Science and Mathematics Education Centre

Student Outcomes, Learning Environment, Logical Thinking and Motivation Among Computing Students in an Indonesian University

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ABSTRACT

This study involved examining differences and similarities between the learning environment perceptions of students attending the Computer Science department and the Management department at an information technology university in Jakarta, Indonesia. In doing so, the study investigated which types of learning environments were most likely to strengthen student outcomes in computer-related courses and identify ways in which the university could enhance the teaching and learning process.

The study examined whether relationships exist between students' cognitive and affective outcomes and four productivity factors: the learning environment; the quality of teacher-student interactions; students' aptitude; and students' motivation to select their chosen subject. To measure the four productivity factors, 422 students from 12 classes were asked to respond to four questionnaires that were modified to suit tertiary-level computing students: (1) the What is Happening in this Class? questionnaire (WIHIC) to measure students' perceptions of the learning environment, (2) the Questionnaire on Teacher Interaction (QTI) to measure students' perceptions of the student-teacher interaction; (3) the Test of Logical Thinking (TOLT) to measure the students' aptitude; and (4) a scale that was developed to measure students' motivation towards their course. To measure students' cognitive outcomes, information was retrieved from the university database and, to measure students' attitudes towards their computer-related subjects, four modified scales from the Test of Science Related Attitudes (TOSRA) were used.

Each of the instruments was found to be valid and reliable in the Indonesian language for use at the university level in terms of factor structure, internal consistency reliability, and ability to differentiate between the perceptions of students in different classrooms. These instruments provide a means by which lecturers can monitor their classroom environments, their lecturer interaction behaviour and their students' logical thinking, motivation and attitudes. Generally, it was found that computer science students perceived the classroom environments

more favourably than management students. These findings related to departmental differences at the university level provide insights into how students from different departments perceive the learning environment. Also, the study pointed to departmental differences in students' logical thinking which could influence the types of learning environment that suit students from different departments. Departmental differences in students' perceptions of the lecturer-student interpersonal behaviour suggest that lecturers should take note that the personal relationships which they build and the ways in which they treat students.

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CHAPTER 1

RATIONALE AND BACKGROUND

1.1 INTRODUCTION

According to Walberg (1991), there are nine factors which influence the productivity of learning and these can be categorised into three broad headings: student aptitude; instruction; and the psychological environment. The present study was undertaken to examine the nature and impact of four factors of learning productivity – classroom climate, interpersonal lecturer behaviour, student aptitude and student motivation towards their chosen major area of study – on the affective and cognitive outcomes of students at Bina Nusantara University, an information technology-based institution of higher learning in Indonesia. This chapter describes the background to this study (Section 1.2), the purposes of the present study (Section 1.3) and the underlying research questions (Section 1.4). Also presented in this chapter is an overview of the organisation of the chapters in the remainder of the thesis (Section 1.5).

1.2 BACKGROUND

This section provides background information relevant to the present study, including a brief introduction to the field of learning environments (Section 1.2.1), an overview of the present challenges faced by the education system in Indonesia (Section 1.2.2), a description of problems that teaching and learning confront in Indonesia's higher education system (Section 1.2.3), and information concerning Bina Nusantara University where the present study took place (Section 1.2.4).

1.2.1 Background to the Field of Learning Environments

The present study examined associations between students' perceptions of the learning environment and four productivity factors in a university in Indonesia. As early as 1936, Kurt Lewin (1936) recognised that the environment was a determinant of human

behaviour. Following Lewin's work, Murray (1938) proposed a Needs-Press Model in which situational variables found in the environment account for a degree of behavioural variance.

Following the work of Lewin and Murray, two research programs embarked on developing instruments that could be used to assess the learning environment. Herbert Walberg's *Learning Environment Inventory* (Anderson & Walberg, 1968) and Rudolf Moos's *Classroom Environment Scale* (Moos & Houts, 1968; Moos & Trickett, 1974) were the first instruments developed to assess students' perceptions of their learning environment, and these paved the way for many subsequent instrument developments.

Since this time, the influence of the learning environment on the education process has received a great deal of attention, and there has been much development in the conceptualisation and assessment of learning environments (Fraser, 1994, 1998a). Whilst different approaches, qualitative and quantitative, have been used in conducting research in the field of learning environments, the use of instruments to assess students' perceptions has been the predominant method. A wide range of instruments suitable for a variety of purposes, age levels and subjects have enabled researchers to examine students' perceptions of their learning environment.

Past studies of interpersonal teacher behaviours have indicated that this important element of the learning environment is strongly related to student outcomes. A study conducted among Australian science and mathematics teachers found that those teachers emphasising leadership, friendly and understanding behaviours were more likely to promote student achievement. It also was found that those teachers whom were perceived as less strict were more likely to promote more positive attitudes whilst those whom were perceived as more strict were likely to promote better achievement (Wubbels, 1993). To measure students' and teachers' perceptions of teachers' interpersonal behaviour, Wubbels and his colleagues developed the Questionnaire on Teacher Interaction (QTI). This instrument was selected for use in the proposed study and has also been used in the Netherlands (Wubbels, Brekelmans, & Hoomayers, 1991),

Singapore (Goh & Fraser, 1995) and Australia (Fisher, Henderson, & Fraser, 1995; Henderson, Fisher & Fraser, 1995). In each case, the studies have found that the quality of the interaction between teachers and students is an important determinant of students' achievement and attitudes. The study of interpersonal teacher behaviour is important not only for facilitating student outcomes, but also for improving teacher competency in classroom communication and for helping to provide the social and emotional backup that a teacher needs in reaching out to students. This relatively new area in classroom environment research involving the QTI has focused mainly on secondary science and mathematics classes in the Netherlands, the USA and Australia. It was considered interesting and timely to extent the area of study from secondary to higher education classrooms and to Indonesia.

Several studies investigated attitudes as one of the student outcome measures to be related to classroom environment. However, the majority of these studies focused specially on science-related attitudes. Many studies showed positive relationships between the students' attitudes towards science and classroom environments, but there was a negative relationship between students' attitudes and classroom environment in a study of sex, attitude and classroom environment by Baker, Leary and Trammel (1992). The present study investigated students' attitudes towards computers, which were measured by the Test of Computer-Related Attitudes (TOCRA), adapted from the Test of Science-Related Attitudes (TOSRA; Fraser, 1981).

According to Linda Lumsden (1994), student motivation naturally has to do with students' desire to participate in the learning process. There are two modes of motivation, namely, intrinsic and extrinsic motivatation. An intrinsically-motivated student undertakes an activity for its own sake, for the enjoyment it provides, the learning it permits, or the feelings of accomplishment it evokes. And the extrinsically-motivated student performs in order to obtain some reward or avoid some punishment external to the activity itself (Lepper, 1988). There are some factors that influence the development of students' motivation, such as general experience, but motivation is stimulated most directly through modelling, communication of expectation, and direct

instruction or socialisation by significant others, especially parents and teachers (Brophy, 1987). Research on motivation started with Atkinson's (1957) discussion of motivation as the product of expectation of succeeding on a task. These studies focus on how student motivation is influenced by the students' decision to select their major. When students select their major subject, this choice usually influences their future careers. As many young people don't have well-defined goals at the time of selection, the driving force behind their choice of major becomes an influential factor. The motivating force behind a student's choice of major could influence their attitudes and achievement in their selected subjects. As such, the motivation behind their choice of subject could be a potential productivity factor.

The logical thinking approach is one of the most effective methods of carrying out the learning process as it allows for a methodical deduction of possible outcomes from given information. An educator, utilising the logical thinking approach, will broaden a child's horizons and enable the child not only to understand better the material being introduced, but also to deal adeptly with other proposed problems. Raths, Jonas, Rothstein and Wassermann (1967) decried the lack of emphasis on thinking in the school. That students are lagging in problem-solving and thinking skills is apparent at all levels of education. Thinking cannot be divorced from content; in fact, thinking is a way of learning content. Research on cognitive development has indicated that formal thought is required to learn many of the concepts taught in primary school, high school and tertiary science courses (e.g., Cantu & Herron, 1978; Goodstein & Howe, 1978). Evidence also suggests that the majority of students in primary and high school grades (Chiappetta, 1976) and a significant proportion of tertiary students (Renner & Lawson, 1973) are unable to utilise formal operations in problem-solving. The consensus of findings from research on cognitive development (e.g. Lawson, 1979; Lawson, Karplus & Adi, 1979; Lovell, 1961) is that science curricula need to be changed so that the cognitive development of learners becomes a focus; teachers need to match instruction to the cognitive level of learners. Further research is needed to investigate the nature of learning for students at different levels of cognitive development. This present study used logical thinking as an indicator of students' aptitude, which is assumed to affect

directly the academic performance of the students. To measure the students' aptitude, this study used the Test of Logical Thinking (TOLT).

This study set out to investigate whether associations exist between students' perceptions of the learning environment and student outcomes. Fraser (1994) tabulated a set of 40 studies in which the effects of classroom environment on students' outcomes were investigated. These studies have involved a variety of cognitive and affective outcome measures and a range of classroom environments instruments across numerous countries and grade levels. There have been a number of studies that investigated associations between the learning environment and student outcomes in countries throughout Asia, including Indonesia (Fraser, Pearse & Azmi, 1982; Schibeci, Rideng & Fraser, 1987), India (Walberg, Singh & Rasher, 1977), Thailand (Fraser, 1984), Singapore (Chionh & Fraser, 1998), Taiwan (Aldridge & Fraser, 1999) and Brunei (Asghar & Fraser, 1995; Riah & Fraser, 1998). Each of these studies has replicated previous research and suggested that the psychosocial climate of classrooms is an important determinant of student outcomes.

The number of such studies undertaken in Indonesia, however, is small, as is the number of studies undertaken at the university level in any country. Of particular interest to the present research are those studies conducted in Indonesia. Fraser, Pearse and Azmi (1982) reported a study in Indonesia involving an Indonesian translation of a modified version of all five scales of the Individualised Classroom Environment Questionnaire (ICEQ) and four scales from the Classroom Environment Scale (CES). In a study of elementary classrooms in Indonesia, Paige (1978, 1979) examined the relationships between classroom learning environment and the two student outcomes of cognitive achievement and individual modernity. Also, a study, running simultaneously to the present study, has examined the learning environment at the university level in Indonesia (Margianti & Fraser, 2001). The results of these studies are reviewed in Chapter 2.

It is interesting to note that research on outcome-environment relationships in developed countries has been replicated in numerous studies (Fraser, 1993a). However, because much of this research in both developed and developing countries has been correlational, other types of studies are needed to establish causal links between classroom climate and students' outcomes. In each case, the studies have found that the quality of the learning environment is an important determinant of students' achievement and attitudes.

1.2.2 Challenges Facing the Education System in Indonesia

In the next decade, education systems will face major issues concerning globalisation, because competition will continue to increase, both in intensity and in scope. Indonesia's recent economic crisis has rendered many industries inoperative, causing many workers to lose their jobs. Facing this global competition and to survive the 'Crisis of Economy', Indonesian education institutions will contend with the challenge of preparing qualified human resources.

Currently, in Indonesia, there are over 1,300 private universities and colleges with about 1.5 million students, and 75 public universities with around 0.5 million students. Among these, there are close to 150 private higher-learning institutions offering undergraduate programs in computing (Directorate General of Higher Education, 2000). Some are very large with more than 15,000 students and some very small with only hundreds of students (Departemen Pendidikan Nasional, 1997).

My 20 years of experience in the education sector, as the leader of a college and later a university, and my work as a lecturer in classes have given me insights into some of the problems experienced by students. It would appear that many of the major problems experienced by students at the tertiary level in Indonesia are associated with not knowing what they plan to do in the future and that they are not motivated to learn. As such, they do not have good work habits, because they do not know why they must work hard. Some students appear to view education more as entertainment and a means by which they can fill their free time. Other problems are associated with lecturers' philosophy of education, with many of them thinking that education is nothing more

than transfer of knowledge, that they have a responsibility just to teach, and that they don't care whether students understand or not.

Developments in computer technology and communication around the world today, especially through development of E-commerce and the Internet, make the world smaller and information easier to change. With this technology, the boundaries among countries will reduce. Information technology will also affect the education system. Tele-education and the virtual campus will grow very fast, and give students the opportunity to study and explore information without dependence on place and time. Students will be able to access information about the topics of their lectures easily, and they also will be able to communicate with their lecturer when they wish.

I have worked for 20 years in a computer-related working and educational environment. During this time, one of my goals as an educator has been to establish a positive learning environment. In my experience, computer-related education can produce positive or negative effects for the student. A potential positive effect might be to strengthen the logical thinking skills of students, whilst a possible negative effect of computer-related education could be for students to become too individualistic and narrow-minded. My experience has shown that some computing students have difficulty in communicating with other people. It is important to strengthen the positive effects and weaken the negative effects through providing an appropriate learning environment that will produce qualified graduates.

1.2.3 Teaching and Learning in Indonesia's Higher Education

Indonesian tertiary institutions generally suffer from low student attendance, especially among the many part-time students in big cities. Students' lack of enthusiasm for learning often results in high dropout rates. Poorly-performing students often think that lecturers cannot help them to improve, and lecturers blame students' ineffective use of their time for their low grades. In my experience, lecturers are often satisfied when just 60% of students in a class pass. Often lecturers are not really motivated to teach. The low salaries for lecturers almost invariably force them to take on side jobs, leaving them

with even less time to spend on improving their teaching. In order to achieve sufficiently positive ratings, some universities are known to tamper with student grades and, in turn, this leads to low-quality graduates.

1.2.4 Bina Nusantara University

Bina Nusantara University (BiNus), has been in operation since 1981. BiNus has particular strengths in information technology. Now it has around 20,000 students. Because BiNus also is concerned about the quality of its education system, it uses ISO-9001 (Lundquist, 1997) as a standard of the quality of the education system. BiNus has five faculties, namely, the Faculty of Engineering, Faculty of Literature, Faculty of Computer Science, Faculty of Economics and Faculty of Mathematics and Science.

The Faculty of Computer Science is the biggest faculty, with about 75% of all students. The Faculty of Management is the second biggest, with around 15% of the student body. This study took place in these two faculties that have students with very different characteristics. Computer Science students usually have a good academic background and good motivation to learn. On the other hand, the Economics students usually have poorer academic performance and lower motivation to learn. They typically think that management studies are easy and therefore feel no real need to study hard. More information about Bina Nusantara University is available on the university homepage at www.binus.ac.id.

Facing the challenge of preparing qualified human resources, BiNus made an effort to improve the quality of teaching and learning by involving both students and lecturers. Students are evaluated based on the usual academic performance criteria, and lecturers are evaluated on their rate of class attendance, the quality of their lecture preparation, their response to student questions, and their ability to motivate students.

Together, these evaluations provide quite an accurate picture. A low lecturer evaluation in a poorly performing class often indicates some sort of competition between lecturer

and students. On the other hand, high student scores and a poor lecturer evaluation are often indicative of a lecturer trying to coax students with good grades.

Currently Bina Nusantara is undergoing a campus-wide change from 'instructional learning' to 'interactive learning' and from 'learning to pass exams' to 'learning to understand'. The change involves modifying the learning environment, especially the university leaders' perspective, the lecturers' perspectives about teaching and learning, and students' attitudes.

The present study was undertaken in Bina Nusantara University because this university has the same problems as other education institutions in Indonesia, which all grew under the control and supervision provided by the rules and regulations of the Government. My desire, as chancellor, is for Bina Nusantara University to become one of the most reputable IT-based universities and for it to expand to become one of the five largest universities in Indonesia. In 2002, I was heralded as one of the top 10 female leaders in business and was the only woman from the education sector to be awarded this honour.

1.3 PURPOSES OF THE STUDY

A main purpose of the present study was to provide important insights into the field of learning environments at the tertiary level in Indonesia. The study was intended to provide useful practical information for guiding the improvement of tertiary computer-related education in Indonesia.

To date, only few studies of the learning environment have been undertaken in Indonesia and none have been at the tertiary level. The study therefore has the potential to create a clearer picture of the classroom contexts that are needed at the tertiary level for students to attain good academic performance and positive attitudes. In addition, the study could assist lecturers at the university level to determine which patterns of lecturer-student interactions are most suitable. Such a study could provide information that lecturers can

use to modify their classroom environments and student-lecturer interactions in order to cater more adequately for the needs of students.

The present study also is likely to provide valuable information to the university in which the data were gathered that can be used to develop strategies for improving classroom practices, management and administration policies for computer-related courses. The results of the study could also provide guidance to other universities in Indonesia regarding achieving better student outcomes in computer-based education.

A specific purpose of the present study was to examine differences and similarities between two distinctly different groups of computing students, those from the Computer Science department and those from the Management department. Students attending both courses are required to learn computing to support their subject and all are students at an information technology-based university in Jakarta, Indonesia. By comparing two quite different groups of computing students, the study investigates which types of learning environments are most likely to strengthen student outcomes in computer-related courses and identify ways in which the university can enhance the teaching and learning process.

The study also examined whether relationships exist between student cognitive and affective outcomes and four productivity factors: the learning environment; the quality of lecturer-student interactions; student aptitude; and student motivation to select their chosen subject.

To measure the four productivity factors, use was made of four questionnaires that were modified to suit tertiary-level computing students: (1) the *What is Happening in this Class?* questionnaire (WIHIC) to measure students' perceptions of the learning environment, (2) the *Questionnaire on Teacher Interaction* (QTI) to measure students' perceptions of the lecturer-student interaction; (3) the *Test of Logical Thinking* (TOLT) to measure the students' aptitude; (4) a scale developed specially for this study to measure students' motivation towards their course.

To measure students' outcomes in terms of their course score, information was retrieved from the university database. To measure students' attitudes towards their computer-related subjects, four scales were modified from the *Test of Science Related Attitudes* (TOSRA).

1.4 RESEARCH QUESTIONS

The present study addressed the following four main research questions:

(1) Is it possible to develop valid and reliable instruments in the Indonesian language to assess:
   a) the learning environment?
   b) lecturer-student interaction?
   c) student aptitude?
   d) motivation?
   e) attitudes?

(2) Is it possible to describe and compare a university Computer Science course and a Management course in terms of the four productivity factors of:
   a) learning environment?
   b) lecturer-student interaction?
   c) student aptitude?
   d) motivation?

(3) What associations exist between each the two student outcomes of achievement and attitudes and the four productivity factors of:
   a) learning environment?
   b) lecturer-student interaction?
   c) student aptitude?
   d) motivation?

(4) What is the relative strength of the association between students' outcomes (achievement, attitudes) and each of the four productivity factors (learning environment, lecturer-student interaction, student aptitude and motivation) for Computer Science students and Management students?

1.5 ORGANISATION OF THE THESIS

This thesis comprises five chapters. Chapter 1 discusses the rationale for the present study. It provides a brief background to the study, including information about the field of learning environments, an overview of the challenges facing the Indonesian education system, particularly at the tertiary level, and a sketch of Bina Nusantara University, where this study took place. This chapter also discusses the purposes of the present study, gives an outline of the research questions, and provides an overview of the organisation of this thesis.

Chapter 2 reviews the literature related to the definition of quality, educational productivity factors, and research on classroom learning environments, highlighting past research developments and findings. Also reviewed in this chapter is literature on interpersonal teacher behaviour, attitudes and logical thinking, focusing on terms, existing assessment instruments and education-related areas.

Chapter 3 discusses methodology and provides insights into procedural aspects of the present study. This includes the research design used in the different phases of the study, the choice of Computer Science and Management students as the focus of the study, and the choice of the sample for this study. Also, discussed in this chapter are instrumentation of the study, development and field testing of the instruments used, administration of the questionnaires and data collection, and the statistical procedures employed in the data analysis.

Chapter 4 reports the data analysis and findings for the present study. The report includes: validation of each questionnaire; associations of the four productivity factors (learning environment, lecturer-student interaction, student aptitude and motivation) with the two learning outcomes of achievement and attitude related towards computer-related courses; and differences in perceptions between Computer Science and Management students.

Chapter 5 concludes the thesis with an overview of the whole thesis. Also, it discusses the findings from the study in terms of the validation of each assessment instrument, the differences in perceptions between Computer Science and Management students, the associations between the four productivity factors and the two students outcomes; and the relative strength of associations between the four productivity factors of learning and students outcomes for the two different departments. Furthermore, this chapter discusses the practical implications of the findings from the study, significance of the study, limitations to the present study, and suggestions for future research on tertiary classroom environments in Indonesia.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The present study examined associations between four predictors of student outcomes (namely, learning environment, interpersonal lecturer behaviour, student aptitude and student motivation towards their major subject) and the affective and cognitive outcomes of students at the tertiary level of education in Indonesia.

This chapter reviews literature relevant to the present study. Section 2.2 defines the term 'quality of education' and Section 2.3 reviews educational productivity factors as suggested by Walberg. The chapter continues by examining the historical background of and describing various research approaches used in classroom learning environment research (Section 2.4), in addition to an overview of past learning environment research that has been undertaken in Indonesia in Section 2.5. Section 2.6 reviews studies that have researched interpersonal teacher behaviour, while Section 2.7 reviews literature related to student attitudes. A review of literature related to student motivation is discussed in Section 2.8 and a review of literature related to logical thinking is in Section 2.9.

2.2 DEFINITION OF EDUCATIONAL QUALITY

'Educational quality' is a term that is used to describe a wide range of concepts and is therefore difficult to measure. By its very nature, educational quality is highly dependent on the criteria used, which might be student outcomes, the education process itself, or the infrastructure and resources, including the curriculum.

Regarding the problematic nature of assessing educational quality, Conrad and Wilson (1994) wrote:

> The assessment of quality has generated more confusion and debate than any other issue for those engaged in program review. Pressure to define what quality means and what types of information should be collected has always existed, but interest has been heightened by the relatively recent emphasis on program review for resource reallocation and retrenchment. (pp.132)

Four main perspectives have been offered on how educational quality should be defined, these being the reputation view, the resources view, the outcomes view and the value-added view. The reputation view assumes that quality cannot be measured directly and is best inferred through the judgements of experts in the fields. The resources view emphasises the human, financial and physical assets available to a program. It assumes that high quality exists when resources such as excellent students, productive and highly-qualified staff, and modern facilities and equipment are prevalent. The outcomes view draws attention away from resources to the quality of the product. In this case, indicators, such as staff publications, students' accomplishments following graduation and employers' satisfaction with program graduates, are used. The value-added view directs attention to what the institution has contributed to a student's education (Astin, 1980). The focus of the value-added view is on what a student has learned while enrolled. In turn, programs are judged on how much they add to a student's knowledge and personal development.

In defining and measuring educational quality, the present study took the value-added view. In this case, the quality of education was measured by the additional value of the students' academic performance.

2.3 EDUCATIONAL PRODUCTIVITY

This section identifies nine factors that, according to Walberg (1981, 1991), influence the productivity of learning. These factors are divided into three categories, student aptitude, instruction and psychological environments (see Figure 2.1)

The present study concentrated on four of the nine factors (one from the Psychological Environments category, one from the Instructional category and two from the Student Aptitude category), which were represented by classroom climate, teacher-student interactions, students' aptitude and students' motivation towards their major. These productivity factors were selected because past research has found them to be influential in terms of student outcomes (Fraser, 1998a). The remainder of this chapter is devoted to discussing these four factors in turn.

Student Aptitude	• Ability or preferably prior achievement as measured by the usual achievement tests
	• Development as indexed by chronological age or stage of maturation
	• Motivation or self-concept as indicated by personality tests or the student's willingness to persevere intensively on learning tasks
Instruction	• Amount of time for which students engage in learning
	• Quality of the instructional experience including method (psychological) and curricular (content) aspects
Psychological Environments	• 'Curriculum of the Home'
	• Morale of classroom social group
	• Peer group outside school
	• Minimum leisure-time television viewing

Figure 2-1: Nine Factors that Influence the Productivity of Learning

2.4 LEARNING ENVIRONMENT

This section reviews literature related to research in the field of learning environments and is divided into seven parts:

- Background issues (Section 2.4.1),
- Historical background to the field of learning environments (Section 2.4.2),
- Use of perceptual measures (Section 2.4.3),
- Choice of unit of analysis (Section 2.4.4),
- Instruments used to measure the classroom learning environment (Section 2.4.5),
- Associations between classroom environment and student outcomes (Section 2.4.6) and
- Other research on classroom environment (Section 2.4.7).

2.4.1 Background Issues

The word 'environment' has many meanings. In the context of the classroom, it can be described as the shared perceptions of the students and sometimes the teachers in that environment (Fraser, 1986a). Broadly, there are two aspects of the classroom environment, the physical environment and the human environment. The physical environment includes the material settings of the classroom, including the furniture, lighting and layout of the objects. The human environment, on the other hand, includes the students and the teacher in that classroom and their interactions with each other. In short, the human environment refers to the psychological and social aspects of the classroom. It is this aspect of the classroom environment in which teachers, as facilitators of learning, could play an important part in making it more conducive for learning for their students. Past studies have shown that effective learning is related to a positive classroom environment (Brophy & Putnam, 1979).

Whilst research has traditionally focused on such variables as intelligence and achievement, research over the past 40 years has indicated that there are other important

variables, including the classroom learning environment, that can impact on student outcomes. Over this period, there has been much interest in the study of the concept of classroom learning environment.

Although the concept of classroom learning environment is somewhat subtle and nebulous (Fraser, 1989), remarkable progress has been made to date in terms of conceptualising it, measuring it and analysing its determinants and effects (Fraser, 1993a). Fraser (1986a) defined classroom environment as the shared perceptions of students and sometimes those of teachers in a particular environment. Such perceptions not only describe or evaluate the class through the participants themselves, but also include information that an observer could miss or consider unimportant.

2.4.2 Historical Background to the Field of Learning Environments

It is discernible from a review of literature on classroom environment research that much of the relevant empirical work can be traced to the contributions of Kurt Lewin and Henry Murray in the 1930s. The familiar B=f(P, E) formula of Lewin (1936) also is referred to as the person-environment interaction paradigm (Hunt, 1975). The B-P-E combination stands for Behaviour (B), Person (P) and Environment (E) together with the interactive function (f). In the classroom setting, behaviour (learning) would be viewed as being jointly determined by the person (the learner) and the environment (way of teaching). Murray (1938) further developed this paradigm through needs-press theory. He introduced 'alpha press' to describe the environment as viewed by an observer and the term 'beta press' to describe the environment as perceived by milieu inhabitants or persons functioning within the particular situation. However, Murray's needs-press theory was applied more in the study of personality rather than the study of the teaching-learning processes in classrooms. Inadvertently, Lewin and Murray paved the way for extending environment research into the classroom context.

Classroom environment research really began to attract attention from the late 1960s with the much-heralded work of, firstly, Walberg (Walberg & Anderson, 1968a, 1968b)

in connection with the research and evaluation related to Harvard Project Physics and, secondly, of Moos related to social climate scales for use in various clinical and family therapy situations as well as school classrooms (Moos, 1973, 1979a, 1979b). It is noteworthy that the efforts of Walberg and Moos pioneered many major research studies into perceptions of classroom environment from the 1970s. There emerged, henceforth, a distinct tradition of research on students' perceptions in their classroom environment (Fraser & Walberg, 1981). This is evidenced in the impressive list of literature reviews concerning the field (e.g. Anderson & Walberg, 1974; Walberg & Haertel, 1980; Chavez, 1984; Fraser, 1989, 1994, 1998a; MacAuley, 1990; von Saldern, 1992; Walberg, 1976), monographs (Fraser, 1981a; Fisher & Fraser, 1983a; Fisher, 1992, 1993), guest-edited journal issues (Fraser, 1980; McRobbie & Ellett, 1997), an annotated bibliography (e.g. Moos & Spinrad, 1984), books (Moos, 1979a; Fraser, 1986a; Fraser & Walberg, 1991; Wubbels & Levy, 1993) and in the editor's introduction to a new international journal entitled *Learning Environments Research* (Fraser, 1998b).

2.4.3 Use of Perceptual Measures

The literature on research on classroom environment reveals that generally three main methodologies have been used. These are the use of trained observers to record systematically observations of classroom events and practices, the use of case studies and the assessment of perceptions of students and teachers. Although the dominant past approach has been the use of perceptions of students and teachers in evaluating the importance of classroom environment, it is acknowledged that there are merits in combining the use of two or more methods within the same study.

Perceptual measures can be justified using five main considerations (Fraser, 1993a). First, the use of questionnaires to capture perceptions of students and teachers is more economical than paper-and-pencil measures that cost much less than the process of having trained outside observers making classroom observations. Second, data from such measure are based on the perceptions of students over many lessons or a period of time, while classroom observations are limited usually to a small number of lessons.

Third, it is believed that perceptual measures bring together the pooled opinions of all students in a class, whereas classroom observation techniques generally involve the perceptions of only one observer. Fourth, student perceptions, being determinants of student behaviour more so that the real situation, can be more important than observed behaviours. Fifth, it has been found that student perceptions account for considerably more variance in student learning outcomes than directly-observed variables in classrooms. After careful consideration of these five factors, it was decided to use student perceptions as the source of classroom environment data for the present study.

2.4.4 Choice of Unit of Analysis

It is apparent also from current literature that research on learning environment often reports results using two levels or units of statistical analysis. The distinction between levels of analysis can be linked to the needs-press theory of Murray (1938), who used the terms 'alpha press' to describe the environment viewed by an external observer and 'beta press' to describe the perception of the environment by inhabitants or persons functioning within the environment. The distinction was carried further when Pace and Stern (1958) used the two terms 'private beta press' (to denote the idiosyncratic view of the environment held by each individual) and 'consensual beta press' (to depict the shared view that members of a group hold about the environment) to differentiate between the personal view of an individual, and the common view shared by a group, of the environment.

Obviously, private and consensual beta press could differ from each other and both also could differ from the independent view of alpha press of a trained nonparticipant observer (Fraser, 1994). This is relevant to studies including perceptions of classroom environment and the literature often suggests that statistical analysis should be performed for two levels or units of analysis: the individual student's score and the class mean score, which corresponds to the distinction between private and consensual beta press.

2.4.5 Instruments Used to Measure the Classroom Learning Environment

Past research on classroom learning environment has been accompanied by the development and validation of numerous instruments over the last 40 years. The instruments used for assessing various psychosocial dimensions in classrooms and laboratories considered in this section are the: Learning Environment Inventory (LEI); Classroom Environment Scale (CES); Individualised Classroom Environment Questionnaire (ICEQ); My Class Inventory (MCI); College and University Classroom Environment Inventory (CUCEI); Science Laboratory Environment Inventory (SLEI); Constructivist Learning Environment Survey (CLES); What is Happening in this Class? (WIHIC) questionnaire and Questionnaire on Teacher Interaction (QTI). Each instrument is a convenient paper-and-pencil questionnaire which can be scored efficiently either by hand or computer. Each instrument has its unique origin and caters for different purposes and backgrounds.

For clarity, Table 2-1 systematically displays the name of the scales in each instrument, the level suitable for its use (primary, secondary, higher education), the number of items in each scale and the classification of each scale according to Moos' three broad domains of classroom climate dimensions (Moos, 1979a). Relationship dimensions 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 one another; personal development dimensions assess basic directions along which personal growth and self-enhancement tent to occur; and system maintenance and change dimensions involve the degree to which the environment is orderly, clear in expectations, maintains control and is responsive to change. The classroom environment scales in these instruments, though different in nature, can still be subsumed within common or similar sets of social dimensions as categorised by Moos under three broad domains. For example, the different classroom environment scales of Cohesion, Friction and Satisfaction of the LEI are classified under Moos' category of relationship and the eight teacher behaviour scales of the QTI all fall within the relationship dimension.

Generally, these measures of classroom environment, though different in their nature and conception, share some of the following common characteristics. Each instrument is a paper-and-pencil questionnaire tapping students' perceptions of different dimensions of the classroom environment. Most of the instruments make use of a five-point rating scale, with the exception of the CES (True-False response format) and the MCI (Yes-No response format). Most of the instruments in Table 2-1 have a parallel actual and preferred version. This actual-preferred distinction provides a source of information regarding the degree of match or mismatch concerning students' perceptions of the ideal and perceived learning environment.

Most of these instruments also has parallel teacher and student versions. This means that information can be obtained from the perceptions of both the teacher and students of each class concerning the actual and the preferred state of the classroom environment. These four sets of data make it possible to study the different perceptions on different forms and the extent to which this difference or congruence affects student learning. The following sections briefly describe each of the instruments in turn.

Learning Environment Inventory (LEI)

The Learning Environment Inventory (LEI) was developed in relation to the evaluation and research on Harvard Project Physics (Fraser, Anderson, & Walberg, 1982; Walberg & Anderson, 1968a) in secondary classrooms. The final version of the LEI contains 15 classroom climate scales, with seven items per scale. Students respond using the four-point Likert scale of Strongly Disagree, Disagree, Agree and Strongly Disagree.

Classroom Environment Scale (CES)

The Classroom Environment Scale (CES) was developed by Rudolf Moos at Stanford University (Fisher & Fraser, 1983b; Moos, 1979a; Moos & Trickett, 1987) and grew out of a comprehensive program of research involving perceptual measures of a variety of human environments including psychiatric hospitals, prisons, university residences and work milieus (Moos, 1974). The final version of the CES has nine scales with 10 items

each, using the response format of True-False. The CES is published with a test manual, a questionnaire, an answer sheet and a transparent hand-scoring key (Moos & Trickett, 1987).

Table 2-1: Overview of Scales in Nine Classroom Environment Instruments (LEI, CES, ICEQ, MCI, CUCEI, SLEI, CLES, WIHIC and QTI)

Instrument	Level	No. of Items	Scales According to Moos' Three Domains		
			Relationship	**Personal Development**	**System Maintenance & Change**
Learning Environment Inventory (LEI)	Secondary	7	Cohesiveness Friction Favouritism Cliqueness Satisfaction Apathy	Speed Difficulty Competitiveness	Diversity Formality Material Environment Goal Direction Disorganization Democracy
Classroom Environment Scale (CES)	Secondary	10	Involvement Affiliation Teacher Support	Task Orientation Competition	Order & Organization Rule Clarity Teacher Control Innovation
Individualised Classroom Environment Questionnaire (ICEQ)	Secondary	10	Personalization Participation	Independence Investigation	Differentiation
My Class Inventory (MCI)	Primary	6-9	Cohesiveness Friction Satisfaction	Difficulty Competitiveness	
College and University Classroom Environment Inventory (CUCEI)	Higher Education	7	Personalization Involvement Student Cohesiveness Satisfaction	Task Orientation	Innovation Individualisation
Science Laboratory Environment Inventory (SLEI)	Upper Secondary / Higher Education	7	Student Cohesiveness	Open-Endedness Integration	Rule Clarity Material Environment
Constructivist Learning Environment Survey (CLES)	Secondary	7	Personal Relevance Uncertainty	Critical Voice Shared Control	Student Negotiation
What Is Happening In This Class Questioner (WIHIC)	Secondary	8	Student Cohesiveness Teacher Support Involvement	Investigation Task Orientation Cooperation	Equity
Questionnaire on Teacher Interaction (QTI)	Secondary Elementary	8-10	Helpful/Friendly Understanding Dissatisfied Admonishing Leadership Student Responsibility/ Freedom Uncertain Strict		

Source: Fraser (1998a)

Individualised Classroom Environment Questionnaire (ICEQ)

The Individualised Classroom Environment Questionnaire (ICEQ) assesses 'individualised' dimensions in the secondary classroom, such as participation and personalisation (Fraser, 1990; Rentoul & Fraser, 1979). The final published version of the ICEQ (Fraser, 1990) contains 50 items altogether, with an equal number of items belonging to each of the five scales. Each item is responded to on a five-point scale with the alternatives of Almost Never, Seldom, Sometimes, Often and Very Often. The scoring direction is reversed for many of the items. The scales are called Personalisation, Participation, Independence, Investigation and Differentiation.

My Class Inventory (MCI)

The My Class Inventory (MCI) is a simplified version of the LEI for use at the elementary or primary school level (Fraser, Anderson & Walberg, 1982; Fisher & Fraser, 1981; Fraser & Fisher, 1982b; Fraser & O'Brien, 1985). Although the MCI was developed originally for use at the primary school level, it also has been found to be very useful with students in the junior high school, especially those who might experience reading difficulties with other instruments. The MCI differs from the LEI in four important ways. First, in order to minimise fatigue among younger children, the MCI contains only five of the LEI's original 15 scales. Second, item wording has been simplified to enhance reading ability. Third, the LEI's four-point response format has been reduced to a two-point (Yes-No) response format. Fourth, students answer on the questionnaire itself instead of on a separate response sheet to avoid errors in transferring responses from one place to another. The final form of the MCI contains 38 items altogether. Although the MCI traditionally has been used with a Yes-No response format. Goh, Young and Fraser (1995) have successfully used a three-point response format (Seldom, Sometimes and Most of the Time) with a modified version of the MCI that includes a Task Orientation Scale.

College and University Classroom Environment Inventory (CUCEI)

The College and University Classroom Environment Inventory (CUCEI) was developed to fill a void for an instrument assessing learning environment at the tertiary level. The CUCEI was designed for use in small classes/groups of up to about 30 students and not for lecture or laboratory situations (Fraser & Treagust, 1986; Fraser, Treagust & Dennis, 1986). It contains seven seven-item scales, using the response format of Strongly Agree, Agree, Disagree and Strongly Disagree. Research using the CUCEI parallels the efforts at assessing learning environments in secondary and elementary classrooms.

Science Laboratory Environment Inventory (SLEI)

The Science Laboratory Environment Inventory (SLEI) is an instrument designed to fulfil another need, that of assessing the environment of science laboratory classes at senior high school or higher education levels (Fraser, Giddings & McRobbie, 1992a, 1992b, 1995; Fraser & McRobbie, 1995; Fraser, McRobbie & Giddings, 1993). The new instrument has five scales (Student Cohesiveness, Open Endedness, Investigation, Rule Clarity and Material Environment) each with seven items. The five response alternatives are Almost Never, Seldom, Sometimes, Often and Very Often. The SLEI underscores the importance and uniqueness of the laboratory in science learning. The SLEI was field tested and validated simultaneously with a sample of over 5,447 students in 269 classes in six different countries (the USA, Canada, England, Israel, Australia and Nigeria) and cross-validated with 1,594 Australian students in 92 classes (Fraser & McRobbie, 1995), 489 senior high school biology students in Australia (Fisher, Henderson & Fraser, 1997) and 1,592 grade 10 chemistry students in Singapore (Wong & Fraser, 1995).

Constructivist Learning Environment Survey (CLES)

The Constructivist Learning Environment Survey (CLES) was developed with an emphasis on the constructivist learning environment and its theoretical framework is provided by three principles of constructivism: learning as construction of knowledge; knowledge is constructed inter-subjectively; and the learner is an interactive co-constructor of scientific knowledge (Taylor, Dawson, & Fraser, 1995; Taylor, Fraser &

Fisher, 1993, 1997; Taylor, Fraser & White, 1994). The CLES contains five scales (Personal Relevance, Uncertainty, Critical Voice, Shared Control and Student Negotiation) with seven items per scale and uses the response format of Very Often, Often, Sometimes, Seldom and Never. The new questionnaire is suitable for use in secondary science and mathematics classrooms. The CLES has been validated with 1083 students in high school science classes in Korea (Kim, Fisher & Fraser, 1999) and 1081 students from 50 classes in Australia and 1879 students from 50 classes in Taiwan (Aldridge, Fraser, Taylor & Chen, 2000)

What is Happening in this Class?(WIHIC) Questionnaire

The What is Happening in This Class? (WIHIC) questionnaire brings parsimony to the field of classroom environment by combining modified versions of the most salient scales from a wide range of existing questionnaires with additional scales that accommodate contemporary educational concerns (e.g., equity and constructivism) (Fraser, Fisher, & McRobbie, 1996). A final form of the WIHIC containing seven eight-item scales, namely, Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation and Equity, has been used successfully in studies in countries including Australia (Dorman, in press), Australia and Taiwan (Huang & Fraser, 1997; Aldridge, Fraser & Huang, 1999), Australia, Canada and England (Dorman, Adams & Ferguson, in press), Singapore (Chionh & Fraser, 1998, 2000; Khoo & Fraser, 1997), Brunei (Riah & Fraser, 1998) and Canada (Zandvliet & Fraser, 1998). The present study used selected scales from the WIHIC to form part of an overall questionnaire. The scales and the reasons for their selection are described in Chapter 3. A copy of the modified version of the WIHIC as used in the present study is provided in Appendix B2.

Questionnaire on Teacher Interaction (QTI)

The Questionnaire on Teacher Interaction (QTI) was developed specially for evaluating teacher-student relationships in secondary classrooms (Wubbels, Brekelmans & Hooymayers, 1991). The QTI was originally an instrument in the Dutch language

developed for use in a teacher education project at the University of Utrecht, Holland; it focuses on the nature and quality of interpersonal relationships between teachers and students (Creton, Hermans & Wubbels, 1990; Wubbels, Brekelmans & Hooymayers, 1991; Wubbels & Levy, 1993). Later an English version was used in the USA (Wubbels & Levy, 1991). Interpersonal teacher behaviour is mapped using eight scales circumrotating on the two axes of influence (dominance-submission) and proximity (cooperation-opposition). The eight scales of teacher interaction behaviour (Leadership, Understanding, Helping/Friendly, Student Responsibility/Freedom, Uncertain, Dissatisfied, Admonishing and Strict behaviour) fall naturally within Moos' category of relationship dimensions. More detailed information concerning the QTI is presented in Section 2.5 as this was one of the main instruments used in the present study. The process of back-translation, used to translate each of the questionnaires into Indonesian, is described in Chapter 3.

2.4.6 Associations between Classroom Environment and Student Outcomes

Research consistently supports the contention that the learning environment of classrooms accounts for variance in student outcomes. Fraser (1994) tabulated a set of 64 studies which shows that associations between outcome measures and perceptions of classroom environment have involved a variety of cognitive and affective outcome measures, a variety of classroom environments instruments and a variety of samples (ranging across numerous countries and grade levels). An interesting and comprehensive meta-analysis by Haertel, Walberg and Haertel (1981) brought together 734 correlations from a total of 12 studies of 10 data sets from 823 classes involving 17,805 students in four nations. This meta-analysis revealed consistent and strong associations between posttest learning scores and regression-adjusted gains in student cognitive and affective outcomes. Of interest to this investigation is the finding that higher achievement was found consistently in classrooms in which students perceived more cohesiveness, satisfaction and goal direction and less disorganisation and friction.

Numerous studies of associations between classroom environment and student learning, involving different subject areas, grade levels and countries, tend to support the important link between the two variables. In a study in Australia (Fraser & Fisher, 1982b), sizeable associations between student perceptions of classroom environment and student outcomes also lent support to a positive link between classroom environment and students outcomes. Studies conducted in the Southeast Asian countries, such as Indonesia (Fraser, 1985; Fraser, Pearse & Azmi, 1982; Paige, 1978, 1979; Margianti & Fraser, 2000; Schibeci, Rideng & Fraser, 1987), Singapore (Chionh & Fraser, 1998, 2000; Goh, Young, & Fraser, 1995; Teh & Fraser, 1993, 1994; Wong & Fraser, 1994, 1996) and Brunei (Riah & Fraser, 1998) replicated prior research in that the nature of the psychological and social climate of classrooms was found to be an important determinant of student outcomes (Fraser, 2000).

Other studies that have explored associations between student outcomes and science laboratory classroom environments include Wong and Fraser's (1994) research undertaken in chemistry laboratories in Singapore secondary schools, which found strong associations between chemistry laboratory environment and student affective outcomes. A study by Henderson, Fisher and Fraser (1994, 1995, 2000) in secondary biology laboratory classroom in Tasmania, Australia, also replicated earlier findings of positive relationships between student outcomes and science laboratory environment.

Fraser and Butts (1982) explored the relationship between students' perceptions of classroom individualisation and their science-related attitudes among lower secondary students. The Individualised Classroom Environment Questionnaire (ICEQ) was used to assess students' perceptions of individualisation while the Test of Science-Related Attitudes (TOSRA) (Fraser, 1981b) was used to measure the attitudes of students towards science. Positive relationships were found between perceived levels of individualisation and science-related attitudes.

Other studies which have reported positive associations between classroom environments and students' attitudes towards science include Keeves (1972), Manley

(1977), Fraser and Fisher (1982a, 1982c, 1983a), Haladyna, Olsen & Shaughnessy, (1982), Schibeci and Riley (1983), Talton and Simpson (1986, 1987), Akindehin (1993) and Krynowsky (1988). However, studies conducted by Anderson and Walberg (1968), in association with work with Harvard Project Physics, found a substantial negative correlation between the classroom environment variable of stratification (the tendency for work in the class to be left to those most capable for the job) and students' attitudes to physics.

Studies about interpersonal teacher behaviours show that it is an important aspect of the learning environment and strongly relates to students' outcome. A study conducted among Australian science and mathematics teachers found that emphasising behaviours from the leadership, friendly and understanding sectors of the model are likely to promote students' outcomes. Those teachers who were stricter were more likely to promote student achievement, while those teachers who were less strict tended to promote more positive student attitudes (Wubbels, 1993). 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). Use of the QTI in senior biology classes (Fisher, Henderson, & Fraser, 1995) established associations between students' perceptions of interpersonal relationships with their teachers and three categories of student outcomes (student attitude, achievement in a written examination and performance on practical tests). Use of the questionnaire in different countries has established the interaction between teachers and students as an important determinant of students' achievement and attitudes (Goh & Fraser, 1995; Henderson, Fisher, & Fraser, 1995; Wubbels, Brekelmans & Hooymayers, 1991).

Research on the interactional behaviour pattern between the teacher and students originated in the Netherlands in the early 1980s (Creton, Wubbels & Hooymayers, 1989; Wubbels, Brekelmans & Hermans, 1987; Wubbels, Creton & Holvast, 1988). As a primary focus of this investigation was interpersonal teacher behaviour, special treatment of this aspect of classroom environment research, together with a review of studies of interpersonal teacher behaviour, is provided in the section 2.5.

Outcome-environment associations were found when the Individualised Classroom Environment Questionnaire (ICEQ) was translated into Indonesian (Paige, 1978; 1979) and the Learning Environment Inventory (LEI) was translated into Hindi for a study in India (Walberg, Singh & Rasher, 1977). Recently, studies of secondary classroom environments were completed in Brunei (Asghar & Fraser, 1995; Riah & Fraser, 1998; Majeed, Fraser & Aldridge, 2001). Studies of learning environment also have been carried out in Singapore at the secondary level in computer-assisted geography classrooms (Teh & Fraser, 1994, 1995a, 1995b), chemistry laboratory classes (Wong & Fraser, 1994; 1996), and mathematics and geography classes (Chionh & Fraser, 2000). A study of secondary science classes was also carried out using a Chinese version of the What is Happening in this Class? questionnaire (Aldridge, Fraser & Huang, 1999). These studies reflect the importance attached to the study of classroom environments and their impact on student learning in secondary classrooms in Asia.

Recently, studies of associations between student outcomes and classroom environment dimensions have been extended from conventional classrooms into the learning environment of science laboratories. This is best illustrated in the study by Fraser, Giddings and McRobbie (1992a) involving 5,447 senior high school and university students in 269 laboratory classes in Australia, the USA, England, Canada, Israel and Nigeria. This cross-national research was the first of its kind in that a new instrument, called the Science Laboratory Environment Inventory (SLEI) and designed for use in laboratory settings, was validated and used in the six countries simultaneously. The finding of significant associations between the nature of the science laboratory environment and affective outcomes replicated prior research in science classrooms. This study also contributed to the development and validation of a new Personal form of the SLEI (involving a student's perceptions of his/her own role within the class) to parallel its Class form (involving a student's perceptions of the class as a whole). Overall, the study also provided insights into the merits and pitfalls of cross-national research of this nature (Fraser, Giddings & McRobbie, 1992a, 1992b, 1995; Fraser, McRobbie & Gidding, 1993).

2.4.7 Other Research on Classroom Environment

This section highlights other lines of classroom environment research that are equally useful and important as those mentioned in the previous sections on associations between student outcomes and classroom environment. A complete picture of the range of classroom environment studies encompassing different grades, subjects, schools and countries can be found in a comprehensive and succinct tabulation of prior research (Fraser, 1994) under the heading of studies using classroom environment perceptions as criterion variables. This table is strong testimony to the interest in the determinants of classroom environment in research over the years. This sections discusses ten lines of research common to the field of learning environments: evaluation of curricula and innovations; congruence between actual and preferred perceptions; gender differences in perceptions; using student perceptions to improve the learning environment; the development of new questionnaires; identifying typologies of learning environments; combining qualitative and quantitative research methods; learning environments in psychology; school-level environment; and studies carried out in Asia.

Evaluation of Curricula and Innovations

In evaluating curricula and innovations, some studies have incorporated classroom environment dimensions as dependent variables and used instruments such as the Learning Environment Inventory (LEI) and the Individualised Classroom Environment Questionnaire (ICEQ). For example, in studies involving an evaluation of the Australian Science Education Project (ASEP) (Fraser, 1979) and Harvard Project Physics (Welch & Walberg, 1972), it was found that classroom environment variables differentiated between curricula, even though there were little differences in student outcomes. Similarly, a recent study by Teh and Fraser (1993) used classroom environment dimensions as criterion variables in assessing the efficacy of a computer-assisted learning innovation in secondary geography classrooms. Findings from curriculum evaluations are useful to schools and administrators but, as pointed out by Fraser (1993a), this is one promising but neglected line of classroom environment research.

Congruence Between Actual and Preferred Perceptions

Studies have been undertaken also to assess differences in perceptions between students and teachers in actual and preferred classroom environments. This line of research was made possible by the availability of actual and preferred forms of some classroom environment instruments, such as the My Class Inventory (MCI), Individualised Classroom Environment Questionnaire (ICEQ) and the Science Laboratory Environment Inventory (SLEI). With separate actual and preferred forms, which can be used either with students or teachers, investigations were made of differences between students and teachers in their perceptions of the same actual classroom environment and that preferred by students or teachers. Fisher and Fraser (1983a) reported a study into differences in perceptions between teachers and students in their actual and preferred classroom environments using the ICEQ. Results revealed that students preferred a more positive environment than was actually the case and that teachers perceived a more positive classroom environment than did their students in the same classrooms. These findings replicate emergent pattern in studies carried out in classrooms of secondary schools in the USA (Moos, 1979a), Australia (Fraser, 1982), Israel (Raviv, Raviv & Reisel, 1990), the Netherlands (Wubbels, Brekelmans & Hooymayers, 1991) and Singapore (Teh & Fraser, 1993; Wong & Fraser, 1994). Generally, these studies emphasise that students and teachers are likely to perceive the nature of the same classroom differently and that students tend to evaluate their actual classroom environment as less positively than their preferred environment.

The availability of actual and preferred forms of classroom environment instruments facilitates person-environment fit studies. In this line of classroom environment research, a person-environment interactional framework was used to explore whether students achieve better in their preferred environment (Fraser, 1991). Findings from a study in science classes by Fraser and Fisher (1983b, 1983c) suggest that an actual-preferred match in the classroom environment could enhance student outcomes.

Gender Differences in Perceptions

Studies of determinants of classroom environment were conducted in countries such as the USA, Australia and Singapore. These focused mainly on how the classroom environment varies with factors such as class size, grade level, subject content, teacher/student personality, the nature of school environment (as opposed to classroom environment) and the type of school (e.g., primary compared with junior high schools). For instance, Walberg and Anderson (1968a, 1968b) examined classroom climate and student characteristics in terms of their unique personalities, shared role expectations and abilities. Walberg (1969) also reported an interesting study of class size and learning environment. A study by Owens and Straton (1980) into student preferences for different types of classroom environment (cooperative, competitive and individualised) revealed that girls preferred a cooperative classroom atmosphere more than boys, whereas boys preferred both competition and individualisation more than girls. Gender-related differences in perceptions of classroom environment were examined also by Teh and Fraser (1993) in a study of computer-assisted learning environment by Wong and Fraser (1994) in a study of chemistry laboratory learning environments and by Margianti and Fraser (2000) in a study of mathematics learning environments in an Indonesian university.

Using Student Perceptions to Improve the Learning Environment

Feedback information derived from perceptions of students has been used in another line of classroom environment research in providing meaningful information to guide teachers in their attempts to improve their classrooms for learning and teaching. Examples of attempts to improve classroom environment are provided by Fraser and Fisher (1986), Fraser, Malone and Neale (1989), Thorpe, Burden and Fraser (1994) and Fraser and Wubbels (1995). A small-scale study of classroom environment by a teacher in a secondary school in Singapore (Quek, 1993) used a modified version of the Classroom Environment Scale (CES) in its actual and preferred forms. The information obtained was used as a means for reflection and improvement of the classroom environment so as to improve student outcomes (Yarrow, Millwater & Fraser, 1997).

Development of New Questionnaires

Apart from studies in conventional classrooms and science laboratory settings, there also have been studies conducted in a more technologically-rich classroom environments involving computer-assisted learning. The studies by Maor and Fraser (1996) and Teh and Fraser (1993, 1994, 1995a) were undertaken in computer-assisted classroom learning environments. Teh's study in Singapore contributed to the development and validation of a new classroom environment instrument, termed the Geography Classroom Environment Inventory (GCEI).

Identifying Typologies of Learning Environments

Research aimed at identifying a typology of classroom environments at university and high schools represents another area of classroom environment research. In fact, the development and validation of the Science Laboratory Environment Inventory (SLEI) (Fraser, Giddings & McRobbie, 1992a) for use in a laboratory setting made possible further investigations into the state of learning in science laboratories. McRobbie and Fraser (1993b) emphasised the need to develop a systematic typology of science laboratory classrooms, similar to a typology of American high school classroom settings as developed by Moos (1978) using the Classroom Environment Scale (CES) and a typology of Dutch physics classes as developed by Wubbels, Brekelmans and Hooymayers (1991) using the Questionnaire on Teacher Interaction (QTI). Moos labelled the American classes as control oriented, innovation oriented, affiliation oriented, task oriented and competition oriented. On the other hand, Dutch physics classes were described as directive, authoritative, tolerant and authoritative, tolerant, uncertain and tolerant, uncertain and aggressive, aggressive and drudging. The study by McRobbie and Fraser (1993b) identified eight major homogeneous groups in university and high school science laboratory classrooms using the SLEI. This is a promising start to the study of typologies of classrooms.

Combining Qualitative and Quantitative Research Methods

The review of literature on classroom environment research (Fraser, 1998a) indicates the desirability of combining qualitative and quantitative research methodologies within the same study (Aldridge, Fraser & Huang, 1999; Fraser & Tobin, 1991; Tobin & Fraser, 1998; Tobin, Kahle & Fraser, 1990). Much has been said of the merits of this combination of research methodologies, with an intensive study by Fraser and Tobin (1989) attesting to the fruitfulness of such an approach. Although the present study benefited from qualitative information obtained from interviews with six students during the pilot testing, the main source of data for the present pioneering study in Indonesia was student responses to measures of outcomes and environment.

School-Level Environment

Another desirable trend that has emerged is the development and use of an instrument for assessing school environment, namely, the School-Level Environment Questionnaire (SLEQ) (Fisher & Fraser, 1991; Burden & Fraser, 1994). Findings from a study (Fisher & Fraser, 1991) using the SLEQ has yielded interesting differences between the climates of primary and secondary schools (Fraser, 1993b). A distinction has been made between research into school climate or environment (e.g., Fraser & Rentoul, 1982) and research into classroom climate or environment. However, it is envisaged that the integration of classroom and school environment variables within the same study will provide scope for teachers to gather information regarding the environment (both class and school) in which they work. In turn, this information is likely to equip the teachers with a sound basis for improving the quality of their working environment and professional lives (Fraser, 1993b; Dorman, 2000a, 2000b).

Studies Carried Out in Asia

Finally, to complete the scene in learning environment research, it can be noted that another desirable trend has emerged with the development and use of instruments for assessing learning environment in Asian countries, such as Singapore (Chionh & Fraser,

1998, 2000; Goh & Fraser, 1998; Goh, Young, & Fraser, 1995; Teh & Fraser, 1993, 1994, 1995a, 1995b; Wong & Fraser, 1994, 1995, 1996), Brunei (Riah & Fraser, 1998; Scott & Fisher, 2000), Korea (Kim, Fisher & Fraser, 1999; Lee & Fraser, 2001), Taiwan (Aldridge & Fraser, 2000; Aldridge, Fraser & Huang, 1999; Aldridge, Fraser, Taylor & Chen, 2000), and Indonesia (Fraser, 1985; Fraser, Pearse & Azmi, 1982; Paige, 1978, 1979; Schibeci, Rideng & Fraser, 1987; Margianti & Fraser, 2000). These studies include some examples of research that successfully translated questionnaires into the national language.

2.5 LEARNING ENVIRONMENT RESEARCH IN INDONESIA

Fraser, Pearse and Azmi (1982) and Fraser (1985) reported a study in Indonesia involving an Indonesian translation of a modified version of all the ICEQ's five scales and four of the CES's nine scales. The sample consisted of 373 students in 18 coeducational social studies classes at the grade 8 and 9 levels in Padang. This study used student measures of satisfaction and anxiety as the outcomes and found that satisfaction was greater in classes perceived as having less independence and greater involvement, while anxiety was lower in classes perceived as having greater differentiation, involvement and affiliation.

In another study of primary classrooms in Indonesia, Paige (1978, 1979) examined the relationship between classroom learning environment and the two outcomes of cognitive achievement and individual modernity. The sample was composed of a stratified random group of 1,621 sixth grade students in 30 rural and 30 urban schools in East Java. Use was made of a revised and translated instrument based on the nine CES scales and three of the LEI's scales that had been modified to fit the East Javanese sociocultural milieu. Specific findings included the trend that individual modernity was enhanced in classrooms perceived as having greater task orientation, competition and difficulty and less order and organisation, while achievement was enhanced in classes higher in speed and lower in order and organisation.

In a study conducted at the tertiary level of education in Indonesia at the same time as the present study, Margianti and Fraser (2000) provided an interim study. This study involved the learning environment, mathematical ability and students' outcomes at a university specialising in computing courses. The study involved 1,056 third-year computer students in 17 classes. Students' perceptions of the classroom environment were measured using a modified Indonesian version of the What Is Happening In This Class? (WIHIC) questionnaire. To assess students' affective outcomes, a scale derived from the Test of Science-Related Attitudes (Fraser, 1981b) was adapted for use in higher education computing classes and translated into Indonesian. The results tentatively suggest that lecturers wishing to improve students' attitudes should include lessons that allow for more Involvement/Teacher Support, Task Orientation and Equity. *T* tests for paired sample were used to compare students' perceptions of their actual learning environment and their preferred learning environment. The results indicate that students would prefer higher levels of all scales. *T* tests for independent samples were computed to determine whether differences exist between the perceptions of male and female students. The results indicate female students perceived more Order and Organisation, Task Orientation and Cooperation and that male students perceived more Equity.

2.6 INTERPERSONAL TEACHER BEHAVIOUR

This section reviews research on studies of interpersonal teacher behaviour and is divided into two parts:

- Teacher interaction in the classroom (Section 2.6.1); and
- Development of the Questionnaire on Teacher Interaction (Section 2.6.2).

2.6.1 Teacher Interaction in the Classroom

This section provides a more in depth overview of research related to students' perceptions of interpersonal teacher behaviour, particularly with regard to its likely

impact on students' cognitive and affective outcomes. Observations of classroom developments and practices have revealed that the interactional behaviour of a teacher plays a pivotal part in directing the flow of teaching and learning in the classroom. From experiences, personal and reported, it also is noticeable that teacher behaviour is a key factor in the discipline problems experienced by teachers, particularly those of beginning teachers (Wubbels, Creton & Hooymayers, 1992). It has been reported that student and beginning teachers often claim that managing their classrooms, particularly in terms of student behaviour, can be a difficult and uphill task (Creton, Wubbels & Hooymayers, 1989; Veenman, 1984). This universal and perennial problem clearly is linked to teacher ability to set the tone and gain student respect and cooperation. It is essential, therefore, that teachers establish a rapport with students that will ensure smooth functioning of the teaching-learning process. It also emphasises the importance of the communication skills of teachers and the social and emotional backup that a teacher can provide in daily classroom communication. The assertion made by many researchers on teacher effectiveness is that the creation and maintenance of a positive classroom climate is conducive for student learning (Brophy & Good, 1986; Doyle, 1986; Emmer, Evertson & Anderson, 1980). This further underscores the fruitfulness of assessing the impact of interpersonal teacher behaviour on student learning. Therefore, a study concerning interpersonal teacher behaviour is part of the fundamental aim of making the teacher-learning process more effective and efficient.

More specifically, a study of interpersonal teacher behaviour is important not only for facilitating student outcomes but also for improving teacher competency in classroom communication and helping to provide the social and emotional backup required by teachers in order to reach out to students. It is widely reported that communication is reciprocal, so that the behaviours of the teacher and students influence each other mutually (Wubbels, Creton & Hooymayers, 1992). It is useful, therefore, to view the concept of interpersonal teacher behaviour from two perspectives. The instructional-methodological perspective of teacher behaviour encompasses technical aspects such as teacher selection of content and materials, methods and strategies and assessment procedures. The interpersonal perspective includes social and emotional aspects and is

concerned with the creation and maintenance of a positive and warm classroom atmosphere.

In distinguishing between methodological and interpersonal perspectives of teacher behaviour, it is possible to avoid confounding between the contributions to student learning made by interpersonal teacher behaviour and other aspects of teacher effectiveness and efficiency in classroom instruction (e.g., school administration and organisation, teacher workload, personality and commitment). Interpersonal teacher behaviour (the way in which the teacher reacts to student behaviour and interacts with students) is conditioned by the classroom environment and significant others. It is within the teacher's purview and control as it is interactive. It is viewed as distinct from teacher personality traits which tend to be stable and unchangeable (Wubbels & Levy, 1993). Clearly, the teacher is a key actor or actress in the classroom and does make a difference with regard to student learning.

Research on teacher behaviour and student learning has taken many forms, including a focus on teacher expectation studies (Cooper & Tom, 1984; Good, 1987), the influence of teacher non-verbal behaviour on student performance (Woodfolk & Brooks, 1985), managing classrooms and students (Brophy, 1988), the influence of teacher socialisation style on student cognition (Rohrkemper, 1984) and studies of expert and novice teachers (Berliner, 1986). However, it was from research which originated in The Netherlands that the study of interpersonal teacher behaviour came to focus more specifically on the impact on the learning of students of the interactional and mutually influencing relationship between teacher and students. This potentially powerful determinant of student learning provided a catalyst for a series of research studies in teacher education since the early 1980s at the University of Utrecht, The Netherlands. Research on associations between student outcomes and interpersonal teacher behaviour produced encouraging results (Creton, Wubbels & Hooymayers, 1989; Wubbels, Brekelmans & Hermans, 1987; Wubbels, Creton & Holvast, 1988; Wubbels & Levy, 1993).

2.6.2 Development of the Questionnaire on Teacher Interaction

The QTI originated in The Netherlands and was used to gather students' and teachers' perceptions of interpersonal teacher behaviour. It was developed by a team of Dutch educational researchers at the University of Utrecht for their research in secondary classrooms (Brekelmans, Wubbels & Creton, 1990; Creton, Hermans & Wubbels, 1990; Wubbels, Brekelmans & Hermans, 1987; Wubbels, Brekelmans & Hooymayers, 1991; Wubbels, Creton & Holvast, 1988; Wubbels, Creton & Hooymayers, 1992; Wubbels & Levy, 1993).

In response to the need for a framework for conceptualising and measuring teacher-student interaction, Wubbels, Creton and Hooymayers (1985) were inspired by the Leary model of interpersonal behaviour (1957) after a review of educational research literature showed no feasible instrument for the purpose. The Leary model provided a graphic representation for human interaction (Wubbels, Creton, Levy & Hooymayers, 1993).

In the adaptation of the Leary model, the behaviours of teachers also were plotted along two-dimensional axes: an Influence dimension (Dominance – Submission, DS) and a Proximity dimension (Cooperation – Opposition, CO), as shown in Figure 2-2. According to Wubbels, Creton, Levy and Hooymayers (1993), the Influence dimension portrays who is controlling or directing the communication process and how often; and the Proximity dimension indicates the degree of cooperation or closeness among those who are involved in the process of communication. These two dimensions of Influence and Proximity were independent and reminiscent of effective teacher behaviours that could influence classroom processes. For instance, directivity and warmth are two aspects of effective teacher behaviour (Dunkin & Biddle, 1974), which bear strong resemblance to Influence and Proximity. Each of these axes (DS and CO) represent opposite behaviours, with the DS axis for dominance and submission and the CO axis for Cooperation and Opposition, as illustrated in Figure 2-2.

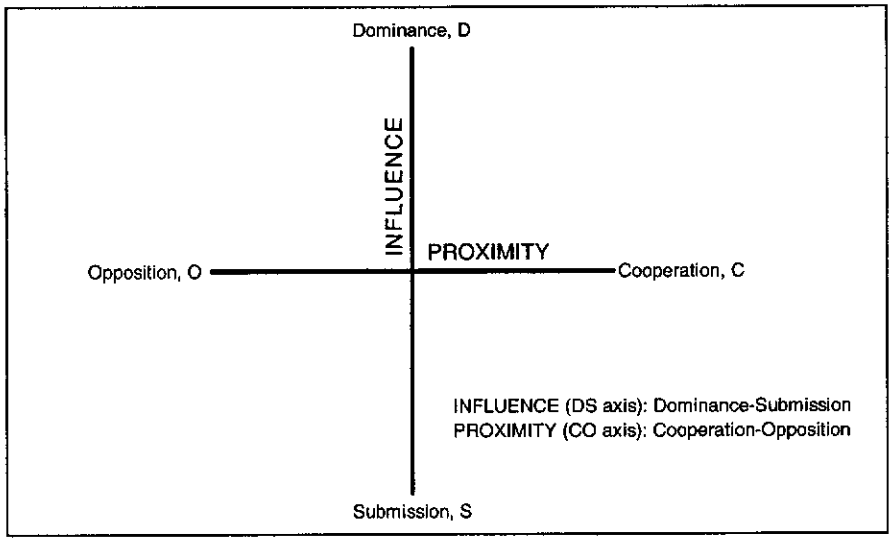

Figure 2-2: Two-Dimensional Axis of the QTI

The two dimensions of DS and CO form the axes in a coordinate system of eight sectors circumrotating the eight different facets of teacher behaviour, namely, Leadership, Helpful/Friendly, Understanding, Student Responsibility/Freedom, Uncertain, Dissatisfied, Admonishing and Strict behaviour (see Figure 2-3). These eight sectors are labelled DC, CD, CS, SC, SO, OS, OD and DO in accordance with their circular placing in the model of interpersonal teacher behaviour.

This model of interpersonal teacher behaviour takes the form of an octagonal circumplex. One predominant characteristic of a circumplex is the rotation of factors (Becker & Krug, 1964; Kent, 1992) and the term circumplex appropriately describes the model with its circumrotating of the eight sectors representing eight facets of teacher behaviour.

Every instance of teacher behaviour can be placed within these eight sectors (Wubbels, Creton, Levy & Hooymayers, 1993). As an illustration of the mapping of teacher behaviour, the sectors DC and CD both include Dominance and Cooperation. In the DC sector, teacher Dominance is a stronger trait than teacher Cooperation (for example, demonstrated through the teacher holding student attention by explaining a concept to

the class, setting an assignment or establishing procedures). In the CD sector, it is the reverse, with more teacher Cooperation and less teacher Dominance (for example, the teacher might be seen moving among groups of students assisting and motivating them in their learning).

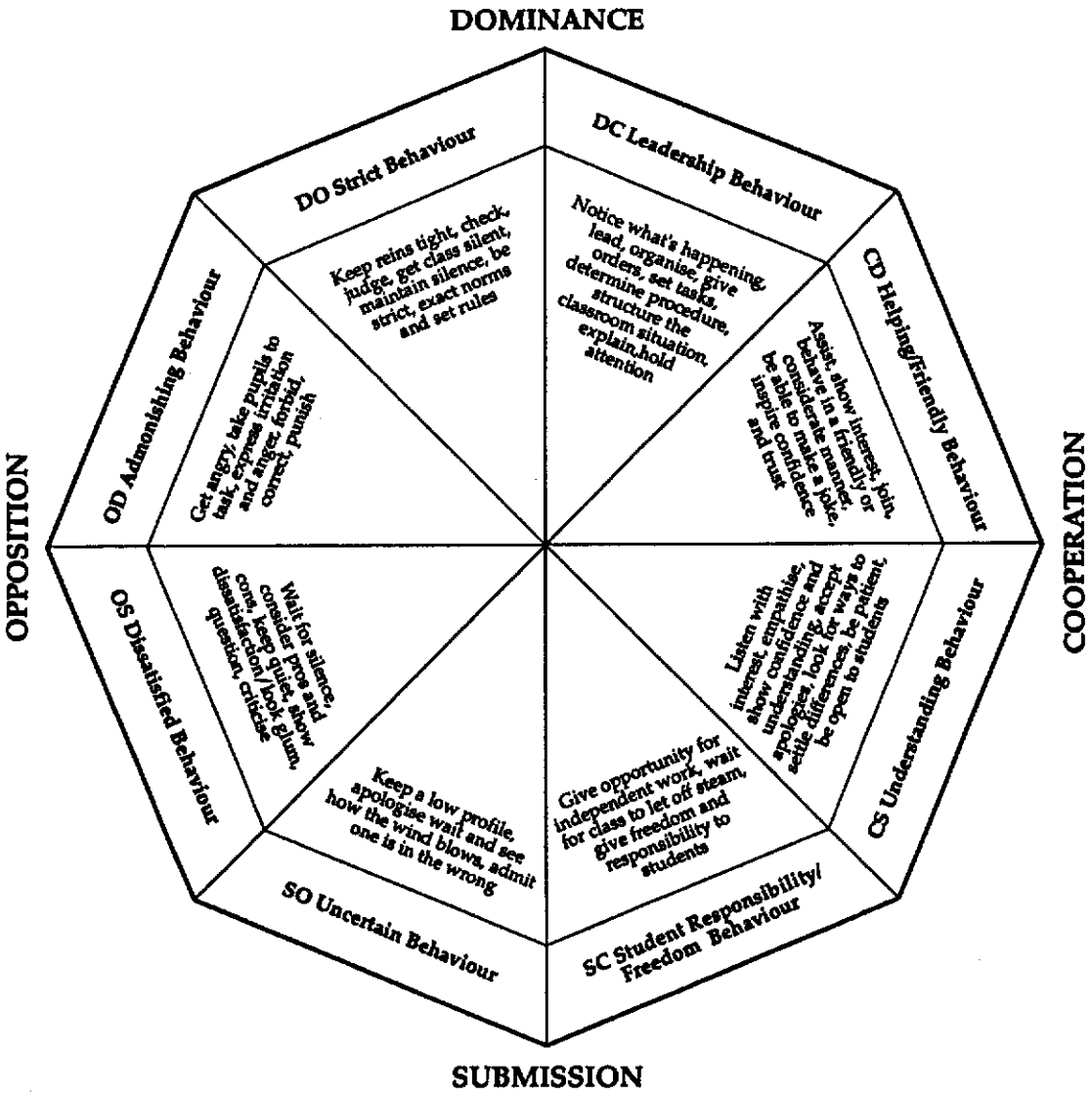

Figure 2-3: Model of Interpersonal Teacher Behaviour

Wubbels (1993) provided a description of typical teacher behaviours belonging to each of the eight sectors, as shown in Figure 2-3. For example, in the Leadership (DC) sector, teachers notice what's happening, lead, organise and give orders while, in the Strict (DO) sector, teachers keep reins tight, get the class silent, maintain silence, exact norms and set rules.

It also can be noted that these two sectors of Leadership (DC) and Strict (DO) are adjacent to each other in the model and that the types of teacher behaviour encompassed by these two adjacent sectors tend to resemble each other more closely. This characteristic of adjacent scales in the model is seen in Figure 2-3. For example, whereas teachers give orders, determine procedures and structure the classroom situation in the DC scale, teachers exact norms and set rules in the DO scale. Similarly, in the adjacent scales of Leadership (DC) and Helping/Friendly (CD), teachers notice what's happening, lead and hold attention. Based on the above assumption regarding adjacent scales in the model, the closer the scales are, the more the types of teacher behaviour in those scales would resemble each other (Wubbels, Creton, Levy & Hooymayers, 1993). In other words, scores on adjacent scales, such as Strict, Leadership and Helpful/Friendly, should correlate highest with one another.

On the other hand, as a scale position in the model is located further away from another scale, it becomes increasingly more different until they are diametrically opposite to each other as in the case of Leadership and Uncertain scales. Evidently, the Leadership scale measures teacher interaction patterns (like lead, organise and give orders) which are the opposite to those measured by the Uncertain scale (for example, apologise, wait and see how the wind blows, and admit one is in the wrong). Figure 2-4 shows the relative positions of scales adjacent to and opposite Leadership (DC).

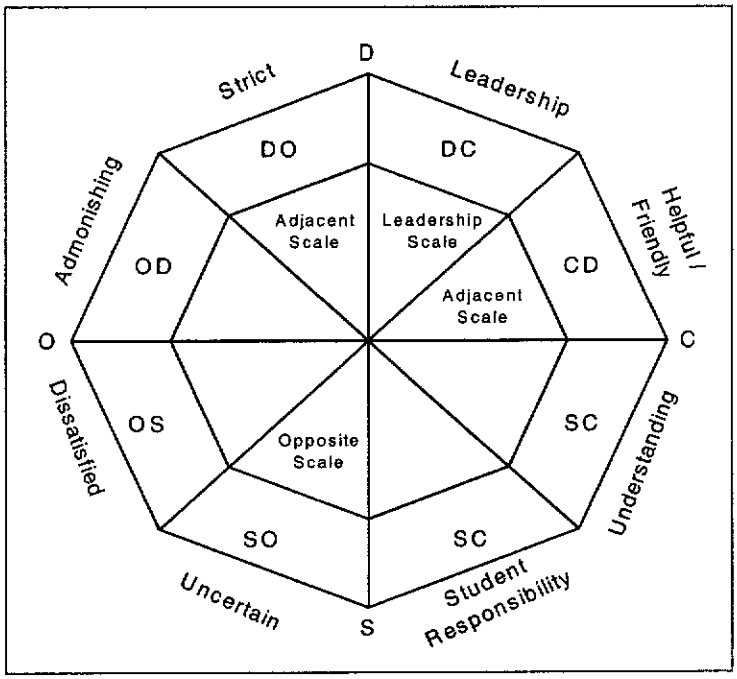

Figure 2-4: Circumplex Showing Scales Adjacent and Opposite to Leadership (DC) Scale

According to Wubbels, Creton, Hooymayers (1992), the Leary model not only presents the researchers with a model to map and describe interpersonal teacher behaviour, but also it provides the basis of a method to measure such teacher behaviours. In addition, the Leary model provides an empirical explanation for the inter-relatedness of the kinds of interpersonal behaviour mapped in the QTI discussed earlier in this section.

The original Dutch version of the QTI was developed after several studies of teacher-training programs conducted by Wubbels and his team at the University of Utrech in The Netherlands in the early 1980s. In accordance with the Leary model for interpersonal teacher behavior, the QTI has the eight teacher behavior scales of Leadership (DC), Helpful/Friendly (CD), Understanding (CS), Student Responsibility/Freedom (SC), Uncertain (SO), Dissatisfied (OS), Admonishing (OD) and Strict (DO) behaviour. These eight facets of teacher behaviour circumrotate on the two axis of DS and CO, starting with Leadership (DC) and ending with Strict (DO). A description of each of the teacher behaviour scales is presented in Table 2-2.

In the earlier Dutch version of the QTI, each scale of teacher behaviour consisted of roughly 10 Items, making a total of 77 Items, based on a five-point rating scale with responses varying from Always to Never (Wubbels, Creton & Hooymayers, 1985).

Table 2-2: Descriptive Information for QTI Scales

Scale Name	Description
	Degree to which ...
Leadership (DC)	... the teacher provides leadership to class and holds student attention.
Helpful/Friendly (CD)	... the teacher is friendly and helpful towards students.
Understanding (CS)	... the teacher shows understanding/concern/care to students.
Student Responsibility/ Freedom (SC)	... students are given opportunities to assume responsibility for their own activities.
Uncertain (SO)	... the teacher exhibits his/her exhibits his/her uncertainty.
Dissatisfied (OS)	... the teacher shows unhappiness/dissatisfaction with students.
Admonishing (OD)	... the teacher shows anger/temper/impatience in class.
Strict (DO)	... the teacher is strict with and demanding of students.

In summary, these eight QTI scales of the model of interpersonal teacher behaviour have the following characteristics. These eight scales of Leadership (DC), Helping/Friendly (CD), Understanding (CS), Student Responsibility/Freedom (SC), Uncertain (SO), Dissatisfied (OS), Admonishing (OD) and Strict (DO) behaviour circumrotate around the two-dimensional axis of Influence (DS: Dominance – Submission) and Proximity (CO: Cooperation – Opposition). The first four teacher behaviour scales of Leadership, Helping/Friendly, Understanding and Student Responsibility/Freedom behaviour appear to be positive teacher behaviours, while the remaining four scales of Uncertain, Dissatisfied, Admonishing and Strict behaviour appear to be negative. However, it should be emphasised that all eight behaviours could be necessary for the teacher to show depending on the situation. For example, undoubtedly, a certain amount of Admonishing and Strict behaviour might be necessary in certain classroom situations.

Adjacent scales in the model describe teacher behaviours that resemble each other to a certain extent (for example, Helping/Friendly and Understanding behaviours; Uncertain and Dissatisfied behaviours as shown in Figure 2-3). Opposite scales in the model (such as Leadership versus Uncertain; Understanding versus Admonishing) portray diametrically different teacher behaviours. With the eight scales of teacher behaviour circumrotating on the two-dimensional coordinates of DS and CO in the circumplex, a scale should correlate positively and highest with its adjacent scale and less strongly with scales that are further away. The highest negative correlation should occur between two scales located opposite each other (for instance, Leadership and Uncertain scales).

In 1991, an American version of the QTI was developed, comprising a total of 64 items, with eight items for each of the eight scales based on the same response format (Wubbels & Levy, 1991). The QTI was translated from Dutch into English and used in the USA in a validation study (Wubbels & Levy, 1991). A main purpose of this study was to find out the reliability and the structural validity of the translated Dutch version of the QTI in an American setting. This cross-national study also compared the interpersonal teacher behaviour of Dutch and American secondary teachers. The results confirmed that both the Dutch and English versions of the QTI displayed similar internal structure and validity.

Both the Dutch and American versions of the QTI were developed initially for educational research purposes at the secondary level. Then came the development of a distinct shorter version (in English) for teachers to use in their classrooms (Wubbels, 1993). This short form of the QTI contains a total of 48 items, with six items for each of the eight scales of teacher behaviour. "This teacher talks enthusiastically about his/her subject" and "This teacher is willing to explain things again" are examples of typical items in the Leadership and Understanding teacher behaviour scales, respectively. The short form was designed specially for use by secondary school teachers to obtain feedback from their students concerning teachers' interpersonal relationships with their classes.

With the emergence of an English version of the QTI, studies into associations between student outcomes and interpersonal teacher behaviour emerged in Israel (Kremer-Hayon & Wubbels, 1992), Australia (Wubbels, 1993; Henderson, Fisher & Fraser, 2000) and Singapore (Goh & Fraser, 1998) and Brunei (Scott & Fisher, 2000), all of which supported the cross-national validity of the QTI.

The findings from an Australian study of secondary science and mathematics classes (Wubbels, 1993) suggest that interpersonal teacher behaviour is an important aspect of the learning environment as it is related to student cognitive and affective outcomes. Teachers who exhibited more Leadership, Friendly and Understanding behaviours in their interactions with students were found to foster greater student achievement, while teachers who showed more Uncertain, Dissatisfied and Admonishing behaviours produced the reverse effect.

Associations between interpersonal teacher behaviour and student outcomes were explored further using the QTI and the SLEI, in an interesting study of student perceptions of science laboratory classroom environment, interpersonal teacher behaviour and student outcomes. The study, conducted in secondary biology classes in Australia, confirmed the reliability and validity of the QTI and indicated that the QTI made an appreciable contribution to the variance in student outcomes (Henderson, Fisher & Fraser, 2000). Another Australian study used perceptions of teachers and students to examine the relationship between interpersonal teacher behaviour and teacher personality in secondary classroom (Kent, 1992).

Evidently, this relatively new area in classroom environment research involving the QTI has focused mainly on secondary science and mathematics classes in the Netherlands, USA and Australia. It was considered timely to extend the area of study from secondary to higher education classrooms in Indonesia. Therefore, it was decided to examine the nature and impact of interpersonal teacher behaviour on student outcomes using student perceptions on an Indonesian version of the QTI for use in higher education classrooms.

On the Indonesian scene, this study has the distinction of being the first classroom learning environment research done in higher education classrooms.

2.7 DEFINING AND MEASURING STUDENT ATTITUDES

One of the major purposes in the present study was the investigation of associations between classroom environment and students' learning outcomes (achievement, attitudes). Hence, there is a need to review literature related to attitudes. This section reviews literature related to attitudes in terms of:

- Defining the term attitude (section 2.7.1);
- Attitude-measuring techniques and instruments (section 2.7.2),
- Attitudes studies related to research on learning environment (Section 2.7.3),
- Test of Science-Related Attitudes (Section 2.7.4).

2.7.1 Defining the Term Attitude

The concept of attitude, its definition and its measurement have been widely explored in books such as Eiser (1984), Mueller (1986) and Lemon (1973). According to Mueller (1986), attitudes cannot be observed or measured directly. Their existence must be inferred from their consequences. Given that an attitude is a non-observable psychological construct whose presence can only be deduced from the behaviour manifested, it is thus not surprising that there is no unanimous agreement amongst social scientists on any given definition for the term attitude. Furthermore, the definition of the term could undergo modification with the passage of time as new light is thrown by attitudes-related research. For example, Thurstone (1928), the social psychologist who first formulated and popularised the methodology for measuring attitude, defined it as the sum total of a person's inclinations and feelings, prejudice and bias, preconceived notions, ideas, fears, threats and convictions about any specified topic. He later modified the definition of attitude to "the affect for or against a psychological object" (Thurstone, 1931). However, Thurstone (1946) later commented that he wished that he had kept to

his draft definition of attitude in his 1928 paper, as this was a narrower definition. According to Allport (1935), however, attitude is a mental or neutral state of readiness. Linton (1945) comments that attitude is the covert response evoked by a value.

The notion that attitudinal behaviour is learned and could be further modified is widely accepted by social scientists. Also, acknowledged by researchers and educators are the relationships of attitudes to values and beliefs and hence its impact on the human psyche.

2.7.2 Attitude-Measuring Techniques and Instruments

Several scaling techniques have been developed to measure attitudes, such as Likert attitude scaling (Likert, 1932), Thurstone scaling, Guttman scaling and the semantic differential technique. In measuring the attitude of a respondent using the Likert scaling technique, the researcher locates the respondent's position on a continuum ranging from the extreme end of positive to that of negative. Responses to given statements about an attitudinal object on a five-point continuum (e.g., strongly agree, agree, uncertain, disagree and strongly disagree) are tallied. An example of an instrument that uses the Likert scale technique is the *Test of Science-Related Attitudes* (TOSRA) developed by Fraser (1981b). The TOSRA is based on the classification of students' attitudinal aims according to Klopfer's (1971) six categories: attitude to science and scientists, attitude to inquiry, adoption of scientific attitudes, enjoyment of science learning experiences, interest in science, and interest in a career in science. This instrument has been widely used to measure attitudes related to the study of science.

The Thurstone scaling techniques were based on methods developed by Allport and Hartman (1925). Three separate methods were developed: paired comparisons, equal-appearing intervals and successive intervals. For paired comparisons (Thurstone, 1927), attitude statements are paired and a judgement has to be given as to which one of the statements is more favourable towards the attitudinal object. The method of equal-appearing intervals requires judgement to be made by classifying each statement into

equidistant categories ranging from 'extremely unfavourable' to 'extremely favourable' (Thurstone & Chave, 1929). The successive intervals method is an extension of the equal-appearing interval method (Saffir, 1937). The difference between the two methods is that the method of successive intervals establishes the intervals statistically rather than depending on subjective judgement as is the case for the equal-appearing interval method.

The Guttman scaling technique developed by Guttman (1944) focuses on scales that are unidimensional. For attitude measurement, the opinion items in the Guttman scales are similar to those in Likert and Thurstone scales. The uniqueness of the Guttman scaling technique is its unidimensionality. This means that a respondent whose score places him/her at a particular point on the attitude continuum must agree with all items below (less positive than) this point and must disagree with all items above this point. Total conformity to this condition is difficult in attitude measures as total consensus amongst respondents to the ordering of statements is difficult to achieve.

The development of the semantic differential technique for attitude measurement by Osgood, Suci and Tannenbaum (1957) resulted from investigation of the nature of meaning. Using factor analysis, Osgood identified the underlying dimensions of meaning such as evaluation, potency and activity. Bipolar adjectives that largely represent the evaluative dimension are constructed. The respondent selects a response on a seven-point scale along the bipolar adjectives continuum (e.g., easy-difficult). The strengths of the semantic differential technique for attitude measurement are that it is usually reliable, relatively easy to construct and quick in the administration. Weaknesses of this technique are encountered when respondents insist on a literal interpretation for some pairs of adjectives (e.g., applying the adjective pair of 'clean-dirty' to an attitudinal object such as 'My Computing lessons') and possibly do not respond to the items concerned. Also the validity of an attitude measure is questionable if respondents 'slant' the answer, as it is easy for respondents to figure out what is being measured. Of the four techniques (Likert, Thurstone, Guttman and the semantic differential), the semantic differential is the most direct in that it asks respondents about their attitudes

towards a certain object. Also, the scales of the semantic differential are transparent (Mueller, 1986). For the present study, the semantic differential technique was selected and used (see discussion in Section 3.4.5).

2.7.3 Attitude Studies Related to Research on Learning Environments

There have been a number of past studies which have investigated student attitudes towards their class as an outcome measure. However, the majority of these studies focused specially on science-related attitudes. Many of these studies have reported positive associations between students' attitudes towards science and classroom environments (Fraser & Butts, 1982; Fraser & Fisher, 1982c, 1983c; Haladyna, Olsen & Shaughnessy, 1982; Keeves, 1972; Krynowsky, 1988; Manley, 1977; Schibeci & Riley, 1983; Talton & Simpson, 1986, 1987; Schibeci, Rideng & Fraser, 1987). A study of the chemistry laboratory classroom environment by Okebukola (1986a) also showed positive relationships between students' attitudes and their participation in laboratory work. Another study by Okebukola (1986b) suggested that cooperative learning was an effective way of developing favourable attitudes towards laboratory work. On the other hand, research associated with Harvard Project Physics showed a negative correlation between classroom environment, stratification and students' attitudes to physics (Anderson & Walberg, 1968).

In a more recent study using the SLEI to investigate students' perceptions of their science laboratory environment, McRobbie and Fraser (1993b) reported overall positive associations between the outcomes of inquiry skills and attitude and the classroom environment variable on Integration (the degree in which non-laboratory theory classes are integrated with laboratory lessons). However, a negative relationship was reported for the classroom environment variable on Open-Endedness and one of the attitudinal outcomes. A negative relationship between students' attitudes and classroom environment was also reported in a study of sex, attitude and classroom environment by Baker, Leary and Trammel (1992).

In research into the relationships between achievement and attitudes, weak correlations have also been found (e.g., Hart, 1978; Hough & Piper, 1982; Maddock, 1978). However, strong correlations were found between achievement and attitudes in studies such as by Marjoribanks (1976) and Tamir (1987).

Several attitude studies have been undertaken in conjunction with classroom environment instruments. Some of these are from Singapore including Goh and Fraser (1998), Khoo and Fraser (1997), Teh and Fraser (1995), Chionh and Fraser (1998) and Wong and Fraser (1998), from Korea including Lee and Fraser (2001) and Kim, Fisher and Fraser (2000), and from Brunei including Riah and Fraser (1998).

Some examples of other studies on attitudes which are not linked to learning environment instruments include: the effect of teachers' positive behaviour on the mathematics achievement and attitudes of secondary students (Chua, 1990); achievement and attitude regarding history (Goh, 1986; Quek, 1995); relationships between the educational attitudes of teachers and their perceptions of their principals' leadership behaviour (Ee, 1986); the effects of an inservice course on teachers' attitudes towards pastoral care (Lee, 1994); and the differences in attitudes amongst low- and high-achieving students (Tan, 1995). As these studies do not relate to the use of learning environment instruments, their findings are not reported here.

The present study investigated students' attitudes towards computers in higher education classes in Indonesia. A review of the existing techniques and instruments used to measure students' attitudes revealed that none of the existing instruments met the needs of the present study. Therefore, the researcher constructed her own attitude instrument (the process is described in Chapter 3) based on the semantic differential technique of Osgood, Suci and Tannerbaum (1957) and the Test of Science-Related Attitudes (Fraser, 1981b) described in the following section.

2.7.4 Test of Science-Related Attitudes

Test of Science-Related Attitudes (TOSRA) is designed to measure seven distinct science-related attitudes among secondary school students, namely: Social Implications of Science, Normality of Scientists, Attitude to Scientific Inquiry, Adoption of Scientific Attitudes, Enjoyment of Science Lessons, Leisure Interest in Science and Career Interest in Science. The TOSRA can be used by teachers, curriculum evaluators, or researchers to monitor students' progress towards achieving attitudinal aims. That is, a teacher might employ TOSRA to obtain information about the science-related attitudes of individual students or, preferably, the whole classes. This could be done at one particular time or could involve changes in attitudes occurring over time. Although it is possible to use TOSRA for assessing the progress of individual students, TOSRA is likely to be most useful for examining the performance of groups or classes of students (e.g. in curriculum evaluation).

Furthermore, TOSRA can be used to provide information about students' attitudes at a particular time, or as a pretest (perhaps over the time of a school term or year) to obtain information about changes in attitudes. When attempting to interpret scores obtained on TOSRA, relative interpretations often can be more meaningful than absolute ones. For example, a comparison of an individual's scores, or a class's mean scores, at two separate times can provide valuable information about changes occurring in student attitudes. Similarly a comparison of the attitudes of two groups of students (e.g. groups following alternative teaching methods or curriculum materials) can be illuminating. Because of the difficulties inherent in making absolute interpretations of scores on TOSRA, it is sometimes helpful for teachers to compare the scores obtained by their students with the average scores obtained by a larger and broader sample.

Table 2-3 shows the name of the seven scales contained in TOSRA, together with the classification of the aim measured by each scale according to Klopfer's (1971) scheme. This table indicates that, while two separate TOSRA scales have been included to measure two separate aims in category H.1, each of the other five TOSRA scales measures aims in one of the remaining categories, namely, H.2 to H.6.

Table 2-3: Name and Classification of each Scale in TOSRA

Scale Name	Klopfer's (1971) Classification
Social Implications of Science (S)	H.1 : Manifestation of favourable attitudes towards science and scientists
Normality of Scientists (N)	H.1 : Manifestation of favourable attitudes towards science and scientists
Attitude to Scientific Inquiry (I)	H.2 : Acceptance of scientific inquiry as away of thought
Adoption of Scientific Attitudes (A)	H.3 : Adoption of 'scientific attitudes'
Enjoyment of Science Lessons (E)	H.4 : Enjoyment of science learning experiences
Leisure Interest in Science (L)	H.5 : Development of interest in science and science-related activities
Career Interest in Science (C)	H.6 : Development of interest in pursuing a career in science

Because category H.1 (manifestation of favourable attitudes towards science and scientists) embraces two somewhat distinct sub-categories, namely, manifestation of favourable attitudes towards science and manifestation of favourable attitudes towards scientists, a separate measure of each was included in TOSRA. The Social Implications of Science scale in TOSRA measures one aspect of manifestation of favourable attitudes towards science which has been afforded importance in the science education literature (Fraser, 1977; Zoller & Watson, 1974), namely, attitude towards the social benefits and problems which accompany scientific progress.

Students' attitudes towards computer-related courses were included as an outcome in the present study. An instrument, based on the Test of Science-Related Attitudes, was developed for the purpose of the present study.

2.8 DEFINING AND MEASURING STUDENT MOTIVATION

One of the aims of the present study was the investigation of associations between student motivation and outcomes (achievement, attitudes) of students. This section reviews literature related to student motivation in terms of:

- Defining student motivation (section 2.8.1),

- Describing factors which influence of the development of student motivation (section 2.8.2),
- Theories associated with motivation (section 2.8.3) and
- Research related to students' motivation (section 2.8.4).

2.8.1 Definitions of Student Motivation

According to Linda Lumsden (1994), student motivation naturally has to do with students' desire to participate in the learning process. But it also concerns the reasons or goals that underlie their involvement or non-involvement in academic activities. Although students could be equally motivated to perform a task, the sources of their motivation could differ.

According to Lepper (1988), the student who is intrinsically motivated to undertake an activity does so for its own sake, for the enjoyment it provides, the learning it permits, or the feelings of accomplishment it evokes. An extrinsically-motivated student, on the other hand, undertakes an activity in order to obtain some reward or avoid some punishment external to the activity itself, such as grades, stickers, or teacher approval.

The term 'motivation to learn' has many different meanings. According to Marshall (1987), it is the meaningfulness, value and benefits of academic tasks to the learner – regardless of whether or not they are intrinsically interesting. Ames (1990) notes that motivation to learn is characterised by long-term, high-quality involvement in learning and commitment to the process of learning.

2.8.2 Factors that Influence the Development of Students' Motivation

According to Brophy (1987), motivation to learn is a competence acquired through general experience but stimulated most directly through modelling, communication of expectations and direct instruction or socialisation by significant others (especially parents and teachers).

A child's home environment shapes the initial constellation of attitudes that they develop towards learning. When parents nurture their children's natural curiosity about the world by welcoming their questions, encouraging exploration and familiarising them with resources that can enlarge their world, they are giving their children the message that learning is worthwhile and frequently fun and satisfying.

When children are raised in a home that nurtures a sense of self-worth, competence, autonomy and self-efficacy, they will be more apt to accept the risks inherent in learning. Conversely, when children do not view themselves as basically competent and able, their freedom to engage in academically-challenging pursuits and capacity to tolerate and cope with failure are greatly diminished.

Once children start school, they begin forming beliefs about their school-related successes and failures. The sources to which children attribute their successes (commonly effort, ability, luck, or level of task difficulty) and failures (often lack of ability or lack of effort) have important implications for how they approach and cope with learning situations.

The beliefs that teachers themselves have about teaching and learning and the nature of the expectations that they hold for students also exert a powerful influence (Raffini, 1993). School-wide goals, policies and procedures also interact with classroom climate and practices to affirm or alter students' increasingly complex learning-related attitudes and beliefs.

2.8.3 Theories Associated with Motivation

According to McKeachie (1994, p. 349):

> Instructors know that student learning and memory are closely tied to *motivation.* Students will learn what they want to learn and will have great difficulty learning material that does not interest them. Students

> are not poor learners; nor are they unmotivated. They are learning all the time – new dance steps, the status hierarchy on campus, football strategy and other more or less complex things – but the sort of learning for which students are motivated is not always that which contributes to attaining the goals of our courses.

In the following, I consider the cognitive view of motivation that is based on the theory of constructivism, as well as Maslow's Hierarchy of Needs.

Motivation and the Scientific Learning Cycle

Wankat and Oreovicz (1993, p. 284) presented the scientific learning cycle as being developed to help students in their mental development. The scientific learning cycle is based on the Piagetian concepts of information constructivism. Figure 2-5 illustrates the scientific learning cycle. During the Exploration Phase, information is presented to students in a controlled way to cause disequilibrium. The process of introducing a state of disequilibrium is referred to as disequilibration. Naturally, the students feel a need to ease the disequilibrium and are thus motivated to do something.

In the next phase, students are presented with supportive definitions and structures that the student will need to be able to accommodate the new information and allow the student to proceed to the third phase and apply the learned concepts. The process of gaining supportive knowledge and accommodating new information is called equilibration.

In this cognitive view of motivation, it is the teacher's first duty to ensure that students will be able to learn. If a student cannot make any sense of new information, supporting structures will not be incorporated into the students' mental structures, and the new information will not be accommodated but will be rejected, returning the student to a state of equilibrium. The teacher should make a point to get to know the students and

should stress the required class prerequisites. The teacher is in a key position to be able to address the deficiency needs of students.

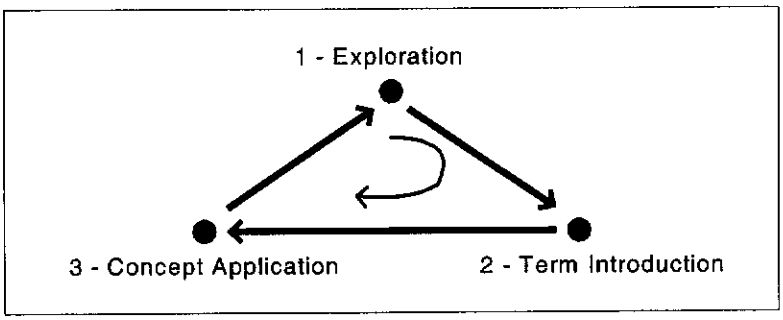

Figure 2-5: The Scientific Learning Cycle

To re-emphasise, the teacher should only introduce controlled amounts of disequilibrium in students and ensure that the required supporting concepts are introduced. The process of equilibration ensures that new information will tend to 'stick' and will make it possible for new information to be accommodated, rather than being rejected by the student.

To motivate students, the scientific learning cycle seems to suggest that it is important that the material presented is not overly organised or comprehensive. Holes and gaps in presentation are not seen as a problem. After all, a reasonable amount of disequilibrium will motivate students to learn. The idea is to present students with enough material so that, if they actively participate, they can easily 'fill in the details themselves', and will arrive at a clear understanding of the material. When done in the correct fashion, the role of the teacher changes slightly from that of information provider to that of educational facilitator where the goal is to help students to participate actively in learning.

It is assumed that gaps in presentation should be controlled. If there are too many gaps in presentation, the teacher will appear lazy to the students. Alternatively, if students are presented with material in a comprehensive fashion, the students will not perceive a

need to participate actively in learning. While impressive, this cognitive view of learning and motivation relies heavily upon intrinsic motivation, which is largely beyond our control. The cognitive view of motivation assumes that a student is not only willing, but is able to learn.

Maslow's Theory and Motivation

Wankat and Oreovicz (1993, p. 298) provide a good introduction to Maslow's theory of motivation that states that individuals have a hierarchy of needs. Figure 2-6 illustrates Maslow's hierarchy. Table 2-4 provides examples for the needs presented in Maslow's hierarchy. At the bottom of the list are the needs for individual identity. The list starts and stops with individual needs, those extreme needs are vastly different.

Maslow's theory states that, when a need is unfulfilled, the individual will be motivated to fulfill that need. Once lower level needs are satisfied, higher-level needs can be addressed. In particular, if one of the lower needs is suddenly not satisfied, then this need will become the most important until it is again satisfied. In unusual circumstances, however, individuals feel a strong motivation that forces them to forego other needs that appear to be more basic. Artists, for example, often feel an overpowering urge to be creative. Maslow (1970) noted that the hierarchy is not invariably followed by all individuals. Nevertheless the following examples should be useful.

Table 2-4: Examples for the Needs Presented in Maslow's Hierarchy

Need	Example
Self Actualization	To become what the individual is most fitted for
Esteem Needs	Self respect, achievement, reputation
Belonginess and Love Needs	Friends, spouse, children
Safety Needs	Security, freedom from fear, order
Physiological Needs	Food, water, air, shelter

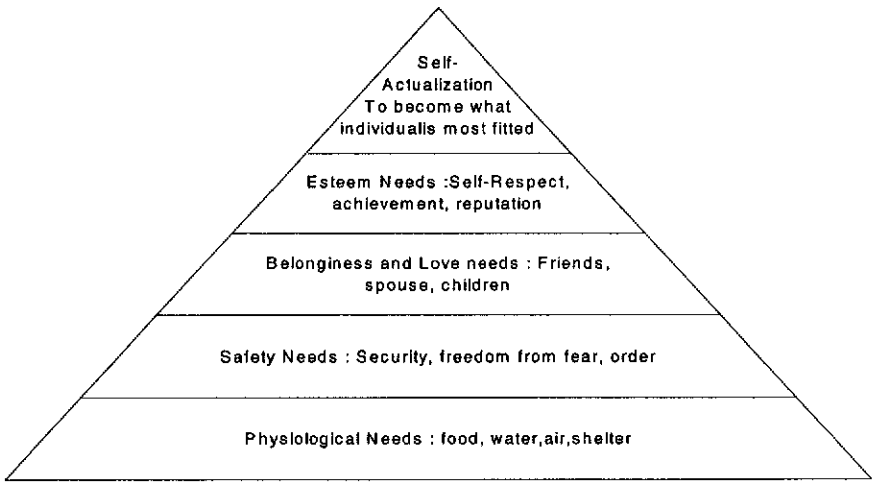

Figure 2-6: Maslow's Hierarchy of Needs

Because teachers and most students have their most basic needs satisfied, we tend to ignore their importance. Teachers must remember, however, that for some of their poorer students these needs could be very important. It is difficult to focus on studying if one is worried about where money for food and rent will come from. Such external problems should be solved by the assistance of financial aid, not by exhortions to study.

A student who is terrified to walk back to a dorm after dark will not benefit from help sessions or the availability of a computer laboratory. Such safety needs must be met by proper campus lighting, police patrols and an escort service before the student can focus on studying.

Students in college find that their needs for belonginess and love are no longer satisfied. Parents and friends who are far away can be insufficient to satisfy these needs. Belonginess needs can become important for any individual who moves to a strange new location, but tends to be worse for freshmen because they have less experience in learning how to fulfill this type of need. New students should visit campus before registration. Mixers and get-togethers are useful in helping new students to meet others. Living in a residence hall is particularly helpful to freshmen.

A sense of achievement and esteem can be gained by receiving positive reinforcement. Strong negative feedback attacks both the need for belonginess and esteem. Students who receive good grades are able to develop a reputation of academic excellence.

The highest level in Maslow's hierarchy, self-actualisation, is the need for individuals to reach their potential. People require time to learn how to satisfy their needs. This self-actualisation occurs in mature individuals and, based on Maslow's studies, is uncommon.

Teachers have an important role to play in helping students to satisfy the belongingness needs, esteem needs, self-actualisation needs and cognitive needs.

2.8.4 Research Related to Students' Motivation

Psychologists and educational psychologists have been studying students' academic motivation for decades. Early researchers on motivation treated motivation similar to an inner drive. However, since Atkinson (1957), discussion of motivation as the product of the expectation of succeeding on a task and perceived value of accomplishing that task, research on motivation has been increasingly treated as a function of cognitive decision making. Attribution theory (Weiner, 1984), self-worth theory (Covington, 1992) and goal-orientation theory (e.g., Ames, 1992; Blumenfeld, 1992; Elliott & Dweck, 1988) all assume that individuals only put forth effort when they perceive that effort will result in fulfilment of their personal goals.

Non-school factors, including parents' comments and actions, can be very influential in the motivation of students (Eccles, Adler, Futterman, Goff, Kaczala, Meece, & Midgley, 1985). However, as a teacher, school administrator, or researcher, one must be very careful not to ask questions that violate rights to privacy.

Another important motivational variable is the effect of task difficulty. A number of researchers (e.g., Blumenfeld, 1992; Paris & Turner, 1994; Stipek, 1996) note the importance of providing students with moderately difficult tasks. Tasks that are too difficult frustrate students, while tasks that are too easy can lead to boredom (Kloosterman & Cougan, 1994) or the feeling that the teacher has low expectations (Nicholls, 1984).

The present study focused on motivation in terms of how students were influenced by their decision to select their major. In this respect, motivation is related to who influenced the students' choice of subject, and whether the choice is made on their own or under the influence of their parents of friends. In addition, the study examined whether students are aware of the influence that their choice of major might have on their future careers.

2.9 LOGICAL THINKING

One of the purposes in the present study was the investigation of associations between logical thinking and students' learning outcomes (achievement, attitudes). This section reviews literature related to logical thinking with respect to:

- Cognitive development and logical thinking (section 2.9.1) and
- Test of Logical Thinking (TOLT) (section 2.9.2).

2.9.1 Cognitive Development and Logical Thinking

Cognitive development is the development of the thinking and organising systems of the brain. It involves language, mental imagery, thinking, reasoning, problem solving and memory development.

Education is, in essence, a lifelong process that entails individuals learning within their specific circumstances and responding to challenges by exploring, questioning and

reaching conclusions. The importance of this perspective of education is generally unrealised. Children are often taught using rote methods of learning that entail regurgitation of facts rather than discovery of information. Education, as such, stifles the thinking process of children, most particularly those who are gifted and in need of greater stimulation to develop their methods of thinking. A proven method of developing the capabilities of gifted children is encouraging them to use logical thinking, allowing them to analyse problems and utilise internal thinking processes to reach their own conclusions.

The logical thinking approach is one of the most effective methods of carrying out the learning process as it allows for a methodical deduction of possible outcomes from given information. An educator, utilising the logical thinking approach, will broaden a child's horizons and enable the child not only to understand better the material being introduced but, also, to deal adeptly with other proposed problems. Rather than providing answers to children, this approach requires that an educator motivate the child to arrive at a 'correct' solution after analysing other possible outcomes and disregarding those that are inaccurate. The role of an educator within the logical thinking approach becomes that of a guide who, by questioning and discussing, challenges children to begin to think for themselves. A child can then begin to formulate an effective problem-solving methodology and find solutions to a greater number of proposed problems. Logical thinking allows a child to reject quick answers, such as 'I don't know' and 'this is too difficult', by empowering them to delve deeper into their thinking processes and understand better the methods used to arrive at a solution and even the solution itself.

As far back as 1967, Raths, Jonas, Rothstein and Wassermann (1967) decried the lack of emphasis on thinking in the schools. They noted that, in many cases, memorisation, drill and quiet classrooms were rewarded, while alternative teaching practices, such as reflection and inquiry, were often frowned upon.

That students are lagging in problem-solving and thinking skills is apparent at all levels of education. However, critical thinking courses and texts, in particular, can result in

fragmentation of thinking skills. Thinking cannot be divorced from content; in fact, thinking is a way of learning content (Raths, Jonas, Rothstein & Wassermann, 1967). In every course, and especially in content subjects, students should be taught to think logically, analyse and compare, question and evaluate. Skills taught in isolation do little more than prepare students for tests of isolated skills (Spache & Spache, 1986). The same criticism can be made with regard to commercial thinking skills materials. However, when such materials are integrated with content, they can become effective tools for attacking real issues.

At each educational level, thinking must be practised in each content field. This means hard work for the teacher. It's much easier to teach students to memorise facts and then assess them with multiple-choice tests. In a course that emphasises thinking, objectives must include application and analysis, divergent thinking and opportunities to organise ideas and support value judgements. When more teachers recognise that the facts that they teach today will be replaced by the discoveries of tomorrow, the content-versus-process controversy might be resolved (Gallagher, 1975).

Classification plays a significant role in the development of logical thinking and abstract concepts from early childhood to adulthood. Classification skill is integral to vocabulary concept development and, therefore, to reading and retention of information (Gerhard, 1975). All classification tasks require the identification of attributes and sorting into categories according to some rule (Furth & Wachs, 1974). While the sorting of concrete objects is an appropriate activity for the young child, verbal analogies (e.g., 'How is a diamond and an egg alike?') are appropriate for a learner of any age. A number of commercial materials contain verbal analogies, logic puzzles, and figural and symbolic problem-solving and attribute games. However, application to a wide variety of environmental objects must follow. Integration of classification activities into content areas is crucial to their value. Applications to mathematics and science, especially the inquiry approach to science, are readily apparent.

What might not be obvious are the applications of classification to reading in the content fields (e.g., social studies) and the retention of information read. Schema theory holds that information, if it is to be retained, must be categorised with something already stored in memory (Tonjes & Zintz, 1987). Brainstorming techniques that aid comprehension are recommended to help students to access their prior knowledge about a topic to be read and thus classify and retain the new information.

Research on cognitive development has indicated that formal thought is required to learn many of the concepts taught in primary school, high school and tertiary science courses (e.g., Cantu & Herron, 1978; Goodstein & Howe, 1978). Evidence also suggests that the majority of students in primary and high school grades (Chiappetta, 1976) and a significant proportion of tertiary students (Renner & Lawson, 1973) are unable to utilise formal operations in problem solving.

The consensus of findings from research on cognitive development (e.g. Lawson, 1979; Lawson, Adi & Karplus, 1979; Lovell, 1961) is that science curricula need to be changed so that the cognitive development of learners becomes a focus; teachers need to match instruction to the cognitive level of learners; and further research is needed to investigate the nature of learning for students at different levels of cognitive development.

As a means of obtaining reliable and valid measures of cognitive development in group settings, a pencil-and-paper test of formal reasoning ability with sound psychometric properties was developed called Test of Logical Thinking (TOLT) is described in the next section.

2.9.2 Test of Logical Thinking (TOLT)

Test of Logical Thinking (TOTL) was designed by Tobin and Capie (1981, 1984) to measure five modes of formal reasoning, namely, controlling variables, proportional reasoning, combinatorial reasoning, probabilistic reasoning and correlational reasoning.

These modes of reasoning were used initially by Lawson (1978) and Lawson, Adi and Karplus (1979).

The purpose of developing the original TOLT and subsequent alternate forms was to provide a tool for research on teaching and learning. Data so obtained would be useful in relating formal reasoning ability to achievement, investigating possible interactions of formal reasoning ability with teacher variables, or statistically controlling for variations in formal reasoning so that the effects of other teacher and student variables could be determined.

The major application of the TOLT has been in classroom-based research to obtain measures of student formal reasoning ability. Tobin and Capie (1982) reported formal reasoning ability, measured with the TOLT, to be significantly related to summative achievement and retention of integrated science processes with middle school learners. At the tertiary level, Yeany, Helseth and Barstow (1980) found TOLT performance to be significantly related to achievement in genetics. In the same investigation, an interaction of formal reasoning ability with locus of control was reported for genetics achievement.

A number of studies have reported significant positive correlations between performance on the TOLT and student achievement. For example, Garnett (1983) reported significant correlations on the TOLT and year 11 student achievement in biology, physics and chemistry. A significant correlation was also obtained for performance on the TOLT and year 10 general science achievement. Tobin and Capie (1982) and Padilla, Okey and Dillashaw (1983) reported significant positive correlations between scores on the TOLT and process skill achievement for middle and secondary school students. Tobin (1984a) reported similar findings for preservice primary teachers and Tobin and Korbosky (1984) reported significant positive relationships between scores on the TOLT and performance on five mathematics tests for a sample of preservice primary teachers. Tobin (1984b) found significant relationships between performance on the TOLT and upper primary mathematics achievement.

The TOLT has also been used in studies of the nature and stability of incorrect reasoning patterns. In a series of studies, a research group at the University of Georgia investigated reasoning patterns associated with controlling variables, proportional reasoning, probabilistic reasoning and correlational reasoning (e.g., Capie, Newton & Tobin, 1981). These studies were later replicated in a Western Australian tertiary institution (e.g., Garnett & Tobin, 1984). On the basis of the above findings, researchers can be encouraged to use the TOLT as a diagnostic tool in research on formal reasoning ability or as a covariable in classroom-based studies.

Researchers have argued that instruction is most effective when it is matched to the developmental level of learners (Lawson, 1979; Lovell, 1961). However, such diagnosis represents an impossible challenge unless teachers can reliably measure the developmental level of students. The TOLT represents a convenient means of identifying students of differing formal reasoning ability.

In primary school classes, the TOLT has been used to identify students who are underachieving. Typically, students who attain high scores on the TOLT achieve at a high level in school subjects such as mathematics, science and social science. In some cases, however, students who attain high scores on the TOLT are unsuccessful in their school studies. In such cases, teachers are able to investigate other variables contributing to lack of success and prescribe data-appropriate instruction. A further use of the TOLT data at the primary school level is to identify students who have attained high scores. The diagnostic value of the TOLT can benefit teachers by differentiating students who are successful with their schoolwork and are unable to use formal reasoning. Students with high scores on the TOLT are often a minority and might not be extended by the regular school curriculum. However, because of their ability to reason abstractly, there is a possibility that a suitable enrichment program can be delivered to provide them with a challenge.

In the present study, the Test of Logical Thinking (TOLT) was translated into Indonesian and used to measure student's logical thinking ability. More detailed information on the items and process of back translation is described in Chapter 3. An Indonesian and an English version of the TOLT, as used in the present study, are provided in Appendices A3 and A1, respectively.

2.10 SUMMARY

This chapter provides a definition of educational quality (Conrad & Wilson, 1994), information about educational productivity factors (Walberg, 1991), a historical account of and the theoretical perspectives that underpin classroom environment research and interpersonal teacher behaviour, and a review of literature related to students' attitudes, motivation towards the student's major subject, and logical thinking.

Four perspectives were offered on how quality should be defined, including the reputation view, the resources view, the outcomes view and the value-added view. The present study used the value-added view, in which the quality of education was measured by the additional value represented by improvement in students' outcomes.

According to Walberg (1991), there are nine factors that influence the productivity of learning, namely: student aptitude (the ability, maturity and motivation of the student); instruction (the amount of time and the quality of instruction); and psychological environments (home environment, classroom environment, peer group and leisure time). The present study concentrated on four of Walberg's nine factors of productivity of learning, represented by classroom climate (the morale of the classroom social group), teacher-student interaction (the quality of instruction), student aptitude (the ability of students) and students' motivation towards their major subject (motivation of students in Walberg's model).

The background history suggests that the field of learning environment research began with the work of Lewin and Murray in the 1930s, which was followed by others such as

Moos, Walberg and Fraser. These researchers laid theoretical foundations for classroom environment research. The pioneering work of Moos and Walberg, and the elaborations by Fraser and his colleagues, has made the classroom environment work a distinct field of research for the last 30 years.

The review indicates that classroom environment research opens new windows for viewing the teaching and learning process. The range of classroom environment instruments available makes it possible for educators to investigate the nature of the learning environment in classroom and laboratory settings from students' and teachers' perspectives. A review of literature reveals that the strongest research tradition in past classroom environment research has been the investigation of associations between student outcomes and student perceptions of psychosocial characteristics of their classroom environments (Fraser, 1989, 1994, 1998a, 1998c; Fraser & Walberg, 1991; Haertel, Walberg & Haertel, 1981). Research using perceptions of both teachers and students across varying grade levels (primary, secondary, higher education), different subject areas (science, mathematics, languages), different types of schools and various countries (the USA, Canada, Australia, Israel and Asia) tends to support the contention that the learning environments of classrooms account for considerable variance in student outcomes. These research activities in the past 30 years were accompanied by the development and validation of various instruments to evaluate classroom environment. Each of the instruments is a paper-and-pencil questionnaire tapping the perceptions of students and teachers of different psychosocial dimensions of their classroom using mainly five-point rating scales, with the exception of the Classroom Environment Scale which has a True-False format and the My Class Inventory (a questionnaire for primary school students) which has a Yes-No format. Thus, improving classroom learning environment is not only educationally desirable, but also it is one way of enhancing students' outcomes. However, in order for this to be possible, teachers must be familiar with classroom environment work. Fraser (1994) indicated that incorporating classroom environment work into preservice and inservice teacher education programs would help teachers to understand the importance of classroom

environment. Other means might involve classroom teachers in collaborative research or in action research.

The review also has shown that the use of classroom environment instruments is not limited to investigating the nature of classroom environments or associations between classroom environment and learning outcomes, but the instruments also have been used in the evaluation of curriculum and innovations, assessing differences in perceptions between students and teachers in actual and preferred classroom environments, person-environment fit studies of whether students achieve better in their preferred environments, investigations of determinants of learning environment (such as grade, subject, teacher and student characteristics and gender), practical attempts at improving classrooms, identifying typologies of classroom environment, use of classroom environment instruments in conjunction with the work of school psychologists, and investigations of associations between school and classroom environments. These studies indicate that these instruments can be used as sources of information upon which educators can make decisions and take systematic actions. Also Tobin and Fraser (1998) suggest that the inclusion of both quantitative and qualitative methods in the same study would help classroom environment researchers to gain better understandings of classroom events. These lines of research have contributed significantly to the enlargement and enrichment of the broad database of classroom environment research.

Furthermore, a relatively new trend in the study of classroom environment originated in the Netherlands with the development and validation of Questionnaire on Teacher Interaction (QTI) to measure interpersonal teacher behaviour (Wubbels & Levy, 1993). The QTI was translated from Dutch into English and has been used in initial studies of associations between interpersonal teacher behaviour and student outcomes. The QTI measures eight dimensions of teacher behaviour: Leadership, Helping/Friendly, Understanding, Student Responsibility/Freedom, Uncertain, Dissatisfied, Admonishing and Strict behaviour. The study of interpersonal teacher behaviour is important not only for facilitating student outcomes but also for improving teacher competency in classroom communication and for helping to provide the social and emotional backup

that a teacher needs in reaching out to students. This relatively new area in classroom environment research involving the QTI has focused mainly on secondary science and mathematics classes in the Netherlands, the USA and Australia (Goh & Fraser, 1998). It was considered timely to extent this area of study from secondary to higher education classrooms and to Indonesia.

The concept of attitude, its definition and its measurement have been widely explored in books such as by Eiser (1984), Mueller (1986) and Lemon (1973). The notion that attitudinal behaviour is learned and could be further modified is widely accepted by social scientists. Also acknowledged by researchers and educators are the relationships of attitudes to values and beliefs and hence the impact of attitudes on the human psyche. Several scaling techniques have been developed to measure attitudes, such as Likert attitude scaling, Thurstone scaling, Guttman scaling and the semantic differential technique. For the present study, the semantic differential technique was selected and used for assessing attitudes towards computing.

Numerous studies have investigated attitudes as one of the student outcome measures to be related to classroom environment. However, the majority of these studies focused specially on science-related attitudes. Many studies (e.g., McRobbie & Fraser, 1993a) showed positive relationships between students' attitudes towards science and classroom environments, but a negative relationship between students' attitudes and classroom environment was reported in a study of sex, attitude and classroom environment by Baker, Leary and Trammel (1992). The present study investigated students' attitudes towards computers, which were measured by the Test of Computer-Related Attitudes, which is based partly on the Test of Science-Related Attitudes (TOSRA; Fraser, 1981b).

According to Lumsden (1994), student motivation naturally has to do with students' desire to participate in the learning process. There are two modes of motivation, namely, intrinsic and extrinsic. An intrinsically motivated student undertakes an activity for its own sake, for the enjoyment it provides, for the learning that it permits, or for the feelings of accomplishment that it evokes. And the extrinsically motivated student

performs in order to obtain some reward or avoid some punishment external to the activity itself (Lepper, 1988).

There are some factors that influence of the development of students' motivation, such as general experience, but motivation is stimulated most directly through modelling, communication of expectations and direct instruction or socialisation by significant others, especially parents and teachers (Brophy, 1987). The scientific learning cycle and Maslow's hierarchy of needs were selected as the basis of the cognitive view of motivation in the present study.

Research on motivation started with Atkinson's (1957) discussion of motivation as the product of expectation of succeeding on a task. Other research on motivation reports that there are many motivational variables, such as task difficulty, non-schooling factors (including parents' comments and actions), and goal orientation and effort (task-oriented, affiliative-oriented and work-avoidant-oriented). The present study focused on how student motivation might be influenced by the reasons behind the students' decision to select their major.

The logical thinking approach is one of the most effective methods of carrying out the learning process as it allows for a methodical deduction of possible outcomes from given information. An educator, utilising the logical thinking approach, will broaden a child's horizons and enable the child not only to understand better the material being introduced, but also to deal adeptly with other proposed problems.

Raths, Jonas, Rothstein and Wassermann (1967) decried the lack of emphasis on thinking in the school. That students are lagging in problem-solving and thinking skills is apparent at all levels of education. Thinking cannot be divorced from content; in fact, thinking is a way of learning content.

Research on cognitive development has indicated that formal thought is required to learn many of the concepts taught in primary school, high school and tertiary science

courses (e.g., Cantu & Herron, 1978; Goodstein & Howe, 1978). Evidence also suggests that the majority of students in primary and high school grades (Chiappetta, 1976) and a significant proportion of tertiary students (Renner & Lawson, 1973) are unable to utilise formal operations in problem solving. The consensus of findings from research on cognitive development (e.g. Lawson, 1979; Lawson, Adi & Karplus, 1979; Lovell, 1961) is that curricula need to be changed so that the cognitive development of learners becomes a focus; teachers need to match instruction to the cognitive level of learners; and further research is needed to investigate the nature of learning for students at different levels of cognitive development.

This present study used logical thinking as the variable that is assumed to affect directly the academic performance of students. To measure logical thinking, this study used selected items from the Test of logical Thinking (TOLT).

Research on learning environments in Indonesia is comparatively recent. Past studies involved investigations into conventional classroom environments, mainly at the secondary level of education.

Usually past studies have involved only one classroom environment instrument. This study is distinctive in that it involved two classroom environment instruments, namely, modified versions of the WIHIC and QTI. By having two instruments in the same study, the joint and unique contributions of each instrument to the variance in learning outcomes at the university level could be determined. This study also makes a unique contribution to classroom environment research because it is one of the first major classroom environment studies at the tertiary level of education in Indonesia.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

The focus of the present study, as discussed in Chapter 1, was to investigate associations between four learning productivity factors identified by Walberg (1991) (namely, learning environment, interpersonal lecturer behaviour, student aptitude, and students' motivation towards their major subject) and the affective and cognitive outcomes of students at Bina Nusantara University.

This chapter describes and justifies the different phases of the present study in terms of: the research design (Section 3.2); the sample for the main study (Section 3.3); instruments used in the present study (Section 3.4); modification, translation and field testing of the instruments (Section 3.5); data collection for the main study (Section 3.6); and statistical procedures used in analysing the data (Section 3.7).

3.2 RESEARCH DESIGN

The present study was primarily quantitative in nature, although a minor qualitative portion was devoted to unstructured interviews prior to the field testing of the instrument (Section 3.5.2). Owing to the tight schedules of the participating students and time constraints encountered by the researcher, further interviews were not possible (see discussion in Section 3.6).

The present study focused on a higher education institution in Indonesia and assessed students' perceptions of the classroom/lecture environment. As the present study was generally exploratory in nature, perceptual measures were considered to provide the most appropriate research method. As outlined by Fraser and Walberg (1981),

perceptual measures can be considered to be more useful than direct observation for several reasons. First, perceptual measures are more economical in terms of time and finance than direct observation. Second, more accurate representations can be obtained using perceptual measures, as "perceptual measures are based on students' experiences over many lessons..." (Fraser, 1986a, p. 3) as opposed to a small number of lesson observations made by an outside observer. Third, the use of perceptual measures enables the researcher to provide a collective representation of the members of the class as opposed to that of a single outside observer. Fourth, perceptual measures were selected because students' behaviours are more likely to be influenced by their perceptions than by the situation as observed by an outsider. And, fifth, research has shown that students' perceptual measures of classroom environments contribute more to the variance in student learning outcomes than do directly-observed variables.

3.3 SAMPLE FOR THE MAIN STUDY

The following section describes the sample for the present study. Section 3.3.1 identifies the two university departments selected for comparison purposes and the academic subject from which students were selected, whereas section 3.3.2 describes the selection of the student sample for the main study.

3.3.1 Selection of the Departments

The sample for the present study was selected from the Computer Science and Management departments at the Bina Nusantara University. These two departments have quite different characteristics in terms of the quality of students whom they attract. The Computer Science department is considered to be one of the top departments at Bina Nusantara University as well as one of the oldest. The department is renown for attracting high-quality students who perform well. The Management Department is a relatively new, fast-growing department. The students who enrol in this department are considered to have one of the poorest academic performances at the Bina Nusantara University.

Table 3-1: Distribution of Cumulative GPA for First Semester of the Year 1998/1999

Department	No. of Students	No. of Students (%)		
		Cum. GPA >3.00	Cum. GPA 2.00-2.99	Cum. GPA <2.00
Computerised Accounting (CA)	6678	1884 (28.2%)	3435 (51.4%)	1359 (20.4%)
Computer Science (CS)	*3035*	*1167 (38.5%)*	*1437 (47.4%)*	*431 (14.2%)*
Information Systems (IS)	*2966*	*1027 (34.6%)*	*1509 (50.9%)*	*430 (14.5%)*
Management (MGT)	*1154*	*96 (8.3%)*	*535 (46.4%)*	*523 (45.3%)*
Accounting (ACC)	769	300 (39.0%)	382 (49.7%)	87 (11.3%)
Computer Engineering (CE)	610	144 (23.6%)	337 (55.3%)	431 (21.1%)
Literature Studies (LS)	251	72 (28.7%)	143 (57.0%)	36 (14.3%)
Industrial Engineering (IE)	236	64 (27.1%)	97 (41.1%)	75 (31.8%)
Architecture (AE)	44	4 (9.1%)	34 (77.3%)	6 (13.6%)
Civil Engineering (SE)	24	3 (12.5%)	16 (66.7%)	5 (20.8%)
Mathematics & Statistics (MT)	11	5 (45.5%)	6 (54.5%)	0 (0.0%)
Total	**15,778**	4766 (30.2%)	7931 (50.3%)	3081 (19.5%)

Table 3-1 provides an indication of students' academic performance, in terms of their cumulative GPA (total score across all subjects), at the end of first semester in the 1998/1999 academic year for each department. Table 3-1 shows that 14.2% of the student body (3035 students) in the Computer Science Department and around 45.3% of the student body (1154 students) in the Management Department achieved a cumulative GPA less than 2.00. On the other side, 38.5% of student body in the Computer Science Department and only 8.3% of student body in the Management Department got a cumulative GPA of more than 3.00. This implies that students in the Computer Science department have stronger academic performance than the students from Management department.

The Computer Science department and Management department were selected because of the their distinct differences. It is hoped that, by comparing the two departments in the present study, it would be possible to identify aspects of the learning environment that can assist lecturers to improve students' performance in the Management department.

This study investigated differences between the teaching and learning processes in Computer Science and Management Departments. To ensure that the samples were

comparable, it was considered appropriate that the students be selected from a course that was taught in both the Computer Science and Management departments. The Research Methods course, taught in second semester of the year 1998/1999, was chosen because it includes the same content for the two departments. The instruments were administered to students in 12 of the 15 Research Methods classes (selected at random) running at the university at that time.

Table 3-2 shows that there are 4 classes of students registered in Research Methods course for the Management department, only 1 class for the Computer Science department, and 10 classes for the Information Systems department. Because this study combined students from the Computer Science and Information Systems departments as one group of students, they are defined as students from the Computer Science department.

Table 3-2: Courses Followed by Students in Management and Computer Science Departments for the Second Semester of the Year 1998/1999

Code	Subject	No. of Class				No. of	Semester of the Students		
		MGT	CS	IS	Total	Students	MGT	CS	IS
IF652	Decision Support Systems	1	-	1	2	86	8	-	6
IG142	Nationality Studies	5	3	-	8	492	4	8	-
IG192	Social Studies	1	-	18	19	1394	8	-	6
MN272	General Management	9	-	10	19	1469	2	-	2
MN842	Organization Behaviour	4	-	10	14	414	4	-	4
MN91	Stadium Generals	1	3	7	11	885	8	6	8
MT324	Operation Research	1	-	2	3	208	4	-	6
SP114	Information Systems Analysis	4	2	-	6	382	4	6	-
ST922	Research Methods	4	1	10	15	1035	4	8	4

3.3.2 Student Sample

This section describes the characteristics of the student sample for the main study. The sample consisted of 422 students altogether (278 students from the Computer Science department and 144 students from the Management department). Of the 700 students, selected to complete the questionnaires, 422 students did so. These 422 students accounted for about 5% of the total student body and around 10% of the student body of

the two departments. The sample provided a fair representation of the total student body (15, 913 students) at Bina Nusantara University.

Of the 422 students, 143 were female and 279 were male. The average GPA of students from the Computer Science department was 2.94, and the average for Management students was 2.50 (from the range of 0-4). A summary description of the sample is presented in Table 3-3.

Table 3-3: Description of the Sample in Two Departments

Characteristic	Computer Science Department	Management Department	Total
Number of Classes	8	4	12
Average class size	35	36	35
Number of students	278 (65.9%)	144 (34.1%)	422 (100%)
Number of female students	93 (22.0%)	50 (11.8%)	143 (33.8%)
Number of males students	185 (43.8%)	94 (22.4%	279 (66.2%)
Number of students with GPA < 2.5	55 (13.0%)	65 (15.4)	120 (28.4%)
Number of students with GPA = 2.5-3.0	95 (22.5%)	47 (11.1%)	142 (33.6%)
Number of students with GPA > 3.0	134 (33.2%)	26 (4.8%)	160 (38.0%)
Average GPA	2.94	2.50	2.80

3.4 INSTRUMENTS USED IN THE PRESENT STUDY

Chapter 2 has described a number of past studies that have reported the successful adaptation and use of classroom environment instruments, that have originated from Western countries, in a variety of cultural settings, including Asian countries (Aldridge & Fraser, 1999; Chionh & Fraser, 1998; Fraser, Pearse & Azmi, 1982; Goh & Fraser, 1995; Goh, Young & Fraser, 1995; Khoo & Fraser, 1997; Riah & Fraser, 1998; Schibeci, Rideng & Fraser, 1987; Teh & Fraser, 1993, 1994; Walberg, Singh & Rasher, 1977; Wong & Fraser, 1994, 1996). These studies have indicated that the instruments are reliable and valid for use in those cultures in which the study took place. A small number of these learning environments instruments have been used successfully in Indonesia, as discussed in Chapter 2 (Fraser, 1985; Fraser, Pearse & Azmi, 1982; Paige, 1978, 1979; Schibeci, Rideng & Fraser, 1987; Margianti & Fraser, 2001). These studies

gave confidence to the researcher to adapt classroom learning environment instruments for use in the present study.

Five instruments were employed in the present study. These instruments all originated in the English language, but were adapted and translated for use in Indonesia (Section 3.5.2). Of the five instruments, two were classroom learning environment instruments for measuring students' perceptions of the psychosocial environment of the Research Methods classes, namely, the Classroom Learning Environment Questionnaire (CLEQ) (described in Section 3.4.1) and the Questionnaire on Teacher Interaction (QTI) (described in Section 3.4.2). One instrument for measuring student aptitude, namely, the Test of Logical Thinking (TOLT) is described in Section 3.4.3. The remaining two instruments were designed by the researcher to measure students' attitudes towards computer-related studies (described in Section 3.4.4) and students' motivation for their choice of major subject (described in Section 3.4.5).

3.4.1 Classroom Learning Environment Questionnaire (CLEQ)

To measure students' perceptions of the classroom learning environment, the present study used the Classroom Learning Environment Questionnaire (CLEQ), which adapted four scales from the What is Happening in this Class? (WIHIC) questionnaire developed by Fraser, Fisher and McRobbie (1996) together with the Innovation scale from the College and University Classroom Environment Inventory (CUCEI) developed by Fraser and Treagust (1986).

The WIHIC questionnaire brings parsimony to the field of learning environment by combining modified versions of the most salient scales from a wide range of existing questionnaires with additional scales that accommodate contemporary educational concerns (e.g., equity and constructivism).

The WIHIC questionnaire has undergone a number of refinements since the development of its original 90-item nine-scale version. The initial development and subsequent modifications of the WIHIC are detailed in Chapter 2.

The final form of the WIHIC has the seven eight-item scales (Aldridge & Fraser, 1999). The WIHIC has been used successfully in its original form or in modified forms in studies involving 1879 high school science students in Taiwan (Aldridge & Fraser, 1999), 250 adult learners (Khoo & Fraser, 1997) and 2310 high school students in Singapore (Chionh & Fraser, 1998), 644 year 10 students in Brunei (Riah & Fraser, 1998) and 1329 Australian high school students and 75 Canadian high school students (Zandvliet & Fraser, 1998).

The present study used scales from the WIHIC questionnaire that were considered pertinent at the university level in Indonesia. The WIHIC was considered by the researcher to be the most appropriate instrument for measuring students' perceptions of the learning environment for three main reasons.

First, of the existing classroom environment instruments discussed earlier in Section 2.4, the WIHIC questionnaire stands out as being parsimonious (Fraser, Fisher & McRobbie, 1996). The WIHIC can provide a fairly comprehensive and clear indication of both the 'actual' state of the psychosocial learning environment of the classroom and the 'preferred' state of the educational environment as desired by the learners. As such, it captures the essence of the general 'health' of the classroom.

Second, the items in the instrument are generally non-threatening to the lecturer and the students in the classroom. It is human nature that people do not want to subject themselves to direct scrutiny and assessment. As the items of the WIHIC do not directly assess the performance, personality or character of the players, it is unlikely that it will be considered threatening. Therefore, the WIHIC questionnaire is likely to receive endorsement from the general population of lecturers and students in Indonesia.

Third, the WIHIC questionnaire is an economical instrument for lecturers who are keen on improving their classroom environment or getting feedback about their invested effort when they administer the instrument to their own classes. Therefore, use of the WIHIC in the present study would pave the way for Indonesian lecturers and researchers to use this questionnaire in future studies.

Four scales were selected for use from the WIHIC questionnaire. These scales were considered pertinent to the university context in Indonesia and have been shown to be good predictors of student outcomes in previous studies (Fraser, 1998a), namely, Student Cohesiveness, Involvement, Task Orientation and Cooperation. Five items from each of four scales were used in the present study in Indonesia. At Bina Nusantara University, staff innovation is considered to be a positive trait, and one that will tend to encourage staff to improve their teaching styles. To assess the extent that teachers are innovative in their classroom, one scale from the College and University Classroom Environment Inventory (CUCEI) was used to measure students' perceptions of Innovation in the learning environment (Fraser, Treagust & Dennis, 1986; Fraser & Treagust, 1986).

The actual version of the WIHIC questionnaire measures students' perceptions of practices which happen in the classroom learning environment (psychosocial state) as experienced by them. In contrast, the preferred version of the WIHIC questionnaire is concerned with "goals and value orientations" (Fraser, 1994, p. 499) and it measures the students' perceptions of the 'ideal' state of the classroom learning environment in which they would like to be. In the present study, only the actual version of the WIHIC questionnaire was used to investigate the associations between the actual psychosocial classroom environments and students' learning outcomes.

The WIHIC questionnaire is also available in a Class form and a Personal form. The Class form "applies to the class as a whole", whereas the Personal form focuses on "the student's own role within that classroom environment" (Fraser, Giddings & McRobbie, 1995, p. 409). The present study used the Class form because it provides a conventional

way whereby students of a class are invited to be the 'eyes' for the researcher and to report on the general 'health' of the psychosocial classroom environment as a whole. Also, the non-threatening nature of the items in the Class form of the questionnaire means that a student is not required to respond to items which would elicit his/her "own role within that classroom", as in the case of the Personal form (Fraser, Giddings & McRobbie, 1995, p. 409; see also Fraser, Fisher & McRobbie, 1996). It was felt that the use of the Personal form could cause unnecessary anxiety for students who could be sensitive and not wish to reveal matters concerning themselves (and, at the same time, would like to be helpful by participating in the survey). It was felt that students would be more willing to volunteer their perceptions of a generalised condition rather than being specific about what they themselves feel or experience, particularly as they did not know the researcher.

The questionnaire has a five-point response scale. The response alternatives for each of the items are Almost Never, Seldom, Sometimes, Often, and Almost Always. The respondent circles the response that best fitted his/her perception of the classroom environment under assessment. The original English version of the WIHIC can be found in Appendix A.

3.4.2 Lecturer-Student Interaction Measure

As part of the present study, a modified version of the Questionnaire on Teacher interaction (QTI) was used to obtain feedback from students concerning their perceptions of interpersonal lecturer behaviour (Wubbels, 1993). The 48-item version of the QTI, originally developed in Australia to measure interpersonal teacher behaviour in the secondary classroom, was adapted to form a version suitable for use at the tertiary level in Indonesia. This new Indonesian version of the QTI has the same eight scales of Leadership (DC), Helping/Friendly (CD), Understanding (CS), Student Responsibility/Freedom (SC), Uncertain (SO), Dissatisfied (OS), Admonishing (OD) and Strict (DO) behaviour, circumrotating on the two axes of DS (Dominance-Submission) and CO (Cooperation-Opposition) as described in Section 2.5. The

Indonesian version, however, has only five items per scale, making a total of 40 items altogether. As the QTI was one of five questionnaires, it was considered appropriate to reduce the number of items and therefore the time taken to complete the questionnaires. In this way, the researcher could reduce the risk of boredom, thereby increasing the reliability.

The questionnaire has a five-point response scale. The response alternatives for each item in this study were Almost Never, Seldom, Sometimes, Often, and Almost Always. The respondent circled the response that best fitted his/her perception of the classroom environment under assessment.

3.4.3 Test of Logical Thinking (TOLT)

To measure student aptitude, especially logical thinking, the present study used the original version of the Test of Logical Thinking (TOLT; Tobin & Capie, 1981). The TOLT was originally designed to measure five modes of formal reasoning: controlling variables, proportional reasoning, combinatorial reasoning, probabilistic reasoning, and correlational reasoning. Each of the 10 items requires participants to select a correct response and justification from a number of alternatives (Tobin & Capie, 1981).

Although the logical thinking was initially studied by Piaget and his colleagues, the development of formal reasoning ability has been extensively researched in adolescents and adults (e.g., Arlin, 1975; Chiappetta, 1976; Farrell, 1969; Lovell, 1961). In the majority of cases, clinical interviews based on protocols described by Inhelder and Piaget (1958, 1975) have been used to assess formal reasoning ability. Two important trends that have emerged from research are that many adolescents and adults are limited in their ability to use formal modes of reasoning and that formal reasoning ability is an important mediator of cognitive achievement (e.g., Cantu & Herron, 1978; Goodstein & Howe, 1978). As a consequence, researchers have emphasised the importance of modifying instructional objectives, materials and activities so that they are suited to the cognitive development of learners.

Research on cognitive development has indicated the following: formal thought is required to learn many of the concepts taught in school; the majority of students are unable to utilise formal operations in problem-solving; curricula need to be changed to focus on the cognitive development of learners; lecturers need to match instruction to the cognitive level of learners; and further research is needed to investigate the nature of learning for students at different levels of cognitive development. As a means of obtaining reliable and valid measures of cognitive development in group settings, a pencil-and-paper test of formal reasoning ability with sound psychometric properties was developed and called the Test of Logical Thinking (TOLT).

As English is a second language in Indonesia, it was necessary to translate the questions from the original TOLT into the Indonesian language. The process of translation and back translation is described in Section 3.5. Adaptations and changes made to the questionnaire during the process of back translation are also described in Section 3.5. The original English version, back-translated English version and Indonesian version of the TOLT (as used in this study) can be found in Appendix C.

The next two sections are related to the development of the attitude instrument and motivation scale. Their development was guided by the three steps described by Fraser (1986a). First, relevant literature and existing measuring instruments for attitudes were reviewed for the identification of appropriate salient dimensions. This process involved subjectivity to a certain extent (e.g. the opinions of the researcher). Second, items for the instruments were written. Third, the instruments were field-tested and opinions from experts and students were sought. Based on the findings, the instruments were fine-tuned for the main study. Instruments developed using the above basic strategy have been termed 'intuitive-rational' scales, in contrast to 'factor analytic' scales (Hase & Goldberg, 1967). Below is a description of the development of these two instruments.

3.4.4 Student Attitude Measure

A questionnaire was designed to measure students' attitudes towards their computer-related studies at the university level based on the Test of Science-Related Attitudes (TOSRA; Fraser, 1981b). For the purposes of the present study, a Test of Computing-Related Attitudes (TOCRA) based on the TOSRA was designed. The study modified three of the seven original TOSRA scales to form a Leisure Interest in Computers scale, an Attitude Towards Computers scale and a Satisfaction scale.

Items in the questionnaire were modified from Fraser's (1981b) Test of Science-Related Attitudes (TOSRA) which was designed to measure seven distinct science-related attitudes among secondary school students, namely, social implication of science, normality of scientists, attitude to scientific inquiry, adoption of scientific attitudes, enjoyment of science lessons, leisure interest in science, and career interest in science.

The response format of the attitude instrument also was modified to make use of the Semantic Differential Technique in which seven pairs of polarised adjectives were used in conjunction with a five-point scale. The semantic differential technique of Osgood, Suci and Tannenbaum (1957) basically measures the psychological meaning of concepts and it involves the "combination of controlled association and scaling procedures" (Osgood, Suci & Tannenbaum, 1957). The respondents were presented with different concepts for semantic differentiation. For the choice of concepts or stimuli in the construction of the attitude instrument, the researcher followed fairly closely the following suggested guidelines of Osgood, Suci and Tannenbaum (1957):

- The concept should elicit varying views from different respondents.
- The concept should contain a single meaning for the respondents (to help them to focus on the concept or stimulus).
- The concept chosen should be familiar to the respondents.

This study used only three of the seven original scales of TOSRA, namely, Student Satisfaction in Computer Studies, Leisure Interest in Computer Studies, and Career Interest in Computers. In addition, for the purposes of this study, an Attitude

Towards the Internet scale was developed. Below is an illustration of the constructs used in the attitude instrument in the main study:

(1) My computing lectures are:
(Attitude related to Student Satisfaction in Computer Studies)

(2) Magazines/television programmes on computer are:
(Attitude related to Leisure Interest in Computer Studies)

(3) A career/job in the area of computers would be:
(Attitude related to Career Interest in Computers)

(4) Using the internet to search for information is:
(Attitude related to inquiry using the internet)

Each of these four constructs had seven sets of polarised of adjectives for differentiation which were selected from Osgood, Suci and Tannenbaum (1957) for this study. All of these pairs of adjectives have been used and validated by Teh (1993) for measuring students' attitudes towards learning Geography in Singapore. Each pair of adjectives was used in conjunction with a five-point scale. The respondent circled the point on the scale which best reflected his or her feeling towards each concept or stimulus. The order for alternative pairs of the adjectives was reversed (and hence is the direction of scoring) so that respondents would not be affected by the 'underlying structure' (adjectives belonging to the same 'favourable or unfavourable ends of the scale').

The following seven pairs of adjectives were used in this study:

Clear	1	2	3	4	5	Confusing
Meaningless	1	2	3	4	5	Meaningful
Important	1	2	3	4	5	Unimportant

Useless	1	2	3	4	5	Useful
Easy	1	2	3	4	5	Difficult
Boring	1	2	3	4	5	Interesting
Pleasant	1	2	3	4	5	Unpleasant

Appendix D1 shows the questionnaire assessing attitude towards computers in the English Language, whereas Appendix D2 shows the Indonesian version of the questionnaire.

3.4.5 Motivation Towards Major Scale

When students select their major subject, the choice will inevitably influence their future careers. As many young people don't have well-defined goals at the time of selection, the driving force behind their choice of major becomes an influential factor. The motivating force behind a student's choice of major could influence their attitudes and achievement in their selected subjects. As such, the motivation behind their choice of subject could be a potential productivity factor.

Table 3-4: Questions about Motivation Towards Major

Item No.	Original English Version	Indonesian Version	Back-Translated English Version
Motivation behind their choice of subject			
1	I chose this major because of my own interest in it.	Saya memilih jurusan ini karena keinginan saya sendiri.	I chose this major because of my own interest.
2	My parents encouraged me to choose this major.	Orangtua saya mendorong saya untuk memilih jurusan ini.	My parents encouraged me to choose/take this major.
3	My friends influenced me to choose this major.	Kawan-kawan saya mempengaruhi saya untuk memilih jurusan ini.	My friends influenced me to choose this major.
Student awareness of their future			
4	I chose this major because it is relevant to my chosen career.	Saya memilih jurusan ini karena sesuai dengan karier pilihan saya.	I chose this major because it is relevant to my chosen career.
5	Achieving well in this major will help my career.	Berhasil baik di jurusan ini akan membantu karier saya	Achieving well in this major will help my career.

A Motivation scale was developed for use in this study to examine the influences behind students' decisions to select their major. Five questions were used, three of which were related to the motivation behind students' choice of subject, whether they made it on

their own, or under the influence of their parents or friends, and two questions were related to students' awareness of the influence that the choice of major has on their future careers. These five questions are presented in Table 3-4.

3.5 MODIFYING, TRANSLATING AND FIELD TESTING THE INSTRUMENTS

To ensure that instruments, originating in a Western country, were suitable for use in an Indonesia university, it was important to modify the questionnaires to make them suitable for use in a different culture and context (Section 3.5.1), then to translate and field test the instruments (Section 3.5.2), and finally to make improvements to the instruments based on the field test (Section 3.5.3).

3.5.1 Modifications to the Instruments

Before the instruments could be used for the main study, it was important to ensure that they were suitable for use in Indonesia. The adaptation process involved a number of steps. First, scales from the different instruments were selected according to their suitability for use in Indonesia (as discussed in Section 3.4). Second, the wording of some of the items was changed to make these items more suitable for use at the university level. Third, the researcher was aware of time restraints that would be in place. To enhance the economy of the questionnaire, it was important that the number of items used was reduced. Finally, the instructions for how to answer the instruments were changed (particularly in the TOLT, for which the items had been changed).

For the present study in Indonesia, the WIHIC and QTI were selected as the most appropriate instruments for measuring students' perceptions of, respectively, the classroom learning environment and lecturer interaction (as discussed in the previous section). During the modification process, the amount of time available to answer the questionnaires and the tertiary level of the students were taken into consideration.

The present study used four of the original WIHIC scales: Student Cohesiveness, Involvement, Task Orientation and Cooperation. Beside these four scales, the scale of Innovation from the College and University Classroom Environment Inventory (CUCEI) was added to this modified version of the WIHIC questionnaire to form the Classroom Learning Environment Questionnaire (CLEQ). For the QTI, all of the original scales were retained. As both the WIHIC and the QTI were originally developed to measure the perceptions of high school students, it was necessary to modify the language to make them suitable for tertiary-level students. For example, the word 'teacher' was substituted by 'lecturer'. Also the number of items in each scale was reduced to make the questionnaires more economical in terms of the time needed for administration. For the WIHIC, three items were omitted from each scale, leaving four five-item scales. For the QTI, one item was omitted from each scale, leaving eight five-item scales.

Table 3-5: Description and Sample Item for the Scales of the CLEQ for the Main Study

Environment Scale	Description	Sample Item
Student Cohesiveness	Extent to which students know, help and are supportive to one another.	Members of this class do favours for one another.
Involvement	Extent to which class lessons involve students' participation.	Students give their opinions during class discussions.
Task Orientation	Extent to which class lessons are on target and the objectives are realised.	Students are ready to start this class on time.
Cooperation	Extent to which students are able to work together for a shared purpose.	During group work, students do their share of the work.
Innovation (from CUCEI)	Extent to which the instructor plans new, and unusual class activities, teaching technique and assignments	The Lecturer thinks up unusual projects for students.

Table 3-5 provides a description of each of the five scales of the modified WIHIC used in the main study. Also given in Table 3-5 is a sample item for each scale.

3.5.2 Translation and Field Testing of Instruments

Once modifications had been made to the instruments, it was necessary to translate them into the Indonesian language. Translations were made using a rigorous procedure of

back-translation (Brislin, 1970) to ensure accuracy. For the purpose of cross-validation, the four scales selected from the WIHIC questionnaire were used in their original form. To ensure that individual items did not change their meaning, each item of the WIHIC was translated into Indonesian and then translated back into English by people who were not involved in the original translations. The original English items were then compared to the items that had been back-translated. Items that had changed in meaning were modified to ensure that the Indonesian translation had the same meaning as the original English ones.

Once translated, the instruments were each given to six staff members of Bina Nusantara University. The staff members were each asked to complete the five instruments. (This was timed to provide feedback regarding the amount of time that would be required to complete them in the main study.) The researcher then sought the expert opinions of the staff members regarding the accuracy, clarity and general comprehensibility of items in the instruments. The interviews provided an important source of feedback information that contributed in an important way to the fine-tuning of the instruments for the main study (see Appendices A2, B2 and C2).

Once interviews with staff were complete, and modifications made on the basis of these interviews, the instruments were then field tested using 40 university students in one class. The students were requested to respond honestly to every item in the questionnaires and were assured by the researcher that all information given would be strictly confidential. Students were told to raise their hands if they were not sure of what to do or did not understand any of the items.

Students responded to all of the instruments and data. Frequency statistics and reliability statistics were used to determine which items were problematic. Interviews with students were then conducted regarding the problematic items, such as those with ambiguities, and further modifications were be made to the questionnaires to ensure that they were clear.

The main purpose of this field test was the gathering of subjective information to guide smooth administration during the main study. The pilot study provided an opportunity to simulate the main study on a reduced scale. This field-testing was also necessary to evaluate (1) the comprehensibility and clarity of the items in the five instruments, (2) the response format of the questionnaire, (3) the procedures for the data collection, and (4) the approximate amount of time required by students to complete each of the instruments.

The insights emerging from the pilot study are summarised below:

(1) The comprehensibility and clarity of the items in the five instruments was investigated. It was clear from students' responses in this pilot study and interviews with six staff that there were some confusing questions, especially for the TOLT (question numbers 3, 4, 7 and 8 as show in Appendix D). Also there was some improvement needed to make all of the instruments more comprehensive.

(2) The response format seemed appealing and clear to the students. There were no indications of any problems among students for the classroom learning environment questionnaire, lecturer interaction questionnaire and motivation scale regarding choosing from the responses of Almost Never, Seldom, Sometimes, Often, Almost Always. Also there was no indication of any problems among students answering the TOCRA, based on the semantic differential technique of Osgood, Suci and Tannenbaum. On the basis of the field test, it was decided that the format for the questionnaires should be retained for use in the main study. The use of different colours for each questionnaire and clear large fonts in the text were retained to make the process of testing more pleasant for the students.

(3) The procedures used for data collection in the field test proved workable and systematic. Directions were simple and straightforward with the students following step-by-step. With this experience during the pilot testing, it was

decided that the researcher would use assistants when collecting data from the 12 classes used in the main study. The administration of the instruments was to take place directly after students had completed the final examination for the Research Methods course. This ensured that the students would be available to complete the questionnaires.

(4) The times taken by students to complete the three questionnaires were within expectations. The slower students took 35 minutes to complete the TOLT, six minutes to complete the TOCRA and 10 minutes to complete the CLEQ, QTI and the motivation scale. Altogether, the slower students took about 51 minutes to complete the three sets of questionnaires. Based on this experience, the researcher estimated that slower students would be able to complete the instruments within the given time frame of one hour in the main study.

The survey also required that the students supply their student identification numbers. This enabled the researcher to access students' data regarding their academic performance from the school data base in the University's Computer Data Centre.

3.5.3 Changes Made to Instruments Based on Field Test

The results of the pilot test also indicated that some items lacked clarity, as indicated below:

(1) The field test indicated problems with the Student Responsibility/Freedom (SRE) scale of the QTI. The negative items (such as Item 40) in this scale were causing some confusion and were changed. Some of the changes to the Student Responsibility/Freedoms scale of QTI for Items 36 and 40 are shown in Table 3-6.

(2) For the TOLT, students indicated that the figures in Questions 3 and 4 were unclear. To make them clearer, the original figures of the pendulum shown in Appendix C1 were changed as shown in Appendix C3. Students also had

difficulty with Questions 7 and 8 of the TOLT. In these questions, the words 'more likely' were replaced with 'prefer more' and the words 'not more likely' were replaced with the words 'prefer less' (see Table 3-7).

(3) No changes were made to the TOCRA. In the pilot test, there were eight statements (eight pairs of adjective) in Question 3 of the TOCRA. There was a typing error. This study used only seven statements (seven pairs of adjectives in conjunction with a five-point differential semantic scale) in each scale.

Appendices A1 and A3 show the English and Indonesian versions of the CLEQ, Appendices B1 and B3 show the English and Indonesian versions of the QTI and Appendices C1 and C3 show the English and Indonesian versions of the TOLT. Appendices D1 and D2 show the English and Indonesian versions of the TOCRA and Appendices E1 and E2 show English versions of the Motivation Scale.

Table 3-6: Changes to QTI Items 36 and 40

Item No	Old Statement	New statement
36	We can decide some things in this teacher's class.	Unchanged
	Kami dapat memutuskan sesuatu di kelas dosen ini.	Kami dapat berbuat sesuka kami di kelas dosen ini.
	We can decide something in this lecturer's class.	We can do anything we want in this lecturer's class.
40	This teacher is lenient.	Unchanged
	Dosen ini toleran.	Dosen ini membiarkan kami tidak menyelesaikan tugas yang diberikan.
	This lecturer is tolerant.	This lecturer allow us not to finish the given task.

Table 3-7: Changes Made to TOLT Questions 7 and 8

Item No.	Language	Old Statement	New Statement
7.	Indonesia	Dari gambar memperlihatkan bahwa tikus gemuk *lebih senang* mempunyai ekor hitam dari pada tikus kurus. Ya Tikus gemuk *lebih suka* mempunyai ekor hitam dibanding tikus kurus. Tidak Tikus gemuk *lebih tidak suka* mempunyai ekor hitam dibanding tikus kurus.	Dari gambar memperlihatkan bahwa tikus gemuk *lebih banyak* mempunyai ekor hitam dari pada tikus kurus. Ya Tikus gemuk *lebih banyak* mempunyai ekor hitam dibanding tikus kurus. Tidak Tikus gemuk *lebih sedikit* mempunyai ekor hitam dibanding tikus kurus.
	English	From the diagram decide whether fat mice are *more likely* to have black tails than thin mice. YES. Fat mice are *more likely* to have black tails than thin mice. NO. Fat mice are *not more likely* to have black tails than thin mice.	From the diagram decide whether fat mice *prefer more* to have black tails than thin mice. YES. Fat *mice prefer more* to have black tails than thin mice. NO. Fat mice *prefer less* to have black tails than thin mice.
8.	Indonesia n	Apakah ikan gemuk *lebih menyukai* garis-garis tebal dibanding ikan kurus?	Apakah ikan gemuk *lebih banyak mempunyai* garis-garis tebal dibanding ikan kurus?
	English	Are fat fish *more likely* to have broad stripes than thin fish?	Do fat fish *prefer more* to have broad stripes than thin fish?

3.6 DATA COLLECTION FOR THE MAIN STUDY

The data for the main study were collected in two phases. First, the instruments were administered to the students and, second, data were accessed through the University computer database.

The data for the main sample were collected from 12 Research Methods classes at Bina Nusantara University. The researcher asked assistants to administer the questionnaires as it was felt that the presence of the lecturer in the classrooms could inhibit student responses somewhat, particularly when they had to express their opinions regarding their lecturers. The students were given a five-minute break between responding to the TOLT and the other questionnaires. All students received the same standard set of instructions. Allowance also was made for students to clarify their doubts, if any, before they began answering the questionnaires. It was logical to begin with the more difficult

instrument (the TOLT) which measures the logical thinking of the students. After completion of the TOLT, the students knew exactly how to proceed to the next part involving completing the other instruments after a break of a few minutes. The process of data collection was systematic and conducted within the allocated time frame of one hour. The responses of 278 'very slow' students, who were unable to complete the questionnaires on time, were excluded from the sample.

To forestall possible confusion in class over class code and student identity, students wrote their student identification number, lecturer code and class identification on the answer sheets. Thereafter, the researcher keyed the data into a computer data base.

The academic achievement records of students were accessed through the University database. These records consisted of the score for each student taking the Research Methods course in which they were all currently enrolled and the GPA score (accumulated score across all subjects before they started the Research Methods class) of those students who were participating in the study.

3.7 STATISTICAL ANALYSIS

Five different instruments were employed in the present study to measure the four productivity factors and learning outcomes. The choice of the units for statistical analysis (Section 3.7.1) and the statistical procedures used for analysing the data obtained from these instruments (Section 3.7.2) are described in the following subsections.

3.7.1 Choice of Unit for Statistical Analysis

Fraser (1986b) discussed the important issue of choosing an appropriate unit or level of statistical analysis. He enunciated four reasons for the need to choose an appropriate unit of statistical analysis. First, with the use of different units of statistical analysis, variables with the same operational definition could have different substantive

interpretations. Second, there is the possibility that relationships found by using a particular unit of statistical analysis could differ in size and even in sign from those obtained using another unit of analysis (Robinson, 1950). Third, there is the possibility of violating the condition of independence of observations, and hence the validity of statistical significance tests, resulting from the use of certain units of statistical analysis (Peckham, Glass & Hopkins, 1969; Ross, 1978). And, fourth, using different units of statistical analysis could mean the testing of conceptually different hypotheses (Burstein, Linn & Capell, 1978).

The two most commonly used units of statistical analysis in prior classroom environment research have been the individual student and the class mean, although some studies have employed the school mean (Brookover, Schweitzer, Schneider, Beady, Flood & Wisenbaker, 1978), the mean of subgroups of students within the class (Walberg, Singh & Rasher, 1977) or the deviation of a student's score from the class mean (Sirotnik, 1980).

For the purposes of the present study and in line with past classroom environment research, the two units of analysis chosen were the individual student score (between student analysis) and the class mean score (between class analysis), with the exception of the investigation of departmental differences, for which the within-class department subgroup mean was used as the unit of analysis.

3.7.2 Statistical Procedures

Altogether there were three stages in the statistical procedures undertaken to analyse the data from the various instruments and to investigate associations between the perceptions of the students' classroom environment and learning outcomes.

Factor and item analyses

Factor and item analyses were undertaken with the aim to refining the instruments and providing evidence of their validity and reliability. The technique most often used to

improve scale internal consistency is to remove any item, which is not reasonably correlated with the total score for its scale. Principal components analysis with varimax rotation was used to check the factor structure.

Validity and reliability of refined scales

Various techniques were used to test the validity and reliability each scale in each instrument. Internal consistency reliability, discriminant validity and ability to differentiate between classrooms are discussed in more detail below.

The internal consistency reliability of each scale in the five instruments used in this study, namely, the modified WIHIC, the QTI, the TOLT, the Motivation scale and the TOCRA, was determined using the Cronbach alpha coefficient for two units of analysis, the individual and the class mean. It is commonly held that a scale score is only interpretable when the scale possesses substantial internal consistency in that each item in the scale measures the same construct as the rest of the items (Cronbach, 1951).

Using two units of analysis, an estimate of the discriminant validity of each scale was derived, using the mean magnitude of the correlation of a scale with the other scales in the same instrument as a convenient index. Scales should possess discriminant validity in that each scale should measure a unique dimension not measured by any other scale in the battery (Campbell & Fiske, 1959).

Discriminant validity is important because it would be uneconomical of experimenters' and subjects' efforts to collect numerous measures of essentially the same dimensions, and because it violates the general methodological principle of parsimony in that it complicates theory and confounds interpretation of results to maintain different names for two traits which are very similar.

A one-way ANOVA was computed for each scale of the instruments, with class membership as the main effect and using the individual student as the unit of analysis,

so as to examine whether there was differentiation between students' perception in different classes. Usually students within the same class should perceive a classroom environment relatively similarly, while the class mean should vary from classroom to classroom. This characteristic can be explored using a one-way ANOVA with class membership as the main effect. The common indices used in this case are ANOVA results such as the significance level and eta^2 statistic. The eta^2 statistic, which is the ratio of 'between' to 'total' sums of squares, indicates the proportion of variance explained by class membership.

The reporting of scale internal consistency and discriminant validity statistics for classroom environment scales can become quite complex. First, as some instruments have more than one form, validation data available for only one form strictly should not be used to infer the validity of other forms of the same instrument. Second, as both the individual students and the class mean have been used commonly in past classroom environment research, it is desirable to have scale statistics available separately for each unit of analysis. As Sirotnik (1980) correctly points out, scale reliability and structure can vary somewhat depending on which unit analysis is adopted.

Simple and multiple correlation for outcome-environment associations

A series of simple and multiple correlation analyses was conducted separately for each instrument to determine the associations between four productivity factors (the classroom learning environment, lecturer-student interaction behaviour, student aptitude and student motivation) and learning outcomes (the course achievement score and students' attitude towards computers) for two units of analysis (the student and the class mean). Sometimes these analyses included a comparison with results from methodologically diverse past studies, or involved two classroom environment instruments in the same study. In the present study, it was possible to estimate the unique and confounded contributions made by each instrument to the prediction of outcome variance. The magnitudes of environment-outcome relationships were compared for two units of analysis, namely, the individual student and the class mean.

A simple correlation analysis of relationships between individual outcome measures and individual environment scales was performed to provide information on associations between particular environment variables and particular outcomes.

A multiple correlation analysis of relationships between each outcome measure and the set of environment scales as a whole was conducted to provide a more complete picture of the joint influence of correlated environment dimensions on outcomes and to reduce the Type I error rate associated with the simple correlation analysis. This analysis is likely to be of particular relevance to people interested in specific outcome measures.

In order to interpret which individual scales were making the largest contribution to explaining variance in learning outcomes, an examination was made of the regression weights to see which ones were significantly greater than zero ($p<0.05$). The regression weight describes the influence of a particular environment variable on an outcome when all other environment variables in the regression analysis are mutually controlled.

MANOVA for differences between departments

Multivariate analyses of variance (MANOVAs) and *t*-tests were performed in order to investigate subgroup department differences in outcomes and environment. Simple and multiple correlation analysis were used to see whether the strength of the association between students' outcomes and each of the four productivity factors differed for Computer Science students and Management students.

3.8 SUMMARY

The present study investigated the associations between four learning productivity factors (classroom learning environment, interpersonal lecturer behaviour, student aptitude and students' motivation towards their major subject) and two student outcomes (the achievement and attitudes of students). The study involved a sample of 422 students from 12 Research Methods classes in one university in Jakarta, Indonesia. Five instruments were used in the present study, namely, the Test of Logical Thinking

(TOLT), the Classroom Learning Environment Questionnaire (CLEQ), the Questionnaire on Teacher Interaction (QTI), the Test of Computer-Related Attitudes (TOCRA) and a Motivation scale. The instruments were translated into Indonesian using a rigorous process of back-translation to ensure that each item retained its original meaning.

Once they had been translated, each of the five instruments were field tested using six staff members and 40 students. The field test included the administration of the questionnaires and interviews with the students and staff. The field test was used to ensure the clarity and comprehensibility of each instrument while also enabling the researcher to obtain valuable information that would guide the smooth administration of the main study.

Table 3-8 shows a summary of the instruments used in this study. This table provides the names of the scales used in each instrument, the number of items in each scale, and a description of each scale.

As a result of this field-testing, amendments were made to improve the comprehensibility of certain items. The field-testing of the instruments assisted in identifying likely problem items for removal and in ensuring that administration for the main study proceeded smoothly and on time. The only difficulty experienced during the data collection was that administration took place directly after the students' final examination. Of 700 sets of questionnaires distributed, only 422 were completed. It is assumed that this was because students were tired.

Data analyses for the two measures of students' outcomes and the measures of productivity were, for the most part, computed separately for two units of analysis (the individual students and the class mean). The data were analysed to determine the reliability and validity of the questionnaires. Factor and item analysis were undertaken to refine the instruments. The internal consistency reliability, discriminant validity and ability to differentiate between classrooms were then used as measures of reliability and

validity for the refined scales. To examine outcome-environment associations, simple and multiple correlations were used. Multivariate analyses of variance (MANOVA) and *t* tests were performed to investigate departmental differences in outcomes and environment.

Table 3-8: Summary of the Instruments Used in This Study

Instrument	Scales Chosen in This Study	Number of Items in Each Scale	Description of the Scale
CLEQ (Appendix A)	Student Cohesiveness	5	Extent to which students know, help and are supportive to one another.
	Involvement	5	Extent to which class lessons involve students' participation.
	Task Orientation	5	Extent to which class lessons are on target and the objectives are realised.
	Cooperation	5	Extent to which students are able to work together for a shared purpose.
	Innovation (from CUCEI)	5	Extent to which the instructor plans new, unusual class activity, teaching technique and assignments.
Teacher-Student Interaction Questionnaire (QTI) (Appendix B)	Dissatisfied (OS)	5	Degree to which lecturer shows unhappiness/dissatisfaction with students.
	Helpful/Friendly (CD)	5	Degree to which lecturer is friendly and helpful towards student.
	Student Responsibility & Freedom	5	Degree to which students are given opportunities to assume responsibility for their own activities.
	Strict (DO)	5	Degree to which lecturer is strict with and demanding of students.
	Leadership	5	Degree to which lecturer provides leadership to class and holds student attention.
	Uncertain (SO)	5	Degree to which lecturer exhibits his/her exhibits his/her uncertainty.
	Admonishing (OD)	5	Degree to which lecturer shows anger/temper/impatience in class.
	Understanding (CS)	5	Degree to which lecturer shows understanding/concern/care to student.
TOLT (Appendix C)	Proportional reasoning	2	
	Controlling variables	2	
	Probabilistic reasoning	2	
	Correlation reasoning	2	
	Combinatorial reasoning	2	
TOCRA (Appendix D)	Student Satisfaction with Computer Lessons	7	
	Leisure Interest in Computers	7	
	Career Interest in Computers	7	
	Attitude towards Internet	7	
Motivation (Appendix E)	Motivation behind their choice of subject	3	
	Student awareness to their future	2	

Owing to the systematic and rigorous procedures undertaken during the process of data collection, it is possible to have high confidence in the quality of the data collected in the present study.

CHAPTER 4

DATA ANALYSIS AND FINDINGS

4.1 INTRODUCTION

The focus of the present study, as discussed in Chapter 1, was to investigate associations between four learning productivity factors (namely, learning environment, interpersonal lecturer behaviour, student aptitude and students' motivation) and the affective and cognitive outcomes of students in Indonesia at the tertiary level of education.

This chapter is devoted to the analyses and results for the data collected for the present study. Section 4.2 examines the reliability and validity of each instrument for assessing the productivity factors, namely, the Classroom Learning Environment Questionnaire (CLEQ) (modified from the What Is Happening in This Class?, WIHIC, questionnaire), the Questionnaire on Teacher Interaction (QTI), the Test of Logical Thinking (TOLT), and a Motivation scale (developed specifically for this study), when used in an Indonesian university. The GPA score (accumulated score across all subjects before students started the Research Methods class) is a further measure of student aptitude and was accessed through the university database. In addition, in order to assess student attitudinal outcomes, the Test of Computer-Related Attitudes (TOCRA) (modified from the Test of Science-Related Attitudes) was developed and validated.

Section 4.3 reports an investigation of whether differences exist between a Computer Science department and a Management department in terms of students' perceptions of the classroom learning environment, lecturer-student interaction, student aptitude and students' motivation.

Section 4.4 reports the associations between each of two types of student outcomes (academic achievement measures and attitude measures) and the four productivity

factors of classroom learning environment, lecturer-student interaction, student aptitude and students' motivation.

Section 4.5 compares Computer Science and Management students in terms of the relative strengths of the associations between each of two types of student outcomes (academic achievement measures and attitude measures) and the four productivity factors of classroom learning environment, lecturer-student interaction, student aptitude and students' motivation.

4.2 VALIDATION OF THE INSTRUMENTS

This section presents a discussion of the analysis and results pertaining to Research Question #1:

> *Is it possible to develop valid and reliable instruments in the Indonesian language to assess:*
>
> *a) the learning environment?*
>
> *b) lecturer-student interaction?*
>
> *c) student aptitude?*
>
> *d) motivation?*
>
> *e) attitudes?*

Reported in this section are the reliability and validity of the instruments used to assess the four productivity factors used in the present study, namely, (a) the Classroom Learning Environment Questionnaire (Section 4.2.1), (b) the Questionnaire on Teacher Interaction (Section 4.2.2), (c) the Test of Logical Thinking and (d) the Motivation scale (Section 4.2.3). Also, data are reported for the outcomes measure, the Test of Computer-Related Attitudes (Section 4.2.4).

4.2.1 Validation of the Classroom Learning Environment Questionnaire (CLEQ)

To measure students' perceptions of the classroom learning environment, the present study adapted four scales selected from the What Is Happening in this Class? (WIHIC; Fraser, Fisher & McRobbie, 1996) questionnaire and one scale from the College and University Classroom Environment Inventory (CUCEI; Fraser & Treagust, 1986).

The original version of the WIHIC has seven, eight-item scales each measuring a different dimension of the learning environment. The origins of the WIHIC, and its use and validity in a variety of countries and subject areas, are described in Chapter 2. Four of the seven scales (namely, Student Cohesiveness, Involvement, Task Orientation and Cooperation) were selected from the WIHIC as suitable for use in the present study in Indonesia. Each scale was reduced to five items to ensure expedience in the administration of the instruments. One scale from the Classroom and University Environment Inventory (CUCEI) (Fraser & Treagust, 1986), namely, Innovation, was included in the new questionnaire, which was called the Classroom Learning Environment Questionnaire (CLEQ). (Chapter 3 provides details regarding the development and translation of the CLEQ and the significance of the scales selected for use in the present study.)

Factor and Item Analyses for CLEQ

Validation of the Classroom Learning Environment Questionnaire (CLEQ), with the sample of 422 students in 12 classes, commenced with factor and item analyses. A factor analysis was used to examine the internal structure of the 25 items in the version of the CLEQ questionnaire used in the present study. Principal components factor analysis with varimax rotation was used to generate orthogonal factors for the data set. The individual students score was used as the unit of statistical analysis because the sample size of 12 classes was too small to permit meaningful factor analysis using the class mean.

A series of principal components factor analyses resulted in the acceptance of a version of the CLEQ comprising 25 items in 3 scales. The Student Cohesiveness and

Cooperation scales came together to form one scale with 10 items, and Involvement and Innovation (from the CUCEI) came together to form another scale also with 10 items (see Table 4-1). For the final version of the questionnaire, nearly all items have a factor loading of at least 0.40 on their own scale and no other scale.

Table 4-1: Factor Loadings for the CLEQ

Item	Factor Loading		
	Student Cohesiveness/ Cooperation	Involvement/ Innovation	Task Orientation
SC1	0.64		
SC2	0.70		
SC3	0.69		
SC4	0.72		
SC5	0.69		
CO16	0.63		
CO17	0.73		
CO18	0.72		
CO19	0.78		
CO20	0.62		
IV6		0.61	
IV7		0.64	
IV8		0.49	
IV9		0.47	0.43
IV10		0.66	
IN21		0.62	
IN22		0.55	
IN23		0.71	
IN24		0.70	
IN25		0.71	
TO11			0.41
TO12			0.66
TO13			0.76
TO14			0.79
TO15			0.71
% Variance	34.12	10.64	6.90
Eigenvalue	8.52	2.66	1.73

The sample consisted of 422 students in 12 classes.
Rotation converged in 5 iterations.
Loadings smaller than 0.4 omitted.
SC – Student Cohesiveness, IV – Involvement, TO – Task Orientation, CO – Cooperation, IN – Innovation

Table 4-1 shows the factor loadings for the CLEQ questionnaire for the sample of 422 students using the individual student as the unit of analysis, along with the percentage of variance and eigenvalue for each scale. The percentage of variance varies from 6.90 to 34.12 for different scales, with the total variance accounted for being 51.66%. The value of the eigenvalue varies from 1.73 to 8.52 for the different scales.

Of the 75 possible loadings in Table 4-1 (25 items x 3 scales = 75), there is only one item for which the three-factor modified structure is not replicated. Item 9 has a loading

of more than 0.40 with the Task Orientation scale as well as with its own scale (namely, Involvement/Innovation). For two of the three environment scales, namely, Student Cohesiveness/Cooperation and Involvement/Innovation, the three-factor structure is supported perfectly.

Item analysis of the 25 items showed that all the items in the three environment scales have sizeable item-remainder correlations (i.e. correlations between a certain item and the rest of the scale excluding that item). Based on the factor and item analyses, a decision was made to retain all 25 items in subsequent analysis.

Reliability, Discriminant Validity and Ability to Differentiate between Classrooms for CLEQ

For the revised 25-item version of the CLEQ, three further indices of scale reliability and validity were generated. The Cronbach alpha reliability coefficient was used as an index of scale internal consistency. Analysis of variance (ANOVA) results were used as evidence of the ability of each scale to differentiate between the perceptions of students in different classrooms. A discriminant validity index (namely, the correlations between scales) was used as evidence that each CLEQ scale measures a separate dimension that is distinct from the other scales in this questionnaire.

The internal consistency reliability of each scale was determined using the Cronbach alpha coefficient for two units of analysis. It is commonly held that a scale score is only interpretable when the scale possesses substantial internal consistency in that each item in the scale measures the same construct as the rest of the items (Cronbach, 1951). Table 4-2 reports the internal consistency reliability (Cronbach alpha coefficient) of each of the three scales for the CLEQ for two units of analysis (individual and class mean).

The scale reliability estimates in Table 4-2 range from 0.78 to 0.90 using the individual as the unit of analysis. These internal consistency indices are higher than those for the original WIHIC cross-validation involving an Australia sample (Fraser, Fisher & McRobbie, 1996), which ranged from 0.67 to 0.88, and are comparable to those in past

studies (Aldridge & Fraser, 2000; Fraser & Chionh, 2000). With the class mean as the unit of analysis, the alpha reliability coefficients in the present study, as expected, are higher and range from 0.97 to 0.99.

Table 4-2: Internal Consistency Reliability (Cronbach Alpha Coefficient), Discriminant Validity (Scale Intercorrelations) and Ability to Differentiate between Classrooms (ANOVA Results) for Two Units of Analysis for the CLEQ

CLEQ Scale	No of Items	Unit of Analysis	Alpha Reliability	Scale Intercorrelations			ANOVA
				Cooperation/ Student Cohesiveness	Involvement/ Innovation	Task Orientation	Eta^2
Cooperation/ Student Cohesiveness	10	Individual	0.90	-	0.50**	0.44**	0.14**
		Class Mean	0.97	-	0.70**	0.83**	
Involvement/ Innovation	10	Individual	0.86		-	0.52**	0.17**
		Class Mean	0.98		-	0.79**	
Task Orientation	5	Individual	0.78			-	0.07**
		Class Mean	0.99			-	

** $p<0.01$ The sample consisted of 422 students in 12 classes.
The eta^2 statistic (which is the ratio of 'between' to 'total' sums of squares) represents the proportion of variance explained by class membership.

The discriminant validity results (correlation between scales) for the three scales of the modified WIHIC range from 0.44 to 0.52 using the individual as the unit of analysis and between 0.70 and 0.83 using the class mean as the unit of analysis. The data suggest that raw scores on the CLEQ assess distinct but somewhat overlapping aspects of learning environment. However, the factor analysis supports the independence of factor scores on the three scales.

An analysis of variance (ANOVA) was used to determine the ability of each CLEQ scale to differentiate between the perceptions of students in different classes. The one-way ANOVA for each scale involved class membership as the independent variable and the individual student as the unit of analysis. Table 4-2 reports the ANOVA results showing that each CLEQ scale differentiated significantly between classes ($p<0.01$). Thus, students within the same class perceived the environment in a relatively similar manner, while within-class mean perceptions of the students varied between classes.

The eta^2 statistic (an estimate of the strength of association between class membership and the dependent variable) ranged from 0.07 to 0.17 for different CLEQ scales. On the whole, these figures are slightly lower than those for the original WIHIC cross-validation involving an Australian sample (Fraser, Fisher & McRobbie, 1996), which ranged from 0.18 to 0.35.

The statistics obtained for the internal consistency (alpha reliability) and the ability of each scale to differentiate between the perceptions of the students in different classrooms (eta^2 statistic from ANOVA) are considered acceptable. The data presented in Table 4-2, in conjunction with the factor analysis results in Table 4-1, support the contention that the CLEQ is a valid and reliable classroom environment instrument for the assessment of students' perceptions of their psychosocial classroom environments at the university level in Indonesia. Therefore, lecturers and researchers in Indonesia can use the CLEQ with confidence in the future.

4.2.2 Validation of the Questionnaire on Teacher Interaction (QTI)

To measure students' perceptions of lecturer-student interaction in the classroom, the present study adapted the Questionnaire on Teacher Interaction (QTI) developed by Wubbels, Brekelmans and Hooymayers (1991). The development, validation and use of the QTI in a number of countries and subject areas are discussed in Section 2.5.

The QTI was modified for use in the present study by obtaining feedback from students concerning their perceptions of interpersonal teacher behaviour. The 48-item version of the QTI, originally developed for use in the secondary classroom (Wubbels, 1993), was adapted to form a version suitable for use at the tertiary level in Indonesia. This new Indonesian version of the QTI uses the same eight scales as the original version, namely, Leadership, Helpful/Friendly, Understanding, Student Responsibility/Freedom, Uncertain, Dissatisfied, Admonishing and Strict behaviour. However, the number of items in the Indonesian version was reduced from six to five items per scale, making a total of 40 items altogether.

Factor and Item Analysis for QTI

Principal components factor analysis followed by varimax rotation resulted in the acceptance of this version of the QTI comprising 40 items in eight scales with five items each. These eight scales were Leadership, Helpful/Friendly, Understanding, Student Responsibility/ Freedom, Uncertain, Dissatisfied, Admonishing and Strict. For the final version of the questionnaire, nearly all items have a factor loading of at least 0.40 on their own scale and no other scale.

Table 4-3 shows the factor loadings for the QTI questionnaire (eight scales, five items per scale) for the sample for 422 students, using the individual student as the unit of analysis along with the percentage of variance and eigenvalue for each scale. The percentage of variance varies from 2.68% to 24.58% for different scales, with the total variance explained being 61.10%. The value of the eigenvalue varies from 1.08 to 9.83 for different QTI scales.

For three of the eight lecturer-student interaction scales, namely, Admonishing, Student Responsibility/Freedom and Strict scales, the a priori factor structure was replicated perfectly. For the Dissatisfied, Leadership, Understanding and Uncertain scales, there are one or two items from other scales that loaded on these scales. And the Helpful/Friendly scale has an item with a loading of less than 0.40 with its own scale (namely, Item 32). Therefore, Item 32 was deleted for the purposes of all subsequent data analyses.

Item analysis of the 40 items showed that 39 items in the eight lecturer-student interaction scales had sizeable item-remainder correlations (i.e. correlations between a certain item and the rest of the scale excluding that items). Based on the factor and item analyses, a decision was made to retain all 39 items in 8 scales in subsequent analyses.

Table 4-3: Factor Loading for Items of the QTI

Item	Factor Loading							
	Admonishing	Helpful/ Friendly	Student Responsibility	Dissatisfied	Leadership	Understanding	Uncertain	Strict
Adm56	0.76							
Adm57	0.69							
Adm58	0.73							
Adm59	0.65							
Adm60	0.74							
HFr31		0.49						
HFr32		-						
HFr33		0.59						
HFr34		0.81						
HFr35		0.78						
SRe36			0.73					
SRe37			0.70					
SRe38			0.77					
SRe39			0.67					
SRe40			0.60					
Dis26				0.74				
Dis27				0.82				
Dis28	0.41			0.74				
Dis29				0.76				
Dis30		-0.43		0.44				
Lea46					0.73			
Lea47					0.74			
Lea48		0.46			0.64			
Lea49					0.60			
Lea50		0.56			0.50			
Und61						0.53		
Und62						0.52		
Und63						0.78		
Und64						0.66		
Und65	-0.46					0.60		
Unc51							0.68	
Unc52							0.74	
Unc53			0.41				0.65	
Unc54							0.62	
Unc55			0.42				0.59	
Str41								0.47
Str42								0.67
Str43								0.61
Str44								0.54
Str45								0.59
% Variance	24.58	11.31	8.53	4.42	3.90	2.96	2.72	2.68
Eigenvalue	9.83	4.52	3.41	1.77	1.56	1.19	1.09	1.08

Loadings smaller than 0.4 omitted. N=422 students. Rotation converged in 10 iterations.

Notes: Adm=Admonishing, HFr=Helpful/Friendly, SRe=Student Responsibility, Dis=Dissatisfied, Lea=Leadership, Und=Understanding, Unc=Uncertain, Str-Strict

Reliability and Ability to Differentiate between Classrooms

The Cronbach alpha coefficient was computed for each QTI scales as a measure of internal consistency reliability. Table 4-4 reports the internal consistency reliability of each of the eight scales for the QTI for two units of analysis: the individual student score (N=422) and the class mean score (N=12). The data in Table 4-4 suggest that the QTI has satisfactory reliability, ranging from 0.65 to 0.87 for the individual as the unit of analysis and between 0.83 and 0.99 using the class mean as the unit of analysis. As expected, the reliability estimates were higher when the class mean was used as the unit of analysis.

Table 4-4: Internal Consistency Reliability (Cronbach Alpha Coefficient) and Ability to Differentiate Between Classrooms (ANOVA Results) for Two Units of Analysis for the QTI

QTI Scale	No of Items	Alpha Reliability		ANOVA
		Individual	Class Mean	Eta^2
Leadership	5	0.83	0.97	0.17**
Helpful/Friendly	4	0.78	0.83	0.18**
Understanding	5	0.77	0.98	0.11**
Student Responsibility	5	0.80	0.99	0.08*
Uncertain	5	0.83	0.99	0.09**
Dissatisfied	5	0.87	0.99	0.07**
Admonishing	5	0.85	0.98	0.12**
Strict	5	0.65	0.99	0.11**

* $p < 0.05$ ** $p < 0.01$
The sample consisted of 422 students in 12 classes.

The reliability figures found for Indonesia (Table 4-4) are higher than the reliability figures (with the class mean as unit of analysis) in Table 4-5 in past studies conducted in The Netherlands, USA and Australia (Wubbels, 1993), which range from 0.68 to 0.90. The highest alpha coefficients occurred for the Helpful/Friendly teacher behaviour scale for studies conducted in The Netherlands, USA and Australia. In contrast, in Indonesia, the Helpful/Friendly behaviour scale had the lowest alpha coefficient, and the highest alpha coefficient in Indonesia occurred for the Dissatisfied teacher behaviour scale. Overall the reliability statistics indicate that the modified Indonesian version of the QTI is satisfactory for use at the tertiary level.

Table 4-5: Internal Consistency Reliability (Cronbach Alpha Coefficient) in Past Research for QTI Scales for Secondary Students in Three Countries Using the Class Mean as Unit of Analysis

QTI Scale	Alpha Reliability		
	The Netherlands	USA	Australia
Leadership	0.83	0.80	0.83
Helpful/Friendly	0.90	0.88	0.85
Understanding	0.90	0.88	0.82
Student Responsibility/Freedom	0.74	0.76	0.68
Uncertain	0.79	0.79	0.78
Dissatisfied	0.86	0.83	0.78
Admonishing	0.81	0.84	0.80
Strict	0.78	0.80	0.72
Sample Size	1,105	1,606	792

Source: Wubblels (1993)

Table 4-4 reports the ANOVA results for scales of the QTI, indicating that all scales differentiate significantly between Indonesian university classes ($p<0.05$). Thus, students within the same class perceived the lecturer-student interaction in a relatively similar manner, while within-class mean perceptions of the students varied between classes. The eta^2 statistic (calculated to provide an estimate of the strength of association between class membership and the dependent variable) ranged from 0.07 to 0.18 for different scales (see Table 4-4).

Pattern of Scale Intercorrelations for QTI

Data regarding the validity of the QTI were also obtained from the intercorrelation matrix and are presented in Table 4-6 for two units of analysis. Correlations were computed at both the individual student and the class levels, with the expected higher class estimates. As discussed previously in Section 2.5.2, the model of interpersonal teacher behaviour (derived from Leary, 1957) has eight scales of teacher behaviour, namely, Leadership (DC), Helpful/Friendly (CD), Understanding (CS), Student Responsibility/Freedom (SC), Uncertain (SO), Dissatisfied (OS), Admonishing (OD), and Strict (DO) behaviour, circumrotating in a clockwise direction on the two axes of Influence (DS) and Proximity (CO).

According to this model, adjacent behaviour scales (e.g., Helpful/Friendly and Understanding) should correlate highest and positively with each other, and the magnitude of the correlation should diminish as the scales become increasingly different as they move further apart from each other until they are diametrically opposite to each other, such as Helpful/Friendly and Dissatisfied, and these should have the highest negative correlation (Wubbels, Creton, Levy & Hooymayers, 1993). This assumption is elaborated further in Chapter 2 with a graphical representation in Figure 2-3.

Scale intercorrelations for the QTI (shown in Table 4-6) generally appear to satisfy this assumption, with minor discrepancies. The Admonishing (OD) sector, at both levels of analysis, best illustrates this assumption in practice (see Figure 4-1). At the individual level of analysis, the adjacent scales of Admonishing and Strict (r=0.62) and Admonishing and Dissatisfied (r=0.68) correlate highest and positively. This correlation becomes smaller for scales located further from each other, and the directly opposite scale of Understanding (CS) has the highest negative correlation of 0.83 with the Admonishing scale. Figure 4-1 illustrates the characteristic assumptions of the model of interpersonal teacher behaviour using the Admonishing (OD) scale's correlations to its adjacent and opposite scales when the individual is used as the unit of analysis.

Table 4-6: Scale Intercorrelations for QTI Using the Individual Student and the Class Mean as the Units of Analysis

QTI Scale	Scale Intercorrelation							
	Leader-ship	Helpfu/ Friendly	Under-standing	Student Responsibility/ Freedom	Uncertain	Dissatisfied	Admonishing	Strict
Leadership	-	0.60	0.49	-0.25	-0.42	-0.26	-0.04	0.34
Helpful/Friendly	0.71	-	0.51	-0.17	-0.33	-0.41	-0.34	0.17
Understanding	0.43	0.72	-	-0.06	-0.40	-0.62	-0.83	0.18
St. Resp./Freedom	-0.64	-0.41	-0.01	-	0.69	0.35	-0.31	-0.21
Uncertain	-0.63	-0.61	-0.33	0.53	-	0.75	0.20	-0.11
Dissatisfied	-0.36	-0.31	-0.34	0.36	0.46	-	0.68	0.12
Admonishing	-0.16	-0.20	-0.38	0.15	0.43	0.59	-	0.25
Strict	0.42	0.22	-0.33	-0.87	-0.46	-0.01	0.62	-

Data above the diagonal are for individual students, while data below the diagonal are for class means.

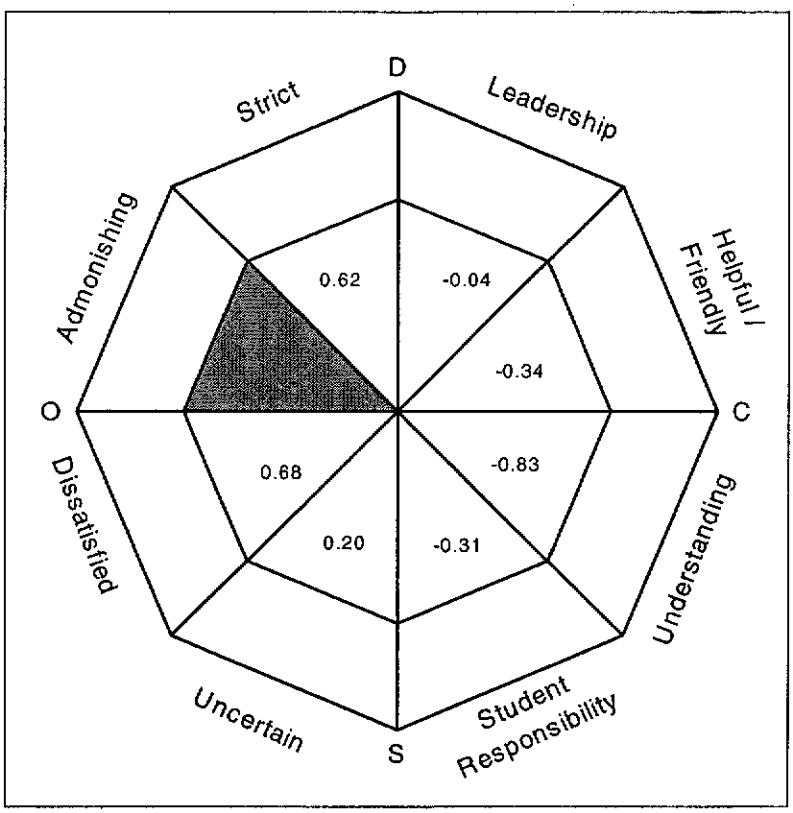

Figure 4-1: Profile of Scale Intercorrelations for Admonishing Scale using the Individual as the Unit of Analysis

The foregoing discussion suggests satisfactory reliability and validity for the Indonesian version of the QTI based on the factor analysis, internal consistency (alpha reliability) and the pattern of scale intercorrelations for the eight QTI scales. In addition, ANOVA results indicate that each QTI scale can differentiate between the perceptions of students in different classes. The results of this study of university level students in Indonesia compare favourably with those of secondary students in The Netherlands, the USA and Australia (Wubbels, 1993). Therefore, lecturers and researchers in Indonesia can use the QTI questionnaire with confidence in the future.

4.2.3 Reliability of the Test of Logical Thinking (TOLT) and Motivation Scale

To measure student aptitude, in particular, students' logical thinking, the present study adapted scales selected from the original version of the Test of Logical Thinking (TOLT; Tobin & Capie, 1981). The TOLT was originally designed to measure five modes of

formal reasoning: controlling variables, proportional reasoning, combinatorial reasoning, probabilistic reasoning, and correlational reasoning. Each of the 10 items in the original version requires participants to select a correct response and justification from a number of alternatives (Tobin & Capie, 1981). Chapter 3 provides additional detail regarding the development and use of the TOLT.

Research on cognitive development has indicated that: formal thought is required to learn many of the concepts taught in school; the majority of students are unable to utilise formal operations in problem-solving; curricula need to be changed to focus on the cognitive development of learners; lecturers need to match instruction to the cognitive level of learners; and further research is needed to investigate the nature of learning for students at different levels of cognitive development.

As English is a second language in Indonesia, it was necessary to translate the questions from the original TOLT into the Indonesian language. The process of translation and back translation is described in Section 3.5.2. Adaptations and changes made to the questionnaire during the process of back translation are also described in Section 3.5.3.

The internal consistency reliability (Cronbach alpha coefficient) for the 10 items of the TOLT was calculated for two units of analysis (individual and class mean). Table 4-7 reports that the reliability estimates were 0.80 for the individual as unit of analysis and 0.98 for the class mean as unit of analysis. Analysis of the data collected from 422 students to determine the internal consistency (alpha reliability) would suggest that the reliability of the TOLT is acceptable.

According to Linda Lumsden (1994), student motivation naturally has to do with students' desire to participate in the learning process. There are two modes of motivation, namely, intrinsic and extrinsic motivation. An intrinsically-motivated student undertakes an activity for its own sake, for the enjoyment it provides, the learning it permits, or the feelings of accomplishment it evokes. The extrinsically-

motivated student performs in order to obtain some reward or avoid some punishment external to the activity itself (Lepper, 1988).

There are some factors that influence the development of students' motivation, such as general experience, but it is stimulated most directly through modelling, communication of expectations, and direct instruction or socialization by significant others, especially parents and teachers (Brophy, 1987). Past research on student motivation is discussed in Chapter 2.

A Motivation scale was developed, specifically for the present study, to allow investigation of the influences behind students' decisions to select their major subject. It is widely recognised that, when students select their major subject, the choice will inevitably influence their future careers. As many young people don't have well-defined goals at the time of selection, the driving force behind their choice of major could become an influential factor. The motivating force behind students' choice of major could influence their attitudes and achievement in their selected subjects. As such, the motivation behind their choice of subject could be a potential productivity factor.

For the present study, a Motivation scale made up of five items was developed. Three items are related to the motivation behind students' choice of subject (i.e., whether students made the choice on their own, or under the influence of their parents or friends) and two questions are related to students' awareness of the influence that the choice of major had on their future careers. The development of the Motivation scale is discussed in Section 3.4.4.

Item analysis of the 5 items showed that all the items in the Motivation scale had sizeable item-remainder correlations (i.e. correlations between a certain item and the rest of the scale excluding that items).

Table 4-7 reports that the scale reliability estimates (Cronbach's alpha coefficient) for the Motivation scale was 0.82 using the individual as the unit of analysis and 0.99 using the class mean as the unit of analysis.

Table 4-7: Internal Consistency Reliability (Cronbach Alpha Coefficient) for Two units of analysis for the Student Aptitude (Logical Thinking) and the Motivation scale

Scale	No. of Items	Alpha Reliability	
		Individual	Class Mean
Student Aptitude (Logical Thinking)	10	0.80	0.98
Motivation	5	0.82	0.99

The sample consisted of 422 students in 12 classes.

4.2.4 Validation of the Test of Computer-Related Attitudes (TOCRA)

To measure students' attitudes towards computer-related studies, the present study adapted selected scales from the Test of Science-Related Attitudes (TOSRA; Fraser, 1981b). The response format of the attitude instrument also was modified to make use of the Semantic Differential Technique (Osgood, Suci and Tannenbaum, 1957) in which seven pairs of polarised adjectives were used in conjunction with a five-point response scale. The development of the semantic differential technique for the measurement of students' attitudes is described in Section 2.6.2.

This study used only three of the seven original scales of TOSRA and modified their names to Student Satisfaction in Computer Studies, Leisure Interest in Computers, and Career Interest in Computers. In addition, for the purposes of this study, an Attitude Towards the Internet scale was developed. Section 3.4.5 provides information regarding the development of the TOCRA for use in an Indonesian university.

Factor and Item Analyses for TOCRA

The data collected from 422 students in 12 classes were used to performa a principal components factor analysis followed by varimax rotation. This resulted in the acceptance of a revised version of the instrument comprising the following 2 scales with 7 items in

each: Leisure Interest in Computers; and Attitude Towards the Internet. The remaining scales were omitted for subsequent analyses. For the final version of the questionnaire, all items have a factor loading of at least 0.40 on their own scale and no other scale (see the factor loadings reported in Table 4-8).

Table 4-8: Factor Loadings for the TOCRA

Scale	Factor Loading	
	Attitude towards Internet	**Leisure Interest in Computers**
ATTL1		0.62
ATTLR2		0.54
ATTL3		0.47
ATTLR4		0.48
ATTL5		0.57
ATTLR6		0.75
ATTL7		0.72
ATTI1	0.67	
ATTIR2	0.82	
ATTI3	0.67	
ATTIR4	0.82	
ATTI5	0.52	
ATTIR6	0.82	
ATTI7	0.72	
% Variance	33.89	14.66
Eigenvalue	4.75	2.05

Note: ATTL – Leisure interest in Computer; ATTI – Attitude towards Internet

Table 4-8 shows the factor loadings for the TOCRA questionnaire (two scales, seven items per scale) for the whole sample, using the individual student as the unit of analysis, along with the percentage of variance and eigenvalue for each scale. The percentage of variance was 14.66% for Leisure Interest in Computers and 33.89% for Attitude towards Internet (making a total of 48.55%). The value of the eigenvalue is 2.05 for Leisure Interest in Computers and 4.75 for Attitude towards Internet.

Item analysis of the 14 items showed that all the items in the two attitudes scales have sizeable item-remainder correlations (i.e., correlations between a certain item and the rest of the scale excluding that item). Based on the factor and item analyses, a decision was made to retain the 14 items in subsequent analyses.

Alpha Reliability and Scale Intercorrelation for Scales of the TOCRA

The internal consistency reliability (Cronbach alpha coefficient) of each of the two refined scales of the TOCRA for two units of analysis (individual and class mean) are reported in Table 4-9. The scale reliability estimate for the Leisure Interest in Computers scale was 0.73 using the individual as the unit of analysis and 0.98 using the class mean as the unit of analysis. For the Attitude towards the Internet scale, the reliability estimate was 0.86 using the individual as the unit of analysis and 0.97 using the class mean as the unit of analysis.

The correlation between scales for the two scales of the TOCRA was 0.38 using the individual as the unit of analysis and 0.39 using the class mean as the unit of analysis.

Table 4-9: Internal Consistency Reliability (Cronbach Alpha Coefficient) and Scale Intercorrelation for Two Units of Analysis for the TOCRA

TOCRA Scale	No of Items	Unit of Analysis	Alpha Reliability	Scale Intercorrelation	
				Leisure Interest in Computers	Attitude towards Internet
Leisure Interest in Computers	7	Individual	0.73	-	0.38
		Class Mean	0.98	-	0.39
Attitude towards Internet	7	Individual	0.86	0.38	-
		Class Mean	0.97	0.39	-

* $p<0.05$ ** $p<0.01$
The sample consisted of 422 students in 12 classes.

The results for the factor structure, internal consistency (alpha reliability) and discriminant validity (scale intercorrelation) suggest that the reliability and validity of the two TOCRA scales are acceptable. Therefore, for the purpose of later analysis, this study made use of the two-seven TOCRA scales (Leisure Interest in Computer and Attitude towards Internet) to assess students' attitudes towards computing at the university level.

From the discussion in Section 4.2, it can be concluded that the five instruments, namely, the Classroom Learning Environment Questionnaire (CLEQ), the modified Questionnaire on Teacher Interaction (QTI), the modified of Test of Logical Thinking

(TOLT), the student Motivation scale, and Test of Computer-Related Attitudes (TOCRA) are valid and reliable for use in Indonesia at the university level.

4.3 DESCRIBING AND COMPARING STUDENTS ENROLLED IN COMPUTER SCIENCE AND MANAGEMENT COURSES

This section reports the findings of analyses conducted to investigate differences between students in the Computer Science course and the Management course in terms of scores for the four productivity factors. Research Question #2 is stated below:

> *Is it possible to describe and compare a university Computer Science course and a Management course in terms of the four productivity factors of:*
>
> *(a) learning environment?*
>
> *(b) lecturer-student interaction?*
>
> *(c) student aptitude?*
>
> *(d) motivation?*

The data were derived from the random sample of 422 students from 12 Research Methods classes described in Section 3.3.2. A breakdown of the student sample by department revealed that there were altogether 278 students from the Computer Science department and 144 students from the Management department.

In seeking an answer to this research question, the unit of analysis chosen as appropriate was the individual student. Ideally, the first step in analysing the data for department differences in the 14 dependent variables (made up of three CLEQ scales, eight QTI scales, one logical thinking scale, the GPA score, and a Motivation scale) would have been to perform multivariate analysis of variance (MANOVA). As the number of students was limited (N=422), it was not considered meaningful to include all 14 dependent variables in a single analysis. Therefore, one MANOVA was performed for the three CLEQ scales, another MANOVA was performed for the eight QTI scales, and

another MANOVA was performed for the logical thinking, GPA score and Motivation scale.

For all MANOVAs, the multivariate test yielded significant results ($p<0.01$) in terms of Wilks' lambda criterion. This meant that there were department differences in the set of criterion variables as a whole. Therefore, *t*-tests for independent samples were conducted and interpreted for each of the 14 individual dependent variables. The results of the *t*-tests are shown in Table 4-10.

Table 4-10: Differences Between Computer Science and Management Students in Terms of Productivity Factors

Scale	Department	Scale Mean	Average Item Mean[a]	Item Standard Deviation	Effect Size	*df*	*t*
CLEQ							
Cooperation/Student	Computer Science	32.95	3.29	0.76	0.32	326	-3.10**
Cohesiveness	Management	35.15	3.52	0.66			
Involvement/	Computer Science	26.09	2.61	0.67	0.65	420	-6.27**
Innovation	Management	30.32	3.03	0.63			
Task Orientation	Computer Science	16.45	3.29	0.67	0.19	420	-2.81**
	Management	17.42	3.48	0.67			
QTI							
Dissatisfied	Computer Science	10.60	2.12	0.82	0.06	420	0.63
	Management	10.33	2.07	0.85			
Helpful/friendly	Computer Science	11.65	2.91	0.65	0.63	420	-4.84**
	Management	13.24	3.31	0.61			
Student Responsibility	Computer Science	10.82	2.16	0.72	0.19	420	1.75
	Management	10.19	2.03	0.68			
Strict	Computer Science	14.95	2.99	0.65	0.11	420	-1.08
	Management	15.31	3.06	0.64			
Leadership	Computer Science	15.10	3.02	0.75	0.41	420	-4.24**
	Management	16.72	3.34	0.73			
Uncertainty	Computer Science	10.40	2.08	0.72	0.12	420	1.08
	Management	9.99	1.99	0.76			
Admonishing	Computer Science	9.55	1.91	0.74	0.15	420	1.49
	Management	8.99	1.80	0.75			
Understanding	Computer Science	17.14	3.42	0.68	0.35	420	-3.36**
	Management	18.33	3.66	0.71			
Motivation, Logical Thinking & GPA							
Motivation	Computer Science	12.64	4.21	0.40	0.26	420	-1.48
	Management	12.96	4.32	0.44			
Logical Thinking	Computer Science	6.36	6.36	0.26	10.49	420	10.64**
	Management	3.58	3.58	0.25			
GPA	Computer Science	3.95	3.95	0.49	0.42	420	8.26**
	Management	3.53	3.53	0.49			

N=278 students enrolled in Computer Science courses and 144 students enrolled in Management courses.
** $p<0.01$
[a] Average item mean=Scale score divided by the number of items in that scale.

With regards to differences between Computer Science and Management students, statistically significant differences are evident in Table 4-10 for classroom climate, lecturer-student interaction, logical thinking and GPA score. No significant between-department difference for students' responses to the Motivation scale was found.

Effect sizes (i.e. the difference in means between students in the two departments expressed in terms of the number of standard deviations) were calculated. These are reported in Table 4-10. For classroom climate, there emerged a significant difference for each of the three modified WIHIC scales. A difference (or effect size) of over half a standard deviation was evident between the perceptions of students enrolled in Computer Science courses and those enrolled in Management courses for the Involvement/Innovation scale. Students enrolled in the Management course considered their classrooms to provide more Involvement/Innovation than their counterparts enrolled in the Computer Science courses (see Figure 4-2). Although department differences were relatively small, but still statistically significant, for Cooperation/Student Cohesiveness and Task Orientation, the direction was consistent for all scales. The Management department students held more favourable perceptions of classroom climate on all scales of the modified CLEQ.

Because the number of items was different for different scales, the average item mean, or the scale mean divided by the number of items in a scale, was used as the basis of comparison.

Secondly, with respect to students' perceptions of lecturer interpersonal behaviour, analyses revealed that those enrolled in Management courses perceived their lecturers as exhibiting significantly more positive interaction qualities, in terms of Leadership, Helpful/Friendly and Understanding behaviours, than those enrolled in Computer Science courses. (These differences in the perceptions are presented graphically in Figure 4-3.) Although the magnitudes of the significant differences on QTI scales generally are small (less than half a standard deviation), it would appear that students

enrolled in Management courses consistently perceived the lecturers' interpersonal behaviour more favourably on all scales (i.e., higher scores on scales with a positive connotation and lower scores on scales with a negative connotation) than did Computer Science students.

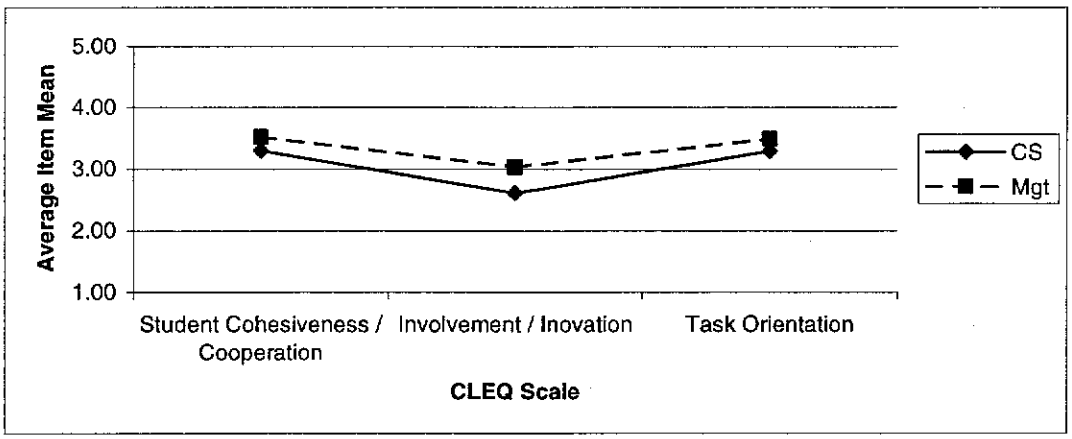

Figure 4-2: Department Differences in Students' Perceptions of Classroom Climate

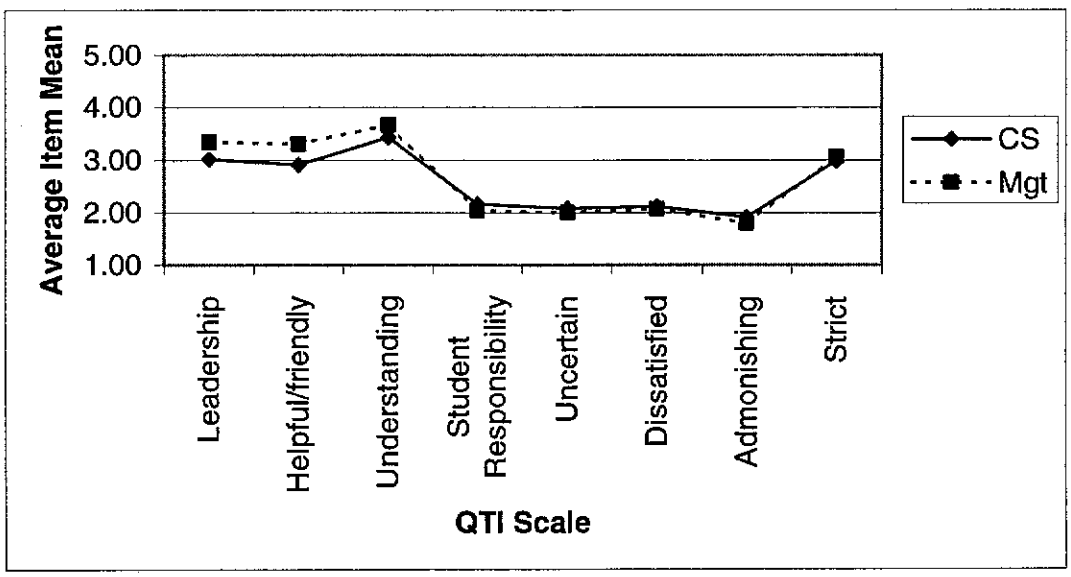

Figure 4-3: Department Differences in Students' Perceptions of Interpersonal Lecturer Behaviour

Finally, for both logical thinking and GPA, there emerged a statistically significant difference of approximately one standard deviation between the scores of students enrolled in Computer Science courses and those enrolled in Management courses. According to students' scores for logical thinking, it would appear that Computer Science students display more logical thinking ability. They also achieve a slightly higher score on the GPA than those enrolled in Management courses (as displayed in Figure 4-4). In contrast, the results in Table 4-10 indicate that students' motivation to choose their courses is similar for both those enrolled in Computer Science courses and those enrolled in Management courses, as displayed in Figure 4-4.

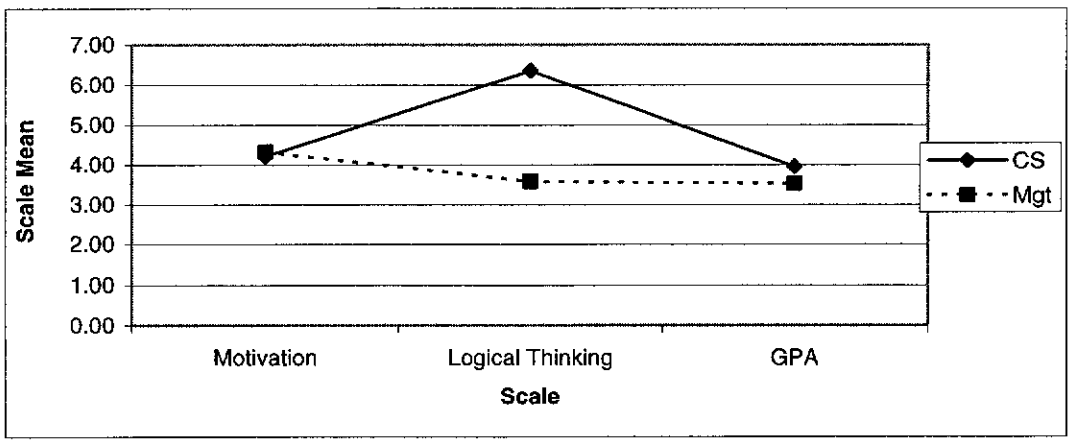

Figure 4-4: Department Differences in Students' Logical Thinking, Motivation and GPA Score

Overall, students enrolled in Management courses viewed classroom climate and interpersonal lecturer behaviour more favourably than those enrolled in Computer Science courses. In contrast, students enrolled in Computer Science courses tend to have more ability in terms of logical thinking and the GPA than those students enrolled in Management courses. However, students' motivation to select their subject was similar for students enrolled in Computer Science courses and those enrolled in Management courses.

4.4 ASSOCIATIONS BETWEEN STUDENT OUTCOMES AND PRODUCTIVITY FACTORS

This section reports associations between the four productivity factors of learning (classroom climate, interpersonal lecturer behaviour, students aptitude and students' motivation for their subject choice) and students outcomes (cognitive and affective). This section presents a discussion of the analysis and results pertaining to Research Question # 3:

> *What associations exist between each the two student outcomes of achievement and attitudes and the four productivity factors of:*
>
> *(a) learning environment?*
>
> *(b) lecturer-student interaction?*
>
> *(c) student aptitude?*
>
> *(d) motivation?*

As a measure of students' achievement, the grade obtained on completion of the Research Methods unit (accessed from the university database) was used for the purposes of the present study. Students' affective outcomes were measured using the two scales of the TOCRA, namely, Leisure Interest in Computers and Attitude toward Internet.

As discussed in Section 3.7.2, the statistical procedures used in investigating associations between students' outcomes and the four productivity factors of learning were simple correlation and multiple regression analysis using the individual and the class mean as units of analysis. The multiple regression analysis was performed separately for each outcome measure. The standardised regression weight was computed to provide information about the unique contribution of each scale to an outcome score when all other scales were mutually controlled. This section reports the results for the associations between student outcomes and (a) the learning environment (Section 4.4.1),

(b) lecturer-student interaction (Section 4.4.2), (c) student aptitude (students' logical thinking and GPA score) and student motivation (Section 4.4.3).

4.4.1 Associations Between Student Outcomes and the Learning Environment

This section presents a discussion of the analysis and results regarding Research Question #3a involving associations between each of two student outcomes (course achievement and attitude) and the learning environment. Students' perceptions of the learning environment were measured using the CLEQ.

As noted above, associations between students' cognitive and affective outcomes and their perceptions of the learning environment were investigated using simple correlation and multiple regression analyses. The multiple regression analysis was performed separately for each outcome measure. The standardised regression weight was computed to provide information about the unique contribution of each learning environment scale to the variance in an outcome score when all other learning environment scales were mutually controlled. Analyses were performed separately using the individual and the class mean as units of analysis.

Table 4-11 provides the results of the simple correlation and multiple regression analyses separately for the three outcomes (course score, Leisure Interest in Computers, and Attitude Towards the Internet). Overall, the results in Table 4-11 suggest relatively weak associations between outcomes and environment for many of the dimensions. For example, the multiple correlation is nonsignificant for each of the three outcomes for both units of analysis.

Altogether, four simple correlations are statistically significant ($p<0.05$). Course scores are positively correlated with Student Cohesiveness/Cooperation with the student as the unit of analysis. The most striking results are the significant correlations between Leisure Interest in Computers and each of the three environment scales at the class level of analysis.

Table 4-11: Simple Correlation (r), Multiple Correlation (R) and Standardised Regression Coefficient (β) for CLEQ Scales and Student Outcomes for the Individual and Class Mean as Units of Analysis

CLEQ Scale	Unit of Analysis	Outcome-Environment Associations					
		Course Score		Leisure Interest in Computers		Attitude towards Internet	
		r	β	r	β	r	β
Student Cohesiveness/ Cooperation	Individual	0.10*	0.10	0.01	-0.03	-0.02	-0.07
	Class Mean	0.08	0.28	0.60*	0.02	0.11	-0.33
Involvement/Innovation	Individual	0.03	-0.04	0.07	0.10	0.08	0.15*
	Class Mean	0.06	0.17	0.75**	0.55	0.30	0.34
Task Orientation	Individual	0.06	0.04	0.01	-0.03	-0.02	-0.06
	Class Mean	-0.01	-0.39	0.69*	0.24	0.24	0.25
Multiple Correlation (R)	Individual		0.11		0.08		0.12
	Class Mean		0.20		0.77		0.35

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

The standardised regression weight was computed to provide information about the unique contribution of each learning environment scale to the student course score when the other two scales were mutually controlled. As anticipated from the small size of the multiple correlations, Table 4-11 indicates that most regression weights are nonsignificant. The only exception is that Involvement/Innovation is a significant independent predictor of Attitudes towards the Internet at the student level of analysis.

4.4.2 Associations Between Student Outcomes and Lecturer-Student Interaction

This section presents a discussion of the analysis and results regarding Research Question #3b involving associations between the two student outcomes of course achievement and attitudes and lecturer-student interaction.

Table 4-12 shows the association between each of the students' outcomes and each QTI scale using the individual and the class mean as the units of analysis. With the individual student as unit of analysis, the results of the simple correlation analysis (reported in Table 4-12) indicate that the Admonishing scale and Strict scale ($p<0.01$) and the

Dissatisfied scale of the QTI ($p<0.05$) are statistically significantly and negatively related to the student course achievement score. The Helpful/Friendly scale and the Understanding scale are statistically significantly ($p<0.01$) and positively related to the student course achievement score.

Table 4-12: Simple Correlation (r), Multiple Correlation (R) and Standardised Regression Coefficient (β) for QTI Scales and Student Outcomes for Individual and Class Mean Units of Analysis

QTI Scale	Unit of Analysis	Associations with QTI Scales					
		Course Score		Leisure Interest in Computers		Attitude towards Internet	
		r	β	r	β	r	β
Dissatisfied	Individual	-0.12*	-0.02	0.01	0.02	0.03	0.02
	Class Mean	-0.54	-1.28	0.41	0.16	0.38	0.06
Helpful/friendly	Individual	0.12**	0.09	0.04	0.11	0.02	0.03
	Class Mean	0.37	0.61	0.37	0.11	-0.07	-0.44
Student Responsibility	Individual	0.08	0.08	-0.04	-0.04	0.04	0.00
	Class Mean	0.16	0.05	-0.24	-0.69	0.14	0.43
Strict	Individual	-0.16**	-0.16**	0.00	0.00	0.00	0.01
	Class Mean	-0.43	-0.68	0.20	-0.56	-0.07	0.71
Leadership	Individual	0.05	0.00	0.00	0.01	0.06	0.17*
	Class Mean	0.05	-0.44	0.38	-0.11	0.27	1.23
Uncertainty	Individual	-0.04	0.02	0.01	0.03	0.10*	0.18**
	Class Mean	-0.24	0.46	0.14	0.53	0.48	1.08
Admonishing	Individual	-0.18**	-0.09	0.02	-0.03	0.00	-0.11
	Class Mean	-0.70*	1.19	0.31	1.51	0.12	-0.52
Understanding	Individual	0.16**	0.11	-0.09	-0.14*	-0.07	-0.14*
	Class Mean	0.67*	0.57	0.17	1.51	-0.03	0.03
Multiple Correlation (R)	Individual		0.28**		0.14		0.19*
	Class Mean		0.81		0.95		0.92

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

The multiple correlation (R) between students' perceptions of the set of eight QTI scales and the students' course score (reported in Table 4-12) is only 0.28 at the student level of analysis, but is statistically significant ($p<0.01$), suggesting that the lecturer-student interaction is positively related to the students' course achievement score. The standardised regression weight was computed to provide information about the unique contribution of each learning environment scale to the student course score when the

other seven scales were mutually controlled. Table 4-12 indicates that only one of the eight QTI scales uniquely accounts for a significant ($p<0.01$) amount of variance in course score (the Strict scale) at the student level of analysis.

With the class mean as unit of analysis, for the achievement outcome, the results of the simple correlation analysis (reported in Table 4-12) indicate that the Admonishing scale is negatively related and the Understanding scale is positively related to achievement. Both are statistically significantly ($p<0.05$). The multiple regression analysis and the standardised regression weights reported in Table 4-12 indicate that none of the eight QTI scales is significantly and independently related to the student achievement.

With the individual student as unit of analysis, the results of the simple correlation analysis reported in Table 4-12 indicate that none of the eight QTI scales is significantly related to the students' Leisure Interest in Computers and only the Uncertain scale is positively and statistically significantly ($p<0.05$) related to the students' Attitude Towards the Internet. The multiple correlation (R) between students' perceptions of the lecturer-student interaction and the Leisure Interest in Computers was statistically nonsignificant. The multiple correlation (R) between students' perceptions of the lecturer-student interaction and the Attitudes towards Internet was 0.19 and statistically significant ($p<0.05$). For the Attitude Towards the Internet scale, scales that uniquely account for a significant proportion of variance are Leadership and Understanding ($p<0.05$) and Uncertainty ($p<0.01$). The Leadership and Uncertain scales are both positively related to students' Attitudes towards the Internet, and the Understanding scale is negatively related. For the Leisure Interest in Computers, the standardised regression weights reported in Table 4-12 indicates that only one of the eight QTI scales, the Understanding scale, uniquely accounts for a significant ($p<0.05$) amount of variance.

With the class mean as the unit of analysis, the results of the simple correlation analysis and the multiple correlation analysis and the standardised regression weights (reported in

Table 4-12) indicate that all of the QTI scale are statistically nonsignificantly related to the students' Leisure Interest in Computers or the Attitude towards Internet.

4.4.3 Associations between Student Outcomes and Student Aptitude and Student Motivation

This section presents a discussion of the analysis and results regarding Research Question #3c and Research Question #3d involving associations between each of the two student outcomes (achievement and attitudes), student aptitude (measured in terms of their logical thinking ability and GPA score) and student Motivation. Student aptitude was measured using the Test of Logical Thinking (TOLT) and the GPA score.

Table 4-13 reports the simple and multiple correlation results between student outcomes, student aptitude and student motivation using the individual and the class mean as the units of analysis. With the individual as unit of analysis, the results of the simple correlation analysis indicate that the logical thinking and GPA score are statistically significantly and positively related to the student achievement ($p<0.01$). The multiple correlation (R) between students' achievement (course score) and students' scores on the set of student logical thinking, GPA and student Motivation was 0.57 and was statistically significant ($p<0.01$), suggesting that the students' logical thinking, GPA and student Motivation, as a set, are related to the students' course achievement score. The standardised regression weight was computed to provide information about the unique contribution of each scale (student logical thinking, GPA score and student Motivation) to student achievement when the other two scales were mutually controlled. Table 4-13 indicates that the student logical thinking scale ($p<0.05$) and the GPA score ($p<0.01$) each uniquely accounts for a significant amount of variance at the student level of analysis. Whereas student logical thinking scores are negatively related to achievement, GPA scores are positively related to achievement.

The results of the simple correlation (reported in Table 4-13), when using the class mean as unit of analysis, indicate that only the GPA score is statistically significantly ($p<0.01$)

and positively related to the course achievement score. The multiple correlation (R) between the students' logical thinking, GPA score and student Motivation and course score is 0.85 and is statistically significant ($p<0.05$) with the class as the unit of analysis. The standardised regression weights reported in Table 4-13 indicate that the GPA is significantly ($p<0.01$) related to the student course achievement score when student logical thinking and Motivation scores are controlled.

Table 4-13: Simple Correlation (r), Multiple Correlation (R) and Standardised Regression Coefficient (β) for Student Logical Thinking, GPA Score and Student Motivation for Individual and Class Mean as Units of Analysis

Scale	Unit of Analysis	Outcome-Factor Association					
		Course Score		Leisure Interest in Computers		Attitude towards Internet	
		r	β	r	β	r	β
Logical Thinking	Individual	0.18**	-0.12*	-0.13**	-0.16**	-0.19**	-0.14*
	Class Mean	0.38	-0.42	-0.52	-1.03*	-0.40	-0.15
Motivation	Individual	0.04	-0.01	-0.16**	-0.17**	-0.01	-0.01
	Class Mean	0.08	0.13	-0.02	-0.18	0.33	0.26
GPA	Individual	0.56**	0.62**	-0.03	0.06	-0.17**	-0.11*
	Class Mean	0.78**	1.11**	-0.12	0.62	-0.41	-0.26
Multiple Correlation (R)	Individual		0.57**		0.21**		0.21**
	Class Mean		0.85*		0.68		0.50

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

With the individual student as unit of analysis, the results of the simple correlation analysis reported in Table 4-13 indicate that the students' logical thinking and Motivation are negatively and significantly ($p<0.01$) related to the Leisure Interest in Computers, and that the students' logical thinking and GPA are negatively and significantly ($p<0.01$) related to the students' Attitude Towards the Internet. The multiple correlation (R) between the set of student logical thinking, GPA Score and student Motivation scales and each TOCRA scale was statistically significant ($p<0.01$) with the individual as the unit of analysis. Table 4-13 indicates that, for the Leisure Interest in Computers scale, the standardised regression weights for the students' logical thinking and the Motivation scale were statistically significant ($p<0.01$). For Attitude Towards the Internet, students' logical thinking and GPA scores uniquely account for a significant ($p<0.05$) amount of variance at the student level.

With the class mean as unit of analysis, the results of the simple correlation analysis and the multiple regressions indicate that students' logical thinking, GPA scores and Motivation all are statistically nonsignificantly related to each scale of TOCRA with just one exception. Table 4-13 indicates that, for the Leisure Interest in Computers scale, the standardised regression weight for the students' logical thinking scale was statistically significant ($p<0.05$).

The results reported in Section 4.4 indicate that the nature of the learning environment is strongly related to neither the students' course achievement score nor their attitudes. In terms of interpersonal behaviour, Understanding and Helpful/Friendly behaviours were positively associated with student achievement scores, while Admonishing, Dissatisfied and Strict behaviours were negatively associated with students' achievement score. The results indicate that the Uncertain behaviour was positively related to the Attitude towards Internet scale. Negative associations were found between student Motivation and student attitude, while student logical thinking and GPA score were positively associated with the course achievement score and negatively associated with student attitudes.

4.5 RELATIVE STRENGTH OF ASSOCIATION BETWEEN STUDENTS' OUTCOMES AND EACH OF THE PRODUCTIVITY FACTORS FOR COMPUTER SCIENCE AND MANAGEMENT STUDENTS

This section presents a discussion of the analysis and results regarding Research Question #4:

> *What is the relative strength of the association between students' outcomes (achievement, attitudes) and each of the four productivity factors (learning environment, lecturer-student interaction, student aptitude and motivation) for Computer Science students and Management students?*

This section compares Computer Science and Management students, in terms of the strength of associations between the four productivity factors of learning (the classroom climate, interpersonal lecturer behaviour, student aptitude – student logical thinking and GPA score – and students' motivation towards their subject choice) and students' learning outcomes.

4.5.1 Comparing Associations Between Student Outcomes and the Learning Environment for Computer Science and Management Students

The simple and multiple correlation analyses for the whole sample (Table 4-13) are reported separately for Computer Science and for Management students at the student level of analysis in Table 4-14. The purpose of these analyses is to look into the relative strength of associations between outcomes and each productivity factor for students in these two different departments. Overall, the results in Table 4-14 suggest relatively similar strengths of associations for Computer Science and for Management courses. For example, the magnitudes of the multiple correlation are fairly similar for the two groups of students.

Table 4-14: Simple Correlation (r), Multiple Correlation (R) and Standardised Regression Coefficient (β) for the CLEQ Scales and Student Outcomes for Computer Science and Management Students

CLEQ Scale	Department	Course Score		Leisure Interest in Computers		Attitude towards Internet	
		r	β	r	β	r	β
Student Cohesiveness/ Cooperation	Computer Science	0.07	0.08	0.03	-0.03	-0.04	-0.10
	Management	0.18*	0.15	-0.11	-0.05	-0.09	-0.05
Involvement/ Innovation	Computer Science	-0.03	-0.12	0.10	0.12	0.10	0.19*
	Management	0.17*	0.16	-0.15	-0.12	-0.10	-0.05
Task Orientation	Computer Science	0.08	0.10	0.03	-0.01	-0.02	-0.07
	Management	0.04	-0.11	-0.10	-0.02	-0.09	-0.04
Multiple Correlation (R)	Computer Science		0.13		0.11		0.16
	Management		0.22		0.16		0.12

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

The sample consists of 278 students enrolled in Computer Science courses and 144 students enrolled in Management courses.

The main exception is for the course achievement score. For achievement, the simple correlation between course score and the learning environment is statistically significant for two scales (Student Cohesiveness/Cooperation, Involvement/Innovation) for

Management students but not for Computer Science students. Also, for the Attitude towards the Internet scale, the regression weight is statistically significant for Involvement/Innovation for Computer Science students but not for Management students.

4.5.2 Comparing Associations Between Student Outcomes and Lecturer Interpersonal Behaviour for Computer Science and Management Students

Table 4-15 compares the relative strength of associations between three student outcomes (course scores, Leisure Interest in Computers and Attitude towards Internet) and interpersonal behaviour (eight QTI scales) for Computer Science and Management students. The results for the multiple correlation at the bottom of Table 4-15 clearly show that these associations generally are stronger for Management students than for Computer Science students. Although the multiple correlation is statistically significant for both Management and Computer Science students for the achievement outcomes, it is significant only for Management students for the two attitudes outcomes. For course achievement for Computer Science students, the results of the simple correlation analysis (reported in Table 4-15) indicate that the Admonishing ($p<0.05$) and Strict scales ($p<0.01$) of the QTI are negatively and statistically significantly related to the student course achievement score. The Student Responsibility/Freedom scale is statistically significantly ($p<0.05$) and positively related to the student course achievement score. For the course achievement score, the standardised regression weight was computed to provide information about the unique contribution of each learning environment scale to the student course score when the other seven scales were mutually controlled. Table 4-15 indicates that only one of the eight QTI scales, the Strict scale, uniquely accounts for a significant ($p<0.01$) amount of variance for Computer Science students.

For course achievement for Management students, the results of the simple correlation analysis reported in Table 4-15 indicate that five from the eight scales of QTI are statistically significantly ($p<0.01$) related to the student achievement score, three of

which (Admonishing, Dissatisfied and Uncertainty) are negatively related and two of which (Understanding and Helpful/Friendly) are positively related. The multiple correlation (R) between students' perceptions of the set of eight QTI scales and the students' course score was 0.40 and is statistically significant ($p<0.01$). The standardised regression weights reported in Table 4-15 indicate that only one of the eight QTI scales is positively and significantly ($p<0.05$) related to the student course achievement score (Understanding scale) for Management students.

Table 4-15: Simple Correlations (r), Multiple Correlations (R) and Standardised Regression Coefficient (β) for the QTI Scales and Student Outcomes for Computer Science and Management Students

QTI Scale	Department	Course Score		Leisure Interest in Computers		Attitude towards Internet	
		r	β	r	β	r	β
Admonishing	Computer Science	-0.13*	-0.07	0.13*	0.10	0.03	0.00
	Management	-0.28**	-0.13	-0.14	-0.19	0.00	-0.23*
Leadership	Computer Science	-0.01	0.06	0.03	0.02	0.08	0.05
	Management	0.15	-0.08	-0.18*	-0.10	-0.07	0.26*
Dissatisfied	Computer Science	-0.05	0.01	0.08	0.01	-0.02	-0.07
	Management	-0.24**	-0.07	-0.09	-0.04	0.11	0.10
Helpful / friendly	Computer Science	0.08	0.07	0.05	0.09	0.09	0.11
	Management	0.24**	0.13	-0.11	-0.01	-0.21*	-0.13
Uncertain	Computer Science	0.08	0.08	0.05	0.03	-0.01	-0.04
	Management	-0.24**	-0.07	-0.02	-0.05	0.27**	0.38**
Understanding	Computer Science	0.08	0.05	-0.06	-0.06	-0.02	-0.15
	Management	0.30**	0.23*	-0.24**	-0.26*	-0.21*	-0.16
Student Responsibility	Computer Science	0.15*	0.08	-0.01	-0.02	0.04	0.13
	Management	-0.06	0.06	-0.05	-0.03	0.10	-0.12
Strict	Computer Science	-0.23**	-0.22**	0.08	0.03	0.09	0.11
	Management	-0.03	-0.09	-0.18*	-0.05	-0.14	-0.12
Multiple Correlation (R)	Computer Science		0.29**		0.16		0.19
	Management		0.40**		0.35*		0.40**

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

The sample consists of 278 students enrolled in Computer Science courses and 144 students enrolled in Management courses.

As anticipated from the magnitudes of the multiple correlations reported in Table 4-15, associations between attitudes and QTI scales are stronger for Management students than for Computer Science students. For both scales of the TOCRA, the results of the

simple correlation analysis reported in Table 4-15 for the Computer Science students indicate that only the Admonishing scale of the QTI is positively and significantly ($p<0.05$) related to the students' Leisure Interest in Computers, and that none of the eight QTI scales is significantly to the students' Attitude Towards the Internet. The multiple correlation (R) between students' perceptions of the lecturer interaction behaviour and the each TOCRA scale is statistically nonsignificant for Computer Science students.

For Management students for student attitudes, the results of the simple correlation analysis reported in Table 4-15 indicate that the Leadership scale, the Strict scale and the Understanding scale all are statistically significantly and negatively related to the students' Leisure Interest in Computers. The Helpful/Friendly and Understanding scales are negatively and significantly ($p<0.05$) related to students' Attitude Towards the Internet while the Uncertain scale is positively and significantly ($p<0.01$) related to this scale for the Management students. The multiple correlation (R) between students' perceptions of the set of eight QTI scales and the students' Leisure Interest in Computers is 0.35 ($p<0.05$) and to the students' Attitude Towards the Internet is 0.40 ($p<0.01$) and is statistically significant The standardised regression weights reported in Table 4-15 indicate that only one of the eight QTI scales is negatively and significantly ($p<0.05$) related to the Leisure interest in Computers (Understanding). The Admonishing scale is negatively and significantly ($p<0.05$) related to students' Attitude towards Internet while the Leadership and Uncertain scales are both positively and significantly ($p<0.05$) related.

Overall, it was found that associations between lecturer interpersonal behaviour and students' outcomes (course achievement score and two student attitudes) were stronger for Management students than for the Computer Science students.

4.5.3 Comparing Associations Between Student Outcomes and Students' Aptitude and Motivation for Computer Science and Management Students

Associations between students' outcomes and logical thinking, GPA and Motivation are reported in Table 4-16 for achievement. The multiple correlation (R) for student logical thinking, the GPA score and motivation was statistically significant ($p<0.01$) for both the Computer Science and Management departments. The results of the simple correlation analysis indicate that the logical thinking scale and the GPA score for Computer Science students, and only the GPA scale for Management students, are statistically significantly ($p<0.01$) and positively related to the student course achievement score. The multiple correlation (R) between the students' course achievement score and students' student logical thinking, GPA score and motivation, is 0.61 for Computer Science students and has the very similar value of 0.60 for Management students. Both are statistically significant ($p<0.01$). Inspection of the standardised regression coefficient in Table 4-16 indicate that the student GPA score is a significant independent predictor of course achievement for both Computer Science and Management students when logical thinking and motivation are mutually controlled.

Table 4-16: Simple Correlations (r), Multiple Correlations (R) and Standardised Regression Coefficient (β) for Logical Thinking, Motivation and GPA and Student Outcomes for Computer Science and Management Students

	Department	Course Achievement Score		Leisure Interest in Computers		Attitude towards Internet	
		r	β	r	β	r	β
Logical Thinking	Computer Science	0.26**	0.01	-0.04	-0.07	-0.13	-0.13*
	Management	0.07	-0.09	-0.06	-0.07	-0.05	0.01
Motivation	Computer Science	0.00	-0.05	-0.23**	-0.24**	-0.15**	-0.15*
	Management	0.12	0.00	-0.08	-0.09	0.09	0.13
GPA	Computer Science	0.61**	0.61**	0.07	0.12	-0.04	0.02
	Management	0.60**	0.62**	0.00	0.03	-0.16	-0.18*
Multiple Correlation (R)	Computer Science		0.61**		0.26**		0.20*
	Management		0.60**		0.10		0.20

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

The sample consists of 278 Computer Science students and 144 Management students.

As expected from the relative sizes of the multiple correlations, associations between attitudes, logical thinking, GPA and motivation are stronger for Computer Science than for Management students (Table 4-16). The results of the simple correlation analysis

indicate that only the motivation scale for Computer Science students is statistically significantly ($p<0.01$) and negatively related to Leisure Interest in Computers and Attitude Towards the Internet scales. The multiple correlation (R) between students' logical thinking, GPA and motivation the students' Leisure Interest in Computers is 0.26 and significant ($p<0.01$) and for Attitude Towards the Internet is 0.20 and significant ($p<0.05$) for Computer Science students. The standardised regression coefficients for Computer Science students, reported in Table 4-16, indicate that logical thinking and motivation are significant independent predictors of Attitude towards Internet when the other two factors are controlled. Motivation is also a significant predictor of Leisure Interest in Computers (for Computer Science students) when logical thinking and GPA score are controlled. For Management students, the GPA score was a significant predictor of Leisure Interest in Computers when both logical thinking and motivation were mutually controlled.

Overall, it was found that associations between student logical thinking, GPA score and student motivation and student outcomes were somewhat stronger for Computer Science students than for the Management students.

4.6 SUMMARY

The present study involved modifying, translating and validating existing questionnaires to make them suitable for assessing the learning environment in Indonesia at the university level. The data were collected from 422 students in 12 research methods classes for Computer Science and Management students. This chapter has presented the analyses and results for the data collected for the present study. The data were analysed to determine the validity and reliability of the Indonesian versions of the Classroom Learning Environment Questionnaire (CLEQ), Questionnaire on Teacher Interaction (QTI), Test of Logical Thinking (TOLT), student Motivation scale and Test of Computer-Related Attitudes (TOCRA).

To examine the reliability of the Indonesian versions of the CLEQ and QTI, factor analyses, item analyses, internal consistency reliability, one-way ANOVA and discriminant validity were used.

A series of principal components factor analysis resulted in the acceptance of version of the CLEQ comprising 25 items in 3 scales. The Cronbach alpha reliability ranged between 0.78 and 0.90 using the individual as the unit of analysis. The discriminant validity results (correlation between scales) ranged from 0.44 to 0.52 for the individual unit of analysis. The results of the analysis of variance (ANOVA) indicate that each CLEQ scale differentiated significantly between classes. The validation results support the contention that the CLEQ is a valid and reliable classroom environment for the assessment of students' perceptions at the university level in Indonesia.

Analyses of data collected also provide evidence for the validity and reliability of the QTI, modified to suit university-level students in Indonesia. Principal components factor analysis resulted in the acceptance of this version of the QTI comprising 39 items. Cronbach alpha coefficients suggest that scales in this version of the QTI have satisfactory reliability, ranging from 0.65 to 0.87 for the individual unit of analysis. Generally, the reliability figures found for the Indonesian version of the QTI (administered at the university level) were higher than those figures found in past studies (used at the high school level) for the class mean as unit of analysis. ANOVA results, for scales of the QTI, indicate that all scales differentiate significantly between Indonesian university classes. Finally, the scale intercorrelations for the QTI appear generally to satisfy the assumption of Leary's (1957) model in that there is a higher correlation for scales adjacent to each other and that the correlation becomes smaller for scales located further from each other. The results of the analysis suggests satisfactory reliability and validity for the Indonesian version of the QTI.

Internal consistency reliability (Cronbach alpha coefficient) was used to report the reliability of the Test of Logical Thinking (TOLT; adapted to suit the Indonesian

context) and a Motivation scale (developed specifically for the present study). For the TOLT, the reliability estimate was 0.80 for the individual as the unit of analysis and, for the Motivation scale, the reliability estimate was 0.82 using the individual as the unit of analysis. These results suggest that the reliability of the TOLT and Motivation scales is acceptable.

Finally, factor and item analyses, internal consistency and discriminant validity were used to determine whether the TOCRA was valid and reliable for use in Indonesia. Principal components factor analysis resulted in the acceptance of a revised version of the instrument comprising two scales with seven items in each. The scale reliability estimates were 0.73 and 0.86 for the individual as the unit of analysis. The results for the factor structure, internal consistency and discriminant validity suggest that the reliability and validity of the two TOCRA scales are acceptable.

Analyses indicate that there were no differences in the motivation of Computer Science students and Management students towards their choice of subject. Students from the Management department viewed interpersonal lecturer behaviour and classroom climate more favourably than did students from the Computer Science department. Also, the results indicated that students from the Computer Science department tended to have more ability in terms of logical thinking, and a slightly higher score on the GPA score than did the Management students. Generally, the patterns of department differences in terms of the four productivity factors were small in magnitude but consistent in direction for all the four productivity factors.

Simple correlation and multiple regression analyses were conducted to determine whether the four productivity factors of learning (classroom climate, interpersonal lecturer behaviour, student aptitude and student motivation) were related to three student outcomes (course score, Leisure Interest in Computers, and Attitude Towards the Internet). Although outcome-environment associations generally were not strong, there was a statistically significant simple correlation for Leisure Interest in Computers and

for all three CLEQ scales for class mean as unit of analysis. In terms of interpersonal behaviour, the results indicated that Understanding and Helpful/Friendly behaviour were positively associated with course achievement scores, while Admonishing, Dissatisfied and Strict behaviours were negatively associated with the course achievement score. Only Uncertain behaviour was found to have a positive association with the Attitude towards Internet scale. Student motivation and students' logical thinking was found to be negatively associated with Leisure Interest in Computers. Students' logical thinking and the GPA score were negatively associated with their attitude and positively associated with their course achievement score.

Also the relative strengths of associations between students' outcomes and each of the productivity factors were compared for Computer Science and Management students. Associations between students' perceptions of the learning environment (as measured by the CLEQ) and student outcomes generally were comparable for Management students and for Computer Science students. However, Student Cohesiveness/Cooperation and Involvement/Innovation were correlated significantly and positively to course achievement for Management students but not for Computer Science students. In terms of interpersonal behaviour, the multiple correlation (R) indicated a statistically significant relationship between teacher interpersonal behaviour and students' course achievement score for both Computer Science and Management students. The relationship between teacher interpersonal behaviour and students' attitudes was statistically significant for students' Leisure Interest in Computers and Attitude towards Internet only for Management students. The multiple correlation between course achievement score, motivation, logical thinking and GPA score was statistically significant for both Computer Science and Management students. The multiple correlation for relationships between students' attitudes and their logical thinking, motivation and GPA, however, were significant for Leisure Interest in Computers and Attitude towards Internet for Computer Science students only.

A discussion of the results and their implications for teaching and learning at the university level in Indonesia is provided in Chapter 5, which also includes an overview of the significance and limitations of the present study in addition to some implications of the findings and suggestions for future research.

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 INTRODUCTION

The present study was undertaken primarily to examine four productivity factors of learning – namely, the classroom learning environment, lecturer-student interpersonal behaviour, students' aptitude (logical thinking and GPA score), and student motivation – and their impact on the affective and cognitive outcomes of students at the university level in Indonesia. In addition, the study investigated whether there were differences between the Computer Science and Management departments in terms of the four productivity factors of learning. Finally, the study sought to measure the strength of the association between the four productivity factors of learning and student outcomes in the Computer Science and Management departments.

The study provides important insights into the field of learning environments and it provides useful information for guiding the improvement of university computer-related education in Indonesia. To date, only a few learning environment studies have been undertaken in Indonesia and none focused on the university level. Therefore, one important contribution made by the study is that widely-applicable questionnaires have been validated in the Indonesian language for use at the university level to assess the classroom environment and lecturer-student interaction. The present study provides a clearer picture of the classroom contexts that are needed at the university level to promote student outcomes. Valuable information is provided to the university in which the data were gathered for use in developing strategies for improving classroom practices, management and administration policies for computer-related courses.

5.2 SUMMARY OF THE THESIS

Chapter 1 of this thesis set the scene by providing a context and rationale for the present study. It provides a brief background to the study, including information about the field of learning environments, and a description of the challenges facing the education system in Indonesia, particularly at the tertiary level.

Bina Nusantara University (BiNus), the site for the present research, is one institution in Indonesia that is concerned over the standard and quality of education. This university, with a student population of around 20,000, has particular strengths in information technology. It faces similar problems to many other universities in Indonesia, making it a suitable site for collection of data. A description of the university and the various faculties and their characteristics are provided in the first chapter.

A main purpose of the present study was to provide important insights into the field of learning environments at the tertiary level in Indonesia. The study was intended to provide useful and practical information for guiding the improvement of tertiary computer-related education in Indonesia. Section 1.3 describes the purpose of the present research and the purposes of the study, whilst Section 1.4 delineates the research questions as being:

(1) Is it possible to develop valid and reliable instruments in the Indonesian language to assess:
   a) the learning environment?
   b) lecturer-student interaction?
   c) student aptitude?
   d) motivation?
   e) attitudes?

(2) Is it possible to describe and compare a university Computer Science course and a Management course in terms of the four productivity factors of:
   a) learning environment?
   b) lecturer-student interaction?
   c) student aptitude?
   d) motivation?

(3) What associations exist between each the two student outcomes of achievement and attitudes and the four productivity factors of:
   a) learning environment?
   b) lecturer-student interaction?
   c) student aptitude?
   d) motivation?

(4) What is the relative strength of the association between students' outcomes (achievement, attitudes) and each of the four productivity factors (learning environment, lecturer-student interaction, student aptitude and motivation) for Computer Science students and Management students?

A review of relevant literature is presented in Chapter 2. This chapter includes a definition of educational quality that was used to help guide the data collection and analysis of the study. The remainder of the chapter was devoted to discussing the four productivity factors that the study concentrated on, namely, the learning environment, interpersonal teacher behaviour, student attitudes, student motivation, and logical thinking. First, literature related to the field of learning environments was reviewed. A historical background to the field of learning environments was provided along with a brief description of the conceptualisation and measurement of the learning environment used in past studies. Also included was an overview of past studies related to the field of learning environments. Second, research on studies of interpersonal teacher behaviour was presented which included the importance of teacher interaction and the development

of the Questionnaire on Teacher Interaction (used in the present study). Third, a review of literature related to students' attitudes was presented. This section defined student attitudes and reviewed various techniques used to measure students' attitudes. Finally, this chapter reviewed literature related to theories associated to student motivation, its definition and factors that influence its development in students. Also included is a review of past studies that have sought to measure student motivation.

Chapter 3 focuses on the research methods and provides insights into procedural aspects of the present study, including the research design, selection of the sample, instruments used in this study, development and field testing of the instruments used, administration of questionnaire, data collection, and statistical procedures employed in the data analysis. This study modified, translated, back-translated and validated existing questionnaires to make them suitable for assessing the learning environment in Indonesia at the university level. This investigation into associations between the four productivity factors of learning and students' learning outcomes involved the administration of five instruments to a random sample of 422 students in 12 Research Methods classes (made up of 278 students from the Computer Science department and 144 students from the Management department). The four productivity factors were assessed using (1) the Classroom Learning Environment Questionnaire (CLEQ); (2) the Questionnaire of Teacher Interaction (QTI); (3) the Test of Logical Thinking (TOLT); and (4) a student Motivation instrument. In addition, student attitudes were assessed using the Test of Computer-Related Attitudes (TOCRA).

Chapter 4 reports the data analysis and finding of this study, including validation of the questionnaire, associations between the four productivity factors and the two learning outcomes, the relative strength of outcome-factor associations for the Computer Science and Management departments, and differences in each productivity factor between Computer Science and Management students. The major findings for the study are overviewed in the following section.

5.3 MAJOR FINDINGS

The major finding of the present study are organised into four components. Section 5.3.1 devotes itself to the validity of instruments used. Section 5.3.2 describes differences between the Computer Science and Management department in terms of the four productivity factors of learning. Section 5.3.3 is concerned with the findings about associations between the four productivity factors of learning and students outcomes. Section 5.3.4 presents findings concerning the strength of associations between the four productivity factors and student outcomes for the Management and Computer Science departments.

5.3.1 Validity of Instruments

The data obtained from the sample of 422 students from 12 Research Methods classes at the university level in Indonesia were analysed to ensure that the instruments were valid and reliable for use at the university level in Indonesia.

Factor analysis of the data (reported in Section 4.2.1) resulted in the acceptance of a revised version of the Classroom Learning Environment Questionnaire (CLEQ) with three scales, namely, Cooperation/Student Cohesiveness, Involvement/Innovation and Task Orientation. Estimates of the internal consistency reliability of the scales were comparable to those in past studies that have made use of the WIHIC (Aldridge & Fraser, 2000; Aldridge, Fraser & Huang, 1999; Fraser & Chionh, 2000; Margianti & Fraser, 2000; Riah & Fraser, 1998; Zandvliet & Fraser, 1998). The discriminant validity of these scales is satisfactory, but suggests that raw scores on the CLEQ assess distinct but somewhat overlapping aspects of learning environment. However, the factor analysis supports the independence of factor scores on the three scales. Analysis of variance indicated that each CLEQ scale is able to differentiate between the perceptions of students in different classes.

Analyses of the data collected using the QTI (reported in Section 4.2.2) resulted in the acceptance of an eight scale factor structure, indicated comparatively high internal consistency reliability, and supported its ability to differentiate between the perceptions of students in different classrooms. The validity of the Indonesian version of QTI can also be considered satisfactory in terms of the pattern of scale intercorrelation (i.e., the correlations of a scale with adjacent scales were higher than correlations with other scales). A comparison of reliability figures (with the class means as the unit of analysis) reported by Wubbels and Levy (1991) and Wubbels (1993) for studies conducted in secondary schools in other countries and the present study revealed some opposing trends. For the study in the Netherlands, the USA and Australia, the highest reliabilities occurred for Helpful/Friendly behaviour and the lowest alpha coefficient occurred for Student Responsibility/Freedom behaviour. But, for the present study in Indonesia, Helpful/Friendly behaviour had the lowest alpha coefficient and the highest alpha coefficient occurred for Dissatisfied behaviour.

The Test of Logical Thinking is a scale that assesses the level of cognitive development of students. Analyses of the data collected using the TOLT (reported in Section 4.2.3) suggest acceptable reliability for this instrument for use in the present study.

Item analysis of the five items of the Motivation scale showed that all the items had sizeable item-remainder correlations. High scale reliability estimates for this scale were found.

Results for the factor structure, internal consistency (alpha reliability) and discriminant validity (scale intercorrelation) for the modified version of Test of Computer-Related Attitudes (TOCRA) provide other researchers with confidence to use this economical instrument in the future to assess students' perceptions of their computer-related attitude.

5.3.2 Between-Department Differences

The second research question asks whether it is possible to describe and compare the Computer Science department and Management department at an Indonesian university, with respect to students' perceptions of the learning environment, lecturer-student interaction, student aptitude (represent by the logical thinking and the GPA) and their motivation for choosing their major. These results from MANOVAs (reported in Section 4.3) are summarised below.

Students from the Management department were found to have more favourable perceptions of the learning environment (in terms of the CLEQ scales) than their counterparts in the Computer Science department. Management students perceived more Involvement/Innovation, Cooperation/Student Cohesiveness and Task Oriented than did Computer Science students. The results of this study indicate that students from the Management department were more likely to be cooperative with other students and tolerant to their peers. This could be because Computer Science students are more likely to be exposed to learning environments that encourage individualism.

The results also indicate that students from the Management department perceive their lecturers as exhibiting significantly more positive interaction qualities in terms of Leadership, Helpful/Friendly and Understanding, than do students from the Computer Science department (see Figure 4-3). It would appear that students from the Management department are more likely to be tolerant of the quality of interpersonal lecturer behaviour than students from the Computer Science department.

Students in the Computer Science department tend to have a higher GPA score than students in the Management department. These students also tend to have more ability in terms of logical thinking than Management students (see Figure 4-4). This would appear rational in light of the fact that students' logical thinking and mathematical ability, both of which are assessed before being accepted into their course, often limit students' choice of field of study. In the researcher's experience, those students who choose to

study Computer Science generally prefer mathematical and logical matters, whereas Management students appear to be more interested in aspects related to communication with others.

Despite differences in GPA scores and logical thinking, there appears to be no differences in the motivation for students' choice of subjects (see Figure 4-4). The results indicate that students, regardless of department, are motivated towards their choice of major for the right reasons.

It would appear from the results of this study that students from the Management department hold more favourable perceptions of their learning environment and interpersonal lecturer behaviour, whereas students from the Computer Science department are more likely to have superior GPAs and logical thinking ability.

5.3.3 Findings Concerning Outcome-Environment Associations

The multiple correlations for the 422 students in 12 classes in Indonesia suggest that the nature of the classroom learning environment is not strongly related to students' course achievement, students' attitudes towards the internet and students' leisure interest in computers. The results differ from those found in previous research, which could be due partly to the smallness the sample size selected for the study. The planned sample was reduced from 700 students to 422. The majority of students omitted from analysis were those who did not have time to complete the questionnaire. These students generally had a lower GPA and experienced difficulties completing the logical thinking questionnaire.

The results of the multiple regression analysis indicate that the nature of the classroom learning environment was not strongly related to the student outcomes of course achievement or attitudes. The results of the simple correlation analysis (reported in Section 4.4.1), with the individual student as unit of analysis, indicate that Student Cohesiveness/ Cooperation scale of the CLEQ was significantly and positively related to the student course achievement score. This suggests that lessons emphasising Student

Cohesiveness/Cooperation are likely to promote student achievement. With the class mean as unit of analysis, Leisure Interest in Computers was significantly correlated with all three CLEQ scales. In all cases, significant outcome-environment correlations were positive.

The simple correlation analysis, with the individual student as unit of analysis, indicated that Admonishing, Dissatisfied and Strict behaviours were negatively associated with course achievement, while Helpful/Friendly and Understanding lecturer behaviour were positively associated with course achievement. This result replicates previous research in Australia (Henderson, Fisher & Fraser, 1995, 2000), Singapore (Fraser & Goh, 2000; Goh & Fraser, 1998; Goh, Young & Fraser, 1995) and Brunei (Riah & Fraser, 1998; Scott & Fisher, 2000). For student attitudes, it was found that only Uncertain behaviour was related positively to the Attitude towards Internet scale and that student perceptions of lecturer behaviour was not related to Leisure Interest in Computers. The multiple correlation indicated that interpersonal lecturer behaviour was positively related to the students' course achievement score and to the Attitudes Towards Internet.

The simple correlation analysis, with the individual student as unit of analysis, indicates that students' logical thinking and GPA scores are negatively related to students' Attitude towards the Internet. Students' logical thinking, on the other hand, is positively related to students' course achievement. The multiple correlation analysis indicates that there is a positive relation between students' logical thinking, GPA score and students' motivation and the student outcomes of course achievement and attitudes. Given that the direction of some of the associations between student outcomes and productivity factors was unexpected, there is a need to replicate the present research with larger samples.

5.3.4 Findings Concerning Differences between Departments in Terms of the Relative Strengths of Outcome-Environment Associations

Simple and multiple correlation analyses were conducted separately for each of the two university departments to look into the relative strength of the association between the

students' scores on the four productivity factors of learning and the students' cognitive and affective outcomes for the Computer Science and Management students.

In term of classroom learning environment, the results (discussed in Section 4.5.1) suggest relatively similar strengths of outcome-environment associations for Computer Science and for Management courses. For example, the magnitudes of the multiple correlations are fairly similar for the two groups of students. The main exception is for the course achievement score. For achievement, the simple correlation between course score and the learning environment is statistically significant for two scales (Student Cohesiveness/Cooperation, Involvement/Innovation) for Management students but not for Computer Science students. Also, for the Attitude towards the Internet scale, the regression weight is statistically significant for Involvement/Innovation for Computer Science students but not for Management students.

In terms of lecturer interpersonal behaviour, there were stronger associations between student perceptions on the eight QTI scales and the student course achievement score and student attitudes for Management students than Computer Science students. For achievement, the simple correlation between course score and lecturer interaction behaviour is statistically significant for three scales (Admonishing, Strict and Student Responsibility) for Computer Science students and statistically significant for four scales (Dissatisfied, Helpful/friendly, Uncertain, Understanding) for Management students. For the Leisure Interest in Computers scale, the simple correlation is statistically significant only for the Admonishing scale for Computer Science students and statistically significant for three scales (Leadership, Understanding, Strict) for Management students. And for the Attitude towards the Internet scale, the simple correlation is significant only for three scales (Helpful/friendly, Uncertain, Understanding) for Management students but not for Computer Science students.

In terms of student motivation and student aptitude, for Computer Science students, there is a stronger association between the student motivation, student aptitude and

student outcomes than for Management department students. For achievement, the simple correlation between course score and the student motivation and student aptitude scales is statistically significant for two scales (logical thinking and the GPA score) for Computer Science students and statistically significant for only the GPA score for Management students. For the Attitude scale, the simple correlation is statistically significant only for the Motivation scale for Computer Science students and not for Management students.

5.4 PRACTICAL IMPLICATIONS OF FINDINGS FROM THE STUDY

There are several tentative implications for lecturers and administrators arising from the results of the present study in Indonesia. In the first place, five widely-applicable instruments have been validated in the Indonesian language for use at university level. These instruments, namely, the Classroom Learning Environment Questionnaire (CLEQ), Questionnaire on Teacher Interaction (QTI), Test of Logical Thinking (TOLT), the student Motivation measure and the Test of Computer-Related Attitudes (TOCRA), provide a means by which lecturers can monitor their classroom environments, their lecturer interaction behaviour and measure the logical thinking, motivation and attitudes of students.

The availability of classroom environment questionnaires (Classroom Learning Environment Questionnaire and Questionnaire on Teacher Interaction) in the Indonesian language enables lecturers easily to obtain feedback about themselves and their classrooms through student perceptions revealed by these paper-and-pencil instruments. These questionnaires can be administered with ease and at little cost, and at a convenient time in class. These instruments provide lecturers with a means to guide improvements in their classroom teaching practice and student outcomes. The results of the present study provide a starting point from which interested lecturers could strive to create and maintain a conducive classroom learning environment through positive interactions with their students. In particular, the present study suggests that lecturers can improve

students' outcomes by displaying more Understanding and Helpful/Friendly behaviours and less Strict, Admonishing and Dissatisfied behaviours.

Findings related to departmental differences at the university level provide insights into how students from different departments perceive the learning environment. These differences could provide valuable information to lecturers regarding the types of learning environments that are most likely to improve student outcomes in different departments. Also, the study points to departmental differences in students' logical thinking which could influence the types of learning environment that suit students from different departments. Departmental differences in students' perceptions suggest that lecturers should take note that the personal relationships which they build and the way in which they treat students.

5.5 SIGNIFICANCE OF THE STUDY

This study is important because it is one of only a handful of studies in the field of learning environments in Indonesia, and it represents one of only a relatively few studies that has focused on the learning environment at the university level anywhere. This study is significant in that, by translating, field-testing, refining, validating and using a modified version of the What Is Happening In This Class? (WIHIC) questionnaire with a sample of 422 students in 12 classes, it has provided other researchers with a widely-applicable, parsimonious, valid, economical, and 'non-threatening' instrument for future use in assessing and monitoring students' perceptions of classroom learning environments.

The study makes an important contribution to the field of learning environments as it pioneered the use of the Questionnaire on Teacher Interaction (QTI) at the university level in Indonesia. Although the QTI has been used in studies in secondary classrooms in The Netherlands, the USA and Australia (Wubbels, 1993; Wubbels, Brekelmans & Hoomayers, 1991; Wubbels & Levy, 1991), in Brunei (Riah, 1998) and in primary

schools in Singapore (Goh & Fraser, 1995, 1998), this is the first time that it has been used in Indonesia. Through careful translation of the QTI into the Indonesian language, along with statistical evidence to support the validity and reliability of the instrument, the present study has provided a widely-applicable questionnaire for future use by lecturers and researchers.

Finally, in investigating associations between student perceptions of classroom environment and their learning outcomes, the study provides some practical and useful information to tentatively guide improvements in student achievement and attitudes through changing the classroom learning environment.

5.6 LIMITATIONS TO THE STUDY

Before the results from the present study can be generalised, there are several considerations that need to be taken into account. Limitations to the present study are related to time constraints, the nature of the student sample and the correlational nature of the study.

In this study, time constraints were encountered in the administration of the questionnaires. Difficulty was experienced in finding a suitable time to collect the data so that it did not interfere with the university's academic calendar. Questionnaires, therefore, were administered directly after the final examination for the Research Methods classes in which the study was conducted. The average time for students to complete the questionnaire was one hour and, as many of the students would have been tired, the quality of the data could have been reduced and, in a number of cases, there was insufficient time for students to complete the questionnaire. This reduced the sample size from 700 to 422, thus reducing the statistical power of some analyses. This might partly explain why the signs of some outcome-productivity factor relationships were in the unexpected direction.

The generalisability of findings from the present study could be limited by the sample involved (Campbell & Stanley, 1963). The present study specifically focused on the classroom learning environment in Research Methods classes in only one university in Indonesia and, therefore, caution should be exercised before its results are applied to classes of other subject areas or in different settings.

In addition, it is felt that time constraints (mentioned above) could have led to an unexpected selection process, which could have biased the sample. Those students who did not complete the questionnaire were generally those who experienced difficulty in the logical thinking test, thus providing a sample of more capable students (who were not necessarily representative of the total student population) and also limiting the variability of scores within the data.

A further limitation of this study essentially is linked to its correlational nature. The findings support the existence of some associations between student outcomes and the four productivity factors. However, it is not possible to draw conclusions regarding the causal effects of these productivity factors on student outcomes, as there was no manipulation of variables in the study. Clearly, further research is desirable if causal linkages are to be established.

Finally, it should be noted that, in an examination-oriented society such as Indonesia, the data collected during the present study could be subjected to biasing influences such as 'demand characteristics', whereby the subjects might respond in accordance with their perceptions of the expectations of the researcher, and 'impression management', whereby the subjects might 'manage' their responses to present them in a specific pattern (Hersen & Barlow, 1976). Thus, the findings from the present study should be interpreted with prudence. It might be desirable, therefore, for future quantitative research to be complemented by qualitative methods, which could provide checks on the validity of questionnaire responses and help to interpret findings (Fraser & Tobin, 1991; Tobin & Fraser, 1998).

5.7 SUGGESTIONS FOR FUTURE RESEARCH

Arising from the findings of this study, its limitations, the practical implications and the significance for classroom lecturers, the following suggestions are proposed for future research.

Classroom environment research in Indonesia, particularly at the university level, is very much in its infancy. The present study is one of the first studies to validate five widely-applicable instruments in the Indonesian language, the Classroom Learning Environment Questionnaire (CLEQ), Questionnaire on Teacher Interaction (QTI), Test of Logical Thinking (TOLT) instrument, Test of Computer-Related Attitudes (TOCRA) and a student motivation measure. These instruments are available in the Indonesian language, with demonstrated reliability and validity for use in future studies in Indonesia. Therefore one suggestion is that these instruments be used to pursue further classroom environment research in Indonesia along the lines elaborated below.

Further use of these instruments in a number of different universities and with a larger sample size selected form throughout Indonesia would be most beneficial. As this study was undertaken in only one university, it would be desirable to replicate the study in other universities. In particular, as the sample size in the present study turned out to be smaller than planned and because some relationships between outcomes and productivity factors were in the unexpected direction, there is a need to replicate the present research with larger samples. The data would provide useful insights into classroom environment, lecturer-student relationships and their combined impact on student learning.

The present study investigated the actual classroom environment of Research Methods classes. Past research has indicated that it is useful to include students' perceptions of actual and preferred classroom environment, teachers' perceptions of actual and preferred classroom environment, and students' perception of actual and ideal interpersonal

teacher behaviour in the same study. Past studies found that there are differences between students' perceptions of actual and preferred classroom environment, and that students' perceptions differ from the teacher's perception of the same classroom environment. It also has been reported that students and teachers have different perceptions of actual and ideal interpersonal teacher behaviour. Therefore, it would be desirable to extend this line of research to Indonesia so that information obtained can be used as a tangible guide for improving classroom environments and interpersonal teacher behaviour (see Fraser & Fisher, 1986).

Time constraints did not permit the use of both qualitative and quantitative methods during the data-collection process of this study. Some qualitative information were obtained during the pilot testing of instruments through observations by the researcher of classroom events, questions posed by students during the administration of the instruments, and interviews with six students. However, the data for the main study were gathered from questionnaire administration and hence quantitative in nature. From a methodological viewpoint, it would be desirable in future research studies of interpersonal relations and the psychosocial climate of classrooms to combine classroom observations, interviews and data from surveys or questionnaires. While quantitative methods involve predetermined classroom environment constructs, qualitative research makes assertions to highlight some salient aspects of classroom environment that emerge during the study (Fraser & Tobin, 1989; Tobin & Fraser, 1998). In this way, the highly complex nature of the way in which teaching and learning takes place is maintained and data are not lost. In addition, data from qualitative methods can help to explicate trends and patterns that arise from quantitative methods. It is highly desirable to combine these two methods in a single study in future research in Indonesia.

Because the school-level environment is distinct from classroom environment, it would be worthwhile to include teachers' perceptions of the school-level environment. Reports of studies in school and classroom environments have been promising (Fraser, Docker & Fisher, 1988; Fisher, Fraser & Wubbels, 1993; Fraser & Rentoul, 1982). Studies

incorporating environmental variables at both the school and classroom levels could generate a wealth of information for both school administrators and teachers to reflect upon and to use as a basis for improving the working environment in Indonesian universities. A high-quality education does not mean simply better facilities. It also means, among other things, a more gratifying place in which teachers can teach and students can learn. In short, the classroom environment is important but the school environment also matters. A study into both school and classroom environments might highlight other factors of school or inter-school differences and could explain variance in student achievement, attitude and behaviour that hitherto have been hidden.

In view of the importance of interpersonal relationships in education, it also would be advantageous to extend investigations into interpersonal relations between school principals and their teachers. An exploratory study in Israel (Kremer-Hayon & Wubbels, 1993) suggested that this could produce interesting results. A study into principal-teacher relationships would provide insight into improving the quality of principal-staff relationship, thereby enhancing the work environment of all concerned (Fisher & Cresswell, 1998).

The above suggestions for further studies are aimed at extending the scope of research on classroom environment in Indonesia, particularly in the area of interpersonal teacher behaviour. It is hoped that this study will stimulate more interest in this area and that its research findings will provide a catalyst in the search for excellence in higher education in Indonesia.

5.8 CONCLUSION

Overall, the findings of the present study have made several distinctive contributions to the field of learning environments. It was one of the first learning environment studies to be carried out in Indonesia and one of only a handful of learning environment studies carried out at the university level worldwide.

The study provides comprehensive validation information for five instruments used to measure the learning environment, lecturer-student interaction, student aptitude (logical thinking and GPA score), student motivation and student attitude towards computer-related studies. These instruments, carefully translated into Indonesian, provide a highly-useful starting point. The results of this study showed that there are differences among three of the productivity factors of learning (classroom climate, lecturer-student interaction, student aptitude) for Computer Science students and Management students. But there is no difference in student motivation between these two departments.

This study also reported that relationships exist among computing students in an Indonesian university between students' cognitive and affective outcomes and four productivity factors of learning: the learning environment; the quality of lecturer-student interactions; students' aptitude; and students' motivation to select their chosen subject. The results indicate that, whilst some associations exist, many of them were relatively weak.

This study also concluded that, in terms of the strength of associations between the four productivity factors of learning and the student outcomes, relationships were stronger for the Management department in terms of lecturer interaction behaviour for student course score and student attitude, and were stronger for the Computer Science department in terms of student motivation and student aptitude for student attitude outcomes. In terms of classroom learning environment, there was similarity between the two departments in the strength of associations between outcomes and productivity factors.

REFERENCES

Akindehin, F. (1993). An investigation of some factors of psychosocial environment in some Nigerian secondary schools. *Research in science and Technological Education, 11,* 117-126.

Aldridge, J.M., & Fraser, B.J. (1999, April). *A cross-national study of classroom environments in Taiwan and Australia.* Paper presented at the annual meeting of the National Association for Research in Science Teaching (NARST), Boston, MA.

Aldridge, J.M., & Fraser, B.J. (2000, January). *Science classroom learning environments in Taiwan and Australia: The potential of cross-cultural research.* Paper presented at the Second International Conference on Science, Mathematics and Technology Education, Taiwan.

Aldridge, J.M., Fraser, B.J., & Huang, T.C.I. (1999). Investigating classroom environments in Taiwan and Australia with multiple research methods. *Journal of Educational Research, 93,* 48-62.

Aldridge, J.M., Fraser, B.J., Taylor, P.C., & Chen C.C. (2000). Constructivist learning environments in a cross-national study in Taiwan and Australia. *International Journal of Science Education, 22,* 37-55.

Allport, G.W. (1935). Attitudes. In C. Murchision (Ed.), *Handbook of social psychology* (pp. 798-884). Worchester, MA: Clark University Press.

Allport, F.H., & Hartman, D.A. (1925). Measurement and motivation of a typical opinion in a certain group. *American Political Science Review, 19,* 735-760.

Ames, C.A. (1990). Motivation: What teachers need to know. *Teachers College Record, 91,* 409-21.

Ames, C.A. (1992). Classrooms: Goals, structures and student motivation. *Journal of Educational Psychology, 84,* 261-271.

Anderson, G.J., & Walberg, H.J. (1968). Classroom climate and group learning.

International Journal of Education Science, 2, 175-180.

Anderson, G.J., & Walberg, H.J. (1974). Learning environments. In H.J. Walberg (Ed.), *Evaluating educational performance: A sourcebook of methods, instruments and examples* (pp. 81-98). Berkeley, CA: McCutchan.

Arlin, P. (1975). Cognitive development in adulthood: A fifth stage. *Developmental Psychology, 11,* 602-606.

Asghar, M., & Fraser, B.J. (1995). Classroom environment and attitudes to science in Brunei Darussalam. *Journal of Science and Mathematic Education in S.E. Asia, XVIII,* 41-47.

Astin, A.W. (1980). When does a college deserve to be called 'high quality'? In *Improving teaching and institutional quality: Current issues in higher education* 1. Washington, DC: American Association for Higher Education. (ED 194 004).

Atkinson, J.W. (1957). Motivational determinants of risk-taking behavior. *Psychological Review, 64,* 359-372.

Baker, D., Leary, R., & Trammel, R. (1992, March). *Where are the gender differences in science and what do they mean?* Paper presented at the annual meeting of the National Association of Research in Science Teaching, Boston, MA.

Becker, W.C., & Krug, R.S. (1964). A circumplex model for social behaviour in children. *Child Development, 35,* 371-396.

Berliner, D. (1986). In pursuit of the expert pedagogue. *Educational Researcher, 15*(7), 5-13.

Blumenfeld, P.C. (1992). Classroom learning and motivation: Clarifying and expanding goal theory. *Journal of Educational Psychology, 84,* 272-281.

Brekelmans, M., Wubbels, Th., & Creton, H.A. (1990). A study of student perceptions of physics teacher behavior. *Journal of Research into Science Teaching, 27,* 335-350.

Brislin, R.W. (1970). Back translation for cross-cultural research. *Journal of Cross-Cultural Psychology, 1,* 185-216.

Brookover, W.B., Schweitzer, J.H., Schneider, J.M., Beady, C.H., Flood, P.K., & Wisenbaker, J.M. (1978). Elementary school social climate and school achievement. *American Educational Research Journal, 15,* 301-318.

Brophy, J. (1987). Synthesis of research on strategies for motivating students to learn. *Educational Leadership, 45,* 40-48.

Brophy, J. (1988). Educating teachers about managing classrooms and students. *Teaching & Teacher Education, 4,* 1-18.

Brophy, J., & Good, T. (1986). Teacher behavior and student achievement. In M.C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed.) (pp. 328-75). New York: Macmillan.

Brophy, J., & Putnam, J.G. (1979). Classroom management in the elementary grades. In D. Duke (Ed.), *Classroom management* (Seventy-eight Yearbook of the National Society for the Study of Education, Part 2). Chicago, IL: University of Chicago Press.

Burden, R., & Fraser, B.J. (1994). Examining teachers' perceptions of their working environments: Introducing the School Level Environment Questionnaire. *Educational Psychology in Practice, 10*(2), 67-73.

Burstein, L., Linn, R.L., & Capell, F.J. (1978). Analysing multilevel data in the presence of heterogeneous within-class regressions. *Journal of Educational Statistics, 3,* 347-383.

Campbell, D.T. (1950). The indirect assessment of social attitudes. *Psychological Bulletin, 47,* 15-38.

Campbell, D.T. & Fiske, D.W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin, 56,* 81-105.

Campbell, D.T., & Stanley, J.C. (1963). Experimental and quasi-experimental designs for research on teaching. In N.L. Gage (Ed.), *Handbook of research on teaching* (pp. 171-246). Chicago: Rand McNally.

Cantu, L., & Herron, D. (1978). Concrete and formal Piagetian stages and science concept attainment. *Journal of Research in Science Teaching, 15,* 135-143.

Capie, W., Newton, R. & Tobin, K.G. (1981, May). *Identifying relationships among reasoning patterns*. Paper presented at the annual meeting of the Jean Piaget Society, Philadelphia, PA.

Chavez, R.C. (1984). The use of high-inference measures to study classroom climate: A review. *Review of Educational Research, 54,* 237-261.

Chiapetta, E. (1976). A review of Piagetian studies relevant to science instruction at the secondary and college level. *Science Education, 60,* 253-261.

Chionh, Y.H., & Fraser, B.J. (1998, April). *Validation and use of the 'What is Happening in this Class?' (WIHIC) questionnaire in Singapore*. Paper presented at the annual meeting of the American Educational Association, San Diego, CA.

Chua, K.G. (1990). *The effect of teachers' positive behavior on mathematics achievement and attitude of secondary one pupils*. Unpublished MEd Dissertation, National University of Singapore.

Conrad, C.F., & Wilson, R.W. (1994). How should quality be assessed? In *Academic Program Reviews*. (ERIC ED 284522).

Cooley, W.W., & Lohnes, P.R. (1976). *Evaluation research in education*. New York: Irvington Publishers, Inc.

Cooper, H.M., & Tom, D.Y.H. (1984). Teacher expectation research: A review with implications for classroom instruction. *The Elementary School Journal, 85,* 77-89.

Covington, M.V. (1992). *Making the grade: A self-worth perspective on motivation and school reform*. Cambridge, England: Cambridge University Press.

Creton, H.A., Hermans, J.J., & Wubbels, Th. (1990). Improving interpersonal teacher behaviour in the classroom: A systems communication perspective. *South Pacific Journal of Teacher Education, 18,* 85-94.

Creton, H.A., Wubbels, Th., & Hooymayers, H.P. (1989). Escalated disorderly situations in the classroom and the improvement of these situations. *Teaching & Teacher Education, 5,* 205-215.

Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16,* 297-334.

Directorate General of Higher Education (2000). *Informasi perguruan tinggi swasta dan direktori PTN* [The directory of private higher education and public higher education – in Indonesian]. [available online] www.dikti.org

Dorman, J.P. (2000a). Validation and use of an instrument to assess university-level psychosocial environment in Australian universities. *Journal of Further and Higher Education, 24*(1), 25-38.

Dorman, J.P. (2000b). Using academics' perceptions of university environment to distinguish between Australian universities. *Educational Studies, 26*(2), 205-212.

Dorman, J. P. (in press). Associations between classroom environment and academic efficacy. *Learning Environment Research: An International Journal.*

Dorman, J. P., Adams, J. E., Ferguson, J. M. (in Press). Confirmatory factor analysis of the 'What is Happening in this Class' questionnaire and its structural invariance across groups. *Journal of Classroom Interaction.*

Doyle, W. (1986). Classroom organization and management. In M.C. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed.) (pp. 392-43). New York: Macmillan.

Dunkin, M.J., & Biddle, B.J. (1974). *The study of teaching.* New York: Rinehart & Winston.

Eccles, J., Adler, T.F., Futterman, R., Goff, S.B., Kaczala, C.M., Meece, J.L., & Midgley, C. (1985). Self-perceptions, task perceptions, socializing influences and the decision to enroll in mathematics. In S.F. Chipman, L.R. Brush, & D.M. Wilson

(Eds.), *Women and mathematics: Balancing the equation* (pp. 95-121). Hillsdale NJ: Erlbaum.

Ee, C.H. (1986). *The relationship between the educational attitudes of teachers and their perceptions of the leadership behaviour of their principals.* Unpublished MEd dissertation, National University of Singapore.

Eiser, J.R. (Ed.). (1984). *Attitudinal judgment.* New York: Springer-Verlag.

Elliott, E.S., & Dweck, C.S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology, 54,* 5-12.

Emmer, E., Evertson, C., & Anderson, L. (1980). Effective classroom management at the beginning of the school year. *Elementary School Journal, 80,* 219-231.

Farrell, M.A. (1969). The formal stage: A review of the research. *Journal of Research and Development in Education, 3,* 111-118.

Fisher, D.L. (Ed.). (1992). *The study of learning environments, Vol. 6.* Launceston: Department of Education, University of Tasmania.

Fisher, D.L. (Ed.). (1993). *The study of learning environments, Vol. 7.* Perth: Science and Mathematics Education Centre, Curtin University of Technology.

Fisher, D.L., & Fraser, B.J. (1981). Validity and use of My Class Inventory. *Science Education, 65,* 145-156.

Fisher, D.L., & Fraser, B.J. (1983a). A comparison of actual and preferred classroom environments as perceived by science teachers and students. *Journal of Research in Science Teaching, 20,* 55-61.

Fisher, D.L., & Fraser, B.J. (1983b). Validity and use of Classroom Environment Scale. *Educational Evaluation and Policy Analysis, 5,* 261-271.

Fisher, D.L., & Fraser, B.J. (1991). School climate and teacher professional development. *South Pacific Journal of Teacher Education, 19,* 17-32.

Fisher, D.L., Fraser, B.J., & Wubbels, Th. (1993). Interpersonal teacher behaviour and school environment. In Th. Wubbels & J. Levy (Eds.), *Do you know what you look*

like?: Interpersonal relationships in education (pp. 103-112). London: The Falmer Press.

Fisher, D.L., Henderson, D., & Fraser, B.J. (1995). Interpersonal behaviour in senior high school biology classes. *Research in Science Education, 25*(2), 125-133.

Fisher, D.L., Henderson, D., & Fraser, B.J. (1997). Laboratory environment and student outcomes in senior high school biology. *American Biology Teacher, 59,* 214-219.

Fraser, B.J. (1977). Attitude to the social implications of science: Its measurement and correlates. *Australian Science Teacher Journal, 23*(2), 96-9.

Fraser, B.J. (1979). Evaluation of a science-based curriculum. In H.J. Walberg (Ed.), *Educational environments and effects: Evaluation, policy and productivity* (pp. 218-234). Berkeley, CA: Mc Cutchan.

Fraser, B.J. (1980). Guest editor's introduction: Classroom environment research in the 1970's and 1980's. *Studies in Educational Evaluation, 6,* 221-223.

Fraser, B.J. (1981a). *Learning environment in curriculum evaluation: A review* (Evaluation in Education Series). Oxford: Pergamon.

Fraser, B.J. (1981b). *Test of Science-Related Attitudes (TOSRA).* Melbourne, Victoria: Australian Council for Educational Research.

Fraser, B.J. (1982). Differences between student and teacher perceptions of actual and preferred classroom learning environment. *Educational Evaluation and Policy Analysis, 4,* 511-519.

Fraser, B.J. (1984). The effects of classroom climate on student outcomes: A replication in two developing countries. *Singapore Journal of Education, 6*(2), 60-63.

Fraser, B.J. (1985). Differences between preferred and actual classroom environment as perceived by primary student and teachers. *British Journal of Educational and Psychology, 54,* 336-339.

Fraser, B.J. (1986a). *Classroom environment.* London: Croom Helm.

Fraser, B.J. (1986b). Two decades of research on perceptions of classroom environments. In B.J. Fraser (Ed.), *The study of learning environments, Vol. 1.* Salem, OR: Assessment Research.

Fraser, B.J. (1989). Twenty years of classroom climate work: Progress and prospect. *Journal of Curriculum Studies, 21,* 307-327.

Fraser, B.J. (1990). *Individualised Classroom Environment Questionnaire.* Melbourne: Australian Council for Educational Research.

Fraser, B.J. (1991). Two decades of classroom environment research. In B.J. Fraser & H.J.Walberg (Eds.), *Educational environments: Evaluation, antecedents and consequences* (pp. 3-27). Oxford: Pergamon.

Fraser, B.J. (1993a, January). *The learning environment in science classroom and its effects on learning.* Paper presented at the International Conference on Science Education in Developing Countries: From Theory into practice, Jerusalem, Israel.

Fraser, B.J. (1993b, September). *A quarter of a century of research on classroom environment.* Paper presented at the Seventh Annual Conference of the Educational Research Association, Singapore.

Fraser, B.J. (1994). Research on classroom and school climate. In D.L. Gabel (Ed.), *Handbook of research on science teaching and learning* (pp. 494-541). New York: Macmillan.

Fraser, B.J. (1998a). Science learning environments: Assessment, effects and determinants. In B.J. Fraser & K. Tobin (Eds.), *International handbook of science education* (pp. 527-564). Dordrecht, The Netherlands: Kluwer.

Fraser, B.J. (1998b). The birth of a new journal: Editor's introduction. *Learning Environments Research: An International Journal, 1,* 1-5.

Fraser, B.J. (1998c). Classroom environment instruments: Development, validity and applications. *Learning Environment Research, 1,* 7-33.

Fraser, B.J. (2000, January). *Improving research on learning environments through international cooperation.* Keynote Address at Second International Conference on Science, Mathematics and Technology Education, Taipei, Taiwan.

Fraser, B.J., Anderson, G.J., & Walberg, H.J. (1982). *Assessment of learning environments: Manual for Learning Environment Inventory (LEI) and My Class Inventory (MCI)* (third version). Perth, Australia: Western Australia Institute of Technology.

Fraser, B.J., & Butts, W.L. (1982). Relationship between perceived levels of classroom individualisation and science-related attitudes. *Journal of Research in Science Teaching, 19,* 143-154.

Fraser, B.J., & Chionh, Y.H. (2000, April). *Classroom environment, self-esteem, achievement, and attitudes in geography and mathematics in Singapore.* Paper presented at the annual meeting of the American Educational Association, New Orleans.

Fraser, B.J., Docker, J.G., & Fisher, D.L. (1988). Assessing and improving school climate. *Evaluation and Research in Education, 2,* 109-122.

Fraser, B.J., & Fisher, D.L. (1982a). Effects of classroom psychosocial environment on student learning. *British Journal of Educational Psychology, 52,* 374-377.

Fraser, B.J., & Fisher, D.L. (1982b). Predictive validity of My Class Inventory. *Studies in Educational Evaluation, 8,* 129-140.

Fraser, B.J., & Fisher, D.L. (1982c). Predicting students' outcomes from their perceptions of classroom psychosocial environment. *American Educational Research Journal, 19,* 498-518.

Fraser, B.J., & Fisher, D.L. (1983a). *Assessment of classroom psychosocial environment: Workshop manual* (Research Seminar and Workshop Series). Perth, Australia: Western Australian Institute of Technology.

Fraser, B.J., & Fisher, D.L. (1983b). Use of actual and preferred classroom environment scales in person-environment fit research. *Journal of Educational Psychology, 75,* 303-313.

Fraser, B.J., & Fisher, D.L. (1983c). Development and validation of short forms of some instruments for measuring student perceptions of actual and preferred classroom learning environment. *Science Education, 67,* 115-131.

Fraser, B.J., & Fisher, D.L. (1986). Using short forms of classroom climate instruments to assess and improve classroom psychosocial environment. *Journal of Research in Science Teaching, 23,* 387-413.

Fraser, B.J., Giddings, G.J., & McRobbie, C.J. (1992a, March). Science laboratory classroom environments: A cross national perspective. In D.L. Fisher (Ed.). *The Study of learning environments, Vol. 6* (pp. 1-18). Launceston: Department of Education, University of Tasmania.

Fraser, B.J., Giddings, G.J., & McRobbie, C.J. (1992b). Assessment of the psychosocial environment of university science laboratory classroom: A cross-national study. *Higher Education, 24,* 431-451.

Fraser, B.J., Giddings, G.J., & McRobbie, C.J. (1995). Evolution and validation of a personal form of an instrument for assessing science laboratory classroom environments. *Journal of Research in Science Teaching, 32,* 399-422.

Fraser, B.J., Malone, J.A., & Neale, J.M. (1989). Assessing and improving the psychosocial environment on mathematics classrooms. *Journal for Research in Mathematics Education, 20,* 191-201.

Fraser, B.J., Fisher, D.L., & McRobbie C.J., (1996, April). *Development, validation and use of personal and class forms of a new classroom environment instrument.* Paper presented at the annual meeting of the American Educational Research Association, New York.

Fraser, B.J., & McRobbie, C.J. (1995). Science laboratory classroom environments at schools and universities: A cross-national study. *Educational Research and Evaluation, 1,* 289-317.

Fraser, B.J., McRobbie, C.J., & Giddings, G.J. (1993). Development and cross-national validation of a laboratory environment instrument for senior high school science. *Science Education, 77, 1-24.*

Fraser, B.J., & O'Brien, P. (1985). Student and teacher perceptions of the environment of elementary school classrooms. *The Elementary School Journal, 85,* 567-580.

Fraser, B.J., Pearse, R., & Azmi (1982). A study of Indonesian students' perceptions of classroom psychosocial environment. *International Review of Education, 28,* 337-355.

Fraser, B.J., & Rentoul, A.J. (1982). Relationship between school-level and classroom-level environment. *Alberta Journal of Education Research, 28,* 212-225.

Fraser, B.J., & Tobin, K. (1989). Student perceptions of psychosocial environments in classrooms of exemplary science teachers. *International Journal of Science Education, 11,* 14-34.

Fraser, B.J., & Tobin, K. (1991). Combining qualitative and quantitative methods in classroom environment research. In B.J. Fraser & H.J. Walberg (Eds.), *Educational environments: Evaluation, antecedents and consequences* (pp. 271-292). Oxford, England: Pergamon Press.

Fraser, B.J., & Treagust, D.F. (1986). Validity and use of an instrument for assessing classroom psychosocial environment in higher education. *Higher Education, 15,* 37-57.

Fraser, B.J., Treagust, D.F. & Dennis, N.C. (1986). Development of an instrument for assessing classroom psychosocial environment at universities and colleges. *Studies in Higher Education, 11*(1), 43-54.

Fraser, B.J., & Walberg, H.J. (1981). Psychosocial learning environment in science classrooms: A review of research. *Studies in Science Education, 8,* 67-92.

Fraser, B.J., & Walberg, H.J. (1991). *Educational environments: Evaluation, antecedents and consequences*. Oxford: Pergamon Press.

Fraser, B.J., & Wubbels, T. (1995). Classroom learning environments. In B.J. Fraser & H.J. Walberg (Eds.), *Improving science education* (pp. 117-144). Chicago, IL: National Society for the Study of Education.

Furth, H.G., & Wachs, H. (1974). *Thinking goes to school: Piaget's theory in practice*. New York: Oxford University Press.

Gallagher, J.J. (1975). *Teaching the gifted child*. Boston: Allyn and Bacon.

Garnett, P. (1983). *Reasoning patterns of secondary school students: Implication for teaching chemistry*. A paper presented at the annual meeting of the Australian and New Zealand Association for the Advancement of Science, Perth.

Garnett, P.J. & Tobin, K.G. (1984). Reasoning patterns of preservice elementary and middle school science teachers. *Science Education, 68,* 621-631.

Gerhard, C. (1975). *Making sense: Reading comprehension improved through categorizing*. Newark, DE: International Reading Association.

Goh, B.K. (1986). *A study on the relationship between achievement and attitude towards local history by secondary school pupils in Singapore*. Unpublished MEd dissertation, National University of Singapore.

Goh, S.C., & Fraser, B.J. (1995). *Learning environment and student outcomes in primary mathematics classroom in Singapore*. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Goh, S.C., & Fraser, B.J. (1998). Teacher interpersonal behaviour, classroom environment and student outcomes in primary mathematics in Singapore. *Learning Environments Research: An international Journal, 1,* 199-229.

Goh, S.C., Young, D.J., & Fraser, B.J. (1995). Psychosocial climate and students' outcome in elementary mathematics classrooms: A multilevel analysis. *Journal of Experimental Education, 64,* 29-40.

Good, T.L. (1987). Two decades of research on teacher expectations: Findings and future directions. *Journal of Teacher Education, XXXVIII,* 32-47.

Goodstein, M., & Howe, A. (1978). The use of concrete methods in secondary chemistry instruction. *Journal of Research in Science Teaching, 15,* 361-366.

Graham, S., & Weiner, B. (1996). Theories and principles of motivation. In D.C. Berliner & R.C. Calfee (Eds.), *Handbook of educational psychology* (pp. 63-84). New York: Macmillan.

Guttman, L. (1944). A basis for scaling qualitative data. *American Sociological Review, 9,* 139-150.

Haertel, G.D., Walberg, H.J., & Haertel, E.H. (1981). Socio-psychological environments and learning: A quantitative synthesis. *British Educational Research Journal, 7,* 27-36.

Haladyna, T., Olsen, R., & Shaughnessy, J. (1982). Relations of student, teacher and learning environment variables to attitudes toward science. *Science Education, 66,* 671-687.

Hart, E.P. (1978). Examination of BSCS biology and non-biology students' ecology comprehension, environmental information level and environmental attitude. *Journal of Research in Science Teaching, 15,* 73-78.

Hase, H.D., & Goldberg, L.R. (1967). Comparative validity of different strategies of constructing personality inventory scales. *Psychological Bulletin, 67,* 231-248.

Henderson, D., Fisher, D.L., & Fraser, B.J. (1994, March). *Learning environments and student outcomes in senior high school biology classes.* Paper presented at annual meeting of National Association for Research in Science Teaching, Anaheim, CA.

Henderson, D., Fisher, D.L., & Fraser, B.J. (1995, April). *Associations between learning environments and student outcomes in biology.* Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Henderson, D., Fisher, D.L., & Fraser, B.J. (2000). Interpersonal behaviour, laboratory learning environments, and student outcomes in senior biology classes. *Journal of Research in Science Teaching, 37,* 26-43.

Hersen, M., & Barlow, D.H. (1976). *Single case experimental designs: Strategies for studying behaviour changes.* New York: Pergamon Press.

Hough, L.W., & Piper, M.K. (1982). The relationship between attitudes toward science and science achievement. *Journal of Research in Science Teaching, 19,* 33-38.

Huang, I., & Fraser, B.J. (1997, April). *The development of a questionnaire for assessing student perceptions of classroom climate in Taiwan and Australia.* Paper presented at the annual meeting of the National Association for Research in Science Teaching, Chicago, IL.

Hunt, D.E. (1975). Person-environment interaction: A challenge found wanting before it was tried. *Review of Educational Research, 45,* 209-230.

Inhelder, B. & Piaget, J. (1958). *The growth of logical thinking from childhood to adolescence.* New York: Basic.

Inhelder, B. & Piaget, J. (1975). *The origin of the idea of chance in children.* New York: N. W. Norton.

Keeves, J.P. (1972). *The home, the school and educational achievement.* Melbourne, Australian Council for Educational Research.

Kent, H.A. (1992, May). *Meeting student needs: Teacher personality and interpersonal style in the classroom.* Paper presented at the Second National Conference on Post Compulsory Education, Launceston College, Launceston, Tasmania.

Khoo, H.S., & Fraser, B.J. (1997). *Using classroom environment dimensions in the evaluation of adult computer courses.* Paper presented at the annual meeting of the National Association for Research in Science Teaching, San Diego, CA.

Kim, H.B., Fisher, D.L., & Fraser, B.J. (2000). Assessment and investigation of constructivist science learning environments in Korea. *Research in Science and Technological Education, 17,* 239-249.

Kloosterman, P., & Cougan, M.C. (1994). Students' beliefs about learning school mathematics. *Elementary School Journal, 94,* 375-388.

Klopfer, L.E. (1971). Evaluation of learning in science. In B.S. Bloom, J.T. Hastings, & G.F. Madaus (Eds.), *Handbook on formative and summative evaluation of student learning* (pp. 559-642). New York: McGraw Hill.

Kremer-Hayon, L., & Wubbels, Th. (1992). Interpersonal relationships of cooperation teachers and student teachers' satisfaction with supervision. *Journal of Classroom Interaction, 27*(1), 31-38.

Kremer-Hayon, L., & Wubbels, Th. (1993). Principals' interpersonal behaviour and teachers' satisfaction. In Th. Wubbels, & J. Levy (Eds.), *Do you know what you look like? Interpersonal relationships in education* (pp. 113-122). London: The Falmer Press.

Krynowsky, B.A. (1988). The relationship between student attitude toward grade ten science and classroom learning environment variables. *Dissertation Abstracts International, 49,* 1107A.

Lawson, A.E. (1978). The development and validation of a classroom test of formal reasoning. *Journal of Research in Science Teaching, 15,* 11-24.

Lawson, A.E. (1979). Combining variables, controlling variables and proportions: Is there a psychological link?. *Science Education, 63,* 67-72.

Lawson, A.E., Adi, H., & Karplus, R. (1979). Development of correlational reasoning in secondary schools: Do biology courses make a difference? *The American Biology Teacher, 41,* 420-425.

Leary, T. (1957). *An interpersonal diagnosis of personality.* New York: Ronald Press.

Lee, M.Y.K. (1994). *The effects of an in-service course on teachers' attitude towards pastoral care.* Unpublished MEd dissertation, National University of Singapore.

Lemon, N. (1973). *Attitudes and their measurement.* London: B.T. Batsford Ltd.

Lepper, M.R. (1988). Motivational considerations in the study of instruction. *Cognition And Instruction, 5,* 289-309.

Lewin, K. (1936). *Principles of topological psychology.* New York: McGraw.

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology, 140,* 44-53.

Linton, R. (1945). *The cultural background of personality.* New York: Appleton-Century-Crofts.

Lovell, K. (1961). A follow-up study of Inhelder and Piaget's the growth of logical thinking. *British Journal of Psychology, 52,* 143-153.

Lumsden, L.S. (1994). Student motivation to learn. *Educational Management,* ERIC Digest, Number 92. (ED 370200).

Lundquist, R. (1997). Quality systems and ISO 9000 in higher education. *Assessment and Evaluation in Higher education, 22,* 159-172.

MacAuley, D.J. (1990). Classroom environment: A literature review. *Educational Psychology, 10,* 1239-1253.

Maddock, M.N. (1978). An exploratory study in school assessment: The relationship between achievement and an attitude scale. *Research in Science Education, 8,* 127-139.

Majeed, A., Fraser, B. J., & Aldridge, J. M. (2001, April). *Learning environments and student satisfaction among junior secondary mathematics students in Brunei Darussalam.* Paper presented at the annual meeting of the American Educational Research Association, Seattle.

Manley, B.L. (1977). The relationship of the learning environment to student attitudes toward chemistry. *Dissertation Abstracts International, 38,* 1320A.

Maor, D., & Fraser, B.J. (1996). Use of classroom environment perceptions in evaluating inquiry-based computer assisted learning. *International Journal of Science Education, 18,* 401-421.

Margianti, E.S., & Fraser, B.J. (2000, January). *Learning environment, mathematical ability and student outcomes among students of university computing courses in Indonesia.* Paper presented at Second International Conference on Science, Mathematics and Technology Education, Taipei, Taiwan.

Marjoribanks, K. (1976). School attitudes, cognitive ability and academic achievement. *Journal of Educational Psychology, 68,* 653-660.

Marshall, H.H. (1987). Motivational strategies of three fifth-grade teachers. *The Elementary School Journal, 88,* 135-50.

Maslow, A.H. (1970). *Motivation and personality* (2nd ed). London: Harper & Row.

McKeachie, W.J. (1994). *Teaching tips: A guidebook for the beginning college teacher* (9th ed.). Lexington, MA: D.C. Heath and Company.

McMillen, L. (1986). Many professors now start at the beginning by teaching their students how to think. *Chronicle of Higher Education* (March 5), 23-25.

McRobbie, C.J., & Ellett, C.D. (Guest Editors). (1997). Advances in research on educational learning environments [special issue]. *International Journal of Educational Research, 27,* 267-354.

McRobbie, C.J., & Fraser, B.J. (1993a). Associations between student outcomes and psychosocial science environment. *Journal of Educational Research, 87,* 78-84.

McRobbie, C.J., & Fraser, B.J. (1993b, April). *A typology of science laboratory classroom environments.* Paper presented at the annual meeting of American Educational Research Association, Atlanta. GA.

Departemen Pendidikan Nasional. (1997). *Directory of higher education in Indonesia 1997/1998.* Jakarta, Indonesia: Direktorat Perguruan Tinggi Swasta, Direktorat Jenderal Pendidikan Tinggi.

Moos, R.H. (1973). *Conceptualizing educational environments* (SEADA Report). New York: Southeast Asia Development Advisory Group of the Asia Society.

Moos, R.H. (1974). *The Social Climate Scales: An overview.* Palo Alto, CA: Consulting Psychologists Press.

Moos, R.H. (1978). A typology of junior high and high school classrooms. *American Educational Research Journal, 15,* 53-66.

Moos, R.H. (1979a). *Evaluating educational environments: Procedures, measures, findings and policy implications.* San Francisco, CA: Jossey-Bass Publishers.

Moos, R.H. (1979b). Educational climate. In d H.J. Walberg (Eds.), *Educational environments and effects: Evaluation, policy and productivity* (pp. 79-100). Berkeley, CA: McCutchan Publishing Corporation.

Moos, R.H. & Houts, P.S. (1968). The assessment of the social atmospheres of psychiatric wards. *Journal of Abnormal Psychology, 73,* 595-604.

Moos, R.H., & Spinrad, S. (1984). *The Social Climate Scales: Annotated bibliography 1979-1983.* Palo Alto, CA: Consulting Psychologists Press.

Moos, R.H., & Trickett, E.J. (1987*). Classroom Environment Scale manual* (2nd ed.). Palo Alto, CA: Consulting Psychologists Press.

Moos, R.H. & Trickett, E.J. (1974). *Classroom Environment Scale manual.* Palo Alto, CA: Consulting Psychologists Press.

Mueller, D.J. (1986). *Measuring social attitudes.* New York: Teacher College Press, Columbia University.

Murray, H.A.(1938). *Explorations in personality.* New York: Oxford University Press.

Nicholls, J.G. (1984). Conceptions of ability and achievement motivation. In R.E. Ames & C. Ames (Eds.), *Research on motivation in education, Volume 1: Student motivation* (pp. 39-73). Orlando, FL: Academic Press.

Osgood, C.E., Suci, G.J., & Tannenbaum, P.H. (1957). *The measurement of meaning.* Urbana, IL: University of Illinois Press.

Owens. L.C., & Straton, R.G. (1980). The development of a cooperative, competitive and individualized learning preference scale for students. *British Journal of Educational Psychology, 50,* 147-161.

Pace, C.R., & Stern, G.G. (1958). An approach to the measurement of psychological characteristics of college environments. *Journal of Educational Psychology, 49,* 269-277.

Padilla, M., Okey, J., & Dillashaw, F. (1983). The relationship between science process skills and formal thinking abilities. *Journal of Research in Science Teaching, 20,* 239-246.

Paige, R.M. (1978). *The impact of classroom learning environment on academic achievement and individual modernity in East Java, Indonesia.* Unpublished Doctoral Dissertation, Stanford University.

Paige, R.M. (1979). The learning of modern culture: Formal education and psychosocial modernity in East Java, Indonesia. *International Journal of Intercultural Relations, 3,* 333-364.

Paris, S.G., & Turner, J.C. (1994). Situated motivation. In P.R. Pintrich, D.R. Brown, & C.E. Weinstein (Eds.), *Student motivation, cognition and learning: Essays in honor of Wilbert J. McKeachie.* Hillsdale, NJ: Lawrence Erlbaum.

Peckham, P.D., Glass, G.V., & Hopkins, K.D. (1969). The experimental unit in statistical analysis: Comparative experiments with intact groups. *Journal of Special Education, 3,* 337-349.

Pedhazur, E. (1975). Analytic methods in studies of educational effects. *Review of Research in Education, 3,* 243-289.

Quek, C.L. (1993, September). *A small-scale study on classroom environment at Raffles Institution.* Paper presented at the Annual Conference of Educational Research Association, Singapore.

Quek, G.C. (1995). *Attitude towards history and academic achievement.* Unpublished MEd dissertation, Nanyang Technological University, National Institute of Education, Singapore.

Raffini, J. (1993). *Winners without losers: Structures and strategies for increasing student motivation to learn.* Boston: Allyn and Bacon.

Raths, L.E., Jonas, A., Rothstein, A., & Wassermann, S. (1967). *Teaching for thinking, theory and application.* Columbus, OH: Charles E. Merrill.

Raviv, A., Raviv, A., & Reisel, E. (1990). Teachers and students: Two different perspectives?! Measuring social climate in the classroom. *American Educational Research Journal, 27,* 141-157.

Renner, J.W., & Lawson, A.E. (1973). Promoting intellectual development through science teaching. *Physics Teacher, 11,* 273-276.

Rentoul, A.J., & Fraser, B.J. (1979). Conceptualization of enquiry-based or open classrooms learning environments. *Journal of Curriculum Studies, 11,* 233-245.

Riah, H. (1998). *Learning environment and its association with student outcomes in chemistry in Brunei Darussalam's secondary schools.* Unpublished doctoral thesis, Curtin University of Technology.

Riah, H., & Fraser, B. J. (1998, April). *The learning environment of high school chemistry classes.* Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.

Robinson, W.S. (1950). Ecological correlations and the behavior of individuals. *American Sociological Review, 15,* 351-357.

Rohrkemper, M.M. (1984). The influence of teacher socialization style on students' social cognition and reported interpersonal classroom behaviour. *The Elementary School Journal, 85,* 244-275.

Ross, K.N. (1978). Sample design for educational survey research: Evaluation in progress. *Studies in Educational Evaluation, 6,* 279-289.

Saffir, M.A. (1937). A comparative study of scales constructed by three psychometric methods. *Psychometrika, 2,* 179-198.

Schibeci, R.A., Rideng, I.M., & Fraser, B.J. (1987) Effects of classroom environment on science attitudes: A cross-cultural replication in Indonesia. *International Journal of Science Education, 9,* 169-186.

Schibeci, R.A., & Riley, J.P. (1983, April). *Influence of student background on science attitudes and achievement.* Paper presented at the annual meeting of the American Educational Research Association, Montreal.

Scott, R.H. & Fisher, D.L. (2000, January). *Validation and use of a Malay translation of an elementary school version of the Questionnaire on Teacher Interaction.* Paper presented at Second International Conference on Science, Mathematics and Technology Education, Taiwan.

Seegers, G., & Boekarts, M. (1993). Task motivation and mathematics achievement in actual task situations. *Learning and Instruction, 3,* 133-150.

Sirotnik, K.A. (1980). Psychometric implications of the unit-of-analysis problem (with examples from the measurement of organizational climate). *Journal of Educational Measurement, 17,* 245-282.

Spache, G.D., & Spache, E.B. (1986). *Reading in the elementary school.* Boston: Allyn and Bacon.

Stipek, D. (1988). *Motivation to learn: From theory to practice.* Englewood Cliffs, NJ: Prentice Hall.

Stipek, D.J. (1996). Motivation and instruction. In D.C. Berliner & R.C. Calfee (Eds.), *Handbook of educational psychology* (pp. 85-113). New York: Macmillan.

Talton, E.L., & Simpson, R.D. (1986). Relationships of attitudes toward self, family and school with attitude toward science among adolescents. *Science Education, 70,* 365-374.

Talton, E.L., & Simpson, R.D. (1987). Relationships of attitude toward classroom environment with attitude toward and achievement in science among tenth grade biology students. *Journal of Research in Science Teaching, 24,* 507-525.

Tamir, P. (1987). Some factors which affect science achievement of high school seniors in Israel. *Research in Science and Technological Education*, 5, 69-92.

Tan, K.H. (1995). *Difference in school related attitudes among low and high achieving students in the normal and express streams.* Unpublished MEd dissertation, Nanyang Technological University, National Institute of Education, Singapore.

Taylor, P.C., Dawson, V., & Fraser, B.J. (1995, April). *Classroom learning environments under transformation: A constructivist perspective.* Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

Taylor, P.C., Fraser, B.J., & Fisher, D.L. (1993, April). *Monitoring the development of constructivist learning environments.* Paper presented at the Annual Convention of the National Science Teachers' Association, Kansas City, MO.

Taylor, P.C., Fraser, B.J., & Fisher, D.L. (1997). Monitoring constructivist classroom learning environments. *International Journal of Educational Research*, 27, 293-302.

Taylor, P.C., Fraser, B.J., & White, L. (1994, April). *CLES: An instrument for monitoring the development of constructivist learning environments.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans. LA.

Teh, G. (1993). *An evaluation of computer-assisted learning in geography in terms of student achievement, student attitudes and classroom environment.* Unpublished PhD thesis, Curtin University of Technology.

Teh, G., & Fraser, B.J. (1993, April). *A study of computer-assisted learning environments in Singapore.* Paper presented at Annual Meeting of the American Educational Research Association, Atlanta, GA.

Teh, G., & Fraser, B.J. (1994). An evaluation of computer-assisted learning in terms of student achievement, attitudes and classroom environment. *Evaluation and Research in Education, 8,* 147-161.

Teh, G., & Fraser, B.J. (1995a). Development and validation of an instrument for assessing the psychosocial environment of computer-assisted learning classrooms. *Journal of Educational Computing Research, 12,* 177-193.

Teh, G., & Fraser, B.J. (1995b). Association between student outcomes and geography classroom environment. *International Research in Geographical and Environment Education, 4*(1), 3-18.

Thorpe, H., Burden, R., & Fraser, B.J. (1994). Assessing and improving classroom environment. *School Science Review, 75,* 107-113.

Thurstone, L.L. (1927). Psychological analysis. *American Journal of Psychology, 38,* 268-389.

Thurstone, L.L. (1928). Attitudes can be measured. *American Journal of Sociology, 33,* 529-554.

Thurstone, L.L. (1931). The measurement of social attitudes. *Journal of Abnormal and Social Psychology, 26,* 249-69.

Thurstone, L.L. (1946). Comment. *American Journal of Sociology, 52,* 39-50.

Thurstone, L.L., & Chave, E.J. (1929). *The measurement of attitude.* Chicago: University of Chicago Press.

Tobin, K.G. (1984a). Teaching strategy analysis models in middle school science education courses. *Science Education, 69,* 69-82.

Tobin, K.G. (1984b). Effects of extended wait time on discourse characteristics and achievement in middle school grades. *Journal of Research in Science Teaching, 21,* 469-482.

Tobin, K.G., & Capie, W. (1981a). The development and validation of a group test of logical thinking. *Journal of Educational and Psychological Measurement, 41,* 413-424.

Tobin, K.G., & Capie, W. (1981b). The Test of Logical Thinking. *Journal of Science and Mathematics Education in S.E. Asia, VII*(1), 5-9.

Tobin, K.G., & Capie, W. (1982). Relationships between classroom process variables and middle school science achievement. *Journal of Educational Psychology, 74,* 441-454.

Tobin, K.G., & Fraser, B.J. (1998). Qualitative and quantitative landscapes of classroom learning environments. In B.J. Fraser & K.G. Tobin (Eds.), *International handbook of science education* (pp. 623-640). Dordrecht, The Netherlands: Kluwer.

Tobin, K.G., Kahle, J., & Fraser, B.J. (Eds.). (1990). *Windows into science classrooms: Problems associated with higher-level cognitive learning.* London: Falmer Press.

Tobin, K.G., & Korbosky, R. (1984). *The predictive validity of a test of formal reasoning ability when used with preservice primary teachers* (Technical Report 10). Perth, Western Australia: Science Mathematics Education Centre, Western Australian Institute of Technology.

Tonjes, M.J., & Zintz, M.V. (1987). *Teaching reading, thinking, study skills in content classrooms.* Dubuque, IA: Brown.

Veenman, S. (1984). Perceived problems of beginning teachers. *Review of Educational Research, 54,* 143-178.

Von Saldern, M. (1992). *Social climate in the classroom: Theoretical and methodological aspects.* New York: Waxmann Munser.

Walberg, H.J. (1969). Class size and the social environment of learning. *Human Relations, 22,* 465-475.

Walberg, H.J. (1976). The psychology of learning environments: Behavioral, structural, or perceptual? *Review of Research in Education, 4,* 142-178.

Walberg, H.J. (1981). A psychological theory of educational productivity. In F.H. Farley & N.J. Gordon (Eds.), *Psychology and education: The state of the union* (pp. 81-108). Berkeley, CA: McCutchan.

Walberg, H.J. (1991). Educational productivity and talent development. In B.J. Fraser & H.J. Walberg (Eds.). *Educational environments: Evaluation, antecedents, and consequences* (pp. 93-109). Oxford, England: Pergamon Press.

Walberg, H.J., & Anderson, G.J. (1968a). Classroom climate and individual learning. *Journal of Educational Psychology, 59,* 414-419.

Walberg, H.J., & Anderson, G.J. (1968b). The achievement-creativity dimension and classroom climate. *The Journal of Creativity Behavior, 2,* 281-291.

Walberg, H.J., & Haertel, G.D. (1980). Validity and use of educational environment assessments. *Studies in Educational Evaluation, 6,* 225-238.

Walberg, H.J., Singh, R., & Rasher, S.P. (1977) Predictive validity of student perceptions: A cross-cultural replication. *American Educational Research Journal, 14,* 45-49.

Wankat, P.C., & Oreovicz, F.S. (1993). *Teaching engineering*. New York: McGraw-Hill.

Weiner, B. (1984). Principles for a theory of student motivation and their application within an attributional framework. In R.E. Ames & C. Ames (Eds.), *Research on motivation in education, Volume 1: Student motivation* (pp. 15-38). Orlando, FL: Academic Press.

Welch, W.W., & Walberg, H.J. (1972). A national experiment in curriculum evaluation. *American Educational Research Journal, 9,* 373-383.

Wong, A.F.L. (1994). *Determinants and effects of perceptions of chemistry laboratory environments in co-educational secondary schools in Singapore.* Unpublished thesis, Curtin University of Technology.

Wong, A.F.L., & Fraser, B.J. (1994, April). *Science laboratory classroom environments and student attitudes in chemistry classes in Singapore.* Paper presented at the

annual meeting of the American Educational Research Association, New Orleans, LA.

Wong, A.F.L., & Fraser, B.J. (1995). Cross-validation in Singapore of the Science Laboratory Environment Inventory. *Psychological Reports, 76,* 907-911.

Wong, A.F.L., & Fraser, B.J. (1996). Environment-attitude associations in the chemistry laboratory classroom. *Research in Science and Technological Education, 14,* 91-102.

Woodfolk, A.E., & Brooks, D.M. (1985). Beyond words: The influence of teachers' nonverbal behaviours on students' perceptions and performance. *Elementary School Journal, 85,* 513-528.

Wubbels, Th. (1993*), Teacher-student relationships in science and mathematics classes* (What Research Says to the Science and Mathematics Teacher, No. 11). Perth: National Key Centre for School Science and Mathematics, Curtin University of Technology.

Wubbels, Th., & Levy, J. (1991). A comparison of the interpersonal behaviour of Dutch and American teachers. *International Journal of Intercultural Relations, 15,* 1-18.

Wubbels, Th., & Levy, J. (Eds.). (1993). *Do you know what you look like?: Interpersonal relationships in education.* London: Falmer Press.

Wubbels, Th., Brekelmans, M., & Hermans, J.J. (1987). Teacher behaviour: An important aspect of the learning environment. In B.J. Fraser (Ed.), *The study of learning environments, Vol. 3* (pp. 10-25). Perth, Australia: Curtin University of Technology.

Wubbels, Th., Brekelmans, M., & Hooymayers, H. (1991). Interpersonal teacher behaviour in the classroom. In B.J. Fraser & H.J. Walberg (Eds.), *Educational environments: Evaluation, antecedents and consequences* (pp. 141-160). Oxford, England: Pergamon Press.

Wubbels, Th., Creton, H.A., & Holvast, A. (1988). Undesirable classroom situations: A systems communication perspective. *Interchange, 19*(2), 25-42.

Wubbels, Th., Creton, H.A., & Hooymayers, H.P. (1985, April). *Discipline problems of beginning teachers.* Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.

Wubbels, Th., Creton, H.A., & Hooymayers, H.P. (1992). Review of research on teacher communication styles with use of the Leary model. *Journal of Classroom Interaction, 27*(1), 1-11.

Wubbels, Th., Creton, H.A., Levy, J., & Hooymayers, H.P. (1993). The model for interpersonal teacher behavior. In Th. Wubbels, & J. Levy (Eds.), *Do you know what you look like?: Interpersonal relationships in education* (pp. 13-28). London: Falmer Press.

Yarrow, A., Millwater, J. & Fraser, B.J. (1997). Improving university and primary school classroom environments through preservice teachers' action research. *Practical Experiences in Profesional Education, 1*(1), 68-93.

Yeany, R.H., Helseth, E.A., & Barstow, W.E. (1980, April). *Interactive instructional videotapes, scholastic aptitude, cognitive development and locus of control as variables influencing science achievement.* Paper presented at the annual meeting of the National Association for Research in Science Teaching, Boston.

Zandvliet, D.B., & Fraser, B.J. (1998, April). *The physical and psychosocial environments associated with classrooms using new information technologies.* Paper presented at the annual meeting of the American Educational Research Association, San Diego, CA.

Zoller, U., & Watson, F.G. (1974). Teacher training for the second generation of science curricula: The curriculum proof teacher. *Science Education, 58,* 93-103.

Appendices

Appendix D

Test of Computer-Related Attitudes

(TOCRA)

Appendix D1: Test of Computer-Related Attitudes (TOCRA)

English Version

DIRECTIONS

This is NOT a test.

This questionnaire contains pairs of words that describe statements about COMPUTER.

Think about how each pair of words describes your feeling on each of the statements about COMPUTER.

There are no 'right' or 'wrong' answers. What is wanted is your opinion.

On the questionnaire, circle the number which best fits your opinion.

If you change your mind on a number, simply cross out the number and circle another number.

EXAMPLE

My Computer lessons are:

Clear	1	2	3	4	5	6	7	Confusing

If your feeling about your Computer lessons is very closely related to 'Clear', you would circle the number '1'.

If your feeling about your Computer lessons is very closely related to 'Confusing', you would circle the number '7'.

If your feeling about your Computer lessons is very closely related to 'your understanding of about 50% of the lessons', you would circle the number '4'.

Thankyou so much for your kind cooperation.

Test of Computer-Related Attitudes
(For each statement, circle ONE number for each pair of words)

Name: ..... Subject : ..... Class : .....

1. My Computer lessons are:

Clear	1	2	3	4	5	6	7	Confusing
Meaningless	1	2	3	4	5	6	7	Meaningful
Important	1	2	3	4	5	6	7	Unimportant
Useless	1	2	3	4	5	6	7	Useful
Easy	1	2	3	4	5	6	7	Difficult
Boring	1	2	3	4	5	6	7	Interesting
Pleasant	1	2	3	4	5	6	7	Unpleasant
Tense	1	2	3	4	5	6	7	Relaxed

2. The magazines/television programmes outside school on Computer are:

Clear	1	2	3	4	5	6	7	Confusing
Meaningless	1	2	3	4	5	6	7	Meaningful
Important	1	2	3	4	5	6	7	Unimportant
Useless	1	2	3	4	5	6	7	Useful
Easy	1	2	3	4	5	6	7	Difficult
Boring	1	2	3	4	5	6	7	Interesting
Pleasant	1	2	3	4	5	6	7	Unpleasant
Tense	1	2	3	4	5	6	7	Relaxed

3. A career/job in the area of Computer would be:

Clear	1	2	3	4	5	6	7	Confusing
Meaningless	1	2	3	4	5	6	7	Meaningful
Important	1	2	3	4	5	6	7	Unimportant
Useless	1	2	3	4	5	6	7	Useful
Easy	1	2	3	4	5	6	7	Difficult
Boring	1	2	3	4	5	6	7	Interesting
Pleasant	1	2	3	4	5	6	7	Unpleasant
Tense	1	2	3	4	5	6	7	Relaxed

4. Using Internet facility as a tool to get the information would be:

Clear	1	2	3	4	5	6	7	Confusing
Meaningless	1	2	3	4	5	6	7	Meaningful
Important	1	2	3	4	5	6	7	Unimportant
Useless	1	2	3	4	5	6	7	Useful
Easy	1	2	3	4	5	6	7	Difficult
Boring	1	2	3	4	5	6	7	Interesting
Pleasant	1	2	3	4	5	6	7	Unpleasant
Tense	1	2	3	4	5	6	7	Relaxed

Appendix D2: Kuestioner Sikap Terhadap Komputer

Indonesian Version

PETUNJUK PENGISIAN:

Ini BUKAN sebuah test.

Kuestioner ini berisi pasangan kata yang menjelaskan tentang sebuah penyataan mengenai KOMPUTER.

Pikirkan tentang bagaimana setiap pasangan kata menjelaskan perasaan Anda pada setiap pernyataan tentang KOMPUTER pada lembar kuestioner.

Tidak ada jawaban 'benar' atau 'salah'. Yang diharapkan adalah pendapat Anda tentang pernyataan yang diberikan.

Pada setiap baris pernyataan pada kuestioner, lingkarilah nomor yang sangat cocok dengan pendapat anda.

Jika Anda mengubah pendapat Anda pada sebuah baris tertentu, coretlah pilihan yang lama dan lingkari pilihan yang baru.

CONTOH:

Mata kuliah – mata kuliah Komputer yang telah saya ikuti adalah:

Jelas 1 2 3 4 5 Membingungkan

Jika perasaan **Anda** tentang mata kuliah – mata kuliah Komputer yang telah anda ikuti; sangat dekat dengan sesuatu yang berhubungan dengan kata 'Jelas', **Anda** dapat melingkari nomor '1'.

Jika perasaan **Anda** tentang mata kuliah – mata kuliah Komputer yang telah anda ikuti; sangat dekat dengan sesuatu yang berhubungan dengan kata 'Membingungkan', **Anda** dapat melingkari nomor '5'.

Jika perasaan **Anda** tentang mata kuliah – mata kuliah Komputer yang telah anda ikuti; sangat dekat dengan sesuatu yang berhubungan dengan 'pengertian **Anda** sekitar 50% dari pelajaran tersebut', **Anda** dapat melingkari nomor '3'.

Terima kasih banyak atas kerjasama Anda

KUESTIONER SIKAP TERHADAP KOMPUTER

(Untuk setiap baris pernyataan, lingkari SATU nomor untuk tiap pasangan kata)

NIM: ..... Mata kuliah: ..... Kelas : .....
Waktu mulai: Pk. ..... Waktu selesai: Pk. ..... Lama: .....menit

1. Mata kuliah – mata kuliah Komputer yang telah saya ikuti adalah:

Jelas	1	2	3	4	5	Membingungkan
Tidak berarti	1	2	3	4	5	Sangat berarti
Sangat Penting	1	2	3	4	5	Tidak penting
Tidak terpakai	1	2	3	4	5	Sangat terpakai
Sangat mudah	1	2	3	4	5	Sangat sulit
Membosankan	1	2	3	4	5	Menarik
Menyenangkan	1	2	3	4	5	Tidak Menyenangkan

2. Majalah / Program televisi tentang komputer adalah:

Jelas	1	2	3	4	5	Membingungkan
Tidak berarti	1	2	3	4	5	Sangat berarti
Sangat Penting	1	2	3	4	5	Tidak penting
Tidak terpakai	1	2	3	4	5	Sangat terpakai
Sangat mudah	1	2	3	4	5	Sangat sulit
Membosankan	1	2	3	4	5	Menarik
Menyenangkan	1	2	3	4	5	Tidak Menyenangkan

3. Karier / pekerjaan dibidang komputer akan:

Jelas	1	2	3	4	5	Membingungkan
Tidak berarti	1	2	3	4	5	Sangat berarti
Sangat Penting	1	2	3	4	5	Tidak penting
Tidak terpakai	1	2	3	4	5	Sangat terpakai
Sangat mudah	1	2	3	4	5	Sangat sulit
Membosankan	1	2	3	4	5	Menarik
Menyenangkan	1	2	3	4	5	Tidak Menyenangkan

4. Menggunakan fasilitas Internet sebagai sarana untuk mencari informasi adalah:

Jelas	1	2	3	4	5	Membingungkan
Tidak berarti	1	2	3	4	5	Sangat berarti
Sangat Penting	1	2	3	4	5	Tidak penting
Tidak terpakai	1	2	3	4	5	Sangat terpakai
Sangat mudah	1	2	3	4	5	Sangat sulit
Membosankan	1	2	3	4	5	Menarik
Menyenangkan	1	2	3	4	5	Tidak Menyenangkan

= Terima Kasih atas Kerjasama Anda =

Appendix E

Motivation Scale

Appendix E1: Motivation Scale

English Version

For these statements below, please draw a circle around:

1	if you	Strongly Disagree
2	if you	Disagree
3	if you are	Not Sure
4	if you	Agree
5	if you	Strongly Agree

M		Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
66	My parents encouraged me to choose this major.	1	2	3	4	5
67	My friends influence me to choose this major.	1	2	3	4	5
68	I choose this major because of my own interest in it.	1	2	3	4	5
69	I chose this major because it is relevant to my chosen career.	1	2	3	4	5
70	Achieving well in this major will help my career.	1	2	3	4	5

Appendix E2: Motivation Scale

Indonesian Version

Untuk pernyataan-pernyataan dibawah ini lingkari angka:

1	jika anda berpendapat	Sangat tidak setuju
2	jika anda berpendapat	Tidak Setuju
3	jika anda berpendapat	Tidak pasti
4	jika anda berpendapat	Setuju
5	jika anda berpendapat	Sangat Setuju

M		Sangat Tidak Setuju	Tidak Setuju	Tidak pasti	Setuju	Sangat Setuju
66	Orangtua saya mendorong saya untuk memilih jurusan ini.	1	2	3	4	5
67	Kawan-kawan saya mempengaruhi saya untuk memilih jurusan ini.	1	2	3	4	5
68	Saya memilih jurusan ini karena keinginan saya sendiri.	1	2	3	4	5
69	Saya memilih jurusan ini karena sesuai dengan karier pilihan saya.	1	2	3	4	5
70	Berhasil baik di jurusan ini akan membantu karier saya dimasa depan.	1	2	3	4	5