THE EFFECTS OF COMPUTER-ASSISTED INSTRUCTION ON THE ACHIEVEMENTS AND ATTITUDES OF PRIVATE POSTSECONDARY VOCATIONAL-TECHNICAL STUDENTS IN A SUPPLEMENTARY ENGLISH COURSE IN THAILAND

DISSERTATION

Presented to the Graduate Council of the
University of North Texas in Partial
Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

By

Jarunee Maneekul, B.A., M.Ed.
Denton, Texas

May, 1996

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The purpose of the study was to determine the effects of normal instruction supplemented by the computer-assisted instruction English program Grammar Game on achievement and attitude scores of vocational-technical students in Thailand.

The experimental design was a 2 x 2 factorial ANOVA design. One hundred seventy-eight students at the Lanna Polytechnical College in Thailand were randomly selected from the population of 10 classrooms. Four classes were intact groups, with two classes randomly assigned to the experimental groups which received Lecture/CAI and the other two as control groups which received Lecture. The 89 students in each group were divided into high- and low-ability, based on their previous English scores. Subjects received treatment for nine weeks. Pre-test and post-test instruments on achievement and attitude were administered to both groups. The Statistical Analysis System (SAS), and the

General Linear Model (GLM) package computer program yielded the MANOVA results.

Based on data analysis, the findings were as follows: (1) There was a significant difference between the students in a Lecture/CAI English program and the students in a Lecture English program when they were compared simultaneously on the achievement and attitude scores, $F(1, 176) = 18.97$, $p < .05$. (2) There was no significant interaction between the types of teaching methods and levels of ability when achievement was used as the dependent variable, $F(1, 174) = .48$, $p > .05$. (3) There was no significant interaction between the types of teaching methods and levels of ability when attitude was used as the dependent variable, $F(1, 174) = .06$, $p > .05$. The conclusion was that normal instruction supplemented by CAI improved achievement and attitude scores. On the other hand, the effect of two types of methods on achievement remained the same for high- and low-ability students and so did the effect of two types of methods on attitude.

Future research should examine different CAI software packages, CAI within a full year, the effects of ability on achievement and attitude, background knowledge, more levels of independent variables, characteristics of an effective CAI program, and a case study with larger population in Thailand.

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CHAPTER I

INTRODUCTION

Background

Advanced technology has brought revolutionary changes in the society, economy, and education of developing countries. Thailand has recognized the importance of technological change and has established it to suit its local conditions. Thailand is emerging as one of the newly industrialized countries with greater emphasis on service industries (APEID, 1992). To cope with the rapid advance of science and technology, the report of the Thailand Education Reform Committee, established by the cabinet in 1974, suggested that education at the elementary school level should include the learning content necessary for everyday life, emphasizing correct work habits and work experience suitable to a student's age. At the secondary school level, the learning content should emphasize work experience and basic vocational skills related to local needs and community demands so that students can earn their living.

In the 1970s the Ministry of Education in Thailand sought to improve the curriculum of primary and secondary schools, vocational colleges, and teachers' colleges by

conducting research and evaluation. The results showed that, unless academic content rather than vocational skills and activities was strongly emphasized, students could not gain sufficient skills and knowledge to improve their way of life. Therefore, in 1977, the National Education Scheme revised the educational system and stated that vocational education should aim at training the workforce in various levels of skills to meet the needs of each community.

Vocational education at the elementary level is necessary to create good work habits and to apply the lessons and work done at school to daily life. At the secondary education level, vocational education goals are to provide students with job skills and also to prepare them for further studies related to their interests and abilities. In 1981 the Upper Secondary School Curriculum was changed to be the same as the Certificate of Vocational Education Curriculum. There are other optional courses offered outside the schools in order to develop students' work (Suwanaagsorn, 1985). Vocational education in Thailand has been provided to all levels of education concerned with the changes in technology.

Vocational education is concerned with the teaching of job-related skills. Qureshi (1992) indicated that one major objective of vocational education in developing countries was to provide well-defined specialized skills concerned with the social and economic environment.

Because of technology the characteristics of all effective workers in a labor market are changed. As indicated by Tally (1989), the demands of the 21st-century workplace will pose a great challenge to vocational education. Workers in the future will need to have higher order thinking skills, creativity, flexibility, and good communication skills. In a rapidly advancing technology, these thinking and problem-solving abilities, rather than one basic occupational skill, will lead to a successful career. Also, reports on the future workforce have indicated that high school and postsecondary students will require skills such as (a) use of computers and technology; (b) problem-solving, critical thinking, and decision-making; (c) resource management; (d) economics of work and the workplace; (e) applied math, science, social science and communications; (f) career and personal planning; (g) interpersonal relationships; (h) information and data manipulation; and (i) technical skills (Lynch, 1991).

The technological changes brought about by computer technology have had a profound impact on vocational education instruction. All vocational programs need to examine their curricula to integrate microcomputers into the learning process because the use of computers has been shown to enhance the learning process. In the United States, colleges and universities routinely offer microcomputer application workshops that integrate computer

literacy and provide training in the use of various software programs on different hardware platforms, such as the MS-DOS, Macintosh, and Unix-based workstations. The situation is different in Third World countries because of limited computing resources and the lack of preparation to deliver a changing curriculum through the use of technology (Hazari, 1992).

Similarly, in an international survey on computers in education in which 22 countries participated, findings indicated that there is much inequity access to computers. Computers tend to be used as add-ons to the existing curriculum rather than as an integral part of the existing curriculum (Pelgrum & Plomp, 1993). In many countries, computer use is confined to elite schools. This means that only students belonging to affluent families have access to the technology (SEAMEO-RECSAM, 1989).

Computer technology is most commonly used for (a) administrative functions, (b) teaching students about computers, and (c) delivering subject matter content for student instruction. It is in the last area that technology has the potential for making the greatest contribution to educational goals (Young & Knezek, 1989).

Steinberg (1991) defined computer-assisted instruction (CAI) as "computer-presented instruction" that is individualized, interactive, and guided. Instruction is individualized because the computer serves as a tutor for

one individual rather than as an instructor for a group. In addition, CAI is interactive in that it involves two-way communication between a learner and a computer system. Moreover, a CAI lesson guides the student to choose an appropriate lesson based on his or her own ability. Finally, CAI is not a method of instruction; it is instruction presented via computers, as an instructional medium.

The categories of CAI are presented as follows:

> 1. Drill and Practice: to provide repetitive practice for concepts previously taught.
> 2. Tutorials: to introduce new concepts to the students.
> 3. Simulations: to recreate a "real life" situation so that the users may experience a new set of circumstances, make choices, and understand the consequences of these choice.
> 4. Problem-solving exercises: to assist in problems requiring large and complex calculations.
> 5. Demonstrations: to assist in demonstrating difficult concepts such as in math and science, using graphics.
> 6. Programming exercises: to give students an understanding of the capabilities and limitations of the computer. (Rodenstein, 1986, p. 4)

As early as 1972, enough studies had been undertaken to warrant Vinsonhaler and Bass's review of 10 such CAI educational experiences (Vinsonhaler & Bass, 1972). In a comparison of CAI and conventional instruction, the conclusion was that students receiving computer drill and practice instruction gained higher achievement scores than students receiving conventional instruction as measured by standardized tests.

Edwards, Norton, Taylor, Weiss, and Duseldorp (1975) examined 32 CAI studies as a supplement to traditional instruction in various subject matters and grade levels and reported the following:

> 1. Normal instruction supplemented by CAI was more effective than normal instruction alone.
> 2. When CAI was substituted for traditional instruction, no clear advantage of either strategy was apparent.
> 3. Each mode of CAI-drill and practice, tutorial, problem solving, simulation-has been shown to be more effective than traditional instruction in some studies but no more effective in other studies.
> 4. Students took less time to learn through CAI than through other instructional methods.
> 5. Retention of learning may not be as strong through CAI as other methods.
> 6. CAI drill and practice may be relatively more effective for low ability students than for average and above average students. (pp. 147-153)

Fisher (1983) showed the following:

> 1. CAI is effective with low-achieving or high-achieving students.
> 2. CAI is best used as a supplement to regular classroom instruction.
> 3. CAI has been most effective in science, foreign languages, and math.
> 4. The best scheduling patterns are frequent short session versus fewer long sessions spent at the computer.
> 5. Most studies indicate a positive outcome in effective measures: increased attention span, improved attendance, and more active participation by students during this mode of instruction. (p. 82)

The most representative summary statement of later reviews is that CAI results in equal or better achievement in less time and with "more positive students" than traditional instruction, especially with below-average ability students (Bass, Ries & Sharpe, 1986, p. 208).

Kulik, Bangert, and Williams (1983) applied meta-analysis to 51 evaluations of computer-based learning in grades 6 through 12. They discovered the following results:

> 1. Compared to conventional instruction, CAI raised final examination scores .32 standard deviation, or approximately from the 50th to the 63rd percentile.
> 2. Retention on follow-up exams given several months after the completion of instruction favored the CAI classes by .17 standard deviations.
> 3. Student attitudes toward the subject matter, computers, or the quality of instruction were generally very positive in the CAI classes.
> 4. Students using CAI take substantially less time to learn the identified content. (pp. 19-26)

To illustrate the benefits of CAI, Kamil (1987) also stated several major advantages to CAI: instruction can be individualized with regard to rate and content. A curriculum can be developed for each student; given the large number of different alternatives, a computer program can be selected based on student performance. Computer-assisted instruction creates attention and motivation. Computer programs are objective. Finally, some tasks can be done in a few seconds or minutes with a computer. Magidson (1978) indicated that CAI has been used effectively to reduce instructor training time, thus providing individualized learning at the learner's own pace. In addition, Offerman (1983) noted that the use of CAI has been proven to be a great benefit in teaching and reinforcing the basic skills and also that the ability to use a computer is rapidly becoming a basic skill.

Student achievement is enhanced when students are instructed by CAI. Further, it is apparent that traditional instruction, supplemented by CAI, provides a more conducive atmosphere for learning. Taylor (1975) stated that all studies surveyed have shown normal instruction supplemented by CAI to be more effective than normal instruction alone.

Chin, Donn, and Conry (1991) investigated the effects of computer-based tests on the achievement and attitudes of 10-grade science students. Results showed that the mean achievement score was significantly higher for the computer-based group. Dahn (1992) also found significant differences in student achievement and significant interaction effects among three groups of 4th- and 6th-grade students who had access to an Integrated Learning System (ILS), those who had CAI, and those who had access to neither. Pettingell (1991) found that creative students who took training on software for 30 to 40 minutes learned tasks taught by rote better than did analytic students.

Jelden (1980) evaluated students' attitudes toward CAI material for industrial arts and electronics technology. It was found that 94% of the students preferred instruction delivered via computer for learning basic concepts and principles. In addition, Roseboro (1992) used the Computer Attitude Scale to measure pre- and post-instruction attitudes toward computers among 132 students enrolled in

four introductory computer science classes. Significant relationships between pre-instruction attitudes toward computers and locus of control, prior computer experience, and profile characteristics were found. In addition, there were significant relationships between post-instruction computer utilization and prior computer experience, as well as post-instruction attitudes toward computers and locus of control.

Based on research study in achievement and attitude toward CAI, the results provide positive evidence. Schubert (1990) examined achievement and attitude of a CAI project on writing poetry in first grade. Computer-assisted instruction contributed positive attitudes and higher performance. Green (1991) also found that a word processing/bilingual group had significantly higher post-test reading achievement and attitudes toward writing among 48 students in a Mexican-American third grade in San Antonio, Texas, than did the control group. Moreover, Jones (1991) found that writing-to-read instruction had influenced the performance of the low achieving disadvantaged students in the experimental group in both reading achievement and positive attitudes toward reading. Similar findings were found in the study of Holly (1990), which indicated a statistically significant achievement gain between pre-test and post-test scores of sixth-grade students after the program Main Idea was used as the

tutorial CAI lesson for a 30-minute session. The affective evaluation showed that the students enjoyed the program. Kinney (1990) also indicated that measures of achievement and attitude were an effective method for improving pronoun usage and decreasing reference error with fourth-grade students when using Pronoun Balance, a CAI program designed and used to assist in the teaching of rule definition, drill and practice, evaluation, and a culminating game.

In the Third World, several investigations have noted that CAI may result in the improvement of students' achievement and attitudes. Jegede and Okebukola (1992) studied the effective use of computers in schools in Nigeria by using a four-part questionnaire with a total of 29 items. Data were collected from a sample of 200 senior secondary students from the Lagos metropolitan area. The results strongly suggested that the majority of Nigerian students demonstrated that CAI had a significant effect on their attitudes.

Royer, Greene, and Anzalone (1994) examined the impact of CAI developed in the United States on the reading and math performance of students enrolled in schools in Grenada. The results of the study indicated that the impact of CAI instruction was positive over the 3 years of the project. The study also stated that lower ability students benefitted more from CAI instruction than higher ability students.

Balcom (1994) emphasized that computerized English as a second language (ESL) lessons are easily tailored to individual need. Based on a number of studies on CAI in ESL, learners improved their language skills. As indicated by Swan (1992), the Computer-Assisted Grammar of English (CAGE) project involved the implementation and evaluation of Computer-Assisted Language Learning (CALL) for Italian secondary school students of English as a foreign language. The CAGE system provided intensive drill and practice in difficult areas of English grammar and was integrated into the students' regular coursework. The results suggested that the CAGE project had a positive impact on ESL learning.

Further, Hussin (1994) studied the kinds of strategies that ESL learners used when dealing with CALL exercises, the types of CALL exercises and the subject areas that were perceived to be helpful to learners, and the perception of CALL programs. The sample population were ESL students at University Kebangsaan, Malaysia. The results of the study indicated that most learners preferred to study information from a computer. Learners perceived CALL to be helpful when the types of exercises and subject areas matched classroom instruction.

Finally, Jannaronk (1991) studied the interaction between basic knowledge levels and reinforcement rates in CAI affecting the learning of English by Mathayom Suksa I

students. The learning achievement of the students in different basic knowledge levels and the effects of different reinforcement rates upon the students' learning achievements were also included. The findings were as follows:

> 1. There was non-interaction between basic knowledge levels and reinforcement rates in CAI program affecting achievement on learning English of Mathayom Suksa I students at 0.05 level of significance.
> 2. There were significant differences between high basic knowledge students and low basic knowledge students on English learning achievement at 0.05 level of significance.
> 3. There were non-significant differences between fixed-ratio and variables-ratio reinforcement schedule in CAI at 0.05 level of significance. (pp. 29-30)

Most studies were conducted at the elementary and secondary levels. Few studies, in fact, have examined the role of CAI in postsecondary vocational education and training programs (Rodenstein, 1986). Because the use of computers in language instruction is a relatively new phenomenon, it should be noted that there is limited research in the area of the use of CAI in ESL learning in developing countries.

Burgos (1991) compared the word processing achievement and attitudes toward computers of students taught by the teacher-directed method with those of a similar group taught by the individual self-paced method at the postsecondary level in Puerto Rico. A significant interaction effect was found between method of instruction and locus of control in attitude change toward computers.

However, no significant interaction was found between method of instruction and locus to affect word processing achievement.

Liu (1992) investigated whether hypermedia-assisted language instruction had any effect on improving vocabulary learning among ESL students. Sixty-three non-native English college students participated in the study. The results indicated that the achievement increased significantly from pre-treatment to post-treatment. Students' anxiety was reduced, and their attitudes improved significantly.

Al-Juhani (1991) examined the effectiveness of CAI in teaching English as a foreign language in Saudi secondary schools. The findings were that teachers with previous CAI training showed higher positive attitudes toward learning English as a foreign language via computer instruction than those with no CAI training. The experimental group had a higher significance in achievement than of the control group. The computer-assisted instruction in EFL improved the students' achievement scores and teachers' attitudes.

Statement of the Problem

The problem of this study was to determine the effectiveness of the lecture technique when supplemented by CAI English program Grammar Game for private vocational-technical postcondary students at the Lanna Polytechnical

College, Chiang Mai, Thailand. Because this type of study was never conducted before in Thailand, a significant data base will be necessary for making decisions to use Lecture and/or CAI in colleges in Thailand to improve students' achievement and attitude scores.

Purpose of the Study

The purpose of this study was to determine the effects of normal instruction supplemented by the computer-assisted instruction English program grammar Game on achievement and attitude scores of vocational-technical students in Chaing Mai, Thailand. To achieve this purpose, normal instruction supplemented by the CAI English program Grammar Games was examined (a) to determine if there would be a difference between the students in a Lecture/CAI English program and the students in a Lecture English program when they were compared simultaneously in achievement scores and attitude scores, (b) to determine if there would be a significant interaction between the types of teaching methods (Lecture/CAI and Lecture) and levels of ability (High and Low) when achievement scores were used as the dependent variable, and (c) to determine if there would be a significant interaction between the types of teaching methods (Lecture/CAI and Lecture) and levels of ability (High and Low) when attitude scores were used as the dependent variable.

Research Hypotheses

The following hypotheses were tested in this study:

1. There will be a difference between the students in a Lecture/CAI English program and the students in a Lecture English program when they are compared simultaneously as to the achievement scores and attitude scores.

2. There will be a significant interaction between the types of teaching methods (Lecture/CAI and Lecture) and the levels of ability (High and Low) when achievement is used as the dependent variable.

3. There will be a significant interaction between the types of teaching methods (Lecture/CAI and Lecture) and levels of ability (High and Low) when attitude is used as the dependent variable.

Significance of the Study

The increase of computer use in schools in Thailand is for management rather than for instruction (APEID, 1985). More schools have computers for administrative uses than for instructional uses. According to Thayanyon (as cited in Talisayon, 1991) computer education at the school level should focus on computer literacy and appreciation, rather than on learning programming skills.

Few studies have been conducted in Thailand on the effectiveness of computer use in college. No research has been completed to date regarding the achievement and

attitudes of students toward computer use in education in Thailand. The findings of this study will have implications for the development of computer use in education offered at vocational-technical colleges in Thailand.

This study was an experimental study on postsecondary students who were taking supplementary English courses at the Lanna Polytechnical College, Chiang Mai, Thailand. Its primary purpose was to determine students' scores and attitudes toward computer use in supplementary English courses. An English lecture supplement by CAI was used as a treatment for experimental groups and an English lecture only was used as a method for control groups.

Delimitation

The scope of this study was limited to students enrolled in the supplementary English course during the first semester (June-September 1995) of the academic year. In the study, achievement scores and attitudes toward computer use in the supplementary English course in only the Lanna Polytechnical College in Chiang Mai, Thailand, were conducted.

Limitations

This study provided information for a specific population. Broad generalization will be possible only regarding students in a similar college environment.

Definition of Terms

Students with high-ability: students whose scores in a previous English course were within the range of 80 to 96.

Achievement: pre-test and post-test scores in the Grammar Test written by the researcher.

Attitudes: pre-test and post-test scores in computer anxiety, computer liking, computer confidence indicating favorable or unfavorable responses measured by the Computer Attitude Scale.

Students with low-ability: students whose scores in a previous English course were within the range of 50 to 80.

Classroom lecture: an instructional method including teacher-directed activities, textbooks, paper-pencil tasks, and other techniques.

Computer-Assisted Language Learning (CALL): the use of computers for delivery of subject matter.

Computer-Assisted Learning (CAL): the use of computers for delivery of subject matter.

Computer-Assisted Instruction (CAI): the use of computers for delivery of subject matter.

Computer-Based Education (CBE): the use of computers for delivery of subject matter.

English as a Second Language (ESL): a program to teach English to students whose first language was one other than English.

Postsecondary students: vocational-technical students in the Lanna Polytechnical College, Chiang Mai, Thailand.

Supplementary English: supplementary English course arranged for students two periods per week in the first semester of the academic year. The evaluation is either to pass or to fail.

CHAPTER II

LITERATURE REVIEW

This chapter presents a review of the literature relevant to this study. It includes the following major areas: (a) computer-assisted instruction, (b) achievement, (c) attitudes, (d) computers in Thailand, (e) computer-assisted instruction in Thailand, and (f) computers in the Lanna Polytechnical College. The chapter focus is on the evolution and recent developments of computers in education generally and on the effectiveness of the use of CAI specifically, with a summary of relevant research studies.

Computer-Assisted Instruction

The principles of CAI began in the 1920s when Sidney Pressey developed the teaching machine, which he designed both as a device for testing and as an aid to classroom instruction. But the machine was neglected during the 1930s and 1940s. In the early 1950s, B. F. Skinner's notions of programmed instruction and teaching machines caused interest. Programs were not carried through, however, because of high costs, unreliable equipment, and inflexibility (Luskin, 1972).

Computer-assisted instruction was developed during the 1960s in university centers such as Stanford University,

the University of Illinois, the University of Dartmouth, the University of Iowa, and Florida State University as well as in school districts of the Chicago City Schools Project (White & Hubbard, 1988). In the 1970s three major changes in educational computing occurred. The first was the development and marketing of the minicomputer. The reduced costs associated with the minicomputer allowed some universities and public schools to purchase systems. The second major change was the invention of the small, inexpensive, and powerful microcomputer, which schools purchased for use in education. The third major change in educational computing was the increase in the amount and variety of software cause by the demand for educational software. Today there is a need for more and better CAI materials that both incorporate proven learning principles and increase the maximum advantage of the capabilities of computers (Price, 1991).

Computer-assisted instruction is defined by Chambers and Sprecher (1983) as the use of a computer to provide course content instruction in the form of drill and practice, tutorials, and simulations. Drill and practice, a common CAI form for repetition, emphasizes rote memory. Tutorials present a question-and-answer format and also provide a new concept of learning.

Simulations provide a model in which the student plays a role and interacts with the computer in order to

illustrate concepts and to develop problem solving. Games are included under the simulation category. The three categories--drill and practice, tutorials, and simulations--are known in the United States as computer-assisted instruction (CAI), computer-based instruction (CBI), or computer-based education (CBE). In Europe and elsewhere, these activities are referred to as computer-assisted learning (CAL). Therefore, the term CAI is synonymous with all of these terms.

Poirot (1980) defined CAI as the use of computers in teaching. It does not involve teaching about computers but, rather, using computers as an aid in the classroom instruction of a particular course. As noted above, there are three types of CAI: drill and practice, simulation, and tutorial. In drill and practice, a teacher presents to a student a concept that can be best understood and retained by repetitive practice. In simulation, a simulated form using computers is displayed because it cannot be observed in actuality. Computer-assisted instruction in tutorials present material to the student and then ask him/her to answer questions.

In the study of Price (1991) which emphasized on the categories of CAI, CAI was divided into five categories which are drill programs, page turners, tutorial programs, simulations, and educational games. White and Hubbard (1991) also suggested that there are four categories of CAI

which are drill and practice, tutorial instruction, simulation, and problem solving.

Differences between CAI and traditional modes of instruction are generally stated. Steinberg (1984) presented the difference between CAI and classroom instruction in terms of five characteristics of CAI, which include human-machine instruction, self-pace learning, record-keeping opportunities, advanced planning required, and development time required.

1. Computer-assisted instruction is human-machine interaction. A student interacts with a machine rather than with another human being so that he/she learns to answer in privacy. Therefore, CAI is an individual activity where the student can see but not hear: CAI directions are presented visually. In contrast, in the classroom, students fail to respond to the question because they feel embarrassed about making mistakes, and they can receive information both aurally and visually.

2. Computer-assisted instruction is individually paced. Each student can study with an appropriate level of difficulty and continue the lesson at his or her appropriate pace. A fast learner can learn without wasting time for repetition of material already learned. On the other hand, traditional classroom instruction is group-paced; slow learners have to study a lesson with the rest of the class although they are not ready.

3. Computer-assisted instruction provides record-keeping opportunities. Data are used to evaluate the lesson as it is being developed and also to manage the student's instructional path. Specific feedback is provided to incorrect responses. In traditional instruction, however, tests, homework, and classroom worksheets provide the evaluation data.

4. Computer-assisted instruction requires advanced planning. Inexperienced authors work individually with experienced persons who encourage and advise the beginner in developing a new instructional approach.

5. Development time is the fifth characteristics because CAI involves producing the lesson, graphics, and computer programming. Consequently, generating a lesson takes a certain amount of time, depending on the complexity of the lesson.

Pelgrum and Plomp (1993) showed that educational tool software (drill/practice, tutorial, and educational games) as well as general purpose programs (word processing and database programs) were in the top 10 available types of software in all populations. In elementary education, drill/practice and educational games were at the top. In secondary education, general purpose and programming languages were at the top.

Several good educational computer uses that are not included in CAI are word processors, database programs,

spread sheet programs, desktop publishing and graphics programs, and writing original programs. These computer tools differ from the use of the computer as a medium of instruction. In CAI, the computer serves as the teacher or tutor to drill, provide practice, or simulate a real-life experience (Price, 1991).

Finally, Steinberg (1991) indicated that CAI is the use of the computer as a medium of instruction. The forms of CAI are classified as drill-and-practice, tutorial, problem solving, or simulation. Educational games are often considered to be a type of simulation. Computer-assisted instruction is self-pacing; it provides active learning, a variety of texts and responses, record keeping, flexibility for learners, and timeliness.

Feldmann and Fish (1991) stated that there is a considerable interest in using microcomputers as a supplemental medium for classroom learning and instruction. Traditional instruction has been delivered primarily through printed materials, such as books, and through the oral exchange between teachers and students. Like traditional instruction, microcomputer programs may also be individualized and interactive, but they have the added benefit of giving the learner greater independence from teacher direction.

The general advantages and limitations of CAI were reviewed by several researchers. Computer-assisted

instruction has demonstrated its potential for education. Compared with traditional school instruction, CAI showed gains over traditional learning by approximately 10 percent. However, the greatest gains were reported when teachers and computers were used together (Atkinson, 1984). Lillie, Hannum, and Stuck (1989) conducted an educational survey of teachers and principals on the instructional use of computers in the United States. This survey revealed that the use of computers has had a significant impact on instruction in four main areas, including (a) increased student motivation, (b) increased student cooperation and independence, (c) increased learning opportunities for high-ability students, and (d) increased opportunities for low-ability students to master basic skills.

In the study of Price (1991), other aspects of learning or instruction affected by the increased use of computers are also included as the six following benefits:

1. Computers help the development of logic, reasoning, and problem-solving competence.

2. Computers help students who have learning handicaps, such as learning disabled students, Chapter I low-income students, and limited-English-speaking students.

3. Computers help below-average students needing remediation.

4. Computers help advanced students.

5. Computers have value for mathematics.

6. Computers help improve self-confidence, provide a sense of accomplishment, and overcome computer anxiety.

Poirot (1980) also stated several advantages of CAI over the conventional classroom. First, with CAI, classroom teaching is student-centered, and the computer adapts its pace to that of the student. The slow student can ask for repetition without embarrassment. The student cannot go ahead without a true understanding of the lesson because the program examines the level of understanding. Second, the computer can free the teacher from certain tedious chores, allowing more time for personal interaction with students. Similarly, Mevarech and Rich (1985) stated that the positive effect of CAI appeared to be the partial release of the teacher from the role of constantly pressuring students to master subject matter content. Students participating in CAI had a higher self-concept concerning their achievements than students exposed to the same material in a traditional setting. In other words, CAI enhanced students' self-esteem (Robertson, Ladewig, Strickland, & Boschung, 1987).

Chambers and Sprecher (1983) noted that CAI satisfies many of the theories of learning. It involves the individual actively in the learning process, which facilitates learning. It also permits the learner to proceed at his or her own pace. Finally, reinforcement of learning in CAI is immediate and systemized.

Along with the unique advantages of CAI, Chambers and Sprecher (1983) included the requirements which, if not met, can limit the effectiveness of CAI as an educational tool. The first requirement is that the course material be carefully prepared by persons knowledgeable in the area of the subject matter's content, computer technology, learning theory, and motivation of the students involved. The second is that the materials should be used in a setting in which teachers provide academic and personal support. Finally, CAI must be inexpensive in order to be successfully used in education. Price (1991) stated that the limitations of CAI include (a) lack of human qualities, (b) restricted text displays, (c) cost, (d) correlation to the curriculum, and (e) lack of software.

Results of formal studies indicated the effectiveness of CAI in improving learning achievement and in affecting positive attitudes of students toward the use of the CAI. The findings of all relevant studies presented below are categorized by the content of the finding.

Achievement

Based on the study of the effect of CAI on achievement, most studies showed that the use of CAI either improved learning or showed no difference when compared to the traditional classroom approach (Alderman, 1978; Burns & Bozeman, 1981; Gershman & Sakamoto, 1981; Levien, 1972;

Murphy & Appel, 1977; Paden, Dalegarrd, & Barr, 1977; Splittgerber, 1979; Taylor, 1975).

Numerous studies have been conducted to assess the effectiveness of CAI. Tutunis (1991) conducted qualitative research on the relationship of computers to teacher training and teaching English to speakers of other languages (TESOL). Subjects were students from teacher training institutions, private language schools, and state secondary schools. The outcomes were as follows:

1. Introduction to computer assisted language learning (CALL) requires special teacher training, but TESOL teachers are not given enough time and financial assistance for self-development. The integration of CALL into TESOL is insignificant.

2. TESOL students enjoy working with computers, but there is no evidence that computers make their learning easier.

3. School managers are not yet interested in CALL.

4. The experts are optimistic about the future of CALL.

In summary of the above results, microcomputers have a subsidiary role in TESOL, and CALL is not integrated into TESOL. Chan (1992) examined the learning environment created by ESL teachers using the micro computers and its impacts on ESL teaching and learning. Data were collected within a 3-month period through various qualitative

research techniques. The results pointed to a need to (a) explicate the context, content, and process of integrating computers into classroom; (b) examine the technological world view to attain a human use of computers in education; (c) define educational goals with questions of why instead of how to; and (d) reconceptualize the ways of education in general and CALL specifically.

Okey (1985) reviewed research related to the effectiveness of CAI during the period from 1970 to 1985. Conclusions drawn from the review reflected positively on the effectiveness of computer based education in promoting learning. Further results indicated that low-ability students and younger children appeared to be positively affected more than high-ability learners and those who were older.

Reinking and Schreiner (1985) investigated the effects of computer-mediated text on measures of reading comprehension and reading behavior. The subjects, 104 fifth- and sixth-grade students, were blocked on the basis of reading ability and then assigned randomly to the four experimental conditions. Each group attended a separate training session led by the experimenter. A three-way mixed-factorial ANOVA was employed to test for differences between means scores. Findings suggested that the comprehension of intermediate-grade good and poor readers was affected by the providing of textual manipulations

mediated by a computer. In another study, Kaufman, Randlett, and Price (1985) found that students with high comprehension scores reported using significantly more strategies when confronted with a comprehension problem than did students with low comprehension scores. This indicated that CAI reading supports were valuable to weak readers when they read more difficult texts, especially if the supports were easily available via computer.

Computer-assisted instruction is an effective supplement to traditional instruction. According to the research findings of the National School Public Relations Association (1982), almost every study conducted to determine the effect CAI has upon student achievement found that traditional instruction that is supplemented by CAI led to higher achievement than traditional instruction alone.

Kulik and Kulik (1979) discussed a review of five studies at the college level in which traditional instruction was supplemented by CAI. They reported that two of the studies revealed superior performance by students receiving CAI supplementary instruction as compared to non-CAI students. The findings were based on students' final examination grades in courses taken. In the other three studies, no significant difference was found between groups in terms of achievement; however, CAI resulted in saving students' time.

Leeds, Davidson, and Gold (1991) determined the performance effects of CAI on developmental composition and mathematics students. Subjects were first-time college freshmen with no computer experience and possessing composite American College Test (ACT) scores of 15 or below. The results, using the California Achievement Test (CAT), indicated that the developmental students' achievement levels for the CAI group were equal to or statistically better than for their non-CAI counterparts.

Saracho (1982) conducted a study to investigate the effect of CAI on basic skills achievement of Spanish-speaking migrant children. Results indicated that students who used the CAI program had greater achievement gains than did students who participated in the regular classroom programs.

Nagata (1992) investigated the effect of a type of computer-assisted language instruction (CALI) exercises on students' language achievement and attitudes toward CALI exercise. Thirty-four subjects in the second-year Japanese language course at the University of Pittsburgh participated in the study. The study found a statistically significant difference between the intelligent CALI and traditional CALI groups in the learners' achievement on the target structures, favoring the intelligent CALI group.

Ewing (1984) determined the effects of the Chapter I CAI reading/language arts program on the academic

performance of sixth-grade students. The sample included 514 sixth-grade students from the Chapter 1 program with 257 low-achieving students in the experimental group receiving reading and language arts instruction through the local educational agency's Chapter 1 program; however, 257 moderate- to high-achieving students in the control group received reading and language art program, which was supplemented via CAI. The non-equivalent control group design was employed to analyze the pre-test/post-test data and to test the hypotheses. The t-test statistical procedure was performed to determine the statistically significant difference existing between the pre-test/post-test scores of the experimental group. Bivariate regression analysis predicted the post-test scores of the experimental group's pre-test scores to the pre-test/post-test scores of the control group. The evidence indicated that CAI had the effect of increasing the overall achievement growth of all Chapter 1 students.

The effectiveness of CAI on ESL has been supported by a number of studies. For example, Diaz-Rico (1992) presented a hypermedia-based skill training simulation to teach ESL teachers to build competency, not only in error detection, but also in error-feedback strategy. A commercial hypermedia authoring program, Authorware Professional, which was a prototype composition error-correction simulation, had been designed. The program design of the

ESL Error Correction was used. Results showed the value of a simulation to teachers.

Emerson (1993) analyzed the computer use of ESL and English as primary language (EPL) in prekindergarten students. This was a qualitative study using the triangulation process to produce grounded theory. Data were collected over a 4-week period through video recordings, subject interviews, parent surveys, and written records. Subject interactions were tabulated according to each category and software use. Results showed that EPL students used teaching/instruction language more and that ESL students used turntaking language more than other language forms. Results also revealed that drill and practice software had more influence on language behavior among ESL and EPL students than did simulation software and that ESL subjects spent less time in the computer center than did EPL students.

Williams (1980) determined whether or not students enrolled in French 102 at the University of Georgia could learn five points of French grammar as effectively through CAI as they could in a conventional class. Chosen by a panel of experts, the five lessons were on reflexive verbs, imperfect tense, indirect object pronouns, y and en, and conditional tense. The results of the study showed that students using CAI materials learned as well as or better than students taught in conventional classes. A student

questionnaire also showed that students overwhelmingly approved of CAI as a teaching medium.

Several studies examined the effects of CAI on vocabulary skill. Ward (1986) compared the effects of CAI and traditional drill and practice on vocabulary and student attitudes toward reading. Results from the study indicated that the group of elementary students receiving the CAI scored significantly higher on vocabulary and exhibited more positive attitudes toward reading than those receiving traditional instruction. Also, CAI taught students the meanings of unfamiliar words. Kolich (1991) focused on the comparative effectiveness of each of the methodologies--the definitional, contextual,and combined or mixed approaches--as they are employed in the design of computer software. Participating in the study were 11th-grade students, who were selected from 14 heterogeneously grouped English classes at a senior high school in rural central Pennsylvania. Students were randomly assigned to one of four treatment groups. Students in the treatment groups were exposed to vocabulary training exercise by means of a software program, Word Attack!, which was created by Davidson Company and presented on an Apple II series microcomputer. The drill and practice program has three major components: word building activities, word lists, and an editor function. The results of the study demonstrated that students who used a modified mixed

approach, that is, one that provided sentence context, definitional or synonym clues, and optional word choices, learned more words than did the students who received definitional information only. The findings also suggested that viable methods can be developed to assess the effectiveness of a vocabulary software program. Moreover, Latham (1990) examined the effect on selected Upward Bound students' vocabulary retention rate and attitude toward computers when using color in a CAI program. Subjects were 71 high school students participating in Upward Bound programs at Texas Christian University and the University of North Texas. A CAI program presented 20 words and definitions via a drill and practice mode. Results revealed a significant difference in long-term memory based on gender and computer experience.

Despite the widespread use of CAI and despite its many positive features, some projects failed to find the effectiveness of CAI compared to the traditional method. Pike (1991) compared the achievement of students in Chapter I schools who did not receive CAI to those who did not receive basic instruction. The study finding did not support the use of CAI for the purpose of increasing students' academic achievement.

Park (1990) compared CAI and self-paced individualized instruction (non-CAI) on reading achievement and changes in attitudes toward the computer. The subjects were 32 adult

students enrolled in an adult basic education program in Northwest Vocational Technical School Adult Education Center in Arkansas during mid-April through mid-November 1989. Both groups required 32 hours of instruction. For the CAI group, one half of the instructional hours were with CAI. The findings indicated that the self-paced individualized instruction was more effective than CAI for improving reading skills. Comparison of change in attitudes toward the computer revealed that no significant difference existed between the two groups. The attitude of CAI students toward CAI become more positive, although it was not statistically significant.

Cordell (1991) determined whether or not learning style affects the outcome of learning. Two hundred subjects were randomly assigned to two CAI design strategies: linear and branching health tutorial. The results showed significant main effects for instructional design, no main effects for learning style, and no effects for interaction of instructional design and learning style.

A study by Cokewood (1980) compared the effectiveness of traditional instruction supplemented by CAI and traditional instruction supplemented by programmed instruction (PI) with the traditional lecture/textbook instruction (TI) approach. The differences in students' achievement by ability level in basic electronics was investigated. Samples were 61 subjects, with two

experimental groups and one control group. The experimental CAI group was given 10 weeks of traditional instruction supplemented by a simulated program. The experimental PI group was given 10 weeks of traditional instruction supplemented by teacher-produced programmed lessons. The TI control group received 10 weeks of traditional lecture/textbook instruction only. Both teacher-produced pre-test and the California Short-Form Test of Mental Maturity were administered to all subjects at the beginning of the study. A quasi-experimental, nonequivalent control group research design was utilized. The findings were that no method was the most effective in enhancing students' achievement in basic electronic problem solving.

Al-Eisa (1993) investigated the effectiveness of learner control over content and over the display of instruction for high-ability and low-ability students in their achievement of reading comprehension from lessons delivered by computer-assisted instruction. Subjects were 152 undergraduate students from the College of Technology in Riyadh, Saudi Arabia. The findings indicated that high-ability students who had control over content, over display instruction, or over both did not gain higher mean scores than high-ability students who did not receive any control.

Gustafson (1982) employed an experimental design approach to examine the effectiveness of a computer-based

learning system in promoting spelling achievement among third- and fourth-grade students. There were no significant differences in spelling growth rates among the ability groups within the program.

Taylor and Rosecrans (1986) investigated the effects of CAI on the vocabulary development of college students. Forty-one subjects were in three intact classes: a control group receiving both only traditional instruction; an experimental group receiving traditional instruction and individualized instruction in CAI class; and an experimental group receiving traditional instruction in class and CAI in a laboratory outside the class structure. All subjects in the experiment used a CAI program. Results of the study revealed that CAI did not improve vocabulary skills among the students.

In a study by Sansom (1988) Wordwork, a CAI program to promote grammar acquisition was used in an ESL class for international students. The experimental group of 10 used Wordwork during a 4-month period, whereas the control group of 10 students did not. Results indicated that Wordwork students did not achieve significantly higher gain in grammar and reading scores than did the control group subjects. Mitchell (1992) found the same results in an investigation on the relationship between the cooperative and individualized computer-based learning environment, auditory and visual learning styles, and academic

achievement of 55 adult ESL students enroll in an intermediate grammar course. There were no significant differences for cooperative versus individualized CAI environment, or between auditory and visual learners. A significant positive correlation was found between students' age and the amount of time required to complete the task. The number of absences and achievement were found to be significantly negatively correlated.

Attitudes

There is considerable evidence to support the notion that students' attitudes are important variables in the teaching and learning process (Zimbardo, 1977). The common finding of studies concerning student attitudes is that students usually develop a more positive attitude toward CAI (Kearsley, Hunter, & Seidel, 1983; Kulik & Cohen, 1980; Magidson, 1978; Splittgerber, 1979; Taylor, 1975).

Several results warrant further discussion. Mathis, Smith, and Hanseng (1970) reported on a study conducted at Florida State University using 64 students randomly selected from a general psychology class. None of the students had experienced CAI prior to the study. The Brown Scale, an instrument for the measurement of expressed attitudes toward CAI; the Hand Scale, used to study attitudes toward the psychology course; and a Semantic Differential Scale, used to assess the students' attitudes

toward the concept of computers, were all utilized to assess students' attitudes. A modified Solomon four-group design was used to assess the effects of the pre-testing on students' post-test attitudes. Results revealed that college students have positive attitudes toward computers. Results also revealed that students making fewer errors on the program had the greatest increase in positive attitudes toward CAI.

The two studies conducted by Smith (1987) examined teachers' and students' efficacy and sex-typing attitudes toward computers in schools from contrasting settings. The first study was an analysis of the computer attitudes of 491 participants (318 students, 173 teachers) in schools that had had an educational computing curriculum for 2 years. The second study assessed attitudes of 421 students and teachers (331 students, 90 teachers) in schools that were in the early stages of computer implementation. Results in both studies showed significant differences in efficacy attitudes by grade level. Sex-typing attitudes were found to be significantly different for males and females in both studies, with females showing stronger feelings for equity in computer use and careers than males did.

Koohang (1989) measured the attitudes toward computers of 81 undergraduate college students participating in three different computer-based education courses in Southern

Illinois University at Carbondale, the College of Education. Four types of attitudes were defined: anxiety, confidence, liking, and perception of usefulness. The Computer Attitude Scale was developed. The instrument was a Likert-type instrument that measured attitudes concerning the usefulness of computers. Seven separate multivariate analyses of variance (MANOVA) were conducted. Post hoc comparisons were conducted for the independent variables of more than two levels. The findings indicated that gender was significant. Male students perceived computers to be more useful than did female students.

Clement (1981) reported that, in general, college students have positive attitudes toward computers. For these students, learning how to use computers was a rewarding and pleasant experience. He explained that students master skills because computers offer many advantages to the educational process, such as informal interaction with students, absence of embarrassment, operation at the student's own pace, problem solving, tutoring, immediate feedback, and absence of subjectivity.

Loyd and Gressard (1984) found that computer experience was significantly related to more positive attitudes about anxiety, confidence, and a liking for computers. The study also focused on the variables of age and gender. According to the researchers, some statistically significant age effects were found.

Hwang (1990) compared the effects of two different types of computer literacy courses on elementary school students' attitudes toward computers in Seoul, Korea. Males showed more positive computer attitudes than female. Students with higher achievement motivation showed more positive computer attitudes than students with lower achievement motivation.

Grogan (1992) examined computer attitude in relation to gender, access to home computer, computer experience, and educational role among 865 students in grades 4, 8, and 12; and teachers and administrators in the Ralston Public Schools, Ralston, Nebraska. The findings, based on the Computer Attitude Scale, were as follows:

1. Students and educators had a positive attitude toward computers.

2. Young students reflected a more positive attitude toward computers than older students.

3. Among the teachers and administrators, no relationship existed between age and computer attitudes.

4. Students and educators displayed significant relationships between computer attitude and home computer access.

5. A significant relationship was shown in computer attitudes and the amount of experience with computers.

6. Gender differences in computer attitudes were not significant.

Marcoulides (1989) showed that the Computer Anxiety Scale (CAS) is an effective and reliable means of measuring students' anxiety toward computers. Computer anxiety has been shown to be a valid predictor of computer achievement in college students taking computer classes.

In a 1990 study, Kernan and Howard suggested that the interaction with the computer, especially over a 12-13 week period, may change one's view of computers. Computer attitude and anxiety scales should be treated as constructs.

Dalton and Hannafin (1988) examined the effects of various mastery-learning teaching methods involving combinations of teacher- and computer-based initial and remedial teaching methods on the accuracy of simple algebraic computations. No attitude differences were found between mastery and conventional instruction, but students receiving computer-based instruction reported more favorable attitudes than those receiving initial instruction from the teacher.

Several studies addressed the negative effects of CAI on attitude. Saracho (1982) found that students who were in non-CAI programs had more favorable attitudes toward CAI than did students in CAI programs. In contrast, Gustafson (1982) found no significant difference in students' attitudes toward spelling. Also, in the study of Pease (1991), the students' heat and temperature concept taught

by computers did not improve their attitudes toward computers.

Computers in Thailand

RECSAM (cited in Talisayon, 1991, p. 121) reported that computer education started in Thailand after the arrival of the first two computers in 1964: an IBM 1620 to Chulalongkorn University and an IBM 1410 to the National Statistical Office. The Ministry of Education in Thailand has no budget support for purchase of microcomputers. According to the Ministry of Education policy on computers in schools, in 1985 two computer education syllabi for upper secondary schools were required. The Ministry's Institute for the Promotion of Teaching Science and Technology designed a 50 minute-course a week. Both courses were optional. The first course, on computer concepts, had to be taken before the second course, on BASIC. In addition, the ministry laid down three criteria for schools offering computer courses: (a) one microcomputer per 3 students, with at least 48 K of memory, keyboard, and monitor, and sufficient disk drives and printers, (b) one trained teacher, (c) 10 students enrolled in each computer course (Hawkrigde, Jaworski, & McMahon, 1991).

Boonme (cited in Cheamnakarin, 1992, p. 28) indicated that the Ministry of Education set three levels of computer

literacy, as in the following: (a) computer appreciation, for students to acquire positive attitudes toward computers, to be familiar with computerized materials, and to develop a background in computers; (b) computer application, for students to be able to use computers as tools for academic and administrative purposes such as word processing, spreadsheet, and database; (c) computer specialization, for students to be able to evaluate the appropriateness and effectiveness of educational software in specific academic and administrative situations, to write programs, and to be aware of potential uses for computers in education and administration.

Watanawaha, Sawetamalya, and Sinatrakool (cited in Hawkridge et al., 1991, pp. 213-214) emphasized that few schools use microcomputers for CAI. Most of the schools with only a few microcomputers use them for administration, management, and record-keeping, but the microcomputers are used for teaching computer studies, rather than for learning with computers.

Computer-Assisted Instruction in Thailand

In many countries, computers were first used in mathematic courses. Later, they were used in science courses, especially in simulating scientific experiments. Today, computers are used as aids in learning other subjects as well. Therefore, the use of computers in

school subjects is a good way to extend computer use in schools in general (Gregorio, 1992).

With the successful use of computers in instruction, researchers in Thailand undertook their own investigations into different kinds of subjects taught in schools, colleges, and universities levels. Regarding the use of computers in rural and urban schools in Thailand, Sukpredee (1988) compared rural and urban students' achievement in Test of Disk (TOAD), Computer-Assisted Instruction as Bilingual Media (CBI), and Computer-Assisted Instruction for Rural Schools (CIR). Sample subjects were 180 students in upper secondary schools in three provinces in the northern region of Thailand. The sample included 90 rural students and 90 urban students. Each group was divided into three subgroups consisting of 30 students, who learned TOAD, CIB, and CIR, respectively. Results have shown that student achievement in the three methods was the same; however, the achievements of rural students and urban students in the three methods differed. The achievements of rural students and urban students were significantly different in TOAD and CBI, but not in CIR. The students' attitudes toward CIR were positive. Administrators' and teachers' attitudes toward CIR were that (a) microcomputers were expensive, (b) teachers should have basic computer knowledge, and (c) CAI should be used. Subjects to be taught by CAI were ranked as follows: mathematics, science,

language, social science, art and music, physical education, and hands-on experience in technical careers. Furthermore, the researcher recommended that the CAI learning material include problems, exercises, content, and graphics and sound.

Several subsequent studies investigated whether or not CAI is effective. Yoshida and Wakui (1994) compared the computer competence of 42 Thai college students with to that of American students. The evidence indicated that the computer competence of inexperienced students was too low-ability. None of the Thai students involved in the study had used computers in their daily life before.

Na-Ubon (1994) also developed computer-assisted instruction for the Pascal language learning program. With the Pascal CAI, the students understood the lesson and developed their own concept of work.

In addition, Ninlakorn (1989) studied the efficiency of the CAI to learn how to use the SPSS/PC$^+$ statistical packages and to learn the opinion of the participants toward this instructional program. The results showed that those participants who received additional instruction through the CAI had higher achievement scores than their pre-test scores, and the set criterion score and they expressed good attitudes toward the CAI.

Wijakkanalan (1987) found the same result in a comparison of the learning achievement in physics of

Matayom Suksa 4 students using the microcomputer programmed tutorial and the conventional tutorial method. The results indicated that the students in the CAI did significantly better than the students in the conventional method. The students' opinions were positive concerning the microcomputer programmed tutorials.

A number of studies have been conducted on the effectiveness of CAI in learning mathematics. Chaijaroen (1987) compared the learning achievement in mathematics of elementary school students using the microcomputer programmed tutorial method and those using conventional tutorial methods. The results indicated that the students using the microcomputer programmed tutorial method performed significantly better than the students who used the conventional tutorial approach, at $p < 0.05$ level. Similarly, students' achievement in CAI with elaborated correction procedures was higher than of those in CAI with basic correction procedures (Kitsubpaibool, 1989).

Moreover, Yindeetakul (1986) found that students with high and low achievement in mathematics, through the use of CAI in the discovery approach and the expository approach, were affected by CAI. For high-achievement students, the discovery approach was superior to the expository approach. On the other hand, for low-achievement students, the result was the opposite. In addition, Tacham (1988) compared the mathematics achievement of students learning CAI with games

and the achievement of those learning CAI without game. The result showed that CAI with games affected students' achievement more than CAI without games.

Several studies examined the effects of CAI in English. Sukawat (1985) conducted research in the effectiveness of CAI in English. Learning achievement on a CAI English article lesson was higher for the introvert personality group than that for the extrovert group. However, CAI had no effect on the comparative learning achievement between males and females. Using CAI in English reading, Kamalyaputra (1986) found that average-level English students performed similarly to students in a non-computer-assisted setting.

Computers in the Lanna Polytechnical College

Vocational education has been one of the priorities of foreign aid to developing countries. Only public institutions have received support, and the purpose of assistance has been to meet urgent manpower needs. According to Qureshi (1992), public authorities should have responsibility for basic education, whereas private sectors should have the main responsibility for vocational education.

In 1979 Chulathep K. established the Lanna Polytechnical College in Chiang Mai, Thailand, as a private vocational technical school in a local area. The

objectives of the school are to develop job skills among Thai students, especially in the northern region of Thailand; to further their education in trade and industrial programs; and to provide educational equity among the rural students.

The school first offered course in automechanics, electronics, and business programs for the first Certificate of Vocational Education. Based on the requirements of Thailand's Ministry of Education, the school now offers the following:

1. Diploma in Technical Education
   Electrical Engineering Technology
2. Diploma of Vocational Education
   Electrical Power Technology
   Auto Technology
   Electronic Technology
3. Certificate of Vocational Education
   Electrical Power Technology
   Auto Technology
   Electronic Technology
   Architectural Techniques

In 1991 the Lanna Polytechnical College was designated as the most outstanding private vocational technical college in Educational Region 8 among all 11 Educational Regions in Thailand. Today, the college is recognized as the largest vocational technical college in the northern

region of Thailand. In addition, the college is involved in the Project School for Excellence, a cooperative project among the Private Vocational Education Department, the Ministry of Education, and the private vocational schools, which are willing to join the project in order to accredit the schools.

In 1994 the college had 2,867 students and 174 faculty members and staff. In 1993 there were 648 students who graduated; 89.85 percent of them have furthered their studies, and 10.2 percent work in the labor market.

The use of computers in the college started with only 12 computers for administration in the college. Now it increases to 40 percent for management and administration, as well as 60 percent for instruction. The objectives of the use of computers in management and administration include classroom planning, text, recordkeeping, scheduling, grading and financial accounting. The objectives of the use of computers for instruction are based on the objectives of computer courses, which are set by the Ministry of Education. The following are four computer courses in the college:

1. Basic Computer focuses on a background of computer, flowchart, and computer language commands.

2. Basic Computer Lab aims at flowchart writing, computer skills, program language, ability to use computer language, and maintenance of the computers.

3. Computer Programming leads the student to study languages (such as BASIC, FORTRAN, and LOGO) and computer graphics.

4. Computer Programming Lab focuses on hands-on experiences in the use of computers and in manipulating available materials such as keyboards, printers, and disk drive. It focuses also on hands-on experiences in basic and high-level language programs; improvement of skills in creating and correcting data files; and use of computer graphics.

A computer lab in the college consists of 15 microcomputers, which are IBM PC compatible with 1 MB memory and 14 VGA MONO monitor. They are stand-alone computers without hard disks. Students take two courses; one is Introduction to Computers, and the other is Basic Programming.

Nevertheless, the computer lab cannot facilitate students' learning because those courses aim toward computer programming rather than computer education. Therefore, as of 1995, there is a new computer lab. The objective is to transfer students' skills in using computers from the classroom to workplace. WORD, LOTUS and DBASE has been taught in the lab. The instruction includes computer's skills.

Wattanawaha (cited in Talisayon, 1991, p. 128) stated that the assistance from computer companies and

associations is usually in the form of training and is at the request of schools. The linkage between companies and schools is mostly a business relationship.

Zebra Computer CO., LTD., established a new computer lab at Lanna Polytechnical College in June 1995. It provides 55 microcomputers, which are IBM 80486 DX2-66 with 1 MB memory, 14 IBM SVGA color monitor, and 4 MB memory. There is an NEC P7300 Printer and an Epson Printer LQ 1170i. The computer lab is supported by the Novell Network System. The new direction of the vocational technical college in the use of computer education will affect students' learning and their future careers.

The supplementary English course focused on the use of English in everyday life. Its primary objective was to improve the students' English language skills in real situations. Upon completing the course, students either passed or failed. No grade was given. This course was for third-year students in the Certificate of Vocational Education program. Instructional materials for the course included videos, songs, movies, and newspapers. Teachers set learning activities. There were 36 periods in 18 weeks, and the students studied this course for two periods a week. A period was 50 minutes.

Computers function as aids for instruction materials. Therefore, the computer can facilitate students in learning many subjects such as science, mathematics, and language.

Summary

The studies in this chapter presented information about computer-assisted instruction, achievement, attitude, computers in Thailand, computer-assisted instruction in Thailand, and computers in the Lanna Polytechnical College. First, in a section of CAI, the development, definitions, characteristics, advantages and limitations of CAI were explained. Second, in a section of achievement, the ESL research studies had shown that the use of CAI either improve or showed no difference when compared to the traditional method. Third, in a section of attitudes, the finding of studies was that students developed a positive attitude toward CAI. Several studies addressed the negative effects of CAI on attitude. Fourth, in a section of computers in Thailand, computers are used for teaching computer studies rather than learning with computers. Fifth, in a section of CAI in Thailand, Thai researchers conducted studies to prove the effectiveness of CAI in English, mathematics, and science. Finally, in a section of computers in the Lanna Polytechnical College, CAI was taught through computer programs (WORD, LOTUS, BASIC, PASCAL, AND LOGO) to train the students to develop their job skills related to the workforce. Computer-assisted instruction is increased in classrooms based on the previous research studies supported different results.

CHAPTER III

METHODOLOGY

This study was designed to investigate the effects of normal instruction supplemented by the CAI English program Grammar Game on the private postsecondary vocational technical students' achievement scores and attitude scores. A classroom lecture supplemented by the CAI English program, Grammar Game was examined by comparing it to a classroom lecture method. Included in this chapter are the study's projected population, sample, research design, experimental material, instrument, procedures, and analysis of data.

The Population

The population for this study was made up of students enrolled in the Lanna Polytechnical College in Chiang Mai, Thailand, in the first semester, starting from June to September of the 1995 academic year. These students were included in the study because in June they were the third-year students in the college's supplementary English course and took their first computer course. The sample population was made up of four intact groups randomly selected from the population of 10 classrooms. The Lanna Polytechnical College offers the supplementary English

course during the first semester. Four classes that were intact groups were selected to participate in the study. Two classes were randomly assigned to the control groups. The other two classes were assigned to the experimental groups. The sample consisted of 178 students; 89 students were in the control groups with 39 low-ability students, and 50 high-ability students. The other 89 students were in the experimental groups with scores below 80 being 39 low-ability students, and of above 80 being 50 high-ability students. The median scores of the previous English course were used to determine the low- and high-ability.

Research Design

A 2 x 2 factorial ANOVA was used in the design with the two independent variables being type of methods and ability. The first variable, type of methods, consisted of two levels (Lecture and Lecture/CAI). The second variable, ability, consisted of two levels (High and Low). There were two main effects and one interaction in testing each dependent variable. Huck (1974) stated that a two-way ANOVA is better procedure than the two separate one-way ANOVA for three reasons. First, the two-way ANOVA answers the same question more quickly and with less computation. Second, it is more powerful when variables are compared. Third, it concerns the interaction between the two independent variables.

		TYPE OF METHOD	
		Lecture	Lecture/CAI
ABILITY	High	N = 50	N = 50
	Low	N = 39	N = 39

Figure 1 A two-way factorial ANOVA design

Experimental Materials

A CAI course in supplementary English took place in a computer laboratory, using 55 IBM microcomputers for the operation of the computer network system. The software, called Grammar Games (Davidson & Associates, 1994), was chosen as a experimental group treatment to study in the class. The required systems for the games are (a) Windows 3.1 or higher, (b) VGA graphics, (c) hard drive with at least 7 MB available spaces, (d) four MB of RAM, (e) sixteen MHz 386 or faster, (f) mouse, (g) printers, and (h) sound cards. Grammar Games, a commercial software in a Windows version produced by Davidson Company, was designed to help students from age 10 to adult develop and improve their grammar skills. The program, based on drill-and-practice, tutorial, and educational games, focused on the most common errors. The contents were punctuation; plurals and possessives; subject-verb agreement; sentence fragments; verb usage; and word usage mistakes.

In the menus, the students selected a level and a game to begin the lesson. The four Grammar Games were represented in the main screen by different signs. Each game had three levels of difficulty. Each sequence contained problems from simple to complex, thus allowing the students to advance. Specific achievement criteria were met, and the students completed the lesson at each level before they moved on. They came back to review the lessons. Progress from one problem level to another was constantly monitored by the computer. Achievement scores were reported at the end of the game.

The four games with different levels in the Grammar Games were as follows:

1. Rain Forest Rescue (Sentence and Fragments)
   - Level 1: The beginning sentence structures
   - Level 2: The intermediate sentence structures
   - Level 3: The advanced sentence structures
2. Falling Fruits (Punctuation)
   - Level 1: Supply missing end punctuation
   - Level 2: Supply missing end punctuation, commas,and semicolons
   - Level 3: Supply missing end punctuation, comma, semicolons, colons, and quotation marks.
3. Hidden Wonders (Verb Usage)
   - Level 1: Correct errors in subject-verb agreement
   - Level 2: Correct errors in verb form

Level 3: Correct errors in subject-verb agreement, verb form, and word usage

4. Jungle Gizmo (Plurals and Possessives)

Level 1: Provide the plural form of a given noun

Level 2: Provide the possessive form of a noun

Level 3: Select the correct form of a given noun in a sentence

With tutorial sections, the students chose help menus and selected a grammar guide to present the contents. Finally, there were five different forms of a 30-question diagnostic test to help the students determine which areas of grammar they needed to study.

Instrument

Achievement Test. At the beginning and at the end of the study, all students took a paper-and-pencil achievement test in English. The Grammar Test was a 40-item test that covered all topics presented in the course. All items were multiple choice. Cronbach's coefficient alpha reliability of internal consistency .76 was gained. All questions were developed based on the previous questions created by the English teachers in the Lanna Polytechnical College and on the content of the software. After the three English teachers had all items to critique, they agreed that all questions were valid.

The Computer Attitude Scale. The Computer Attitude Scale (CAS) was developed at the University of Virginia by Loyd and Gressard (1984). It consisted of 30 items divided into three 10-item subscales: (a) computer anxiety, (b) computer confidence, and (c) computer liking. The items presented were positively and negatively worded statements, such as "Computers make me feel nervous and uncomfortable," or "Computers do not scare me at all." There were 15 positive statements and 15 negative statements, which were the reversed statements in order to eliminate a response set. The scale was a Likert instrument. Students were instructed to strongly disagree, slightly disagree, slightly agree, and strongly agree with a particular statement. Responses were scored on a 4-point scale, with a 4 indicating the most favorable opinion and a 1 indicating the least favorable opinion. Scores ranged from 30 to 120, depending on the weakness or strength of the attitudes. Item responses were coded. All scores on the negative statements were reversed. A higher total scale indicated a more positive attitude toward computers. The coefficient alpha reliability for computer anxiety, computer confidence, computer liking, and the total score were .86, .91, .91, and .95, respectively. Mean scores from the norming group were 30.5 for anxiety, 30.7 for liking, 28.9 for confidence, and 90.1 for total score. Because of the reasonable reliability coefficients of the

three subscales and of the total score based on the three subscales, Loyd and Gressard indicated that they can represent a general attitude toward computers in terms of liking, confidence, and freedom from anxiety. In addition, the CAS was easy and convenient to administer in order to evaluate attitudes toward a computer educational program. For this study, the researcher translated from English into the Thai language to the students. Three English teachers in the college checked to ensure that all Thai translated statements had the same content as those in English. With a pilot study to a group of students in the college the coefficient alpha reliability for the CAS in the Thai version was .91. Administration time for the survey was approximately 10 minutes.

Procedure

For this study, the IRB Institution approved the Human Subjects in Research Form. The college permitted the researcher to include 178 students in the study. Prior to the study, the students were classified as relatively low- and high-ability, based upon the 80th median split of the scores of a previous English course. The scores below 80 were low-ability, and above 80 were high-ability. The highest and lowest scores were 96 and 50 with the range score of 46. The mean scores were 78.81, and standard deviation was 8.94.

The study was conducted for 9 weeks during the first semester of the academic year. Each instructional approach used in this study had two components: Lecture and Lecture supplemented by CAI (Lecture/CAI). Lectures were given to two control groups, and the researcher presented lectures supplemented by CAI to the other two experimental groups. All students signed informed consent forms before they received treatments.

Control and experimental groups were pre-tested on the Grammar Test and the Computer Attitude Scale in mid-June. Post-testing took place in mid-August. Treatment was delivered from the middle of June through August. Post-test scores were analyzed because of a random selection.

Students in the experimental groups were scheduled in the computer lab for approximately 18 sessions over a period from mid-June 1995 to mid-August 1995. Before they used the computers, direct instructions were given to the students in order to prepare them for operation of the computer and the software. The students were given lectures for the first period, and then they practiced CAI individually for the last period. There were two sessions per week for 9 weeks. Each session for the class lasted 50 minutes. The students participated in CAI during the regularly scheduled time for instruction.

In addition to the lectures, the two experimental groups received CAI instruction through use of the software

package Grammar Games. Prior to the supplementary CAI instruction, lectures with the same contents were given to the control groups. The experimental groups were exposed to the Grammar Games for grammar training through the use of computers (one computer per student) for tutorials and drill-and-practice.

However, the control groups studied in the classrooms with pen-and-pencil exercises. All materials presented in the software were printed out for the control groups to study. All control groups received regular classroom instruction in English.

Post-tests for achievement and the CAS were administered to both the experimental groups and the control groups at the last session. The post-tests required 40 minutes to complete, and the CAS test, 10 minutes.

Analysis of Data

Data obtained for the statistical analysis of this study were collected from 178 students. A total of 178 responses was used for analysis purposes. All total scale scores for each student were recorded at the end of pre-test and post-test of both the achievement test and the CAS test. Only the post-test scores were analyzed because the control and experimental groups were randomly assigned to different treatments.

The data were analyzed on a 2 x 2 factorial design by the Statistics Analysis System (SAS) and the General Linear Model (GLM) package computer program. Both multivariate analysis of variance (MANOVA 2 x 2) and univariate analysis of variance were utilized to compare group means in analyzing data.

CHAPTER IV

FINDINGS AND ANALYSIS OF DATA

The purpose of this study was to determine the effects of normal instruction supplemented by the CAI English program on the achievement and the attitude scores of vocational-technical students. This chapter contains statistical and descriptive analyses of those achievement scores and attitude scores. The findings relevant to each hypothesis were presented in order.

Results of Hypothesis Testing

The first null hypothesis stated that there would be no difference between the students in a Lecture/CAI English program and the students in a Lecture English program when they were compared simultaneously on the achievement scores and the attitude scores. The level of significance for testing the hypothesis was set at $p \leq .05$. The Statistical Analysis System (SAS) and General Linear Model (GLM) package computer program were used to calculate the MANOVA.

In the first analysis, data were derived from the type of English program (Lecture vs. Lecture/CAI). Table 1 displays the descriptive statistics of the post-test scores of both control and experimental groups.

Table 1

Means, Standard Deviations, and Sample Sizes of Vocational-Technical Students' Achievement and Attitude Post-test Scores

Variable	Cases	Means	SD
Achievement			
Control	89	18.85	3.91
Experimental	89	21.44	4.38
Attitude			
Control	89	87.19	10.30
Experimental	89	94.19	11.12

The Pearson correlation coefficient between achievement scores and attitude scores was not significant, $r = .099$, $p > .05$. There was a significant difference obtained on the overall MANOVA by Wilk's Lambda = .83, F (2, 175) = 17.42, and $p < .05$. There were differences between the mean scores of the control and the experimental groups when the achievement scores and the attitude scores were compared simultaneously.

As indicated in Table 2, the univariate analysis of variance was performed, with a significant difference between the achievement scores of the control and the

experimental groups at a significant level of .0001, $F(1, 176) = 17.34$, $p < .05$ for the main effect. There were differences in the achievement mean scores between the control and the experimental groups. The mean scores of the control group were 18.85, and of the experimental group, 21.44.

Table 2

Summary Table for ANOVA of Achievement

Source	df	SS	MS	F	Significance
ANOVA					
Achievement					
Between	1	299.78	299.78	17.34	.0001
Within	176	3043.12	17.29		
Total	177	3342.90			

As indicated in Table 3, the univariate analysis of variance was performed, with a significant difference between the attitude scores of the control and the experimental groups at a significant level of .0001, $F(1, 176) = 18.97$, $p < .05$ for the main effect. There were differences in the attitude mean scores between both groups. The mean scores of the control group were 87.19, and of the experimental group, 94.19.

Table 3

Summary Table for ANOVA of Attitude

Source	df	SS	MS	F	Significance
ANOVA					
Attitude					
Between	1	2180.50	2180.50	18.97	.0001
Within	176	20233.50	114.96		
Total	177	22414.00			

The second null hypothesis stated that there would be no significant interaction between the types of teaching methods (Lecture/CAI and Lecture) and levels of ability (High and Low) when achievement was used as the dependent variable. As indicated in Table 4, the univariate test of two-way ANOVA did not yield a significant interaction between method and ability, $F(1, 174) = .48$, $p > .05$. Hypothesis 2 was not supported. The non-interaction was interpreted as evidence that there was no difference between the types of teaching methods across the two levels of ability.

Table 4

Analysis of Variance-Achievement Score

Source	df	SS	MS	F	Significance
Method	1	299.78	299.78	17.96	.0001
Ability	1	131.22	131.22	7.86	.0056
Method*Ability	1	8.04	8.04	.48	.4884

As indicated in Table 5, the mean scores of the control group for the Method x Ability interaction were 17.68 for the low-ability level and 19.80 for the high-ability level. The mean scores of the experimental group for the Method x Ability interaction were 20.72 for the low-ability level and 22.02 for the high-ability level.

Table 5

Achievement: Cell Means of Method x Ability Interaction

	Ability	
	Low	High
Method		
Control	17.64	19.80
Experimental	20.72	22.02

The third null hypothesis stated that there would be no significant interaction between the types of teaching methods (Lecture/CAI and Lecture) and levels of ability (High and Low) when attitude was used as the dependent variable. As indicated in Table 6, the univariate test of two-way ANOVA did not yield a significant interaction between method and ability, $F(1, 174) = .06$, $p > .05$. Hypothesis 3 was not supported. The non-interaction was interpreted that there was no difference between the types of teaching methods across the two levels of ability.

Table 6

Analysis of Variance-Attitude Score

Source	df	SS	MS	F	Significance
Method	1	2180.50	2180.50	19.88	.0001
Ability	1	1144.00	1144.00	10.43	.0015
Method*Ability	1	6.59	6.59	.06	.8066

As indicated in Table 7, the mean scores of the control group for the Method x Ability interaction were 84.10 for the low-ability level and 89.60 for the high-ability level. The mean scores of the experimental group for the Method x Ability interaction were 91.54 for the low-ability level and 96.26 for the high-ability level.

Table 7

Attitude: Cell Means of Method x Ability Interaction

	Ability	
	Low	High
Method		
Control	84.10	89.60
Experimental	91.54	96.26

Summary

Based upon these findings, there was a significant main effect for method when using achievement scores and attitude scores as dependent variables simultaneously, and no significant interaction between method and ability when using achievement scores and attitude scores as dependent variables, respectively. Conclusions and discussion based upon these findings are presented in the final chapter.

CHAPTER V

SUMMARY

Summary of the Study

The purpose of this study was to determine the effects of lecture supplemented by the CAI English program on the achievement and attitude of vocational-technical college students. A total of 178 students at the Lanna Polytechnical College in Thailand were randomly selected from the population of 10 classrooms. Four classes were intact groups with two classes randomly assigned to the experimental groups and the other two as control groups. The 89 students in each group were divided into high- and low-ability, based on their previous English scores.

The 2 x 2 factorial analysis of variance design was selected for this experiment. The independent variables were two methods of teaching (Lecture/CAI vs. Lecture) and two ability levels (High vs. Low). The dependent variables were achievement scores and attitude scores. Grammar Games is a commercial software used as a CAI course as a supplement to the Lecture. The instruments were the 40-item Achievement Test developed by the researcher, with the coefficient alpha of .76, and the 30 items of the Computer Attitude Scale developed by Loyd and Gressard (1984) with

the coefficient alpha of .95. The coefficient alpha reliability for the CAS in the Thai version was .91. Low- and high-ability groups were divided by the median score in the previous English course.

Both experimental and control groups took pre-tests and post-tests in achievement and attitude. There were 18 sessions over a period from mid-June 1995 to mid-August 1995. The control group was taught by Lecture and the experimental group was taught by Lecture supplemented by CAI for two periods a week for 9 weeks. The data were analyzed by the Statistical Analysis System (SAS), and the General Linear Model (GLM) package computer program was used to carry out the MANOVA computations. The following hypotheses were tested:

1. There will be a difference between the students in a Lecture/CAI English program and the students in a Lecture English program when they are compared simultaneously as to achievement scores and attitude scores.

2. There will be a significant interaction be0xeen the types of teaching methods (Lecture/CAI and Lecture) and levels of ability (High and Low) when achievement is used as the dependent variable.

3. There will be a significant interaction between the types of teaching methods (Lecture/CAI and Lecture) and levels of ability (High and Low) when attitude is used as the dependent variable.

The findings resulting from the analysis of statistical data in this study were the following:

1. Significant difference was found in the mean scores of the control and the experimental groups when the achievement scores and the attitude scores were compared simultaneously.

1.1 Significant difference was found in the achievement mean scores of the control and the experimental groups.

1.2 Significant difference was found in the attitude mean scores of the control and the experimental groups.

2. No significant interaction was found between the types of teaching methods and levels of ability when using achievement as the dependent variable.

3. No significant interaction was found between the types of teaching methods and levels of ability when using attitude as the dependent variable.

Conclusions

The conclusions drawn from this study suggest that the Lecture supplemented by CAI can positively affect college students' achievement and attitude. This conclusion is based on the finding that students receiving Lecture/CAI attained greater mean scores on these two variables when compared to non-CAI students. Hypothesis 1 was rejected.

There was no interaction between types of teaching methods and levels of ability when using achievement as the dependent variable. Thus Hypothesis 2 was retained. There was no interaction between types of teaching methods and levels of ability when using attitude as the dependent variable. Thus Hypothesis 3 was retained.

Discussion

The multivariate analysis of variance for achievement and attitude was found to be significant. The Lecture/CAI treatment overall appeared to improve students' achievement and attitude toward the use of computer. The major findings were the dramatic improvement in achievement and attitude scores of students who received the Lecture/CAI course. The Grammar Games software presented the information in an effective and meaningful way when it was used as a supplement to lecture. Students were given a meaningful context and the opportunity for practicing language skills within a single environment. As indicated by the multiple choice questions of the Grammar Test, the students within Lecture/CAI had higher mean scores in the raw data than did the students with Lecture. The finding is consistent with reports of previous research by Chin, Donn and Conry (1991), indicating the effects of a computer-based test on the achievement of students. The mean achievement score was significantly higher for the

computer-based group. Another study supporting this finding is the study of Cartagena (1990) which found that students receiving CAI had shown high achievement.

As with a study involving attitude and two methods of teaching (Lecture/CAI vs. Lecture), the result indicated that the students with Lecture/CAI had a higher attitude toward working with computers than did the students with Lecture. The results supported previous research findings (Bratt, 1986; Gaston, 1988; Grogan, 1992; Hamby, 1986; Kulik, Bangert, & William, 1983; Pease, 1992; Roseboro, 1992) which asserted that the students had positive attitudes toward CAI. No significance was found in the Pearson product-moment correlation coefficient between achievement score and attitude score, $\underline{r} = .099$, $\underline{p} > .05$ indicated that there was a low positive linear relationship between the variables. The finding is consistent with the study of Payne (1993), which indicated no significant difference between the attitude of the two groups regarding method of instruction. The attitude toward method of instruction had no impact on students' achievement. However, computer attitudes did not relate to the achievement scores contradict the notion of Al-Rami (1990) that students' attitudes toward CAI are predictive of their achievement.

Although there was no significant interaction between the methods and ability when achievement was used as the

dependent variable, the cell means in experimental groups with high- and low-ability were higher than those of the control groups with high- and low-ability. The cell mean differences of the achievement between the experimental and control groups were 3.08 for low-ability and 2.22 for high-ability. The data indicate that the effect of the two types of method on achievement was the same across the two levels of ability. The effect of the Lecture/CAI treatment on achievement remained the same for high- and low-ability.

Although there was no significant interaction between the methods and ability when using attitude as the dependent variable, the cell means of the experimental groups with high- and low-ability were higher than those of the control groups with high and low ability. The cell mean differences of the attitude between the experimental and control groups were 7.44 for low-ability and 6.66 for high-ability. The data indicate that the effect of the two types of method on attitude was the same across the two levels of ability. The effect of the Lecture/CAI treatment on attitude remained the same for high- and low-ability. The result was consistent with the study of Avent (1993), which indicated that though the grammar mean score of the computer group was higher than that of the language lab group at every ability level, there was no interaction between type of instruction and ability group. In a comparison of the performances by the same individuals on

two different vocabulary measures, the mean scores were significant higher for computer-taught items than for non-computer taught items. There was no interaction between the type of instruction and the ability group.

The observations suggested that the nonsignificant result may have been due to the following:

1. Mortality. In the study, all classrooms were scheduled to study for an extra two periods per week. All subjects were tired of learning. Some subjects were absent.

2. Instrumentation. The treatment groups using computer-supplemented lecture did not have access to a network immediately because the program did not run smoothly and it wasted time.

3. Experimental treatment diffusion. Because the control and the experimental groups were in the same course in the school, they communicated with one another about the lessons.

4. Hawthorne Effect. The subjects in the experimental group knew that they were in a study; therefore, they performed well.

5. Randomly assigned groups. Classrooms were intact groups. All subjects were given the same treatment. The subjects were not treated as individuals but as members of an intact group. The problem was that each student in the intact groups had different background knowledge.

Implications

This study found significant benefits in achievement and attitude through using Lecture/CAI. As Thailand is a developing country, the use of computers in education shows a positive benefit from using the Lecture/CAI approach in teaching English to vocational students, including changes in attitude toward learning and the skill improvement.

The implications for educators are the following:

1. Using computers in supplementary English results in greater achievement by vocational students. They should also benefit in other basic skill areas such as mathematics, if the material is presented and practiced through the use of computer.

2. The use of computer education for teaching and learning basic job skills and advanced job skills is very important for vocational students. The students have much more positive attitudes toward learning when they realize the importance of using the computer which is essential for their future career.

3. The use of computer education in vocational education schools needs the cooperation of experienced programmers, educators, and professional software producers to train teachers to be able to use computer in teaching and learning, including the development of computer lessons for students.

4. Teachers should explore the potentials of computer-assisted instruction and should seek technical knowledge and training in the operation of technological devices. Teacher educational programs should integrate computer literacy courses in their curricula and should define the teacher's role in the classroom.

5. In the competition of educational investment, if schools can facilitate computer education for students, they can receive much more profit in providing the facility.

Recommendations for Further Research

The following recommendations are offered for future study:

1. This study should be replicated using another CAI software package.

2. This study should be replicated with a full year in the computer-assisted instruction program.

3. Further study should be conducted on the effects of ability on achievement and attitude.

4. Further study should be investigated to learn whether or not background experience and knowledge affects achievement scores.

5. Further study should add more levels of methods and levels of ability in order to increase independent variables in the study.

6. Further research should be conducted to determine the characteristics of an effective CAI program.

7. Further study should be a case study approach to use with a larger population in Thailand.

APPENDIX A

LETTER OF APPLICATION TO CONDUCT RESEARCH

UNT BOX 12789
Denton, TX 76203
U.S.A.

April 1, 1995

Mr. Sommit Thipayamondol
Director
Lanna Polytechnical College
Chiang Mai 50000, Thailand

Dear Mr. Thipayamontol:

Currently, I am a doctoral student at University of North Texas. My dissertation plan is to conduct an experimental study for nine weeks for the purpose of determining the effects of computer-assisted instruction on the achievements and attitudes of private postsecondary vocational-technical students in a supplementary English course.

This letter is written to request permission to utilize the Lanna Polytechnical College as a base for conducting research in the pursuit of a doctoral study at the Department of Technology, Training, and Development in the College of Education at the University of North Texas as part of the requirement for the Doctor of Philosophy. Attached are a copy of the research proposal and an informed consent letter. The program is designed to provide the students opportunity to improve learning skills and attitudes toward computer-assisted instruction.

Approval of this study will be greatly appreciated. Our findings will be made available with reference to college systems only, and all information and data concerning individual students will be confidential.

Sincerely,
Jarunee Maneekul
Jarunee Maneekul
Doctoral Candidate
Applied Technology, Training, and Development

APPENDIX B

LETTER OF APPROVAL TO CONDUCT RESEARCH

Lanna Polytechnical College
137 Moo 4 Superhighway Rd.
Pa-tun District
Chiang Mai 50300 , THAILAND
Tel (053) 213-061 , (053) 210-314
Fax (053) 219-175

April 9, 1995

Miss Jarunee Maneekul
UNT BOX 12789
Denton, TX 76203
U.S.A.

Dear Jarunee:

Your request to conduct the research for your dissertation in the Lanna Polytechnical College is approved. As the system made a large financial commitment with the purchase of the computer lab, I will be interested in the results of your study.

Please let me know if I can be of your assistance.

Sincerely,

Sommit Thipayamondol

Sommit Thipayamondol
Manager of Lanna Polytechnical College

APPENDIX C

INFORM CONSENT FORM

INFORMED CONSENT FORM

NAME OF SUBJECT: _____

I agree to participate in the research entitled "The Effects of Computer-Assisted Instruction on the Achievements and Attitudes of Private Postsecondary Vocational-Technical Students in a Supplementary English Course in Thailand" which is being conducted by Miss Jarunee Maneekul.

The following points have been explained to me:

1. The investigator will be Miss Jarunee Maneekul, a Ph. D. student at University of North Texas. The dissertation will be conducted for nine weeks for the purpose of determining the effects of computer-assisted instruction on the achievements and attitudes of private postsecondary vocational-technical students in a supplementary English course in Thailand. The reason for the research will be to compare the achievements and attitudes of the students with CAI method and without CAI method.

2. The benefits that I may expect from it are:
(a) additional instruction and practice in computer education
(b) assessment of my ability to learn English
(c) a score on a test concerning a supplementary English course which will count as 40 percent of my course grade.

3. The procedures are as follows:
(a) students should sign a consent form before they participate in the research,
(b) a variability length (up to 40 minutes) CAI treatment program will be completed by each student,
(c) at the beginning of the treatment and at the end of the treatment, each student will be asked to complete a questionnaire concerning his attitudes towards computer,
(d) a forty item multiple choice test on English will be administered to all students before and after the treatment,
(e) the investigator requests the use of the test results and attitude scores for the purpose of the study, and
(f) completion of the CAI and the post-test are requirements for a supplementary English course; inclusion of student data (achievement scores and attitude scores) in the study is contingent upon the student signing the consent form.

4. There are no discomforts or stresses expected during this study.

5. No current or potential risks are foreseen as a consequence of participation in this study.

6. The results of this participation will be confidential and will not be released. All attitude tests and achievement tests will be kept in the office of English department of the Lanna Polytechnical College. All information will be given and collected directly by the investigator. All results collected will be compiled into a secured computer file and all of the raw data will be stored in a locked container in the office. To preserve confidentiality, all scores will be recorded in a code number that will allow the investigator to determine my identity. Then all scores will be in the college's records in order to obtain my grade.

7. The investigator will answer any further questions about the research, either now or during the course of the project. If I have any questions or problems connected with my participation in this project, I should contact the investigator at (053)210-314(work) or (053)216-965(home).

I have seen a clear explanation and understand the purpose and procedure or treatment; possible appropriative procedures that would be advantageous to me: and the attendant discomforts or risks involved and the possibility of complications which might arise. I have seen a clear explanation and understand the benefits to be expected as well as the description of confidentiality. I understand that the procedure or treatment to be performed is investigational and that I may withdraw my consent at any time without prejudice or penalty. With my understanding of this, having received this information and satisfactory answers to the questions I have asked, I voluntarily consent to the procedure or treatment designed in the paragraph above.

_____
DATE

_____ _____
Signature of Investigator Signature of Participant

This project has been reviewed and approved by UNT Committee for the Protection of Human Subjects (817) 565-3940.

APPENDIX D

THE GRAMMAR TEST

THE LANNA POLYTECHNICAL COLLEGE

Grammar Test (1 hr.) Semester I, 1995
Supplementary English Course I By Jarunee Maneekul

Direction: There are 40 questions divided into 4 parts; plural & possessive, punctuation, verb usage, and sentence & fragment. Choose the correct answer.

Part 1: Plural & possessive are item 1 to item 10. Choose the correct answer.

1. How many _____ do you have?
   a. child
   b. childs
   c. children
   d. childrens

2. She wants to buy five _____.
   a. flower
   b. flowers
   c. floweres
   d. flower's

3. May I borrow your _____?
   a. pen
   b. pens
   c. pen's
   d. pens'

4. We have thirty-two _____.
   a. tooth
   b. tooths
   c. teeth
   d. teeths

5. Give me two _____, please.
   a. egg
   b. eggs
   c. egg's
   d. egg'

6. This is _____ book.
   a. David's
   b. David
   c. Davids
   d. Davids'

7. This is _____ car.
   a. Sam
   b. Sam's
   c. Sams'
   d. Sams'es

8. Her _____ hands are small.
   a. baby
   b. babys'
   c. baby's
   d. babys's

9. Today is my _____ birthday.
   a. father's
   b. father'
   c. father
   d. fathers

10. A _____ house is beautiful.
    a. Birds
    b. Bird's
    c. Bird'es
    d. Bird

Part 2: Punctuation are from item 11 to item 20. Fill in the blank with the correct punctuation. Mark the correct answer on your answer sheet.

a. .
b. ?
c. !
d. ,

Rosa: I have a new job (11)
Gary: Congratulations (12) How do you like it (13)
Rosa: Oh (14) It's great (15)
Gary: Uh huh (16) I wash cars (17) and I like manual jobs (18)
Rosa: How many hours do you work (19)
Gary: I work four hours (20)

Part 3: Verb usage are from item 21 to item 30.

21. A: Please _____ down.
B: Thank you.
a. sits
b. sit
c. sat
d. sitting

22. A: How did you _____ out about this job?
B: From the advertisement in the Bangkok Post.
a. finds
b. find
c. found
d. finding

23. A: Have you ever worked before?
B: No, sir. I have never had a full-time job but I have _____ for my father.
a. works
b. work
c. worked
d. working

24. A: What have you done for your father?
B: I have helped him to _____ electric appliances.
a. repairs
b. repaired
c. repairing
d. repair

25. A: Good. We need someone to work in Electrical Service. The salary will _____ 2,300 baht a month to start.
B: All right.
a. been
b. be
c. beening
d. being

26. A: Can you _____ on August the first?
B: Yes, I think I can.
a. starts
b. start
c. started
d. starting

27. A: Fine. Welcome to the Thai Construction Company. I _____ you will enjoy working here.
B: Thank you. I'm sure I will.
a. hoped
b. hopes
c. hoping
d. hope

28. A: Good. Please _____ a biodata form.
B: Yes,sir.
a. write
b. wrote
c. writing
d. writes

29. A: Would you _____ it to my secretary?
B: Certainly, sir.
a. gives
b. give
c. gave
d. giving

30. A: _____ you.
B: Good-bye.
a. Sees
b. See
c. Saw
d. Seeing

Part 4: Sentences & fragment are from item 31 to item 40. Choose the correct answer and mark it on your answer sheet.

a. Sentence
b. Phrase
c. Clause
d. All of the above

____ 31. Mangrove trees can live in Salty seawater.
____ 32. Using elephants to collect logs
____ 33. The house which is small
____ 34. Mark showed George the map.
____ 35. Choosing a job
____ 36. A bird is flying.
____ 37. Sunee who is my beautiful wife
____ 38. He goes to school.
____ 39. A van which loaded with heavy equipment
____ 40. The train which carried oil

APPENDIX E

THE COMPUTER ATTITUDE SCALE

แบบทดสอบทัศนคติต่อคอมพิวเตอร์เพื่อการเรียนการสอน

คำสั่ง ให้นักศึกษาวงกลมตัวเลขหลังข้อความ ๓๐ ข้อภายใน ๑๐ นาที

๑ = ไม่เห็นด้วยอย่างยิ่ง ๓ = เห็นด้วย

๒ = ไม่เห็นด้วย ๔ = เห็นด้วยอย่างยิ่ง

๑. คอมพิวเตอร์ไม่น่ากลัวสำหรับฉัน	๑	๒	๓	๔
๒. ฉันไม่เก่งคอมพิวเตอร์	๑	๒	๓	๔
๓. ฉันต้องการทำงานโดยใช้คอมพิวเตอร์	๑	๒	๓	๔
๔. การใช้คอมพิวเตอร์ทำให้ฉันประหม่า	๑	๒	๓	๔
๕. ฉันรู้สึกธรรมดาเมื่อลองแก้ปัญหาใหม่โดยคอมพิวเตอร์	๑	๒	๓	๔
๖. การท้าทายให้แก้ปัญหาด้วยคอมพิวเตอร์ไม่ดึงดูดใจฉันเลย	๑	๒	๓	๔
๗. ฉันไม่กลัวเมื่อคนอื่นคุยเรื่องคอมพิวเตอร์	๑	๒	๓	๔
๘. ฉันคิดว่าตนเองไม่ถนัดงานคอมพิวเตอร์ขั้นสูง	๑	๒	๓	๔
๙. ฉันคิดว่าการทำงานด้วยคอมพิวเตอร์สนุกและเร้าใจ	๑	๒	๓	๔
๑๐ ฉันก้าวร้าวและเกลียดคอมพิวเตอร์	๑	๒	๓	๔
๑๑ ฉันแน่ใจว่าทำงานด้วยคอมพิวเตอร์ได้	๑	๒	๓	๔
๑๒ การแก้ปัญหาด้วยคอมพิวเตอร์ไม่ดึงดูดใจฉัน	๑	๒	๓	๔
๑๓ ฉันไม่รำคาญใจเมื่อเรียนคอมพิวเตอร์	๑	๒	๓	๔
๑๔ ฉันไม่ถนัดใช้คอมพิวเตอร์	๑	๒	๓	๔
๑๕ ฉันพยายามแก้ไขปัญหาด้วยคอมพิวเตอร์จนกระทั่งสำเร็จ	๑	๒	๓	๔
๑๖ ฉันอึดอัดใจกับการใช้คอมพิวเตอร์	๑	๒	๓	๔
๑๗ ฉันแน่ใจว่าเรียนคอมพิวเตอร์ได้	๑	๒	๓	๔
๑๘ ฉันไม่เข้าใจว่าทำไมคนอื่นชอบใช้คอมพิวเตอร์มาก	๑	๒	๓	๔
๑๙ ฉันเรียนคอมพิวเตอร์ได้อย่างสบาย	๑	๒	๓	๔
๒๐ ฉันคิดว่าการใช้คอมพิวเตอร์นั้นยาก	๑	๒	๓	๔
๒๑ เมื่อเริ่มใช้คอมพิวเตอร์ฉันคิดว่ายากที่จะเลิกใช้คอมพิวเตอร์	๑	๒	๓	๔
๒๒ ฉันรู้สึกห่อเหี่ยวเมื่อลองใช้คอมพิวเตอร์	๑	๒	๓	๔
๒๓ ฉันทำคะแนนดีในวิชาคอมพิวเตอร์	๑	๒	๓	๔
๒๔ ฉันทำงานด้วยคอมพิวเตอร์ได้น้อย	๑	๒	๓	๔

พลิกหน้า ๒

๒๕ ฉันรู้สึกสบายเมื่อใช้คอมพิวเตอร์	๑	๒	๓	๔
๒๖ ฉันคิดว่าไม่สามารถเรียนคอมพิวเตอร์ได้	๑	๒	๓	๔
๒๗ ฉันคิดแก้ปัญหาต่อแม้ว่าจะแก้ปัญหาด้วยคอมพิวเตอร์ ไม่ได้ในห้องเรียน	๑	๒	๓	๔
๒๘ คอมพิวเตอร์ทำให้ฉันอึดอัดและสับสน	๑	๒	๓	๔
๒๙ ฉันมั่นใจมากเมื่อใช้คอมพิวเตอร์	๑	๒	๓	๔
๓๐ ฉันไม่มีความสุขเมื่อคุยถึงเรื่องคอมพิวเตอร์กับคนอื่น	๑	๒	๓	๔

ชื่อ .....

เลขที่ .....

ห้องเรียน .....

SURVEY OF ATTITUDES TOWARD THE LEARNING ABOUT AND WORKING WITH COMPUTERS

The purpose of this survey is to gather information concerning student's attitudes toward the learning and working with computers. It should take about ten minutes to complete this survey. All responses are kept confidential. Please return the survey to your instructor when you are finished.

THE COMPUTER ATTITUDE SCALE

Below are a series of statements. There are no correct answers for these statements. They have been set up in a way which permits you to indicate the extent to which you agree or disagree with the ideas expressed. Place a circle to mark each number which is closest to your agreement or disagreement with the statements.

	Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
1. Computers do not scare me at all.	4	3	2	1
2. I'm no good with computers.	4	3	2	1
3. I would like working with computers.	4	3	2	1
4. Working on a computer would make me very nervous.	4	3	2	1
5. Generally I would feel OK about trying a new problem on the computer.	4	3	2	1
6. The challenge of solving problems with computers does not appeal to me.	4	3	2	1
7. I do not feel threatened when others talk about computers.	4	3	2	1
8. I don't think I would do advanced computer work.	4	3	2	1
9. I think working with computers would be enjoyable and stimulating.	4	3	2	1
10. I feel aggressive and hostile towards computers.	4	3	2	1
11. I am sure I could do work in computers.	4	3	2	1
12. Figuring out computer problems does not appeal to me.	4	3	2	1
13. It wouldn't bother me at all to take computer courses.	4	3	2	1
14. I'm not the type to do well with computers.	4	3	2	1
15. When there is a problem with a computer run that I couldn't immediately solve, I would stick with it until I have the answer.	4	3	2	1
16. Computers make me feel uncomfortable.	4	3	2	1
17. I am sure I could learn a computer language.	4	3	2	1
18. I don't understand how some people can spend so much time working with computers and seem to enjoy it.	4	3	2	1
19. I would feel at ease in a computer class.	4	3	2	1
20. I think using a computer would be very hard for me.	4	3	2	1
21. Once I start trying to work on the computer, I would find it hard to stop.	4	3	2	1
22. I get a sinking feeling when I think of trying to use a computer.	4	3	2	1
23. I could get good grades in computer courses.	4	3	2	1
24. I will do as little work on computers as possible.	4	3	2	1
25. I would feel comfortable working on a computer.	4	3	2	1
26. I do not think I could handle a computer course.	4	3	2	1
27. If a problem is left unsolved in a computer class, I would continue to think about it afterward.	4	3	2	1
28. Computers make me feel uneasy and confused.	4	3	2	1
29. I have a lot of self confidence when it comes to working with computers.	4	3	2	1
30. I do not enjoy talking with others about computers.	4	3	2	1

Your name: _____
Your number: _____
Your class: _____

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