Science and Mathematics Education Centre

Computer Classroom Learning Environments and Students' Attitudes towards Computer Courses in Tertiary Institutions in Thailand

Kanokporn Charik

This thesis is presented for the Degree of
Doctor of Science Education
of
Curtin University of Technology

October 2006

Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university.

Signature:

Date: 15/07/2006

ABSTRACT

This thesis is significant in that it is one of the first evaluations of a computer classroom psychosocial learning environment and investigation of associations between learning environment factors and students' attitudes at the tertiary level in Thailand. Both quantitative and qualitative methods were used in this study. Three questionnaires were employed to provide quantitative data: the College and University Classroom Environment Inventory (CUCEI), the Computer Laboratory Environment Inventory (CLEI), and the Attitude towards Computer and Computer Courses (ACCC). The three questionnaires were administered to 905 computer science students in order to investigate their perceptions of their learning environment and associations between this and their attitudinal outcomes. Overall, the results generated from scale internal reliability analysis, mean correlations and ANOVAs suggested that the modified Thai versions of the CUCEI, CLEI, and ACCC are valid and reliable instruments for measuring students' perceptions of computing laboratory learning environments in a Thailand university. The results of an application of the CUCEI and CLEI demonstrated that students had positive perceptions about their computer classroom learning environment. The qualitative data obtained from student interviews supported the information from questionnaires and provided more detail about the computer classrooms. Measurements of students' attitudes indicated that students enjoyed their classes and thought they were useful. Regarding associations between students' attitudes and perceptions of the computer classroom, most scales of the Thai CUCEI and CLEI, were statistically significantly positively associated with the four scales of the Thai version of the ACCC. Importantly, there were significant negative correlations between scales of the CUCEI, and CLEI with the Anxiety scale.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude and appreciation to many people who have contributed for the completion of this study.

My most sincere gratitude and appreciation goes to my supervisor, Professor Darrell Fisher. He is a wonderful Professor, continually gives me various kinds of effective ideas, works hard, and encourages me to success. I am proud to have been his student.

I am grateful to University administrators, instructors, my friends, staff, and computer science students, who allowed me to collect data, participated in my study and supported me in the best way they could.

My very special thanks goes to my friends, Dr. Tuenjai Pinkerd, Dr. Wayudi and Mr. Lance Garret who always encouraged and constantly supported me through this study. My special thanks also go to my kind senior colleague, Mr. Kosum Charoenruay who encouraged me and replaced me when I obtained study leave from my work place.

I deeply appreciate their support and encouragement.

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

Page

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

This study focuses on computer classroom learning environments, both in lecture situations and computer laboratories, and students' attitudes towards computing courses in tertiary institutions in Thailand. Computing has been a subject of academic study for over 40 years in Thailand. It has been taught in many courses with many names, such as computer science, computer studies or electronic data processing. Generally, these courses are designed for the computing specialists who could start their careers as programmers or systems analysts. In Thailand, especially in higher education, computing courses may be offered as foundation, major and minor courses. In addition, the policy of the Thai Government is to enhance students' knowledge in using computers at all levels.

Thai students study computer courses both in theory and practice. Therefore, the learning environment for computer courses needs to be investigated both in normal classrooms and computer laboratories. Universities across Thailand offer computer science programmes where it is a requirement that all students take a computer course while students whose majors are computer science, communication arts, and others take several computer courses.

1.2 CONTEXT IN THAILAND

This section describes the context of computer science education in Thailand in a number of ways. These are: the significance of the computer, the Thai Government Policy in science and technology education, the National ICT for Education Master Plan, computer science curriculum in universities, and quality assurance and accreditation.

1.2.1 Significance of computers

The computer is considered as the first use of technology, in the long history of mankind, capable of making information processing fully automatic (Lavonen, Meisalo, & Lattu, 2000). In Thailand, the computer has become an important tool in the daily life of Thai people. Some people use the computer as a modern fully-automated technology of information processing. Moreover, information technology (IT) and information and communication technology (ICT) also play important roles in many people's lives. Thai lifestyle has been changing day by day. In many offices, institutions, and other work places computing tools such as word processors are installed to replace typing on paper. E-mail is used to replace posting letters, web-pages replace bulletin board newspapers, web-based instructions replace text materials, electronic data bases replace journals and books, the virtual university replaces the old-style university, and so on. These changes indicate that Thai people need to learn more about computers and become competent with computers. Therefore, the demand for computing courses in tertiary institutions is getting higher. To serve this demand, many institutions must provide computing courses and computing workshops.

1.2.2 Thai Government policy in science and technology education

The Thai Government policy on science and technology education has been planned with an emphasis on two points. The first is that science and technology is a most important curriculum area and it must be provided by all institutions at all levels, including foundation level, primary school, high school, undergraduate and graduate levels. The second is that there must be adequate production of educators of science and technology. The production of science and technology experts should enhance competition at the global level and create a strong and stable Thai economy. The vision of ICT for Education in the Master Plan impacts on the mission of all schools, institutes and learning centres. These institutions have to provide computing courses to achieve the aims of the plan.

1.2.3 The National ICT for Education Master Plan

The newly constructed National ICT for Education Master Plan states that:

> Thai society could be transformed in to learning society, if Thais have an opportunity to access lifelong learning and keep up with the changing world of new knowledge and information technology. They will learn how to gain knowledge for themselves. ICT will enable learners to access useful information and ICT for education will harness ICT as a tool for learning, in which every learner has the right and opportunity to access knowledge at any time, any place (National Advisory Committee on ICT in Education Reform, 2002, p. 22).

The Master Plan also provides a vision of ICT for Education. By 2005, every learner should have the opportunity to access ICT of adequate quality for learning at a reasonable cost. The vision for learners, teachers, administrators, schools/institutes/ learning centres is stated as:

1) Learners are able to use ICT as a tool for learning throughout their lives.

2) Teachers should have a high level of ICT knowledge and skills including an understanding of the development of learning and teaching media for instruction.

3) Administrators must have vision regarding management and innovation in using ICT for teaching and learning, both in and out of school.

4) The infrastructure enables the learners to connect and access ICT for education conveniently in schools, institutes and learning centres.
(National Advisory Committee on ICT in Education Reform, 2002, pp. 24-26).

At present, computers have played important roles especially for Information and Communication Technology (ICT). In Thailand, computers are used widely for many purposes ranging from office work to school work, by adults and children. Computers are utilized in educational institutes for two major tasks. First, computers deal with administration and management in all offices. Secondly, computers serve as instructional tools.

The Ministry of Education in Thailand realized the significant role of the computer in the modern world. Thus, computer studies have been designated for compulsory courses starting by secondary education. University students are required to take computer courses at least to expand their basic knowledge on computer literacy to competency level for their advanced schoolwork. More specific computer courses are also offered for university students. Competent and skilled personnel on computers are trained for various kinds of work in the real world. Computer science, computer engineering, computer architecture, information technology are major disciplines that produce computer experts in Thailand.

1.2.4 Computer science curriculum in universities

Therefore, universities in Thailand have a compulsory mission to produce educators who are experts in science and technology. All these institutes have provided science and technology courses for both regular students and part-time students. For science majors, they offer physics, biology, chemistry, environmental science and computer science. Most students pay much attention to studying computer science. For technology, the institutes offer electronics, construction, etc. Universities are supporting the development of science and technology teachers by providing many workshops for teachers from primary and secondary schools and some government officers. These workshops involving computers have interested many stakeholders.

Computer science is concerned with the design and implementation of efficient software solutions to computer-solvable problems. In order to produce efficient software solutions, the computer scientist must have a substantial amount of knowledge in such areas as mathematics, science, software design, programming languages, computer architecture, and problem solving and proof techniques. The Bachelor of Science degree offered through the Computer Science Department in the universities not only provides intensive study in these areas of knowledge, but also focuses on the development of the ability to integrate and apply this knowledge to the solution of important real-word problems. In order to earn the Bachelor of Science degree in computer science, the student must take course requirements of at least 144 units. They are the listed as follows:- 1) general education requirements 33 units, 2) computer science at least 100 units, 3) free elective at least 10 units.

1.2.5 Quality assurance and accreditation

As acknowledged by computing lecturers and teachers, the quality of computing courses in institutions has been a problem in Thailand, particularly, according to follow-up studies of students who have graduated (Savanananandu,1987). Savanananandu attempted to find out whether the college-level computer curricula were relevant to the market needs. Five computer courses from four universities in Thailand were assessed. The results of this study found that the computer curriculum offered by the universities was not completely relevant. This means that the computer curiculum needs to be reformed both in structure and outcomes, therefore, many institutions have been concerned about computing curriculum development. The study of Savanananandu is described in more detail in Chapter 2.

To solve these problems, the office of the National Education Commission in Thailand arranges quality assurance and accreditation for tertiary institutions. Therefore, each university undergoes quality assurance and accreditation. One of the processes in quality assurance is quality assessment of teaching and learning in each department. The assessment instrument for computer classroom learning environment can serve the computer department in this mission and it also provides help to computing instructors who develop the curriculum.

Teaching computer courses in schools, colleges, and universities in Thailand is arranged in classrooms and laboratories. In regular classrooms, teachers tend to organize or manage learning activities and students themselves tend to receive the lessons from teachers. Teachers' planning for classes is the frame within which activities are shaped. Students' roles, however, tend to be passive if traditional methods are used but may become active if the teachers plan more innovative lessons. Teachers and students interact at some level and this interaction becomes a factor that helps create a learning environment. Researchers pay much attention to finding ways to get positive interactions in classrooms. Positive interactions makes students happy while negative interactions do not. Teachers normally like their students to feel happy in class so they are likely to enhance happiness, and therefore learning, for their students. Teachers need to receive feedback from students in class and assess their own behaviours in order to create a good learning environment as

well as happy lessons. This feedback can help teachers reflect and improve their teaching and classroom management.

In laboratories, students need to learn through hands-on practice and experimentation. Theory will be applied in the laboratories. Equipment and software are part of the environment and steps of learning and teaching in laboratories must be well planned. That is, students interact with equipment, software, theories, other students and teachers. In laboratories, students mainly concentrate on getting the experiments or tasks done. The environment in laboratories involves many more factors than those in regular classrooms.

Education processes that can lead to competent computing studies involve several key factors. Curriculum, methods of teaching, materials, and facilities must be considered. Moreover, relationships between instructors and students as well as learning environments are also main issues of investigation. Educators in many countries have paid attention to studying the learning environment (Fraser, 1998b). In the Netherlands, researchers used a quesionnaire named the *Questionaire on Teacher Interaction* (QTI) to investigate the relationships between teachers and students (Wubbels, Brekelmans, & Hooymayers, 1991). In Australia, Fisher, Henderson, and Fraser (1995) studied associations between teacher-student interactions in science classes and student outcomes. Moreover, cross-validation and comparative study with the QTI has been completed at various grade levels in the USA (Wubbels & Levy, 1993), Singapore (Goh & Fraser, 1996), and Brunei (Riah & Fraser, 1998b).

Other countries in Asia have also been interested in the classroom learning environment. Margianti, Fraser, and Aldridge (2001) studied the relationship between attitudes and achievement of university students in computer classrooms in Indonesia. She found that learning environments influence students' outcomes. Other researchers have found that learning environments can help predict students' learning achievement (Fraser, 1998b).

For this study, the researcher was interested in investigating the learning environments of computing courses. The assessment of students' perception of the

learning environment can provide very good feedback for instructors who can improve the learning environments in their classrooms as well as in their laboratories. The significance of learning environment studies is explored further in the next section.

1.3 SIGNIFICANCE OF CLASSROOM LEARNING ENVIRONMENTS

Classroom environment is a key aspect in the success of the education process and learning occurs in good classroom environments. Fraser (1998a) pointed out the meaning of the educational environment and the ways in which it could increase students' learning. He noted that defining the classroom or school environment in terms of the shared perceptions of the students and teachers has the dual advantage of characterizing the setting through the eyes of the participants themselves and capturing data which the observer could miss or consider unimportant. Fraser (1998a) also stated that students are at a good vantage point to make judgments about classrooms because they have encountered many different learning environments and have enough time in class to form accurate impressions. Even if teachers are inconsistent in their day-to-day behaviour, they usually project a consistent image of the long-standing attributes of classroom environment Fraser (1998a, p. 528).

In any good classroom, cooperative learning between students and teachers is a key factor to encourage good learning climates. Fraser (1998a) suggested that classroom environment researchers should work on the relative effectiveness of cooperative, competitive, and individualistic goal structures. Past studies show the generally positive effect of cooperative learning approaches on student achievement (Johnson, Maruyama, Johnson, Nelson, & Skon 1981). Therefore, cooperation is an important dimension in the classroon which should be provided by teachers to encourage effective learning environments.

Many instruments for assessing classroom environment have been constructed, but it is important that the instrument is valid and reliable for the particular purpose, therefore, the instrument must be designed to assess the particular classroom environment. Brophy and Good (1986) stated that in constructing a tool for assessing the learning environment, a researcher needs to take several factors into account,

such as those proposed by Moos (1979). Moos and Trickett (1987) developed an instrument to evaluate classroom environment based on social climate. Fraser, Williamson, and Tobin (1987) argued that classroom environment instruments can be used as a source of process criteria in the evaluation of educational innovations. Instruments are keys to finding out how the classroom environment creates a learning atmosphere. However, the most appropriate tool should be selected or designed for a particular classroom study.

Some examples of these instruments designed for assessing learning environment in a variety cases are the following. The *Learning Environment Inventory* (LEI) was one of the first instruments and was developed and validated for evaluation and research related to Harvard Project Physics, (Fraser, Anderson, & Walberg, 1982; Walberg & Anderson, 1968). The *Classroom Environment Scale* (CES) grew out of research involving perceptual measures of a variety of human environments including psychiatric hospitals, prisons, university residences and work milieus (Fisher & Fraser, 1983; Moos, 1979; Moos & Trickett, 1987). The *Individualised Classroom Environment Questionnaire* (ICEQ) was developed for assessing those dimensions which distinguish individualized classrooms from conventional ones (Fraser, 1990), while the *My Class Inventory* (MCI) was developed originally for use at the primary school level. It also has been found to be useful with junior high school students especially those with limited reading skills (Fisher & Fraser, 1981; Fraser, Anderson, & Walberg, 1982; Fraser & O'Brien, 1985). The *College and University Classroom Environment Inventory* (CUCEI) was developed and focused on the tertiary level or colleges and universities learning environments (Fraser & Treagust, 1986; Fraser, Treagust, & Dennis, 1986). The Questionnaire on Teacher Interaction (QTI) (Wubbels, Creton, & Hooymayers, 1985) focused on the nature and quality of interpersonal relationships between teachers and students. The *Science Laboratory Environment Inventory* (SLEI) is an instrument specifically suited to assessing the environment of science laboratory classes at the high school or higher education levels, (Fraser, Giddings, & McRobbie, 1995; Fraser & McRobbie, 1995). The *Constructivist Learning Environment Survey* (CLES) (Taylor, Dawson, & Fraser, 1995; Taylor, Fraser, & Fisher, 1997) was developed to assist researchers and teachers to assess a particular classroom's environment consistent with a constructivist epistemology, and also assists teachers to reflect on

their epistemological assumptions and reshape their teaching practice. The *What Is Happening In This Class* (WIHIC) questionnaire that brings to the field of classroom environment by combining a modified version of the most salient scales from a wide range of existing questionnaires with additional scales that accommodate contemporary educational concern (Fraser, Fisher, & McRobbie, 1996). Currently, much new technology is integrated into the classrooms. It results in many new instruments being developed suitable for assessing the learning environment based on technology-rich situations. Moreover, context in the classroom learning environment has been changed continually by advanced educational technology. Therefore, classroom learning environment needs to be evaluated continually. The *Computer Laboratory Environment Inventory* (CLEI) focused on assessing learning environment in computer classroom (Newby & Fisher, 1997). While the *Web-Based Leaning Environment Instrument* (WEBLEI) was developed for assessing web-based learning environment (Chang & Fisher, 2003). Finally, the *Technology-Rich Outcomes-Focused Learning Environment Inventory* (TROFLEI) is a widely-aplicable and distinctive questionnaire for monitoring students' perceptions of their learning environments in technology-rich, outcomes-focused learning setting (Aldridge & Fraser, 2003).

Many of these questionnaires are available in two forms: the Actual and Preferred. Whereas the Actual Form measures the learning environment as perceived by students, the Preferred Form 'is concerned with goals and value orientations and measures perceptions of the classroom environment ideally liked or preferred' (Fraser, 1998a, p. 539). Importantly, learning environment research which has adopted a person-environment fit perspective (Hunt, 1975) has revealed that the similarity between the actual environment and that preferred by students leads to improved student achievement and attitudes (Fisher & Fraser, 1983; Fraser & Fisher, 1983a, 1983b).

Previous studies have found that student outcomes are strongly associated with learrning environments (Fisher, Henderson, & Fraser, 1997; Fraser & McRobbie, 1995; McRobbie & Fraser, 1993; Teh & Fraser, 1995; Wong & Fraser, 1996). Therefore, implementation of improved curriculum needs to establish a positive learning environment for all institutions and education levels. The assessment of

classroom learning environments with suitable questionnaires not only provides the teacher with an authentic view of students' perceptions toward their classrooms but also is important for student outcome development.

1.4 SIGNIFICANCE OF PRESENT STUDY

This study is significant for five reasons. First, it will provide new information about learning environments in computer classrooms and laboratories and students' attitudes toward computer use and computer courses. Secondly, it will have implications for curriculum development and also improving students' attitudes towards computer use and computer courses. Thirdly, students will have an opportunity to voice their opinions on learning and teaching about computers so that they can help improve their own ability. Fourthly, it will provide computer teachers with knowledge of instruments that they can use for their further research. Finally, this study can help serve the policy of universities to improve students' knowledge on computer learning and teaching.

1.5 RESEARCH OBJECTIVES OF STUDY

The overall aim of this research study was to validate classroom learning environment instruments and investigate students' perceptions of their computer classroom learning environment in tertiary institutions in Thailand. Associations between these perceptions and students' attitudes towards computer use and computer courses were also investigated.

The objectives of this study were to:

1. translate and validate Actual and Preferred versions of the College and University Classroom Environment Inventory (CUCEI) as modified by Nair (1999), the Actual version of the Computer Laboratory Environment Inventory (CLEI), and the Attitude towards Computer and Computer Courses (ACCC);
2. use the two versions of the CUCEI to investigate students' perception of computer classroom learning environment;

3. compare how students' actual perceptions of their computing lecture classrooms differ from their preferred perceptions;
4. use the CLEI in the Actual Form to investigate students' perceptions of their computer laboratory;
5. use the ACCC to investigate student attitudes toward computers and computer courses;
6. compare male and female students' perceptions of their lecture classroom and laboratory;
7. investigate associations between students' perceptions of their lecture classroom and their attitudes towards computers and computing courses; and
8. investigate associations between students' perceptions to their computer laboratory and their attitudes towards computers and computing courses.

These objectives gave rise to the following research questions.

1. Is the College and University Classroom Environment Inventory (CUCEI) a valid and reliable questionnaire for use in Thailand?
2. Is the Computer Laboratory Environment Inventory (CLEI) a valid and reliable questionnaire for use in Thailand?
3. Is the Attitude towards Computers and Computer Courses (ACCC) a valid and reliable questionnaire for use in Thailand?
4. What are students' perceptions of their actual computer classroom learning environments?
5. What is the difference between students' actual and preferred perceptions of the learning environments of their computer classrooms?
6. Are there any differences between males and females in perceptions of their computer classroom learning environments?
7. Are there any differences between males and females in perception of their computer laboratory learning environments?
8. Are there any associations between students' perceptions of their computer lecture classroom and their attitudes towards computers and computing courses?

9. Are there any associations between students' perceptions of their computer laboratory and their attitudes towards computers and computer courses?

1.6 METHODOLOGY

The main purposes of this study were to validate three computer classroom learning environment instruments, the Personal Form of the CUCEI which had been developed by Nair and Fisher 1999, the CLEI and the ACCC and to utilize them to examine the learning environments of computer classrooms and students' attitudes towards computing courses in universities in Thailand.

The sample consisted of 905 computer science major students in 33 classrooms from 11 universities. These students studied in a variety of computing courses, each course requiring four hours a week for formal study, two hours for laboratory time, two hours for lecture time. Students also can work and practise in the laboratory as often they please.

Data were collected in the second semester in the 2002 academic year on two occasions. First, the students' responses to the questionnaires were obtained and secondly the students responded to interviews with audio tape recording. All of the students who were participants were introduced to the aims of study and the questionnaires to be completed to ensure they understood the purpose of the questionnaires. For the qualitative method, in which interviews were used, volunteers were sought to take part and give their opinions of the classroom environment. Two volunteers from each classroom were interviewed. Then the data were transcribed to complement the quantitative data which were obtained through questionnaires.

The data were analyzed in three steps: first, the instrument validity was checked using the Cronbach alpha reliability, discriminant validity and one–way ANOVA. Secondly, the students' perceptions towards learning environments in lecture classrooms were compared between the actual and preferred by using a t-test and effect size; thirdly, differences between male and female students' perception toward their lecture classroom and laboratory were compared using a t-test and effect size; and fourthly, the correlations between students' perceptions of computer laboratories

and their attitudes toward computer use and computer courses were investigated by using both simple and multiple correlations.

1.7 OVERVIEW OF THESIS

This first chapter has provided the introduction, background, significance, objectives of the study, a summary of the methodology, and an overview of thesis. Chapter 2 contains a review of the relevant literature, beginning with an overview of technology education in Thailand; advances in technology education computer teaching; study of learning environment; instruments for assessing classroom environments particularly focusing on the CUCEI, CLEI, ACCC; past research studies of these questionnaires in many countries; and the effects of learning environments and technology-rich classroom learnings on student attitudes. Chapter 3 describes the methodology used in this research study and includes details of the translation and validation of the three questionnaires. Chapter 4 describes the validation of the three classroom learning environment instruments. Chapter 5 describes the results of the application of the learning environment instruments and the data on students' perceptions of their computing lecture classrooms. Comparisons between students' perceptions on both the Preferred and Actual Forms of the CUCEI, and students' perceptions to their computer laboratories also are included. Chapter 6, describes the results of association between students' perceptions of their learning environment and their attitudes. Finally, Chapter 7 addresses the conclusions, provides a summary of major findings, suggests implications of the study, and provides directions for future research studies.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In today's modern world, rapid changes in technology have resulted in rapid changes in society that continue to take place almost everywhere. Higher education has the obligation and duty to prepare its students for these changes in order for them to survive in today's world. One of the fastest changing major areas in higher education is computer science. It is a subject in which students learn to understand and use computers efficiently, and benefit from this not only during their current study, but more so in their future work and survival in our high-tech and competitive world. Higher education therefore has the duty to encourage and motivate students by providing them with a positive learning environment.

This study, the aim of which is to assess the psychosocial learning environment of computer science classrooms and laboratories, involved several driving forces. First, instruments for assessing the computer classroom and laboratory environment were adapted and validated for the Thai university context. Second, an investigation of some determinants of students' perceptions of the computer laboratory and classroom learning environments was conducted. Third, an investigation of students' attitudes toward computer and computing courses was carried out. Finally, the association between student attitudes and their perceptions of computer classroom and laboratory learning environment was investigated.

The purpose of this chapter is to review the literature on which the present investigation was built. In particular, this chapter provides the background for answering the research questions related to computer courses in a Thai university context. Section 2.2 reviews literature pertaining to technological education in Thailand and the advances of technological education in computer teaching. A review of previous studies in learning environment which provide a historical perspective of the nature and the instruments involved in the study is presented in section 2.3. The following section reviews issues related to the instruments that are

used to investigate technology-rich learning environments. Issues regarding students' attitudes in technology-rich classrooms are reviewed in section 2.5. This study also involves investigation of the associations between students' perception of their learning environment and their attitudes, therefore, issues related to the effect of learning environment on students attitudes is discussed in this section. Descriptions of prior studies that employed the CUCEI, the CLEI and the ACCC are presented in section 2.6. Finally, the chapter concludes with a summary in section 2.7.

2.2 TECHNOLOGICAL EDUCATION

This section discusses issues related to technological education. Section 2.2.1 covers the current trend of technological education in Thailand, whereas section 2.2.2 discusses the advances of technological education in computer teaching.

2.2.1 Technological education in Thailand

Research on technological education in Thailand has been done at various levels. However, in tertiary education, there have been only a few studies involving aspects of computer science and computer classroom-learning environments that have been completed.

In 1987, Savananandu attempted to find out whether there is relevance between college level computer curricula and market needs. Five computer curricula from four universities in Thailand were assessed. The data were collected through four types of questionnaires that were handed out to three respondent groups. These groups were fourth year students who were graduating within the next 30 days from the day the questionnaires were handed out; graduated students who were currently in the work force; employers and eight experts in the computer science. Four assertions were made from this study. First, as computer technology advances extremely fast, graduates of different years are exposed to different learning experiences. Secondly, system analysts are mostly needed in the computer professionals markets, followed by programmers. Not as many computer engineers as should be are in demand. Thirdly, it was found that the relevance of five computer curricula to the market needs offered by the faculty of two universities were

incomplete. Even though the computer engineering curriculum and electronic data processing curriculum offered by the Faculty of Commerce and Accountancy at one of the universities had high aims, some faculties have difficulties in pinpointing what the curriculum is producing. One computer science curriculum offered by another university was highly orientated to the market needs.

In 1995, Manapee studied the curriculum and teaching environments of the computer science programs at a university in Thailand (Manapee, 1995). Her study revealed that four of the undergraduate computer curricula needed to be constantly modified and modernized to keep up with new technologies by improving subject matter to suit current applications and situations. Moreover, for the short-term curricula, she offered four suggestions as follows. First, the instructors, equipment, course materials and space, all need to be improved. Second, more computer-degree instructors and more training for current instructors are needed. Third, the lecture rooms and laboratories should be separated, and the students exposed to actual practices. Finally, although the computer curricula offered are usually appropriate; the learning environment, however, is still at a rather moderate level that needs to be improved.

Another study that evaluated the curriculum and instruction management of computer science programs at the bachelor degree at the tertiary level is the work of Sripai (1999). He evaluated four dimensions of computer science curriculum management with four groups: 79 computer instructors, 384 senior computer science students, 229 computer science graduates and 93 of their superiors. The results were presented in four phases: First, in relation to context, the curriculum should be designed in such a way as to prepare highly qualified computer experts. Thus, the content of both general education and major subjects should be modified to be more up to date, but also correspond to the basic background knowledge of the students. Second, in relation to input, the number of instructors should be increased; also the instructors should develop their knowledge to make themselves better instructors. Students should improve their knowledge, interest in learning and their learning ability. Instructional support materials and classrooms should correspond to students' needs. Third, in relation to process, the instructional management should be student

centred. Finally, in relation to production, the graduates should have organizational skills, accuracy in working, discipline, and be active and self-confident.

In 1999, Tansopontanasak conducted a distinctive research study on the physical environment in the computer classroom (Tansopontanasak, 1999). He designed and developed a student screen monitoring system via a network, and connected the computers of the Computer Engineering Department with the Faculty of Engineering classrooms of the Chulalongkorn University. In his case study, he helped instructors by providing them with special hardware that was not required to be plugged into the network. The program could be divided into two sections. Briefly, one section functioned as a client monitoring student computer screens, the other functioned as a server that sent their screen to a monitoring computer. The TCP/IP standard network protocol was used to send data through an RFB application protocol with the surprising result that this program could actually be used in a computer classroom with 27 computers.

In addition, Modemanee (2000) conducted a study relating computer classroom design with cooperative learning. Five principal cooperative learning approaches were investigated. These approaches were Student Teams Achievement Division, Teams Games Tournaments, Jigsaw, Learning Together and Group Investigation. The result of the study revealed that a workstation for cooperative learning functioned best when two workstations were joined in a half-circle shape for the group, alternatively facing the front of the class. The five cooperative learning approaches were suitable for this computer classroom design, with the most effective being the Learning Together and Group Investigation approaches.

In 2001, Lapa evaluated the use of primary school computer laboratories. Using a questionnaire that was administered to 15 computer laboratory teacher-supervisors and 108 teachers, it was shown that the use and maintenance of computer-laboratories were viewed at a moderate level. However, there were an inadequate number of computers with too low a memory per unit available for effective student practice.

In 1996, a unique study that investigated the physical environment of computer classrooms was conducted by Chitwiriya (1996) using a small number of experts as data sources. Briefly this study showed that a computer classroom in elementary schools should be on a leveled floor and the classroom size should be eight by ten metres for 25 workstations. It was also concluded that computers should be placed in rows, facing the front of the room.

It is noteworthy that research on technology education in Thailand designed to result in an improvement in the curricula being taught, usually only focused on the physical classroom-learning environment. No specific research study was found that examined the psychosocial learning environment. Indeed, educators and policy makers should consider using research studies that not only deal with the physical environment but with the psychosocial learning environment as well. More research focusing on the computer classroom psychosocial learning environment is needed in Thailand and this present study was conducted in order to begin to fill this gap.

2.2.2 The advance of technology education in computer teaching

As constructivism in computer teaching is increasing as ICT progresses rapidly, its impact on computer teaching is unavoidable. Instructors try to manage their educational work by being innovative within this vast developing technology. Educational researchers become more and more interested in effective educational theories and ideas referring to the concepts of constructivism, cooperative learning, and effective teaching and learning strategies. Instructors need to organize their classrooms by establishing a positive learning environment based on these ideas. Some research studies related to this issue are reviewed in the following sections.

2.2.2.1 Constructivism

Presently, constructivism is one of the most popular strategies for effective teaching and learning, and increasingly is used to encourage students to learn for understanding and reducing rote learning. Constructivist models shift the focus from the student as a passive recipient of information to being an active constructor of knowledge (Good & Brophy, 1995). Constructivists believe that learners learn from experience, phenomena, objects, events, activities, and processes. Interpretations of

these experiences are based on the student's previous knowledge, thoughts, and reflections on experiences and eventually meaning making (Bruner, 1990). Meaning making is the heart of constructivism.

Jonassen, Peck and Wilson (1999) indicated that knowledge is constructed, but not transmitted. Individuals can make sense of everything they may meet by constructing their own representations or models of their experiences. Thus, knowledge cannot be simply transmitted by the teacher to their students; teaching is not a process of imparting knowledge. Knowledge construction comes from activity; therefore, knowledge is embedded in activity and experiences. By using constructivist's ideas, computer instructors can provide students with situations and activities, promoting their thinking, meaning making and constructing knowledge through assignments and computer laboratory activities. Tasks should support critical thinking and flexibility with respect to learning opportunities and individual differences.

In Thailand, Wanpen and Fisher (2005) studied constructivist learning environments in computer classroom and associations between learning environments and attitudinal outcomes. Two questionnaires were administered to students undertaking computing courses in a tertiary institute in the northeast of Thailand, These were the Constructivist Learning Environment Survey (CLES) and the Computer Laboratory Environment Inventory (CLEI).The results indicate that students rated the sharing of control as low at 2.69 (max 5.0). The other scales (Personal Relevance, Uncertainty, Critical Voice and Student Negotiation) ranged from 3.29 to 3.70. Students perceived their computer laboratory environment least favourably on the availability of resources but perceived it most favourably on integration. Moreover, there were positive associations between students' attitudinal outcomes and the characteristics of both the constructivist and the computer laboratory learning environment. Student attitudes were most influenced by the relevance of their lessons to their real life.

2.2.2.2 Cooperative learning

Cooperative learning is a pedagogical technique that has students work together in groups on a structured learning task with the aim of maximizing their own and each other's learning (Johnson, Johnson, & Holubec, 1998).Yang and Liu (2005) claimed that this pedagogical technique is one of the most widespread and fruitful areas of

theory, research and practice in education, moreover, it has been applied to computer science learning at all levels. Many researchers have identified the positive research effect of cooperative learning on student achievement (Johnson & Johnson, 1991; Ravenscroft, Buckless, McCombs, & Zuckerman, 1995; Slavin, 1995).

The applications of cooperative learning models in computer learning are found in many studies. Yang and Liu (2005) employed Johnson and Johnson's "learning together" approach used to teach third-grade students information literacy. They investigated the perceptions and attitudes, interactive processes, behaviour and patterns of student learning information technology via a cooperative approach. The results showed that there is a positive value of a cooperative approach when effectively integrated into computer curriculums. Group interaction was more procedure related, including topic choice, duty assignation, content selection, and computer operation. Most students mastered computer skills, but approached a knowledge-building project with less of a sense of synthesis and integration. Moreover, four different forms of interactions (Individual, Authoritative, Argumentative and Consolidated) were found during the earlier stages of learning cohesion and this increased in the later stages.

Another study was directed at the influence of group constitution on group function, in particular the influence of teamwork and cooperative learning on the individual's perception of the subject. Computer science students were placed in groups at the beginning of course using team role concept. Students indicated that working in teams contributed to their understanding of the subject and that they gained on a personal and social level (Blignaut & Venter, 1998).

2.2.2.3 Integration of technology into the classroom

Computer technology has the potential to transform a passive learning environment into one which is more active (Weigel, 2002). Additionally, Roblyer (2003) demonstrated that the inclusion of technology resulted in the following. First, an increasing amount and type of technology resources which are available to instructors and learners was necessary; and secondly, the shift in learning strategies which the flexibility of computer technology can afford is promising. It appears that the introduction of computers into the classroom provides a richer learning

environment where the learner is more actively involved in learning (Chang & Fisher, 2003).

Jonassen, Peck, and Wilson, (1999, p. 2) described how technology can be integrated into the classroom and that students learn from thinking, thinking about what they do or what they did, what they believe in, what others have done and believe, and thinking about the thinking processes they use. They suggested that thinking mediates learning and learning is the result of thinking. Different activities result in different kinds of thinking. These different kinds of thinking might be the requirement to memorize a list, read a book, understand a lecture, solve a problem, design a new product, or discuss a point. The use of technology might support these activities. They concluded that learners do not learn directly from the technology, rather they learn by thinking about what they are doing.

Jonassen, Peck, and Wilson (1999, p. 13) further demonstrated that technology plays five useful roles in the kind of learning environment, which fosters learning. First, technology as a tool to support knowledge construction for the learner's ideas, understanding, and beliefs, producing organized multimedia knowledge based on learners. Second, technology as an information vehicle, exploring knowledge to support learning-by-constructing, to access needed information, comparing perspectives, beliefs, and world views. Third, technology as context to support learning by doing, representing and stimulating meaningful real-world problems, situations and contexts, representing beliefs, perspectives, arguments and information from others, defining a safe, controllable problem space for students thinking. Fourth, technology as a social medium to support learning by conversing for collaborating with others, discussing, arguing, and building consensus among members, supporting discourse among knowledge-building communities. Fifth, technology as an intellectual partner to support learning-by-reflecting, helping learners to articulate and represent what they know, reflecting on what they have learned and how they came to know it, for supporting learners internal negotiations and meaning making, for constructing personal representations of meaning, for supporting mindful thinking.

Technology also can help to facilitate the knowledge-constructed classroom (Muir-Hezig, 2003). Many researchers monitor the influence computers have on the teaching and the learning process. Through the use of computers, classrooms could become more student-centred and individualized learning would take place more than ever before (Bork, 1985; Papert, 1980; Ragosta, 1983). In student-centred classrooms, computers can aid students to collaborate, use critical thinking, and find alternatives to solutions of problems. Negroponte, Resnick, and Cassell (1997) supported this idea by stating that the Internet allows children and adults from around the world to meet and study together, thereby learning from each other.

It is apparent in the literature that with the growth of digital technologies, students can take responsibility for their own development. This is a shift from being a passive recipient to becoming an active and independent learner. In this process the role of the teacher moves from being an expert to becoming a collaborator or a guide. Finally, Muir-Herzig (2003) suggested that in the case of students learning with technology and who have technology integrated into the curriculum, potentially these could be a positive change in the students' classroom grades, GPA, and attendance.

2.3 STUDY OF LEARNING ENVIRONMENT

There has been remarkable progress in conceptualising, the study of learning environments over the last six decades. This section reviews the long history of learning environment studies. A definition on learning environment, the criteria of a good learning environment and suggested efforts in improving learning environments are presented in section 2.3.1. A review of research on past learning environment in various contexts is provided in section 2.3.2. Following this section, a discussion of the instruments employed in the various study of learning environment is outlined in section 2.3.3. The College and University Classroom Environment Inventory is introduced in section 2.3.4. and technology-rich learning environments are described in 2.3.5.

2.3.1 Concept of learning environment

Wilson (1996, p. 5) defined learning environment as a place where people can learn by working together and supporting each other by using a variety of tools and information resources in their guided pursuit of learning goals and problem-solving activities. This place is an exploration space where learners perform learning activities, use information resources and knowledge construction to solve problems. Moreover, learners are presented with complex and relevant problems, projects, or experiences that they accept or reject as a challenge (Jonassen, Peck, and Wilson, 1999, p. 194). Studies on learning environment are usually based on study the perspectives of the participants from within such classroom environments.

The study of learning environments was contributed greatly by the concepts of Lewin and Murray. Initially, Lewin (1936) suggested that human behaviour is determined by both the environment and its interactions with the personal characteristics of the individual. He proposed a most important human behaviour formula which has influenced the theoretical framework for learning environment research. The symbolic function is B=f (P, E), human behaviour (B) is believed to be a function (f) of the person (P) and of the environment (E).

In 1938, Murray adopted Lewin's approach to study human environment and introduced the need-press model, which refers to the personal needs of an individual and environmental press, He described the *personal needs* as referring to motivational, personality characteristic representing tendencies to move in the direction of certain goals, and *environmental press* as providing an external situational counterpart, supporting or frustrating the expression of the internalised personality needs. Moreover, significantly he differentiated *environmental press* into two types, alpha press and beta press. Alpha press is the environment as perceived by an external observer, whereas beta press is the environment as perceived by the participants in that environment. In 1956, Stern, Stein, and Bloom further differentiated Murray's beta press into *private* and *consensual press*. Private beta press refers to each person's view of the environment, and consensual beta press provides a shared view of the environment by a group member. These definitions have guided many research studies where students' perceptions and teachers'

perceptions have been used to describe the classroom learning environment as it is considered that the perspectives of the participants from within the environment are better than the outside observers' views. This is the approach that was used in the research described in this thesis.

2.3.1.1 The quality of learning environment

It is very clear that educators do pay attention to the quality of the learning environment. Many studies related to the quality of the learning environment have been implemented. For example, Killen (2003) introduced the idea that the quality of a learning environment is embodied in six elements. These elements are Explicit quality criteria, High expectations, Academic engagement, Social support for student achievement, Student self-regulation, Student directions. The elements are explained by Killen (pp. 18-19) as follows. *Explicit quality criteria:* Teachers should ensure that their students realize the importance of the outcomes they are required to achieve and how quality of their achievement will be judged. *High expectations:* Teachers should expect students to achieve outcomes to high standards, and usually try to improve student's strengths, abilities and interests by indicating interest in their students and their study. *Academic engagement:* Academic engagement will be evident if students are on task, focused on important issues and consciously strive to learn. Students should seriously engage in learning in order to achieve deeper understanding. *Social support for student achievement:* Teachers should expect all students to achieve and develop a learning environment which will support success. A sense of community in the classroom and a climate of mutual respect developed by the teachers can make students promote understanding rather than reinforce prejudices. *Student self-regulation:* Teachers should encourage and require students to regulate their own behaviours so that there is minimum need for discipline and regulation. *Student directions:* Students should be given as much control as is feasible over what and how they learn through negotiation and guidance. They should be encouraged to assume responsibility for their own learning. In summary, it is the heart of good modern teaching that teachers should provide students with a good quality learning environment.

The ideas of Killen mentioned above demonstrate the potential of the teacher to influence the quality of the learning environment in the classroom. The teacher is the

most importance person who has the responsibility to organize a good quality classroom for their students. The next section discusses issues related to establishing a positive learning environment.

2.3.1.2 Establishing a positive learning environment

Having a positive learning environment is not only valuable in its own right but it also leads to highly valued improvements in student achievement (Walberg, 2002). Many researchers agree with Walberg, they claim that positive learning environments have to be created to enhance student's satisfaction, engagement in learning, and academic achievement (Ames, 1992; Candy, Crebert, & O'Leary, 1994; Ramsden, Margetson, Martin, & Clarke, 1995). Instructors who consider creating a positive learning environment must be supportive of all students and respect the diversity of languages, cultures, values, and attitudes, which they bring into the classrooms. Students who feel they belong to the class will be more at ease, enthusiastic and willing to become actively involved in learning.

Instructors can establish a safe, comfortable, and supportive environment more effectively if they know of the students' perceptions towards classroom environments. Thus, instructors can use information obtained from classroom environment assessments to guide attempts to create a positive learning environment. The criteria that guide the establishment of a positive learning environment are as follows: teacher personality, teacher-student relationships, student-student relationships, innovative education, task orientated curricula, involved students, cooperative learning, individualization and so on. These factors are foundation scales in the development of instruments to investigate classroom leaning environments.

2.3.2 The questionnaires employed in various learning environment studies

One of the most obvious features of the field of learning environments is the availability of a variety of economical, valid, and widely applicable questionnaires, which have been developed and used for assessing students' perceptions of the learning environment (Fraser, 2002). The following section describes some of these instruments.

2.3.2.1 Questionnaires for assessing psychosocial learning environment

Classroom environment questionnaires have been used as sources of predictor and criterion variables in a variety of research studies (Fraser, 1989). Students' perceptions are useful in helping educators understand classroom processes (Walberg, 1976). The development and the use of questionnaires in learning environments studies began in the 1960s in conjunction with the evaluation of the Harvard Project Physics materials (Walberg & Anderson, 1968). Subsequently, this area of research has undergone incredible growth, diversification and internationalisation. It is claimed that learning environment study is one of few fields of educational research that has such a rich diversity of valid, economical and widely applicable assessment instruments.

To study a learning environment, it is important that the questionnaires are valid and reliable for the particular purpose. To achieve this, many instruments have been designed to assess a particular classroom environment. Brophy and Good (1986) stated that in constructing the tools to assess a learning environment, researchers needed to take several factors into account, within these factors, students' and teachers' perceptions are key characteristics.

Most research studies in the learning environments are based on the three dimensions proposed by Moos in 1976. These are Relationship Dimension, Personal Development Dimension, and System Maintenance and System Change Dimension. The Relationship Dimension assesses the extent to which people are involved in the setting, support and help each other, and express themselves freely and openly. Examples of this dimension are the extent of student involvement and cohesiveness with other students (Moos, 1979, p. 14). The Personal Development Dimension assesses the basic directions along which personal growth and self-enhancement intend to occur in the particular environment (Moos, 1976, p. 331). Examples of this are task orientation and competition. The System Maintenance and System Change Dimension assesses the extent to which the environment is orderly and clear in its expectations, maintains control and it responds to change (Moos, 1979, p. 16). Examples of this are orderliness, organization and innovation.

Fraser, (1994, 1998a, 1998b) provided a comprehensive and convenient review of the development of the use of questionnaires for assessing classroom and school level environments. Among the existing instruments, there are nine major instruments for measuring classroom-learning environment. The nine major classroom environment instruments, namely, Learning Environment Inventory (LEI), Classroom Environment Scale (CES), Individualised Classroom Environment Questionnaire (ICEQ), My Class Inventory (MCI), College and University Classroom Environment Inventory (CUCEI), Questionnaire on Teacher Interaction (QTI), Science Laboratory Environment Inventory (SLEI), Constructivist Learning Environment Survey (CLES) and What Is Happening In This Class (WIHIC), have had much use in studies from primary school to university, and have proven validity and reliability. All of these instruments capture Moos' three psychosocial dimensions.

Fraser (1998a, 1998b) classified the scales of these instruments into Moos's dimensions as follows:

1) The ones that show Dimension of Relationships. This category includes Cohesiveness, Friction and Favouritism, Cliqueness, Satisfaction, Apathy (LEI, MCI, and SLEI); Involvement, Affiliation, Teacher Support (CES, WIHIC); Personalisation, Participation (ICEQ, ICEQ, and CUCEI); Helpfulness/Friendliness, Understanding, Dissatisfaction, Admonishment (QTI); Personal Relevance and Uncertainty (CLES).
2) The ones that show the Dimension of Personal Development. This category includes Speed, Difficulty, Competitiveness (LEI, MCI); Task Orientation (CES, CUCEI, WIHIC); Independence, Investigation (ICEQ, SLEI, and WIHIC); Open-end-ness, Integration (SLEI); Critical Voice, Shared Control and Cooperation (CLES, WIHIC).
3) The ones that show a System Maintenance and System Change Dimension. This category includes Diversity, Formality, Material Environment, Goal Direction, Disorganisation, Democracy (LEI, SLEI); Order and Organization, Clarity of Rules, Teacher Control, Innovation (CES, CUCEI, SLEI); Differentiation (ICEQ); Leadership, Student Responsibility and Freedom, Uncertainty, Strictness (QTI); Student Negotiation (CLES); and Equity (WIHIC).

Researchers have used these instruments not only to measure the nature of the classroom learning environment, but also to investigate associations between the environment and other aspects of learning. Although the strongest tradition of research in this area is studies of the link between students' outcomes and their learning environment, the focus of the studies has been expanded to such areas as evaluation of curriculum innovation, classroom learning environment improvement, differences between teacher and student perceptions, whether students achieve better in their preferred environment, incorporating educational environment ideas into school psychology, and teacher assessment (Fraser, 1994, 1998a, 1998b).

For example, Fraser and Rentoul (1982) stated that studies, which are related to the classroom environment, should break away and be used to investgate the school environment. Fraser, Williamson, and Tobin (1987) demonstrated that classroom environmental instruments could be used as a source of process criteria in the evaluation of educational innovations.

2.3.2.2 Personal and Class Forms of classroom environment instruments

Questionnaires for essessing classroom environments are designed as Personal and Class Forms. The Personal Form assesses a student's perception of his or her role in the classroom, whereas in the Class Form students provide perceptions of the class as a whole (Nair, 1999 p. 36). Fraser, Fisher, and McRobbie (1996) confirmed that the student's personal perception of his or her role in the classroom actually did yield more feedback from participants, more valid data, especially for their case studies on individual students, which investigated the differences on perceptions of students in the 'within-classroom' subgroups (Fraser, Fisher, & McRobbie, 1996; Fraser, Giddings, & Mc Robbie, 1992, 1993; Fraser & Mc Robbie, 1995; Fraser & Tobin, 1991).

However, the research on the characteristics and associations of the Personal Forms on learning environments is still in its infancy and further research will be required before the implications associated with the Personal Forms of instruments are fully understood. Nevertheless, development of Personal Forms makes the study of individuals or groups of students within a classroom more valid.

2.3.3 Research on assessing the learning environment

Previous studies have shown the significance of learning environment assessment (Fraser, 1989). Assessing the learning environment has an impact on improving classrooms, and can make students' outcomes more predictable. Western and Asian studies on the subject have demonstrated associations between learning environments and student outcomes, by using learning environment assessments and evaluation of educational programs and identifying determinants of learning environments.

2.3.3.1 Assessing and improving classroom learning

Many educators and educational researchers realize that classroom learning environment assessment is most significant for improving the classroom learning and the curriculum. The data gained from assessing the classroom learning environments can be used to guide teachers attempt to improve their classrooms (Fraser, 1989). Fraser suggested to teachers a method for improving classroom environment included two basic steps. Firstly, the teacher examines students' perceptions of their actual and preferred classroom environment and identifies the differences between the actual and preferred classroom environments. Secondly, the teacher reduces these differences by introducing some new strategies.

An example of this process of improving the classroom environment was shown in a case study of a teacher at a co-educational government school in a suburb of Sydney, Australia. She improved her classroom environment of 26 grade six students of lower ability through using the My Class Inventory (MCI) and taking five fundamental steps developed from the two referred to above. The steps were Assessment, Feedback, Reflection and discussion, Intervention, and Reassessment.

1. Assessment. The MCI was administered to all students in the class. The Preferred Form was administered first, and the Actual Form was answered a few days later.

2. Feedback. Student responses were used to construct profiles that showed the major differences between the actual and preferred environments.

3. Reflection and discussion. The teacher discussed the profiles with her colleagues, clarified the interpretation and implication of the profiles, and used the main criteria of where the difference between actual and preferred score could be reduced for selecting scales to target.

4. Intervention. The teacher used particular strategies in an intervention in an attempt to change the classroom environment.

5. Reassessment. The teacher readministered the Actual Form of the MCI with students again at the end of the intervention, and again constructed the profiles. This allowed the teacher to see whether students perceived their classroom environment differently from before. The results show that changes did occur and that the students perceived more satisfaction, and cohesiveness, and less friction, competitiveness, and difficulty with the work (Fraser, 1989).

2.3.3.2 Teacher-student relationships in classrooms

One element in assessing classroom-learning environment is assessing the teacher-student relationship. Many educators have been interested in the interpersonal relationship between teachers and their students (Doschak & Fisher, 2005; Fraser & Fisher, 1982; Koul & Fisher, 2003; Wubbels, Creton, & Hooymayers, 1992). They measured teacher-student relationships in classrooms with an effective instrument named the Questionnaire on Teacher Interaction (QTI).

Wubbels, Creton and Hooymayers (1992) created a teacher profile of student-teacher interaction by using the feedback from the QTI based on eight scales of student perceptions: Leadership, Helping/Friendly, Understanding, Student Responsibility and Freedom, Uncertain, Dissatisfied, Admonishing and Strict. They believe that interpersonal teaching behavior is an important aspect of the learning environment and strongly related to student outcomes. Emphasizing the leadership, friendliness and understanding behaviours are very likely to promote students' outcomes. On the other hand, increased uncertainty, dissatisfaction, and admonishing behaviours are negatively associated with students' outcomes.

There are interesting dilemmas for teaching in that in order to promote high achievement, teachers have to be stricter, but to promote better attitudes; they have to be less strict. All teachers at various levels can use the QTI to assess the perceptions of teachers' behaviours by their own students, using it as a basis for reflecting on their own teaching. The voices of students can provide a basis for guiding systematic attempts to improve their teaching practice.

2.3.3.3 Monitoring constructivist classroom learning environments

Constructivism is an effective strategy for learning and teaching as mentioned in section 2.2.2.1. Most researchers and educators realise the significance of this strategy for meaningful leaning (Fraser, 2002). Constructivism emerged in classrooms rapidly, replacing traditional teaching. Thus it is very clear that the monitoring constructivist classroom learning environments is worthwhile.

An important questionnaire for assessing the degree of a constructivist epistemology which is consistent in particular classroom learning environment is called the Constructivist Learning Environment Survey (CLES). The first version of the CLES was introduced by Taylor and Fraser (1991). It also was consistent with von Glasersfeld's perspective of radical constructivism (von Glasersfeld, 1981, 1988). After that, the original version was revised by many researchers, adding socio-cultural aspects, and the perspective of critical constructivism. (Taylor & Campbell-Williams, 1993; Taylor, Dawson, & Fraser, 1995; Taylor, Fraser, & White, 1994). The CLES has been used to explore students' perceptions in many countries, for example, Australia (Taylor & Campbell-Williams, 1993; Taylor, Dawson, & Fraser, 1995; Taylor & Fraser, 1991; Taylor, Fraser, & Fisher, 1997; Taylor, Fraser, & White, 1994), Korea (Lee & Fraser, 2001), and Thailand (Puacharearn & Fisher, 2004; Wanpen & Fisher, 2005).

2.3.3.4 Evaluation of educational innovations

Fraser (2002) emphasised the potential value of evaluating the impact of educational innovations and new curricula on the classroom learning environment. That is, educational researchers can effectively employ classroom environment instruments as a valuable source of process criteria for evaluating educational innovations, such as the use of a classroom environment inventory to assess the use of a computerized

database indicated that the students were more inquiry orientated through its use (Fraser, 2002; Maor & Fraser, 1996).

The evidence of evaluation of educational innovations and developing new instruments are addressed in many studies and many countries. In Australia, Chang and Fisher (2003) developed *the Web-Based Learning Environment (WEBLEI)* for assessing student perceptions of core aspects of the Web-based learning environment. In New Zealand, Clayton (2003) developed *the Online Learning Environment Survey (OLES)* to explore online learning environments. In Singapore, Lang and Wong (2003) created an instrument named *the E-Learning Classroom Environment Questionnaire (ELCEQ)* for assessing students' perceptions of their e-learning classrooms. Teh and Fraser, (1994) created *the Geography Classroom Environment Inventory (GCEI)* for evaluating computer-assisted learning.

2.3.3.5 Combining qualitative and quantitative methods in assessing learning environments

Considerable progress has been made in the learning environment research, and the benefits of combining the qualitative and quantitative method have been acknowledged (Fraser & Tobin, 1991; Maor & Fraser, 1996; Tobin, 1990).

The use of questionnaires provided a quantitative way of assessing learning environments, however, other studies have reported a combination of qualitative and quantitative methods. This is considered to be noteworthy for reasons such as:

1) The combination of qualitative observational data and quantitative classroom environment data add to the richness of the database as a whole.
2) The use of a combination of qualitative and quantitative methods provides an important source of students' views on their classrooms
3) Through a combination of quantitative classroom climate data and qualitative information, greater credibility can be placed on findings, because they emerge consistently from data obtained using a range of different data collection methods.

Another example of using both, the qualitative and the quantitative method is the study of Chan in 2000. Chan applied the qualitative and the quantitative methods for

assessing nursing student's perceptions of their clinical learning environment. The quantitative data were obtained from randomly selected nursing students during their clinical field placement, by using the *Clinical Learning Environment Inventory* (CLEI). The qualitative data were collected from interviewing the nursing students. The qualitative data revealed students' feelings and their perceptions about their clinical placement matched the quantitative results from the five scales of the CLEI.

Fraser and Tobin also illustrated the merits of combining the qualitative and quantitative method in learning environment research, by drawing on three case studies of successful attempts to questionnaire surveys and ethnographic methods together within the same investigation. Three studies focus on:

1) high-level cognitive learning,
2) the nature and role of "target" students who dominate the classroom discourse,
3) exemplary teachers.

Together, these three studies comprised a massive qualitative database, consisting of field notes based on approximately 650 hours, of observation in the science classrooms. These case studies have produced a surprisingly large and rich yield in terms of our understanding on classroom learning environments.

2.3.3.6 Cross-national studies

Cross-national educational research studies provide much promise for generating new insights in classroom learning environments (Fraser, 2002). There are different education systems and cultural backgrounds in each country. So it was believed necessary to conduct some research and assessment on the learning environments in different countries (Wubbels, 1993)

Wubbels (1993) demonstrated that such cross-national studies of learning environments were required for many reasons. First, there was the need to correct the bias towards Anglo-Saxon results of the educational research. Secondly, cross-national studies could broaden the perspective of the researchers, thus helping to strengthen the sensibility of their idiosyncratic features of their own educational systems, and thirdly, the international comparison could contribute to a better

understanding of the relative influence of the number of significant variables in the teaching and learning processes.

Fraser (2002) supported the idea of Wubbels that educational research, which crosses national boundaries is significant for two other reasons. First, there are bigger variations in variables of interest, such as teaching methods and student attitudes, in a sample drawn from multiple countries than from a one-only country sample. Secondly, the taken-for-granted familiar educational practices, beliefs and attitudes in one country can be strange and be questioned when research involves two countries.

Examples of cross-national or cross-cultural research studies are those of Fisher, Goh, Wong, and Rickards (1997) which was done in Singapore and Australia, of Aldridge and her team (Aldridge & Fraser, 2000; Aldridge, Fraser, & Huang, 1999; Aldridge, Fraser, Taylor, & Chen, 2000) in Australia and Taiwan, and a study of Adolphe, Fraser, and Aldridge (2003) in Australia and Indonesia.

2.3.3.7 Gender differences

Various studies, such as those by Raaflaub and Fraser (2002), Henderson, Fisher, and Fraser (2000), Aldridge, Fraser, Fisher, and Wood (2002) and Margianti, Fraser, and Aldridge (2001) have involved investigation of the different genders' perception of their learning environments, especially in science, mathematics, and computing classes. These studies have revealed that male and female perceptions of their classroom learning environments are different.

In Canadian maths and science classrooms, Raaflaub and Fraser (2002) used the What Is Happening In this Classroom (WIHIC) questionnaire, to investigate the different perception of the learning environment, and found that the females' perceptions were higher than the males' on teachers support, cooperation, and equity.

Henderson, Fisher, and Fraser (2000) investigated students' perceptions of their learning environment by using *the Environmental Science Learning Environment Inventory (ESLEI)*. Their results demonstrated that females perceived greater levels

of student cohesiveness, integration, task orientation, involvement, and a more favourable material environment than did the males.

Aldridge, Fraser, Fisher, and Wood (2002) assessed the different perceptions of males and females in a technology-rich learning environment, and found that females perceived a more positive classroom environment than did the males in terms of student cohesiveness, cooperation, equity and young adult ethos.

Margianti, Fraser, and Aldridge (2001) investigated male and female perceptions of the actual classroom learning environment in computing courses in an Indonesian university. They used the WIHIC as the questionnaire. The results indicated that female students had significantly higher perceptions than did the male students on three scales, namely, Order and Organization, Task Orientation, and Cooperation. On the other hand, male students perceived significantly more equity in the classes than did the females.

In biology and chemistry classes in Israel, Tamir and Caridin (1993) used the Learning Environmental Inventory (LEI) for assessing Israeli and Arabic students' perception of their classroom learning environment but unusually found no gender differences in students' perceptions of their classroom learning environment.

2.3.4 The College and University Classroom Environment Inventory (CUCEI)

The College and University Classroom Environment Inventory was developed for assessing student and instructor perceptions of classroom psychosocial environment in small classrooms of universities and colleges. The CUCEI has four distinct forms similarly with many classroom learning environments assessment instruments, which measure student perceptions of actual classroom learning environment, student perceptions of preferred classroom learning environment, instructor perceptions of actual classroom learning environment, and instructor perceptions of preferred classroom learning environment (Fraser, Treagust, Williamson, & Tobin, 1987).

Fraser, Treagust, and Dennis (1986) described the development of the initial CUCEI. This development of the CUCEI was guided by four criteria:

1) Consistency with secondary-school instruments

Researchers examined all dimensions contained in existing questionnaires for the secondary school level for guidance in identifying dimensions for inclusion.

2) Coverage of Moos' general categories

Researchers chose dimensions which provided coverage of the three categories of Moos (1974).

3) Salient to higher education teachers and students

Interviews were used during the CUCEI development process. A number of higher-education teachers and students were asked to comment on draft versions of items in an attempt to ensure that dimensions of the CUCEI and individual items were considered salient to teachers and students.

4) Economy

To achieve economy in answering and processing, the CUCEI was designed with a relatively small number of reliable scales and each scale has a small number of items.

The initial CUCEI contained seven scales. The first four scales, Personalization, Involvement, Student Cohesiveness, Satisfaction covered the Relationship Dimensions. Task Orientation covered the Personal Development Dimensions and the other two scales, Innovation and Individualization covered the System Maintenance and System Change Dimension. Each scale contains seven items and each item is responded to on a four-point scale, Strongly Agree, Agree, Disagree, and Strongly Disagree. Some items are negative items. Items are arranged in cyclic order so that the first item examines Personalization (The instructor considers students' feelings.), the second item examines Involvement (The instructor talk rather than listen.), the third, Student Cohesiveness (The class is made up of individuals who don't know each other well.), the fourth, Satisfaction (The students look forwards to coming to classes.), the fifth, Task Orientation (Students know exactly what has to be done in our class.), the sixth, Innovation (New ideas are seldom tried out in this

class.) and the seventh, Individualization (All students in the class are expected to do the same work, in the same way and in the same time). The preliminary validation data of the initial four forms of CUCEI, namely, Student Actual, Student Preferred, Instructor Actual, Instructor Preferred, has been obtained in Australia and the USA. (Fraser, Treagust, & Dennis, 1986), using both the individual and class mean as the unit of analysis. The results show that the alpha coefficients ranged from 0.53 to 0.90 for the individual as the unit of analysis and from 0.78 to 0.96 for the class mean as the unit of analysis. Similarly, to obtain the mean correlation of a scale with all the other scales both the individual and the class as the unit of analysis were used. The results suggested that each scale of the CUCEI has adequate discriminant validity for use in its both Actual and Preferred Forms. The differentiating between the perceptions of students in different classrooms was also examined for each scale of the CUCEI by using a one-way ANOVA. The results indicated that each scale differentiated significantly (p <0.001) between classrooms.

Williamson, Tobin, and Fraser (1986) examined the internal consistency and discriminant validity of The CUCEI with 742 learners in Australia and found that the CUCEI is a suitable and useful instrument for use among student in high schools. Internal consistencies of the Actual Form ranged from 0.70 to 0.87 when the individual student was used as the unit of analysis. For the Preferred Form, the internal consistencies ranged from 0.64 to 0.82. In Asia, Khine and Goh (2001) investigated the internal consistency reliability of the CUCEI in a tertiary institution in Singapore and they found that each scale in the CUCEI has satisfactory internal consistency, ranged from 0.65 to 0.90.

The CUCEI also was used in a study of the effects of classroom environment on student outcomes. Fraser, Treagust, Williamson and Tobin (1987) studied associations between higher education classroom environment and student outcomes with a sample of 34 classes, 30 Australian classes and four American classes. The two outcome measures were Satisfaction and Locus of Control (Paulus & Christie, 1981). Associations between the two outcomes measures and the other six classroom climate dimensions measured by the CUCEI were investigated using both univariate and multivariate statistical tests. The results showed that significant univariate associations emerged between Satisfaction and the six environment variables and

between Locus of Control and the two environment variables of Student Cohesiveness and Task Orientation. These indicated that classroom satisfaction was higher in the classrooms that provided for greater personalization, involvement, student cohesiveness, task orientation, innovation, and individualization. Moreover Locus of Control scores were higher in classrooms perceived to have more focus on student cohesiveness and task orientation. The result of a multivariate tests revealed that the multiple correlation between an outcome measure and the set of six environment scales was significant.

Nair and Fisher (2000) modified the original CUCEI in three ways. First, the actual and preferred versions of the questionnaire were personalised by changing the wording, such as in Task Orientation where the original CUCEI statement was: "Class assignments are clear so everyone knows what to do," to "Class assignments are clear and I know what to do" in the Personal Form. Secondly, two scales of the initial CUCEI were omitted from the modified version. There were the Satisfaction and Involvement scales. Therefore, only five of the original scales were used, and two new scales were added, Cooperation and Equity. The cooperation scale was included as one of the seven scales because the levels of cooperation seem to change as students proceed to higher levels of education. The Equity scale was included in order to allow investigations of students' perception of the environment with respect to gender. Thirdly, the existing four responses alternatives were replaced with a five-point Likert Scale. Each item is responded to with the alternatives of Almost Never, Seldom, Sometimes, Often and Almost Always. The idea to use the five-point Likert Scale was thought to give respondents a greater choice in their responses. Moreover, it is also considerate to better represent the personalised nature of the questionnaire.

Table 2.1
Descriptive Information for the Scales of the Modified CUCEI

Scale	Description	Moos' category
Personalization	Emphasis on opportunities for individual students to interact with the instructor and on concern for students personal welfare	Relationship
Innovation	Extent to which the instructor plans new, unusual class activities, teaching techniques and assignment	System Maintenance and System Change
Student Cohesiveness	Extent to which students know, help, and are supportive of each other	Relationship
Task Orientation	Extent to which class activities are clear and well organised	Personal Development
Individualisation	Extent to which students are allowed to make decisions and are treated differently according to ability, interests and rate of working	System Maintenance and System Change
Cooperation	Extent to which students cooperate rather than compete with on another on learning tasks	Personal Development
Equity	Extent to which students are treated equally by the teacher	System Maintenance and System Change

Nair (1999, p.76)

The modified CUCEI version of Nair and Fisher contains four forms, Student Actual Form, Student Preferred Form, Teacher Actual Form, Teacher Preferred Form. Each Form has 49 items. Item are arranged as seven sets for assessing seven scales, the first set contains item 1 to item 7 for assessing the Personalization scales, the second set contains item 8 to item 14 for assessing the Innovation scale, respectively. Sample items of the scales of the CUCEI are given in the next chapter (Table 3.1).

The modified CUCEI was shown to be a good quality questionnaire by the assessment of internal consistency, discriminat validity and factor analysis. The result shows that the reliability coefficients using the individual student as the unit of analysis ranged from 0.73 to 0.93 and 0.76 to 0.94 for the actual and preferred versions respectively with the class means as the unit of analysis. All alpha reliability values were higher, ranging from 0.84 to 0.97 for the actual version and 0.87 to 0.98 for the preferred version. For discriminant validity, the mean correlations of the scales ranged from 0.15 to 0.38 for the actual and from 0.25 to 0.47 for the preferred

version. It means that the CUCEI appears to measure distinct although somewhat overlapping aspects of classroom environment. A principal component factor analysis, followed by varimax rotation, show an instrument in which 44 of the 49 items had a factor loading greater than 0.30. The conventional cut-off value of 0.30 was chosen for the factor loading (Stevens, 1992). This result was also found to be very similar for the Preferred Form. Five items which had a factor loading of less than 0.30 were deleted. The factor loading values of the remaining 44 items in the instrument confirmed the seven factor structure of the CUCEI. This work led to the conclusion that the CUCEI is a distinct questionnaire especially in its modified form (Nair & Fisher, 1999).

2.3.5 Technology-rich learning environment

One of the major shifts in education today is due to the influence of information and communication technology (ICT), thus classrooms at all levels are becoming technology-rich learning environments (Khine, 2003). Technologies that can support student learning are available in meaning making and knowledge construction. Computer and network communication enhance access to information and support explorations and construction of knowledge (Jonassen, 2000). Advanced educational technology and the progress of information technology communication influenced the classroom-learning environments which became increasingly technology rich due to the developments in computer-assisted instruction, online learning, web-based learning, and using the Internet in education, etc. (Khine & Fisher, 2003, p. ix).

Digital technologies also have progressed rapidly and have affected the learning environment. Many educators now are providing a technology-rich learning environment to improve education at all levels. The next sections will describe the effects of technology on learning environments, Online learning in higher education and Computer laboratories.

Many research studies now are involving technology-rich learning settings, including the validation and application of new instruments for assessing technology-rich class room learning environments. Chang and Fisher (2003), Khine (2003), Aldridge and Fraser (2003), Trinidad (2003), Zandvliet (2002, 2003), Clayton (2003) have

developed a variety of questionnaires suitable for assessment of new learning settings.

2.3.5.1 The effects of technology on the learning environment

Schools and universities have changed their learning environments as a consequence of rapid changes and advances in science and technology and computers that have affected instructional process significantly. Traditional learning and teaching methods have been influenced by modern technology, thus influenced administrative processes, as well as the learning environment. Technology impacts effective pedagogy and the role of the classroom teacher, enriches the learning environment and enhance the learning experience for students, but only if effective teacher facilitates the experience and responds to student need individually (Rickards, 2003). At present, learning environments are designed with classrooms technology in mind and three main factors in technology have been established. First, t*echnology alters orientation.* Technology affects learners and lecturers. It changes their traditional ways of learning and teaching. Learning and teaching activities engage the use of technology. Indisputably, learning environments depend very much, if not totally, on technology. Secondly, t*echnology alters techniques.* At present, learning and teaching methods, all need technology and practiced through a variety of techniques, like two-way distance learning, video conferencing, and open classrooms as well as self-learning, just to name a few examples of the role technology plays in our days. Thirdly, t*echnology alters situations of learning.* The changes in learning situations and learning environments had influenced learning situation at all levels, but learning not always designed by lecturers alone. Learners now can partly choose their own learning methods. Moreover many students believe that Web-based learning as an opportunity for them to gain higher education without having to physically attend classes and academics worldwide have realized the attraction and extent of this learning mode (Chang & Fisher, 2003). Web-based learning or virtual classrooms on the Internet show the important role of technology in learning.

2.3.5.2 Online learning in higher education

More academics are accepting the challenge of using web-based or online learning in higher education to deliver coursework (Chang & Fisher, 2003). The online learning environment utilizes a model of an integrated behaviourist and constructivist model

according to Bannan and Milheim (1997) and the learning becomes more collaborative and interactive (Hiltz, 1994). The character of online learning involves a separation of place and time between instructor and learner, learners and learners, and learners and learning resources. Therefore, the role of instructors and learners in online learning has changed, instructors have to be a facilitator or a guide rather than being an instructor. They need to be responsive, competent, and organized in their facilitation of student interaction. The learners should participate actively, to learn collaboratively and cooperatively in the online learning environment, seek solutions to problems confined within the knowledge area being studies, share the resources and other materials that they find with other learners, discuss with other learners in order to generate deeper levels of understanding of the course material (Hiltz, 1994; Khan, 1997).

2.3.5.3 Computing laboratories

Laboratories play an important role in most computing courses, giving students skills that cannot be obtained by simply reading books. Students need hands-on practice in order to acquire the knowledge and must be mastered before any progress can be made (Azemi, 1995). Laboratories also provide students with the opportunity to gain proficiency, including: (1) familiarizing students with the computing environment; (2) reinforcing material taught during the lecture; (3) teaching students the principles of using computers; (4) providing closer contact between staff and students; (5) stimulating and maintaining interest in the subject; (6) teaching theoretical material not included in lectures; (7) fostering critical awareness, e.g. avoiding systematic errors; (8) developing problem solving skills; (9) stimulating conditions in an information systems development environment; (10) stimulating independent thinking; (11) developing communicating technical concepts and solution skills; (12) providing motivation to acquire specific knowledge; and (13) bridging the gap between theory and practice (cited in Newby (2003, p. 190) adapted from Boud, Dunn, & Hegarty-Hazel, 1986).

Furthermore, computer laboratories can support web-based instruction. Many students now have the opportunity for higher education without having to attend classes. Students also can access the open computer laboratories instead of attending class. With the potential of computer laboratories mentioned before, all colleges and

universities should try to improve learning environments in computer laboratories. Educators need to have more information on students' perception of the psychosocial environment in computer laboratories.

2.4 QUESTIONNAIRES FOR TECHNOLOGY-RICH CLASSROOMS

This section describes in more detail some of the questionnaires designed specifically for use in technology-rich classroom. However, all of these modified questionnaires are still following the three dimensions, developed by Moos in 1976.

Five questionnaires are reviewed:
The Computer Classroom Environment Inventory, (CCEI);
The Technology-Rich Outcome-Focused Learning Environment Inventory, (TROFLEI);
The Web-Based Learning Environment Instrument, (WEBLEI);
The E-Learning Classroom Environment Questionnaire, (ELCEQ);
And the Computer Laboratory Environment Inventory, (CLEI).

2.4.1 The Computer Classroom Environment Inventory, *CCEI*

In 1993, Maor and Fraser developed the Computer Classroom Environment Inventory (CCEI) for assessing students' perceptions of a learning environment that involves an inquiry-based learning approach and the use of a computerized database. The questionnaire scales included the Satisfaction scale from the Learning Environment Inventory, Investigation from the Individualized Classroom Environment Questionnaire, and Open-Endedness and Material Environment from the Science Laboratory Environment Inventory. The final version of the CCEI contains 30 items in five scales. The results of Maor and Fraser's study reported that the refined version of each CCEI scale had acceptable internal consistency, especially for scales containing a relatively small number of items and discriminant validity data indicated that the CCEI scales measure distinct aspects of the computer classroom environment (Maor & Fraser, 1993).

2.4.2 The Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI)

This new instrument, the Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI) is a modified version of all the WIHIC. The scales are Student Cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation and Equity.

Three new scales were developed. (Differentiation, Computer Usage and Young Adult Ethos) which were considered relevant to an outcomes-focused and ICT rich learning environment. Therefore, this questionnaire measures ten dimensions of actual and preferred classroom environments at the senior secondary school level. The questionnaire has 77 items, including a novel structure, incorporating the actual and preferred responses on the same form, and so providing an economical format for reducing administration time (Aldridge & Fraser, 2003).

The TROFLEI has been found to be valid and reliable at senior high school levels for a number of different subjects and learning areas, and it displays factorial validity satisfactory for both the Actual and Preferred Forms of the questionnaires. Further analyses supported the ability of all scales to actually respond and differentiate between classrooms. Therefore, teachers and researchers can use it to assess their classrooms with confidence.

2.4.3 The Web-Based Learning Environment Instrument (WEBLEI)

The Web-Based Learning Environment Instrument (WEBLEI) was designed for use in university environments and contains four scales: Access, Interaction, Response and Result. The first three scales have been adapted from the work of Tobin in 1998 on connecting community learning. The final scale focused on information structure and design aspects of the web-based material, (Chang & Fisher, 2003). The WEBLEI was administered to 344 students of the Curtin Business School at Curtin University of Technology, Australia. The factor analysis confirmed that there were indeed four scales in the WEBLEI. The Cronbach alpha reliability coefficient presented showed figures ranging from 0.68 to 0.87 acceptable in terms of their internal consistency.

The discriminant validity showed that the correlations ranged from 0.37 to 0.49, indicating that the scales of the WEBLEI measured distinct, although somewhat overlapping, aspects of the learning environment.

2.4.4 The E-learning Classroom Environment Questionnaire (ELCEQ)

The E-learning classroom environment questionnaire, the ELCEQ is a modified version of the Computer Classroom Environment Inventory (Maor & Fraser, 1996). The purpose of adapting this questionnaire was to evaluate the effectiveness of using e-learning in addition to normal face-to-face-interaction for science studies (Lang & Wong, 2003). The Actual and Preferred Forms of the ELCEQ had five scales: Investigation, Open-Endedness, Organisation, Material Environment and Satisfaction. This instrument used a five-point Likert scale with options of: Almost Never, Seldom, Sometimes, Often, and Almost Always. The alpha reliabilities ranged from 0.55 to 0.70 for the Actual Form and from 0.70 to 0.87 for the Preferred Form. All of the five ELCEQ scales had a Cronbach alpha coefficient above the 0.6 level meaning that the ELCEQ is a reliable instrument for assessing students' perceptions in the ICT learning environment.

2.4.5 The Computer Laboratory Environment Inventory (*CLEI*)

The Computer Laboratory Environment Inventory (CLEI) is an instrument designed to assess computer laboratories and was developed by Newby and Fisher (1997). They modified the CLEI from the SLEI (Science Laboratory Environment Inventory), designed by Fraser, Giddings, and McRobbie (1991). Descriptive information of the CLEI is provided in Table 2.2.

Table 2.2
Descriptive Information for the Scales of the CLEI

Scale	Description	Moos' Category
Student Cohesiveness	Extent to which students know, help, and are supportive of each other	Relationship
Open-Endedness	Extent to which the laboratory activities encourages an open-ended, divergent approach to use of computers	Personal Development
Integration	Extent to which the laboratory activities are integrated with non laboratory and theory classes	Personal Development
Technology Adequacy	Extent to which the hardware and software is adequate for the tasks required	System maintenance and System Change
Laboratory Availability	Extent to which the laboratory and computers are available for use	System maintenance and System Change

Newby & Fisher (1997, p. 183)

The CLEI has five scales, Student Cohesiveness, Open-Endedness, Integration, Technology Adequacy, and Material Environment. Each scale has seven items arranged in cyclic order. The items are scored 1, 2, 3, 4, and 5, respectively, for the responses Almost Never, Seldom, Sometimes, Often, Almost Always. Negative item are scored in the reverse manner. Sample items from the CLEI are given in the next chapter in Table 3.2.

The CLEI questionnaire was administered to both undergraduate and postgraduate students taking courses within the Curtin University of Technology Business School. Results indicated that the Cronbach alpha reliability measures ranged from 0.54 to 0.94. The mean correlation of a scale with the other scales of the questionnaire was also acceptable and ranged from 0.06 to 0.22 indicating that there is little overlap in what they measure but, the correlation between Technology Adequacy and Material Environment was significant ($p< 0.01$) (Newby & Fisher, 1997).

While learning computer science, students have to be involved in both listening to lectures in the classroom and practising in the computer laboratory. Therefore, it was considered that the instrument that is most suitable for this research was the CLEI. The main reason for this was that the five scales of the CLEI cover the essential

criteria for evaluating a computer laboratory-learning environment. As there was no standard instrument for assessing the learning environment of the computer laboratory in Thailand, it was decided to translate the CLEI into the Thai language for use in this study.

2.5 STUDENTS' ATTITUDES IN TECHNOLOGY-RICH CLASSROOMS

Psychologists such as Fishbein and Ajzen in 1975 and Rosenberg and Hovland in 1960 defined attitudes in terms of its components or domains. The domain is the cognitive, or what a person believes in an attitude object; the affective is what a person feels about the attitude object, how favourably or unfavourably it is evaluated; and the behavioural, or how a person actually responds to the attitude object based on the cognitive and affective domains.

Researchers have monitored attitudes in technology-rich classrooms in many domains. There is a liking or enjoyment of computers (Gressard & Loyd 1986), anxiety or fear of computers; computers are beneficial tool tools and the belief that computers are autonomous entities, capable of supplanting individuals (Davis 1993; Lee, 1970).

Lee (1970) recognised two independent attitudinal dimensions: the belief that computers are beneficial tools and the belief that computers are autonomous entities, capable of supplanting individuals. On the other hand, Gressard and Loyd (1986) considered three main aspects: anxiety or fear of computers, confidence in one's ability to use or learn about computers, and a liking or enjoyment of computers. Self-confidence in one's ability to use computers is important because it is a determining factor in a student's expectation for being successful (Shashaani, 1993). Therefore, it was decided to investigate students' attitudes to their computer courses in this study.

2.5.1 Learning environment effect on attitudes

Previous classroom environment research has involved investigations on associations between students' attitudes and the nature of the classroom environment and has

found that students' attitudes scores are higher in classrooms in which students perceive a more positive learning environment (Fraser, 1986).

Newby and Fisher (1997) found that, out of 20 possible relationships between computer laboratory environment variables and student attitude variables, nine were significant. They revealed that the more open ended the computer laboratory work was the more the students enjoyed the work and the less anxious they were about computers and work involving computers. Less anxious students will go beyond the given class work and find computers more enjoyable. There was also a strong association between the adequacy of the technology and lack of anxiety, indicating the importance of using hardware and software suitable for the required tasks. Student cohesiveness was positively associated usefulness of their class and this could imply that students find a class more useful if they get on well with their fellow students. Enjoyment was associated with both, integration and material environment, implying that students enjoy using computers more in a course in which the laboratory classes are integrated with the content of the lectures, where the purpose of the laboratory class is clear, and where the laboratories themselves are suitably equipped.

Aldridge and Fraser (2003) found evidence that associations existed between the classroom learning environment and students' attitude towards their subject and students' attitude towards computer use. The results suggested that the scales of Teacher Support, Equity, and Young Adult Ethos accounted for a significant amount of variance in students' attitudes towards their subject. As for associations with student attitudes to computer use, the results indicated that differentiation and computer usage are statistically, significantly and positively related to students attitudes to computer use at an individual level of analysis.

Another study integrated the theoretical perspectives and empirical findings of computer self-efficacy and attitudes toward computers, Chung, Schwager, and Turner (2002). They suggested that students' years of computer experience and knowledge were less important than their actual computer usage on a daily basis for academic and personal purposes, indicating that students' computer software usage

had a significant effect on the differences in student's computer self-efficacy and attitudes toward computers in a university environment.

2.5.2 Instruments for assessing students' attitudes

There are many instruments available for measuring students' attitude towards computer learning. Often, these instruments were developed and guided by the attitude domains suggested from the studies of Gressard and Loyd (1986) and Loyd and Loyd (1985). For example, Woodrow in 1991 administered four instruments to 98 student teachers. The scales included *the Computer Attitude Scale* (Gressard & Loyd, 1986), *the Computer Use Questionnaire* (Griswold, 1983), *the Attitudes Toward Computers Measure* (Reece & Gable, 1982), and *the Computer Survey Scales* (Stevens, 1982). Gardner, Discenza, and Dukes (1993) administered four instruments to 244 undergraduate students. The Computer Attitude Scale and Attitudes toward Computers Measure, and *the Computer Anxiety Index* were employed. It was found that any of these could be used to measure attitude.

Other studies assessed many types of students' attitudes by developing a variety questionnaires and some of these are discussed in following sections.

2.5.2.1 The Computer Attitude Scale (CAS)

The CAS was used as a measure of attitude towards computer by Loyd and Gressard (1984) and consists of three subscales with ten items each: the Computer Anxiety, Computer Liking and Computer Confidence. Each item was rated on a five-point Likert-type scale, ranging from strongly disagree (1) to strong agree (5). Loyd and Gressard also reported that the coefficient alpha reliabilities were 0.86, 0.91, and 0.91 for Computer Anxiety, Computer Liking and Computer Confidence, respectively, and 0.95 for the total instrument. Khine & Fisher (2001) selected the CAS as an instrument in his research without any modification because it had been used internationally and previous studies indicated that the reliability of the scale was high. He found that the Cronbach alpha reliabilities, using individual student scores as the units of analysis were 0.66 (Computer Anxiety), 0.81 (Computer Confidence), 0.65 (Computer Liking), respectively, and the reliability for the total questionnaire was found to be 0.90.

2.5.2.2 The Computer Attitude Scale, CATT

Dambrot, Watkins-Malek, Silling, Marshall and Garver developed the CATT in 1985. This was a 20 item scale that consisted of nine positive and eleven negative statements. Each item was rated on a five-point Likert-type scale, ranging from Strongly Disagree (1) to Strongly Agree (5). Dambrot, et al., reported a coefficient alpha of 0.84. In addition, the CATT has been shown to be related to students' math anxiety scores, maths experience, computer experience, maths aptitude, high school achievement and gender. Other researchers reported similar reliability coefficients in their studies; Dambrot, Silling, and Zook (1988) reported 0.81. Zakrajsek, Waters, Popovich, Craft, and Hampton (1990) reported 0.86, and Smith, Caputi, and Rawstorne (2000) reported 0.85.

2.5.2.3 The Attitude towards Computers and Computer Courses, ACCC

Newby and Fisher (1997) developed an instrument for assessing students' attitudes towards computers and computer courses and named it the Attitudes towards Computers and Computer Course (ACCC). The scales Anxiety and Enjoyment were modified from Gressard and Loyd, 1986 scales and Usefulness of Computer was adapted from Koohang's 1989 scale. A fourth scale was included to measure the students' perception of the usefulness of their course. All the scales had seven items and items were arranged in cyclic order as with the CLEI. Items were scored 1, 2, 3, 4 and 5, for the responses: Strongly Disagree, Disagree, Not Sure, Agree, Strongly Agree, respectively. Negative Items were scored in the reverse manner. A description of the scales of the ACCC and sample items from each is provided in the next chapter in Table 3.3.

The ACCC was administered to 104 Australian students and to 109 American students. The results demonstrated that the alpha reliabilities vary from 0.64 to 0.90 for the Australian sample and from 0.72 to 0.89 for the American sample. The mean correlations also showed that the scales measure overlapping aspects of students' attitudes towards computers and the course (Newby, 2003).

2.5.3 Gender differences in attitudes towards computer

Studies of gender differences in attitudes towards computers tend to focus on many areas including men's and women's interests in computers, perceptions of computers, level of confidence and self-efficacy when people are working with computers, computer anxiety, and so on (Shashaani & Khalili, 2001). Different results from several studies have been demonstrated. There are both significant difference and no evidence of significant difference in gender difference in different studies.

Shashaani and Khalili (2001) studied attitudes about computers with Iranian undergraduate students and found that there were no significant gender differences in respondents' liking for computers or their perceptions of the usefulness of computers. Male and female students believed equally in the positive effects of computers on individuals and society.

In another survey, Francis (1994), using a sample of with 378 undergraduate students, found no evidence of significant gender differences in the mean scores, of male and female undergraduate students on the three sub-scales of Computer Anxiety, Computer Confidence or Computer liking. She also revealed that the expectation of such gender differences in computer-related attitudes cannot be uncritically generalized to all populations since the results from some studies clearly show more positive computer-related attitudes between males and females.

Clarke and Finnie (1998) supported the two previous studies of Shashaani and Khalili, and Francis. Again, they found no significant gender differences in commerce students and their attitudes computers

However, contrasting results were shown in the studies of Makrakis and Sawada (1996), Collis and Williams (1987), and Koohang (1989). Makrakis and Sawada surveyed 773 Japanese and Swedish students and found that males scored higher on aptitude and liking for computers and on rating of computers' usefulness. Similary, Collis and Williams studies of Canadian and Chinese adolescents' attitudes toward computers revealed that in both countries males were more positive than females in

the attitudes towards computers and showed higher self-confidence about working with computers. Koohang also found that male college students rated computers as more useful than female students did. In other studies, males show more interest in learning about computers and find working with computers more enjoyable and have greater access to computers than do females (Badagliacco, 1990; Ogletree & Williams, 1990). Okebukola (1993) found higher levels of computer anxiety among females than among males. On the other hand, some studies found no sex differences in computer anxiety (Campbell & Dobson, 1987; Makrakis, 1992). Because of these varying results it was decided to investigate male and female differences in this study.

2.6 PREVIOUS STUDIES USING THE CUCEI, CLEI AND THE ACCC

Previous studies with the CUCEI, CLEI, and ACCC have demonstrated their strengths for use in classroom learning environments studies in different countries. Results have shown strong factorial validity, internal consistency and the ability to differentiate between classes. Some of the applications of these questionnaires are discussed in the following sections.

Crump (2002) used the modified and personalised version of the CUCEI with first year tertiary students, and reported that the questionnaire generally was a reliable and suitable instrument. In her study, the Task Orientation was abandoned, because it did not form its own clean factor because the items correlated highly with the Equity items. The internal consistency of both the Actual Form and Preferred Form had the alpha values that ranged from 0.70 to 0.93. The mean correlations between scales for the Actual Form ranged from 0.03 to 0.62 and from 0.04 to 0.59 for the Preferred Form.

Logan (2003) also investigated the quality of the modified CUCEI and considered students' perceptions of the learning environment in computer studies classrooms in secondary schools in New Zealand. She found that the internal consistency of the scales ranged from 0.64 to 0.91 and from 0.73 to 0.93 for the Actual Form and Preferred Form, respectively. Mean correlation values for the Actual Form ranged from 0.21 to 0.39 and from 0.35 to 0.47 for the Preferred Form. A correlation value

of 0.5 implies that scales have about 20% of common variance, this was taken as an acceptable overlap, and suggested that some scales of the CUCEI are not completely independent. The mean scores were 2.97 to 3.96 for the Actual Form and from 3.70 to 4.24 for the Preferred Form. Students preferred a more positive learning environment than they perceived in actual situations on all seven scales. On the Actual Form, the means scores for Innovation and Individualisation scales were quite low (2.96) whereas all the other scales were greater than 3.5 (maximum score of 5). These indicated that students were generally satisfied with their actual learning environments.

The use of the CUCEI, CLEI and ACCC questionnaires provides an important source of students' view of their classrooms. Together the CUCEI, CLEI and ACCC can provide quantitative data on learning environments in both regular classrooms and laboratories.

2.7 SUMMARY

Studies in a number of countries around the world have provided information on the psychosocial learning environments in computer classrooms and laboratories. Researchers in Australia, America and in Asia have used these studies to improve the computer-learning environment, however, there has been very little research in Thailand even though computer learning has been required for many years.

At present, computer issues are included in curricula at all levels in Thai schools; therefore, understanding of how learning occurs in computer classrooms and laboratories must be put into focus. Computers have become media for learning, especially in mathematics, science and technology and other areas, therefore knowledge of psychosocial learning environments can play a crucial role for improving students' outcomes.

Instructors and researchers can use information obtained from classroom environment questionnaires to guide and improve classrooms. Assessment of student perceptions on both their actual and preferred classroom environment can be used to identify differences between the actual classroom environment and that preferred by

students. Strategies can then be considered to aim at reducing these differences. Therefore, it is important to validate the CUCEI, CLEI and ACCC so that instructors and researchers can use them with confidence in Thailand. This study aimed to do this. Furthermore, through the use of these questionnaires, our understanding of learning in tertiary computer classes can be enhanced.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

During the past decade, overwhelming empirical evidence has shown that computer classrooms have increasingly flourished, not only at the university level but also at all other educational levels as well (Fisher & Stolarchuk, 1998). Although many universities have provided computer science courses for over 20 years, developing a high quality computer classroom learning environment has now become a central issue. Thus, in order to improve the computer science curriculum, assessment of students' perceptions, and attitudes towards computer use and computers, becomes quite important for instructors, educators, and university administrators. In order to achieve the highest benefit from the high cost of providing computer classrooms, it is necessary to understand the classroom learning environment. As a consequence, this study aims to assess the students' perceptions and attitudes in computer classrooms and laboratories.

The differences of students' responses between the Actual and Preferred Forms of the CUCEI can provide teachers and administrators in educational institutions with valuable information. Therefore, the two forms of CUCEI were used in this study. Also the CLEI was used to investigate the learning environment in the computer laboratories and the ACCC was also used to determine student attitudes toward computer laboratories and courses.

This chapter discusses the research methodology of this study and is organised into three main sections. Section 3.2 deals with the research questions, section 3.3 provides the research methodology adopted for this study, and a summary of the research questions, data collection strategy, and data presentation is presented in section 3.4.

3.2 SPECIFIC RESEARCH QUESTIONS

This study was designed to investigate, in depth, the classroom environment of the regular classrooms and computer laboratories of computer science courses. The study was guided by several research questions which were as follows:

1. Is the College and University Classroom Environment Inventory (CUCEI) a valid and reliable questionnaire for use in Thailand?
2. Is the Computer Laboratory Environment Inventory (CLEI) a valid and reliable questionnaire for use in Thailand?
3. Is the Attitude towards Computers and Computer Courses (ACCC) a valid and reliable questionnaire for use in Thailand?
4. What are students' perceptions of their actual computer classroom learning environment?
5. What is the difference between students' actual and preferred perceptions of the learning environments of their computer lecture classrooms?
6. Are there any differences between males and females in perceptions of their computer classroom learning environments?
7. Are there any differences between males and females in perception of their computer laboratory learning environments?
8. Are there any associations between students' perceptions of their computer lecture classroom and their attitudes towards computers and computer courses?
9. Are there any associations between students' perceptions of their computer laboratory and their attitudes towards computers and computer courses?

3.3 RESEARCH DESIGN

In order to answer the research questions, a combination of quantitative and qualitative approaches was used. In the quantitative method, three questionnaires were employed. These were the College and University Classroom Environment Inventory (CUCEI), the Computer Laboratory Environment Inventory (CLEI), and the Attitude towards Computers and Computer Courses (ACCC). Qualitative data

were obtained from interviews with students. The details of each instrument and their preparation are described in more detail in the next sections.

3.3.1 Selection and preparation of instruments

The first instrument used in this study in both Actual and Preferred Forms was the College and University Classroom Environment Inventory (CUCEI) which was adapted and modified by Nair and Fisher (2000). The item scoring in each scale of the CUCEI employed a five-point Likert response scale where each item is responded to with the alternative of Almost Never, Seldom, Sometimes, Often and Almost Always. The use of a five-point Likert response scale was thought to give participants a greater choice in their responses (Nair, 1999).

The CUCEI was selected to assess the computer science classroom learning environments for the following reasons. First, it was specifically designed for upper secondary and tertiary levels (Fraser, Treagust, & Dennis, 1986). Second, the scales of the CUCEI provide coverage of the three general categories of dimensions identified by Moos (1974). Third, it is economical to use because it consists of seven scales to assess the quality of classroom leaning environments. Fourth, it has both Actual and Preferred Forms. The Actual Form can demonstrate the authentic situations which are provided by the teachers in the classes while the Preferred Form can indicate the ideal situation that student prefer. It is noteworthy that the Preferred Form has provided a possible approach towards improving classrooms. Student achievement can be improved if instructors change the classroom learning environments to more closely match with the students' preferred environments (Fraser & Fisher, 1983a, b). Fifth, the CUCEI has been validated in many countries; it has become a standard instrument (Fisher & Parkinson, 1998; Fraser, Treagust, & Dennis, 1986; Yarrow, Millwater, & Fraser, 1997). Sixth, the CUCEI which was modified by Nair is a Personal Form; previous studies have shown the effectiveness of the personal form of a questionnaire (Fraser, Fisher, & McRobbie, 1996; Fraser, Giddings, & McRobbie, 1992).

This questionnaire, as described in Table 3.1, comprises 49 items in seven scales, namely, Personalization, Innovation, Student Cohesiveness, Task Orientation,

Individualization, Cooperation and Equity. Items 7, 8, 12, 14, 15, 18, 19, 21, 24, 25, 27, 36, 41, and 42 are negative items and scored in the reverse manner (see Appendix A).

Table 3.1
Descriptions of Scales in CUCEI and Representative Items

Scale Name	Description	Sample Items
Personalisation	Extent of opportunities for individual students to interact with the instructor and of concern for students' personal welfare	The instructor goes out of his/her way to help me.
Innovation	Extent to which the instructor plans new, unusual activities, teaching techniques and assignments	The instructor often thinks of unusual activities.
Student Cohesiveness	Extent to which students know, help and are friendly towards each other	I make friends easily in this class.
Task Orientation	Extent to which class activities are clear and well organized	Class assignments are clear and I know what I am doing.
Individualisation	Extent to which students are allowed to make decisions and are treated differently according to ability, interests and rate of working	I am allowed to choose activities and how I will work.
Cooperation	Extent to which students cooperate rather than compete with one another on learning tasks	I work with other students in this class.
Equity	Extent to which students are treated equally by the teacher	I have the same opportunity to answer question as other students.

Item designated (+) are scored 1,2,3,4 and 5, respectively for responses Almost Never, Seldom, Sometimes, Often, and Almost Always. Item designated (-) are scored 5,4,3,2 and 1, respectively for responses Almost Never, Seldom, Sometimes, Often, and Almost Always.

Source: Nair & Fisher (2000, p. 440)

The second instrument selected was the Computer Laboratory Environment Inventory (CLEI) as described in Table 3.2. Again, the CLEI was chosen because: this instrument was designed for assessing learning environments in computer

laboratories; the CLEI has five scales covering three categories of dimensions which were identified by Moos; and it has been validated in Australia by Newby and Fisher (1997). The alpha coefficient reliability figures ranged from 0.60 to 0.89 and the mean correlations of the scales of the CLEI ranged from 0.08 to 0.22.

The CLEI comprises 35 items with five scales, namely, Student Cohesiveness, Open-Endedness, Integration, Technology Adequacy, and Laboratory Availability. Items 3, 4, 5, 6, 8, 15, 23, 26, 27, 30 and 33 are negative items and are scored in the reverse manner (see Appendix C)

Table 3.2
Descriptions of Scales in CLEI and Representative Items

Scale Name	Description	Sample Item
Student Cohesiveness	Extent to which students know, help, and are supportive of each other	I get along well with students in this laboratory class (+)
Open-Endedness	Extent to which the laboratory activities encourages an open-ended, divergent approach to use of computers	There are opportunity for me to pursue my own computing interests in this laboratory class (+)
Integration	Extent to which the laboratory activities are integrated with non laboratory and theory classes	The laboratory work is unrelated to the topics that I am studying in my lecture (-)
Technology Adequacy	Extent to which the hardware and software is adequate for the tasks required	The computers are suitable for running the software I am required to use (+)
Laboratory Availability	Extent to which the laboratory and computers are available for use	I find that the laboratory is crowded when I am using the computer (-)

Items designated (+) are scored 1,2,3,4 and 5, respectively for responses Almost Never, Seldom, Sometimes, Often, Almost Always. Items designated (-) are scored 5,4,3,2 and 1, respectively for responses Almost Never, Seldom, Sometimes, Often, Almost Always

Source: Newby & Fisher (2000, p. 431)

The third instrument was the Attitude towards Computers and Computer Courses (ACCC). The reasons for selecting this questionnaire were that it has four effective scales for assessing students' attitudes toward computers; and it was tested with an

Australian sample and the results indicated high score reliabilities, 0.80 to 0.90. Descriptions of Scales of the questionnaire are described in Table 3.3, it has 28 items in the four scales of Anxiety, Enjoyment, Usefulness of Computers, and Usefulness of Course. Each items is measured on a Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). Items 36, 37, 38, 41, 48, 51, 52, 53, and 63 are negative items and are scored in the reverse manner (see Appendix C)

Table 3.3
Descriptions of Scales in the ACCC and Representative Items

Scale	Description	Sample Item
Anxiety	Extent to which the student feels comfortable using a computer	Working with a computer makes me very nervous (+)
Enjoyment	Extent to which the student enjoys using a computer	I enjoy learning on a computer (+)
Usefulness of Computers	Extent to which the student believes computers are useful	My future career will require a knowledge of computers (+)
Usefulness of Course	Extent to which the student found the course useful	I do not think I will use what I learned in this class (-)

Items designated (+) are scored 1,2,3,4 and 5, respectively for responses Strongly Disagree, Disagree, Not sure, Agree, Strongly Agree. Items designated (-) are scored 5,4,3,2 and 1, respectively for responses Strongly Disagree, Disagree, Not sure, Agree, Strongly Agree

Source: Newby & Fisher (2000, p. 432)

As mentioned above concerning the quality of the three questionnaires, the researcher selected the CUCEI, the CLEI and the ACCC for use in this study with high confidence. The steps taken for the preparation of the questionnaires for use in Thailand are described in the following paragraphs.

Because the original instrument was designed for Western students, with all statements in English, careful translations and back translations as suggested by Brislin (1970, 1980) were carried out. The two forms of the CUCEI were translated into the Thai language by an English speaking instructor who teaches English courses, then back translated by another English speaking instructor who is fluent in

English. However, a problem arose during the back translation because the way to represent tense, present, past, and future is different in the Thai language. The present tense in the English language describes the events or actions that are factual or habitual. For example, when the third item in the CUCEI – "The instructor goes out of his/her way to help me" –was translated into the Thai language, the students were confused by the item. However, this problem was solved by the addition of more Thai words for clarification for the Thai students. The CLEI and ACCC were also translated and modified in the same way as the CUCEI. The differences between the original versions and the new English versions were discussed and corrected to clarify the Thai version. The first Thai versions of the CUCEI, CLEI, and ACCC were trialled with three computer science students of the university. The three students were asked to mark the items that they felt were unclear. The comments from the three students were used to modify the items, so that all sentences in the final versions were clear to the students.

For their administration, the three instruments were organized into a two part survey. The first part included the Actual and Preferred Forms of the CUCEI, while the second part comprised the Actual Form of the CLEI and the ACCC.

For preparation of the interview questions, each of the seven scales of the CUCEI was analyzed to establish a few suitable interview questions about each scale. The seven interview questions also were tried out with three computer students. Again unclear questions were revised.

3.3.2 Sample

The second year students who studied in the universities were selected to be the sample. Thirty-three classes from 11 universities were chosen, three from the Northern provinces, two from the North-Eastern provinces, two from the Southern provinces, two from the Middle provinces, and another two from the Bangkok area. The sample was composed of the second year undergraduate students undertaking computer courses. The reason for selecting the second year students was because they took a variety courses that required working in computer laboratories.

Each of these courses took four periods per week, two periods were lectures on theoretical aspects and another two periods were conducted in the computer laboratory.

Assignments were based upon the theories the students had studied on in the regular classes. Both lecture and laboratory classes also took 15 weeks in one semester. All students enrolled in a variety of computer courses which required working in a computer laboratory. There were 382 male and 523 female students, a total of 905 students, involved in this study. Thirty-three instructors were willing to let their students participate. The reason for selecting participating institutes from all areas of Thailand was that there is a different culture in each local area, such as the language accent, food style, religion and so on.

All the students studied a computer science major. Emphasis in this major is on software and information technology, although introductory architecture is included. The program is designed to prepare students for careers involving computer systems and their application in industry and management. Students taking this major receive solid grounding in the fundamentals of computer languages, operating systems, and the formal mathematical tools required to use the computer in solving complex tasks. The students have the opportunity to become involved in these areas of interest in terms of theory, software and hardware. This includes microprocessors and computer architecture, computer graphics, database systems, distributed systems, computer networks, numerical analysis, operating systems, programming languages, program specification and verification, performance evaluation, and information technology management.

Many of the computer science students tend to view themselves as "computer programming" majors. Yet just a few clever students of computer science majors actually become programmers. Instead, many computer science graduates end up in jobs which require at least some knowledge of the machine itself, such as the role of caches and the physical structure of computer networks, as well as the software which interfaces the hardware, such as the operating system and device drivers. However, some of computer science graduates become computer teachers.

3.3.3 Data collection procedures

At present, educational research has claimed that there are merits in moving beyond the traditional practice of choosing either qualitative or quantitative methods. Instead, a combination of qualitative and quantitative methods within the same study has been recommended (Fraser, Williamson, & Lake, 1988 cited in Fraser & Tobin, 1991; Howe, 1988). It is noted by researchers (Fraser, 2002; Fraser & Tobin, 1991) that in the relatively new and rapidly growing field of classroom learning environment, studies involving qualitative and quantitative methods have provided rich insights into classroom life. Researchers and educators realize the potential advantages of combining qualitative and quantitative aspects within the same research study on learning environments. Consequently, this study utilized both qualitative and quantitative methods as means of data collection. The quantitative method involved using the questionnaires, while the qualitative method involved the use of interviews.

3.3.3.1 The physical environment

The classrooms where the questionnaires were administered for this study are computer science classrooms. These classes have computer laboratory characteristics; typically there is one personal computer for an instructor, an overhead projector, a multimedia projector or television monitor, a white board with pens is also provided in front of the class. There are two bulletin boards and 25 to 40 desktop computers for students. The majority of the computers used in these institutions are Pentium three or four versions. The software loaded into each PC included a Word processor (Microsoft Word), Presentation software (Microsoft PowerPoint), Spreadsheet/graphing software (Excel, etc), WWW. Browser and e-mail programs. Every personal computer can be connected with the Internet with the LAN system.

3.3.3.2 Ethical issues

The ethical issues for this study respected all participants. At first, letters asking for students to be allowed to participate in this study were sent to targeted universities, addressed to the President of each individual university prior to the data collection schedule. A sample of this letter is provided in Appendix G. The letter described the

research title, aims of the study, the targeted participants, a timetable of data collection, and provided a sample of the questionnaires. The confidentiality of the participants also was described on the first page of each questionnaire. The participants were assured that the data from the questionnaires and interviews would be used only for this study.

For the confidentiality of the participants, pseudonyms replaced the students' real names. At each university, the researcher introduced herself to the instructor and described the aim of this study, the methods of the research study, the research instruments and negotiated a data collection schedule with the instructors.

3.3.3.3 Questionnaire survey

After formal permission letters were sent to each university president, the researcher visited all targeted universities as planned. At each university, the researcher introduced herself to the administrators, President or Vice president (Academic), Dean of science faculty, coordinators of computer science program and computer science instructors who were willing to let their students respond to the questionnaires and be interviewed.

The researcher negotiated and planned the exact times to administer the questionnaires and conduct student interviews with the coordinator of the computer science program and other involved instructors. The researcher visited the computer science classes after the necessary formalities were over; introduced herself to the students, described the nature of the questionnaires, the aim of the study, and thanked instructors and students for their participation. It was important to emphasize here that all questionnaires related only to the instructor who taught the same subject in the same class. Moreover, promises were made to students that the data from the questionnaires and interviews would be used only for this study. The first section of the questionnaire was given to students and they were directed to take time to complete this section. Similarly, the second section was given to them when they were working in the computer laboratories. The completed questionnaires were kept in sealed envelopes, one for each class.

3.3.3.4 Interview

Interviews were used for collecting the qualitative data. Cannell and Kahn, (1968) defined the interview as a two-person conversation initiated by the interviewer for the specific purpose of obtaining research-relevant information. The interview may serve three purposes. First, it is used as the principal means of gathering information having direct bearing on the research objectives. Second, by using interviews we can test hypotheses or suggest new ones; or identify variables and relationship. Third, it can be used in conjunction with other methods in a research undertaking (Cohen, Manion & Morrison, 2000). The interview might be used to follow up unexpected results, to validate other methods, to go deeper into the motivation of respondents and their reasons for responding (Kerlinger, 1986). It was for these reasons that the interview method was selected.

Gaskell suggests an individual interview process is a conversation lasting normally for one to one and a half hours. The interview starts with some introductory comments about the research, a word of thanks to the interviewee for agreeing to talk, and a request for permission to tape record the session. The interviewer should be open and relaxed about tape recording, which can be justified as a helpful record of the conversation rather than taking notes. The interviewer should focus his/her attention on listening and understanding what has been said. It is important to give the respondent time to think, so pauses should not be filled with a further question (Gaskell, 2000). Keeping in mind Gaskell's suggestion, the researcher prepared introductions as following, "Hello, thank you for coming and participating in the interview. During the interview, please feel free to answer the questions, your answers are an important guide for instructors developing classroom learning environments. This conversation in the interview session will be presented as an idea and used in this study without reference to your real name, your instructor's name nor your university. Do you mind if I record the interview by tape recorder? Are you ready? OK I will start with the first question..." .

Based on suggestions by Patton (1990), thus, the interview guide approach was considered to be the appropriate type of interview for the qualitative method in this study.

In so doing, an interview protocol was developed to guide the process. A description of the interview protocol is provided in Table 3.4. As stated earlier, the interview questions, matched the seven scales of CUCEI. Again, student interviewees' names were replaced with codes. Such that IS 1.1, IS 1.2 (IS 1.2 = interviewee student number 2 from class 1).

Following the administration of the questionnaires, male and female students were asked to be volunteers for interviews; however, in some universities only female students were available. Two students in each class were interviewed individually; the data from these interviews provided an insight into how the students perceived their computer classroom learning environments.

Table 3.4
The Interview Protocol in Accord with the CUCEI Scales

CUCEI Scales	Interview Questions
Personalization	1. Can you describe your instructor's personality? 2. Is your instructor approachable, helpful and responsive?
Innovation	1. Does your instructor plan new, unusual activities? 2. How does your instructor manage new activities?
Student Cohesiveness	1. Did you make friends easily in this class? 2. Have you a good relationship with your classmates?
Task Orientation	1. Are class assignments clear and do you understand your work? 2. Is this class always well organised?
Individualisation	1. Are you allowed to choose activities and how you will work? 2. Have you any opportunity to pursue your particular interests in this class? 3. Does your instructor let you do assignments that follow your own interests?
Cooperation	1. Do you cooperate with other students when doing assignment work? 2. And how do you cooperate with them? 3. Do you learn from other students in this class?
Equity	1. Do you receive the same encouragement from the instructor as other student do? Please tell me the detail? 2. How do you get the same amount of help from the instructor as do other students? 3. Were you treated differently according to your ability?

3.3.4 Data analysis and data presentation

All questionnaires were first tallied into a Microsoft Excel spreadsheet organized by individual classes, then imported into SPSS Version 11. The vertical axis listed the

students' numbers and the horizontal axis contained each item in the three instruments and some additional details, for example, the course students were taking, classes, gender, and additional information. The negative questions were re-coded.

To answer research questions 1, 2, and 3, statistics related to internal consistency, discriminant validity, and capability of differentiating between classrooms were computed. Cronbach alpha coefficients (Cronbach, 1951) were computed for each scale using the individual student and the class mean as the units of analysis. The alpha coefficient value can vary from 0.00 to 1.00. The value 0.00 indicates no reliability and 1.00 is perfect. A value of 0.50 is considered a sufficient level for scale internal consistency for questionnaires like these (DeVellis, 1991).

The Pearson coefficient (r) was computed to estimate the discriminant validity of questionnaires, using the mean correlation of a scale with the other scales as a convenient index, for each of the two forms of the CUCEI, the CLEI and the ACCC, using both the individual student and the class mean as the units of analysis. The strength of correlation values range between -1 to +1, the value 0 could be interpreted as having no association, the value 1 could be interpreted as having perfect association. Lutz (1983) suggests that to interpret the value of the coefficient (r) 0.15, 0.40, 0.65 could be described as weak, moderate and strong, respectively. The negative or positive signs in the front of the correlation value indicate the direction of the relationship (Lutz, 1983; Walsh, 1990).

To investigate the ability of each instrument to differentiate students' perceptions from other groups, the eta^2 was analysed. The eta^2 is the ratio of the between group sum of squares and the total sum of squares. The higher the eta^2 the better the instrument is. These figures imply that learning environment instruments have the ability to differentiate between students' perceptions in different classes: students in a class should perceive their learning environment similarly but different from students' perceptions in different classes (Walsh, 1990).

To answer research question 4, which explore students' perceptions in their actual computer classroom learning environments, means, standard deviations, the vectors

of students' perception of the Actual Form of the CUCEI, data from student interview, the Actual Form of the CLEI, are presents for indicating the direction and magnitude of the students' responses.

To answer research questions 5, 6, and 7 which explore the differences of students' perceptions, means, standard deviations, and *t*-tests were used. Trochim (2005b) gave the picture of *t*-test as the ratio of the difference between group means divided by the standard error of the difference and this is used to assess whether the means of the two groups are statistically different from each other. These results are presented in Chapter 5.

Finally, research questions 7 and 8 in this study relate to aassociations between computer classroom learning environment and student attitudinal outcomes. These were examined using simple correlations (r), multiple correlations (R) and standardized regression coefficients (β). An examination of R^2 was used to indicate how much of the percentage of the variance in the ACCC scales could be attributed to students' perceptions towards their computer science classes and computer laboratories. The results of these analyses are shown in Chapter 6.

3.4 SUMMARY

This chapter presents the methodology used to investigate the validity and reliability of the three questionnaires, and applications of these three questionnaires to assess students' perceptions towards their computer classroom learning environments. Assessment of students' attitudes toward computer use and computer class and the investigation of the relationships between their perception and their attitudes toward their computer classroom are also included. The research design presented in this chapter was guided by the theoretical framework arising from the review in Chapter 2.

The analysis of results is presented in the next three chapters. Chapter 4 is devoted to answer the first three research questions; the validity and reliability of the three questionnaires used in this study is discussed. Chapter 5 provides students' perception of their computer classrooms, differences between students' perceptions

of their actual and preferred learning environments, and differences between males and females. Finally, the results of students' attitudes toward computer use and computer courses, and associations between students' perceptions of their learning environment and their attitudes are described in Chapter 6.

CHAPTER 4

VALIDATION OF THE INSTRUMENTS

4.1 INTRODUCTION

Questionnaires are a most important method for assessing classroom learning environment and an effective evaluation depends on the quality of these instruments. Therefore, educational researchers need to investigate the validity and reliability of any instruments before they are applied to actual situations.

In this study, this information included discriminant validity, the scale's internal consistency reliability, and the questionnaire's ability to distinguish between different classes. Collectively, these statistical measures provide an indication of the suitability of each questionnaire for portraying the classroom learning environments being studied, as well as providing evidence on the validity of the questionnaires for future and wider use in the Thailand educational context.

This chapter provides the details of the reliability and validity of the three instruments, namely, the College and University Classroom Environment Inventory (CUCEI), the Computer Laboratory Environment Inventory (CLEI), and students' Attitudes towards Computers and Computer Courses (ACCC). Data analysis was conducted based on the responses of 905 computer science students in 33 classes at the undergraduate level of 11 tertiary institutes in Thailand.

The analysis and the results presented in this chapter relate to research questions 1 to 3, and are structured for discussion into three main sections. Section 4.2 describes the results of CUCEI analyse answer to research question 1. Sections 4.3 and 4.4 report similar analyses for the CLEI and the ACCC in responses to research question 2 and 3, respectively. A summary of the reliability and validity of the three questionnaires is presented in section 4.5.

4.2 VALIDATION OF THE THAI VERSION OF THE CUCEI

It is important to ensure that each item in the scales of the questionnaires used in this research assessed a common construct. Therefore, alpha reliability figures, measured as the Cronbach Alpha coefficient, were calculated using both the individual score and the class mean as the units of analysis. Similarly, mean correlations of a scale with the other scales were also calculated to investigate the discriminant validity of the questionnaire. Finally, a one-way analysis of variance (ANOVA) was performed to determine if the Thai version of the CUCEI was able to differentiate significantly between students' perceptions in different classrooms or groups. The results are summarized in Tables 4.1 and Table 4.2 for the Actual and Preferred Forms of the CUCEI, respectively.

Table 4.1
Internal Consistency Reliability (Cronbach Alpha Coefficient), Mean Correlations and Eta^2 for Two Units of Analysis of the CUCEI Actual Form (N = 905)

Scales	Number of items	Unit of Analysis	Alpha Reliability	Mean Correlation	ANOVA (eta^2)
Personalisation	7	Individual	0.81	0.33	0.10***
	7	Class	0.89	0.48	
Innovation	6	Individual	0.72	0.17	0.14***
	6	Class	0.66	0.30	
Student Cohesiveness	7	Individual	0.81	0.14	0.14***
	7	Class	0.95	0.14	
Task Orientation	7	Individual	0.62	0.33	0.18***
	7	Class	0.85	0.47	
Cooperation	7	Individual	0.88	0.28	0.14***
	7	Class	0.96	0.39	
Individualisation	6	Individual	0.56	0.16	0.12***
	6	Class	0.56	0.29	
Equity	7	Individual	0.89	0.33	0.09***
	7	Class	0.92	0.52	

***$p<0.001$

4.2.1 Internal consistency reliability of the Thai version of the CUCEI

The alpha reliability values of the actual CUCEI scales are shown in Table 4.1. When the individual student was used as the unit of analysis, after the deletion of items 8 and item 36, the Cronbach alpha coefficients ranged from 0.56 to 0.89, being greater than the threshold level of 0.6 suggested by Nunnally (1967, 1978) or DeVellis (1991) who suggested that level of 0.5 was satisfactory. Similarly, when using the class mean as the unit of analysis, the alpha reliabilities ranged from 0.56 to 0.96. Four scales, namely, Personalization, Student Cohesiveness, Cooperation, and Equity have reliabilities of more than 0.80. Two scales, Innovation and Task Orientation, are reasonably acceptable, with modest scores of 0.72 and 0.62, respectively. The Individualization scale has the lowest alpha reliability score but is acceptable at 0.56. A further revision of its items could improve this. Therefore, the Actual Form of the CUCEI is reliable for use in the Thailand university context.

Table 4.2
Internal Consistency Reliability (Cronbach Alpha Coefficient), Mean Correlations and Eta^2 for Two Units of Analysis of the CUCEI Preferred Form (N = 905)

Scales	Number of items	Unit of Analysis	Alpha Reliability	Mean Correlation	ANOVA (eta^2)
Personalisation	7	Individual	0.71	0.34	0.16***
	7	Class	0.84	0.69	
Innovation	6	Individual	0.57	0.35	0.11***
	6	Class	0.88	0.58	
Student Cohesiveness	7	Individual	0.75	0.37	0.21***
	7	Class	0.90	0.68	
Task Orientation	7	Individual	0.70	0.43	0.17***
	7	Class	0.97	0.71	
Cooperation	7	Individual	0.87	0.42	0.12***
	7	Class	0.93	0.76	
Individualisation	6	Individual	0.56	0.33	0.10***
	6	Class	0.85	0.61	
Equity	7	Individual	0.85	0.39	0.09***
	7	Class	0.93	0.71	

***$p<0.001$

With regard to the Preferred Form of the Thai version of the CUCEI, Table 4.2 indicates that after items 8 and 36 were deleted, the Cronbach alpha coefficients ranged from 0.56 to 0.87 and from 0.56 to 0.97, when the individual score and class means were used as the unit of analysis, respectively. These results indicate that the alpha reliability values of all seven scales of the Preferred Form of the CUCEI are acceptable.

4.2.2 Discriminant validity of the Thai version of the CUCEI

The discriminant validity of the CUCEI was investigated by using the mean correlation of a scale with the other six scales as a convenient index. A lower mean correlation of a scale suggests a greater discriminant validity of that scale. As shown in Table 4.2, the discriminant validity for the actual CUCEI scales ranged from 0.14 to 0.33 when the individual student was used as the unit of analysis, and from 0.14 to 0.52 when the class mean was utilized as the unit of analysis. Furthermore, Table 4.2 reveals that the mean correlations for the preferred CUCEI scales ranged from 0.33 to 0.43 when using the individual score as the unit of analysis. These results maintain validity of the questionnaire. Unfortunately, when the class mean was the unit of analysis, this study found that the mean correlation scores of the Preferred Form of the CUCEI were more than 0.76. Nevertheless, generally these results indicate that both the Actual and Preferred Forms of the CUCEI scales measure distinct aspects of computer classroom learning environment adequately. These are somewhat overlapping in the case of the Preferred Form.

4.2.3 Capability of Thai version of the CUCEI in differentiating between classrooms

To provide further validitation information on the CUCEI in this study, and in keeping with previous classroom learning environment research, each scale's ability to differentiate between the perceptions of students in different classrooms was examined. This analysis involved the eta^2 statistic through a one-way ANOVA with class membership as the main effect. It was calculated to determine whether the CUCEI was capable to differentiate between the students' perceptions in different classes. In the Actual Form, the eta^2 ranged from 0.09 to 0.18 as exposed in Table

4.2. For the Preferred Form, the eta^2 values ranged from 0.09 to 0.21 as shown in Table 4.3. These results indicate that each CUCEI scale is able to differentiate significantly ($p<0.001$) between classes.

Considering the results generated from the discriminant validity analysis, scale internal reliabilities and the ability to differentiate between classes, this study suggests that the Thai version of the CUCEI is a reasonably robust instrument to measure students' perceptions of computer classroom learning environment at the tertiary level in Thailand.

4.3 RELIABILITY AND VALIDATION OF THE THAI VERSION OF THE CLEI

In response to research question 2: 'Is the Computer Laboratory Environment Inventory (CLEI) a valid and reliable questionnaire for use in Thailand?' this section describes the results for internal consistency, discriminant validity and ability to differentiate between students' perceptions in different classes for the CLEI. A summary of the results is presented in Table 4.3. The alpha reliabilities are elucidated in Section 4.3.1, while the interpretation of discriminant validity and ability of the CLEI to differentiate students' perceptions are provided in Sections 4.3.2 and 4.3.3

Table 4.3
Internal Consistency Reliability (Cronbach Alpha Coefficient), Mean Correlations and Eta^2 for Two Units of Analysis of the CLEI Actual Form (N=905)

Scales	Unit of Analysis	Alpha Reliability	Mean Correlation	ANOVA (eta^2)
Student Cohesiveness	Individual	0.73	0.37	0.20***
	Class	0.92	0.55	
Open-Endedness	Individual	0.61	0.35	0.09***
	Class	0.61	0.53	
Integration	Individual	0.61	0.33	0.20***
	Class	0.85	0.54	
Technology Adequacy	Individual	0.68	0.41	0.16***
	Class	0.83	0.59	
Laboratory Availability	Individual	0.75	0.33	0.22***
	Class	0.92	0.56	

***$p<0.001$

4.3.1 Internal consistency reliability

Table 4.3 presents the results based on two units of analysis, namely, individual score and class mean. It is shown that Cronbach alpha coefficient which represents alpha reliability of each scale ranged from 0.61 to 0.75 if the individual student score was used as the unit of analysis and ranged from 0.61 to 0.75 if the class means were used. Five scales of the CLEI, namely, Student Cohesiveness, Open-Endedness, Integration, Technology Adequacy and Laboratory Availability were above 0.68. The Open-Endedness scale possessed the lowest score of 0.61. Overall, these scores suggest that all scales of the Thai version of the CLEI are reliable (DeVellis, 1991; Nunnally, 1967, 1978).

4.3.2 Discriminant validity

The discriminant validity of the Thai version of CLEI was investigated in a similar way to the CUCEI. As shown in Table 4.3, the discriminant validity for the CLEI scales as shown by the mean correlation scores ranged from 0.33 to 0.41 when the individual student was used as the unit of analysis and from 0.53 to 0.59 when the class mean was employed. This indicates that the Thai version of the CLEI measures somewhat distinct aspects of computer classroom learning environments although to some extent, some scales of the Thai version of CLEI are overlapping with those of others.

4.3.3 Capability of the Thai version of the CLEI in differentiating between classrooms

Again, to confirm the validity of the CLEI in this study, and in keeping with previous learning environment research, a one-way ANOVA was executed to display each scale's ability to differentiate between the perceptions of students in different classrooms. The eta^2 score ranged from 0.09 to 0.22 as shown in Table 4.3. This result indicates that all scales of the CLEI posses the ability to significantly ($p<0.001$) differentiate students' perceptions from different classes or groups.

Overall, the results generated from scale internal reliability analysis, mean correlation and the ANOVA suggest that the modified Thai version of the CLEI is a valid and reliable instrument for measuring students' perceptions of computing laboratory learning environments in a Thailand university.

4.4 RELIABILITY AND VALIDATION OF THAI VERSION OF THE ACCC

The validity of the Thai version of the Attitudes towards Computers and Computer Courses (ACCC) questionnaire is as important as the other instrument in order to obtain an accurate picture of the learning environment investigated in this study. Therefore, similar analyses were conducted with this questionnaire. Table 4.4 presents the results of these analyses.

Table 4.4
Internal Consistency Reliability (Cronbach Alpha Coefficient), Mean Correlations and Eta^2 for Two Units of Analysis of the ACCC (N=905)

Scales	Unit of Analysis	Alpha Reliability	Mean Correlation	ANOVA (Eta^2)
Usefulness Course	Individual	0.64	0.18	0.15***
	Class	0.87	0.24	
Anxiety	Individual	0.72	0.51	0.14***
	Class	0.89	0.80	
Usefulness Computers	Individual	0.66	0.18	0.14***
	Class	0.77	0.29	
Enjoyment	Individual	0.70	0.25	0.14***
	Class	0.84	0.24	

***p<0.001

4.4.1 Internal consistency reliability of the Thai version of the ACCC

As shown in Table 4.4, the alpha reliability of the ACCC scales scores are relatively high, ranging from 0.64 to 0.72 when the individual student was used as the unit of analysis, and from 0.77 to 0.89 when the class means were employed as the unit of analysis. These scores support the claim that the ACCC questionnaire is reliable (De

Vellis, 1991; Nunnally, 1967, 1978). This result suggests that the four scales of the ACCC, namely, Usefulness Course, Anxiety, Usefulness Computers and Enjoyment are acceptable and reliable for use in Thailand.

4.4.2 Discriminant validity of the Thai version of ACCC

The discriminant validity of the ACCC was investigated by using the mean correlation of a scale with the other three scales as a convenient index. The results are presented in Table 4.4 and again both the individual student score and the class mean were used as the units of analysis. As shown, the discriminant validity ranged from 0.18 to 0.51 when the individual student was used as the unit of analysis, suggesting that the Thai version of ACCC has distinct scales.

When the class means were utilized as unit of analysis, the mean correlation scores ranged from 0.24 to 0.29 for all scales, except for the Anxiety scale that had a score of 0.80. These results also suggest that the Thai version of ACCC measures distinct aspects of computer classroom learning environment with the use of the class mean score as a unit of analysis. The score of 0.80 indicates that items in the Anxiety scale overlap with items in other scales, but given the nature of this scale this could be expected.

4.4.3 Capability of the Thai version of the ACCC in differentiating between classrooms

This analysis involved the eta^2 statistic showed a range from 0.14 to 0.15 and indicated that all scales of the Thai version of the ACCC significantly ($p<0.001$) differentiated between computer classroom environments. Consequently, these findings provide further reliability and validity of the Thai version of the ACCC questionnaire for assessing the computer classroom-learning environment in Thailand educational context.

4.5 SUMMARY

This chapter reports the findings and discussions concerning the reliability and validity of the three questionnaires used in this study. Briefly, it is concluded that the three questionnaires met the criteria required to be good and reliable instruments to investigate university computer classroom learning environments in Thailand educational context. Generally, each scale in these questionnaires exhibited satisfactory internal consistency reliability and discriminant validity, and differentiated between the perceptions of students in different classes. Consequently, these three instruments were used for further analysis to describe the nature of computer classroom learning environments and the differences between students' perceptions of their learning environments based on gender and forms of questionnaires. The results are presented and discussed in Chapter 5. Chapter 6 is devoted to the presentation and discussion of the results regarding associations between students' perception and their attitudes toward computer laboratory and computer classrooms.

CHAPTER 5

COMPUTER CLASSROOM LEARNING ENVIRONMENTS

5.1 INTRODUCTION

The purpose of this research was to validate the three instruments used for the study and to investigate the students' perception of their computer classroom and laboratory learning environment, the students' attitudes toward computer and computer laboratory and the associations of those learning environment perceptions and attitudes in the Thailand University context. The study was directed by eight research questions that focused on the validation of the instruments and the assessment of students' perceptions toward their computer classroom learning environment. The validation of the instruments was presented and discussed in Chapter 4, now Chapter 5 is devoted to discussing results of an application of the instruments.

More specifically, this chapter focuses on the responses to research questions:

(4) What are students' perceptions of their actual computer classroom learning environment?

(5) What is the difference between students' actual and preferred perceptions of the learning environments of their computer lecture classrooms?

(6) Are there any differences between males and females in perceptions of their computer classroom learning environments?

(7) Are there any differences between males and females in perceptions of their computer laboratory learning environments?

As indicated in section 3.3, the responses were subjected to descriptive statistical analysis by calculating the means and standard deviations for each scale for each instrument. The average item mean, or the scale mean divided by the number of items in a scale, was used as the basis of comparison between different scales of each instrument. Furthermore, to provide a more detailed picture of these learning environments, *t*-tests using either paired samples or independent samples were conducted to investigate the differences between two groups' perceptions of each

scale. In this study, comparisons were made between males and females, actual and preferred perceptions.

This chapter is organised into six sections. The introduction to the chapter is presented in section 5.1. A description of the typical computer classroom learning environment in Thailand universities is presented in section 5.2. The differences between students' actual and preferred perceptions of their computer lecture classroom environments and their computing laboratories are discussed in section 5.3. The differences between males and females in perceptions of their computer classroom learning environments and of their computer laboratory learning environments are presented in section 5.4. Finally, a summary of this chapter is provided in section 5.5.

5.2 DESCRIPTIONS OF TYPICAL COMPUTER CLASSROOM LEARNING ENVIRONMENTS

To explore the nature of the computer classroom learning environment, the average item mean (the scale mean divided by the number of items in that scale) and average item standard deviation of each scale for both Actual and Preferred Forms of the questionnaire were calculated. This section provides a view of Thailand university students' perception of their computer classroom learning environments. Section 5.2.1 reports students' responses toward both the actual and preferred Thai version of CUCEI. The differences of students' views of actual and preferred learning environments are also discussed. Section 5.2.2 discusses the description of students' views of their computer laboratory.

5.2.1 Students' Perception of the Actual and Preferred Forms of the College and University Classroom Environment Inventory (CUCEI)

5.2.1.1 Data from questionnaire

A summary of the average items means and average standard deviations for the two versions of the questionnaire is reported in Table 5.1 and the same data are graphed in Figure 5.1.

Table 5.1
Average Item Means, and Standard Deviations of Students' Perceptions of Actual and Preferred Forms of the CUCEI

Scale	Mean		Standard Deviation		*t*-test
	Actual	Preferred	Actual	Preferred	
Personalisation	3.27	3.78	0.64	0.52	20.92***
Innovation	3.27	3.50	0.53	0.46	9.47***
Student Cohesiveness	3.99	4.04	0.73	0.63	2.42**
Task Orientation	3.35	3.90	0.52	0.55	25.86***
Cooperation	3.70	3.98	0.65	0.62	13.77***
Individualisation	2.90	3.37	0.46	0.45	21.95***
Equity	3.34	3.79	0.69	0.68	17.33***

***p<0.001, **p<0.01, *p<0.05 n=905

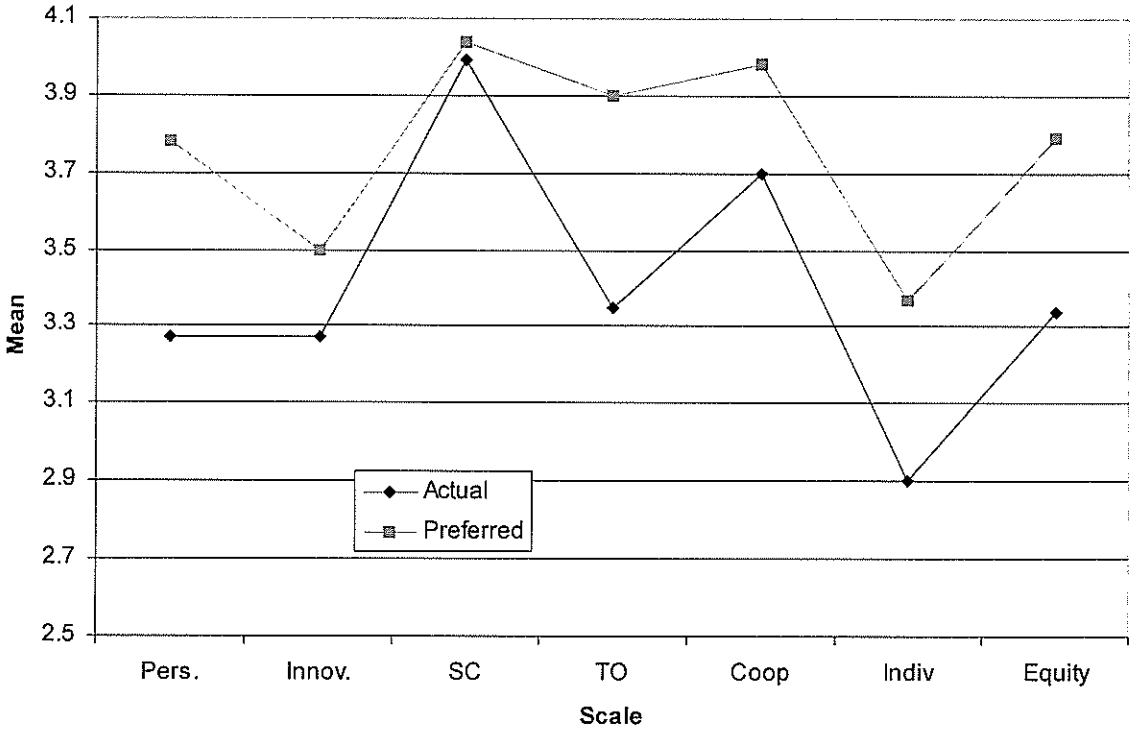

Figure 5.1. Comparisons between students' perceptions of actual and preferred computer science classroom learning environments.

Generally, the results revealed that students possessed a positive view of their computer classroom learning environments. The mean scores for all scales were higher than 3.00 for both actual and preferred learning environments with the exception of the actual Individualisation scale which was 2.90. These scores indicate that students generally experience the activities referred to in the questionnaire. Overall, these results indicate that Thai university students have a relatively positive learning environment.

Results from *t*-tests for paired samples showed that these differences are statistically significant (mostly $p<0.001$) on all scales. The results, which are consistent with previous studies (Nair & Fisher, 2000), suggest that most students would prefer a learning environment which is characterised by having more personalisation, enhancing students' cohesiveness, providing clearer task orientation, doing more investigations, allowing individuality but also ensuring greater cooperation as well as more equity during class sessions. Teachers or principals can use these differences in both actual and preferred scales as a focus for improving the classroom learning

environment in keeping with Fraser's (1989) five stages for learning environment enhancement.

5.2.1.2 The vectors of students' perception of the Actual Forms of the CUCEI

Again, assessing classroom leaning environments can provide an effective source of information for teachers in improving their classrooms (Fraser, 1981). So it is interesting to further analyse the average item mean of the seven scales of the CUCEI, considering only the scores of the seven scales. The vectors of students' perception of the actual scales of the CUCEI can be used to guide teachers' in improving their classrooms. They could be classified into five categories. The first category should be the scale of Student Cohesiveness with its highest score of 3.99. This numerical value was relatively high with respect to the remainder. This indicates that the students gave their strongest responses for the scale upward from "Sometimes" to "Often" as shown with the magnitude and direction in Figure 5.1. The magnitude of 3.99 or about 4.00 was not above our expectation of students' normal behaviours in their daily life. We can see students have their group members from five to seven persons performing their activities together.

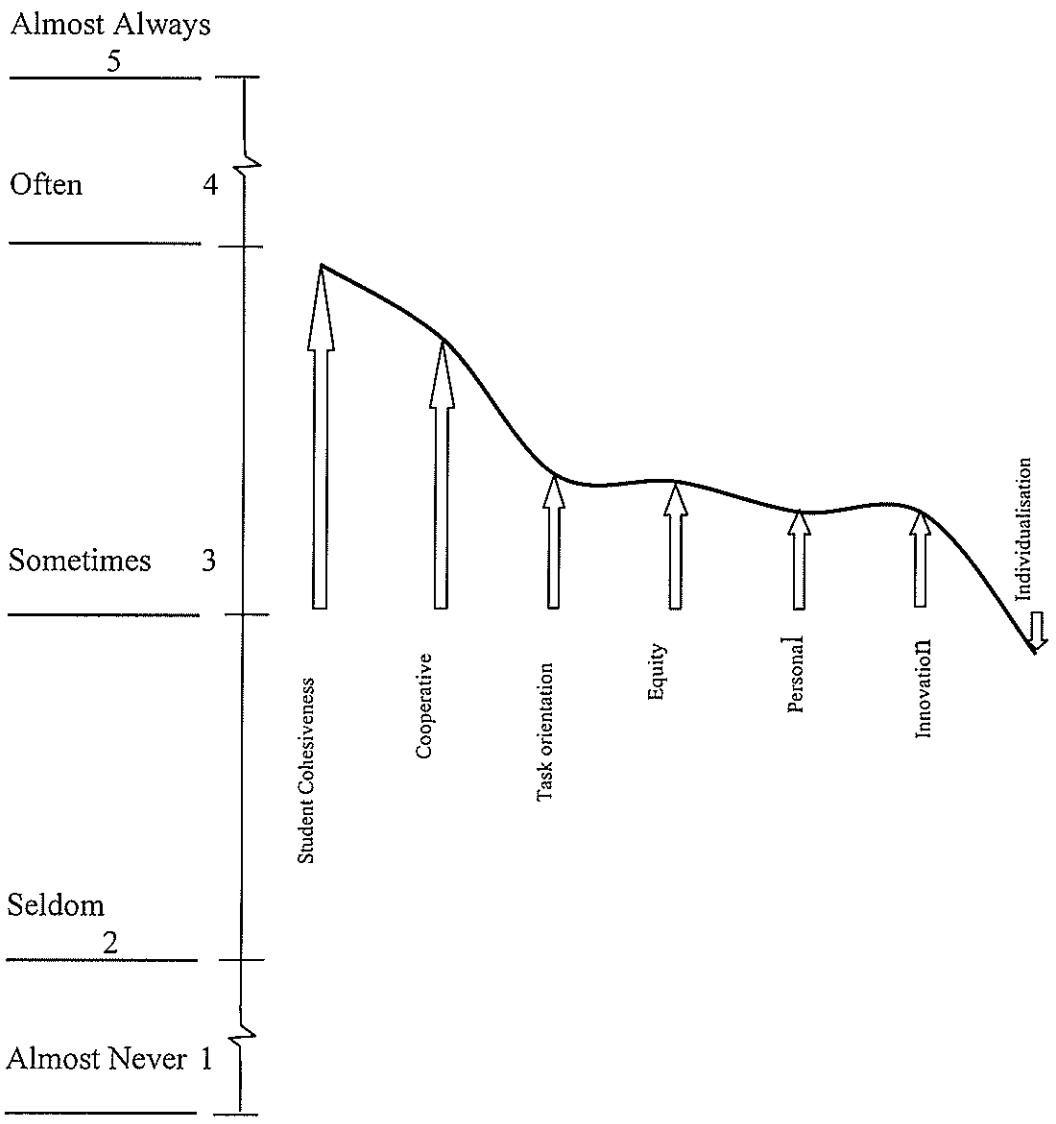

Figure 5.2. The direction and magnitude of the students' responses to the seven scales of CUCEI Actual Form (the magnitude of the arrows were an arbitrary unit).

In addition, when looking at the seven questions in this scale there is ample evidence to vividly demonstrate that the Student Cohesiveness scale can be used as an instrument to gauge the students' relationships in computer science classrooms. Furthermore, the score on the Actual Form of this scale was not too different from the Preferred Form when compared with the others scales. This reflects the fact that students are satisfied with the level of classmate cohesiveness.

For the scale of Cooperation, the score was 3.70. This value is slightly lower than for the Student Cohesiveness scale, but still relatively high. This indicates that students responded quite strongly using "Sometimes" to "Often". Thai students have become

accustomed always to designing and completing their projects in groups. These scales constituted the second category.

The scales of Task Orientation and Equity had quite similar scores of 3.35 and 3.34, respectively. This indicates that students on average gave their responses in the "Sometimes" to "Often" level and these scales made up a third category.

The scales of Personalisation and Innovation also had similar scores of 3.27 but the arrows are shortened so these scales were constructed to be in a fourth category. The last category was the scale of Individualisation with its' score of 2.90 and the opposite direction of the students' responses from "Sometimes" to "Seldom".

Even though the seven scales of the CUCEI are not interval or ratio variables, when all scales were rearranged in order of the magnitudes and directions we can create a smooth curve which shows their relationships as a function. Next we looked at the curve in the manner of rate of changing from the right to the left hand side the graph starting from the bottom point of Individualisation. The slope of the tangent line to the Individualisation point is steepest when going to Innovation. This was the same as the Preferred Form of the CUCEI as in Figure 5.3. This supports the belief that students gave valid responses to both forms of the CUCEI.

Generally, the results revealed that the students possessed positive perceptions of their computer classroom learning environments. The mean scores for all scales were higher than 3.00 for the actual learning environments with the exception of the Individualisation scale which was 2.90. Overall, these results indicate that Thai university students are relatively happy with the existing learning environment.

5.2.1.3 Data from student interviews

At present, educational research has claimed that there are merits in moving beyond the traditional practice of choosing either qualitative or quantitative methods. Instead, the combination of qualitative and quantitative methods within the same study has been recommended. In addition, instruments that can assess both qualitative and quantitative situations can become better research tools (Fraser, Williamson, & Lake, 1988; Howe, 1988).

Using information from interviews supports particular data from the CUCEI and assists in understanding the students' perceptions of their computer classroom learning environments. As mentioned in section 2.4.3, positive learning environments have to be created to enhance students' satisfaction and engagement in learning. Moreover, assessing the learning environment has an impact on improving classrooms, and can make students' learning experience more predictable.

The use of the CUCEI with its seven scales is an important source of students' views of their classrooms. In this study, it is noteworthy that the seven scales of the CUCEI were used to guide the interview process. It is most interesting to understand students' perceptions towards their computer classroom learning environments. Besides the students' perceptions as articulated through questionnaire, additional benefit from interviews can guide the instructor in monitoring and better understanding students' perceptions. The data from the interview might also be useful for the instructor to effect changes to improve learning environments.

The objective of this interview was to obtain more detail of the students' perceptions toward their computer classroom learning environment. The data from this interview also can be used as a tool to cross check and verify how the students perceive their learning environment through their responses in the questionnaire. Two volunteer students were selected from each class to participate in this interview. Therefore, from 33 classes a total of 66 students were interviewed. After the students were given both forms of the Thai version of CUCEI, two of the students who volunteered were selected to be interviewed. The interviews were open-ended and guided by an interview protocol.

This section presents described the results from the interviews with students. The interviews as guided by the interview protocol focused on each scale of the Thai version of the CUCEI, namely, Personalisation, Innovation, Student Cohesiveness, Task Orientation, Cooperation, Individualisation, and Equity. Themes for interpreting students' perception of each scale followed the scale description as mentioned in Table 3.1. Most of students' comments were relatively positive about all scales. Nevertheless, a few student comments reflected a relatively negative

perception on several scales. In the following sections the results from the interviews are given scale by scale.

Personalisation

Regarding the Personalisation scale, two main questions were used to assess the students' feelings toward the instructor's personality. These questions are: (1) Can you describe the most impressionable characteristics of your instructor's personality? And (2) Is your instructor approachable, helpful and responsive? Please explain more. The guide for judging students' perceptions in this scale is embedded in the items that belong to this scale. For example, 'the instructor considers students' feelings, is interested in students' problems, is helpful and friendly, and able to clearly explain the material'. The interview results show that generally the students are satisfied with their instructor's personality. They commented that the instructor considers students' feelings, such as:

> *My instructor is kind to me. He helps me to learn a lot of new knowledge. (IS 9.1)*

> *The instructor is patient. She clearly explains in detail so I can understand and can solve the problems. (IS 16.1)*

> *My instructor is concerned about students' feelings. After he finishes each lecture, he always asks us if any of us have any questions. He always asks if we understand what he has explained. (IS 12.1)*

> *I know my instructor is concerned about my feelings. She often asks me, have you any questions, what part don't you understand? (IS 16.1)*

Concerning the item 'Instructors are helpful', students provided positive views like:

> *If I have some problems, I can ask help from him. He always readily gives help. (IS 28.1)*

Similarly, students also provided affirmative comments on the item 'Instructors are able to explain', such as:

> *My instructor is a very good teacher. She explained clearly and made the lessons easily understood. (IS 32.1)*

However, one student had a contrasting comment suggesting that the particular instructor is not good at explaining.

> *My instructor isn't good at explaining. She was unclear about my questions but I respect her, so after that I didn't ask her so many questions. I believe that she might answer me unclearly as she did before. (IS 2.1)*

Innovation

Regarding the Innovation scale, students' perceptions are interpreted from on their responses to the two main questions: (1) Did your instructor plan new, interesting activities? and (2) How did your instructor manage new activities? The students provided various comments both positive and negative, as follows:

> *My instructor created an WBI (web based instruction lesson) for this course. I am comfortable to learn with WBI any time I want and I have no need to take notes when I listen to the lecture. I can print out the material easily (IS11.1)*

> *The instructor didn't plan any new lessons. He always uses the old style of teaching. (IS 27.1)*

Task Orientation

On the Task Orientation scale, the themes for judging students' perceptions are their responses towards classroom activities and organisations. Two main questions were used: (1) Are class assignments clear and do you know clearly what you are doing? Please explain and (2) Is this class always well organised? Most of the students' comments were positive and only a few students gave negative responses.

Most students believed class activities were carefully planned as they typically said:

> *I know well what activity is included for this class, because my instructor gave me a course description which has a lot of detail about the teaching and learning activities provided in this class. (IS 28.1)*

There were a few students who stated that the class was not well organized:

> *This class usually started late, because some students came to class late. (IS 17.1)*

The instructor had many meetings so she was often absent from class, participating in meetings. (IS 23.1)

Cooperation

To determine the students' perceptions regarding the Cooperation scale, three main questions were used. These questions were: (1) Do you cooperate with other students when doing assignment work? (2) How do you cooperate with them? and (3) Do you learn from other students in this class? Various comments were provided by the interviewed students. Many students stated that cooperation with other classmates was important and useful, and the instructor often asked the students to work cooperatively:

Our instructor assigned me to work in a group for this class. The clever student was a group leader. He could plan a good work program for group assignments. (IS 5.1)

In the computer classroom, one should not study alone, sharing ideas are helpful (IS 6.1)

My instructor lets my classmates and I work as a group. It is helpful. We can share many important ideas, it is an excellent experience, and I can learn more with clever friends. (IS 9.1)

Nevertheless, a few negative comments were also given such as:

When I work in a group, some friends are lazy, they were not interested in and didn't do the work. (IS 2.1)

Student Cohesiveness

In relation to the Student Cohesiveness scale, the guide for judging students' perceptions was the degree to which students know, help and are friendly towards each other. Two main questions were used: (1) Did you make friends easily in this class? Please tell me in more detail? and (2) Do you have a good relationship with your classmates?

Generally, students felt they knew each other well. They provided various comments like:

My classmates and I are with each other most of time. We study in the same class and also stay in the same accommodation. So we know each other well. (IS 6.1)

My classmates and I have studied in the same major for over one year. I know all of my classmates' names but only a few are my close friends. (IS 5.1)

I know all of my classmates' names since we have studied together for over one year. (IS 14.1)

Students also stated that they often shared material with one another:

I share text books with my friends. (IS 28.1)

I have shared text books that I own with my friends and they let me borrow their books as well. (IS 21.1)

Specifically, students also explained that they are helpful to each other, they explained lessons to each other and helped solved problems together.

When I didn't understand some lessons, I always asked my friends, they are nice and clearly explain things to me. I didn't ask the instructor in class, because I fear that some of my classmates might think that I am stupid and could not understand something easy. (IS 6.2)

When my classmates had some problems, I helped them, then we became good friends. (IS 9.2)

I explain to my friends when they misunderstand some topics. I also ask clever friends to explain to me some things in the difficult topics. (IS 8.1)

In my class, I am in the middle level. I can ask good students to explain things to me for some difficult lessons, then I explain some things to other students. (IS 5.2)

Very few minor negative comments were presented:

Some good students didn't help me. They don't want another student to have a good assignment, as good as their work. (IS 32.1)

Individualisation

Three main questions were utilised to discover students' feelings towards the Individualisation scale. These three questions were: (1) Are you allowed to choose activities to help your work? (2) Have you any opportunity to pursue your particular interests in this class? Please tell me in more detail? and (3) Did you instructor let you do assignments that followed your own interests? These questions were set to allow student to express their views pertaining to making decisions and being treated according to ability, interests and rate of work by the instructor or lecturer. In general, students provided positive responses. Students generally felt that they had opportunities to follow their own interests.

> *The instructor directed my classmates and I to select and create a software program for small business management, I decided to create a software program for renting movie CDs that could be used by video renting shops. My classmates chose to create a program for seat booking in cinemas. (IS 9.2)*

> *I have the opportunity to pursue my own interests. I enjoy working by myself. Sometimes I was terrible, and had no idea how to solve the problems, I tried to relax, and went away from my project for a while. Finally I could solve it. I was so proud of my success and felt that oh I could do it. (IS 15.1)*

However, there are very few comments were also presented that they were designed to do the same kind of assignment and project:

> *I was allowed to do the same kind of assignments as my classmates. I felt happy about this, since if I had some problems with doing the assignment I could look at my friends' works. (IS 4.1)*

> *The instructor designed my classmates and me do the same kind assignment and project. (IS 5.1)*

Equity

In order to assess students' views about the Equity scale, three questions were used based on the main theme of whether or not the students were treated equally by the instructor. The three questions were: (1) Do you receive the same encouragement from the instructor as other students do? Please tell me in more detail? (2) Do you

get the same amount of help from the instructor as do the other students? Please tell me in more detail? and (3) Are you treated differently according to your ability? Please tell me in more detail?

Most comments showed that the students agreed that they were treated equally by the lecturer:

> *I have opportunity to ask questions equal to all other students in this class. (IS 16.2)*

> *The instructor always looks around the class and whenever my classmates and I raise a hand and ask for help, and the instructor comes to us and gives help equally. (I.S 16.1)*

> *In this class, the instructor treats my friends and me equally. (IS 6.2)*

> *The instructor always yields to students who make a mistake and compliment good students fairly. (IS 9.1)*

Again there were very few negative comments stated such as:

> *The instructor is interested in asking questions to the clever students more than to me. (IS 17.1)*

The results from these interviews with students provided the ability to scrutinize in more detail the students' perceptions towards their computer classroom learning environments. Both the questionnaire and the interview data confirmed that many students have satisfied perceptions on their computer laboratory environments.

5.2.2 Students' perceptions of their computer laboratory environments

To investigate students' views about their computer laboratory learning environments, the Thai version of the Computer Laboratory Environment Inventory (CLEI) was administered to 905 students. As explained in Chapter 3, this questionnaire documents the students' views on five scales of their computer

laboratory. The average means and standard deviations of all scales of the CLEI were calculated and displayed in Table 5.2 and Figure 5.3.

Table 5.2
Average Item Means, and Standard Deviations of Students' Perceptions of Each Scale of the CLEI

Scale	Mean	Standard Deviation
Student Cohesiveness	3.54	0.58
Open-Endedness	3.25	0.46
Integration	3.25	0.48
Technology Adequacy	3.08	0.55
Availability	2.80	0.72

n=905

Table 5.2 and Figure 5.3 show that students hold positive views about their computer laboratory learning environment. The mean scores for all scales are higher than 3.00 (maximum 5.00), with the exception of the Availability scale. These scores indicate that the Thai university computer laboratory has provided the students with a relatively conducive learning environment. The lecturers have established the computer laboratory as a place that provides cohesiveness among students, open endedness among class members, integration of technology and insures the appropriateness of technology is maintained. Nonetheless, the lowest score on the Availability scale warrants the university administrators considering providing students with a more adequate number of computers. The score indicates that students still experience delays when they need to use computers for their assignments at the universities.

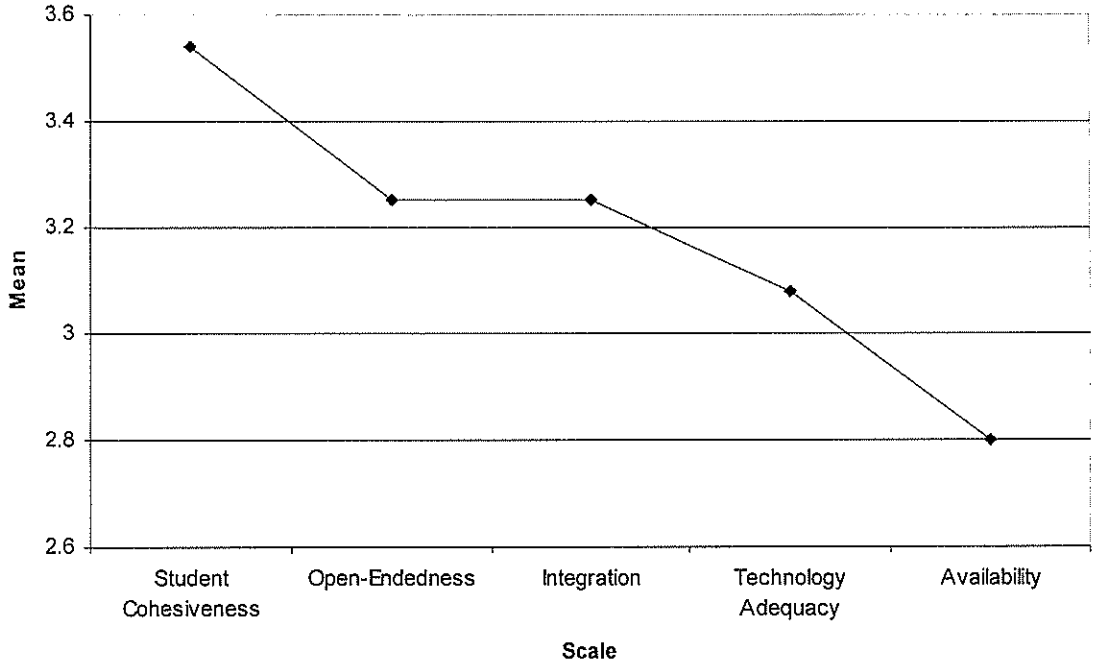

Figure 5.3. Students' perceptions of the Computer Laboratory Environment Inventory (CLEI).

5.3 DIFFERENCES BETWEEN MALES AND FEMALES IN PERCEPTION OF THEIR COMPUTER CLASSROOM LEARNING ENVIRONMENTS

This section provides responses to research question 5 regarding whether are there any differences between males and females in perceptions of their computer classroom learning environments? Section 5.3.1 discusses the differences between male and female students' view of their actual computer classroom learning environment. Whereas Section 5.3.2 describes the differences between male and female students' views of their preferred computer classroom learning environment.

5.3.1 Differences between male and female students' perceptions of the actual computer classroom learning environment

Generally, this study found that both male and female students viewed their actual computer classroom learning environment differently for all seven scales. A summary of the findings is presented in Table 5.3 and Figure 5.4.

Table 5.3
Average Item Means and Standard Deviations of Male and Female Students Perceptions of the Actual Thai Form of the CUCEI

Scale	Mean		Standard Deviation		*t*-test
	Male	Female	Male	Female	
Personalisation	3.28	3.26	0.60	0.67	0.63
Innovation	3.32	3.24	0.50	0.56	2.06*
Student Cohesiveness	3.86	4.08	0.74	0.72	-4.47**
Task Orientation	3.31	3.38	0.50	0.54	-1.89
Cooperation	3.62	3.76	0.64	0.65	-3.30**
Individualisation	2.95	2.86	0.46	0.46	3.00*
Equity	3.28	3.26	0.64	0.73	0.14

***$p<0.001$, **$p<0.01$, *$p<0.05$ male n=382 female n=523

Female students have better perceptions of the classroom learning environment than do males on three scales, namely Student Cohesiveness, Task Orientation and Cooperation. Significant differences occurred on Student Cohesiveness ($p<0.01$) and Cooperation ($p<0.05$). These findings suggest that female students experienced their computer classroom with greater feelings of cohesiveness and cooperation among class members. On the other hand, male students possess significantly stronger views on two other scales, namely, Innovation ($p<0.05$) and Individualisation ($p<0.05$). These findings confirmed that males viewed their learning environments with more individualisation rather than cooperation. Finally, although males hold slightly more positive views on Personalisation and Equity scales, the differences on these scales between male and female students' perceptions are not significant.

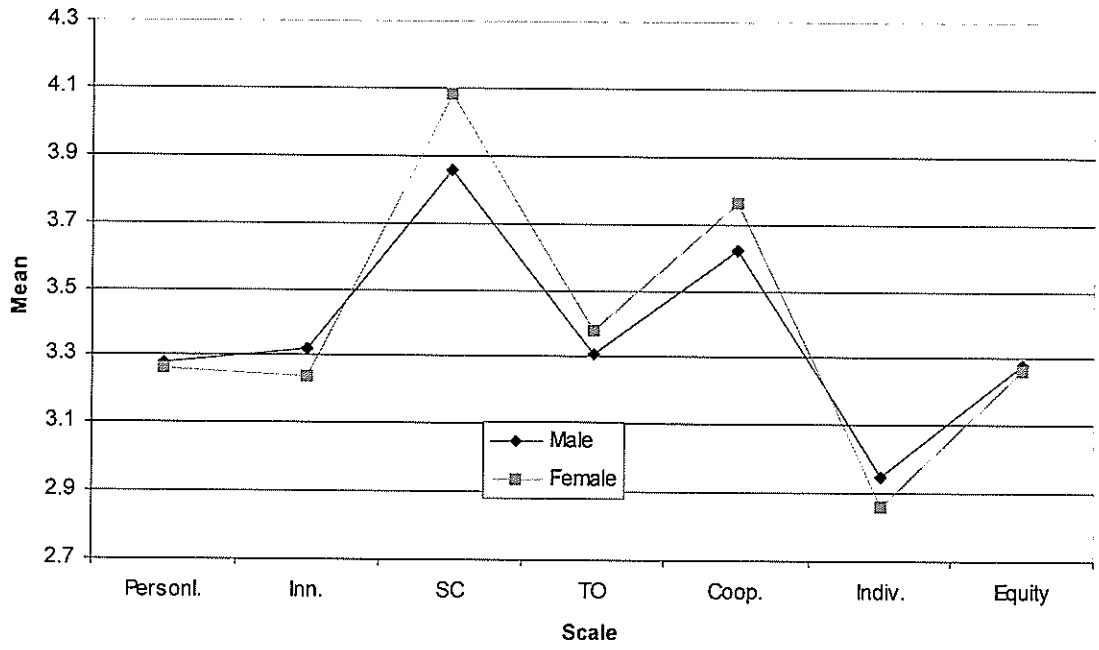

Figure 5.4. Comparisons between male (N=382) and female (N=523) students' perceptions of the actual Thai version of the CUCEI.

5.3.2 Differences between male and female students' perceptions of the preferred computer classroom learning environment

Similar to the findings explained previously, this study also found that both male and female students viewed their actual computer classroom learning environment differently for all seven scales. However, a consistent pattern occurs in which female students tend to possess more positive views of an ideal learning environment. A summary of the findings is presented in Table 5.4 and Figure 5.5.

Table 5.4
Average Item Means and Standard Deviations of Male and Female Students' Perceptions of the Preferred Thai Form of the CUCEI

Scale	Mean		Standard Deviation		*t*-test
	Male	Female	Male	Female	
Personalisation	3.72	3.83	0.56	0.49	-3.03*
Innovation	3.44	3.54	0.47	0.46	-3.25**
Student Cohesiveness	3.90	4.14	0.65	0.59	-5.76**
Task Orientation	3.80	3.98	0.55	0.54	-4.70**
Cooperation	3.95	4.01	0.62	0.62	-1.25
Individualisation	3.35	3.39	0.44	0.45	-1.35
Equity	3.75	3.81	0.69	0.67	-1.38

***p<0.001, **p<0.01, *p<0.05 male=382 female=523

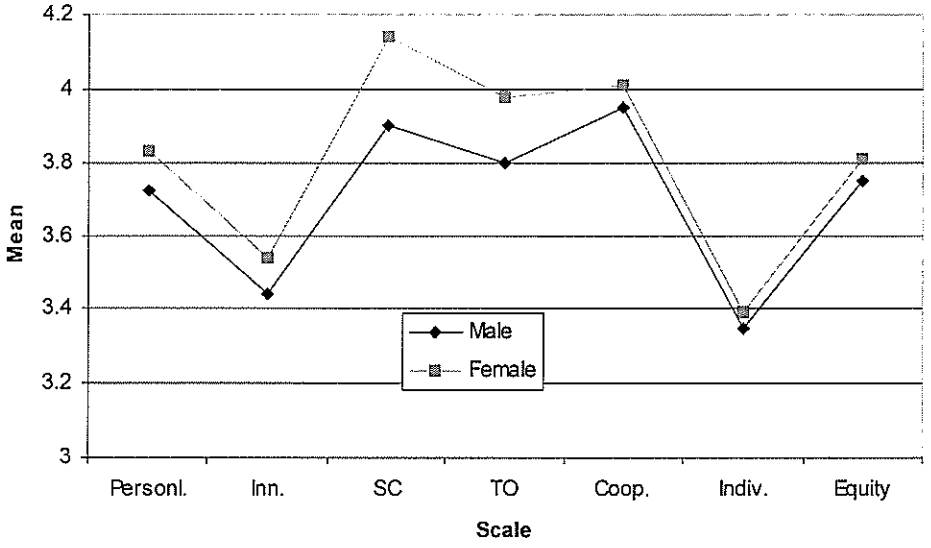

Figure 5.5. Comparisons between male and female students' perceptions of the actual and preferred science classroom learning environments.

The results suggest that on all seven scales of their preferred computer classroom learning environment, females tend to have a higher perception than do the males. Significance differences occurred for four scales, namely, Personalisation (p<0.05), Innovation (p<0.01), Student Cohesiveness (p<0.01), and Task Orientation (p<0.01).

5.4 THE DIFFERENCES BETWEEN MALES AND FEMALES IN PERCEPTIONS OF THEIR COMPUTER LABORATORY LEARNING ENVIRONMENTS

This section offers a direct response to research question (6) Are there any difference between males and females in perception of their computer laboratory learning environments? The results confirmed that there are differences between male and female students' perceptions of their computer laboratory learning environments presented in Table 5.5 and Figure 5.6.

Table 5.5
Average Item Mean, Average Item Standard Deviation of Male (N=382) and Female (N=523) Students' Perceptions of Thai version of the CLEI

Scale	Mean		Standard Deviation		*t*-test
	Male	Female	Male	Female	
Student Cohesiveness	3.50	3.56	0.55	0.60	-1.41
Open-Endedness	3.30	3.22	0.42	0.47	2.72**
Integration	3.20	3.28	0.44	0.50	-2.50*
Technology Adequacy	3.13	3.04	0.58	0.57	-2.28*
Availability	2.88	2.79	0.63	0.68	2.00*

***p<0.001, **p<0.01, *p<0.05 male=382 female=523

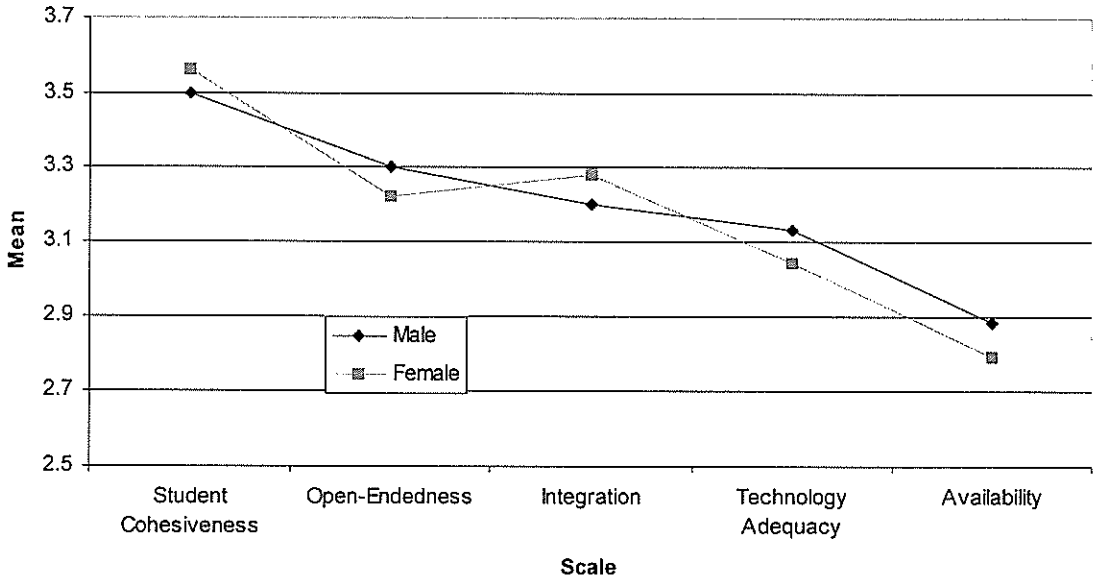

Figure 5.6. Male and female students' perceptions of the Thai Actual Form of the CLEI.

Figure 5.6 shows that female students hold more positive perceptions than do males for two scales, namely, Students Cohesiveness and Integration. Significant differences exist on the latter scale ($p<0.05$). On the other hand, male students possess a significantly better view ($p<0.01$) for the other three scales of the Thai version of the CLEI. These findings imply that the lecturers should provide the computer laboratory with a situation that enhances male students' feeling of cohesiveness and technology integration and, in view of female students' perceptions, the lecturer need to consider actions that may provide female students with the opportunity for open ended activities, adequate technology, adequacy and readily available computers

5.5 SUMMARY

This chapter reports the results of the use of two questionnaires, namely, the Thai versions of the CUCEI and CLEI. The descriptions of computer classrooms and laboratory learning environments can be summarised as follows. First, there was a gap between the actual and preferred perceptions held by the students. Obviously, students were not content with the actual learning environment as indicated in their preferred view of what kind of learning environment should be created by the

lecturer. Students would prefer a learning environment that has more personalisation and allows more innovation. They also prefer a learning environment that has better student cohesiveness, clearer task orientation, more investigations, and greater cooperation, as well as greater equity during class session.

Second, female students have somewhat higher preferences for the computer classroom learning-environment than do male students on all scales, but slightly poorer perceptions on the scales on the actual CUCEI. With regard to gender equity, lecturers should be aware of this fact and make efforts to eliminate this gap. Lecturers should strive to enhance the teaching atmosphere in order to meet their students' needs and expectation.

Third, disparities were also discovered between perceptions of male and female students toward the Thai version of CLEI. Similar to their perceptions with the Thai CUCEI, male students tend to possess a more positive view for three scales, namely, Open-endedness, Technology Adequacy, and Availability, than do female students. Female students, on the other hand, viewed their learning environment as one that has good student's cohesiveness and integration. Consequently, the lecturers should consider this fact and may examine and improve their teaching practices in order to eliminate the gap between male and female students' perceptions of their computer laboratory environments.

The next chapter provides a description of associations between students' views of their computer classroom and computer laboratory learning environment and students' attitude toward computer and computer courses.

CHAPTER 6

ASSOCIATIONS BETWEEN STUDENTS' PERCEPTIONS OF THEIR COMPUTER LABORATORY ENVIRONMENT AND THEIR ATTITUDES

6.1 INTRODUCTION

The results related to students' perceptions of their computer classrooms and laboratory learning environments have been elaborated in Chapter 5. This chapter, which is in response to the last two research questions 7 and 8, presents the results of the analyses of associations between students' perceptions of their computer lecture classroom and their attitudes towards computers and computing courses. Students' attitudes toward computers and their computer courses are presented in section 6.2. The associations between students' perceptions of computer classroom learning environment and their attitudes toward computers and computing courses are elaborated in section 6.3, whereas the association between students' perceptions of their computer laboratory learning environment and their attitudinal outcomes is discussed in section 6.4. The chapter concludes in section 6.5 by providing a brief summary.

6.2 STUDENTS' ATTITUDES TOWARD COMPUTERS AND COMPUTER COURSES (ACCC)

Students' attitudes toward computers and their computer courses were assessed using the Thai version of the Attitudes toward Computers and Computers Course (ACCC). Again, this questionnaire explores students' views on four scales, namely, Usefulness of Course, Anxiety, Usefulness of Computers and Enjoyment. The results are displayed in Table 6.1, Figure 6.1 and Figure 6.2.

Table 6.1
Average Item Mean, Average Item Standard Deviation of Students' Perceptions of the Thai version of the ACCC (n=905)

Scale	Mean	Standard Deviation
Usefulness Course	3.41	0.56
Anxiety	2.47	0.61
Usefulness Computer	3.77	0.55
Enjoyment	3.88	0.52

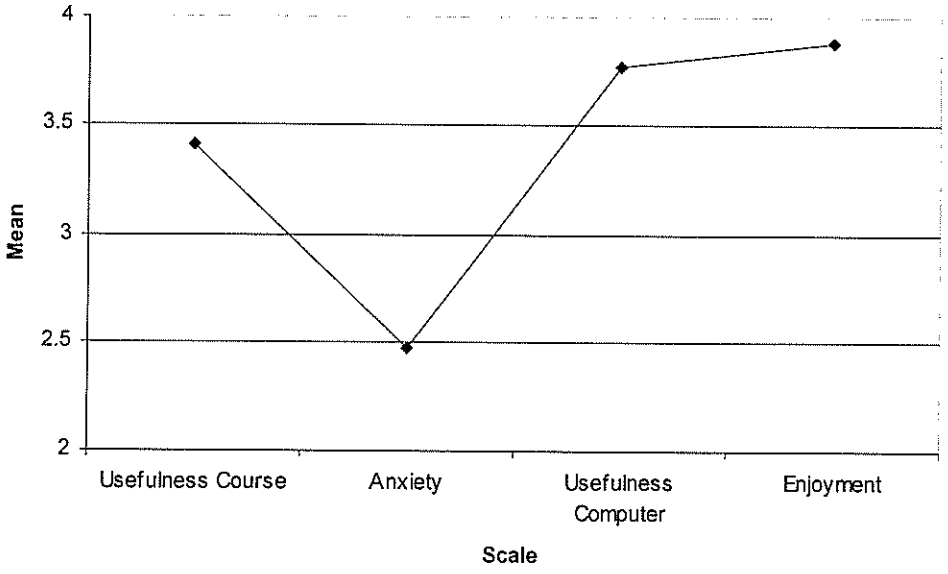

Figure 6.1. Students' attitudes towards computers and computer courses.

This study shows that Thai university students value computers as important tools and view computer courses as a significant subject for their future careers. These findings are indicated by the scores on the scales of Usefulness of Computers and Usefulness of Course, which are 3.77 and 3.41, respectively. These scores are in accordance with the students' view toward enjoyment of their computer courses. The Enjoyment scale has the highest score among the scales. In general, these results show that currently computer courses in this sample of Thai Universities are viewed as important subjects and need to be maintained. On the other hand, despite these positive views, this study also revealed that some students might experience a little anxiety during their computer course and when using the computer. Table 6.1 and

Figure 6.1 show that the Anxiety scale has the lowest score of the attitude scales. Despite this, it is still 2.5 so the computer science instructors and university administrators should take into account that their students' are feeling some level of anxiety.

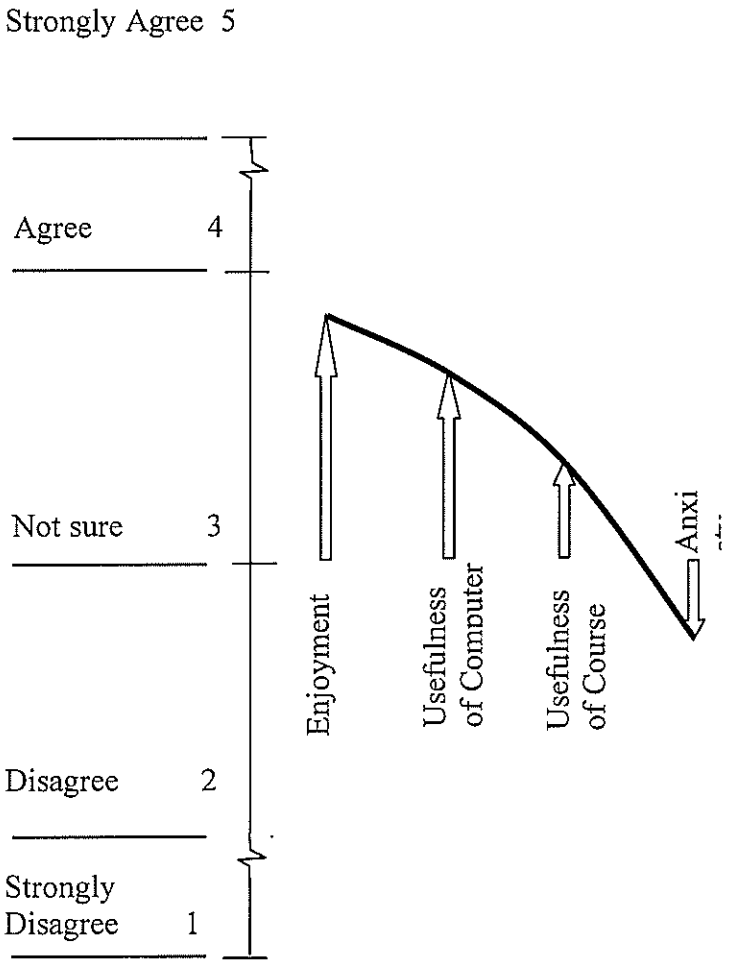

Figure 6.2. The direction and magnitude of the students' responses to the four scales of the ACCC (the magnitude of the arrows were in arbitrary unit).

Figure 6.2 shows the direction and magnitude of the students' responses to the four scales of the ACCC. These vectors can be classified into two categories. The first categories are the scales of Enjoyment, Usefulness of Computers, and Usefulness of Course. This indicates that students on average gave their responses in the "Not sure" to "Agree" level for these three scales. The second category relates to the scale of Anxiety, where students' responses were in the "Disagree" to "Not sure" level

indicating that sometimes, some students still have an anxious feeling when they are working in computer laboratories. Computer science instructors can use these results as a guide for improving students' attitudes, specially trying to increase enjoyment, usefulness of computers and usefulness of course, and reducing anxiety.

6.3 ASSOCIATIONS BETWEEN STUDENTS' PERCEPTIONS OF THE COMPUTER CLASSROOM LEARNING ENVIRONMENT AND THEIR ATTITUDE TOWARD COMPUTERS AND COMPUTER COURSES

As mentioned in Chapter 3 section 3.2, correlations between students' attitudinal outcomes and students' perceptions of the computer classroom and computer laboratory-learning environment were investigated. Simple and multiple correlations between each scale of the Thai version of the CUCEI and the Thai version of the ACCC; as well as the correlation between the Thai version of the CLEI and the Thai version of the ACCC using individual scores as the units of analysis (n=905) were conducted. Simple correlations indicate the bivariate association between students' attitudinal outcomes as revealed by the ACCC scores and each of the scales of the Thai versions of the CUCEI and CLEI. On the other hand, multiple correlations or multiple regression analysis offer the joint and unique influence of each scale in the Thai versions of the CUCEI and CLEI on each scale of the Thai ACCC. A significant beta weight confirms that a scale of the Thai CUCEI or of the Thai CLEI is related to students' outcomes when the six scales and four scales, respectively, are mutually controlled. A summary of simple correlations (r), multiple correlations (R) and standardised regression coefficients (β) for the associations between the computer classroom learning environment and students' attitudinal outcomes is presented in Table 6.2, whereas for the association between the computer laboratory learning environment and students' attitudinal outcomes is presented in Table 6.3, section 6.4.

Table 6.2

Simple Correlation (r), Multiple Correlation (R) and Standardised Regression Coefficient (β) for Association Between Computer Classroom Learning Environment Scales and Student Attitudinal Outcomes.

Scale	Strength of environment-outcome association							
	Usefulness of Course		Anxiety		Usefulness of Computer		Enjoyment	
	r	*β*	*r*	*β*	*r*	*β*	*r*	*β*
Ps	0.26**	0.07	-0.13**	-0.04	0.15**	0.08*	0.20**	0.10*
Inn	0.10**	0.05	-0.03	-0.04	-0.07*	-0.03	-0.02	-0.01
SC	0.24**	0.15***	-0.30**	-0.26***	0.35**	0.25***	0.33**	0.24***
TO	0.25**	0.03	-0.19**	-0.06	0.17**	-0.01	0.17**	-0.04
Co	0.30**	0.13***	-0.20**	-0.03	0.34**	0.19***	0.31**	0.16**
Ind	0.14**	0.03	-0.00	0.06	-0.10**	-0.15***	-0.01	-0.06
Eq	0.31**	0.17***	-0.16**	-0.08*	0.20**	0.10**	0.22**	0.10*
R	0.40***		0.33***		0.44***		0.40***	
R^2	0.16***		0.11***		0.19***		0.16***	

*p<0.05; **p<0.01; ***p<0.001

Table 6.2 shows that all scales of the Thai CUCEI, with the exception of the Individualisation scale, are statistically significantly (p<0.01) associated with the four scales of the Thai version of the ACCC. The Individualisation scale is statistically significant and positively associated with the Usefulness of Course, however, it is negatively associated with the Usefulness of Computer scale.

A significant negative correlation exists between five scales of the Thai CUCEI and the Anxiety scale. Apparently, Innovation and Individualisation have no impact on student anxiety level.

The multiple regression analysis produced significant multiple correlations (R) of 0.40 (p<0.001) for usefulness of the computing course, of 0.33 (p<0.001) for students' anxiety during computer lessons, of 0.44 (p<0.001) for usefulness of computers, and of 0.40 (p<0.001) for students' enjoyment during computing course.

These scores imply that the improvement of computer classroom learning environment may enhance students' attitude towards computers and computing courses.

Furthermore, investigations of the value of β reveal that the value of Student Cohesiveness (β=0.15, p<0.001), Cooperation (β=0.13, p<0.001) and Equity (β=0.17, p<0.001) scales of the Thai version of CUCEI are strong predictors of students' attitude towards the usefulness of computing course. Students' attitudes toward the usefulness of the computing course tend to be more positive when there are good levels of student cohesiveness, cooperation among class members, and equal opportunity to do the tasks in their computing classroom.

With regard to students' anxiety during computing lessons, two scales of the Thai CUCEI, namely, Student Cohesiveness and Equity function as strong predictors as indicated by the β values. The β values are both negative. The Students Cohesiveness has a β value of –0.26 (p<0.001) and the Equity scale a β value of –0.08 (p<0.05). These results suggest that student anxiety would be reduced in classes characterised by greater Student Cohesiveness and Equity.

A similar trend has occurred on the effect of the Thai CUCEI scales upon students' feelings toward usefulness of computer and enjoyment during computing courses. Students' attitudes of the usefulness of computer were positively affected by the scales of Personalization ($\beta = 0.08$, p<0.05), Student Cohesiveness ($\beta = 0.25$, p<0.001), Cooperation ($\beta = 0.19, p$<0.001), Equity ($\beta = 0.10, p$<0.01), but were negatively shaped by the amount of individualisation established in the classroom ($\beta = -0.15, p$<0.001).

This finding suggests that in order to increase the students' attitudes toward the usefulness of computer, instructors need to provide higher levels of Personalization, Student Cohesiveness, Cooperation and Equity. However, there is an inverse relationship between degree of students' attitudes of the usefulness of computer and the Individualisation scale. Students' attitude toward the usefulness may be reduced if instructors provided more individualisation. The computer science classrooms

should be managed by good instructor personalisation, developing student cohesiveness, enabling students to do more tasks cooperatively, giving the students more equity, and reducing the amount of individualisation.

On the other hand, students' enjoyment during computer lessons is statistically significantly ($p<0.05$ and $p<0.001$) influenced by four scales of the CUCEI, namely, Personalisation ($\beta = 0.10, p<0.05$), Student Cohesiveness ($\beta = 0.24, p<0.001$), Cooperation ($\beta = 0.16, p<0.01$) and Equity ($\beta = 0.10, p<0.05$). Hence, the instructor may increase student enjoyment during computing courses by taking more personal interest in students, helping them when they have problems immediately and answering students' questions with clear descriptions. Instructors could also improve the student cohesiveness and cooperation and give students equal opportunities and attention during the classroom activities.

The R^2 values which were all significant, indicate how much of the percentage of the variance in ACCC scales could be attributed to students' perceptions of their computer science classrooms. Table 6.2 shows the 16% of the variance in students' attitude to usefulness of the course can be explained by students' perceptions of their learning environment similarly, 11% of the variance in Anxiety, 19% in Usefulness of Computers and 16% for Enjoyment, respectively, can be attributed to students' perceptions of their learning environments.

6.4 ASSOCIATIONS BETWEEN STUDENTS' PERCEPTIONS OF THE COMPUTER LABORATORY LEARNING ENVIRONMENT AND THEIR ATTITUDES TOWARD COMPUTERS AND COMPUTER COURSES

As explained in section 6.3, details of associations between students' views of computer laboratory learning environment and their attitudes toward computers and computing courses is elaborated in this section. Table 6.3 provides a summary of the associations.

Table 6.3

Simple Correlation (r), Multiple Correlation (R) and Standardised Regression Coefficient (β) for Associations Between Computer Laboratory Learning Environment and Student Attitudinal Outcomes

Scale	Strength of environment-outcome association							
	Usefulness of Course		Anxiety		Usefulness of Computer		Enjoyment	
	r	*β*	*r*	*β*	*r*	*β*	*r*	*β*
SC	0.40**	0.19***	-0.30**	-0.20***	0.35**	0.29***	0.36**	0.29***
OE	0.38**	0.19***	-0.17**	-0.01	0.25**	0.13***	0.23**	0.09*
INT	0.43**	0.26***	-0.35**	-0.26***	0.26**	0.12**	0.29**	0.16**
TA	0.31**	0.14***	-0.17**	-0.09*	0.13**	0.07	0.14**	0.10*
AV	0.13**	-0.11*	-0.01	0.15***	-0.06	-0.24***	-0.08*	-0.28***
R	0.54***		-0.41***		0.44***		0.46***	
R^2	0.29***		-0.17***		0.19***		0.21***	

*p<0.05; **p<0.01; ***p<0.001

As shown in Table 6.3, this study indicates that the five scales of the Thai version of the CLEI are statistically and significantly related to the four scales of the Thai version of the ACCC. Increased levels of student cohesiveness, open-endedness of activities, the integration of theory and practice, and the technology adequacy increased students' attitudes toward computer and computing courses. On the other hand, the availability of the laboratory strongly and positively shaped students' views toward the usefulness of the computing course, but negatively impinged on students' enjoyment of computer laboratory activities.

Further investigation focused on the multiple regression analysis generates a significant multiple correlation (R) of 0.54 (p<0.001) for usefulness of computing course, of 0.41 (p<0.001) for students' anxiety during computer lessons, of 0.44 (p<0.001) for usefulness of computers, and of 0.46 (p<0.001) for students' enjoyment of the computing course. These results suggest that the improvement of computer laboratory learning environment may augment students' attitude towards computers and computing courses.

An examination of the β values shows similar trend as did the scales of the Thai version of CUCEI upon the four scales of the Thai ACCC. Table 6.3 reveals that all five scales of the Thai CLEI function as good predictors of students attitudes toward the usefulness of computer course. In detail, both Student Cohesiveness and Open-Endedness scales have β scores of 0.19 ($p<0.001$), the Integration scale has 0.26 of β score ($p<0.001$), whereas Technology Adequacy and Availability scale possess β scores of 0.14 ($p<0.01$) and - 0.11 ($p<0.05$), respectively. Hence the instructor may increase student attitudes toward the usefulness of computer course by providing students with an effective computer laboratory in which there are high levels of student cohesiveness, open-endedness, integration, and technology adequacy.

The effects of all scales of the Thai CLEI upon the Usefulness of Computer and Enjoyment scales of the Thai ACCC are similar. All scales of the Thai CLEI, except Technology Adequacy, are shown to be predictors of the students' way of thinking about the usefulness of the computer as a tool and of their enjoyment during computing lessons. The β scores ranged from 0.09 ($p<0.05$) to 0.28 ($p<0.001$). The Technology Adequacy scale has no significant effect on students' attitude toward the usefulness of computers, but it may act as a relatively good predictor for student enjoyment (β=0.10, $p<0.05$). Concerning the Anxiety scale of the Thai ACCC, this study shows that all scales of Thai CLEI, with the exception of the Open-Endedness scale, may have an effect on it, with the β scores ranging from 0.09 ($p<0.05$) to 0.26 ($p<0.001$). It is suggested that these four scales would act as relatively consistent predictors for shaping students' anxiety during students' time in the computer laboratory.

Furthermore, inspection of the β signs indicates some negative relationships exists between some scales of the Thai CLEI and students' attitudinal outcomes. As indicated in Table 6.3, it is interesting to note that students' nervousness during their activities in computer laboratory is less when their perceptions of Student Cohesiveness, Integration and Technology Adequacy are more positive.

Again, the result of the R^2 values indicates percentage of the variance in ACCC scales that could be attributed to students' perceptions of their computer laboratories.

These were 29% for Usefulness of Course, 17% for Anxiety, 19% for Usefulness of Computer and 21% for Enjoyment.

Additionally, this study found that student's perceptions of the availability of the computer laboratory consistently shaped their attitudes. The lower the students perceptions on the Availability scale, the less positive their attitudes are. Table 6.3 indicates that a poor computer laboratory learning environment will increase students' anxiety and reduce their feelings of the usefulness of computer and computing course as well as their enjoyment during their interaction with computer and in their computing course.

6.5 SUMMARY

The results of the application of the ACCC have been presented in this chapter, including analyses of associations between students' perceptions of their learning environments and attitudes toward computer and computing courses. The results reveal that all scales of ACCC were significantly related to the scales of the CUCEI. The results are similar on all the scales of the CLEI. These findings together with the others presented in Chapters 4 and 5 are discussed in a broader context in Chapter 7 and are followed by conclusions and recommendations for further study.

CHAPTER 7

CONCLUSIONS, IMPLICATIONS AND LIMITATIONS

7.1 INTRODUCTION

The main purpose of this thesis was to describe and analyse the status of computer classroom learning environments, both in lecture situations and computer laboratories at tertiary institutions in Thailand. The research examined students' perception of their computer classrooms and computer laboratory learning environments as well as their attitudes toward computers and computer courses.

This chapter is organised into six main sections. An overview of the research is presented in section 7.2, followed by an overview of the research design in section 7.3. A summary of the major findings obtained through the research that have been discussed in Chapters 4, 5 and 6 and are summarised in section 7.4. A discussion of the limitations of this research is presented in section 7.5. The implications of the results are described in section 7.6. Recommendations and possibilities for future research are discussed in section 7.7. Finally, a summary of the chapter is provided in section 7.8.

7.2 OVERVIEW OF THE RESEARCH

This research investigated the status of computer classrooms and laboratory learning environments at tertiary institutions in Thailand. The research was guided by three specific issues of interest and the derived research questions.

The first issue was to examine the validity and reliability of the questionnaires used for evaluating learning environments, and this was addressed by research questions 1 to 3:

1. Is the College and University Classroom Environment Inventory (CUCEI) a valid and reliable questionnaire for use in Thailand?
2. Is the Computer Laboratory Environment Inventory (CLEI) a valid and reliable questionnaire for use in Thailand?

3. Is the Attitude towards Computers and Computer Courses (ACCC) a valid and reliable questionnaire for use in Thailand?

The second issue involved students' perceptions of their computer classroom learning environment and was addressed by research questions 4 to 7:

4. What are students' perceptions of their actual computer classroom learning environment?
5. What is the difference between students' actual and preferred perceptions of the learning environments of their computer lecture classrooms?
6. Are there any differences between males and females in perceptions of their computer classroom learning environments?
7. Are there any differences between males and females in perceptions of their computer laboratory learning environments?

The third issue involved associations between students' perceptions of their learning environment and their attitudes towards computers and computers courses. This issue was addressed by research questions 8 and 9:

8. Are there any associations between students' perceptions of their computer lecture classroom and their attitudes towards computers and computer courses?
9. Are there any associations between students' perceptions of their computer laboratory and their attitudes towards computers and computer courses?

7.3 OVERVIEW OF THE RESEARCH DESIGN

In order to answer all eight research questions, a combination of quantitative and qualitative approaches was used. In the quantitative method, three questionnaires were employed: these were the College and University Classroom Environment Inventory (CUCEI), the Computer Laboratory Environment Inventory (CLEI), and the Attitude towards Computers and Computer Courses (ACCC). Additionally, qualitative data were obtained from interviews with students.

The three questionnaires were translated into the Thai language and validated. The validated Thai version of the CUCEI, was used to investigate students' perceptions of computer classroom environments in Thailand universities. Similarly, the validated Thai version of the CLEI was employed to investigate students' perception of computer laboratory learning environments. Finally, the validated Thai version of the ACCC was utilized to determine students' attitudes toward computers and computer courses. The development of the Thai versions of these questionnaires followed standard procedures that included the translation of the original questionnaires into the Thai language, and back translation of the Thai versions into English. The questionnaires were administered to approximately 950 students in 33 classes from 11 Thailand universities. The instruments' validity, such as factor structure, scale internal consistency reliability, and ability to differentiate between perceptions of groups were analysed using the Statistical Package for Social Science (SPSS) software. Other measures including means, standard deviations, and *t*-test procedures were made and analysed also using the SPSS software. The data obtained from this research were presented descriptively and supported with tables and graphics.

7.4 A SUMMARY OF THE MAJOR FINDINGS

A summary of the major findings and discussion of the responses to each research question is presented in the following sections.

7.4.1 Research question 1

> Is the College and University Classroom Environment Inventory (CUCEI) a valid and reliable questionnaire for use in Thailand?

The alpha reliability (Cronbach alpha coefficient) values of the actual CUCEI scales when the individual student was used as the unit of analysis ranged from 0.56 to 0.89 being greater than the threshold of 0.5 given by De Vellis (1991). Similarly, this study found that alpha reliability scores ranged from 0.56 to 0.95 when using class means as the unit of analysis. With regard to the Preferred Form of the Thai version of CUCEI, the Cronbach alpha coefficients ranged from 0.56 to 0.87 when

the individual scores were used as the units of analysis and from 0.56 to 0.97, when the class means were used as the units of analysis. These scores suggest that the alpha reliability scores of the Actual and Preferred Forms of the CUCEI are satisfactory and the questionnaires are reliable for use in the Thailand university context. These alpha reliability values are quite similar to the values of the original form of the CUCEI reported by Fraser, Treagust, Williamson, and Tobin in 1986. They ranged from 0.53 to 0.83 and 0.55 to 0.82 for the Actual and Preferred Forms, respectively. In Nair's study (1999), the alpha reliability values of the Actual and Preferred Forms ranged from 0.73 to 0.93 and 0.76 to 0.94, respectively.

The discriminant validity of the actual CUCEI scales ranged from 0.14 to 0.33 when the individual student was used as the unit of analysis, and from 0.14 to 0.52 when the class mean was utilized as the unit of analysis. Furthermore, the mean correlation for the preferred CUCEI scales ranged from 0.33 to 0.43 using the individual score as the unit of analysis, and from 0.58 to 0.76 when the class mean was utilized as the unit of analysis. These results indicate the discriminant validity of the questionnaire.

To further validate the CUCEI in this study, each scale's ability to differentiate between the perceptions of students in different classrooms was examined. This analysis involved the use of the eta^2 statistic through a one-way ANOVA. In the Actual Form, the eta^2 values were significant and ranged from 0.09 to 0.18. For the Preferred Form, the eta^2 values also were significant and ranged from 0.09 to 0.21. These data indicate that each of the CUCEI scales is able to differentiate significantly (p <0.001) between classes.

Considering the results generated from discriminant validity analysis, scale internal reliability analysis and the series of ANOVA tests, it can be concluded that the Thai version of the CUCEI is a reasonably robust instrument to measure students' perceptions of computer classroom learning environments at the tertiary level in Thailand.

7.4.2 Research question 2

Is the Computer Learning Environment Inventory (CLEI) a valid a reliable questionnaire for use in Thailand?

The results in this study indicated that the Cronbach alpha coefficients for each of the scales ranged from 0.61 to 0.75 if the individual student score was used as the unit of analysis and from 0.61 to 0.75 if class means were used as the units of analysis. Therefore, this study suggests that all scales of the Thai version of CLEI possess satisfactory internal consistency. These alpha reliability values of the CLEI are lower than those reported in Australia by Newby (1997) on three scales (Student Cohesiveness, Integration and Technology Adequacy) and higher on the other two scales (Open-Endedness and Laboratory Availability).

The discriminant validity for the CLEI scales, as shown by the mean correlations, ranged from 0.33 to 0.41 when the individual student was used as the unit of analysis and from 0.53 to 0.59 for the class means. This indicates that the Thai version of CLEI measures somewhat overlapping aspects of the computer classroom learning environment.

The CLEI scale's ability to differentiate between the perceptions of students in different classrooms was examined again using the eta^2 statistic. The eta^2 scores ranged from 0.09 to 0.22 and were statistically significant ($p<0.001$) indicating that all scales of the CLEI possess the ability to differentiate between students' perceptions in different classes.

Taken as a whole, on reviewing the results generated from scale internal reliability analysis, mean correlations and a series of ANOVAs, this study claims that the Thai version of CLEI is a valid, robust and reliable instrument for measuring students' perceptions of computer laboratory learning environments in the Thailand university context.

7.4.3 Research question 3

Is the Attitude towards Computers and Computer courses (ACCC) a valid and reliable questionnaire for use in Thailand?

This study found that the alpha reliability of the ACCC scales scores was relatively high. Scores ranged from 0.64 to 0.72 when the individual student score was used as the unit of analysis, and from 0.77 to 0.89 for the class means. These alpha reliability values are slightly lower than the values of the ACCC reported by Newby (1997).

Discriminant validity of the ACCC was again investigated by calculating the mean correlation of one scale with the three other scales. These mean correlations for the ACCC scales ranged from 0.18 to 0.51 when the individual student was used as the unit of analysis, and ranged from 0.24 to 0.80 for the class means. In general, these results indicate that the ACCC scales measure, except for the Anxiety scale, distinct aspects of computer classroom learning environments. Nevertheless, a minor revision was needed regarding the Anxiety scale in order to improve the strength of the questionnaire. The items in this scale should be modified and made more suitable for the Thai context.

This study found that the eta^2 values ranged from 0.14 to 0.15 indicating that all scales of the Thai version of the ACCC are able to significantly ($p<0.001$) differentiate between students' perceptions of their computer classroom environment. Consequently, these findings indicate that the Thai version of the ACCC can be used with confidence in the Thailand educational context.

7.4.4 Research question 4

What are students' perceptions of their actual computer classroom learning environment?

Generally, data analysis results from the CUCEI revealed that the students had positive perceptions toward their computer classroom learning environments. The

mean scores for all scales were higher than 3.00 for actual learning environments with the exception of the Individualisation scale which was 2.90. These scores indicate that students always experience a considerable degree of the activities assessed by the questionnaire. Overall, these results indicate that Thai students are relatively happy with in the existing learning environments. This finding is similarly to Logan's New Zealand study where students had a positive perception towards their learning environments but less satisfied with the two scales of Individualization and Innovation (Logan, 2003).

The results from the student interviews provided more information on how the students' perception was generally positive on each of the seven scales. For Personalization, students commented positively on how the instructor showed concern for students feelings, and was helpful and gave clear explainations. For Innovation, students spoke of how the web-based instruction lessons provided a comfortable learning environment. For Task Orientation, students gave positive opinions on how they knew and understood what activities were important in the class because the instructors gave them a course description which included a lot of detail about the learning and teaching activities. For the Cooperation scale, students commented on how working as a group is helpful. They could share many important ideas with their group members and could learn more with clever friends. For the Student Cohesiveness scale, students spoke of how well they worked with their classmates. They were happy to get help from friends when they had problems and they also shared useful material with their classmates. For Individualisation, students thought that they have ample opportunities to pursue their own interests. However, a few students expressed the desire to work on the same kind of assignments as their classmates. For Equity, students stated that they were treated equally and cited examples, such as the instructor corrects all the students when they make mistakes and compliments all the students who perform well.

Furthermore, this study found that students hold positive views toward their computer laboratory learning environment. The mean scores for all scales are higher than 3.00 (maximum 5.00) with the exception of the Availability scale. These scores indicate that computer laboratories in Thai universities provide the students with a relatively supportive learning environment. The lecturers have established the

computer laboratory as a place in which cohesiveness among students, open-endedness of activities, integration of technology, and the appropriateness of technology are maintained. Nonetheless, the lowest score of the students' views on the Availability scale warrant the university administrators to provide the students with a more adequate number of computers. This score indicated that the students still experienced delay when they needed to use computers for their assignments at the university.

7.4.5 Research question 5

> What is the difference between students' actual and preferred perceptions of the learning environments of their computer lecture classrooms?

Results from *t*-tests for paired samples showed that there were significant differences (mostly $p<0.001$) between students' perceptions of their actual and preferred computer classroom learning environment on all scales. Students perceived their actual learning environment as being less than their preferred learning environment. This result suggest that most students would prefer a learning environment which is characterised by having more personalisation, enhancing students' cohesiveness, providing clearer task orientation, doing more investigations, allowing individuality but also ensuring greater cooperation as well as more equity during class sessions. These differences in both actual and preferred scales can be used by the instructors as a focus for improving the classroom learning environment as suggested by Fraser (1989). This finding is similar to many other studies in that students prefer a more favourable environment than they perceive to be actually present. (Fraser, Treagust, Williamson, & Tobin, 1987; Logan, 2003).

7.4.6 Research question 6

> Are there any differences between males and females in perceptions of their computer classroom learning environments?

Generally, this study found that both male and female students viewed their actual computer classroom learning environment differently on all seven scales. Female

students held significantly better perceptions of the classroom-learning environment than did the males on three scales, namely, Student Cohesiveness, Task Orientation and Cooperation. This result is similar to study by Margianti, Fraser, and Aldridge (2001) that also found that female students' perceptions of the actual learning environment were greater than males on Task Orientation and Cooperation. On the other hand, male students have significantly higher perceptions on the scales of Innovation and Individualisation. These findings confirmed that males viewed their learning environments as having more individualisation rather than cooperation.

7.4.7 Research question 7

> Are there any differences between males and females in perceptions of their computer laboratory learning environments?

The findings confirmed that there were differences between male and female students' perceptions of their computer laboratory learning environment. Female students had significantly more positive perceptions than did males on two scales, namely, Student Cohesiveness and Integration. On the other hand, male students had significantly greater views than did female students for the other three scales of the Thai version of the CLEI. These findings imply that lecturers should provide a computer laboratory environment that enhances male students' feeling of cohesiveness and technology integration. In view of the female students' perceptions, the lecturer needs to consider actions that may allow female students to have more open-ended activities more adequate technology and increased availability of computers.

7.4.8 Research question 8

> Are there any associations between students' perceptions of their computer lecture classrooms and their attitudes towards computers and computer courses ?

The results from simple correlation analysis found that there were positive associations between students' perceptions of their computer classroom learning

environments and students' attitudes to the Usefulness of Course, Usefulness of Computer and Enjoyment scales. However, a negative association was found with the Anxiety scale.

The multiple regression analysis produced a positive significant multiple correlation (R) for the Usefulness of Computer Course scale, the Usefulness of Computers, and the Enjoyment scale. However, there was a negative but statistically significant multiple correlation for students' anxiety during computer lessons. These results suggest that a good learning environment not only has impact on students to have more positive attitudes toward usefulness of computers and their course and their enjoyment of the classes, but also for reducing students' anxiety during the course. Instructors should establish positive classroom learning environments based on seven criteria. The first criterion is personalization, in which instructors should show concern for students' feelings, provide constant support to students in solving their problems, explain lessons and give clear answer questions to students. Secondly, with regard to innovation, instructors may use ICT to facilitate pedagogy based on the ideas of constructivism, and use a web-based process to help deliver coursework. Third, concerning student cohesiveness, instructors should organize activities which encourage students to have the opportunity to help and support each other. Fourth, in regard to task orientation, instructors should clearly explain to students which activities are important in class and provide course descriptions that include a lot of detail about the learning and teaching activities. Fifth, with regard to cooperation, instructors should design pedagogical techniques that enable students to work together in a group on learning tasks. Sixth, in relation to individualisation, instructors could facilitate students with experiences allowing them to make individual choices on what to do next. Finally, with regard to equity, instructors should treat students equally, such as every student who makes a mistake should be corrected, all students who perform well should be complimented and moreover all students who have problems should be supported.

With regard to students' anxiety during the computer course, two scales of the Thai CUCEI, namely, Student Cohesiveness and Cooperation function as strong predictors. It is clear that increasing student cohesiveness and utilising cooperative methods of learning can reduce students' anxiety.

It was clear in the results that students' enjoyment of their computer lessons is influenced by increasing amounts of personalisation, student cohesiveness, cooperation, and equity in learning environment. Hence, the instructors could increase student's enjoyment during the computer courses by creating a more positive learning environment characterized by having more personalisation, greater student cohesiveness, more cooperation, and equal equity in the classroom environment. Moreover instructors should encourage students' feeling of their belonging to the class, by being enthusiastic and willing to become actively involved with their students in learning.

7.4.9 Research question 9

> Are there any associations between students' perceptions of their computer laboratory and their attitudes towards computers and computer courses?

This study showed that the five scales of the Thai version of CLEI are statistically and significantly related to the four scales of the Thai version of ACCC. The results from simple correlation analysis found that there were positive associations between students' perceptions of their computer laboratory learning environments and students' attitudes to the Usefulness of Course, Usefulness of Computer and Enjoyment scales. Nevertheless, there was an expected negative association with Anxiety scale.

The multiple regression analysis also generated a positive significant multiple correlation (R) for Usefulness of Computer Course, Usefulness of Computers, and students' Enjoyment during the computer course. However, a statistically negative significant multiple correlation for students' Anxiety during computer lessons was found. These results suggest that students may have more positive attitudes about the usefulness of their courses, and computers and enjoy their work and have less anxiety about their work in computer laboratories, if they are provided with an improved learning environment. Instructors could improve learning environments in computer laboratories by focussing on the following five factors. First, they should encourage their students to help and support their classmates by assigning them to work as groups. Second, they should assign laboratory activities which encourage an

open-ended, divergent approach to the use of computers. Third, they should use laboratory activities which are integrated with non laboratory and theory classes. Fourth, they should support their laboratory tasks with adequate hardware and software for the tasks required. Fifth, they should ensure that the laboratory and computers are readily available for student use.

7.5 LIMITATIONS OF THE STUDY

This study has investigated the status of computer classrooms and laboratory learning environments in the Thailand university context. While many of the findings of this current study may relate to other studies in computer classrooms in other places, caution should be taken in generalising the results due to the limitations of the study. The limitations relate to the instruments used, and the study sample.

This research utilized three instruments that were adapted from well-established questionnaires originally developed in a Western context. Although the development processes of these instruments followed a standardized process and the findings have confirmed that the instruments developed in this study were reliable and provide relatively valid data, the interpretation of the data may have limitations. The context of this study is different from the context where the original questionnaires were developed.

Also it should be noted that the number of male and female students in each computer class is not equal. Some classes contain more female students than male students. Moreover, in interviewing, more female students were willing to be volunteers.

Finally, this research has demonstrated that there are associations between students' perceptions of the learning environments of their computing classes and their attitudes, however a cause an effect relationship cannot be assumed. This could be a focus for another study.

7.6 IMPLICATIONS OF THE STUDY

This section discusses the implications that the research findings could have on future computer education in Thailand's universities. This study is significant because, by informing authorities of the results, it may provide directions for present and future policy makers, instructors and university administrators to improve computer education practices in Thailand universities. Specifically, four significant implications can be drawn from this study. The first is associated with researchers as educators and teacher trainers; the second addresses policy makers in Thailand; the third speaks to the university administrators; and the fourth provides counsel for the instructors.

7.6.1 Implications for researchers

The researchers can use the Thai versions of these instruments for assessing learning environments in other classes where students are required to perform, practice and do their assignments in a computer laboratory. Researchers also can modify each item in each scale of the CUCEI, CLEI and ACCC to make them more suitable in the Thai context. All seven scales in the CUCEI cover good classroom learning environment characteristics and can be used as a basis for developing other questionnaires for a variety of classrooms in Thai universities. Similarly, the five scales of the CLEI also can be employed as criteria for assessing standards of computer laboratories. It is also clear that researchers can use qualitative methods like interviewing for collecting important descriptive data.

There is another interesting result from the vectors of students' perception on the Actual Form of the CUCEI. Students' perceptions are not quiet as high on the scales of Innovation and Individualisation. So it is very interesting to consider what the factors that caused this to happen are and how these factors could be improved to provide the students with a better environment. This is especially so in regard to the scale of Individualisation, which was ranked lowest with a score of 2.90.

It would also be worthwhile to include additional variables like cognitive styles and learning styles in future learning environment studies.

7.6.2 Implications for policy makers

Academic quality insurance policy is established in Thai universities. The data gained from students' perceptions of their classroom learning environment from this study could be used as information for guiding academic quality insurance policy. One academic quality insurance policy is processed by assessing the quality of classroom organization of the instructors. The three questionnaires in this study could be used in this process.

7.6.3 Implications for university administrators

The findings provided significant issues that university administrators need to take into consideration. The research findings suggested that there were gaps between students' perceptions of the actual and preferred computer classroom and laboratory learning environments. The findings may help the university administrator to facilitate changes in the university, such as providing improved facilities for computer laboratory and educational technology workshop training for computer instructors, so that the students' preferred learning environment can be accommodated. It is expected that by being in their preferred learning environment, students may learn better (Fraser, 1998a). Furthermore, the findings can also inform the university administrators about the students' perceptions of their computer classrooms and laboratories and their attitudes toward computers and computer courses. University administrators may use these findings as starting points for bringing about improvement, such as providing a facility for computer laboratory and workshop for educational technology for computer instructors.

7.6.4 Implications for instructors

The results from this study can provide computer science instructors with a picture of students' perceptions in their computer classroom learning environments in Thailand, especially the difference between students' perceptions of their actual and preferred learning environments. Thus, computer science instructors can use these results to guide them in improving their classroom and, for example, organize

activities in the classroom to provide students with high levels of task orientation and good personalisation.

7.7 RECOMMENDATIONS AND POSSIBILITIES FOR FUTURE RESEARCH

In concluding this study, recommendations are given for improvements of computer education in Thailand universities and suggestions for possible future research offered.

This study has shown the significance of the classroom learning environment toward students' attitudes in computer classrooms and laboratories and the researcher has put forward practical policy recommendations. As a standard practice the instructors and the administrators should regularly assess students' perceptions of their computer classrooms and laboratory learning environments. The lecturers can use the results as evaluations of their teaching practices and as a guide for improving those practices.

Despite the limitations described in section 7.5, this study has broken new ground in investigating the non-physical computer classroom and laboratory learning environments. The study could be replicated using larger samples so that a more valid portrait of computer education in Thailand universities can be obtained.

Considering the geographical conditions of Thailand, it is possible that the results generated from this study are not fully describing the picture of computer education in Thai universities. A replication of this study with a larger sample of universities and classes will lead to a more complete and detailed view of computer education in Thai universities.

Also, further research that focuses on improving computer classroom and laboratory learning environments should be conducted, because this study has shown those students' attitudes are influenced by their perceptions of classroom learning environment. However, it is suggested that future research needs to develop

instruments that are even more sensitive to the culture of the computer classroom in the Thai university context.

7.8 SUMMARY

The present study serves as the first psychosocial learning environment assessment for computer science curriculum in Thailand universities. This research confirms the validity of the three questionnaires, the CUCEI, the CLEI and the ACCC which can be employed in the Thailand university context. The instructors, administrators and educational researchers can use these instruments for investigating students' perceptions of their classroom learning environments and attitudes with confidence. The research results not only demonstrated the whole view of students in psychosocial learning environments of computer science curriculum in Thailand but also revealed that there are differences between students' perceptions of their actual and preferred learning environments. Thus improving computer classroom learning environment in universities in Thailand should be considered, and be completed to bring the actual perception closer to the preferred one. The results also indicated that the computer classroom learning environments are associated with students' attitudes. Therefore, instructors can improve students' attitudes and as a consequence their cognitive achievement, by improving their learning environments.

REFERENCES

Adolphe, F. S. G., Fraser, B. J., & Aldridge, J. M. (2003). A cross-national study of classroom environment and attitudes among junior secondary science students in Australia and Indonesia. In D. L. Fisher & T. Marsh (Eds.), *Making science, mathematics and technology education accessible to all* (Vol. 2, pp. 435-445): The Key Centre for School Science and Mathematics, Curtin University of Technology, Perth, Australia.

Aldridge, J. M., & Fraser, B. J. (2000). A cross-cultural study of classroom learning environments in Australia and Taiwan. *Learning Environments Research, 3*, 101-134.

Aldridge, J. M., & Fraser, B. J. (2003). Effectiveness of a technology-rich and outcomes-focused learning environment. In M. S. Khine & D. L. Fisher (Eds.), *Technology-rich learning environments: A future perspective* (pp. 41-69). Singapore: World Scientific.

Aldridge, J. M., & Fraser, B. J., Fisher, D. L., & Wood, D. (2002, April). Assessing students' perceptions of outcomes-focused, technology-rich learning environments. Paper presented at the annual meeting of the American Educational Research Association (AERA), New Orleans, LA.

Aldridge, J. M., Fraser, B. J., & Huang, I. T.-C. (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.

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

Arthur, W., & Olsen, E. (1991). Computer attitudes, computer experience, and their corelates: An investigation of path linkages. *Teaching of Psychology, 18*, 51-54.

Azemi, A. (1995). Teaching computer programming Courses in a Computer Laboratory Environment. *Proceeding-Frontiers in Education Conference, pp2a5.18-2a5.20.*

Badagliacco, J. M. (1990). Gender and race difference in computing attitudes and experience. *Social Science Computer Review, 8*(1), 42-64.

Bannan, B., & Milheim, W. D. (1997). Existing Web-Based instruction courses and their design In B. H. Khan (Ed.), *Web-based instruction* (pp. 381-387). Englewood Cliffs, New jersey: Educational Technology publication, Inc.

Baron, L. J. (1997). The effects of cooperative training and ability and grouping on microcomputer learning. *Computers in Human Behavior, 13*(3), 285-304.

Bernard, E., & Whitley, J. (1996). Gender differences in computer-related attitudes: It depends on what you ask. *Computers in Human Behavior, 12*(2), 275-289.

Blignaut, R. J., & Venter, I. M. (1998). Teamwork: can it equip university science students with more than rigid subject knowledge? *Computers & Education, 31*, 265-279.

Bork, A. (1985). *Personal computers for education.* New York; Harper& Row.

Booth, D. (1997). Evaluation of a change in teaching methods using the College and University Classroom Environment inventory (CUCEI). In R. Pospisil & L. Willcoxson (Eds.), *Learning Through Teaching, Proceedings of the 6th Annual Teaching Learning Forum* (pp. 44-49). Perth: Murdoch University.

Boud, D., Dunn, J., & Hegarty-Hazel, E. (1986). *Teaching in laboratories.* Guildford, Surrey, UK; SRHE & NFER-Nelson.

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

Brislin, R. W. (1980). Translation and content analysis of oral and written material. In H. C. triandis & J. W. Berry (Eds.), *Handbook of cross-cultural psychology: Methodology* (Vol. 2, pp. 389-444). Boston: Allyn and Bacon, Inc.

Brophy, J., & Good, T. L. (1986). Teacher behavior and student achievement. In M. C. Wittrock (Ed.), *Handbook of Research on Teaching (third edition)* (pp. 328-375). New York: Macmillan.

Bruck, D., R., H., Hood, B., Macdonald, J., & Moore, S. (2001). Enhancing students satisfaction in higher education: the creation of staff teaching communities. *Australasian Educational Research, 28*(2), 79-97.

Bruner, J. (1990). *Acts of meaning. Cambridge,* Mass: Harvard University Press.

Byrd, D. M., & Koohang, A.A. (1989). A professional development question: is computer experience associated with subjects' attitudes toward the perceived usefulness of computers/ Journal of Research on computing in education (summer), 401-410.

Campbell, N. J., & Dobson, J. E. (1987). An inventory of student computer anxiety. *Elementary School Guidance Counselling, 22*, 149-155.

Cannell, C.F. & Kahn, R.L. (1968). Experimentation in social psychology. In G. Lindzey and E. Aronson (Eds.). *Handbook of Social Psychology,* Vol. 2, Reading, MA: Addison Wesley.

Chan, D. S. (2000). Assessing nursing students' perceptions of hospital learning environment. Unpublished doctoral thesis, Curtin University of Technology, Perth.

Chang, V., & Fisher, D. L. (2003). The validation and application of a new learning environment instrument for online learning in higher education. In M. S. Khine & D. L. Fisher (Eds.), *Technology-rich learning environments: A future perspective* (pp. 1-18). Singapore: World Scientific.

Chitwiriya, K. (1996). *A Study of Physical Environment of Computer Classrooms in Elementary Schools Under the Jurisdiction of the Office of Private Education.* Unpublished master thesis, Chulalongkorn University, Bangkok (Thailand).

Chung, S. H., Schwager, P. H. & Turner, D. E. (2002). An empirical of students' computer self-efficacy: Differences among four academic disciplines at a large university. *The Journal of Computer Information Systems*; Summer 2002; 42, 4.

Candy, P. C, Crebert, G. and O'Leary J. (1994). *Developing Lifelong Learners Through Undergraduate Education.* Commissioned Report No. 28. National Board of Employment, Education and training. AGPS, Canberra.

Clarke, M. C., & Finnie, G. R. (1998). Changes in entry-level university students' attitude to computers for 1985-1997. *South African Computer Journal, 21*, 26-32.

Clayton, J. (2003). Assessing and researching the online learning environment. In M. S. Khine & D. L. Fisher (Eds.), *Technology-rich learning environments: A future perspective*. Singapore: World Scientific.

Cohen, L., Manion, L., & Morrison, K. (2000). *Research method in education (5th ed.)*. London: RoutledgeFalmer.

Collis, B. A., & Williams, R. L. (1987). Differences in adolescents' attitudes toward computers and selected school subjects. *Journal of Educational Computing Research, 8*, 17-27.

Cronbach, D. J. (1951). *coefficient alpha and internal structure of tests. Psychometrika*, 16(3), 297-334.

Crump, B. J. (2002). *First-year programming students' perceptions of their tertiary learning environment.* Unpublished doctoral thesis, Curtin University of Technology, Perth.

Dambrot, F. H., Silling, S. M., & Zook, A. (1988). Psychology of computer use: sex differences in prediction of course grades in a computer language course. *Perception and motor Skills, 66*, 627-636.

Dambrot, F. H., Watkins-Malek, M. A., Silling, S. M., Marshall, R. S., & Garver, J. (1985). Correlates of sex differences in attitudes toward and involvement with computers. *Journal of Vocational Behaviour, 27*, 71-86.

Davis, F. D. (1993). User acceptance of information technology: system characteristics, user perceptions and behavioral impacts. *International Journal of Man- Machine Studies, 38,* 475-487.

DeVellis, R. F. (1991). *Scale development: Theory and applications (Vol.26)*: Newbury Park: SAGE Publication.

Dryden, M., & Fraser, B. J. (1996, April). *Evaluating urban systemic reform using classroom learning environment instruments*: Perper presented at the annual meeting of Amarican Educational Research Association, New York.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention: An introduction to theory and research.* Reading, MA: Addison-Wesley.

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

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

Fisher, D. L., Goh, S. C., Wong, A. F. L., & Rickards, T. W. (1997). Perceptions of interpersonal teacher behaviour in secondary science classrooms in Singapore and Australia. *Journal of Applied Research in Education, 25*, 125-133.

Fisher, D. L., Henderson, D., & Fraser, B. J. (1995). Interpersonal Behaviour in Senior High School Biology Classes, *Research in Science Education 25,* 125-133.

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

Fisher, D. L., & Parkinson, C. (1998).). Improving nursing education classroom environment. *journal of nursing Education, 36*, 87-108.

Fisher, D. L., & Stolarchuk, E. (1998). *The effect of using labtop computers on achievemenet, attitude to science and classroom environment in science* (Paper presented at the Proceedings Western Australia Institute for Education Research Forum).

Francis, L. J. (1994). The relationship between computer related attitudes and gender stereotyping of computer use. *Computers Educ, 22*(4), 283-289.

Francis, L. J., Katz, Y. J., & Jones, S. H. (2000). The reliability and validity of the Hebrew version of the Computer Attitude Scale. *Computers & Education, 35*, 149-159.

Fraser, B. J. (1981). Using environmental assessments to make better classroom. *Journal of Curriculum Studies, 13*, 131-144.

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

Fraser, B. J. (1989). *Assessing and improving classroom environment*. (What Research Says, No. 2). Perth: Curtin University of Technology.

Fraser, B. J. (1994) Research on classroom and school climate. In D. Gabel (Ed.), *Handbook of research on science teaching and learning* (pp. 493-541). New York: Macmillan.

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

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

Fraser, B. J. (1998b). Classroom environmemt instruments: Development, validity and applications. *Learning Environments Research: An International Journal, 1*, 7-33.

Fraser, B. J. (2002). Learning environments research: Yesterday, today and tomorrow. In S. C. Goh & M. S. Khine (Eds.), *Studies in educational learning environments: An international perspective* (pp. 1-25). Singapore: World Scientific.

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) (3rd ed.)*. Perth: Western Australian Institute of Technology.

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

Fraser, B. J., & Fisher, D. L. (1983a) Student Achievement as a Function of Person-Environment Fit: A Regression Surface Analysis, *British Journal of Educational Psychology 53*, 89-99.

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

Fraser, B. J., Fisher, D. L., & McRobbie, C. J. (1996). *Development, Validation and the 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., Giddings, G. J., & McRobbie, C. J. (1991, April). *Science laboratory classroom environments: A cross-national perspective*. Paper presented at the annual meeting of American Educational Research Association. Chicago.

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

Fraser, B. J., Giddings, G. J., & McRobbie, C. J. (1992, March). *Science laboratory classroom environments: A cross-national study* (Paper presented at the annual meeting of the National Association for Research in Science Teaching, Boston, MA.

Fraser, B. J., & McRobbie, C. J. (1995). Science laboratory classroom environments at school 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 classroom 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 Classroom, *Elementary School Journal 85,* 567-580.

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

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

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 in universities and colleges. *Studies in Higher Education, 11*, 43-54.

Fraser, B. J., Treagust, D. F., Williamson, J. C., & Tobin, K. G. (1987). Validation and application of college and university classroom environment inventory

(CUCEI). In B. J. Fraser (Ed.), *The Study of Learning Environments* (Vol. 2, pp. 17-30). Perth: Curtin University of Technology,.

Fraser, B. J., Treagust, D. F., Williamson, J. C., & Tobin, K. G. (Eds.). (1986). *Validation and application of the college and university classroom environment inventory (CUCEI)* (The Study of Learning Environments (Volume 2). Salem, Oregon: Assessment Research.

Fraser, B. J., Williamson, J. C., & Lake, J. (1988Apirl). *Combining quantitative and qualitative methods in the evaluation of an alternative to conventional high school* (Paper presented at annual meeting of American Educational Research Association, New Orleans).

Fraser, B. J., Williamson, J. C., & Tobin, K. (1987). Use of Classroom and School Climate Scales in Evaluating Alternative High school. *Teaching and teacher Education, 3*, 219-231.

Gardner, D. G., Discenza, R., & Dukes, R. L. (1993). The measurement of computer attitudes: An empirical comparison of available scales. *Journal of Educational Computer Research, 9*(4), 487-507.

Gardner, H. (1985). *The frames of mind: Theory of multiple intelligences*. New York: Basic Books.

Gaskell, G., (2000). Individual and group interviewing. In M. W. Bauer & G. Gaskell (Eds.), *Qualitative researching with text, image and sound: A practical handbook* (pp. 38-56). London: SAGE.

Goh, S. C., & Fraser, B. J. (1996). Validation of an Elementary School Version of the Questionnaire on Teacher Interaction, *Psychological Reports, 79,* 512-522.

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

Good, T., & Brophy, J. (1995). *Looking in classrooms (5th ed.)*. New York: Harper Collins.

Gressard, C. P., & Loyd, B. H. (1986). Validation studies of a new computer attitude scale. *Association for Educational Data Systems Journal, 18*, 295-301.

Griswold, P. A. (1983) Some determinants of computer awareness among education majors. *Association of Educational Data systems Journal, Winter, 92-103.*

Henderson, D., Fisher, D. L., & Fraser, B. J. (2000). Interpersonal behaviour, laboratory learning environment, and student outcomes in senior biology classes. *Research in Science and Teaching, 37*(1), 26-43.

Howe, K. (1988) Against the quantitative-qualitative incompatibility thesis: Or dogmas die hard. *Educational Research*, 17 (8), 10-16.

Hiltz, S. R. (1994). The virtual classroom: *Learning without limits via computer networks*. Norwood, New Jersey: Ablex.

Hunt, D. E. (1975). Person-environment interaction: A challenge found wanting before it was tried. *Review of Educational Research, 45*, 219-230.

Johnson, D. W., & Johnson, T. R. (1991). Cooperative learning and classroom and school climate. In B. J. Fraser, & H. J. Walberg (Eds.), *Educational environment: Evaluation, antecedents, and consequences* (pp. 55-74). London: Pergamon.

Johnson, D. W., Johnson, R., & Holubec, E. (1998). *Cooperation in the classroom (7th ed.)*. Edina, MN: Interaction Book Company.

Johnson, D. W., Maruyama, G., Johnson, R., Nelson, D., & Skon, L. (1981). The effects of cooperative, competitive, and Individualistic goal structures on achievement: A meta-analysis. *Psychological Bulletin, 89*, 47-62.

Jonassen, D. H. (1996). *Computers in the classroom: Mindtools for critical thinking*: Englewood Cliffs, NJ: Merrill/ Prentice-Hall.

Jonassen, D. H. (2000). *Computer as mindtools for schools: Engaging critical thinking*. Columbus, Ohio: Merrill.

Jonassen, D. H., Peck, K. L., & Wilson, B. G. (1999). *Learning with technology: A constructivist perspective*. New Jersey: Prentice Hall.

Jonassen, D. H., & Reeves, T. C. (1996). Learning with technology: Using computers as cognitive tools. In D. H. Jonassen (Ed.), *Handbook of research for educational communications and technology* (pp. 693-719). New York: Macmillan.

Kerlinger, F. N. (1986) *Foundations of behavioral research* (third edition). New York: Holt, Rinehart & Winston.

Khan, B. H. (1997). *Web-based instruction.* Englewood Cliffs, New Jersey: Educational technology Publication, Inc.

Khine, M. S., Fisher, D. L. (2001, December). *Classroom environment and teachers' cultural background in secondary science classes in an Asian context*. Paper presented at the annual meeting of the Australian Association of Research in Education, Fremantle, Perth, Australia.

Khine, M. S. (2003) Creating a technology-rich constructivist learning environment in a classroom management module. In M. S. Khine & D. L. Fisher (Eds.), *Technology-rich learning environments: A future perspective* (pp. 1-18). Singapore: World Scientific.

Khine, M. S. & Fisher, D. L. (2003). From the editors. In M. S. Khine & D. L. Fisher (Eds.), *Technology-rich learning environments: A future perspective* (pp. 1-18). Singapore: World Scientific.

Khine, M. S., & Goh, S. C. (2001 December). *Investigation of tertiary classroom learning environment in Singapore.* Paper presented at the International Educational Research Conference, Australian Association for Educational Research, Fremantle, Australia.

Khoo, H. S., & Fraser, B. J. (1997, April). *The learning environments associated with computer application courses for adults in Singapore.* Paper presented at the annual meeting of American Educational Research Association. Chicago.

Killen, R. (2003). *Effective teaching strategies: Lessons from research and practice (3rd ed.).* NSW: Social Science Press.

Koohang, A. A. (1987). A study of the attitudes of pre-service teacher toward the use of computers. *Educl Commun. Technology Journal, 35*, 145-149.

Koohang, A. A. (1989). A study of attitudes toward computers: Anxiety, Confidence, Liking, and Perception of Usefulness, *Journal of Research on Computing in Education, 22,* 137-150.

Koul, R. B., & Fisher, D. L. (2003, January). Teacher and student interaction in science classrooms in Jammu, India. In D. L. Fisher & T. Marsh (Eds.), *Proceedings of the third International conference on science, mathematics and technology education: Making science, mathematics and technology education accessible to all* (Vol. 2, pp. 455-464). The Key Centre for School Science and Mathematics, Curtin University of Technology, Perth, Australia.

Kunpaibut, W. (1994). *Attitudes toward Computer of Computer-Major Students in Teachers Colleges under the United Colleges of Ratanakosin.* Srinakharinwirot Mahasarakham University, Mahasarakham (Thailand).

Lang, Q. C., & Wong, A. F. L. (2003). Evaluating e-learning environments in singapore lower secondary science classrooms. In M. S. Khine & D. L. Fisher (Eds.), *Technology-rich learning environments: A future perspective* (pp. 285-305). Singapore: World Scientific.

Lapa, P. (2001). *A follow up and evaluation in using computer laboratory in reform schools under the jurisdiction of Amphur Chumpae, Changwat Khon Kaen.* Unpublished Master thesis, Khon Khan University, Khon Kaen (Thailand).

Lavonen, J., Meisalo, V., Lattu, M., Leinonen, L., & Wilusz, T. (2000). Using Computers in science and technology education, *ITiCSE2000 Working Group Reports, 127-134).*

Lee, R. S. (1970). Social attitudes and the computer revolution. *Public Opinion Quarterly*, 53-59.

Lee, S. , & Fraser, B. J. (2001, December) *Assessment description and effective of science classroom environment in Korea.* Paper presented at the Annual Conference of the Australian Association for Research in Education, Fremantle, Australia.

Lewin, K. (1936). *Priciples of topological psychology.* New York: McGraw-Hill.

Lizzio, A., Wilson, K., & Simons, R.). University students' perceptions of the learning environment and academic outcomes: implication for theory and practice. *Studies in Higher Education, 27*, 27-52.

Logan, K. A. (2003). *The culture of computer classrooms in single-sex and mixed-sex secondary schools in Wellington, New Zealand.* Unpublished doctoral thesis, Curtin University of Technology, Perth.

Loyd, B. H., & Gressard, C. (1984) Reliability and factor validity of computer attitude scales. *Educational and Psychological measurement, 44*, 501-505.

Loyd, B. H., & Loyd, D. E. (1985). The reliability and validity of an instrument for the assessment of computer attitudes. *Educational and Psychological measurement, 45*, 903-908.

Lutz, G. M. (1983). *Understanding social statistics.* New York: Macmillan.

Makrakis, V. (1992). Cross-cultureal comparison of gender differences in attitude towards computers in Japan and Sweden. *Scand. J. Educl. Res., 36*, 275-287.

Makrakis, V., & Sawada, T. (1996). Gender, computers and other school subjects among Japanese and Swedish students. *Computers & Education, 26*(4), 225-231.

Manapee, P. (1995). *A Study of Computer Science Curriculum and Instruction at Chulalongkorn University.* Unpublished masters thesis, Chulalongkorn University, Bangkok (Thailand).

Maor, D. (1998). How does one evaluate students, participation and interaction in an internet-based unit? [Proceedings of the7th Annual Teaching Learning Forum, The University of Westren Australia, February 1998]. Perth: UWA.

Maor, D., & Fraser, B. J. (1993). Use of classroom environemnt perceptions in evaluating inquiry-based computer learning. In D. L. Fisher (Ed.), *The study of learning environment* (Vol. 7, pp. 57-71). Perth: Curtin University of Technology.

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., & Aldridge, J. M. (2001, December). *Investigation the learning environment and students outcomes at the university level in*

Indonesia. Paper presented at the annual conference of the Australian Association for Research in Education, Fremantle, Australia.

Massoud, S. L. (1991). Computer attitudes and computer knowledge of adult students. *Journal of Educational Computing Research, 7*, 267-291.

McRobbie, C. J., & Fraser, B. J. (1993). Associations between student outcomes and psychosocial science environment. *Journal of Educational Research, 87*, 78-84.

Michaelsen, L. K., Jones, C. F., & Watson, W. E. (1993). Beyond groups and co-operation: Building high performance learning teams. *To Improve the Academy, 12*, 127-145.

Modemanee, C. (2000). *A proposed computer classroom design for cooperative learning for elementary school students.* Unpublished Master thesis, Chulalongkorn University, Bangkok (Thailand).

Moos, R. H. (1974). *The social climate scales: An overview.* Palo Alto, California: Consulting Psychologists Press.

Moos, R. H. (1976). *The human context: Environmental determinants of behaviour.* New York: John Wiley & Sons.

Moos, R. H. (1979). *Evaluating Educational Environments:* Procedures, Measures, Finding and policy Implications. San Francisco: Jossey-Bass Publishers.

Moos, R. H., & Trickett, E. J. (1987). *Classroom environment scale manual (2nd ed.).* Palo Alto: California: Cosulting Psychologists Press.

Muir-Herzig, R., G. (2003). Technology and its impact in the classroom. *Computers & Education, 42(2004)*, 111-131.

Murray, H. A. (1938). *Explorations in personality.* New York: Oxford University Press.

Nai, L., & Gill, K. (2005). Gender and cultural difference in Internet use: A study of China and the UK. *Computers & Education.*

Nair, C. S., (1999). *Transition from senior secondary to higher education: A learning environment perspective.* Unpublished doctoral thesis, Curtin University of Technology, Perth.

Nair, C. S., & Fisher, D. L. (1999, August). A learning environment study of tertiary classrooms. Paper presented at the annual research forum of the Western Australia Institute for Educational research, Perth, WA.

Nair, C. S., & Fisher, D. L. (2000). Transition from senior secondary to higher education: A learning environment perspective. *Research in Science Education, 30*(4), 435-450.

National Advisory Committee on ICT in Education Reform (2002). National ICT for Education Master Plan, Bangkok: Ministry of Science and Technology.

Negroponte, N,. Renick, M., & Cassell, J. (1997). Creating a learning revolution. Retrieved on 24 July 2001. from http://education.unesco.org/unesco/educprog/lwf/doc/portfolio/opinion8.htm.

Newby, M. (2003). Computer Laboratory environments: providing a suitable practical learning experience. In M. S. Khine & D. L. Fisher (Eds.), *Technology-rich learning environments: A future perspective* (pp. 187-207). Singapore: World Scientific.

Newby, M. (2000). Factors influencing Perceptions of computer laboratory environment, attitudes and achievement. In D. L. Fisher & J. H.Yang (Eds.), *Improving Classroom Research Through International Cooperation* (pp.429-444). Perth: Curtin University of Technology.

Newby, M. (1997). *A study of the effectiveness of computer laboratory classes as learning environments.* Unpublished doctoral thesis, Curtin University of Technology, Perth.

Newby, M., & Fisher, D. L. (1997). An instrument for assessing the learning environment of a computer laboratory. *Journal of Educational Computing Research,16*(2), 179-190.

Newhouse, P. (2001b). Development and use of an instrument for computer-supported learning environments. *Learning Environments Research: An International Journal, 2*(2), 115-138.

Nunnally, J. (1967). *Psychometric theory*, New York: McGrawHill.

Nunnally, J. (1978). *Psychometric theory* (2nd.ed.), New York: McGrawHill.

Ogletree, S. M., & Williams, S. M. (1990). Sex and sex-trping effects on computer attitudes and aptitude. *Sex Roles, 23*(11/12), 703-712.

Okebukola, P. A. (1993). The gender factor in computer anxiety and interest among some Australian high school students. *Educational Research, 35*, 181-189.

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas.* New York: Basic Books.

Patton, M. Q. (1990). *Qualitative evaluation and research methods. (2nd ed.).* Newbury Park, CA: Sage Publications, Inc.

Paulus, D. & Christie, R. (1981). Spheres of control: An interactionist approach to assessment of perceived control. In H. M. Lefcourt (Ed.), *Research with the Locus of Control Construct Volume 1 Assessment Methods.* New York: Academic Press.

Puacharearn, P., & Fisher, D. L. (2004, May). *The effectiveness of constructivist teaching on improving learning environment in Thai secondary school science classrooms.* Paper presented at the SEAMEO-UNESCO Education Congress & Expo, Bangkok, Thailand.

Raaflaub, C. A., & Fraser, B. J. (2002, April). *Investigating the leaning environment in Canadian mathematics and science classes in which computer are used.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Ragosta, M. (1983). Computer-assisted instruction and compensatory education: A longitudinal analysis. *Machine Mediated Learning, 1,* 97-127.

Ramsden, P. Margetson, D. Martin, E. & Clarke, S. (1995) *Recognizing and rewarding good teaching in Australian higher education*, Committee for the Advancement of University Teaching, Canberra.

Ravenscroft, S. P., Buckless, F. A., McCombs, G. B., & Zuckerman, G. J. (1995). Incentives in student team learning: An experiment in cooperative group learning. *Issues in Accounting Education, 10*(1), 97-109.

Reece, M. T., & Gable, R. K. (1982). The development and validation of a measure of general attitudes toward computers. *Educational and Psychological measurement, 42*, 913-916.

Riah, H., & Fraser, B. J. (1998, April). *Chemistry learning environment and its association with students' achievement in chemistry* Paper presented at the annual meeting of the American Educational Research Association. San Diego, CA.

Rickards, T. (2003).Technology-rich learning environments and the role of effective teaching In M. S. Khine & D. L. Fisher (Eds.), *Technology-rich learning environments: A future perspective* (pp. 115-132). Singapore: World Scientific.

Roblyer, M. D. (2003). *Integrating educational technology into teaching(3rd ed.).* Columbus, Ohio upper Saddle River, New Jersey: Merrill Prentice Hall.

Rosenberg, M. J., & Hovland, C. I. (1960). Cognitive, affective, and behavioral components of attitudes, In M. J. Rosenberg, C. I. Hovland, W. J. McGuire, R. P. Abelson, and J. W. Brehm, *Attitude organization and change* (pp. 1-14). New Haven, CT: Yale University Press.

Ragosta, M. (1983). Computer-assisted instruction and compensatory education: A longitudinal analysis. *Machine Mediated Learning, 1,* 97-127.

Savananandu, T. (1987) A study of Relevancy of College-Level Computer Curricula to the Market Needs. Bangkok: Chulalongkron University.

Shashaani, L. (1993). Gender-based differences in attitudes toward computers. *Computers & Education, 20*(2), 169-181.

Shashaani, L. (1997). Gender differences in computer attitudes and use among college students. *Journal of Educational Computing Resarch, 16*(1), 37-51.

Shashaani, L., & Khalili, A. (2001). Gender and computers: similarities and differences in Iranian college students' attitudes toward computers. *Computers & Education, 37*, 363-375.

Slavin, R. E. (1995). *Cooperative learning: Theory, research, and practice (2nd ed.)*. Boston: Allyn&Bacon.

Slavin, R. E. (1996). Research on co-operative learning and achievement: What we know, what we need to know. *Contemporary Educational Psychology, 21*, 43-69.

Smith, B. L., Caputi, P., & Rawstorne. (2000). Differentiating computer experience and attitudes toward computers : An empirical investigation. *Computers in Human Behavior, 16*, 509-581.

Spady, W. G. (1994). *Outcome-based education: Critical issues and answers*: Arlington, VA: American Association of School Administrators.

Sripai, S. (1999). *A study on computer science program at the bachelor degree in science level in Rajabhat Institutes.* Unpublished master thesis, King Mongkuts University of Technology, Bangkok.

Stern, G. G., Stein, M. I., & Bloom, B. S. (1956). *Methods in personality assessment.* Glencoe, IL: Free Press.

Stevens, D. J. (1982). Educators' perceptions of computers in education: 1979 and 1982. *Association of educational Data Systems Journal, 15* , 1-15.

Stevens, J. (1992). Applied multivarlate statistics for the social sciences. Hillsdale, NJ; Lawrence Eribaum.

Tamir, P. & Caridin, H. (1993). Characteristics of learning environment in biology and chemistry classes as perceived by Jewish and Arab high school students in Israel. *Research in Science and Technological Education, 11*, 1-15.

Tansopontanasak, K. (1999). *Students screen monitoring system via network in a computer classroom.* Unpublished masters thesis, Chulalongkorn University, Bangkok (Thailand).

Taylor, P. C., & Campbell-Williams, M. (1993). Discourse towards balanced rationality in the high school mathematics classroom: Ideas from Habermas' critical theory. In J. Malone & P. C. Taylor (Eds.), *Proceeding of Topic Group 10 of the Seventh International Congress of Mathematics Educators (ICME-7): University of Quebec. Perth: Curtin University of Technology.*

Taylor, P. C., Dawson, V., & Fraser, B. J. (1995, April). *A constructivist perspective on monitoring classroom learning environments under transformation* (Paper presented at the annual meeting of the American Educational research Association). San Francisco, CA.

Taylor, P. C., & Fraser, B. J. (1991, April). *CLES: An instrument for assessing constructivist learning environment.* Paper presented at the annual meeting of the National Association for Research in Science Teaching, The Abbey, Fontane, Wisconsin.

Taylor, P. C., Fraser, B. J., & Fisher, D. L. (1997). Monitoring constructivist classroom learning environments. *International Journal of Educational Research, 27*(4), 293-301.

Taylor, P. C., Fraser, B. J., & White, L. R. (1994). *CLES: An instrument for monitoring the development of constructivist learning environments* (Paper presented at the American Educational Research Association). New Orleans.

Teh, G., & Fraser, B. J. (1994). An evaluation of computer-assisted learning in terms of achievement, attitudes and classroom environment. *Evaluation and Research in Education, 8*, 147-161.

Teh, G., & Fraser, B. J. (1995). Associations between student outcomes and geography classroom environment. *International Research in Geographical and Environmental Education, 4*(1), 3-18.

Tobin, K. G. (1990). Social constructivist perspectives on the reform of science education. *Australian Science Teachers Journal, 36* (4), 29-35.

Tobin, K. G. (1998). Qualitative perceptions of learning environments on the World Wide Web. In B. J. Fraser & K. G. Tobin (Eds.), *International Handbook of Science Education* (pp. 139-162). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Trinidad, S. (2003). Working with technology-rich learning environments: strategies for success. In M. S. Khine & D. L. Fisher (Eds.), *Technology-rich learning environments: A future perspective* (pp. 97-113). Singapore: World Scientific.

Trochim, W. M. K. (2005, 01/16/2005). *The t-test.* Retrieved 1/24/2005, 2005, from http://www.socialresearchmethods.net/kb/stat_t.htm

von Glasersfeld, E. (1981). The concepts of adaptation and viability in a radical constructivist theory of knowledge. In I. E. Sigel, D. M. Brodinsky & R. M. Golinkoff (Eds.), *New Directions in Piagetian theory and practice.* New Jersey: Lawrence Erlbaum Associates.

von Glasersfeld, E. (1988). The reluctance to change a way of thinking. *The Irish Journal of Psychology, 9*(1), 83-90.

Vygotsky, L. (1962). *Thought and language*. Cambridge, MA: MIT Press.

Walberg, H. J. (1976). Psychology of learning environment: Behavioral, structural, or oerceptual? *Review of Research in Educational Psychology, 57*, 297-301.

Walberg, H. J. (1981). A phychological theory of educational productivity. In F. Farley & N. Gordon (Eds.), *Psychology and education*. The state of the union. Berkeley: McCutchan.

Walberg, H. J. (2002). In S. C. Goh & M. S. Khine (Eds.), *Studies in Educational Learning Environments: An Internation perspective* (pp. back cover). Singapore: World Scientific.

Walberg, H. J., & Anderson, G. J. (1968). Classroom climate and individual learning. *Journal of Educational Psychology, 59*, 414-419.

Walsh, A. (1990). *Statistics for the social science with computer application*. New York: Harper & Row, Publishers, Inc.

Wanpen, S. & Fisher, D. (2005, August). Associations between students' perceptions of their learning environment and a tertiary laboratory classroom in Thailand. Paper presented at the Fourth International Conference on Science, mathematics and technology education, Victoria, Canada.

Weigel, V. (2002). Deep learning for digital age; Technology's untapped potential to enrich higher education. san francisco: jossey- bass.

Williams, S. W., Ogletree, S. M., Woodburb, W., & Raffield, P. (1993). Gender roles, computer attitudes, and dyadic computer interaction performance in college students. *Sex Roles, 29*, 515-525.

Williamson, J. C., Tobin, K.G., & Fraser, B. J. (1986, April) Use of classroom and school environment scales in evaluating alternative high school. Paper presented at the annual meeting of American Educational Research Association, San Francisco, CA.

Wilson, B. G. (1996). *Constructivist learning environment: Case studies in instructional design*. New Jersey: Educational Technology Publications Englewood Cliffs.

Wong, A. F. L., & Fraser, B. J. (1996). Environment-attitude associations in the chemistry laboratory classroom. *Research in science and Technological Education, 14*(1), 91-102.

Woodrow, J. E. J. (1991a). A comparison of four computer attitude scales. *Journal of Educational Computer Research, 7*(2), 165-187.

Woodrow, J. E. J. (1991b). Locus of control and computer attitudes as determinants of the computer literacy of student teachers. *Computers & Education, 16*(3), 237-245.

Woods, J., & Fraser, B. J. (1995). *Utilizing feedback data on students' perceptions of teaching style and preferred learning style to enhance teaching effectiveness* (Paper presented at the annual meeting of the National Association for Research in Science Teaching). San Francisco, CA.

Wubbels, T. (1993). Teacher-student relationships in science and mathematics classes. In B. J. Fraser (Ed.), *Research Implications for Science and Mathematics Teachers* (Vol. 1). Perth: National Key Centre for School Science and Mathematics, Curtin University of Technology.

Wubbels, T., Brekelmams, M., & Hooymayers, H. P. (1991). Interpersonal teacher Behavior in the Classroom, in B. J. Fraser & H. J. Walberg (Eds.) *Educational Environments: Evaluation, Antecedents and Consequences (pp.* 141-160). London: Pergamon.

Wubbels, T., Creton, H.A., & Hooymayers, H. P. (1985). *Discipline problems of beginning teacher, interactional behaviour mapped out.* Paper presented at the American Education Research Association, Chicago, IL.

Wubbels, T., 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*, 1-11.

Wubbels, T., & Levy, J. (1993). *Do you know what you look like?: Interpersonal relationship in education.* London: The Falmer Press.

Yang, S. C., & Liu, S. F. (2005). The study of interactions and attitudes of third-grade students' learning information technology via a cooperative approach. *Computers in Human Behavior, 21*, 45-72.

Yarrow, A., Millwater, J., & Fraser, B. J. (1997). Improving university and primary school classroom environments through preservice teachers' action research. *International Journal of Practical Experiences in Professional Education, 1*(1), 69-93.

Zakrajsek, T. D., Waters, L. K., Popovich, P. M., Craft, S., & Hampton, W. T. (1990). Convergent Validity of scales measuring computer-related attitudes. *Educational Psychological Measurement, 50*, 343-349.

Zandvliet. (2003). Learning environments in new contexts: Web-capable classrooms in Canada. In M. S. Khine & D. L. Fisher (Eds.), *Technology-rich learning environments: A future perspective* (pp. 133-156). Singapore: World Scientific.

Zandvliet, D. B. (2002). Learning environments in technology-rich classrooms. In S. C. Goh & M. S. Khine (Eds.), *Studies in Educational Learning Environments: An International Journal* (pp. 49-72). Singapore: World Scientific.

APPENDICES

Appendix A: Student Actual Form of the CUCEI English version

College and University Classroom Environment Inventory (CUCEI)

Personalised Form

Student Actual Form

Directions

This questionnaire contains statements about practices which could take place in this class. You will be asked how often each practice takes place. There are no **'right' or 'wrong'** answers. Your opinion is what is wanted. Think about how well each statement describes what this class is like for you.

Draw a circle around

1. if the practice takes place	**Almost Never**
2. if the practice takes place	**Seldom**
3. if the practice takes place	**Sometimes**
4. if the practice takes place	**Often**
5. if the practice takes place	**Almost Always**

Be sure to give an answer for all questions. If you change your mine about an answer just cross it out and circle another.

Some statements in this questionnaire are fairly similar to other statements. Don't worry about this. Simply give your opinion about all statements.

University ..... Class .....
Sex .....

	Remember that you are describing your **actual** *classroom*	Almost Never	Seldom	Some-time	Often	Almost Always
1	The instructor considers my feelings.	1	2	3	4	5
2	The instructor is friendly and talks to me.	1	2	3	4	5
3	The instructor goes out of his/her way to help me.	1	2	3	4	5
4	The instructor helps me when I am having trouble with my work.	1	2	3	4	5
5	The instructor moves around the classroom to talk with me.	1	2	3	4	5
6	The instructor is interested in my problems.	1	2	3	4	5
7	The instructor is unfriendly and inconsiderate towards me.	1	2	3	4	5
8	New ideas are seldom tried out in this class.	1	2	3	4	5
9	My instructor uses new and different ways of teaching in this class.	1	2	3	4	5
10	The instructor thinks up innovative activities for me to do.	1	2	3	4	5
11	The teaching approaches used in this class are characterized by innovation and variety.	1	2	3	4	5
12	Seating in this class is arranged in the same way each week.	1	2	3	4	5
13	The instructor often thinks of unusual activities.	1	2	3	4	5
14	I seem to do the same type of activities in every class.	1	2	3	4	5
15	My class is made up of individuals who don't know each other well.	1	2	3	4	5
16	I know most students in this class by their first names.	1	2	3	4	5
17	I make friends easily in this class.	1	2	3	4	5
18	I don't get much of a chance to know my classmates.	1	2	3	4	5
19	It takes me a long time to get to know everybody by his/her first name in this class.	1	2	3	4	5
20	I have the chance to know my classmates well.	1	2	3	4	5
21	I am not very interested in getting to know other students in this class.	1	2	3	4	5

	Remember that you are describing your **actual** *classroom*	Almost Never	Seldom	Some-time	Often	Almost Always
22	I know exactly what has to be done in this class	1	2	3	4	5
23	Getting a certain amount of work done is important in the class	1	2	3	4	5
24	I often get sidetracked in this class instead of sticking to the point.	1	2	3	4	5
25	This class is always disorganised.	1	2	3	4	5
26	Class assignments are clear and I know what to do.	1	2	3	4	5
27	This class seldom starts on time.	1	2	3	4	5
28	Activities in this class are clearly & carefully planned.	1	2	3	4	5
29	I cooperate with other students when doing assignment work.	1	2	3	4	5
30	I share my books and resources with other students when doing assignments.	1	2	3	4	5
31	I work with other students on projects in this class.	1	2	3	4	5
32	I learn from other students in this class.	1	2	3	4	5
33	I work with other students in this class.	1	2	3	4	5
34	I cooperate with other students on class activities.	1	2	3	4	5
35	Students work with me to achieve class goals.	1	2	3	4	5
36	I am expected to do the same work as all the students in the class, in the same way and in the same time.	1	2	3	4	5
37	I am generally allowed to work at my own pace in this class.	1	2	3	4	5
38	I have a say in how class time is spent.	1	2	3	4	5
39	I am allowed to choose activities and how I will work.	1	2	3	4	5
40	Teaching approaches in this class allow me to proceed at my own pace.	1	2	3	4	5
41	I have little opportunity to pursue my particular interests in this class.	1	2	3	4	5
42	My instructor decides what I will do in this class.	1	2	3	4	5
43	The instructor gives as much attention to my questions as to other students questions.	1	2	3	4	5
44	I get the same amount of help from the instructor as do other students.	1	2	3	4	5
45	I am treated the same as other students in this class.	1	2	3	4	5

	Remember that you are describing your **actual** *classroom*	Almost Never	Seldom	Some-time	Often	Almost Always
46	I receive the same encouragement from the instructor as other students do.	1	2	3	4	5
47	I get the same opportunity to answer questions as other students.	1	2	3	4	5
48	My work receives as much praise as other students work.	1	2	3	4	5
49	I have the same amount of say in this class as other students.	1	2	3	4	5

Thank you for your time and cooperation

Appendix B: Student Preferred Form of the CUCEI English version

College and University Classroom Environment Inventory (CUCEI)

Personalised Form

Student Preferred Form

Directions

This questionnaire contains statements about practices which could take place in this class. You will be asked how often each practice takes place. There are no **'right' or 'wrong'** answers. Your opinion is what is wanted. Think about how well each statement describes what this class is like for you.

Draw a circle around

1. if the practice takes place	**Almost Never**
2. if the practice takes place	**Seldom**
3. if the practice takes place	**Sometimes**
4. if the practice takes place	**Often**
5. if the practice takes place	**Almost Always**

Be sure to give an answer for all questions. If you change your mine about an answer just cross it out and circle another.

Some statements in this questionnaire are fairly similar to other statements. Don't worry about this. Simply give your opinion about all statements.

University …….. Class ……
Sex ……

	Remember that you are describing your **preferred** *classroom*	Almost Never	Seldom	Some-time	Often	Almost Always
1	The instructor would consider my feelings.	1	2	3	4	5
2	The instructor would be friendly and talks to me.	1	2	3	4	5
3	The instructor would go out of his/her way to help me.	1	2	3	4	5
4	The instructor would help me when I am having trouble with my work.	1	2	3	4	5
5	The instructor would move around the classroom to talk with me.	1	2	3	4	5
6	The instructor would be interested in my problems.	1	2	3	4	5
7	The instructor would be unfriendly and inconsiderate towards me.	1	2	3	4	5
8	New ideas would be seldom tried out in the class.	1	2	3	4	5
9	My instructor would use new and different ways of teaching in the class.	1	2	3	4	5
10	The instructor would think up innovative activities for me to do.	1	2	3	4	5
11	The teaching approaches used in the class would be characterized by innovation and variety.	1	2	3	4	5
12	Seating in the class would be arranged in the same way each week.	1	2	3	4	5
13	The instructor would often think of unusual activities.	1	2	3	4	5
14	I would do the same type of activities in every class.	1	2	3	4	5
15	My class would be made up of individuals who did not know each other well.	1	2	3	4	5
16	I would know most students in the class by their first names.	1	2	3	4	5
17	I would make friends easily in the class.	1	2	3	4	5
18	I would not get much of a chance to know my classmates.	1	2	3	4	5
19	I would take a long time to get to know everybody by his/her first name in the class.	1	2	3	4	5

	Remember that you are describing your **perferred** *classroom*	Almost Never	Seldom	Some-time	Often	Almost Always
20	I would have the chance to know my classmates well.	1	2	3	4	5
21	I would not be very interested in getting to know other students in the class.	1	2	3	4	5
22	I would know exactly what had to be done in the class	1	2	3	4	5
23	Getting a certain amount of work done would be important in the class	1	2	3	4	5
24	I would often get sidetracked in the class instead of sticking to the point.	1	2	3	4	5
25	The class would be is always disorganized.	1	2	3	4	5
26	Class assignments would be clear and I know what to do.	1	2	3	4	5
27	The would class seldom starts on time.	1	2	3	4	5
28	Activities in this class would be clearly & carefully planned.	1	2	3	4	5
29	I would cooperate with other students in my class when doing assignment work.	1	2	3	4	5
30	I would share my books and resources with other students when doing assignments.	1	2	3	4	5
31	I would work with other students on projects in the class.	1	2	3	4	5
32	I would learn from other students in the class.	1	2	3	4	5
33	I would work with other students in the class.	1	2	3	4	5
34	I would cooperate with other students in my class on class activities.	1	2	3	4	5
35	Students would work with me to achieve class goals.	1	2	3	4	5
36	I would be expected to do the same work as all the students in the class, in the same way and in the same time.	1	2	3	4	5
37	I would generally be allowed to work at my own pace in the class.	1	2	3	4	5
38	I would have a say in how class time is spent.	1	2	3	4	5
39	I would be allowed to choose activities and how I would work.	1	2	3	4	5

	Remember that you are describing your **perferred** *classroom*	Almost Never	Seldom	Some-time	Often	Almost Always
40	Teaching approaches in this class would allow me to proceed at my own place.	1	2	3	4	5
41	I would have little opportunity to pursue my particular interests in the class.	1	2	3	4	5
42	My instructor decides what I would do in this class.	1	2	3	4	5
43	The instructor would give as much attention to my questions as to other students questions.	1	2	3	4	5
44	I would get the same amount of help from the instructor as do other students.	1	2	3	4	5
45	I would be treated the same as other students in the class.	1	2	3	4	5
46	I would receive the same encouragement from the instructor as other students do.	1	2	3	4	5
47	I would get the same opportunity to answer questions as other students do.	1	2	3	4	5
48	My work would receives as much praise as other students work.	1	2	3	4	5
49	I would have the same amount of say in the class as other students.	1	2	3	4	5

Thank you for your time and cooperation

Appendix C: Student Actual Form of the CLEI and ACCC English version

Computer Laboratory Environment Inventory and Attitude towards Computers and Computer Courses Questionnaire (CLEI and ACCC)

Actual Form

Directions

This questionnaire is used to survey student's opinions about the actual computer laboratory environment in your present computer classroom and students' attitudes toward computer and computer course. There are no right or wrong answers. Please provide the responses from your opinions. Your responses will be used in the study to improve future learning environment in a computer classroom and will not affect any of your courses' evaluations. Your academic results used will be kept confidential and will not be used for any other purposes.

How to respond to the survey

Please read each statement describing learning environment and consider if it is like an actual situation in your classroom. Draw a around the number indicating how often the situation occurs in your classroom.

For 1-35
1 Almost never
2 Seldom
3 Sometimes
4 Often
5 Almost always

For 36-63
1 Strongly Disagree
2 Disagree
3 Not sure
4 Agree
5 Strongly Agree

Please give responses to all statements. Don't worry if you find some statements are fairly similar. If you want to make changes to your responses, just cross them out and circle others.

University ..... Class .....
Sex .....

	Remember that you are describing your **Actual** *computer Laboratory*	Almost Never	Seldom	Some-time	Often	Almost Always
1	I get on well with students in this laboratory class.	1	2	3	4	5
2	There is opportunity of me to pursue my own computing interests in this laboratory class.	1	2	3	4	5
3	What I do in the lecture is unrelated to my laboratory work.	1	2	3	4	5
4	The computer software is difficult to use.	1	2	3	4	5
5	I find that the laboratory is crowded when I am using the computer.	1	2	3	4	5
6	I have little chance to get to know other students in this laboratory class.	1	2	3	4	5
7	In this laboratory class, I am required to design my own solutions to a given problem.	1	2	3	4	5
8	The laboratory work is unrelated to the topics that I am studying in my lecture.	1	2	3	4	5
9	The computer software runs without any problems	1	2	3	4	5
10	The laboratory room is readily available.	1	2	3	4	5
11	Members of this laboratory class help me.	1	2	3	4	5
12	In my laboratory sessions, other students produce different solutions than I do for the same problem.	1	2	3	4	5
13	My lecture material is integrated with laboratory activities.	1	2	3	4	5
14	The computers are powerful enough to cope with the demands	1	2	3	4	5
15	Outside my normal laboratory classes, I have to wait if I want to use a terminal or a computer.	1	2	3	4	5
16	I get to know students in this laboratory class well.	1	2	3	4	5
17	I am encouraged to go beyond the regular laboratory exercise and do some investigations of my own.	1	2	3	4	5
18	I use the theory from my lecture sessions during laboratory activities.	1	2	3	4	5

	Remember that you are describing your **Actual** *computer Laboratory*	Almost Never	Seldom	Some-time	Often	Almost Always
19	The computer software available enables students to make good use of the computer	1	2	3	4	5
20	I can gain access to the laboratory outside my normal classes	1	2	3	4	5
21	I am able to depend on other students for help during laboratory classes.	1	2	3	4	5
22	In my laboratory sessions, I solve different problems than some of the other students.	1	2	3	4	5
23	The topics covered in lectures are quite different from topics with which I deal in laboratory sessions.	1	2	3	4	5
24	The computers are in good working condition	1	2	3	4	5
25	There is enough free laboratory time during the week for me to complete all my laboratory work comfortably.	1	2	3	4	5
26	It takes me a long time to get to know everybody by his/her first name in this laboratory class.	1	2	3	4	5
27	In my laboratory sessions, the instructor decides the best way for me to solve a given problem.	1	2	3	4	5
28	What I do in laboratory sessions helps me to understand the theory covered in lectures.	1	2	3	4	5
29	The computers are suitable for running the software I am required to use	1	2	3	4	5
30	It is difficult for me to find a terminal / computer free when I want to use one.	1	2	3	4	5
31	I work cooperatively in laboratory sessions.	1	2	3	4	5
32	I decide the best way to proceed when developing a solution to a problem given in the laboratory class	1	2	3	4	5
33	My laboratory work and lecture material are unrelated.	1	2	3	4	5
34	When I make a mistake, the computer software behaves satisfactorily (i.e. the computer does not 'hang')	1	2	3	4	5
35	There are enough computers / terminals for students to use	1	2	3	4	5

	Remember that you are describing your attitude towards computer and computer course	Strongly Disagree	Disagree	Not sure	agree	Strongly agree
36	I do not think I will ever use what I learned in this class	1	2	3	4	5
37	I feel comfortable when a conversation turns to computers	1	2	3	4	5
38	Studying about computers is a waste of time	1	2	3	4	5
39	It is fun to find out how computer systems work	1	2	3	4	5
40	This class provided me with skills I expect to use in the future	1	2	3	4	5
41	I feel at ease when I am around computers	1	2	3	4	5
42	My future career will require a knowledge of computers	1	2	3	4	5
43	I enjoy using a computer	1	2	3	4	5
44	This class has increased my technical skills	1	2	3	4	5
45	Working with a computer makes me very nervous.	1	2	3	4	5
46	I cannot imagine getting a job that does not involve using computers	1	2	3	4	5
47	I think working with computers would be enjoyable and stimulating	1	2	3	4	5
48	I gained few useful skills from this class	1	2	3	4	5
49	I get a sinking feeling when I think about trying to use a computer	1	2	3	4	5
50	Computers are an important factor in the success of a business.	1	2	3	4	5
51	The challenge of solving problems using a computer does not appeal to me	1	2	3	4	5
52	The skills gained in this class are too specific to be generally useful in the future	1	2	3	4	5
53	Computers make me feel uncomfortable.	1	2	3	4	5
54	The use of computers will increase in my discipline in the future	1	2	3	4	5
55	I would like to work with computers.	1	2	3	4	5

	Remember that you are describing your attitude toward computer and computer course	Strongly Disagree	Disagree	Not sure	agree	Strongly agree
56	This class helped develop my problem – solving skills	1	2	3	4	5
57	Computers make me feel uneasy and confused.	1	2	3	4	5
58	All university students need a course about using computers	1	2	3	4	5
59	I enjoy learning on a computer	1	2	3	4	5
60	As a result of this class I feel confident about tackling unfamiliar problems involving computers	1	2	3	4	5
61	I feel aggressive and hostile towords computers	1	2	3	4	5
62	Knowledge of the use of computers will help me get a job	1	2	3	4	5
63	Learning about computers is boring	1	2	3	4	5

Thank you for your time and cooperation

Appendix D: Student Actual Form of the CUCEI Thai version

แบบสอบถามเรื่องสภาพแวดล้อมที่เป็นจริงในห้องเรียนคอมพิวเตอร์ ระดับอุดมศึกษา

Computer Classroom learning Environment Inventory in Tertiary Level (Actual Form)

คำชี้แจง

1. แบบสอบถามนี้เป็นส่วนหนึ่งของงานวิจัย เรื่องสภาพแวดล้อมในห้องเรียนคอมพิวเตอร์ เจตคติของนักศึกษาต่อการใช้คอมพิวเตอร์และวิชาคอมพิวเตอร์ ข้อมูลจากแบบสอบถามนี้จะเป็นประโยชน์ในการพัฒนาเครื่องมือสำหรับประเมินสภาพแวดล้อมในห้องเรียน ตลอดจนพัฒนาการเรียนการสอนวิชาคอมพิวเตอร์

2. ข้อมูลจากการตอบแบบสอบถามนี้จะไม่มีผลกระทบต่อนักศึกษา อาจารย์ และสถาบัน การรายงานผลจะนำเสนอสรุปเป็นภาพรวมโดยไม่กล่าวถึงชื่อนักศึกษา อาจารย์ และสถาบัน ความเห็นของนักศึกษาแต่ละคนจะเป็นความลับ จึงขอความร่วมมือจากนักศึกษาให้ตอบแบบสอบถามให้ครบทุกข้อตามความเห็นของนักศึกษา เพื่อจะได้ผลที่ตรงตามความเป็นจริง และสามารถนำไปใช้ประโยชน์ได้

3. แบบสอบถามมี 49 ข้อ ให้นักศึกษาวงกลมล้อมรอบตัวเลขจาก 1 — 5 ที่ตรงกับความเห็นของนักศึกษา

5 มากที่สุด

4 มาก

3 ปานกลาง

2 น้อย

1 น้อยที่สุด

ถ้าต้องการเปลี่ยนคำตอบ ให้ทำเครื่องหมายกากบาท X ทับหมายเลขนั้น แล้วเลือกทำเครื่องหมายวงกลมข้ออื่นที่คิดว่าดีกว่า นักศึกษาไม่ต้องกังวลเรื่องคำถามบางข้อที่มีลักษณะที่คล้ายคลึงกัน ให้ตอบไปตามที่เห็นสมควร

ข้อมูลผู้ตอบแบบสอบถาม รหัสวิชา .....

มหาวิทยาลัย ..... เพศ .....

	โปรดระลึกว่าท่านกำลังบรรยายถึงสภาพแวดล้อมที่<u>เป็นจริง</u>ในห้องเรียนคอมพิวเตอร์	น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
1	อาจารย์คำนึงถึงความรู้สึกของฉัน	1	2	3	4	5
2	อาจารย์เป็นมิตรและพูดคุยกับฉัน	1	2	3	4	5
3	อาจารย์ละจากงานที่กำลังทำอยู่มาช่วยเหลือฉัน	1	2	3	4	5
4	อาจารย์ช่วยเหลือฉันในขณะที่ฉันมีปัญหาในการทำงาน	1	2	3	4	5
5	อาจารย์เดินรอบๆห้องเรียนเพื่อมาสนทนากับฉัน	1	2	3	4	5
6	อาจารย์สนใจปัญหาของฉัน	1	2	3	4	5
7	อาจารย์ไม่เป็นมิตรและไม่คำนึงถึงความรู้สึกของฉัน	1	2	3	4	5
8	แนวคิดใหม่ถูกนำมาทดลองใช้น้อยในห้องเรียนนี้	1	2	3	4	5
9	อาจารย์ของฉันใช้วิธีการสอนใหม่ๆ และหลากหลายในห้องเรียนนี้	1	2	3	4	5
10	อาจารย์คิดหากิจกรรมที่เป็นนวัตกรรมใหม่มาใช้ฉันทำ	1	2	3	4	5
11	วิธีสอนที่ถูกใช้ในห้องเรียนนี้มีลักษณะเป็นนวัตกรรมและมีความหลากหลาย	1	2	3	4	5
12	การจัดที่นั่งในห้องเรียนถูกขัดแบบเดิมเหมือนกันทุกสัปดาห์	1	2	3	4	5
13	อาจารย์คิดหากิจกรรมแปลกๆ มาสอนบ่อยๆ	1	2	3	4	5
14	ฉันรู้สึกเหมือนกับว่าได้ทำกิจกรรมเหมือนๆ เดิมในทุกครั้งที่เรียน	1	2	3	4	5
15	ห้องเรียนของฉันประกอบด้วยนักศึกษาแต่ละคนที่ไม่เคยรู้จักกัน	1	2	3	4	5
16	ฉันรู้จักชื่อนักศึกษาทุกคนในห้องเรียนนี้	1	2	3	4	5
17	ฉันผูกมิตรกับนักศึกษาคนอื่นๆ ได้ง่ายในห้องเรียนนี้	1	2	3	4	5
18	ฉันไม่มีโอกาสมากนักที่จะรู้จักเพื่อนร่วมชั้น	1	2	3	4	5
19	ฉันใช้เวลานานที่จะรู้จักชื่อของทุกคนในห้องเรียนนี้	1	2	3	4	5

	โปรดระลึกว่าท่านกำลังบรรยายถึงสภาพแวดล้อมที่ <u>เป็นจริง</u>ในห้องเรียนคอมพิวเตอร์	น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
20	ฉันได้มีโอกาสรู้จักเพื่อนร่วมชั้นเป็นอย่างดี	1	2	3	4	5
21	ฉันไม่สนใจที่จะเข้าไปรู้จักนักศึกษาคนอื่นๆ ในห้องเรียนนี้	1	2	3	4	5
22	ฉันรู้อย่างชัดเจนว่าจะต้องทำอะไรบ้างในห้องเรียนนี้	1	2	3	4	5
23	ฉันรู้ว่าปริมาณงานที่ทำสำเร็จเป็นเรื่องที่มีความสำคัญในห้องเรียนนี้	1	2	3	4	5
24	ฉันทำงานเบี่ยงเบนไปจากประเด็นหลักที่กำหนดให้ค่อนข้างมาก	1	2	3	4	5
25	ห้องเรียนนี้ไม่มีระบบระเบียบ	1	2	3	4	5
26	งานที่กำหนดในห้องเรียนนี้ชัดเจน และฉันรู้ว่าจะต้องทำอะไรบ้าง	1	2	3	4	5
27	ห้องเรียนเริ่มเรียนไม่ตรงเวลา	1	2	3	4	5
28	กิจกรรมในห้องเรียนนี้ชัดเจนและถูกวางแผนมาเป็นอย่างดี	1	2	3	4	5
29	ฉันร่วมมือกับนักศึกษาคนอื่นๆ ในขณะปฏิบัติงานตามที่ได้รับมอบหมาย	1	2	3	4	5
30	ฉันแบ่งปันหนังสือและอุปกรณ์อื่นๆ กับเพื่อนนักศึกษาในขณะที่ทำงานตามที่อาจารย์มอบหมาย	1	2	3	4	5
31	ฉันทำงานโครงการร่วมกับนักศึกษาคนอื่นๆ ในห้องเรียนนี้	1	2	3	4	5
32	ฉันเรียนรู้จากเพื่อนนักศึกษาคนอื่นๆ ในห้องนี้	1	2	3	4	5
33	ฉันทำงานกับนักศึกษาคนอื่นๆ ในห้องเรียนนี้	1	2	3	4	5
34	ฉันร่วมมือกับนักศึกษาคนอื่นๆ ในการทำกิจกรรม	1	2	3	4	5
35	นักศึกษาคนอื่นๆ ทำงานกับฉันเพื่อบรรลุจุดประสงค์ของวิชานี้	1	2	3	4	5
36	ฉันถูกคาดหวังให้ทำงานชนิดเดียวกันกับนักศึกษาทั้งหมดโดยทำด้วยวิธีเดียวกันและในเวลาเดียวกัน	1	2	3	4	5
37	ฉันได้รับอนุญาตให้ทำงานตามระดับความสามารถของฉันในห้องเรียนนี้	1	2	3	4	5
38	ฉันมีโอกาสเสนอความคิดเห็นว่าควรจะใช้เวลาในการเรียนอย่างไร	1	2	3	4	5

	โปรดระลึกว่าท่านกำลังบรรยายถึงสภาพแวดล้อมที่<u>เป็นจริง</u>ในห้องเรียนคอมพิวเตอร์	น้อยที่สุด	น้อย	ปาน กลาง	มาก	มากที่สุด
39	ฉันได้รับอนุญาตให้เลือกกิจกรรมและเลือกวิธีทำงานในชั้นเรียนนี้	1	2	3	4	5
40	วิธีการสอนในห้องเรียนนี้อนุญาตให้ฉันทำงานต่อเนื่องไปตามความสามารถของฉัน	1	2	3	4	5
41	ฉันมีโอกาสเพียงเล็กน้อยที่จะติดตามความสนใจพิเศษของฉันในห้องเรียนนี้	1	2	3	4	5
42	อาจารย์ของฉันเป็นผู้ตัดสินใจว่าฉันจะทำกิจกรรมใดในห้องเรียนนี้	1	2	3	4	5
43	อาจารย์ให้ความสนใจกับคำถามของฉันมากเท่ากับคำถามของเพื่อนนักศึกษาคนอื่นๆ	1	2	3	4	5
44	ฉันได้รับความช่วยเหลือจากอาจารย์เท่าๆ กับนักศึกษาคนอื่นๆ	1	2	3	4	5
45	ฉันได้รับการปฏิบัติเช่นเดียวกับนักศึกษาคนอื่นๆ ในห้องเรียนนี้	1	2	3	4	5
46	ฉันได้รับการสนับสนุนการให้กำลังใจจากอาจารย์เหมือนกับนักศึกษาคนอื่นๆ	1	2	3	4	5
47	ฉันมีโอกาสตอบคำถามเท่ากับนักศึกษาคนอื่นๆ	1	2	3	4	5
48	งานของฉันได้รับการชมเชยมากเท่าๆ กับงานของนักศึกษาคนอื่นๆ	1	2	3	4	5
49	ฉันได้พูดแสดงความคิดเห็นในห้องเรียนนี้เท่ากับนักศึกษาคนอื่นๆ	1	2	3	4	5

ขอขอบคุณในความร่วมมือตอบแบบสอบถาม

Appendix E: Student Preferred Form of the CUCEI Thai version

แบบสอบถามเรื่องสภาพแวดล้อมที่นักศึกษาปรารถนาในห้องเรียนคอมพิวเตอร์ระดับอุดมศึกษา

Computer Classroom learning Environment Inventory in Tertiary Level (Preferred Form)

คำชี้แจง

1. แบบสอบถามนี้เป็นส่วนหนึ่งของงานวิจัย เรื่องสภาพแวดล้อมในห้องเรียนคอมพิวเตอร์ เจตคติของนักศึกษาต่อการใช้คอมพิวเตอร์และวิชาคอมพิวเตอร์ ข้อมูลจากแบบสอบถามนี้จะเป็นประโยชน์ในการพัฒนาเครื่องมือสำหรับประเมินสภาพแวดล้อมในห้องเรียน ตลอดจนพัฒนาการเรียนการสอนวิชาคอมพิวเตอร์

2. ข้อมูลจากการตอบแบบสอบถามนี้จะไม่มีผลกระทบต่อนักศึกษา อาจารย์ และสถาบัน การรายงานผลจะนำเสนอสรุปเป็นภาพรวมโดยไม่กล่าวถึงชื่อนักศึกษา อาจารย์ และสถาบัน ความเห็นของนักศึกษาแต่ละคนจะเป็นความลับ จึงขอความร่วมมือจากนักศึกษาให้ตอบแบบสอบถามให้ครบทุกข้อตามความเห็นของนักศึกษา เพื่อจะได้ผลที่ตรงตามความเป็นจริง และสามารถนำไปใช้ประโยชน์ได้

3. แบบสอบถามมี 49 ข้อ ให้นักศึกษาวงกลมล้อมรอบตัวเลข จาก 1 — 5 ที่ตรงกับความเห็นของนักศึกษา

5 มากที่สุด

4 มาก

3 ปานกลาง

2 น้อย

1 น้อยที่สุด

ถ้าต้องการเปลี่ยนคำตอบ ให้ทำเครื่องหมายกากบาท X ทับหมายเลขนั้น แล้วเลือกทำเครื่องหมายวงกลมข้ออื่นที่คิดว่าดีกว่า นักศึกษาไม่ต้องกังวลเรื่องคำถามบางข้อที่มีลักษณะที่คล้ายคลึงกัน ให้ตอบไปตามที่เห็นสมควร

ข้อมูลผู้ตอบแบบสอบถาม รหัสวิชา .....

มหาวิทยาลัย ..... เพศ .....

	โปรดระลึกว่าท่านกำลังบรรยายถึงสภาพแวดล้อมที่ <u>ปรารถนา (อยากให้เป็น)</u> ในห้องเรียนคอมพิวเตอร์	น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
1	อาจารย์ควรคำนึงถึงความรู้สึกของฉัน	1	2	3	4	5
2	อาจารย์ควรเป็นมิตรและพูดคุยกับฉัน	1	2	3	4	5
3	อาจารย์ควรละจากงานที่กำลังทำอยู่เพื่อมาช่วยเหลือฉัน	1	2	3	4	5
4	อาจารย์ควรช่วยเหลือฉันในขณะที่ฉันมีปัญหาในการทำงาน	1	2	3	4	5
5	อาจารย์ควรเดินรอบๆห้องเรียนเพื่อมาสนทนากับฉัน	1	2	3	4	5
6	อาจารย์สนใจปัญหาของฉัน	1	2	3	4	5
7	อาจารย์ไม่ควรเป็นมิตรและไม่คำนึงถึงความรู้สึกของฉัน	1	2	3	4	5
8	แนวคิดใหม่ควรถูกนำมาทดลองใช้น้อยในห้องเรียนนี้	1	2	3	4	5
9	อาจารย์ของฉันควรใช้วิธีการสอนใหม่ๆ และหลากหลายในห้องเรียนนี้	1	2	3	4	5
10	อาจารย์ควรคิดหากิจกรรมที่เป็นนวัตกรรมใหม่มาใช้ฉันทำ	1	2	3	4	5
11	วิธีสอนที่ถูกใช้ในห้องเรียนนี้มีควรลักษณะเป็นนวัตกรรมและมีความหลากหลาย	1	2	3	4	5
12	การจัดที่นั่งในห้องเรียนควรถูกจัดแบบเดิมเหมือนกันทุกสัปดาห์	1	2	3	4	5
13	อาจารย์ควรคิดหากิจกรรมแปลกๆ มาสอนบ่อยๆ	1	2	3	4	5
14	ฉันควรรู้สึกเหมือนกับว่าได้ทำกิจกรรมเหมือนๆ เดิมในทุกครั้งที่เรียน	1	2	3	4	5
15	ห้องเรียนของฉันควรประกอบด้วยนักศึกษาแต่ละคนซึ่งไม่เคยรู้จักกัน	1	2	3	4	5
16	ฉันควรรู้จักชื่อนักศึกษาทุกคนในห้องเรียนนี้	1	2	3	4	5
17	ฉันควรผูกมิตรกับนักศึกษาคนอื่นๆ ได้ง่ายในห้องเรียนนี้	1	2	3	4	5

	โปรดระลึกว่าท่านกำลังบรรยายถึงสภาพแวดล้อมที่ <u>ปรารถนา (อยากให้เป็น)</u> ในห้องเรียนคอมพิวเตอร์	น้อยที่สุด	น้อย	ปาน กลาง	มาก	มากที่สุด
18	ฉันไม่ควรมีโอกาสมากนักที่จะรู้จักเพื่อนร่วมชั้น	1	2	3	4	5
19	ฉันควรใช้เวลานานที่จะรู้จักชื่อของทุกคนในห้องเรียนนี้	1	2	3	4	5
20	ฉันควรได้มีโอกาสรู้จักเพื่อนร่วมชั้นเป็นอย่างดี	1	2	3	4	5
21	ฉันไม่ควรสนใจที่จะเข้าไปรู้จักนักศึกษาคนอื่นๆ ในห้องเรียนนี้	1	2	3	4	5
22	ฉันควรรู้อย่างชัดเจนว่าจะต้องทำอะไรบ้างในห้องเรียนนี้	1	2	3	4	5
23	ฉันควรรู้ว่าปริมาณงานที่ทำสำเร็จเป็นเรื่องที่มีความสำคัญในห้องเรียนนี้	1	2	3	4	5
24	ฉันควรทำงานเบี่ยงเบนไปจากประเด็นหลักที่กำหนดให้ค่อนข้างมาก	1	2	3	4	5
25	ห้องเรียนนี้ไม่ควรมีระบบระเบียบ	1	2	3	4	5
26	งานที่กำหนดในห้องเรียนนี้ควรชัดเจน และฉันรู้ควรว่าจะต้องทำอะไรบ้าง	1	2	3	4	5
27	ห้องเรียนไม่ควรเริ่มเรียนตรงเวลา	1	2	3	4	5
28	กิจกรรมในห้องเรียนนี้ควรชัดเจนและถูกวางแผนมาเป็นอย่างดี	1	2	3	4	5
29	ฉันควรร่วมมือกับนักศึกษาคนอื่นๆ ในขณะปฏิบัติงานตามที่ได้รับมอบหมาย	1	2	3	4	5
30	ฉันควรแบ่งปันหนังสือและอุปกรณ์อื่นๆ กับเพื่อนนักศึกษาในขณะที่ทำงานตามที่อาจารย์มอบหมาย	1	2	3	4	5
31	ฉันควรทำงานโครงการร่วมกับนักศึกษาคนอื่นๆ ในห้องเรียนนี้	1	2	3	4	5
32	ฉันควรเรียนรู้จากเพื่อนนักศึกษาคนอื่นๆ ในห้องนี้	1	2	3	4	5
33	ฉันควรทำงานกับนักศึกษาคนอื่นๆ ในห้องเรียนนี้	1	2	3	4	5
34	ฉันควรร่วมมือกับนักศึกษาคนอื่นๆ ในการทำกิจกรรม	1	2	3	4	5
35	นักศึกษาคนอื่นๆ ควรทำงานกับฉันเพื่อบรรลุจุดประสงค์ของวิชานี้	1	2	3	4	5

	โปรดระลึกว่าท่านกำลังบรรยายถึงสภาพแวดล้อมที่ <u>ปรารถนา (อยากให้เป็น)</u> ในห้องเรียนคอมพิวเตอร์	น้อยที่สุด	น้อย	ปาน กลาง	มาก	มากที่สุด
36	ฉันถูกคาดหวังให้ทำงานชนิดเดียวกันกับนักศึกษาทั้งหมดโดยทำด้วยวิธีเดียวกันและในเวลาเดียวกัน	1	2	3	4	5
37	ฉันควรได้รับอนุญาตให้ทำงานตามระดับความสามารถของฉันในห้องเรียนนี้	1	2	3	4	5
38	ฉันควรมีโอกาสเสนอความคิดเห็นว่าควรจะใช้เวลาในการเรียนอย่างไร	1	2	3	4	5
39	ฉันควรได้รับอนุญาตให้เลือกกิจกรรมและเลือกวิธีทำงานในชั้นเรียนนี้	1	2	3	4	5
40	วิธีการสอนในห้องเรียนนี้ควรอนุญาตให้ฉันทำงานต่อเนื่องไปตามความสามารถของฉัน	1	2	3	4	5
41	ฉันควรมีโอกาสเพียงเล็กน้อยที่จะติดตามความสนใจพิเศษของฉันในห้องเรียนนี้	1	2	3	4	5
42	อาจารย์ของฉันควรเป็นผู้ตัดสินใจว่าฉันจะทำกิจกรรมใดในห้องเรียนนี้	1	2	3	4	5
43	อาจารย์ควรให้ความสนใจกับคำถามของฉันมากเท่ากับคำถามของเพื่อนนักศึกษาคนอื่นๆ	1	2	3	4	5
44	ฉันควรได้รับความช่วยเหลือจากอาจารย์เท่าๆ กับนักศึกษาคนอื่นๆ	1	2	3	4	5
45	ฉันควรได้รับการปฏิบัติเช่นเดียวกับนักศึกษาคนอื่นๆ ในห้องเรียนนี้	1	2	3	4	5
46	ฉันควรได้รับการสนับสนุนการให้กำลังใจจากอาจารย์เหมือนกับนักศึกษาคนอื่นๆ	1	2	3	4	5
47	ฉันควรมีโอกาสตอบคำถามเท่ากับนักศึกษาคนอื่นๆ	1	2	3	4	5
48	งานของฉันควรได้รับการชมเชยมากเท่าๆ กับงานของนักศึกษาคนอื่นๆ	1	2	3	4	5
49	ฉันควรได้พูดแสดงความคิดเห็นในห้องเรียนนี้เท่ากับนักศึกษาคนอื่นๆ	1	2	3	4	5

ขอขอบคุณในความร่วมมือตอบแบบสอบถาม

Appendix F: Student Actual Form of the CLEI and ACCC Thai version

Computer Laboratory Environment Inventory and Attitude towards Computers and Computer Courses (CLEI& ACCC) Actual Form

แบบสอบถามความคิดเห็นเกี่ยวกับสภาพแวดล้อมของห้องปฏิบัติการคอมพิวเตอร์และเจตคติของนักศึกษาเกี่ยวกับคอมพิวเตอร์

<u>จุดประสงค์ในการสำรวจ</u>

แบบสอบถามชุดนี้ใช้สำรวจความคิดเห็นของนักศึกษาเกี่ยวกับสภาพแวดล้อมในการเรียนในห้องปฏิบัติการคอมพิวเตอร์ที่นักศึกษาใช้ฝึกปฏิบัติ และเจตคติของนักศึกษาเกี่ยวกับการใช้คอมพิวเตอร์และวิชาคอมพิวเตอร์ที่นักศึกษาเรียน ไม่มีคำตอบข้อใดถูกหรือผิด ความคิดเห็นของท่านจะเป็นประโยชน์ในการพัฒนาห้องปฏิบัติการคอมพิวเตอร์ข้อมูลจากแบบสอบถามจะเป็นความลับและจะนำไปใช้เฉพาะการศึกษาวิจัยเท่านั้น

<u>วิธีการตอบแบบสอบถาม</u>

พิจารณาเลือกข้อความที่นักศึกษาเห็นว่าเป็นสถานการณ์ที่เกิดขึ้นในห้องปฏิบัติการคอมพิวเตอร์และตามความคิดเห็นของนักศึกษา และและเจตคติของนักศึกษาเกี่ยวกับการใช้คอมพิวเตอร์และวิชาคอมพิวเตอร์ที่นักศึกษาเรียน โดยวงกลมรอบตัวเลขจาก 1 – 5

สำหรับข้อ 1-35

5 มากที่สุด

4 มาก

3 ปานกลาง

2 น้อย

1 น้อยที่สุด

สำหรับข้อ 36-63

5 เห็นด้วยอย่างยิ่ง

4 เห็นด้วย

3 ไม่แน่ใจ

2 ไม่เห็นด้วย

1 ไม่เห็นด้วยอย่างยิ่ง

ข้อมูลผู้ตอบแบบสอบถาม รหัสวิชา .....

มหาวิทยาลัย ..... เพศ .....

	สภาพแวดล้อมการเรียนในห้องปฏิบัติการคอมพิวเตอร์	น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
1	ฉันเข้ากับเพื่อนๆ ในห้องปฏิบัติการคอมพิวเตอร์ได้ดี	1	2	3	4	5
2	ฉันมีโอกาสได้ติดตามเรื่องที่ฉันสนใจในห้องปฏิบัติการคอมพิวเตอร์	1	2	3	4	5
3	เรื่องที่ฟังจากการบรรยายไม่สัมพันธ์กับงานในห้องปฏิบัติการคอมพิวเตอร์ของฉัน	1	2	3	4	5
4	Software ยากแก่การใช้	1	2	3	4	5
5	ฉันพบว่าห้องปฏิบัติการคอมพิวเตอร์แน่นไปด้วยผู้คนขณะที่ฉันใช้เครื่องคอมพิวเตอร์	1	2	3	4	5
6	ฉันมีโอกาสเพียงเล็กน้อยที่ได้รู้จักกับนักศึกษาในห้องปฏิบัติการคอมพิวเตอร์	1	2	3	4	5
7	ฉันได้รับหมอบหมายให้ออกแบบการแก้ปัญหาด้วยตนเองในการทำงานที่อาจารย์กำหนดให้	1	2	3	4	5
8	งานในห้องปฏิบัติการไม่สัมพันธ์กับหัวข้อที่อาจารย์บรรยาย	1	2	3	4	5
9	ไม่มีปัญหาในการใช้ Software	1	2	3	4	5
10	ห้องปฏิบัติการพร้อมที่จะใช้ได้อยู่เสมอ	1	2	3	4	5
11	สมาชิกในห้องปฏิบัติการนี้ช่วยเหลือฉัน	1	2	3	4	5
12	นักศึกษาคนอื่นๆมีวิธีการแก้ปัญหาได้หลายรูปแบบมากกว่าฉัน สำหรับปัญหาเดียวกัน	1	2	3	4	5
13	เอกสารประกอบการบรรยายมีการเสนอกิจกรรมต่างๆในห้องปฏิบัติการด้วย	1	2	3	4	5
14	คอมพิวเตอร์มีความสามารถเพียงพอที่จะตอบสนองความต้องการต่างๆ ได้	1	2	3	4	5
15	ในเวลานอกเหนือจากเวลาเรียนในห้องปฏิบัติการคอมพิวเตอร์ ถ้าฉันต้องการใช้คอมพิวเตอร์ ฉันต้องรอ	1	2	3	4	5

	สภาพแวดล้อมการเรียนในห้องปฏิบัติการคอมพิวเตอร์	น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
16	ฉันรู้จักนักศึกษาในห้องปฏิบัติการนี้ดี	1	2	3	4	5
17	ฉันได้รับการสนับสนุนให้ทำแบบฝึกหัดในห้องปฏิบัติการเพิ่มจากปกติและค้นหาด้วยตนเอง	1	2	3	4	5
18	ฉันนำทฤษฎีจากการฟังคำบรรยายมาใช้ในห้องปฏิบัติการคอมพิวเตอร์	1	2	3	4	5
19	มี Software พร้อมที่จะให้นักศึกษาใช้ได้เป็นอย่างดี	1	2	3	4	5
20	ฉันสามารถใช้ห้องปฏิบัติการได้หลังจากช่วงเวลาการเรียน	1	2	3	4	5
21	ฉันสามารถขอความช่วยเหลือจากนักศึกษาคนอื่นๆระหว่างการเรียนในห้องปฏิบัติการ	1	2	3	4	5
22	ขณะทำงานในห้องปฏิบัติการคอมพิวเตอร์ ข้าพเจ้าสามารถแก้ปัญหาได้มากกว่านักศึกษาคนอื่นๆ	1	2	3	4	5
23	หัวข้อในการบรรยายแตกต่างจากหัวข้อที่ฉันต้องปฏิบัติในห้องปฏิบัติการคอมพิวเตอร์	1	2	3	4	5
24	เครื่องคอมพิวเตอร์อยู่ในสภาพที่ใช้งานได้ดี	1	2	3	4	5
25	ห้องปฏิบัติการว่าง ฉันสามารถเข้าไปทำงานได้อย่างสะดวกสบาย	1	2	3	4	5
26	ฉันต้องใช้เวลานานที่จะรู้จักชื่อของทุกคนในห้องปฏิบัติการคอมพิวเตอร์	1	2	3	4	5
27	ในขณะปฏิบัติ อาจารย์ตัดสินใจเลือกวิธีที่ดีที่สุดให้ฉันใช้แก้ปัญหาในการทำงานที่กำหนดให้	1	2	3	4	5
28	งานที่ฉันทำในห้องปฏิบัติการคอมพิวเตอร์ช่วยให้ฉันเข้าใจทฤษฎีจากช่วงที่ฟังการบรรยาย	1	2	3	4	5

	สภาพแวดล้อมการเรียนในห้องปฏิบัติการคอมพิวเตอร์	น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
29	เครื่องคอมพิวเตอร์ที่ใช้เหมาะสมกับ Soft ware	1	2	3	4	5
30	เป็นการยากสำหรับฉันที่จะหาเครื่องคอมพิวเตอร์ว่างในตอนที่ฉันต้องการใช้	1	2	3	4	5
31	ฉันร่วมมือทำงานกับนักศึกษาคนอื่นๆในห้องปฏิบัติการคอมพิวเตอร์	1	2	3	4	5
32	ฉันเลือกวิธีการแก้ปัญหาที่ดีที่สุดในการทำงานที่กำหนดให้ในห้องปฏิบัติการคอมพิวเตอร์	1	2	3	4	5
33	งานในห้องปฏิบัติการคอมพิวเตอร์และเอกสารจากการบรรยายไม่สัมพันธ์กัน	1	2	3	4	5
34	เมื่อฉันทำผิดพลาด Software ของคอมพิวเตอร์ยังปฏิบัติงานได้เป็นที่พอใจเช่น Computer ไม่ hang	1	2	3	4	5
35	มีคอมพิวเตอร์ เพียงพอสำหรับให้นักศึกษาใช้	1	2	3	4	5

	เจตคติของนักศึกษาต่อวิชา คอมพิวเตอร์และการใช้คอมพิวเตอร์	ไม่เห็นด้วยอย่างยิ่ง	ไม่เห็นด้วย	ไม่แน่ใจ	เห็นด้วย	เห็นด้วยอย่างยิ่ง
36	ฉันไม่คิดว่าฉันจะนำสิ่งที่ได้เรียนในห้องปฏิบัติการคอมพิวเตอร์ไปใช้	1	2	3	4	5
37	ฉันรู้สึกสะดวกสบายเมื่อมีการสนทนาเรื่องคอมพิวเตอร์	1	2	3	4	5
38	การศึกษาเรื่องคอมพิวเตอร์เป็นเรื่องเสียเวลา	1	2	3	4	5
39	ฉันรู้สึกสนุกเมื่อรู้ว่าระบบคอมพิวเตอร์ทำงานได้อย่างไร	1	2	3	4	5
40	ชั้นเรียนนี้ช่วยให้ฉันมีทักษะที่ฉันคาดว่าจะใช้ในอนาคต	1	2	3	4	5
41	ฉันรู้สึกปลอดโปร่งใจเมื่ออยู่ใกล้เครื่องคอมพิวเตอร์	1	2	3	4	5
42	อาชีพในอนาคตของฉันจะต้องการใช้ความรู้ทางคอมพิวเตอร์	1	2	3	4	5
43	ฉันสนุกสนานในการใช้คอมพิวเตอร์	1	2	3	4	5
44	ชั้นเรียนนี้ได้เพิ่มทักษะทางเทคนิคให้แก่ฉัน	1	2	3	4	5
45	การทำงานกับเครื่องคอมพิวเตอร์ทำให้ฉันกังวลใจ	1	2	3	4	5
46	ฉันไม่สามารถจินตนาการถึงการได้งานซึ่งจะไม่เกี่ยวข้องกับคอมพิวเตอร์เลย	1	2	3	4	5
47	ฉันคิดว่าการทำงานกับคอมพิวเตอร์จะสนุกสนานและตื่นเต้น	1	2	3	4	5
48	ฉันได้รับทักษะที่เป็นประโยชน์เล็กน้อยจากชั้นเรียนนี้	1	2	3	4	5
49	ฉันเกิดความรู้สึกเบื่อหน่ายเมื่อคิดว่าจะต้องพยายามใช้เครื่องคอมพิวเตอร์	1	2	3	4	5
50	คอมพิวเตอร์เป็นปัจจัยที่สำคัญต่อความสำเร็จทางธุรกิจ	1	2	3	4	5
51	การแก้ปัญหาที่เกิดจากการใช้คอมพิวเตอร์ไม่ใช่เรื่องยุ่งยากสำหรับฉัน	1	2	3	4	5

	เจตคติของนักศึกษาต่อวิชา คอมพิวเตอร์และการใช้คอมพิวเตอร์	ไม่เห็นด้วยอย่างยิ่ง	ไม่เห็นด้วย	ไม่แน่ใจ	เห็นด้วย	เห็นด้วยอย่างยิ่ง
52	ทักษะที่ได้จากชั้นเรียนนี้มีประโยชน์น้อยต่อส่วนรวมในอนาคต	1	2	3	4	5
53	คอมพิวเตอร์ทำให้ฉันยุ่งยากใจ	1	2	3	4	5
54	การใช้คอมพิวเตอร์จะเพิ่มขึ้นในสาขาวิชาของฉันในอนาคต	1	2	3	4	5
55	ฉันอยากจะทำงานกับเครื่องคอมพิวเตอร์	1	2	3	4	5
56	ชั้นเรียนนี้ช่วยพัฒนาทักษะการแก้ปัญหาของฉัน	1	2	3	4	5
57	คอมพิวเตอร์ทำให้ฉันรู้สึกไม่ปลอดโปร่งและสับสน	1	2	3	4	5
58	นักศึกษาในระดับมหาวิทยาลัยทุกคนจำเป็นต้องเรียน course เกี่ยวกับการใช้คอมพิวเตอร์	1	2	3	4	5
59	ฉันสนุกสนานกับการเรียนรู้เรื่องคอมพิวเตอร์	1	2	3	4	5
60	ผลจากการเรียนในชั้นนี้ฉันรู้สึกมั่นใจเกี่ยวกับการแก้ปัญหาที่ไม่คุ้นเคยของคอมพิวเตอร์	1	2	3	4	5
61	ฉันรู้สึกเกลียดคอมพิวเตอร์	1	2	3	4	5
62	ความรู้เรื่องการใช้คอมพิวเตอร์จะช่วยให้ฉันได้งานทำ	1	2	3	4	5
63	การเรียนรู้เกี่ยวกับคอมพิวเตอร์เป็นเรื่องที่น่าเบื่อ	1	2	3	4	5

ขอขอบคุณในความร่วมมือตอบแบบสอบถาม

Appendix G: Letter requesting permission

ที่ ศธ 1528.03/ว.003

สถาบันราชภัฏรำไพพรรณี
อำเภอเมือง จังหวัดจันทบุรี 22000

6 มกราคม 2546

เรื่อง ขอความร่วมมือและขออนุญาตเก็บข้อมูลในสถาบัน

เรียน อธิการบดี

สิ่งที่ส่งมาด้วย แบบสอบถาม จำนวน 1 ชุด

ด้วย นางกนกพร จารึก อาจารย์สถาบันราชภัฏรำไพพรรณี ซึ่งกำลังศึกษาระดับปริญญาเอก สาขา Science Education ตามโครงการความร่วมมือระหว่างสถาบันราชภัฏอุดรธานี กับ Curtin University of Technology ประเทศออสเตรเลีย และกำลังดำเนินการวิจัยประกอบการทำวิทยานิพนธ์เรื่อง "Computer Classroom Learning Environments and students' attitudes towords computing course in Tertiary Institutions in Thailand" โดยใช้กลุ่มตัวอย่างเป็นนักศึกษาสถาบันราชภัฏที่เรียนวิชาเอกคอมพิวเตอร์

เพื่อให้การดำเนินงานวิจัยประกอบการทำวิทยานิพนธ์นี้ ได้ข้อมูลที่ถูกต้องสมบูรณ์ สถาบันฯ จึงขอความร่วมมือจากท่าน อนุญาตให้ นางกนกพร จารึก ประสานกับคณบดีคณะวิทยาศาสตร์ หัวหน้าโปรแกรมคอมพิวเตอร์ อาจารย์ผู้สอนวิชาคอมพิวเตอร์ในภาคเรียนที่ 2/2545 นี้ เพื่อให้ผู้วิจัยแจกแบบสอบถามนักศึกษาชั้นปีที่ 2 ที่เรียนวิชาเอกคอมพิวเตอร์ ในรายวิชาที่มีการฝึกปฏิบัติในห้องปฏิบัติการคอมพิวเตอร์ จำนวน 4 ห้องเรียน และสัมภาษณ์นักศึกษาห้องเรียนละ 2 คน

จึงเรียนมาเพื่อโปรดพิจารณาให้ความอนุเคราะห์ สถาบันหวังเป็นอย่างยิ่งว่าจะได้รับความร่วมมือจากท่านด้วยดี จึงขอขอบพระคุณเป็นอย่างสูงมา ณ โอกาสนี้

ขอแสดงความนับถือ

(ผู้ช่วยศาสตราจารย์สิริชัย ประทีปชาย)
อธิการบดีสถาบันราชภัฏรำไพพรรณี

คณะครุศาสตร์
โทร.(039)313188
โทรสาร.(039)313188