisher  Tony Rickards  Professor Barry Fraser

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## To Parents of Year 8, 9 & 10 Science Students:

Associate Professor Darrell Fisher, Tony Rickards and Professor Barry Fraser from the National Key Centre for School Science and Mathematics, Curtin University of Technology, are conducting a study to examine gender and cultural differences in teacher-student interpersonal behaviour.

The Key centre sponsors extensive educational research, publication and teacher professional development programs. It aims to improve the quality of, and participation in, school science and mathematics.

This study is unique in that it focuses on a technique which teachers can use for examining what is occurring in their own classrooms and will help them establish how teacher-student interpersonal behaviour affects student outcomes.

They anticipate that about 5000 students from at least 40 Australian schools including government and non-government schools (country and metropolitan) will be participating in the study.

The study would involve your son or daughter answering a questionnaire which would take about 30 minutes to complete, in some cases, a personal interview at a later date and time convenient to you and the school.

The anonymity of individual schools, teachers and students will be preserved throughout as identification numbers will be used for all the data analyses. All data collected will be treated as confidential and any published results will not reveal individual student or teacher names.

If you agree to your son or daughter's participation in this study, please sign the slip below and return it to me as soon as possible.

Thank you for your kind cooperation.

Yours faithfully

_____
Principal

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I hereby grant permission for my son/daughter

_____ (name)

to answer questionnaires related to the learning environment of secondary science students.

_____ (Signature) _____ (Date)

## APPENDIX F

**Letter of Consent to Interview Students.**

Dear Parents & Guardians

The purpose of this note is to inform you about my visits to your child's science class. I am a doctoral student at the Science and Mathematics Education Centre at Curtin University of Technology and the reason for my visits is to collect data about teacher - student interactions in science classes. (Mail merge teacher name here) your child's science teacher has been kind enough to invite me into his/her classroom and I have permission from the Principal, (Mail merge principal name here), to enter the school for the purpose of my research. I will be talking to some of the students about their perceptions of their learning environment. The discussion will take between five and ten minutes and will be conducted at a time when students are involved in individual work so that they will not miss any important teaching time. I have found in the past that these discussions are beneficial to students because it helps them reflect on the things that they have been learning. The information collected in the discussions will not contribute to assessment and will not affect the student's grades. Student participation in the discussions will be voluntary and any students' wish not to be involved will be respected. The data collected from students will be anonymously reported in my thesis.

If you have any questions regarding my visits, the student discussions or any other aspect of my research please contact me at Curtin University of Technology on 3513593. If you can't contact me personally please leave a message and I will call you back as soon as possible.

Yours faithfully,

_____

Tony Rickards
Doctoral Student