TEACHERS' PERCEPTIONS OF COMPUTER USE IN
ELEMENTARY AND SECONDARY CLASSROOMS
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
Suladda Loipha, B.Ed., M.Ed.
Denton, Texas
May, 1992
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The purpose of this study was to create a base of descriptive information about computer applications in the elementary and secondary classrooms of Thailand. To accomplish this task, two forms of questionnaires were developed and administered to a randomly selected sample of 527 school teachers and 94 college instructors throughout the Northeastern area of Thailand. Data were analyzed using a chi-square test, a t-test, and a one-way analysis of variance procedure.

The following major findings are based on information collected and analyzed in this study:

1. The majority of teachers worked in schools without computers. For schools where computers were present, the administrators provided information services and administrative encouragement for teachers to use computers. Only 24.86% of the school teachers in the sample used computers in their classrooms. Among users, the large percentage of Thai teachers used computers in connection with mathematics, science, and computer literacy. The application types used most often were drill and practice, tutorials, and problem-solving.
ACKNOWLEDGEMENTS

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Without the contributions of these people, this study could never have been completed.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
</tr>
<tr>
<td>Chapter</td>
</tr>
<tr>
<td>1. INTRODUCTION</td>
</tr>
<tr>
<td>Statement of the Problem</td>
</tr>
<tr>
<td>Purpose of the Study</td>
</tr>
<tr>
<td>Research Questions</td>
</tr>
<tr>
<td>Hypotheses of the Study</td>
</tr>
<tr>
<td>Background and Significance of the Study</td>
</tr>
<tr>
<td>Definition of Terms</td>
</tr>
<tr>
<td>Limitations of the Study</td>
</tr>
<tr>
<td>Basic Assumptions</td>
</tr>
<tr>
<td>2. REVIEW OF RELATED LITERATURE</td>
</tr>
<tr>
<td>Computer Applications in Classrooms</td>
</tr>
<tr>
<td>Computer Assisted Instruction (CAI)</td>
</tr>
<tr>
<td>Effectiveness of CAI</td>
</tr>
<tr>
<td>Integrating Computers into the Curriculum</td>
</tr>
<tr>
<td>Teacher Preparation</td>
</tr>
<tr>
<td>Research Related to Computer Applications</td>
</tr>
<tr>
<td>in Elementary and Secondary Classrooms</td>
</tr>
<tr>
<td>3. METHODOLOGY</td>
</tr>
<tr>
<td>Population and Sampling</td>
</tr>
<tr>
<td>Development of the Instrument</td>
</tr>
<tr>
<td>Pilot Study</td>
</tr>
<tr>
<td>Procedures for Collection and Analysis of Data</td>
</tr>
<tr>
<td>4. PRESENTATION AND ANALYSIS OF THE DATA</td>
</tr>
<tr>
<td>Sample Characteristics</td>
</tr>
<tr>
<td>Research Question Findings</td>
</tr>
<tr>
<td>Chapter</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>5. SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS</td>
</tr>
<tr>
<td>Summary</td>
</tr>
<tr>
<td>Findings</td>
</tr>
<tr>
<td>Conclusions</td>
</tr>
<tr>
<td>Recommendations</td>
</tr>
<tr>
<td>APPENDIX</td>
</tr>
<tr>
<td>REFERENCES</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table                                      Page
1. Questionnaire Blueprint                  61
2. Statistical Analysis Design              66
3. Percentage of Participants in Each Characteristic by Subgroup  72
4. Percentage of Teacher Interest in Computer Subjects  74
5. Percentage of College Instructors Considering Each Computer Subject Important for School Teachers  75
6. Teacher Ratings of Interest in Instructional Applications  77
7. College Instructors' Ratings of Instructional Computing Applications Important for School Teachers  79
8. Teachers' Interest in an Instructional-Related Computing Course  80
9. Elementary vs. Secondary Teachers' Interest in Learning Computer Subjects  82
11. Male vs. Female Teachers' Interest in Learning Computer Subjects  84
12. Teachers' Interest in Learning Computer Subjects Based on Their Educational Background  85
13. Teachers' Interest in Learning Computer Subjects Based on Their Teaching Experience  87
15. Computer User vs. Nonuser Interest in Selected Instructional Computing Applications  90
<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>16. <strong>Male vs. Female Teachers' Interest in Selected Instructional Computing Applications</strong></td>
<td>92</td>
</tr>
<tr>
<td>17. <strong>Teachers' Interest in Selected Instructional Computing Applications Based on Their Educational Backgrounds</strong></td>
<td>94</td>
</tr>
<tr>
<td>18. <strong>Multiple Range Test for the Three Categories of Educational Background Regarding Interest in Tutorials and Simulations</strong></td>
<td>95</td>
</tr>
<tr>
<td>19. <strong>Teachers' Interest in Selected Instructional Computing Applications Based on Their Teaching Experience</strong></td>
<td>96</td>
</tr>
<tr>
<td>20. <strong>Multiple Range Test for the Three Categories of Teaching Experiences Regarding Interest in Computer Use for Student Records</strong></td>
<td>97</td>
</tr>
<tr>
<td>21. <strong>Teachers' Responses Regarding Likelihood of Events Occurring in the 1990s</strong></td>
<td>98</td>
</tr>
<tr>
<td>22. <strong>College Instructors' Responses Regarding Likelihood of Events Occurring in the 1990s</strong></td>
<td>100</td>
</tr>
<tr>
<td>23. <strong>Male vs. Female Teachers' Beliefs Regarding the Impact of Computers on Education in the Next 10 Years</strong></td>
<td>102</td>
</tr>
<tr>
<td>24. <strong>Elementary vs. Secondary Teachers' Beliefs Regarding the Impact of Computers on Education in the Next 10 Years</strong></td>
<td>104</td>
</tr>
<tr>
<td>25. <strong>Computer User vs. Nonuser Beliefs Regarding the Impact of Computers on Education in the Next 10 Years</strong></td>
<td>106</td>
</tr>
<tr>
<td>26. <strong>Teachers' Beliefs Regarding the Impact of Computers on Education in the Next 10 Years Based on Educational Background</strong></td>
<td>108</td>
</tr>
<tr>
<td>27. <strong>Multiple Range Test for the Three Categories of Educational Background Regarding an Increase Interest in Instructional Computing Applications</strong></td>
<td>109</td>
</tr>
<tr>
<td>28. <strong>Teachers' Beliefs Regarding the Impact of Computers on Education in the Next 10 Years Based on Teaching Experience</strong></td>
<td>110</td>
</tr>
<tr>
<td>Table</td>
<td>Page</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>29. Teachers' Opinions Regarding the Integration of Computers into the Curriculum</td>
<td>112</td>
</tr>
<tr>
<td>30. College Instructors' Opinions Regarding the Integration of Computers into the Curriculum</td>
<td>113</td>
</tr>
<tr>
<td>31. School Teachers' vs. College Instructors' Opinions Regarding the Integration of Computers into the Curriculum</td>
<td>114</td>
</tr>
<tr>
<td>32. Male vs. Female Teachers' Opinions Regarding the Integration of Computers into the Curriculum</td>
<td>115</td>
</tr>
<tr>
<td>33. Elementary vs. Secondary Teachers' Opinions Regarding the Integration of Computers into the Curriculum</td>
<td>116</td>
</tr>
<tr>
<td>34. Computer User vs. Nonuser Opinions Regarding the Integration of Computers into the Curriculum</td>
<td>117</td>
</tr>
<tr>
<td>35. School Teachers' Opinions Regarding the Integration of Computers into the Curriculum Based on Educational Background</td>
<td>118</td>
</tr>
<tr>
<td>36. ANOVA for Teachers' Opinions Regarding the Integration of Computers into the Curriculum Based on Teaching Experience</td>
<td>119</td>
</tr>
<tr>
<td>37. Multiple Range Test for the Three Categories of Teaching Experiences Regarding Computers as Instructional Aids</td>
<td>120</td>
</tr>
<tr>
<td>38. Percentage of Teachers Who Worked in Schools Which Had Computers Based on the Number of Computers</td>
<td>121</td>
</tr>
<tr>
<td>39. Percentage of Teachers Who Received Various Types of Information Services from Their Schools</td>
<td>122</td>
</tr>
<tr>
<td>40. Teachers' Opinions Regarding Promotional Services Provided by Schools</td>
<td>123</td>
</tr>
<tr>
<td>41. Teachers' Opinions Regarding How Computers Were Made Available to Students in the Schools</td>
<td>125</td>
</tr>
<tr>
<td>Table</td>
<td>Page</td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>42. Teachers' Opinions Regarding How Computers Were Made Available to Teachers for Instructional Management</td>
<td>126</td>
</tr>
<tr>
<td>43. Teacher Satisfaction With Computer Software Availability</td>
<td>127</td>
</tr>
<tr>
<td>44. Teachers' Opinions Regarding Their Satisfaction With Quality of Computer Software Available</td>
<td>127</td>
</tr>
<tr>
<td>45. Percentage of Teachers Who Use Computers for Selected Subjects</td>
<td>128</td>
</tr>
<tr>
<td>46. Percentage of Teachers Who Use Computers for Each Type of Computer Application</td>
<td>129</td>
</tr>
<tr>
<td>47. Percentage of Teachers Who Use Computers for Each Instructional Management Activity</td>
<td>130</td>
</tr>
<tr>
<td>48. Percentage of Teachers Who Use Computers for Each Type of Presentation</td>
<td>132</td>
</tr>
<tr>
<td>49. Percentage of Teachers Reporting the Effect of Instructional Computing on Selected Student Characteristics</td>
<td>133</td>
</tr>
<tr>
<td>50. Teachers' Opinions Regarding Areas of Greatest Computing Needs</td>
<td>134</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

The use of computers, particularly microcomputers, is having a dramatic impact on various aspects of human life. Education is one area that is highly influenced by computers. With the decrease in computer costs and the development of better and more diversified learning materials designed for personal computers, there has been an impressive growth in the use of computers in schools all around the world (Saloman, 1989). The ability to anticipate the potential use of computers is essential. However, in order to maximize future possibilities for the use of computers, an awareness of their past influence and current impact, as well as their potential, is necessary. Armed with this information, educators can make wise decisions about the acquisition and future use of computers (Tolman & Allred, 1984).

Statement of the Problem

The problem of this study was to determine teachers' computing interests, the future role of computing, and the status of computer use in elementary and secondary classrooms of Thailand.
Purpose of the Study

The purpose of this study was to create a base of descriptive information about teachers' perspectives toward computer use in the elementary and secondary classrooms of Thailand.

Research Questions

Specifically, the following questions concerning teachers and educators in Thailand were investigated:

1. What are school teachers' and college instructors' opinions regarding teachers' preparation to utilize computers?

1.1 Are school teachers interested in learning about computers and their instructional applications?

1.2 Do differences exist among school teachers who are interested in learning about computers and their instructional applications based on gender, school level, educational background, experience in using computers in the classroom, and teaching experience?

1.3 How do school teachers and college instructors view the impact of computers on education?

1.4 Do school teachers view the impact of computers on education differently based on their sex, school level, educational background, experience in using computers in the classroom, and teaching experience?
1.5 Do school teachers and college instructors view the impact of computers on education differently?

2. What are school teachers' and college instructors' opinions regarding the integration of computers into the curriculum?

2.1 Do school teachers and college instructors view the integration of computers into the curriculum differently?

2.2 Do school teachers view the integration of computers into the curriculum differently based on their school level, educational background, experience in using computers in the classroom, and teaching experience?

3. What kinds of encouragement and incentives are provided by schools to use computers?

3.1 Are school teachers provided with computer services?

3.2 Are school teachers encouraged to use computers?

3.3 Are school teachers prepared to use computers?

4. What is the current status of computer utilization in classrooms?

4.1 How available are computers to these users?

4.2 How satisfied are teachers with the available software?

4.3 How do teachers use computers in their classrooms?

4.4 What effects do teachers believe computers have on students?
4.5 What are teachers' most urgent needs in the area of instructional computing?

Hypotheses of the Study

In relation to the purpose of this study and the research questions, the following hypotheses were tested:

1. No significant differences exist in teachers' perspectives of the impact of computers on education between or among the following groups: (a) male and female teachers, (b) teachers who use computers and those who do not, (c) elementary and secondary school teachers, (d) teachers with different educational backgrounds, (e) teachers with different teaching experiences, and (f) school teachers and college instructors.

2. No significant differences exist in teachers' interest in learning about computers and computer use between or among the following groups: (a) male and female teachers, (b) teachers who use computers and those who do not, (c) elementary and secondary school teachers, (d) teachers with different educational backgrounds, and (e) teachers with different teaching experiences.

3. No significant differences exist in teachers' opinions regarding the integration of computers into the curriculum between or among the following groups: (a) teachers who use computers and those who do not, (b) elementary and secondary school teachers, (c) teachers
with different educational backgrounds, (d) teachers with
different teaching experiences, and (e) school teachers and
college instructors.

Background and Significance of the Study

Computers have been categorized as an instructional
technology which possesses a variety of important attributes.
Computers are tools that facilitate a large variety of
content and symbolic modes, ranging from printed words to
dynamic schemes, from graphs to musical notations, and from
realistic pictures to dance notations. Even more
importantly, computers differ from other instructional
technologies in the variety of activities that they afford,
ranging from responses to questions, as in drill and practice
programs, to autonomous hypothesis testing in simulations;
from discovery-like activities via game playing to rigorous,
logical planning, as in programming; and from writing and
revising to categorizing and calculating. No other available
technology offers such a wide variety of content, symbolic
modes, and learning activities (Saloman, 1989). In addition,
computers offer a unique development of partner-like
interactive and individualized relations to the user.
Because of the unique attributes of computers, an
understanding of their roles and potential is very important
to school teachers, school administrators, and educators
(Tolman & Allred, 1984). Espinosa (1990) suggested that
computer utilization for educational purposes usually falls into one of three categories. First, a computer is a tool for daily life skills. Computer awareness and computer operation skills are necessary in order for students to take advantage of this tool. Second, a computer is integrated into the curriculum through computer assisted instruction (CAI) which includes learning simulations, educational games, drill and practice, and problem-solving software. To serve this purpose computers provide instruction, problems, simulations, or data analysis opportunities; guide students through the learning sequences or data analysis possibilities; evaluate students until a required level of proficiency is reached; and keep records of students' progress. Third, a computer is a management, administrative, and teaching tool. These functions are performed by using programs which monitor and update students' interactions with the computer; assist in word processing, personnel management, accounting, payroll, inventory, maintenance, and budget; create and score tests; and design and produce instructional materials. Many research findings indicate that a computer can substantially contribute to the educational process only when some of its unique attributes are capitalized upon, and under particular conditions.

At present, there is a growing desire to capitalize on computers' unique attributes and to fully integrate them into regular learning activities. What is the nature of this
integration and how can it be accomplished? The integration of computers into a curriculum means that these two components affect each other reciprocally. The designers of a curriculum take into consideration computers' unique possibilities and computers are used to serve the curriculum rather than their own purposes. This reciprocal relationship takes place on at least three levels: the level of goals and objectives, the level of pedagogical thought, and the level of instructional content and activities.

At the first level, there is a change in the goals toward which computers are used. The initial stages of computer-use activities, such as programming, were self-serving. Increasingly, however, computer activities have been designed to serve curricular goals. Changes at the first level need to be accompanied by a change in pedagogical thought that is manifested by a growing acceptance of computers as a technology that allows more independent exploration, more personally tailored activities, more team work, and significantly less didactic instruction. This implies a gradual change in the teacher's role—from information delivery to learning management, and from authoritative source of information to guide for self-propelled exploration. Finally, reciprocal changes of goals and of educational thought are reflected in instructional contents and activities, the level at which the integration
of computers and curricula is actually realized (Saloman, 1989).

A major challenge facing educators involves pre-service and in-service teacher training in computer use. An additional concern is the content and nature of that training (Tolman & Allred, 1984). However, successfully changing any educational practice creates the development of positive teachers' attitudes toward the educational issues involved. What may appear to be a desirable goal in principle, must be viewed as desirable by the teachers and educators concerned before it can be implemented quickly and effectively into classroom practice (Woodrow, 1987). Although, as Brovey and Chen (1984) pointed out, curriculum content changes are relatively easy to implement. Attitudes and teaching behaviors are very resistant to change. The role of teacher attitudes toward computers is very important to the successful implementation of computer use in education. The attitudes of the educators involved should be evaluated prior to, and periodically during, the early stages of their introduction (Stevens, 1982).

In conclusion, introducing a computer course into the curriculum, integrating computer topics into regular subjects, and using computers as teaching aids require the full support of the teachers who implement the changes. It is worthwhile to look at teachers' perceptions of what they
need to know in order to achieve some of the potentials that computers have to offer in education.

Education in Thailand is a governmental function. Three government ministries, the Office of the Prime Minister, the Office of University Affairs, and the Ministry of Education, administer Thai education. The Office of University Affairs coordinates higher education institutions and the government. The Ministry of Education is responsible for elementary and secondary school education and, mostly, the teacher and vocational technical education. The National Education Commission, under the Office of the Prime Minister, is responsible for the Educational Development Plan (UNESCO, 1984).

The present 6-3-3 structure of the Thai educational system was introduced in 1978. The major elements of the formal educational system are as follows (Chantavanich, 1985).

1. Pre-school education consists of two or three grades of kindergarten or a 1-year pre-primary education organized in elementary schools.

2. Elementary education consists of first grade through sixth grade. All children from 6 years of age are required to be in school until the end of the sixth grade. It emphasizes literacy, numeracy, communication skills, and abilities relevant to future occupational roles.
3. Secondary education comprises junior grades and senior grades. It aims to provide appropriate academic and vocational knowledge consistent with the learner's age, needs, interests, skills, and aptitudes which are ultimately beneficial to the individual's career and to society at large.

4. Higher education aims at the full development of human intellectual abilities, the advancement of knowledge and technology, and the provision of the high-level academic and professional personnel needed for national development.

Computer education in Thailand has been in effect for 20 years (United Nations Educational, Scientific, and Cultural Organization [UNESCO], 1985). As of 1990, 15 universities and 36 teachers colleges in Thailand provide computer courses for both graduate and undergraduate students. In 1983, some secondary schools in Thailand acquired microcomputers and began offering elective courses in microcomputers. In 1985, the Ministry of Education implemented a computer curriculum for the upper secondary school level throughout the country. Computer applications in Thailand are rapidly expanding at all school levels. The Institute for the Promotion of Teaching of Science and Technology in Thailand (IPST) initiated a pilot project in 1987 to encourage the integration of computers in teaching mathematics and physics at the upper secondary level. Topics in mathematics and physics were identified for which computer software was to be
written. The institute has developed a number of computer programs in mathematics and physics.

However, Thailand as a whole lags behind developed countries in its use of computers in the school system. Most teacher training programs for computers in Thailand concern learning or teaching about computers rather than teaching with computers or computer applications in education (Talisayon, 1989). Thai educators need to seriously consider and plan for the coming information era.

Emphasis on the best possible use of computers is important in order to help teachers to accomplish the goals of education. Questions that need to be answered included the following: Are computers now available for use by teachers and students? Are computers used for instructional purposes, and, if so, along what lines? Are teachers interested in adapting modern technology for instructional purposes? These questions provide the focus for this survey study which is designed to gather information about the perspectives of Thai educators toward computer use in their classrooms.

The findings of this study provide an improved base of descriptive information about teachers' perspectives toward computer use in the elementary and secondary classrooms of Thailand. This information is intended to serve two policy objectives. The first objective is to inform teacher institutions in Thailand regarding pre-service and in-service
programs for educating teachers about computers and their instructional applications. The second objective is to provide information which will help guide school management of the applications of technology to accomplish the mission of the schools.

Definition of Terms

For conceptual clarity, the following terms used in the survey and throughout this study are defined as follows:

Administrative computing refers to any of a number of computer applications used by administrators for school management functions.

College instructors refer to instructors in the college of education in universities and teachers colleges in the Northeastern area of Thailand.

Computers refer to microcomputers that can be programmed to process information.

Elementary school teachers refer to teachers in elementary schools from grade 1 to grade 6 in the Northeastern area of Thailand.

Instructional computing refers to any of a number of computer applications used by teachers directly with students, or indirectly as instructional or classroom management aids.

Instructional computing applications refer to any technique for applying computer technology to the solution of
a variety of information processing problems (hereafter refers to computer applications).

Perspectives refer to opinions toward a concept.

Secondary school teachers refer to teachers in secondary schools from grade 7 to grade 12 in the Northeastern area of Thailand.

Software refers to computer programs which include application programs, operating systems, and languages.

Teachers refer to elementary school teachers, secondary school teachers, and college instructors in the Northeastern area of Thailand.

Limitations of the Study

This study was limited to school teachers and college instructors in the Northeastern area of Thailand. Therefore, the results of this study can be generalized only to populations similar to those in this study.

Basic Assumptions

The following basic assumptions apply to this study:

1. It is assumed that the random sample chosen was representative of all school teachers and college instructors in the Northeastern area of Thailand.

2. It is assumed that the subjects responded honestly to the questionnaire employed in this study.
CHAPTER 2

REVIEW OF RELATED LITERATURE

The following review of related literature is divided into three major parts: (a) computer applications in classrooms including computer assisted instructions (CAI), the effectiveness of computer use in classrooms, and the integration of computers in the curriculum, (b) teacher preparations including computer programs for pre-service and in-service teachers and how to implement the programs, and (c) research related to computer applications in elementary and secondary classrooms.

Computer Applications in Classrooms

Educational uses of computers in education can be categorized into two primary uses: instructional applications and administrative applications (Telem, 1984). Administrative applications of computers include the use of word processing, data base, test generator, and grading software (Mojkowski, 1985; Wagschal, 1984). Instructional uses include the use of computers as a topic of instruction through the teaching of computer programming and computer literacy, as a medium for instruction through the use of various types of CAI, and as a tool for managing instruction (CMI) (O'Connor, 1986). Hill (1983) described management
uses of computers as the generation of teaching materials, analysis and scoring of tests, recording of attendance and academic progress, performance of class ranks, and storage of grades. Introducing teachers to these management uses is often an effective way to motivate them to use computers in instruction (Parrish & DeBold, 1982; Wagschal, 1984).

**Computer Assisted Instruction (CAI)**

By definition, CAI involves the individualized teaching of a concept or material using the computer as the instructor (Steinberg, 1984). Taylor (1980) classified CAI as tutor applications in which the computer performs a teaching role. Atkinson (1984) summarized the various types of basic uses of CAI. He generalized that computers can be used either to provide supplementary material to the regular classroom or as a substitute for other modes of instruction. In considering a more detailed classification of the types of CAI, he stressed that computers can be used for drill and practice, tutorial, simulation, instructional games, and computer managed instruction activities.

**Drill and practice CAI.** The term drill and practice refers to any situation in which the same kind of exercise or problem is presented repeatedly and for which students are typically expected to provide a single correct response. One of the standard ways to provide drill and practice is through
worksheets, which are often prepared by a teacher for a particular purpose. A significant disadvantage of worksheets is that students frequently are allowed to complete an entire set of exercises incorrectly and rehearse incorrect procedures repeatedly before any feedback is provided by the teacher. Once students have repeated the incorrect procedures with the belief that they are correct, it is difficult for them to unlearn the incorrect procedures and to relearn correct procedures. Drill and practice CAI can alleviate this deficiency. CAI provides feedback after each question so that students know immediately whether the procedure used to obtain an answer is correct. CAI also includes diagnosis of students' difficulties, provides remedies for their difficulties and selects extra practice for exercises that cause particular difficulty for an individual student (Bright, 1987).

Bright (1987) also suggested that good features of drill and practice CAI programs include the use of a variety of feedback responses for both correct and incorrect answers. After an incorrect answer, students should have an opportunity to respond again. Another desirable feature of drill and practice CAI is the large pool of questions from which particular ones can be selected. Drill and practice CAI programs can be more effective if they incorporate sophisticated instructional strategy characteristics.
Teachers should use care to select CAI programs which are effective and which meet specific curricular needs.

Pantiel and Peterson (1984) suggested that well-developed drill and practice programs can be tailored to meet the varying ability levels and specific skill deficiencies of students. These authors emphasized that this is especially important as teachers make decisions about using this form of CAI as a means of reinforcement for children who are up to grade level with a specific skill or for children who need remedial work at a lower level. They also noted that programs which provide short drill and practice and a simple concept are especially effective with elementary students.

Bright (1987), who suggested using drill and practice CAI in the classroom, recommended that drill and practice CAI in the primary grades should probably be used only in small sessions, spread over an extended period of time. He warns that drill and practice CAI should not be used to replace other instruction; drill and practice in any of its forms should not be expected to do that. According to Bright, two very important characteristics of drill and practice CAI for primary grades are appropriate reading levels and simple input procedures. Because primary grade children cannot be expected to have well-developed keyboard skills, a program should accept input which requires only a few keystrokes.

According to Pantiel and Peterson (1984), drill and practice CAI programs have a number of natural advantages for
educators. They offer a new medium for achieving educational objectives and fit needs that teachers can clearly recognize. In a time when student achievement in basic skill areas is declining, drill and practice programs offer students individualized practice with immediate reinforcement, something even the best teachers cannot always provide.

Ninety-four percent of the elementary teachers surveyed by Dickey and Kherlopian (1987) who used software revealed that they used drill and practice with their pupils despite an orientation to programming and other types of software utilization. Elementary teachers trained by Ponte (1986), however, preferred drill and practice applications.

Much of the research that has been done on CAI has dealt with drill and practice programs. Most frequently, the results have been that students learn about the same amount of material through CAI as through conventional instruction but that learning is achieved either in less time or at faster rate with CAI (e.g., Bracey, 1982; Edwards, Taylor, Weiss, & Van Dusselldorp, 1975; Jamison, Suppes, & Wells, 1974; Kulik, Kulik, & Cohen, 1980; Shanoski, 1987; Thomas, 1979).

In conclusion, as long as drill and practice are necessary for attaining the goals of school education, drill and practice CAI has a role to play in providing that instruction. Teachers, however, must demand that drill and practice software take full advantages of computers without
cluttering instruction with inappropriate uses of computer capabilities. As with any instructional material, care must be taken in the selection of the particular software that is used in order to assure that objectives are taught and efficient use is made of students' time.

**Tutorial CAI.** A tutorial CAI program is any program that teaches new information to a user (Bright, 1987). In addition to teaching new information, Bright suggested that most tutorial programs also evaluate the user's level of understanding and provide drill and practice of needed material. Tutorial computer applications seek to place the computer in the role of a tutor, who carries the full instructional burden of guiding a student to the achievement of a specified set of objectives. Merrill et al. (1986) suggested that tutorial CAI lessons should incorporate most of the nine events of instruction: gaining attention, presentation of objectives, recall of prerequisites, presentation of stimuli, providing guidance, eliciting performance, providing feedback, assessing performance, and enhancing retention and transfer.

Tutorial CAI possesses some advantages over conventional instruction. Tutorial CAI can analyze responses of each student during the course of the instruction. All of the responses can also be remembered with full accuracy, so that each student's history is complete. In addition, tutorial
applications provide automated individualized instruction, which allows students to work at their own pace. Instruction is tailored to specific individual student needs.

According to Bright (1987), there are two uses of tutorial programs in the classroom. The first is to provide primary instruction on a topic. The second is to provide backup instruction for students who were absent, did not grasp the material during the first exposure, or needed support and reinforcement to classroom instruction. For primary instruction, much of the tutorial use is for teaching material of which the teacher is unsure or that has special presentation requirements, such as the need for accurate pictures or animation. Tutorial programs are not likely to replace teachers as the primary source of new information. Great care should be used in the selection of tutorials which are to be used in this manner.

According to Merrill et al. (1986), in an individualized classroom environment, tutorials should be one of many alternative instructional packages designed to teach a particular objective. A tutorial program can also be used as a component of a more comprehensive instructional system which includes textbook reading assignments, laboratory experiences, small group discussion, videotapes, and written reports.

Bright (1987) also suggested that tutorial programs should deal with content that involves rules or
relationships. Content that is best presented with illustrations is particularly appropriate because pictures can be easily and cheaply manipulated on a monitor screen. A microcomputer tutorial program can determine whether prerequisite material has been mastered, can identify and isolate relationships between parts of material, can present extra explanations to help students develop understandings of those relationships, and can employ color and motion in various combinations to correct misunderstandings.

In conclusion, tutorials can be used as an alternative mode of instruction in the primary grades in order to help students focus on simple concepts and relationships. Students in the primary grades operate at the concrete operation level; therefore, relationships among concepts are difficult to learn. Ordinary whole-group instruction in this area is likely to fail to take account of the many different misconceptions that students develop because of their limited abilities to process information. Computer tutorials are more likely to help individual students acquire these concepts.

Simulations. A simulation is a representation or model of some real object, system, or phenomenon. It is an imitation of reality (Merrill et al., 1986). A computer simulation is a program in which a few features of a real world situation are abstracted and then used to form a model
of a simplified version of that same situation. A computer simulation typically takes advantage of computer capabilities such as graphics, rapid data processing, and branching according to user inputs more than other types of CAI. As the capabilities of microcomputers increase, more and more complex simulations will be possible. Eventually, it may be possible to teach content through simulation that would be impossible to teach in any other way. Bright (1987) described the characteristics of a simulation program which differ from drill and practice or tutorial programs:

1. A simulation typically involves complex material and focuses on interactions between conditions and variables, each of which has more than one value.

2. A simulation is not usually completely self-contained; that is, the user is responsible for control of some of the features of a simulation. Simulations are designed to respond to user input, within predetermined acceptable limits, and to model the effects of those inputs on the real-world situation and consideration.

3. The instructional intent of most simulation CAI is to communicate information or understanding of the processes that are part of the situation being modeled. That is, the instructional intent is one of the aspects of problem solving.
4. The time required to complete a simulation is considerably more than the time required for drill and practice or tutorial programs.

5. The level of interaction among students is much greater than in drill and practice or tutorial programs. Students should work together on a simulation so that they can check their processes and engage in discussion during the course of the program.

There are at least six major reasons why simulations are valuable instructional applications (Merrill et al., 1986).

1. There is less risk in a simulation than in reality.
2. Training costs are reduced.
3. Simulations are frequently more convenient than real life situations. A simulation can be used at any time, independent of weather conditions, daylight, or other constraints.
4. Simulations minimize the negative effects of time. Some phenomena take place in reality over great periods of time. Through simulations, time can be compressed, and students can experience the critical elements of the phenomena several times within a short period.
5. The ability to focus on specific aspects of a phenomenon is frequently increased. Through the use of color graphics, sound effects, animation, and textual descriptions, useful aspects of situations can be enhanced and extraneous
aspects can be minimized, thus making it easier for students to learn critical information.

6. The experiences in a simulation are repeatable.

Ediger (1988) suggested that, in simulations, students (a) participate in role playing—each role needs to be as realistic as possible; (b) make conclusions and choices—the involved learner interacts much with the microcomputer; (c) receive feedback or information pertaining to choices made; (d) revise their frame of reinforce in the making of new decisions after receiving feedback; (e) engage in higher levels of cognition, rather the recall level; (f) apply knowledge that has been acquired previously; (g) analyze a situation prior to the making of a new decision; (h) bring background knowledge when synthesizing content to make choices; (i) evaluate feedback received from choices made; and (j) comprehend content within the framework of each program.

According to Bright (1987), when applying simulations in the classroom, teachers should search for simulations that fit into the curriculum rather than trying to fit the curriculum to a simulation. Teachers can increase the likelihood that intended learning outcomes will be reached by providing substantial classroom support for the simulation. Bright also suggested three methods for providing this support. First, setup is necessary to focus students' attention on the processes that are important and on the
variables that are involved in the simulation. Students need to be given some assistance on how to separate relevant from irrelevant information. The rules of interactions need to be discussed so that students can focus on the interactions themselves. Second, monitoring the simulation is one means by which teachers can determine if students are learning the intended outcomes. If not, teachers may need to intervene in order to refocus attention on the relevant attributes of the simulation. Third, debriefing is important in order to determine what students have learned and to allow them to share their knowledge. Merrill et al. (1986) suggested that simulations should be preceded by other appropriate events of instruction such as gaining attention, stating the objective, recalling prerequisite skills, presenting the stimulus, and learning guidance.

A study by Woodward, Carnine, and Gersten (1988) demonstrated the potency of simulations as supplements to classroom instruction. Their results showed that simulation improves both recall of basic information and problem solving skills. Results of studies by Krishnamachari (1989), Hedlund and Casolara (1986), Johnson and Johnson (1986), Sherwood and Hasselbring (1984), Vockell and Rivers (1984), and McGuire (1976) indicated that students usually scored better on posttests when computer simulations were used.

In conclusion, simulations are stimulating applications because they use the full potential of computers' dynamic
interactive, graphic, and sound capabilities. Simulated interactions provide several special benefits over real interaction: reduced risk, reduced training costs, greater convenience, time compression or expansion, focus on critical aspects, and repetition. Computer simulations need to be an integral part of other instructional activities in the classroom. Teachers should provide the necessary information and background required to enable students to obtain the maximum benefit from participation in simulations.

Instructional games. According to Merrill et al. (1986), an instructional game is a game for which the teacher has determined a set of instructional objectives prior to the time at which the game is given to students to play. The game usually involves some elements of competition or challenge against an opponent task and is governed by a definite set of rules. These rules determine how the game is played, what actions are allowed, what actions are prohibited, and what constitutes winning the game. Bright, Harvey, and Wheeler (1985) based their classifications of games on timing of the game relative to the regular instruction designed to produce mastery of content. That is, they divided games into three types: post-instructional games, co-instructional games, and pre-instructional games. A post-instructional game is used as review or practice of content already mastered. A co-instructional game is used as
part of primary instruction and is designed to produce mastery of the content. A pre-instructional game is used as readiness for instruction and is designed to produce mastery of the content.

Another classification of games by Dennis, Muoznicks, and Stewart (1979) groups games into three types—free form games, rigid form games, and open form games. Free form games can also be called simulation games and are characterized by a scenario in which the play progresses and the players take on roles. Rigid form games are typical content-related games that are used in classroom instruction. Open form games are essentially problem-solving situations that have little if any relevance to real world situations.

The development of computer technology has provided a new impetus to understand both how games teach and what kinds of concepts and skills can be taught through games. Malone and Lepper (1983) attempted to identify attributes of educational computer games which optimize their intrinsic motivational power. These attributes suggest useful criteria for selecting educational computer games for use in the classroom. Malone and Lepper classified these motivational attributes into the following two major types: individual and interpersonal motivations. Successful educational computer games generally include one or more of the following individual motivation factors: challenge, curiosity, control, fantasy. Interpersonal motivations involve interaction with
others and include co-operation, competition, and recognition.

Reynolds and Martin (1988) suggested that a well-developed, effective educational computer game should include the following characteristics: (a) a clearly stated educational objective and content; (b) gaming interactions that facilitate the mastery of the objective; (c) player control of interaction and game progression; (d) incorporation of challenge, fantasy, and curiosity; (e) prompt feedback on performance and progression; (f) a mechanism for correcting errors and improving performance; and (g) positive reinforcement that is appropriately timed.

In conclusion, educational computer games should be an integral part of other instructional classroom activities. It is important that time and effort be spent in preparing students for the experience and in debriefing them afterward. Introductory and follow-up activities lend a proper perspective to students' experiences and help to maximize the value of games. It is also important to remember that one of the great strengths of educational games is their ability to promote a higher level of student motivation. Curricula which have been hard to teach due to low student interest or motivation may be strengthened through the use of a carefully selected and integrated educational computer game. This is especially true with dissemination or verbal information tasks which require students to simply memorize information.
Computer managed instruction. Gorth and Nassif (1984) explained that computer-managed instruction (CMI) is the use of computer technology to collect, analyze, and report information concerning the performance of students in an educational program. Software can be written to carry out analyses of students' performances at working assigned problems. Fong (1989) stressed that students' work can be diagnosed to pinpoint their weaknesses. Computers can also prescribe activities for students whose weaknesses have been diagnosed. This mode of presentation helps teachers to look for students' weaknesses and, based on the suggested activities, to conduct remedial work to correct students' errors. Computer-based instructional management is potentially one of the most promising applications of computer technology in the instructional process. The data and information management capabilities provided by computers provide teachers with a quick and easy way to organize and retrieve instructionally-related information on individual students or on various groups of students.

Effectiveness of CAI

Literature on the effectiveness of CAI includes an abundance of studies. In general, an examination of individual studies on CAI effectiveness reveals differences
in design, methodology, setting, sample size, and evaluation instruments. In a study of the effectiveness of CAI, Becker (1987) eliminated 34 out of 51 studies. Eleven studies were discarded because they did not compare learning with computers to traditional learning. Another eight were eliminated because they had no measure to determine how comparable the groups were when they started the study or did not randomly assign students to comparison groups. Another seven studies were removed because they lasted fewer than eight weeks. Finally, eight studies were discarded because of their limited number of students.

In order to establish a broader base for understanding the potential of CAI, two basic types of reviews have been used to integrate findings on CAI effectiveness. One type is narrative reviews. In these reviews, the authors provide narrative comments about and summaries of studies that support or do not support CAI. The other type of review is meta-analysis which involves using objective procedures to locate studies, quantitative techniques to describe studies and their outcomes, and statistical methods to determine overall findings.

Narrative reviews. One of the first published reviews using the descriptive method was done by Vinsonhaler and Bass (1972) on 10 studies of computer use in mathematics and language instruction. In almost all studies, advantages were
found in favor of the computer group and, in most of the studies, this advantage was statistically significant. Vinsonhaler and Bass found that differences in gains were greater in mathematics studies than in language studies.

Jamison, Suppes, and Wells (1974) reviewed more than 20 studies of computer based methods as part of their overall review of alternative instructional media. They reported that CAI was found to be effective when CAI was used as a supplement to classroom instruction for elementary and remedial students. For secondary and college levels, they found that CAI was used effectively as a replacement for traditional instruction. At about the same time that Jamison et al., reported their results, Edwards et al. (1975) conducted a review which focussed solely on CAI. They reviewed and coded 30 studies for type of CAI, subject area, grade level, supplemental or replacement use, and results. Their findings were similar to the previous reviews in that CAI was found to be more clearly effective at elementary levels, and supplemental use seemed more effective than replacement uses. Overall, CAI appeared to show promise as a means of reducing the time required for learning.

Thomas (1979) reviewed studies of computer based instruction for achievement, attitude, time reduction, retention, and cost data. Thomas reported that 36 of the 49 studies reviewed found achievement results equal to those of other methods. The only results which showed a clear-cut
advantage for computer-based methods were those concerning time reduction.

Crosby (1983) focused on the effectiveness of instructional computing on students with mild learning problems. The most significant finding of this review was consistent with that of the previous reviews—computer instruction used as a supplement to classroom instruction achieved superior results to that used to replace classroom instruction.

Hasselbring (1987) focused on the kinds of skills and applications which seem to yield the most promising results. He found that drill and practice comprise an effective strategy for increasing fluency in both mathematics and spelling skills primarily when (a) students have already acquired strategies for retrieving answers from memory, or (b) drill is used as a follow-up to adequate tutorial instruction. He also found that reading decoding skills seem to be enhanced by drill, but little evidence exists on computer effects with other reading skills. Hasselbring also reported that simulations may assist in teaching problem solving if they are used in the context of teaching methods which help students identify and use appropriate information to improve decision-making.
Meta-analysis reviews. Kulik (1981) presented a paper comparing the results of meta-analysis performed by himself and other early meta-analysis researchers (Cohen, 1981; Ebeling, 1981; Hartley, 1977; Smith, 1980) on computer based instruction, programmed instruction, and tutoring. Kulik first observed that the results on each method of instruction were consistent across reviewers—that tutoring raised achievement in mathematics .60 standard deviation units over traditional instruction and that programmed instruction had an effect size of about .01.* Comparing the self-paced methods in computer based studies, Kulik found consistent evidence of a grade-by-achievement interaction. The self-paced method seemed to result in higher effects at the college level than at the elementary level. The opposite results occurred with structured drill methods, which yielded much higher effect size with elementary students. These results seem to indicate that older students profit more from tutorial instruction, which they can structure themselves, while elementary students do better with drill-type instruction, which is already structured for them (Roblyer, Castine, & King, 1989).

* This estimate is usually calculated by subtracting the mean score achieved by the non-treatment group from that achieved by the group of treatment under study. The result is then divided by a measure of the spread of scores achieved by the two groups: the pooled standard deviation (Roblyer, Castine, and King, 1989).
Researchers at the Center for Research on Learning and Teaching at the University of Michigan conducted major reviews of CAI using meta-analysis at the college, secondary, and elementary levels. The first of these, published by Kulik, Kulik, and Cohen in 1980, focused on results from college level studies. The average effect size on achievement in the college level studies which were included was found to be about .25. Effects on attitudes were also generally small (.18 to .24). Second, the University of Michigan team performed two reviews of studies at the secondary level (Bangert-Drowns, Kulik, & Kulik, 1985; Kulik, Bangert, & Williams, 1983). Both of these studies revealed approximately the same effect size in achievement (.32 and .26, respectively).

The second review also separated the studies into traditional CAI, management uses (CMI), and unstructured computer-enriched instruction (CEI) such as using simulations and teaching programming to aid learning of mathematics. Effect sizes were significantly higher with CAI and CMI (.36 and .40, respectively) than with CEI (.07). Both teams concluded that overall findings were better at this level than at the college level.

Kulik, Kulik and Bangert-Drowns (1985) also reviewed results from 32 studies at the elementary level. This effect size was the highest of the three grade levels (.47), giving final confirmation to Kulik's original hypothesis that an
aptitude by treatment interaction (ATI) exists with respect to computer-based treatment at different grade levels. No significant relationships were found between higher effect sizes and other study variables, such as type of CAI or gender of students.

A more recent meta-analysis of computer based instruction at the elementary level was conducted by Niemiec and Walberg (1985). Niemiec and Walberg reviewed 43 studies and found evidence of several aptitude-by-treatment interactions. They found that certain types of students seemed to profit more from CAI based treatments than others. Specifically, the following groups had substantially higher achievement: lower achievers, exceptional students, younger students, and boys. Tutorial CAI was also found to be more effective than drill applications.

An update of meta-analysis study on computer based instruction was provided by a review by Roblyer et al. (1989) of research conducted between 1980 and 1987. Three-fourths of the studies reviewed were conducted between 1985 and 1987. The following general trends in the effects of computer-based instruction are based on their reviews:

**Reduction in learning time.** Eight reviews at various grade levels concluded that using computer based treatments resulted in substantially decreased learning time. Kulik (1985) found that the saving in time was an average of 32%.
Attitudes. Findings from the Florida Department of Education (1980) and the University of Michigan studies indicated that attitudes are positively affected by computer based treatments. According to Roblyer et al. (1989), attitudes toward school and subject matter were most affected by computer use. The effect was significantly different from zero, a result consistent with that of past reviews. Improving students' self-image and self-confidence through computer use has not been adequately studied.

Content area. The review of Roblyer et al. (1989) showed some indication of the trend in past studies that computer applications are more effective in teaching mathematics than in teaching reading language skills. However, unlike past reviews, Roblyer et al.'s study did not reveal significant differences between effects for reading and mathematics (p < .05). Moreover, the results from their study indicated that science achieved the highest overall effect size. The small number of studies from this area limits the conclusions that can be drawn at this time.

Grade level. The only significant differences among groups included in any of the analyses occurred in the comparison of elementary, secondary, and college levels. This finding is in marked contrast to past results which have consistently indicated the highest results at elementary
levels. The review of Roblyer et al. found significantly higher results at college and adult levels.

**Application type.** The only areas with a sufficient number of studies in this analysis were reading and mathematics. All types of applications for mathematics were about equally effective. In reading, tutorial applications achieved higher effects than other types. This finding is consistent with Roblyer and King's (1983) previous review of reading studies. It should be noted, however, that the high positive effects from science studies were all with simulations for unstructured work. Clearly, the effectiveness of various types of CAI applications varies according to content area and skills being taught.

Kulik and Kulik (1991) reported in the results of a meta-analysis of findings from 254 controlled evaluation studies that computer-based instruction (CBI) usually produces positive effects on students. Size of effect varied according to study features. Effects were larger in published than in unpublished studies. CBI also produced small but positive changes in student attitudes toward teaching and computers and reduced substantially the amount of time needed for instruction.

**Integrating Computers Into the Curriculum**

The Computer Technology and Reading Committee (1984) stressed the importance of integrating computers into all
disciplines of the curriculum. Diem (1984) recommended that computer applications be integrated into all instructional objectives. Ruff (1985) called for the development of a curriculum which uses microcomputers and other instructional materials interchangeably.

Educators continue to seek ways to implement computers more effectively into their curricula. German classrooms include the following three directions in implementing computers: (a) new subject matter about computers is added to one or two traditional subjects, such as mathematics; (b) teaching about computers is one theme across several subjects; and (c) new computer subject matter is integrated into all traditional school subjects (Gorny, 1991). According to Gorny, the third approach is the most advanced method because it fulfills the general objectives of making information technology an everyday tool for all students. Sheingold, Kane, and Endreweit (1983) described the process of integrating computers into the curriculum as one of change. According to Sheingold et al., the task of integrating computers into the curriculum is not merely to put two matching pieces, a curriculum and a computer, together. Rather, it is to actively mold the pieces so that they complement each other. Plomp, Pelgrum, and Steerneman (1990) listed the following possible consequences of using computers properly and intensively, with respect to the curricular aspects: (a) Educational goals and objectives may
change in the direction of more emphasis on productive skills such as problem solving, information handling, and inquiry skills; (b) The content of the curriculum may change toward more opportunities for students to work on real-life problems; (c) Teaching strategies and, as a consequence, the role of teachers may change; (d) Students will work more in small groups, or individually at the computer, in different locations for different periods of time; and (e) The assessment of students' achievement may change.

Plomp et al. (1990) also emphasized the importance of the realization that real integration of computers into the curriculum comprises more than simple innovation. The integration of computer use in the classroom covers three dimensions of change: (a) the use of new hardware and software materials; (b) the use of new activities, behaviors or practices in teaching and learning; and (c) changes in beliefs and understandings.

Hill (1983) suggested that teachers focus on the following two key questions as they attempt to integrate computers into the curriculum: (a) How do the software and the computer activities assist in meeting instructional objectives? and (b) Does the plan to use computers utilize their unique potential and is there an advantage in their use over other media? Bullock (1988) also indicated that teachers should mold their lesson plans around their teaching objectives rather than around the software itself.
Hawkins and Sheingold (1986) added that computer applications do not always fit easily into the curriculum. Modification and reshaping are sometimes necessary. The curriculum must be examined seriously to determine the ways in which computers can be used with good teaching practices in order to enhance both teaching and learning (Bradley, 1984).

Komoski (1984) suggested that the integration process should involve an assessment of curricular areas that can be improved through the use of computers and the location of software which is more effective than other instructional materials. According to Parker (1985), teachers should focus on the goals of the curriculum, analyze student achievement in order to identify objectives that students have trouble mastering, and then use the computer as a teaching tool in these areas.

Weller and Wolfe (1985) stressed the need for a plan which includes goals and objectives in the introduction of computers into the curriculum. The skills and concepts to be learned through the use of computers, as well as appropriate software, should be identified. Logistics for student use of computers and an evaluation process for the learning objectives need to be developed.

According to Swick (1989), the effective utilization of computers must be based on an understanding of how children learn. With the nature of children's learning and
development, specific criteria have been identified as critical to their successful integration into the classroom. Swick suggested two criteria: (a) the integration of computers into the natural context of the classroom and (b) the utilization of computers as interactive learning tools. Furthermore, Swick also determined the guidelines to meet educational needs of young children as follows:

1. Integrate computers into the environment so that children use them as a natural medium for learning.

2. Provide extensions of the classroom computer environment in another part of the center where special projects and parent-child computer experiences can occur.

3. Use computers as part of the total curriculum, relating content to the context of other activities in the program.

4. Select software that promotes children's active exploration of the environment.

5. Experiment with different uses of computers so that the program avoids the mathematical flavor often associated with commercial learning tools.

Swick (1989) also suggested that the practices that imply the effective integration of computers into the curriculum include (a) developing hardware in a natural context, (b) relating software to the overall goals of the curriculum, (c) integrating computer usage into other learning activities in the other programs, (d) sequencing
programs according to the developmental levels of the children, (e) providing for the extension of program concepts to other learning stations, and (f) developing software that invites creative participation by children.

In a review of related research, Benjamin, Bryant, and Mack (1990) suggested the following instructional principles for integrating computer use in the classroom:

1. Computer education should be integrated into the regular curriculum. Computers should be utilized as another medium through which educators teach the standard curriculum.

2. Traditional computer literacy curricula should be de-emphasized.

3. Computers can most appropriately be used to help students experience important learning processes.

4. CAI should be carefully chosen and properly implemented. The best CAI is that which is closely tied to classroom curricular objectives and which requires higher level thinking by students.

5. There should be a lessening of emphasis on programming.

6. In schools where a shortage of computers exists, a laboratory arrangement is recommended. Where adequate resources exist, computers should also be placed in classrooms.
7. Students require adequate time to practice using computers. A minimum of 3 days per week and 30 minutes per day are appropriate goals.

Anderson (1990-1991) made the following suggestions for teachers who wish to integrate computers into the curriculum:

1. Consider curricular objectives and individual needs. The first practice for successful computer lessons is to correlate the software used with curricular objectives and student needs.

2. Be actively involved in technology-based lessons. By providing students with an introduction to the software and by guiding students when using the program and extending students' understanding of the material, teachers make the students' experience with technology more meaningful.

3. Structure lessons so that students work together in groups.

4. Take advantage of technology training opportunities.

5. Collaborate with other teachers for lesson ideas and improvement.

Maddux (1991) listed the following three conditions that must be met before curriculum integration can be regarded as a realistic educational goal:

1. There must be a substantial body of excellent software available for use in teaching a variety school subjects.
2. There must be a sufficient number of computers and peripherals in the schools to permit distribution to individual classrooms.

3. Teachers must develop the level of interest and expertise in educational computing to enable them to intelligently integrate computing into their classrooms and their teaching methods.

Teacher Preparation

As computers continue to be integrated into schools, it becomes increasingly necessary to train teachers and educators to use this new technology appropriately. Kull and Archambault (1984), who conducted a survey of teacher preparation in computer education, found that there is, indeed, a widespread response on the part of colleges and departments of education to the need for including computer studies as part of the education of teachers. Their findings suggest that a large majority of institutions are not training computer education specialists, but are, instead, aiming their courses at teachers who are preparing for, or engaged in, all areas and levels of teaching.

Fulton (1989) stated that, although almost all schools of education currently offer some form of computer training to their students, this typically consists of a basic introduction to computers in one education course which is not enough to prepare teachers to use computers in a wide
range of classroom applications. Fulton suggested that what is needed is a dual focus on training and education. Training gives teachers the necessary skills to work with the technology, and education provides a vision of how to work with it. Education and training are two coequal sides of the educational technology preparation issue: one is not appropriate without the other, and neither can stand alone.

Bitter and Yohe (1989) suggested that two fundamental goals in preparing teachers should be the application of products and the understanding of processes. The products of technology refer to teachers' ability to apply technical skills to produce desired results. The primary motive for teaching about the products of technology is to provide practical experiences so that novices can feel comfortable using new methods. According to Bitter and Yohe, the types of products for teachers to master fall into two categories. The first is learning to use technology as an instructional tool. Classroom management skills are needed by teachers in order to fulfill the demands placed upon them by administrators. The second area relates to the delivery of instruction. Technology can be used as a teaching tool; thus, teachers must understand the various methods of integrating hardware and software into the curriculum. As with the presentation of using technology as a management tool, the presentation of instructional software should provide practical, hands-on experiences. Bitter and Yohe
also suggested that teachers' knowledge about technology must go beyond the application of products to the understanding of the processes. The teaching of the process of educational technology should include not only the technical aspects, but also the conceptual skills required of teachers in the information age. The conceptual skills are the limits, extensions, and the future of technology. The process of educational technology does not change as rapidly as do the products. A broad understanding of the processes enables teachers to apply technology in a number of specific situations. Bitter and Yohe emphasized that teachers' preparation programs cannot practically place students in every situation that they may experience during their careers, but a conceptual understanding of the processes can enable teachers to cope with the many changes they are likely to encounter.

Valdez (1989) described three stages that most teachers experience when learning to use technology for educational improvement. The first is awareness of what software packages are available in their content or subject area. This stage is characterized by skepticism or interest about the capability of technology and its value to students. The second major stage is concerned with adoption, implementation, and integration. The needs of teachers in this phase center around curriculum integration, instructional design, research findings, and software and
hardware availability. Important resources are content persons who are knowledgeable about how technology can be integrated into the curriculum to meet present and future learning expectations. The third major phase is concerned with reinforcement, adaptation, and new versions. At this stage, application software becomes increasingly important. Resource persons for this phase are exemplary teachers, instructional designers, and visionary individuals who are capable of inspiring participants to go beyond the existing software and exploit their own creativity.

Criswell (1989) indicated the following three problems with computer training for pre-service teachers: (a) there is a need to ensure basic microcomputer skills in all education students as early as possible, (b) coursework needs to be properly sequenced in order to develop more sophisticated software evaluation skills, and (c) student teachers need practical experience integrating microcomputers into classrooms. In order for teacher education institutions to address these problems, Criswell made the following recommendations:

1. Develop a sequence of instruction that provides all teacher education students with a specific level of basis microcomputer understanding by the completion of their liberal studies.

2. Develop training for teacher education instructors that permits them to appropriately model the use of
microcomputers in the classroom as an instructional tool. This lends support to the integration of microcomputers into the learning process and helps to reinforce basic microcomputer skills with students.

3. Sequence additional microcomputer courses and experiences beyond basic entry-level courses. Ensure that these courses are taught after students develop an understanding of the principles of effective teaching and learning.

4. Provide training for cooperating teachers so that clinical experiences include the actual utilization of microcomputers in the classroom.

Based on the findings of their studies, Kloosterman, Ault, and Harty (1987) provided a list of recommendations for teacher training institutions:

1. New teachers should be provided with a course in instructional development which focuses on the integration of software into their subject area. They should also have experience in planning units of study which use computers as teaching tools.

2. New teachers should have word processing experience on at least two different word processors, as well as database experience.

3. New teachers should be exposed to a variety of software.
4. New teachers should be familiar with models that can be used for innovations and creativity in teaching, and should be allowed to work with teachers who operationalize those models.

Telem (1984) proposed a training program based on the premise that administrators and teachers should receive a common basis that will introduce them to the world of computers. Beyond this basic training program, the path splits into an instructional path and an administrative path. The instructional path provides teachers with the primary skills needed to (a) utilize and apply computers in the instructional process, especially in their respective teaching fields; (b) display competence in computer programming and authoring language, thus enabling them to develop or acquire CAI software; (c) integrate CAI into a course by designing and applying drill and practice, simulation, and models as teaching tools; and (d) utilize and apply CMI in classroom administration.

The administrative path provides educational administrators with the primary skills needed to (a) utilize or apply computers in a school's administration, and especially in their specific areas of responsibility; (b) display competence in programming, thus enabling them to decide on software that will serve in their administrative tasks; and (c) understand CAI and CMI principles.
Based on the results of a study by the Northwest Council for Computer Education and Oregon University the following competencies were proposed for computer-using educators (Niess, 1990).

Every elementary school teacher should (a) fit the computer to the curriculum, rather than the curriculum to the computer; (b) obey copyright laws and discuss ethical issues of computer use; (c) use the computer as a personal and professional tool; (d) integrate, where appropriate, applications of the computer (computer assisted instructional software, word processing written compositions) in a variety of subject and content areas, in a variety of teaching and learning strategies (cooperative learning, individual learning, problem solving); (e) use basic computer terminology; (f) demonstrate familiarity with the everyday operation of computer hardware and software in order to troubleshoot minor problems with various computer laboratory structures and their management; (g) use the computer in his or her own learning of subject matter; (h) demonstrate familiarity with computing topics and educational materials available for the elementary level; (i) use a variety of sources for information on computers in education; (j) demonstrate knowledge of the impact of computer-based technology on our society, including present and future uses of computing technology in the home, at school, and at work;
and (k) instruct students in keyboarding and the use of appropriate media and software resources.

Every middle school teacher should (a) fit the computer to the curriculum, rather than the curriculum to the computer; (b) obey copyright laws and discuss ethical issues that result from the increasing use of computers in our society; (c) integrate, where appropriate, computer uses, applications, and topics (including computer-as-a-tool applications, vocational opportunities, multi-media techniques) in a variety of teaching and learning situations in a specialization area; (d) use the computer as a personal and professional tool; (e) demonstrate and teach familiarity with computer hardware, including everyday operation of a variety of machines, everyday operation and use of custom features of classroom machines, and minor troubleshooting of basic equipment problems; (f) use basic computer terminology; (g) use computer in his or her own learning of subject matter; (h) use a variety of sources for information on computers in education; and (i) identify, use, teach, and correct keyboarding skills of students.

Every high school teacher should (a) fit the computer to the curriculum, rather than the curriculum to the computer; (b) use the computer as a personal and professional tool; (c) obey copyright laws and discuss ethical issues that result from the increasing presence of computers in our society; (d) demonstrate knowledge of the impact of computer
based technology on our society, including present and future uses of computing technology in the home, at school, and at work; (e) design and implement appropriate computer uses and applications (including multi-media technology, simulations, CD-ROM, databases, hypermedia, telecommunications) in a variety of teaching and learning situations in a specialization area; (f) use basic computer terminology; (g) use the computer in his or her own learning of subject matter; and (h) demonstrate and teach familiarity with computer hardware, including everyday operation of a variety of machines, everyday operation and use of custom features of classroom machines, and minor troubleshooting of basic equipment problems.

Gorny (1991) recommended a computer program for teacher education curricula in Germany comprised of a preliminary course for beginner students without any computer skills and two courses of approximately 50 hours each on fundamental concepts of informatics exemplified with applications software. During the later years students should have the opportunity to take courses on the methodological problems of applying computers in his or her subject areas.

Bitter and Yohe (1989) designed an instructional model for infusing technology into a teacher education program. Their model consists of the following four linear levels of instruction throughout the training program:
Level 1—**Individualized, skills-based introduction to technology.** A skill-based introductory course which emphasizes practical, hands-on experience is needed for every prospective teacher.

Level 2—**Specialization within content areas.** This phase of the technology program should stress specific integration techniques and reinforce the fundamentals learned in previous coursework. Teaching strategies using technology as well as traditional methods should be presented within the same subject area. The teaching of technology uses should be integrated with existing topics in such courses.

Level 3—**Advanced instruction.** Features of this phase of coursework should concentrate upon a number of courses for undergraduate students in order to further develop skills in producing instructional systems that can be applied once they enter the field.

Level 4—**Service.** The teacher preparation program should support teachers after graduation by providing for informal and formal education. The service component of the teacher education program should have separate education for each venture in order to ensure improvement.

Research Related to Computer Applications in Elementary and Secondary Classrooms

In the survey of teachers on the use of computers in fifth through ninth grade classrooms, Dickey and Kherlopian (1987) found that 70% of the teachers surveyed in the United
States had access to computers. A large percentage of teachers with access to computers reported that they did not use them. The most frequently used applications reported by teachers were drill and practice, tutorial, and educational game software. A large percentage of the mathematics and science teachers used problem-solving software. Most of the teachers reported that computers had a positive effect on students' attitudes and academic achievement.

Kloosterman, Ault, and Harty (1987) completed an in-depth case study of several schools with model computer curricula. Based on their observations and interviews, schools with model computer curricula were found to provide support and opportunities for teachers to integrate computers into their classes. They found that schools were beginning to realize that computers are an integral part of school learning rather than just a supplement to the traditional curriculum. They also found that many schools were struggling with hardware and software problems and curricular questions. As teachers become more comfortable using computers, they look for effective ways to integrate computers into their teaching areas.

In a statewide training program for teachers, Stieglitz and Costa (1988) found that only about one-half of the 1,000 participants surveyed actually used computers in class after their in-service training. In their study, participants only completed a few hours of introductory training. A great
variability was found in how often computers were used and the type of use that resulted. Stieglitz and Costa also noted that while 89% of the participants felt computers had substantial benefits for students, only about one-half used computers instructionally. Most of their computer use was directed at drill and practice (60%), with only about 30% of the participants using computers for problem solving. Although the participants tended to have positive attitudes about the use of computers, the researchers concluded that developing positive attitudes alone does not necessarily lead to high levels of computer use.

Schug (1988) also found that only about 18% of the sample of high school social studies teachers surveyed actually used computers instructionally, despite the fact that almost 50% had received basic training in the use of computers. The teachers in Schug's study also expressed positive attitudes toward the use of computers in the future. Schug noted that basic training in computers is seldom enough to significantly cause a change in the patterns of computer use after training. Schug recommended that in-depth training for teachers should be developed which focuses on software and new computer applications. Schug also noted that the lack of access to computers, inadequate software, preparation time, and occasional mechanical problems were variables that constrained the instructional use of computers among social
science teachers who had received introductory in-service training.

Based on the results of his research, Wigmore (1989) made the following suggestions to increase the use of computers by science teachers: (a) decrease class size, (b) increase the number of computers in the classroom, and (c) provide more release time for teachers to implement instructional computing into their classes.

Main and Roberts (1990), who conducted a survey concerning educational technology in California public schools, found that more than 90% of the schools' computers were available for instruction and instructional support. The most common locations for the computers was in the classroom and in the laboratory. The most commonly used computer applications were word processing and individual drill and practice or tutorial.

In 1990, Heck concluded research concerning the use of microcomputer-based laboratory techniques for 50 secondary science teachers. According to Heck, science teachers indicated the need for additional support in terms of preparation time to develop effective laboratory experiences for students, more computer hardware, and assistance in the selection of new software programs.

Welle-Strand (1991) reported the results of a 4-year research project concerning computer applications in classrooms which was conducted by the Ministry of Church and
Education, Norway. The content of the experimental project was basically influenced by the intention of the Program of Action, school readiness, and the local and regional educational authorities' support. Experiments were first focused upon machines and software, but the focus was later changed to pedagogical aspects. The results differed between schools and were dependent upon the quality of the aspects mentioned. Following are some interesting results of the projects:

1. The use of computers appeared to have a positive effect on the abilities of students to complete tasks and solve problems.

2. The use of computers appeared to promote cooperation among students and between teachers and students.

3. The motivation among students to use computers in their work was high, and was most often higher than for similar tasks when computers were not being used.

4. The students' self-images were strengthened through mastering the computer.

5. Students' results were influenced by the quality of project implementation, as well as by teacher performance (quality and stability). More students gained experience as the project adapted to new subjects and more teachers.

6. Teacher use was primarily influenced by external and internal competency building. Competency building within a
school was crucial, and was influenced by the school's climate.

7. Dissemination to other teachers within a school was influenced by the enthusiasm and push of projects teachers and by their ability to demonstrate the use of computers.

Summary

Computers can access large amounts of information and manipulate it for educational purposes. This technology frees teachers from administrative tasks so they can give more attention to the needs of each student and the adaptation of the curriculum. The integration of computers into the curriculum often leads to new ways of looking at the curriculum and at education. It has the potential of promoting a more individualized, competency-based type of learning. This new vantage point can change the role of teachers from that of distributors and presenters of knowledge to that of facilitators of instruction. Many of these changes presently remain as potential rather than actual transformations. Greater and more thoughtful use of computers by educators at all levels will gradually make these changes a reality.
CHAPTER 3

METHODOLOGY

This study was designed to provide a base of descriptive information about computer applications in classrooms in Thailand. The goal for this study was to collect detailed descriptions of the existing status of computer use in schools which could be used to develop intelligent plans for improving computer applications in classrooms in Thailand. The survey method was the most appropriate choice for this study because the research did not trace any interrelationships between facts, as in an interrelationship study, and did not study any changes that take place as a function of time, as in a developmental study (Dalen, 1979).

Population and Sampling

The population of this study consisted of elementary and secondary school teachers and college instructors in the Northeastern area of Thailand. The Northeastern region consists of 16 provinces and has 18 million inhabitants, approximately one-third of the population of Thailand. The majority of Northeasters live in rural areas and make their living as small scale farmers. The sample, which consisted of 320 elementary and 320 secondary school teachers and 100 college instructors, was selected by means of a
stratified random sampling technique. The stratified random sampling technique was used for the following reasons: (a) A stratified random sample assures representation of the important characteristics within the population being sampled, and (b) stratified random sampling offers the possibility that a very heterogeneous population (which would require a large sample size without stratification) can be stratified into a number of relatively homogeneous strata, each requiring a relatively small sample. Subjects were grouped according to the following characteristics: province, gender, and school level.

Development of the Instrument

The questionnaire employed was developed for this study. First, the survey concerning computer use in the classroom developed by National Education Association was studied for ideas about content and format (Norman, 1983). Second, items were constructed for the current instrument based on the research questions, the research objectives, and the review of literature. Twenty-seven items were written and organized into two parts: Part A to be answered by all teachers, and Part B to be answered by teachers who used computers in classrooms (see Table 1). Third, the constructed questionnaire was then reviewed by a panel of experts in computer education and other fields of education to verify content and face validity. The panel consisted of two
American experts and three Thai experts. Panel members were asked to review and rate all items based on their appropriateness and the degree of alignment with respective objectives and research questions. Items which were rated as poor by a majority of the panel members were revised. The revisions were then resubmitted to the panel of experts for verification.

<table>
<thead>
<tr>
<th>Information Category</th>
<th>Item</th>
<th>Research Question</th>
<th>Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher characteristics</td>
<td>1-5</td>
<td>-</td>
<td>All</td>
</tr>
<tr>
<td>Teacher support</td>
<td>6-10</td>
<td>3</td>
<td>School Teachers</td>
</tr>
<tr>
<td>Integration of computer into school curriculum</td>
<td>11</td>
<td>2</td>
<td>All</td>
</tr>
<tr>
<td>Teacher preparation</td>
<td>12-16</td>
<td>1</td>
<td>All</td>
</tr>
<tr>
<td>Learning interest</td>
<td>12-14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Future perspectives</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teacher preparation program</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description of computer use</td>
<td>17-27</td>
<td>4</td>
<td>Computer Users</td>
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<tr>
<td>Equipment</td>
<td>17-18</td>
<td></td>
<td></td>
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<td>Applications</td>
<td>19-22</td>
<td></td>
<td></td>
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<td>Student use, effect</td>
<td>23</td>
<td></td>
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<td>Computer programs</td>
<td>24-25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Needs</td>
<td>26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>27</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pilot Study

A pilot study was conducted using 35 subjects who were drawn from the same population as the main study. The 35 subjects included 10 elementary and 12 secondary school teachers and 13 college instructors. The pilot study was conducted in order to assure that the questions were clear and understandable and that the instructions for completing the survey instrument were free of ambiguities. The questionnaire, a cover letter, and a postage-paid envelope were mailed to the subjects. When the subjects completed their responses to the questionnaire, the completed questionnaires were returned by mail. A week after each completed questionnaire was received, a new copy of the questionnaire, the cover letter, and a postage-paid envelope were mailed to the same respondents. They were asked to respond to the questionnaire again. They were also asked to comment about any items in the questionnaire that needed clarification or improvement. Their suggestions were used in the final revision of the questionnaire.

The returned questionnaires from the first and second administrations were analyzed using the chi-square for test-retest reliability. The $n \times n$ contingency table between the first responses and second responses of each item was constructed (where $n$ is a number of values of each item). Next, the chi-square value of each item was calculated. Results of the analysis showed that every item in the
questionnaire was reliable and that the chi-square on each item indicated a high degree of consistency between the two responses (the lowest p < .02).

Procedures for Collection and Analysis of Data

Following the final revision of the instrument, a letter requesting permission and asking for cooperation with this study was sent to the school superintendents of each province in the Northeastern area of Thailand. This letter indicated support from the Dean of the College of Education at Khon Kaen University. Next, a letter explaining the purposes of the study and procedures for administration of the questionnaires, the final revised questionnaire, and a postage-paid envelope were mailed to each subject. After 3 weeks, a second reminder letter, accompanied by another copy of the questionnaire, was sent to non-respondents. Seven hundred and forty questionnaires were sent to 320 elementary school teachers, 320 secondary school teachers, and 100 college instructors. Six hundred and twenty-one questionnaires were returned, representing a return rate of 83.92%. Upon the return of the questionnaires, responses were assigned numerical codes to facilitate statistical analysis by computer.

In order to consolidate and classify responses to the research questions, statistical analyses were performed
through the use of the computer program, the Statistical Package for the Social Science (SPSS), as follows:

1. To determine educators' opinions toward encouragement and incentives to use computers, integration of computers into the curriculum, teacher preparation, impact of computers on education, and description of computer use in the classroom, the statistical analysis required the use of standard descriptive statistics to report the overall opinions of the sample.

2. Three independent sample t-tests were employed to investigate whether significant differences in opinions toward the integration of computers into the curriculum existed between school teachers and college instructors, elementary and secondary school teachers, teachers who used computers and teachers who did not.

3. In order to investigate whether significant differences in opinions toward the integration of computers into the curriculum existed among teachers with different educational backgrounds and teachers with different teaching experiences, one-way analysis of variance (ANOVA) was used. If any significant differences were found while testing the hypotheses using one-way ANOVA, the Scheffe method was employed to find the significant pairs. The Scheffe method, according to Ferguson (1981), is more rigorous than the Tukey, Newman-Keuls, or Duncan tests. The Scheffe method was
appropriate for this study because it permits comparison between groups of unequal numbers.

4. In order to determine if significant differences in opinions toward the impact of computers on education existed between school teachers and college instructors, male and female teachers, elementary and secondary school teachers, and teachers who used computers and teachers who did not, the t-test was employed.

5. In order to determine if significant differences in opinions toward the impact of computers on education existed among teachers with different educational backgrounds and teachers with different teaching experiences, one-way analysis of variance (ANOVA) was used. If any significant differences were found while testing the hypotheses using one-way ANOVA, the Scheffe method was employed to find the significant pairs.

6. In order to determine if significant differences in opinions toward teachers' interest in learning about computers and computer use existed between male and female teachers, elementary and secondary school teachers, and teachers who used computers and teachers who did not, the t-test and the contingency chi-square test were employed.

7. In order to determine if significant differences in opinions toward teachers' interest in learning about computers and computer use existed among teachers with different educational backgrounds and teachers with different
teaching experiences, one-way analysis of variance (ANOVA) and the contingency chi-square test were used. If any significant differences were found while testing the hypotheses using one-way ANOVA, the Scheffe method was employed to find the significant pairs.

The findings of this study are reported at .05 or smaller levels of significance. Statistical analyses used to analyze the data are summarized in Table 2.

Table 2

*Statistical Analysis Design*

<table>
<thead>
<tr>
<th>Information Category</th>
<th>Variable</th>
<th>Statistical Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher characteristics</td>
<td>Item 1-5</td>
<td>Descriptive Statistics</td>
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<tr>
<td>Integration of computers into the curriculum</td>
<td>Item 11</td>
<td>Descriptive Statistics</td>
</tr>
<tr>
<td>Teacher preparation</td>
<td>Item 11-14, 16</td>
<td>Descriptive Statistics</td>
</tr>
<tr>
<td>Impact of computers</td>
<td>Item 15</td>
<td>Descriptive Statistics</td>
</tr>
<tr>
<td>Encouragement and incentives to use computers</td>
<td>Item 8-10</td>
<td>Descriptive Statistics</td>
</tr>
<tr>
<td>Description of computer use</td>
<td>Item 17-26</td>
<td>Descriptive Statistics</td>
</tr>
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<td>Information Category</td>
<td>Variable</td>
<td>Statistical Analysis</td>
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</tr>
<tr>
<td>Differences in opinions toward the integration of computers into the curriculum</td>
<td>-School level</td>
<td>T-test</td>
</tr>
<tr>
<td></td>
<td>-Experience in computer use</td>
<td>T-test</td>
</tr>
<tr>
<td></td>
<td>-School teachers and college instructors</td>
<td>T-test</td>
</tr>
<tr>
<td></td>
<td>-Teaching experience</td>
<td>One-way ANOVA</td>
</tr>
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<td></td>
<td>-Educational background</td>
<td>One-way ANOVA</td>
</tr>
<tr>
<td>Differences in opinions toward the impact of computers on education</td>
<td>-Sex</td>
<td>T-test</td>
</tr>
<tr>
<td></td>
<td>-Experience in computer use</td>
<td>T-test</td>
</tr>
<tr>
<td></td>
<td>-School level</td>
<td>T-test</td>
</tr>
<tr>
<td></td>
<td>-School teachers and college instructors</td>
<td>T-test</td>
</tr>
<tr>
<td>Differences in opinions toward the impact of computers on education</td>
<td>-Educational background</td>
<td>One-way ANOVA</td>
</tr>
<tr>
<td></td>
<td>-Teaching experience</td>
<td>One-way ANOVA</td>
</tr>
<tr>
<td>Differences in opinions toward teachers' interest in learning about computers and computer use</td>
<td>-Sex</td>
<td>T-test and Chi-square</td>
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<td></td>
<td>-Experience in computer use</td>
<td>T-test and Chi-square</td>
</tr>
<tr>
<td></td>
<td>-School level</td>
<td>T-test and Chi-square</td>
</tr>
<tr>
<td>Information Category</td>
<td>Variable</td>
<td>Statistical Analysis</td>
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<td></td>
<td>-Teaching experience</td>
<td>One-way ANOVA and Chi-square</td>
</tr>
</tbody>
</table>
CHAPTER 4

PRESENTATION AND ANALYSIS OF THE DATA

The findings and a discussion and interpretation of data analysis are presented in this chapter. Data were gathered to answer the following questions.

1. What are school teachers' and college instructors' opinions regarding teacher preparation to utilize computers?
   1.1 Are school teachers interested in learning about computers and their instructional applications?
   1.2 Are there any differences among school teachers who are interested in learning about computers and their instructional applications based on their gender, school level, educational background, experience using computers in the classroom, and teaching experience?
   1.3 How do school teachers and college instructors view the impact of computers on education?
   1.4 Do school teachers view the impact of computers on education differently based on their gender, school level, educational background, experience using computers in the classroom, and teaching experience?
   1.5 Do school teachers and college instructors view the impact of computers on education differently?
2. What are school teachers' and college instructors' opinions concerning the integration of computers into the curriculum?

2.1 Do school teachers view the integration of computers into the curriculum differently from college instructors?

2.2 Do school teachers view the integration of computers into the curriculum differently based on their school level, educational background, experience using computers in the classroom, and teaching experience?

3. What kinds of encouragement and incentives to use computers are provided by schools?

3.1 Are school teachers provided with computer services?

3.2 Are school teachers encouraged to use computers?

3.3 Are school teachers prepared to use computers?

4. What is the current status of computer utilization in classrooms?

4.1 How available are computers to these users?

4.2 How satisfied are teachers with the available software?

4.3 How do teachers use computers in classrooms?

4.4 What effects do teachers believe computers have on students?

4.5 What are teachers' most urgent needs in the area of instructional computing?
Sample Characteristics

Survey participants consisted of elementary and secondary school teachers and college instructors in the Northeastern area of Thailand. For analytical purposes, participants were grouped according to the following characteristics: gender, school level, experience using computers, educational background, and teaching experience. The composition and size of the sample by subgroups are shown in Table 3.

As shown in Table 3, the sample consisted of 527 school teachers (84.86%) and 94 college instructors (15.16%). Three hundred fifty-nine (68.12%) of the 527 school teachers were female, and 168 (31.88%) were male; 281 (53.32%) of the 527 school teachers were working in elementary schools, and 246 (46.68%) were working in secondary schools; 131 school teachers (24.86%) had used computers in the classroom, and 396 (75.14%) had never used computers; 58 school teachers (11%) held no degrees, 411 (77.99%) held bachelor's degrees, and 58 (11%) held master's degrees; 37 of the 527 school teachers (7.02%) had worked for less than 5 years, 85 (16.13%) had worked for 5 to 10 years, and 405 (76.85%) had worked for more than 10 years.

Research Question Findings

Based on the research questions, the findings and interpretations of data analysis are presented in four main
Table 3

Percentage of Surveyed Respondents in Each Characteristic by Subgroup

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>College instructors</td>
<td>94</td>
<td>15.14</td>
</tr>
<tr>
<td>School teachers</td>
<td>527</td>
<td>84.86</td>
</tr>
<tr>
<td>Sex</td>
<td>527</td>
<td>100.00</td>
</tr>
<tr>
<td>Female</td>
<td>359</td>
<td>68.12</td>
</tr>
<tr>
<td>Male</td>
<td>168</td>
<td>31.88</td>
</tr>
<tr>
<td>School level</td>
<td>527</td>
<td>100.00</td>
</tr>
<tr>
<td>Elementary</td>
<td>281</td>
<td>53.32</td>
</tr>
<tr>
<td>Secondary</td>
<td>246</td>
<td>46.68</td>
</tr>
<tr>
<td>Computer experience</td>
<td>527</td>
<td>100.00</td>
</tr>
<tr>
<td>Users</td>
<td>131</td>
<td>24.86</td>
</tr>
<tr>
<td>Nonusers</td>
<td>396</td>
<td>75.14</td>
</tr>
<tr>
<td>Educational background</td>
<td>527</td>
<td>100.00</td>
</tr>
<tr>
<td>No degree</td>
<td>58</td>
<td>11.00</td>
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<tr>
<td>Bachelor degree</td>
<td>411</td>
<td>77.99</td>
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<tr>
<td>Master's degree</td>
<td>58</td>
<td>11.00</td>
</tr>
<tr>
<td>Teaching experience</td>
<td>527</td>
<td>100.00</td>
</tr>
<tr>
<td>Less than 5 years</td>
<td>37</td>
<td>7.02</td>
</tr>
<tr>
<td>5 to 10 years</td>
<td>85</td>
<td>16.13</td>
</tr>
<tr>
<td>More than 10 years</td>
<td>405</td>
<td>76.85</td>
</tr>
<tr>
<td>Total</td>
<td>621</td>
<td>100.00</td>
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</tbody>
</table>

categories:  (a) Teacher preparation (Questions 1, 1.1, 1.2, 1.3, 1.4 and 1.5); (b) Integration of computers into the curriculum (Questions 2, 2.1, and 2.2); (c) Encouragement and incentive to use computers (Questions 3, 3.1, 3.2, 3.3); and
(d) The current status of computer utilization in the classroom (Questions 4, 4.1, 4.2, 4.3, 4.4 and 4.5).

1. Teacher Preparation

This section contains a summary of responses to research question 1: What are the school teachers' and college instructors' opinions regarding teachers' preparation to utilize computers?

1.1 Teacher interests. Whatever engages the attention of teachers can be regarded as an important consideration in the preparation of teachers for educational computing. The types of interests that teachers have can be the focus of training programs for teachers. In this section, teachers' interests in learning about computers are examined with respect to general computer topics, specific instructional applications, and formal training.

The percentage of teachers expressing interest in each computer subject is shown in Table 4. The percentage of teachers with interest ranged from 78.70% who were interested in instructional applications to 35.90% who were interested in the history of computer development. Three-fourths of all teachers were interested in computer applications for instructional purposes. The four leading subjects which were of interest to the majority of the teachers surveyed were computer applications for instructional purposes (78.70%),
Table 4

Percentage of Teacher Interest in Computer Subjects

<table>
<thead>
<tr>
<th>Computer subject</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer applications for instructional purposes</td>
<td>415</td>
<td>78.70</td>
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<tr>
<td>Computer programming</td>
<td>372</td>
<td>70.60</td>
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<tr>
<td>Implementation of computers in the classroom</td>
<td>335</td>
<td>63.60</td>
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<tr>
<td>Operation of computer hardware</td>
<td>307</td>
<td>58.30</td>
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<tr>
<td>Integration of computers into the curriculum</td>
<td>286</td>
<td>54.03</td>
</tr>
<tr>
<td>Development of educational software</td>
<td>277</td>
<td>52.60</td>
</tr>
<tr>
<td>How to teach computer science</td>
<td>264</td>
<td>50.10</td>
</tr>
<tr>
<td>Selection of computer hardware for the classroom</td>
<td>218</td>
<td>41.40</td>
</tr>
<tr>
<td>History of computer development</td>
<td>189</td>
<td>35.90</td>
</tr>
</tbody>
</table>

N = 527

computer programming (70.60%), implementation of computers in the classroom (63.60%), and operation of computer hardware (58.30%).

The opinions of college instructors concerning computer subjects that school teachers need to study were also investigated. Data presented in Table 5 reflect the percentage of college instructors who considered each of the
Table 5
Percentage of College Instructors Considering Each Computer Subject Important for School Teachers

<table>
<thead>
<tr>
<th>Computer subject</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer applications for instructional purposes</td>
<td>78</td>
<td>83.00</td>
</tr>
<tr>
<td>Operation of computer hardware</td>
<td>68</td>
<td>72.30</td>
</tr>
<tr>
<td>Implementation of computers in the classroom</td>
<td>67</td>
<td>71.30</td>
</tr>
<tr>
<td>Computer programming</td>
<td>55</td>
<td>58.50</td>
</tr>
<tr>
<td>Integration of computers into the curriculum</td>
<td>43</td>
<td>45.70</td>
</tr>
<tr>
<td>Development of educational software</td>
<td>41</td>
<td>43.60</td>
</tr>
<tr>
<td>How to teach computer science</td>
<td>34</td>
<td>36.20</td>
</tr>
<tr>
<td>Selection of computer hardware for the classroom</td>
<td>34</td>
<td>36.20</td>
</tr>
<tr>
<td>History of computer development</td>
<td>21</td>
<td>22.30</td>
</tr>
</tbody>
</table>

N = 94

computer subjects important for school teachers to learn. The four leading subjects that college instructors viewed as important for school teachers to learn were computer applications for instructional purposes (83%), operation of computer hardware (72.3%), implementation of computers in the classroom (71.3%), and computer programming (58.5%). Their opinions were similar to those of school teachers; however,
college instructors viewed computer programming less important than did school teachers (58.5% and 70.6%, respectively).

As shown in Table 4, 78.7% of the teachers expressed interest in learning about instructional computing applications. The topic was examined more closely through a question that focused on specific applications. Teachers were asked to indicate the extent of their interest on a four-point scale which ranged from no interest to great interest. The results of teachers' rating shown in Table 6 suggest that, regardless of application type, many teachers were interested in the ways computers could be applied for instructional purposes. More than 65% of the teachers expressed some interest or great interest in every application type. The five application types which were of greatest interest to teachers were enrichment activities for high ability students (89.8%), maintenance of student records (88.8%), monitoring of student mastery of difficult material (86.9%), tutorials to teach students concepts or content (85.8%), and development of students' problem-solving abilities (85.5%). The smallest percentage of teachers reported some or great interest in applications for computer games to practice and reward student performance (65.1%).

The opinions of college instructors regarding school teachers' knowledge and skills about computer applications in the classroom were also investigated. The same question that
Table 6

Teachers’ Ratings of Interest in Instructional Applications

<table>
<thead>
<tr>
<th>Computer Applications</th>
<th>Percentage of Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NI</td>
</tr>
<tr>
<td>Drill and practice for all students.</td>
<td>0.8</td>
</tr>
<tr>
<td>Remedial drill for low ability students</td>
<td>1.9</td>
</tr>
<tr>
<td>Enrichment activities for high ability students</td>
<td>0.2</td>
</tr>
<tr>
<td>Tutorials to teach students some concepts or content</td>
<td>0.2</td>
</tr>
<tr>
<td>Simulations to enrich student understanding</td>
<td>0.8</td>
</tr>
<tr>
<td>Visual-technical aid to accompany teacher presentation</td>
<td>0.9</td>
</tr>
<tr>
<td>Standardized presentation of difficult concepts</td>
<td>2.3</td>
</tr>
<tr>
<td>Monitoring of student mastery of difficult material</td>
<td>1.5</td>
</tr>
<tr>
<td>Testing to monitor student progress</td>
<td>0.2</td>
</tr>
<tr>
<td>Computer games to practice and to reward student performance</td>
<td>7.6</td>
</tr>
<tr>
<td>Maintenance of student records</td>
<td>0.6</td>
</tr>
<tr>
<td>Development of student's problem-solving ability</td>
<td>0.4</td>
</tr>
</tbody>
</table>

NI = No interest; LI = Little interest; I = Interest; GI = Great interest; N = 527
was asked of school teachers regarding interest in instructional applications, was also asked of college instructors concerning what knowledge and skills of instructional applications they believed school teachers should possess. The opinions of college instructors regarding each instructional purpose are shown in Table 7. The five instructional applications with which college instructors agreed or strongly agreed were development of students' problem-solving abilities (91.5%), enrichment activities for high ability students (90.4%), maintenance of student records (88.3%), testing to monitor student progress (86.2%), and drill and practice for all students or tutorial to teach students some concepts or content (83.5%). The smallest percentage of college instructors reported agreement or strong agreement concerning computer games to practice and reward student performance (57.4%).

Teachers' interest in learning about instructional computing was perhaps most evident in their responses to a question regarding their interest in taking an instructionally-related computer course. As shown in Table 8, 1.3% of the teachers expressed no interest in such a course, but 90.3% indicated that they were somewhat or very interested.

1.2 Comparison of teacher interest. This section contains summaries to responses to research question 1.2:
<table>
<thead>
<tr>
<th>Computer Applications</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Drill and practice for all students</td>
<td>3.2</td>
</tr>
<tr>
<td>Remedial drill for low ability students</td>
<td>8.5</td>
</tr>
<tr>
<td>Enrichment activities for high ability students</td>
<td>1.1</td>
</tr>
<tr>
<td>Tutorials to teach students some concepts or content</td>
<td>1.1</td>
</tr>
<tr>
<td>Simulations to enrich student understanding</td>
<td>6.4</td>
</tr>
<tr>
<td>Visual-technical aid to accompany teacher presentation</td>
<td>4.3</td>
</tr>
<tr>
<td>Standardize presentation of difficult concepts</td>
<td>8.5</td>
</tr>
<tr>
<td>Monitor student mastery of difficult material</td>
<td>4.3</td>
</tr>
<tr>
<td>Testing to monitor student progress</td>
<td>3.2</td>
</tr>
<tr>
<td>Computer games to practice and to reward student performance</td>
<td>7.4</td>
</tr>
<tr>
<td>Maintain student records</td>
<td>1.1</td>
</tr>
<tr>
<td>Development of students' problem-solving ability</td>
<td>1.1</td>
</tr>
</tbody>
</table>

1 = Disagree; 2 = Slightly agree; 3 = Agree; 4 = Strongly agree; $N = 94$
Table 8

Teachers' Interest in an Instructional-Related Computing Course

<table>
<thead>
<tr>
<th>Response Category</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not very interested</td>
<td>7</td>
<td>1.3</td>
</tr>
<tr>
<td>Somewhat interested</td>
<td>106</td>
<td>20.1</td>
</tr>
<tr>
<td>Very interested</td>
<td>370</td>
<td>70.2</td>
</tr>
<tr>
<td>Undecided</td>
<td>24</td>
<td>4.5</td>
</tr>
</tbody>
</table>

N = 527

Are there any differences among school teachers who are interested in learning about computers and their instructional applications based on their gender, school level, educational background, experience in using computers in the classroom, and teaching experience?

Two interest measures were included in the survey: interest in learning about certain computer subjects and interest in learning about instructional applications. Teacher responses were analyzed to determine whether there were differences among or between various subgroups on specified variables. To determine differences in interest concerning certain computer subjects, data were analyze using the chi-square test. This test was used because survey data existed in the form of frequencies rather than as scores or measurements along a scale. Computed chi-square values were
interpreted at the .05 level of significance, with degrees of freedom depending upon the number of categories being compared.

Data presented in Table 9 show the percentage of elementary school teachers and secondary school teachers who were interested in each computer subject. As shown in the table, elementary and secondary school teachers' responses were significantly different for three of the nine subjects identified. Larger percentages of secondary school teachers than of elementary school teachers were interested in learning about computer programming and the development of educational software. Meanwhile, larger percentages of elementary school teachers than of secondary school teachers reported they were interested in the operation of computer hardware.

Data presented in Table 10 show the percentage of school teachers who use computers and teachers who do not use computers in the classrooms regarding their interests in learning computer subjects. As reported in Table 10, user and nonuser responses were significantly different for only one of the nine subjects identified. A larger percentage of nonusers than users were interested in learning the history of computer development.

Data presented in Table 11 show the percentage of male teachers and female teachers interested in each computer subject. As shown in Table 11, responses of male and female
Table 9

**Elementary vs. Secondary Teachers' Interest in Learning Computer Subjects**

<table>
<thead>
<tr>
<th>Computer Subject</th>
<th>Percentage of Teachers</th>
<th>Chi-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elementary</td>
<td>Secondary</td>
</tr>
<tr>
<td><strong>Statistically significant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation of computer hardware</td>
<td>61.2</td>
<td>55.8</td>
</tr>
<tr>
<td>Computer programming</td>
<td>64.8</td>
<td>78.5</td>
</tr>
<tr>
<td>Development of educational software</td>
<td>45.6</td>
<td>61.6</td>
</tr>
<tr>
<td><strong>Statistically insignificant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of computer development</td>
<td>39.1</td>
<td>32.6</td>
</tr>
<tr>
<td>Computer applications for instructional purposes</td>
<td>76.2</td>
<td>82.2</td>
</tr>
<tr>
<td>Implementation of computers in the classroom</td>
<td>65.5</td>
<td>62.0</td>
</tr>
<tr>
<td>Selection of computer hardware for the classroom</td>
<td>43.1</td>
<td>39.7</td>
</tr>
<tr>
<td>How to teach computer science</td>
<td>50.9</td>
<td>49.6</td>
</tr>
<tr>
<td>Integration of computers into the curriculum</td>
<td>56.2</td>
<td>52.1</td>
</tr>
</tbody>
</table>

*\( p < .05 \)

Teachers were significantly different for the two subjects—computer programming and development of educational software. A larger percentage of male teachers than female teachers
Table 10

Computer User vs. Nonuser Interest in Learning Computer Subjects

<table>
<thead>
<tr>
<th>Computer Subject</th>
<th>Percentage of Teachers</th>
<th>chi-Square (df = 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Users</td>
<td>Nonusers</td>
</tr>
<tr>
<td>History of computer development</td>
<td>25.4</td>
<td>39.0</td>
</tr>
<tr>
<td>Operation of computer hardware</td>
<td>54.1</td>
<td>59.5</td>
</tr>
<tr>
<td>Computer programming</td>
<td>73.0</td>
<td>69.9</td>
</tr>
<tr>
<td>Development of educational software</td>
<td>58.2</td>
<td>50.9</td>
</tr>
<tr>
<td>Computer applications for instructional purposes</td>
<td>78.7</td>
<td>78.8</td>
</tr>
<tr>
<td>Implementation of computers in the classroom</td>
<td>61.5</td>
<td>64.2</td>
</tr>
<tr>
<td>Selection of computer hardware for the classroom</td>
<td>37.7</td>
<td>42.5</td>
</tr>
<tr>
<td>How to teach computer science</td>
<td>53.3</td>
<td>49.1</td>
</tr>
<tr>
<td>Integration of computers into the curriculum</td>
<td>55.7</td>
<td>53.8</td>
</tr>
</tbody>
</table>

*P < .05

were interested in learning computer programming and the development of educational software.

Differences in teachers' interest based on their educational backgrounds were assessed using a chi-square
Table 11

**Male vs. Female Teachers' Interest in Learning Computer Subjects**

<table>
<thead>
<tr>
<th>Computer Subject</th>
<th>Percentage of Teachers</th>
<th>Chi-Square (df = 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td><strong>Statistically significant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer programming</td>
<td>84.5</td>
<td>65.2</td>
</tr>
<tr>
<td>Development of educational software</td>
<td>63.4</td>
<td>48.2</td>
</tr>
<tr>
<td><strong>Statistically insignificant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of computer development</td>
<td>39.1</td>
<td>34.8</td>
</tr>
<tr>
<td>Operation of computer hardware</td>
<td>64.0</td>
<td>56.0</td>
</tr>
<tr>
<td>Computer applications for instructional purposes</td>
<td>83.9</td>
<td>76.9</td>
</tr>
<tr>
<td>Implementation of computers in the classroom</td>
<td>69.6</td>
<td>61.3</td>
</tr>
<tr>
<td>Selection of computer hardware for the classroom</td>
<td>39.6</td>
<td>46.0</td>
</tr>
<tr>
<td>How to teach computer science</td>
<td>53.4</td>
<td>49.0</td>
</tr>
<tr>
<td>Integration of computers into the curriculum</td>
<td>60.2</td>
<td>51.8</td>
</tr>
</tbody>
</table>

*P < .05

test. The results are shown in Table 12, which provides the percentage of teachers, based on their educational backgrounds, who were interested in learning about computer
Table 12

**Teachers' Interest in Learning Computer Subjects Based on Their Educational Background**

<table>
<thead>
<tr>
<th>Computer Subject</th>
<th>Percentage of Teachers</th>
<th>Chi-Square</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Degree</td>
<td>Bachelor's</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Statistically significant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer applications for instructional purposes</td>
<td>65.5</td>
<td>79.3</td>
</tr>
<tr>
<td>Computer programming</td>
<td>56.4</td>
<td>71.0</td>
</tr>
<tr>
<td>Development of educational software</td>
<td>51.2</td>
<td>37.6</td>
</tr>
<tr>
<td><strong>Statistically insignificant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>History of computer development</td>
<td>45.5</td>
<td>35.3</td>
</tr>
<tr>
<td>Operation of computer hardware</td>
<td>56.4</td>
<td>58.9</td>
</tr>
<tr>
<td>Implementation of computer in the classroom</td>
<td>58.2</td>
<td>63.3</td>
</tr>
<tr>
<td>Selection of computer hardware for the classroom</td>
<td>40.0</td>
<td>39.9</td>
</tr>
<tr>
<td>How to teach computer science</td>
<td>60.0</td>
<td>48.2</td>
</tr>
<tr>
<td>Integration of computers into the curriculum</td>
<td>45.5</td>
<td>54.0</td>
</tr>
</tbody>
</table>

*p < .05

Subjects. As shown in Table 12, the responses of teachers based on their educational backgrounds were significantly
different regarding computer applications for instructional purposes, computer programming, and the development of educational software. A larger percentage of teachers with a master's degree than with no degree or with a bachelor's degree were interested in learning these three subjects.

Differences in teachers' interest based on their teaching experiences were also examined using a chi-square test. The results shown in Table 13 reveal that, based on teaching experience, teachers responded significantly different for two of the nine subjects specified. Teachers with more than 5 years of teaching experience seemed to be more interested in learning about computer hardware than teachers with less than 5 years of teaching experience.

The second measure probed into their interest in instructional computing applications more deeply. Teachers were asked the extent to which they were interested in learning about 12 instructional computing applications. To determine the differences in teachers' interest toward each type of instructional applications based on various demographic classifications, the t-test and ANOVA were employed. Computed t-values and F-values were interpreted at the .05 level of significance.

In order to determine whether differences in teachers' interest toward each type of instructional computing applications were affected by school level, a t-test was employed. The results are illustrated in Table 14, which
Table 13
Teachers' Interest in Learning Computer Subjects Based on Their Teaching Experience

<table>
<thead>
<tr>
<th>Computer Subject</th>
<th>Percentage of Teachers</th>
<th>Chi-Square (df=2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;5 yrs</td>
<td>5-10 yrs</td>
</tr>
<tr>
<td><strong>Statistically significant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operation of computer hardware</td>
<td>30.0</td>
<td>51.8</td>
</tr>
<tr>
<td>Selection of computer hardware for the classroom</td>
<td>23.3</td>
<td>45.9</td>
</tr>
<tr>
<td><strong>Statistically insignificant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer applications for instructional purposes</td>
<td>66.7</td>
<td>74.1</td>
</tr>
<tr>
<td>Computer programming</td>
<td>70.0</td>
<td>62.4</td>
</tr>
<tr>
<td>Development of educational software</td>
<td>56.7</td>
<td>57.6</td>
</tr>
<tr>
<td>History of computer development</td>
<td>20.0</td>
<td>36.5</td>
</tr>
<tr>
<td>Implementation of computers in the classroom</td>
<td>66.7</td>
<td>69.4</td>
</tr>
<tr>
<td>How to teach computer science</td>
<td>36.7</td>
<td>52.9</td>
</tr>
<tr>
<td>Integration of computers into the curriculum</td>
<td>46.7</td>
<td>55.3</td>
</tr>
</tbody>
</table>

*<p < .05

also shows that the responses of elementary and secondary school teachers were significantly different for 10 of the 12
Table 14

Elementary vs. Secondary Teachers' Interest in Selected Instructional Computing Applications

<table>
<thead>
<tr>
<th>Computer Applications</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Statistically significant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enrichment activities</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary teachers</td>
<td>3.27</td>
<td>1.03</td>
<td>2.02*</td>
<td>521</td>
</tr>
<tr>
<td>Secondary teachers</td>
<td>3.43</td>
<td>0.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tutorials</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary teachers</td>
<td>2.99</td>
<td>0.97</td>
<td>3.31*</td>
<td>521</td>
</tr>
<tr>
<td>Secondary teachers</td>
<td>3.25</td>
<td>0.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simulations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary teachers</td>
<td>2.90</td>
<td>0.98</td>
<td>2.76*</td>
<td>521</td>
</tr>
<tr>
<td>Secondary teachers</td>
<td>3.12</td>
<td>0.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual-technical aid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary teachers</td>
<td>2.82</td>
<td>1.01</td>
<td>4.26*</td>
<td>521</td>
</tr>
<tr>
<td>Secondary teachers</td>
<td>3.16</td>
<td>0.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standardized presentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary teachers</td>
<td>3.07</td>
<td>1.07</td>
<td>2.40*</td>
<td>521</td>
</tr>
<tr>
<td>Secondary teachers</td>
<td>3.28</td>
<td>0.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring of student mastery</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary teachers</td>
<td>3.10</td>
<td>0.99</td>
<td>2.48*</td>
<td>521</td>
</tr>
<tr>
<td>Secondary teachers</td>
<td>3.30</td>
<td>0.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary teachers</td>
<td>3.08</td>
<td>0.98</td>
<td>2.61*</td>
<td>521</td>
</tr>
<tr>
<td>Secondary teachers</td>
<td>3.29</td>
<td>0.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer games</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary teachers</td>
<td>2.86</td>
<td>1.1</td>
<td>2.25*</td>
<td>521</td>
</tr>
<tr>
<td>Secondary teachers</td>
<td>2.66</td>
<td>0.99</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance of records</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary teachers</td>
<td>3.21</td>
<td>1.0</td>
<td>2.95*</td>
<td>521</td>
</tr>
<tr>
<td>Secondary teachers</td>
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<tr>
<td>Elementary teachers</td>
<td>3.1</td>
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<td>2.42*</td>
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Table 14 Continued

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</tr>
<tr>
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<td>0.96</td>
<td>1.70</td>
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<td>Secondary teachers</td>
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<td>0.83</td>
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<tr>
<td>Remedial drill</td>
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</tr>
</tbody>
</table>

*p < .05

application modes. Secondary school teachers expressed greater interest in these 10 application modes than did elementary school teachers. The elementary and secondary teachers' opinions were similar on drill and practice for all students and for low ability students.

Teachers' level of experience in using computers was also a focus of the analysis. Differences in teachers' interest toward instructional computing applications were assessed using a $t$-test. The results of the $t$-test for teacher interest toward each type of instructional applications are shown in Table 15.

As shown in Table 15, the responses of users and nonusers were significantly different for 3 of the 12 types of instructional computing applications. Nonusers expressed greater interest in computer games to practice and reward
Table 15

Computer User vs. Nonuser Interest in Selected Instructional Computing Applications

<table>
<thead>
<tr>
<th>Computer Applications</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
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<tr>
<td>Nonusers</td>
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<td>1.07</td>
<td>2.86*</td>
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<td>Users</td>
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<td>1.02</td>
<td></td>
<td></td>
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<tr>
<td>Enrichment</td>
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<td>Nonusers</td>
<td>3.29</td>
<td>0.98</td>
<td>2.02*</td>
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<td>Users</td>
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<tr>
<td>Visual-technical aid</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Nonusers</td>
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<td>525</td>
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<td>Users</td>
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<td>0.80</td>
<td></td>
<td></td>
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<td><strong>Statistically insignificant</strong></td>
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</tr>
<tr>
<td>Tutorials</td>
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<td></td>
</tr>
<tr>
<td>Nonusers</td>
<td>3.09</td>
<td>0.93</td>
<td>0.65</td>
<td>525</td>
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<tr>
<td>Users</td>
<td>3.15</td>
<td>0.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simulations</td>
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</tr>
<tr>
<td>Nonusers</td>
<td>2.97</td>
<td>0.96</td>
<td>1.05</td>
<td>525</td>
</tr>
<tr>
<td>Users</td>
<td>3.07</td>
<td>0.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standardized presentation</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Nonusers</td>
<td>3.13</td>
<td>1.02</td>
<td>0.91</td>
<td>525</td>
</tr>
<tr>
<td>Users</td>
<td>3.21</td>
<td>0.91</td>
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<tr>
<td>Monitoring of student mastery</td>
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<tr>
<td>Nonusers</td>
<td>3.15</td>
<td>0.97</td>
<td>1.30</td>
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<td>Testing</td>
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<td>0.82</td>
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<td></td>
</tr>
<tr>
<td>Maintenance of records</td>
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<td></td>
</tr>
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<td>Users</td>
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Table 15 Continued

<table>
<thead>
<tr>
<th>Computer Applications</th>
<th>Mean</th>
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<th>t</th>
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</thead>
<tbody>
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<td><strong>Statistically insignificant</strong></td>
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</tr>
<tr>
<td>Problem-solving</td>
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</tr>
<tr>
<td>Drill and practice</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Users</td>
<td>2.97</td>
<td>0.95</td>
<td>0.77</td>
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<tr>
<td>Nonusers</td>
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<tr>
<td>Nonusers</td>
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</tbody>
</table>

*P < .05

student performance. Meanwhile, users expressed greater interest in using computers to enrich high ability students and to accompany presentations.

A comparison of teachers' interest toward each type of instructional application by gender is shown in Table 16. The responses of male and female teachers were significantly different for 11 of the 12 types of instructional applications. Male teachers expressed greater interest in all 11 types of instructional applications. Male and female teachers expressed similar interest only in computer games to practice and reward student performance.

A comparison of teachers' interest in each type of instructional application based on their different
Table 16

Male vs. Female Teachers' Interest in Selected Instructional Computing Applications

<table>
<thead>
<tr>
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<td>3.45*</td>
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<tr>
<td>Female</td>
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<td>0.94</td>
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<td>0.97</td>
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<td>518</td>
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<tr>
<td>Female</td>
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<td>1.05</td>
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<td>0.77</td>
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<td>Female</td>
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<td>0.98</td>
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<td>0.78</td>
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<td>Female</td>
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Table 16 Continued

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<th>Computer Applications</th>
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<tr>
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<td>0.79</td>
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<td>0.96</td>
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</tr>
<tr>
<td>Computer games</td>
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<td>2.65</td>
<td>1.03</td>
<td>1.58</td>
<td>518</td>
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<tr>
<td>Female</td>
<td>2.81</td>
<td>1.03</td>
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<td></td>
</tr>
</tbody>
</table>

*p < .05

Educational backgrounds is presented in Table 17. Analysis of variance was employed to determine whether differences of responses existed. The data reveal that differences among teachers with different educational backgrounds were significant at the .05 level for 2 application types—tutorials and simulations. A pairwise comparison was employed to determine which pairs differed significantly. Data in Table 18 show the results of the significant pairs. The results of a Scheffe analysis indicate that teachers with a master's degree exhibited greater interest in tutorials and simulations than did teachers with no degrees.

Results of an analysis of variance for teachers' interest toward each type of instructional application regarding teaching experiences are presented in Table 19.
Table 17

**Teachers' Interest in Selected Instructional Computing Applications Based on Their Educational Backgrounds**

<table>
<thead>
<tr>
<th>Computer Applications</th>
<th>Mean Square Between Group</th>
<th>Mean Square Within Group</th>
<th>E</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tutorials</td>
<td>3.17</td>
<td>0.78</td>
<td>4.07*</td>
<td>.02</td>
</tr>
<tr>
<td>Simulations</td>
<td>2.79</td>
<td>0.83</td>
<td>3.38*</td>
<td>.04</td>
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<tr>
<td>Test Statistics significant</td>
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<td></td>
</tr>
<tr>
<td>Computer games</td>
<td>1.74</td>
<td>1.11</td>
<td>1.57</td>
<td>.20</td>
</tr>
<tr>
<td>Enrichment</td>
<td>1.12</td>
<td>0.82</td>
<td>1.37</td>
<td>.25</td>
</tr>
<tr>
<td>Visual-technical aid</td>
<td>1.35</td>
<td>0.87</td>
<td>1.54</td>
<td>.21</td>
</tr>
<tr>
<td>Standardized presentation</td>
<td>1.68</td>
<td>0.97</td>
<td>1.74</td>
<td>.18</td>
</tr>
<tr>
<td>Monitoring of student mastery</td>
<td>0.66</td>
<td>0.84</td>
<td>0.78</td>
<td>.45</td>
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<tr>
<td>Testing</td>
<td>1.62</td>
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<td>2.04</td>
<td>.13</td>
</tr>
<tr>
<td>Maintenance of records</td>
<td>1.75</td>
<td>0.82</td>
<td>2.14</td>
<td>.12</td>
</tr>
<tr>
<td>Problem solving</td>
<td>0.39</td>
<td>0.87</td>
<td>0.45</td>
<td>.64</td>
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<tr>
<td>Drill and practice</td>
<td>0.12</td>
<td>0.82</td>
<td>0.15</td>
<td>.96</td>
</tr>
<tr>
<td>Remedial drill</td>
<td>1.26</td>
<td>0.84</td>
<td>1.49</td>
<td>.23</td>
</tr>
</tbody>
</table>

*p < .05

The results show a significant difference among group means for 1 of the 12 application types specified—using the computer to maintain student records. A Scheffe range test
Table 18

Multiple Range Test for the Three Categories of Educational Backgrounds Regarding Interest in Tutorials and Simulations

<table>
<thead>
<tr>
<th>Mean</th>
<th>Group</th>
<th>Group</th>
<th>Group</th>
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<td></td>
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<td>3.10</td>
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<tr>
<td></td>
<td>3.36</td>
<td>3</td>
<td>3.01</td>
</tr>
</tbody>
</table>

Group 1 = No degree; Group 2 = Bachelor's; Group 3 = Master's

*p < .05

was performed to identify pairs with significant differences (Table 20). The results show significant differences between groups of teachers with more than 10 years experience and teachers with 5 to 10 years experience, and between teachers with 5 to 10 years experience and teachers with less than 5 years experience. Teachers with more than 10 years experience and teachers with less than 5 years experience expressed greater interest in this application type than did teachers with 5 to 10 years experience. No other significant
Table 19

Teachers' Interest in Selected Instructional Computing Applications Based on Their Teaching Experience

<table>
<thead>
<tr>
<th>Computer Applications</th>
<th>Mean Square Between Group</th>
<th>Mean Square Within Group</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Statistically significant</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintain records</td>
<td>3.60</td>
<td>0.81</td>
<td>4.44*</td>
<td>.02</td>
</tr>
<tr>
<td>Statistically insignificant</td>
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<td></td>
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<td>3.31</td>
<td>1.11</td>
<td>3.08</td>
<td>.06</td>
</tr>
<tr>
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<td>0.79</td>
<td>0.57</td>
<td>.56</td>
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<tr>
<td>Simulations</td>
<td>0.25</td>
<td>0.84</td>
<td>0.30</td>
<td>.74</td>
</tr>
<tr>
<td>Enrichment</td>
<td>1.30</td>
<td>0.82</td>
<td>1.59</td>
<td>.21</td>
</tr>
<tr>
<td>Visual-technical aid</td>
<td>0.05</td>
<td>0.87</td>
<td>0.06</td>
<td>.94</td>
</tr>
<tr>
<td>Standardize presentation</td>
<td>0.31</td>
<td>0.97</td>
<td>0.32</td>
<td>.72</td>
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<tr>
<td>Monitor student mastery</td>
<td>0.32</td>
<td>0.83</td>
<td>0.38</td>
<td>.68</td>
</tr>
<tr>
<td>Testing</td>
<td>1.42</td>
<td>0.79</td>
<td>1.80</td>
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<tr>
<td>Problem solving</td>
<td>1.05</td>
<td>0.87</td>
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<td>0.82</td>
<td>0.15</td>
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<tr>
<td>Remedial drill</td>
<td>1.26</td>
<td>0.84</td>
<td>1.49</td>
<td>.23</td>
</tr>
</tbody>
</table>

*p < .05

pairs were found. Teachers with different teaching experiences expressed similar interest toward the other 11 types of applications.
Table 20

Multiple Range Test for the Three Categories of Teaching Experiences Regarding Interest in Computer Use for Student Records

<table>
<thead>
<tr>
<th>Mean</th>
<th>Group</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.89</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.10</td>
<td>3</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.36</td>
<td>1</td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Group 1 = Less than 5 yrs; Group 2 = 5 to 10 yrs; Group 3 = More than 10 yrs. *p < .05

1.3. Teacher beliefs. Teachers' expectations about the future of computers in education were elicited from the questionnaire. This question was related to the likelihood of several computer-related events happening within 10 years. The question used a three-point scale: unlikely, possible, or very likely. Examination of responses to the question makes it possible to see how teachers perceived and understood the computer movement in education.

The percentages of teachers who expressed the likelihood of a number of events occurring within 10 years are shown in Table 21. Most teachers (80% or more) considered 8 of the 10 events to be possible or very likely. The following four
Table 21

**Teachers' Responses Regarding Likelihood of Events Occurring in the 1990s**

<table>
<thead>
<tr>
<th>Event</th>
<th>Response Category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Computers will stimulate innovative teaching</td>
<td>1.3</td>
</tr>
<tr>
<td>Knowing how to use a computer will be regarded as a basic skill</td>
<td>1.1</td>
</tr>
<tr>
<td>Teachers with computer skills will be in great demand</td>
<td>1.3</td>
</tr>
<tr>
<td>Learning by computers in school will be common</td>
<td>4.6</td>
</tr>
<tr>
<td>Computers will replace some teachers</td>
<td>4.0</td>
</tr>
<tr>
<td>Learning by computers out of school will be common</td>
<td>3.6</td>
</tr>
<tr>
<td>Instructional interest in computers will wane</td>
<td>2.1</td>
</tr>
<tr>
<td>Most public schools will have computers in classrooms</td>
<td>9.9</td>
</tr>
<tr>
<td>Computers will render many teaching skills obsolete</td>
<td>22.4</td>
</tr>
<tr>
<td>Schools without a computer curriculum will be regarded as inadequate</td>
<td>15.9</td>
</tr>
</tbody>
</table>

1 = Unlikely; 2 = Possible; 3 = Very likely; 4 = Don't know

N = 527
events were considered to be very likely to occur by more than 60% of the teachers: computers will stimulate innovative teaching, knowing how to use a computer will be regarded as a basic skill, teachers with computer skills will be in great demand, and learning by computer in school will be common. The two events viewed as unlikely to occur or undecided by a fairly large percentage of teachers were: computers will render many teaching skills obsolete (22.4% thought this was unlikely and 18.7% did not know), and schools without computers will be regarded as inadequate (15.9% thought this was unlikely and 33.8% did not know).

The opinions of college instructors toward the impact of computers on education was also investigated. Data presented in Table 22 reflect the opinion of college instructors toward the likelihood of a number of events occurring in the 1990s. The largest percentage of college instructors considered the event, a teacher with computer skills will be in great demand, very likely to occur (75.5%). Most college instructors (80% or more) considered 8 of the 10 events specified possible or very likely to occur. These college instructors' perspectives were similar to those of the school teachers. The lowest percentage of college instructors considered the following two events very likely to occur: computers will render many teaching skills obsolete (26.6%), and schools without a computer curriculum will be regarded as inadequate (18.1%).
Table 22

College Instructors' Responses Regarding Likelihood of Events Occurring in the 1990s

<table>
<thead>
<tr>
<th>Event</th>
<th>Response Category</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Teachers with computer skills will be in great demand</td>
<td>1.1</td>
</tr>
<tr>
<td>Knowing how to use a computer will be regarded as a basic skill</td>
<td>1.1</td>
</tr>
<tr>
<td>Learning by computers in school will be common</td>
<td>6.4</td>
</tr>
<tr>
<td>Instructional interest in computers will wane</td>
<td>1.1</td>
</tr>
<tr>
<td>Learning by computers out of school will be common</td>
<td>5.3</td>
</tr>
<tr>
<td>Computers will stimulate innovative teaching.</td>
<td>1.1</td>
</tr>
<tr>
<td>Computers will replace some teachers</td>
<td>3.2</td>
</tr>
<tr>
<td>Most public schools will have computers in classrooms</td>
<td>11.7</td>
</tr>
<tr>
<td>Computers will render many teaching skills obsolete</td>
<td>10.6</td>
</tr>
<tr>
<td>Schools without a computer curriculum will be regarded as inadequate</td>
<td>12.8</td>
</tr>
</tbody>
</table>

1 = Unlikely; 2 = Possible; 3 = Very likely; 4 = Don't know
N = 94
1.4 Comparison of teacher beliefs. This section is based on responses to research question 1.4: Do school teachers view the impact of the computer on education differently based on their gender, school level, educational background, experience in using computers in the classroom, and teaching experience? To determine differences in teachers' beliefs regarding the impact of computers on education based on various demographic classifications, the \( t \)-test and ANOVA were employed. Computed \( t \)-values and \( F \)-values were interpreted at the .05 level of significance.

A statistical analysis focused on the gender variable was performed to determine whether male and female teachers differed significantly in their beliefs regarding the impact of computers on education. Data in Table 23 provide the results of the \( t \)-test of differences between the means for male and female teachers in each event. Significant differences in mean scores between male and female teachers were found regarding two events: schools without a computer curriculum will be regarded as inadequate (\( t = 2.13, p < .05 \)) and instructional interest in computers will wane (\( t = 2.05, p < .05 \)). Male teachers expressed greater beliefs in these two events than did female teachers. No significant differences were found for the other events.

Further analyses were conducted in an effort to compare the mean scores of teachers' beliefs regarding the impact of computers on education by school level. As shown in
Table 23

Male vs. Female Teachers' Beliefs Regarding the Impact of Computers on Education in the Next 10 Years

<table>
<thead>
<tr>
<th>Event</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Statistically significant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schools without a computer curriculum will be</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>regarded as inadequate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.84</td>
<td>1.03</td>
<td>2.13*</td>
<td>518</td>
</tr>
<tr>
<td>Female</td>
<td>2.61</td>
<td>1.19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructional interest in computers will wane</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.70</td>
<td>0.60</td>
<td>2.05*</td>
<td>518</td>
</tr>
<tr>
<td>Female</td>
<td>2.55</td>
<td>0.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Statistically insignificant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teachers with computer skills will be in great demand</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.72</td>
<td>0.57</td>
<td>1.17</td>
<td>518</td>
</tr>
<tr>
<td>Female</td>
<td>2.64</td>
<td>0.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowing how to use a computer will be regarded as a basic skill</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.75</td>
<td>0.54</td>
<td>1.42</td>
<td>518</td>
</tr>
<tr>
<td>Female</td>
<td>2.66</td>
<td>0.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning by computer in school will be common</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.62</td>
<td>0.64</td>
<td>1.04</td>
<td>518</td>
</tr>
<tr>
<td>Female</td>
<td>2.55</td>
<td>0.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning by computers outside of school will be common</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.60</td>
<td>0.65</td>
<td>1.05</td>
<td>518</td>
</tr>
<tr>
<td>Female</td>
<td>2.52</td>
<td>0.80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers will stimulate innovative teaching.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.71</td>
<td>0.55</td>
<td>1.66</td>
<td>518</td>
</tr>
<tr>
<td>Female</td>
<td>2.60</td>
<td>0.72</td>
<td></td>
<td></td>
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</table>
Table 23 Continued

<table>
<thead>
<tr>
<th>Event</th>
<th>Mean</th>
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<th>t</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Statistically insignificant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers will replace some teachers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.53</td>
<td>0.70</td>
<td>0.73</td>
<td>518</td>
</tr>
<tr>
<td>Female</td>
<td>2.59</td>
<td>0.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most public schools will have computers in classrooms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.38</td>
<td>0.76</td>
<td>0.32</td>
<td>518</td>
</tr>
<tr>
<td>Female</td>
<td>2.35</td>
<td>0.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers will render many teaching skills obsolete</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.35</td>
<td>1.01</td>
<td>0.02</td>
<td>518</td>
</tr>
<tr>
<td>Female</td>
<td>2.36</td>
<td>1.10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05

Table 24, a t-test was employed to determine significant differences between group means for each event. A significant difference was found between the beliefs of elementary school teachers and secondary school teachers toward one event—learning by computer outside of school will be common (t = 2.60, p < .05). Secondary school teachers expressed greater beliefs in this event than did elementary school teachers. No significant difference was found for the other events. In other words, elementary school teachers and secondary school teachers exhibited similar beliefs regarding the likelihood of the occurrence of the other events in the next 10 years.
Table 24

Elementary vs. Secondary Teachers' Beliefs Regarding the Impact of Computers on Education in the Next 10 Years

<table>
<thead>
<tr>
<th>Event</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Statistically significant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning by computers outside of school will be common</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>2.47</td>
<td>0.80</td>
<td>2.60*</td>
<td>521</td>
</tr>
<tr>
<td>Secondary</td>
<td>2.64</td>
<td>0.68</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Statistically insignificant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schools without a computer curriculum will be regarded as inadequate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>2.58</td>
<td>1.21</td>
<td>1.96</td>
<td>521</td>
</tr>
<tr>
<td>Secondary</td>
<td>2.78</td>
<td>1.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructional interest in computers will wane</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>2.54</td>
<td>0.84</td>
<td>1.67</td>
<td>521</td>
</tr>
<tr>
<td>Secondary</td>
<td>2.66</td>
<td>0.69</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teachers with computer skills will be in great demand</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>2.61</td>
<td>0.82</td>
<td>1.84</td>
<td>521</td>
</tr>
<tr>
<td>Secondary</td>
<td>2.73</td>
<td>0.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowing how to use a computer will be regarded as a basic skill</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>2.68</td>
<td>0.77</td>
<td>0.05</td>
<td>521</td>
</tr>
<tr>
<td>Secondary</td>
<td>2.69</td>
<td>0.62</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning by computers in school will be common</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>2.57</td>
<td>0.78</td>
<td>0.20</td>
<td>521</td>
</tr>
<tr>
<td>Secondary</td>
<td>2.58</td>
<td>0.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers will stimulate innovative teaching</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>2.61</td>
<td>0.72</td>
<td>0.96</td>
<td>521</td>
</tr>
<tr>
<td>Secondary</td>
<td>2.66</td>
<td>0.62</td>
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</tbody>
</table>
Table 24 Continued

<table>
<thead>
<tr>
<th>Event</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistically insignificant</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers will replace some teachers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>2.62</td>
<td>0.80</td>
<td>1.45</td>
<td>521</td>
</tr>
<tr>
<td>Secondary</td>
<td>2.52</td>
<td>0.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most public schools will have computers in classrooms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>2.33</td>
<td>0.84</td>
<td>0.75</td>
<td>521</td>
</tr>
<tr>
<td>Secondary</td>
<td>2.39</td>
<td>0.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers will render many teaching skills obsolete</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>2.40</td>
<td>1.11</td>
<td>1.25</td>
<td>521</td>
</tr>
<tr>
<td>Secondary</td>
<td>2.28</td>
<td>1.02</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05

An analysis focused on a comparison of teachers' beliefs regarding the impact of computers on education based on experience in using a computer in classrooms was conducted using a *t*-test. The results are shown in Table 25. Teachers with and without computer-using experience expressed their beliefs differently regarding 3 of the 10 events specified: learning by computer in school will be common (*t* = 2.43, *p* < .05); most public schools will have computers in classrooms (*t* = 2.12, *p* < .05); and learning by computers outside of school will be common (*t* = 2.06, *p* < .05). Users expressed greater beliefs in these three events than did nonusers. Teachers with and without experience in using
Table 25

Computer User vs. Nonuser Beliefs Regarding the Impact of Computers on Education in the Next 10 Years

<table>
<thead>
<tr>
<th>Event</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Statistically significant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning by computers in school will be common</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonusers</td>
<td>2.52</td>
<td>0.79</td>
<td>2.43*</td>
<td>525</td>
</tr>
<tr>
<td>Users</td>
<td>2.71</td>
<td>0.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most public schools will have computers in classrooms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonusers</td>
<td>2.31</td>
<td>0.86</td>
<td>2.12*</td>
<td>525</td>
</tr>
<tr>
<td>Users</td>
<td>2.49</td>
<td>0.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning by computers outside of school will be common</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonusers</td>
<td>2.50</td>
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<tr>
<td>Users</td>
<td>2.66</td>
<td>0.64</td>
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<td><strong>Statistically insignificant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schools without a computer curriculum will be regarded as inadequate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonusers</td>
<td>2.64</td>
<td>1.16</td>
<td>0.87</td>
<td>525</td>
</tr>
<tr>
<td>Users</td>
<td>2.74</td>
<td>1.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructional interest in computers will wane</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonusers</td>
<td>2.58</td>
<td>0.81</td>
<td>0.52</td>
<td>525</td>
</tr>
<tr>
<td>Users</td>
<td>2.62</td>
<td>0.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teachers with computer skills will be in great demand</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonusers</td>
<td>2.63</td>
<td>0.81</td>
<td>1.08</td>
<td>525</td>
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<tr>
<td>Users</td>
<td>2.72</td>
<td>0.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knowing how to use computers will be regarded as a basic skill</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonusers</td>
<td>2.67</td>
<td>0.77</td>
<td>0.59</td>
<td>525</td>
</tr>
<tr>
<td>Users</td>
<td>2.71</td>
<td>0.52</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Statistically insignificant

<table>
<thead>
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<th>Event</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer will stimulate innovative teaching.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonusers</td>
<td>2.61</td>
<td>0.73</td>
<td>1.02</td>
<td>525</td>
</tr>
<tr>
<td>Users</td>
<td>2.68</td>
<td>0.55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer will replace some teachers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonusers</td>
<td>2.58</td>
<td>0.80</td>
<td>0.76</td>
<td>525</td>
</tr>
<tr>
<td>Users</td>
<td>2.52</td>
<td>0.73</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers will render many teaching skills obsolete</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonusers</td>
<td>2.36</td>
<td>1.08</td>
<td>0.59</td>
<td>525</td>
</tr>
<tr>
<td>Users</td>
<td>2.29</td>
<td>1.07</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05

computers expressed similar beliefs regarding the likelihood of the other events occurring in the next 10 years.

In order to determine whether differences in teachers' beliefs regarding the impact of computers on education were affected by educational background, an analysis of variance was employed. Data in Table 26 present the results of an analysis of variance for opinions toward the impact of computers on education by teachers with different educational backgrounds. These data reveal that the difference was significant for 1 of the 10 events specified—instructional interest in computers will wane ($t[2,521] = 4.39$, $p < .05$).

Further analysis using the Scheffe test was conducted in an
Table 26

Teachers' Beliefs Regarding the Impact of Computers on Education in the Next 10 Years Based on Educational Background

<table>
<thead>
<tr>
<th>Computer Applications</th>
<th>Mean Square Between Group</th>
<th>Mean Square Within Group</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statistically significant</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructional interest in computers will wane</td>
<td>2.60</td>
<td>0.59</td>
<td>4.39*</td>
<td>.01</td>
</tr>
<tr>
<td>Learning by computers in school will be common</td>
<td>1.19</td>
<td>0.53</td>
<td>2.24</td>
<td>.11</td>
</tr>
<tr>
<td>Most public schools will have computers in classrooms</td>
<td>0.50</td>
<td>0.67</td>
<td>0.75</td>
<td>.47</td>
</tr>
<tr>
<td>Learning by computers out of school will be common</td>
<td>0.99</td>
<td>0.56</td>
<td>1.76</td>
<td>.17</td>
</tr>
<tr>
<td>Schools without a computer curriculum will be regarded as inadequate</td>
<td>0.26</td>
<td>1.33</td>
<td>0.19</td>
<td>.83</td>
</tr>
<tr>
<td>Teachers with computer skills will be in great demand</td>
<td>0.64</td>
<td>0.55</td>
<td>1.16</td>
<td>.31</td>
</tr>
<tr>
<td>Knowing how to use a computer will be regarded as a basic skill</td>
<td>0.52</td>
<td>0.49</td>
<td>1.06</td>
<td>.35</td>
</tr>
<tr>
<td>Computer will stimulate innovative teaching.</td>
<td>0.17</td>
<td>0.46</td>
<td>0.37</td>
<td>.69</td>
</tr>
<tr>
<td>Computer will replace some teachers</td>
<td>0.23</td>
<td>0.60</td>
<td>0.38</td>
<td>.68</td>
</tr>
<tr>
<td>Computers will render many teaching skills obsolete</td>
<td>0.49</td>
<td>1.15</td>
<td>0.42</td>
<td>.65</td>
</tr>
</tbody>
</table>

a_n = 2, b_n = 521, *p < .05
Table 27

Multiple Range Test for the Three Categories of Educational Backgrounds Regarding an Increase Interest in Instructional Computing Applications

<table>
<thead>
<tr>
<th>Mean</th>
<th>Group</th>
<th>2</th>
<th>1</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.55</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.67</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.86</td>
<td>3</td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Group 1 = No degree, Group 2 = Bachelor's, Group 3 = Master's. *p < .05

attempt to determine the pairs of significant differences.

Results show that teachers with master's degrees expressed their beliefs differently from teachers with bachelor's degrees at the .05 level of significance. Teachers with master's degrees expressed greater beliefs than did teachers with bachelor's degrees. No other significant pairs were found (Table 27). Teachers with different background knowledge expressed similar beliefs regarding the likelihood of the other events occurring in the next 10 years.

Table 28 contains a comparison of teachers' beliefs regarding the impact of computers on education based on different levels of teaching experience. The results show that differences of opinions among teachers with different
Table 28

Teachers' Beliefs Regarding the Impact of Computers on Education in the Next 10 Years Based on Teaching Experience

<table>
<thead>
<tr>
<th>Computer Applications</th>
<th>Mean Square Between Group(^a)</th>
<th>Mean Square Within Group(^b)</th>
<th>(\epsilon)</th>
<th>(p)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Statistically insignificant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructional interest in computers will wane</td>
<td>0.20</td>
<td>0.60</td>
<td>0.32</td>
<td>.72</td>
</tr>
<tr>
<td>Learning by computers in school will be common</td>
<td>0.20</td>
<td>0.54</td>
<td>0.37</td>
<td>.69</td>
</tr>
<tr>
<td>Most public schools will have computers in classrooms</td>
<td>0.29</td>
<td>0.67</td>
<td>0.43</td>
<td>.65</td>
</tr>
<tr>
<td>Learning by computers out of school will be common</td>
<td>0.30</td>
<td>0.56</td>
<td>0.53</td>
<td>.59</td>
</tr>
<tr>
<td>Schools without a computer curriculum will be regarded as inadequate</td>
<td>1.77</td>
<td>1.33</td>
<td>1.33</td>
<td>.26</td>
</tr>
<tr>
<td>Teachers with computer skills will be in great demand</td>
<td>1.12</td>
<td>0.55</td>
<td>2.04</td>
<td>.13</td>
</tr>
<tr>
<td>Knowing how to use a computer will be regarded as a basic skill</td>
<td>0.88</td>
<td>0.49</td>
<td>1.78</td>
<td>.17</td>
</tr>
<tr>
<td>Computer will stimulate innovative teaching.</td>
<td>0.35</td>
<td>0.46</td>
<td>0.77</td>
<td>.46</td>
</tr>
<tr>
<td>Computer will replace some teachers</td>
<td>0.38</td>
<td>0.60</td>
<td>0.63</td>
<td>.53</td>
</tr>
<tr>
<td>Computers will render many teaching skills obsolete</td>
<td>1.43</td>
<td>1.15</td>
<td>1.25</td>
<td>.29</td>
</tr>
</tbody>
</table>

\(a_n = 2, \quad b_n = 517, \quad ^*p < .05\)
levels of teaching experience regarding the likelihood of each event were not significant. In other words, teachers with different teaching experiences expressed similar beliefs regarding the impact of computers on education.

2. Integration of Computers into the Curriculum

This section includes findings related to research question 2: What are school teachers' and college instructors' opinions regarding the integration of computers into the curriculum? The frequencies and percentage of responses of the teachers toward integration of computers into the curriculum are shown in Table 29.

As shown in Table 29, 72.3% of the school teachers agreed or strongly agreed that the school curriculum needed to be revised in order to fully integrate computers into teaching and learning each school subject. Meanwhile, 62.8% of the teachers agreed or strongly agreed that computers should be integrated into teaching and learning any school subject. At the same time, 64.8% of the teachers agreed or strongly agreed that computers should be counted as instructional aids.

The opinions of college instructors regarding the integration of computers into the curriculum was also investigated. Data in Table 30 show that 74.5% of the college instructors agreed or strongly agreed that computers should be counted as instructional aids. Consequently, 55.3%
Table 29

Teachers' Opinions Regarding the Integration of Computers Into the Curriculum

<table>
<thead>
<tr>
<th>Descriptions</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DA</td>
</tr>
<tr>
<td>Computers should be integrated into teaching and learning any school subject</td>
<td>16.8</td>
</tr>
<tr>
<td>Computers should be counted as instructional aids</td>
<td>18.1</td>
</tr>
<tr>
<td>School curricula should be revised in order to fully integrate computers into</td>
<td>10.6</td>
</tr>
<tr>
<td>teaching and learning each subject</td>
<td></td>
</tr>
</tbody>
</table>

DA = Disagree; SA = Slightly agree; AG = Agree; SA = Strongly Agree. N = 527

of the college instructors agreed or strongly agreed that the school curriculum should be revised in order to fully integrate computers into the teaching and learning of any school subject. Meanwhile, 34% of the college instructors disagreed that computers should be integrated into the teaching and learning of any school subject.

2.1 Comparison between the opinions of teachers and college instructors regarding the integration of computers into the curriculum. This section includes findings related to research question 2.1: Do school teachers view the
Table 30

College Instructors' Opinions Regarding the Integration of Computers Into the Curriculum

<table>
<thead>
<tr>
<th>Descriptions</th>
<th>Percentage of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DA</td>
</tr>
<tr>
<td>Computers should be integrated into teaching and learning any school subject</td>
<td>34.0</td>
</tr>
<tr>
<td>Computers should be counted as instructional aids</td>
<td>8.5</td>
</tr>
<tr>
<td>School curricula should be revised in order to fully integrate computers into teaching and learning each subject</td>
<td>16.0</td>
</tr>
</tbody>
</table>

DA = Disagree; SA = Slightly agree; AG = Agree; SA = Strongly Agree. N = 527

integration of computers into the curriculum differently from college instructors? A t-test was employed to determine if a significant difference existed between the responses of school teachers and college instructors regarding the integration of computers into the curriculum. As shown in Table 31, differences were found in the opinions of college instructors and school teachers regarding the integration of computers into the curriculum at the .05 level of significance.
Table 31

**School Teachers' vs. College Instructors' Opinions Regarding the Integration of Computers Into the Curriculum**

<table>
<thead>
<tr>
<th>Event</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computers should be integrated into teaching and learning any school subject</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School teachers</td>
<td>2.66</td>
<td>0.98</td>
<td>4.06*</td>
<td>93</td>
</tr>
<tr>
<td>College instructors</td>
<td>2.10</td>
<td>0.92</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers should be counted as instructional aids</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School teachers</td>
<td>2.58</td>
<td>0.91</td>
<td>5.04*</td>
<td>93</td>
</tr>
<tr>
<td>College instructors</td>
<td>3.25</td>
<td>0.91</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School curricula should be revised in order to fully integrate computers into teaching and learning each subject.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School teachers</td>
<td>2.87</td>
<td>0.89</td>
<td>2.97*</td>
<td>93</td>
</tr>
<tr>
<td>College instructors</td>
<td>2.49</td>
<td>0.87</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05

2.2 **Comparison of teachers' responses toward the integration of computers into the curriculum.** This section includes findings related to research question 2.2: Do school teachers view the integration of computers into the curriculum differently based on their gender, school level, educational background, experience in using computers in classroom, and teaching experience?

In order to determine whether differences in teachers' opinions toward the integration of computers into the
curriculum were affected by gender, a t-test was employed. The results of the t-test for teachers' opinions regarding the integration of computers into the curriculum based on gender are shown in Table 32. Male teachers and female teachers expressed different opinions regarding the integration of computers into the curriculum on the following two aspects: Computers should be integrated into teaching and learning any school subject (t(518) = 3.72, p < .05); and curricula should be revised in order to fully integrate computers into teaching and learning any school subject.

Table 32

**Male vs. Female Teachers' Opinions Regarding the Integration of Computers Into the Curriculum**

<table>
<thead>
<tr>
<th>Description</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computers should be integrated into teaching and learning any school subject</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>2.53</td>
<td>1.03</td>
<td>3.72*</td>
<td>518</td>
</tr>
<tr>
<td>Male</td>
<td>2.89</td>
<td>1.01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers should be counted as instructional aids</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>2.55</td>
<td>0.98</td>
<td>0.06</td>
<td>518</td>
</tr>
<tr>
<td>Male</td>
<td>2.54</td>
<td>1.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School curricula should be revised in order to fully integrate computers into teaching and learning each school subject.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>2.75</td>
<td>0.97</td>
<td>2.53*</td>
<td>518</td>
</tr>
<tr>
<td>Male</td>
<td>2.98</td>
<td>0.91</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05*
(£[518] = 2.53, p < .05). Male teachers seemed to have more positive views than did female teachers toward the two aspects of integration.

Data in Table 33 provide a comparison of elementary and secondary school teachers' opinions toward the integration of computers into the curriculum. As shown in the table, elementary and secondary school teachers expressed their opinions differently regarding one aspect of integration: Computers should be integrated into teaching and learning any

Table 33
Elementary vs. Secondary Teachers' Opinions Regarding the Integration of Computers Into the Curriculum

<table>
<thead>
<tr>
<th>Description</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computers should be integrated into teaching and learning any school subject</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>2.54</td>
<td>1.02</td>
<td>2.64*</td>
<td>521</td>
</tr>
<tr>
<td>Secondary</td>
<td>2.78</td>
<td>1.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers should be counted as instructional aids</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>2.56</td>
<td>0.98</td>
<td>0.10</td>
<td>521</td>
</tr>
<tr>
<td>Secondary</td>
<td>2.55</td>
<td>1.04</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School curricula should be revised in order to fully integrate computers into teaching and learning each subject.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>2.81</td>
<td>0.93</td>
<td>0.23</td>
<td>521</td>
</tr>
<tr>
<td>Secondary</td>
<td>2.83</td>
<td>0.98</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p < .05
school subject ($t_{521} = 2.64, p < .05$). Secondary school teachers seemed to have a greater tendency to agree with this aspect of integration.

Data in Table 34 provide a comparison of teachers' responses toward the integration of computers into the curriculum based on their experience in using computers in

Table 34

Computer User vs. Nonuser Opinions Regarding the Integration of Computers Into the Curriculum

<table>
<thead>
<tr>
<th>Description</th>
<th>Mean</th>
<th>SD</th>
<th>t</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computers should be integrated into teaching and learning any school subject</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonusers</td>
<td>2.61</td>
<td>1.07</td>
<td>0.98</td>
<td>525</td>
</tr>
<tr>
<td>Users</td>
<td>2.71</td>
<td>0.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computers should be counted as instructional aids</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonusers</td>
<td>2.55</td>
<td>1.03</td>
<td>0.59</td>
<td>525</td>
</tr>
<tr>
<td>Users</td>
<td>2.49</td>
<td>0.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School curricula should be revised in order to fully integrate computers into teaching and learning each subject.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonusers</td>
<td>2.79</td>
<td>1.02</td>
<td>0.73</td>
<td>525</td>
</tr>
<tr>
<td>Users</td>
<td>2.86</td>
<td>0.78</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p < .05
the classroom. A t-test was employed to determine significant differences between the group means. No significant differences were found on any of the aspects of integration. Nonusers and users exhibited similar opinions toward each of the aspects of integration of computers into the curriculum.

An analysis of variance was used to determine teachers' opinions toward the integration of computers into the curriculum based on educational backgrounds. Data in Table 35 show that no significant differences were found. School

Table 35

School Teachers' Responses Toward the Integration of Computers Into the Curriculum Based on Their Educational Background

<table>
<thead>
<tr>
<th>Description</th>
<th>Mean Square Between Groupb</th>
<th>Mean Square Within Groupb</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computers should be integrated into teaching and learning any school subject</td>
<td>0.30</td>
<td>1.07</td>
<td>0.28</td>
<td>.75</td>
</tr>
<tr>
<td>Computers should be counted as instructional aids</td>
<td>0.20</td>
<td>1.00</td>
<td>0.20</td>
<td>.82</td>
</tr>
<tr>
<td>School curricula should be revised in order to fully integrate computers into teaching and learning each subject</td>
<td>0.05</td>
<td>0.92</td>
<td>0.05</td>
<td>.95</td>
</tr>
</tbody>
</table>

a_n = 2, b_n = 521, *p < .05
teachers with different background knowledge expressed similar opinions regarding the integration of computers into the curriculum.

Further analyses were made to compare teachers' opinions regarding the integration of computers into the curriculum based on their teaching experience. As shown in Table 36, an analysis of variance was employed to determine significant differences among group means. A significant difference was evident in teachers' opinions toward one of the three aspects.

Table 36

ANOVA for Teachers' Opinions Regarding the Integration of Computers Into the Curriculum Based on Their Teaching Experience

<table>
<thead>
<tr>
<th>Description</th>
<th>Mean Square Between Group^a</th>
<th>Mean Square Within Group^b</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computers should be integrated into teaching and learning any school subject</td>
<td>2.99</td>
<td>1.06</td>
<td>2.82</td>
<td>.06</td>
</tr>
<tr>
<td>Computers should be counted as instructional aids</td>
<td>4.38</td>
<td>0.97</td>
<td>4.49*</td>
<td>.02</td>
</tr>
<tr>
<td>School curricula should be revised in order to fully integrate computers into teaching and learning each subject</td>
<td>0.33</td>
<td>0.90</td>
<td>0.36</td>
<td>.70</td>
</tr>
</tbody>
</table>

\(^a_n = 2, \quad ^b_n = 517, \quad * p < .05\)
of integration based on teaching experience of less than 5 years, 5 to 10 years, and more than 10 years. Teachers with different levels of teaching experience expressed different opinions regarding the idea that computers should be counted as instructional aids ($F_{2,517} = 4.49, p < .05$).

Subsequently, a pairwise comparison was performed to determine significant pairs. Results of the pairwise comparison using the Scheffe method revealed significant differences between teachers with less than 5 years experience and teachers with more than 10 years experience (Table 37).

Table 37

<table>
<thead>
<tr>
<th>Mean</th>
<th>Group</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.10</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.42</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.61</td>
<td>3</td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

Group 1 = Less than 5 yrs; Group 2 = 5 to 10 yrs; Group 3 = More than 10 yrs. *p < .05

3. Encouragement and Incentive to Use Computers

This section includes findings related to research question 3: What kinds of encouragement and incentives are
provided by schools to use computers? Instructional computing requires support. In order to use instructional computing, teachers must have equipment, training, and professional encouragement.

Many teachers who worked in schools where computers were present were assessed. Data in Table 38 show that only 30% of teachers in the sample worked in a school which had computers. Only 11.60% of the teachers worked in schools which had more than 10 computers. A majority of the teachers (70%) worked in schools without computers.

Table 38

Percentage of Teachers Who Worked in Schools Which Had Computers Based on the Number of Computers

<table>
<thead>
<tr>
<th>Number of Computers</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>No computer</td>
<td>369</td>
<td>70.00</td>
</tr>
<tr>
<td>1 to 10</td>
<td>97</td>
<td>18.40</td>
</tr>
<tr>
<td>More than 10</td>
<td>61</td>
<td>11.60</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>527</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Subsequently, teachers who worked at schools which had computers were queried concerning the types of information services they received. Data in Table 39 indicate that
teachers received various types of computer-processed information from school administrators. For the majority of teachers (60.75%), the information received concerned students' test performances. The information service received least frequently by the teachers (4.43%) concerned student health records.

Promotional services should also be provided by schools for teachers. Promotional services are designed specifically to help teachers use computers effectively for both instructional purposes and administrative purposes. Data in Table 40 illustrate the percentage of teachers who

Table 39

Percentage of Teachers Who Received Various Types of Information Services from Their Schools

<table>
<thead>
<tr>
<th>Types of Information</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student test performance</td>
<td>96</td>
<td>60.75</td>
</tr>
<tr>
<td>Individualized educational plans</td>
<td>52</td>
<td>32.91</td>
</tr>
<tr>
<td>Student educational history</td>
<td>38</td>
<td>24.05</td>
</tr>
<tr>
<td>Student attendance</td>
<td>24</td>
<td>15.19</td>
</tr>
<tr>
<td>Resource Inventory</td>
<td>24</td>
<td>15.19</td>
</tr>
<tr>
<td>Student health record</td>
<td>7</td>
<td>4.43</td>
</tr>
</tbody>
</table>

N = 158
received each kind of promotional services from their schools.

As shown in Table 40, the largest percentage of teachers who worked in schools with computers (60.13%) reported receiving inservice training about computers. Teachers reported that school administrators recognized their efforts to use computers in schools (39.24%). Other types of administrative promotional services which were reported by teachers in the computer area were auxiliary materials (36.71%), release time (23.42%), training stipend (23.42%), and computer specialist (23.42%). The smallest number of

Table 40
Teachers' Opinions Regarding Promotional Services Provided by Schools

<table>
<thead>
<tr>
<th>Promotional Services</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inservice training</td>
<td>95</td>
<td>60.13</td>
</tr>
<tr>
<td>Teacher recognition</td>
<td>62</td>
<td>39.24</td>
</tr>
<tr>
<td>Auxiliary materials</td>
<td>58</td>
<td>36.71</td>
</tr>
<tr>
<td>Release time</td>
<td>37</td>
<td>23.42</td>
</tr>
<tr>
<td>Training stipends</td>
<td>37</td>
<td>23.42</td>
</tr>
<tr>
<td>Computer specialist</td>
<td>37</td>
<td>23.42</td>
</tr>
<tr>
<td>Summer workshops</td>
<td>22</td>
<td>13.92</td>
</tr>
</tbody>
</table>

N = 158
teachers reported summer workshops as a promotional activity (13.92%).

4. Current Status of Computer Utilization in the Classroom

This section includes a response to research question 4: What is the current status of computer utilization in classrooms. Frequencies and percentages were used to determine the status of computer utilization in classrooms on each of the following five aspects: computer availability, computer software, how teachers use computers, student effects, and computer needs.

4.1 Computer availability. This section contains findings related to research question 4.1: How available are computers to these users? Only 24.86% of the school teachers in the sample used computers in the classroom. The teachers were asked how computers were made available for students to use in the classroom and for teachers to use in managing instruction. Data in Tables 41 and 42 include the results of this question.

According to data in Table 41, 54.2% of the teachers reported that most of the computers in their schools were made available to students in a computer laboratory. About 21% of the teachers reported that one or more computers were temporarily available in their schools for students to use. Only 8.4% of the teachers reported that at least one computer was available in classrooms at all times.
As shown in Table 42, 34.35% of the teachers reported that computers were available for them to use for instructional management on a limited basis. Meanwhile, 32.83% of the teachers reported that computers were available in classrooms at all times. The lowest percentages of the teachers reported that no computers were available (9.92%) and that computers were occasionally available (8.4%) for their use in planning, preparation, and management of instruction.

Table 41
Teachers' Opinions Regarding How Computers Were Made Available to Students in the Schools

<table>
<thead>
<tr>
<th>Description</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>One or more computers are available in classroom at all times</td>
<td>11</td>
<td>8.40</td>
</tr>
<tr>
<td>Many computers are located in a computer laboratory available for student use</td>
<td>71</td>
<td>54.20</td>
</tr>
<tr>
<td>One or more computers are available outside of classrooms for student use</td>
<td>21</td>
<td>16.03</td>
</tr>
<tr>
<td>One or more computers are temporarily available for student use</td>
<td>28</td>
<td>21.37</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>131</td>
<td>100.00</td>
</tr>
</tbody>
</table>
4.2 Computer software. This section contains findings related to research question 4.2: How satisfied are teachers with available software?

Data in Table 43 show the results of teacher satisfaction with the amount of software available in their schools. About 72.52% of the teachers indicated that they were not at all satisfied (23.67%) or were more dissatisfied than satisfied (48.85%) concerning the amount of software available in their schools. Data in Table 44 reveal that teachers were satisfied with the quality of the software
available in their schools; 41.98% were more satisfied than dissatisfied and 30.54% were well satisfied.

4.3 How teachers use computers. This section contains findings related to research question 4.3: How do teachers use computers in classrooms? This section is focused on four facets of how the teachers used computers: computer use by subject, type of computer applications used, type of activities used, and type of presentation used.

Table 43
Teacher Satisfaction With Computer Software Availability

<table>
<thead>
<tr>
<th>Level of Satisfaction</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all satisfied</td>
<td>31</td>
<td>23.67</td>
</tr>
<tr>
<td>More dissatisfied than satisfied</td>
<td>64</td>
<td>48.85</td>
</tr>
<tr>
<td>More satisfied than dissatisfied</td>
<td>28</td>
<td>21.37</td>
</tr>
<tr>
<td>Well satisfied</td>
<td>8</td>
<td>6.11</td>
</tr>
<tr>
<td>Total</td>
<td>131</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Data in Table 45 show results related to computer use in connection with a number of school subjects. Computers were used by teachers most often for mathematics (29.77%), science (26.72%), and computer literacy (25.19%). Few teachers used
Table 44
Teachers' Opinions Regarding Their Satisfaction With the Quality of Computer Software Available

<table>
<thead>
<tr>
<th>Level of Satisfaction</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all satisfied</td>
<td>12</td>
<td>9.16</td>
</tr>
<tr>
<td>More dissatisfied than satisfied</td>
<td>24</td>
<td>18.32</td>
</tr>
<tr>
<td>More satisfied than dissatisfied</td>
<td>55</td>
<td>41.98</td>
</tr>
<tr>
<td>Well satisfied</td>
<td>40</td>
<td>30.54</td>
</tr>
<tr>
<td>Total</td>
<td>131</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Table 45
Percentage of Teachers Who Used Computers for Selected Subjects

<table>
<thead>
<tr>
<th>Subject</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>39</td>
<td>29.77</td>
</tr>
<tr>
<td>Science</td>
<td>35</td>
<td>26.72</td>
</tr>
<tr>
<td>Computer literacy</td>
<td>33</td>
<td>25.19</td>
</tr>
<tr>
<td>Foreign language</td>
<td>16</td>
<td>12.21</td>
</tr>
<tr>
<td>Thai</td>
<td>14</td>
<td>10.69</td>
</tr>
<tr>
<td>Social studies</td>
<td>10</td>
<td>7.63</td>
</tr>
</tbody>
</table>

N = 131
computers for teaching foreign languages (12.21%), Thai language (10.69%) or social studies (7.63%).

Four types of computer applications were specified in this survey: drill and practice, tutorial, simulations, and problem-solving. Teachers were asked which applications they used and how frequently they used them. As shown in Table 46, the highest percentage of teachers (40.46%) used computers for drill and practice—15.27% sometimes, 19.85% often, and 5.35% always. Approximately 36% of the teachers used tutorials, but only 16% of the teachers often or always used this application. The smallest percentages of teachers used simulations (22.9%), and only 5.34% of the teachers always or often used this application.

<table>
<thead>
<tr>
<th>Application Type</th>
<th>Percentage of Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never</td>
</tr>
<tr>
<td>Drill and practice</td>
<td>59.54</td>
</tr>
<tr>
<td>Tutorials</td>
<td>63.36</td>
</tr>
<tr>
<td>Problem-solving</td>
<td>69.47</td>
</tr>
<tr>
<td>Simulations</td>
<td>77.10</td>
</tr>
</tbody>
</table>

N = 131
This investigation was also focused on computer use in the area of management of instruction. Teachers were asked to indicate the types of instructional management activities for which they used computers and how frequently they were used. Data in Table 47 show the results.

Table 47

Percentage of Teachers Who Use Computers for Each Instructional Management Activity

<table>
<thead>
<tr>
<th>Activity Type</th>
<th>Percentage of Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never</td>
</tr>
<tr>
<td>Developing, administering, or scoring student tests</td>
<td>42.75</td>
</tr>
<tr>
<td>Preparing administrative paperwork</td>
<td>45.04</td>
</tr>
<tr>
<td>Developing print materials for student activities</td>
<td>53.43</td>
</tr>
<tr>
<td>Computing and analyzing student data</td>
<td>57.25</td>
</tr>
<tr>
<td>Recording student performance</td>
<td>58.78</td>
</tr>
<tr>
<td>Organizing and inventorying supplies and equipment</td>
<td>61.07</td>
</tr>
<tr>
<td>Prescribing and directing student activities</td>
<td>63.36</td>
</tr>
<tr>
<td>Developing software for student activities</td>
<td>71.75</td>
</tr>
</tbody>
</table>

N = 131
As shown in Table 47, the majority of teachers (50.0% or more) used computers for two instructional management activities: developing, administering, or scoring student tests (57.25%), and preparing administrative paperwork (54.96%). More than 40% of the teachers used computers for each of the following activities: developing printed materials for student activities (46.57%), computing and analyzing student data (42.75%), and recording students' performance (41.22%). The smallest percentages of teachers used computers for two activities: prescribing and directing students' activities (36.64%), and developing software for students' activities (28.25%).

Teachers were also asked to specify the types of presentation methods used and how frequently they were used. The results are shown in Table 48. Approximately 25% of the teachers used computers for all of the types of presentation specified. The largest percentage of teachers used two methods: individual work (28.24%) and small group work (28.24%). The smallest percentage of teachers used the following two methods: whole class working on multiple computers (25.19%) and demonstrations (24.43%). Very few teachers reported that they used one type of presentation exclusively.

4.4 Student effect. This section contains findings related to research question 4.4: What effects do teachers
Table 48

**Percentage of Teachers Who Use Computers for Each Type of Presentation**

<table>
<thead>
<tr>
<th>Type of Presentation</th>
<th>Percentage of Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never</td>
</tr>
<tr>
<td>Individual work</td>
<td>71.76</td>
</tr>
<tr>
<td>Small group</td>
<td>71.76</td>
</tr>
<tr>
<td>Whole class working on multiple computers</td>
<td>74.81</td>
</tr>
<tr>
<td>Demonstrations</td>
<td>75.57</td>
</tr>
</tbody>
</table>

*N = 131*

believe computers have on students? Teachers were asked to indicate whether instructional computing had a negative effect, no effect, a positive effect, or if they did not know what effect it had on students. This question was asked with respect to a number of student characteristics. The results are shown in Table 49.

As shown in Table 49, no evidence was found from the teachers' reports to support the contention that instructional computing had a negative effect on students. In fact, the teachers' opinions provided some support for the position that computing had a positive effect on students. A majority of the teachers (50% or more) believed that computing had a positive effect on all of the student
Table 49

Percentage of Teachers Reporting the Effect of Instructional Computing on Selected Student Characteristics

<table>
<thead>
<tr>
<th>Student Characteristic</th>
<th>Percentage of Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Negative Effect</td>
</tr>
<tr>
<td>Cognitive learning</td>
<td>0.00</td>
</tr>
<tr>
<td>Subject interest</td>
<td>0.76</td>
</tr>
<tr>
<td>Motivation</td>
<td>0.00</td>
</tr>
<tr>
<td>Self-confidence</td>
<td>0.00</td>
</tr>
<tr>
<td>Test performance</td>
<td>0.00</td>
</tr>
<tr>
<td>Attention span</td>
<td>0.00</td>
</tr>
<tr>
<td>Social status</td>
<td>1.53</td>
</tr>
<tr>
<td>Self-discipline</td>
<td>2.29</td>
</tr>
<tr>
<td>Social behavior</td>
<td>2.29</td>
</tr>
</tbody>
</table>

N = 131

characteristics. The largest percentages of teachers believed that computing had a positive effect on cognitive learning (86.26%), subject interest (85.50%), and motivation (83.21%). The smallest percentage of teachers believed that computing had a positive effect on social behavior (59.54%), self-discipline (65.65%), and social status (72.52%).
4.5 Computing needs. This section contains findings related to research question 4.5: What are teachers' most urgent needs in the area of instructional computing? Teachers' responses to this question are summarized in Table 50.

Table 50
Teachers' Opinions Regarding Areas of Greatest Computing Needs

<table>
<thead>
<tr>
<th>Area of need</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware</td>
<td>37</td>
<td>28.24</td>
</tr>
<tr>
<td>Software/courseware</td>
<td>45</td>
<td>34.35</td>
</tr>
<tr>
<td>Personal knowledge</td>
<td>42</td>
<td>32.06</td>
</tr>
<tr>
<td>Administrative support</td>
<td>7</td>
<td>5.34</td>
</tr>
</tbody>
</table>

N = 131

As shown in Table 50, the largest percentage of teachers (34.35%) reported that their greatest need was for software or courseware. Others reported that their area of greatest need was for personal knowledge about computers (32.06%) or for hardware (28.24%). The smallest percentage of teachers (5.34%) reported their greatest need was for administrative support.
CHAPTER 5

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

This chapter culminates an effort to investigate computer applications in elementary and secondary classrooms in Thailand. It includes a summary of the purposes, methodology and procedure, and the major findings. Conclusions and recommendations based on the knowledge and insight gained from examination of the findings are also presented.

Summary

The purpose of this study was to create a base of descriptive information about the perspectives of school teachers and college instructors toward computer applications in elementary and secondary classrooms in Thailand. A comparison was provided of the opinions of the respondents toward computing interests, the impact of computers on education, and the integration of computers into the curriculum based on their gender, school level, position as a school teacher or college instructor, computer experience, educational background, and teaching experience. An attempt was made to develop suggestions for teacher education institutions in Thailand regarding preservice and inservice
programs designed to educate teachers about computers and their instructional applications.

In order to accomplish the purpose of the study, two versions of a questionnaire were constructed to collect data. Form A was administered to school teachers and Form B was distributed to college instructors. Five hundred and twenty-seven school teachers and 94 college instructors were randomly selected from the school teachers and college instructors in the Northeastern area of Thailand.

Four main categories of data were collected concerning computer applications in the elementary and secondary classrooms in Thailand: teacher preparation, integration of computers into the curriculum, encouragement and incentive for using computers, and the current status of computer use in classrooms.

Basic descriptive statistics were used to analyze, describe, and summarize computer applications in the classroom in each facet specified. A t-test was employed to determine differences based on gender, school level, and computer experience for the following facets: teachers' interest in instructional applications, the impact of computers on education, and the integration of computers into the curriculum. A one-way analysis of variance procedure was performed to test for significant differences regarding educational background and teaching experience. A contingency chi-square test was also used to determine
differences in responses regarding teachers' interests in computer subjects based on gender, school level, experience in using computers, educational background, and teaching experience.

Findings

The following major findings are based on the information collected and analyzed in this study:

1. School teachers were interested in learning about many computer-related subjects, especially about computer applications for instructional purposes (78.70%), computer programming (70.60%), implementation of computers in the classroom (63.60%), operation of computer hardware (58.30%), and development of educational software (52.60%).

2. The computer-related subjects considered important for school teachers by college instructors were similar to those considered important by the school teachers. However, the college instructors viewed computer programming as being less important than did school teachers (58.50% and 70.60%, respectively).

3. Teachers were especially interested in the ways computers could be applied for instructional purposes, regardless of application type. More than 65% of all teachers expressed some degree of interest in every application type. The five largest percentages of teacher interest toward computer application types were for
enrichment activities (89.8%), maintenance of student records (88.8%), monitoring of student mastery (86.9%), tutorials (85.8%), and problem-solving (85.5%)

4. The five largest percentages of college instructors expressing agreement or strong agreement concerning school teachers' computer knowledge and skills in each type of instructional applications were for problem-solving (91.5%), enrichment activities (90.4%), maintenance of student records (88.3%), testing (86.2%), and tutorials (83.5%).

5. Most teachers were interested in an instructional-related computer course if provided (90.3%).

6. Secondary school teachers were significantly more interested in learning computer programming, the operation of computer hardware, and the development of educational software than were elementary school teachers.

7. Male teachers were significantly more interested in learning computer programming and the development of educational software than were female teachers.

8. Teachers without computer-using experience were significantly more interested in learning the history of computer development than were teachers with computer experience.

9. Teachers with different educational backgrounds expressed different levels of interest in computer applications for instructional purposes, computer programming, and the development of educational software.
10. Teachers' interests in learning about the operation and selection of computer hardware for the classroom differed according to their level of teaching experience.

11. Secondary school teachers were more interested in all of the application modes except computer games and drill and practice than were elementary school teachers.

12. Male teachers were more interested than were female teachers in all of the types of instructional computing applications except computer games.

13. Teachers' interests in 3 of the 12 computer instructional applications differed based on whether or not they had computer experience. Teachers without computer experience expressed greater interest in computer games to practice and reward student performance, while teachers with computer experience expressed greater interest in using computers to enrich the teaching of high ability students and to accompany presentations.

14. Teachers with master's degrees exhibited greater interest in tutorials and simulations than did teachers without degrees.

15. Teachers with more than 10 years of teaching experience exhibited greater interest in using computers to maintain student records than did teachers with 5 to 10 years of experience. Teachers with less than 5 years experience expressed greater interest in this type of application than did teachers with 5 to 10 years of experience. Teachers with
a variety of teaching experiences presented similar interest toward the other 11 types of computer applications specified.

16. The majority of teachers (80%) expected computers to have an impact on education in the future. The following four events were considered most likely to occur by more than 60% of the teachers: computers will stimulate innovative teaching, knowing how to use computers will be regarded as a basic skill, teachers with computer skills will be in great demand, and learning by computer in school will be common. The following two events were viewed as unlikely to occur or undecided by a fairly large percentage of teachers: computers will render many teaching skills obsolete, and schools without computers will be regarded as inadequate.

17. The college instructors' perspectives of the impact of computers on education were similar to those of the school teachers.

18. Significant differences were evident between male and female teachers concerning their rating of the impact of computers on education for the following two statements: schools without a computer curriculum will be regarded as inadequate, and instructional interest in computers will wane. Male teachers viewed these two events as being more likely to occur than did female teachers.

19. A significant difference was evident between the beliefs of elementary school teachers and secondary school teachers concerning the impact of computers on education for
one statement: learning by computer out of school will be common. No significant differences were found for the other events.

20. Teachers with and without computer experience differed in their beliefs concerning the impact of computers on education for the following three events: learning by computer in school will be common, most public schools will have computers in classrooms, and learning by computers out of school will be common. Teachers with computer experience viewed these three events more likely to occur than did teachers without computer experience.

21. The beliefs of teachers with master's degrees differed from those of teachers with bachelor's degrees regarding the impact of computers on education for only one event: instructional interest in computers will wane. Teachers with master's degrees viewed this event more likely to occur than did teachers with bachelor's degrees.

22. Differences in teachers' teaching experience did not significantly affect their opinions regarding the impact of computers on education.

23. Approximately 72% of the teachers agreed or strongly agreed that school curriculum should be revised in order to fully integrate computers into teaching and learning each school subject. About 62% of the teachers agreed or strongly agreed that computers should be integrated into teaching and learning any school subject. Meanwhile, 64.8%
of the teachers agreed or strongly agreed that computers should be considered as instructional aids.

24. Differences were evident between the opinions of male and female teachers regarding the integration of computers into the curriculum on the following two aspects: computers should be integrated into teaching and learning any school subject, and curricula should be revised in order to fully integrate computers into teaching and learning any school subject. Male teachers expressed more-positive views than did female teachers toward these two aspects.

25. Elementary school teachers expressed opinions that were different from those of secondary teachers regarding the integration of computers into the curriculum for only one aspect: computers should be integrated into teaching and learning any school subject. Secondary teachers agreed with this aspect more often than did elementary school teachers.

26. Computer users and nonusers exhibited similar opinions regarding the integration of computers into the curriculum.

27. School teachers with different educational backgrounds expressed similar opinions regarding the integration of computers into the curriculum.

28. Teachers with varying levels of teaching experience expressed different opinions regarding the idea that computers should be counted as instructional aids. Significant differences were evident between teachers with
less than 5 years experience and teachers with more than 10 years experience. Teachers with less than 5 years experience expressed a greater tendency to agree with this idea than did teachers with more than 10 years experience.

29. Thirty percent of the school teachers in the sample worked in schools where computers were available. Only 11.60% of the teachers worked in schools which had more than 10 computers. The majority of teachers worked in schools without computers. Eighty-two percent of the teachers in schools with computers reported that they were encouraged by their school administrators. Teachers who worked in schools with computers received various types of computer-processed information from their school administrators. The majority of teachers in schools with computers (60.75%) received information services concerning student test performance. The smallest percentage of these teachers received information services concerning student health records. The largest percentage of teachers in schools with computers (60.13%) received inservice computer training. Teachers in schools with computers reported that school administrators recognized teachers who made an effort to use computers in their classrooms (39.24%). Other types of administrative promotional services which were reported by the teachers included auxiliary materials (36.71%), release time (23.42%), and computer specialists (23.42%).
30. Only 24.86% of the school teachers in the sample used computers in their classrooms; 20.13% were secondary school teachers and only 4.75% were elementary school teachers. The majority of computer users (54.2%) reported that most of the computers in their schools were available for students at a computer laboratory. About 21% reported that at least one computer was temporarily available for students to use. Only 8.4% of the teachers reported that at least one computer was available for students in a classroom at all times. About 34% of the computer users reported that a computer was available for them to use for instructional management on a limited basis. Approximately 32% of the computer users reported that a computer was available in their classrooms at all times for use in planning, preparing, and managing instruction.

31. About 72.52% of the computer users expressed some degree of dissatisfaction with the amount of software available in their schools. However, computer users were satisfied with the quality of the software available in their schools (72.52%).

32. The largest percentages of teachers in the user group used computers in connection with mathematics (29.77%), science (26.72%), or computer literacy (25.19%). The highest percentage of teachers used computers for drill and practice (40.46%). Simulation applications were used least (22.9%). The majority of users (50% or more) used computers for two
instructional management activities: developing, administering, or scoring student tests (57.25%) and preparing administrative paperwork (54.96%). The smallest percentages of users used computers for prescribing and directing student activities (36.64%) and for developing software for student activities (28.25%).

33. Approximately 25% of the users used computers for all types of presentations: demonstration, individual work, small group, and whole class working on multiple computer terminals. The majority of users sometimes or often used all types of presentations; however, very few indicated that they used one type exclusively.

34. The majority of users believed that computing had a positive effect on all of the student characteristics listed. They believed that computing had a positive effect on cognitive learning (86.26%), subject interest (85.50%), motivation (83.21%), self-confidence (77.10%), achievement test performance (77.20%), attention span (74.05%), and social status (72.52%).

35. Among the teachers who used computers, the greatest needs were for software or courseware (34.35%), followed by needs for personal knowledge about computing (32.06%) and for more computers (28.24%).
Conclusions

Based on the findings of this study, the following conclusions are made:

1. As of 1991, most elementary and secondary schools in the 16 provinces of the Northeastern area of Thailand did not have computers. Only 30% of the school teachers sampled worked in schools where computers were present. For schools where computers were present, the administrators provided information services and administrative encouragement for teachers to use computers.

2. The majority of school teachers in the Northeastern area of Thailand had never used computers in the classrooms, especially at the elementary school level. Only 24.86% of the school teachers sampled had used computers in their classrooms; 20.11% were secondary school teachers and 4.75% were elementary school teachers.

3. Among the computer users, the largest percentage of Thai teachers used computers in connection with mathematics, science, and computer literacy. According to application types, drill and practice was used with most often, followed by tutorials and problem-solving. Simulation application was used least. These conclusions are consistent with those of Dickey and Kherlopian (1987), and Harty, Kloosterman, and Matkin (1988). Rather than just programming activities, computers are being used to teach and practice school subject
matters which were formerly presented through lecture or printed material.

4. Among schools where computers were present, most of the computers were located in computer laboratories for students to use. Very few schools could provide a computer in every classroom. Most of the users were not satisfied with the amount of software available at their schools. Subsequently, the greatest computing need of teachers was software, followed by the needs for personal knowledge about computing and for more computers.

5. Most of the teachers who were users found that computers had a positive effect on all of the student characteristics listed. They believed that computing had a positive effect on cognitive learning, subject interest, motivation, self-confidence, achievement-test performance, attention span, and social status. Thus, it is concluded that Thai teachers possessed very positive attitudes toward computer use in their classrooms.

6. Teachers believed that computers would very likely be involved in a number of educational changes; for example, they would effect innovative teaching, computer skills would be regarded as basic skills, an increase in demand for teachers with computer skills would occur, and learning by computers in and out of school would become a common practice. Teachers did not believe computers would render many teaching skills obsolete or that schools without
computers would be regarded as inadequate. In general, teachers viewed computers as having a positive impact on education.

7. Teachers agreed that computers should be integrated into the teaching and learning of any school subject. In order to fully integrate computers into teaching and learning, however, teachers agreed that the curriculum should be revised. This idea is associated with that of Kloosterman, Ault, and Harty (1987), that schools are beginning to realize that computers are an integral part of learning rather than a supplement to the traditional curriculum.

8. According to the findings of this study, teachers were interested in many computer-related subjects, especially computer instructional applications, the implementation of computers in the classroom, the operation of computers, and computer programming. The knowledge and skills implied by these four subjects can be regarded as fundamental for instructional computing purposes. The professional use of computers in classrooms requires that teachers know how to operate computers, make instructional applications for teaching and learning their subjects, and develop programs to serve their own purposes. However, college instructors considered computer programming less important for school teachers. This perspective coincides with the opinion of Ellis and Kuerbis (1985) that teachers do not need to be able
to program computers. They need to be able to use them effectively for teaching and learning school subjects. According to their study, computer programming was not among the essential competencies of teachers. According to the results of this study, secondary school teachers and male teachers expressed greater interest in computer programming.

9. Regardless of the application type, many teachers were interested in learning how computers could be applied for instructional purposes. Teachers were especially interested in learning about instructional computing applications for enrichment purposes, maintenance of student records, monitoring of student mastery, tutorials, and problem-solving. It is concluded that the teachers were interested in using computers in their classrooms as a tool for managing instruction as well as instructional aid. Furthermore, male teachers exhibited greater interest in all types of computer applications except computer games than did female teachers. Secondary school teachers also were more interested in almost every type of computer applications, except computer games and drill and practice, than were elementary school teachers. Elementary school teachers considered computer games and drill and practice to be important and appropriate for teaching and learning at this level.

Thai teachers had very positive attitudes toward using computers for instructional purposes and were willing to
improve their knowledge and skills about computer applications in the classroom. The major problems were that schools lacked adequate funding to provide teachers with sufficient computer hardware, software, and computer training. In order to fully integrate computers into the curriculum, the Ministry of Education, in cooperation with teacher education institutions in Thailand, should seriously address this obstacle.

Recommendations

On the basis of the findings and conclusions of this study, the following recommendations are made:

1. Teacher education institutions in Thailand should provide computing programs, both inservice and preservice programs, for all elementary and secondary school teachers where emphasis is placed upon computer use for instructional purposes in each school subject.

2. Both elementary and secondary schools should be provided with sufficient computer hardware and software in order to facilitate the effective integration of computers into the teaching and learning of school subjects.

3. Greater emphasis should also be placed on computer use for management of instruction and for more diversified activities.

4. School curricula should be assessed regarding ways to gain the advantages of computer use and to integrate
computers into the teaching and learning of any school subject.

5. Research should be conducted to develop a computer curriculum model for each school subject in order to utilize the potential of computers in elementary and secondary classrooms.

6. This research should be replicated in Thailand on a nation-wide basis.
APPENDIX
Section I: Background Information.

1. What is your sex? (Circle one number.)
   1 Female
   2 Male

2. Please check below the number of years of full-time teaching experience you have completed. Include the current year. (Circle one.)
   1 Less than 5 years.
   2 5 to 10 years
   3 More than 10 years

3. In what kind of community do you now teach? (Circle one.)
   1 Urban community
   2 Small town
   3 Rural

4. At what level do you teach? (Circle one.)
   1 Elementary
   2 Secondary

5. Please check below the highest degree you have earned, and indicate the year in which you received it. (Circle one.)
   1 Bachelor's degree: 19
   2 Master's degree: 19
   3 Doctor's degree: 19
   4 No degree
Section 2: Computers in the School.

6. Is there a computer in your school? (Circle one.)
   1. Yes ________ GO ON TO Q.7
   2. No ________ SKIP TO Q.11
   3. Don't know

7. Please specify the number of computers?
   Number of computers ______

8. Does your school use a computer to provide you with the following information? (Circle all that apply)
   a. Student attendance
   b. Student test performance
   c. Student educational history
   d. Student health records
   e. Resource inventory
   f. Individual educational plans for special students
   g. Other (please specify)

9. Does your school promote teacher use of computers?
   (Circle one.)
   1. Yes ________ GO ON TO Q.10
   2. No ________ SKIP TO Q.11
   3. Don't know.
10. Has your school provided the following services to promote teacher use of computers? (Circle all that apply.)

01 Inservice training
02 Summer workshops
03 Release time for training
04 Stipend for training
05 Auxiliary materials (texts, guides)
06 Computer specialist to help teachers
07 Recognition of teacher effort to use computers

Other (please specify)

11. What is your opinion regarding the integration of computer into the school curriculum? Circle ONE number for each line, and use this scale:

1 = Disagree  3 = Agree
2 = Slightly agree  4 = Strongly agree

a. Computers should be integrated into teaching and learning any school subject................. 1  2  3  4

b. Computers should be counted as instructional aids............. 1  2  3  4
1 = Unlikely to occur  3 = Very likely to occur
2 = Could possibly occur  4 = No opinion

Section 3: Teacher Preparation

12. How much interest do you have in learning how to use a computer for the following purposes?

Circle ONE number for each line, and use this scale:
1 = No interest  3 = Interest
2 = Little interest  4 = Great interest

a. Drill and practice for all students.  1  2  3  4
b. Remedial drill for low ability students..........................  1  2  3  4
c. Enrichment activities for high ability students.................  1  2  3  4
d. Tutorials to teach students specific concepts or content...........  1  2  3  4
e. Simulations to enrich student understanding.......................  1  2  3  4
f. Visual-technical aid to accompany my presentation...............  1  2  3  4
g. Standardized presentation of difficult concepts....................  1  2  3  4
1 = No interest  3 = Interest
2 = Little interest  4 = Great interest

h. Monitoring of student mastery of difficult material................. 1  2  3  4

i. Testing to monitor student progress.............................. 1  2  3  4

j. Computer games to practice and to reward students' performance...... 1  2  3  4

k. Maintenance of student records....... 1  2  3  4

l. Development of students' problem-solving ability............. 1  2  3  4

m. Other (please specify)
   ................................................................. 1  2  3  4

13. How interested are you in taking a course to learn how to use a computer for instructional purposes? (Circle one.)

   1  Not very interested  2  Somewhat interested
   3  Very interested  4  Undecided

14. Are you interested in learning about any of the following subjects related to computers in the classroom? (Circle ALL that apply.)

   01 History of computer development
   02 Operation of computer hardware
   03 Computer programming
   04 Development of educational software
15. To what extent do you believe the following will occur in the 1990s? Circle ONE number on each line, and use this scale:

1 = Unlikely to occur       3 = Very likely to occur
2 = Could possibly occur    4 = No opinion

a. Learning by computers in school
   will be common............... 1  2  3  4
b. Learning by computers outside of school
   will be common............... 1  2  3  4
c. Most public schools will have
   computers in classrooms....... 1  2  3  4
d. Knowing how to use a computer
   will be regarded as a basic skill.. 1  2  3  4
e. Schools without a computer
   curriculum will be regarded as
   inadequate.................... 1  2  3  4
f. Teachers with computer skills will
   be in great demand............. 1  2  3  4
1 = Unlikely to occur     3 = Very likely to occur
2 = Could possibly occur    4 = No opinion

g. Computers will render many
teaching skills obsolete............ 1  2  3  4

h. Computers will stimulate innovative
teaching............................. 1  2  3  4

i. Computers will replace some teachers 1  2  3  4

j. Instructional interest in computers
will wane............................ 1  2  3  4

16. What is your opinion regarding teacher preparation
programs in a teacher college or university concerning
computer applications in classroom?  (Circle ALL that
apply)

1  At least one course about computer applications in
the classroom should be included in a preservice
preparation program.

2  Knowledge and skills about computer applications
should be integrated in a teaching method course
for any subject area.

3  Knowledge and skills about computer applications
should be part of educational technology
courses.

4  It is not necessary to include information about
computer applications in classroom into a
preservice teacher preparation programs.
PART B: FOR TEACHERS WHO USE COMPUTERS

*IF YOU USE A COMPUTER for instructional purposes, please continue with question 17.

17. How are computers made available to students in your class(es)? (Circle ONE)
   1 One or more computers are available in the classroom for students at all times.
   2 Many computers are located in a computer laboratory which available for student use on limited basis.
   3 One or more computers are available outside of the classroom for students use on a limited basis.
   4 One or more computers are temporarily available for student use.

18. How are computers made available to you for planning, preparing, and managing instruction? (Circle ONE)
   1 A computer is always available in the classroom for managing instruction.
   2 A computer is available whenever you are free to use it in managing instruction.
3. A computer is available for managing instruction on a limited basis.

4. A computer is occasionally available for managing instruction.

5. No computers are available to use for managing instruction.

19. For which instructional subjects do you use a computer? (Circle ALL that apply)

01 Thai language
02 Foreign language
03 Social study
06 Science
07 Mathematics
08 Computer literacy course
09 Other (please specify)__________________

20. How often do you use a computer in the following ways to provide instruction? Circle ONE number on each line, and use this scale:

1 = Never  3 = Often
2 = Sometimes  4 = Always

a. Drill and practice.................... 1 2 3 4
b. Tutorial (teach rules and concepts). 1 2 3 4
c. Gaming................................. 1 2 3 4
d. Simulation.............................. 1 2 3 4
e. Problem-solving....................... 1 2 3 4
g. Other (please specify)_______________ 1 2 3 4
21. How often do you use a computer in the following ways to manage instruction? Circle ONE number on each line, and use this scale:

a. Developing, administering or scoring student tests............... 1 2 3 4
b. Recording student grades and progress 1 2 3 4
c. Developing printed materials for student activities............... 1 2 3 4
d. Developing software for student activities......................... 1 2 3 4
e. Organizing and inventorying supplies and equipment............... 1 2 3 4
f. Prescribing and directing student activities....................... 1 2 3 4
g. Computing and performing analysis of data about students......... 1 2 3 4
h. Preparing administrative paperwork. 1 2 3 4
i. Other (please specify)____________________1 2 3 4

22. How often do you use the following methods to make computers available to your students? Circle ONE number on each line, and use this scale:

1 = Never 3 = Often
2 = Sometimes 4 = Always

a. Demonstrations....................... 1 2 3 4
b. Individual work....................... 1 2 3 4
c. Small group............................ 1 2 3 4
23. How satisfied are you with the amount of computer software available in your area of computer use? (Circle one)
1 Not at all satisfied
2 More dissatisfied than satisfied
3 More satisfied than dissatisfied
4 Well satisfied

24. How satisfied are you with the quality of computer software available in your area of computer use? (Circle one)
1 Not at all satisfied
2 More dissatisfied than satisfied
3 More satisfied than dissatisfied
4 Well satisfied

25. What effect do you think computers have had on your students? Circle ONE number on each line, and use this scale:
1 = Negative effect 3 = Positive effect
2 = Negligible or no effect 4 = Don't know

a. Motivation... 1 2 3 4
b. Subject interest... 1 2 3 4
1 = Negative effect  3 = Positive effect
2 = Negligible or no effect  4 = Don't know

c. Attention span....................... 1  2  3  4
d. Self-confidence....................... 1  2  3  4
e. Cognitive learning.................... 1  2  3  4
f. Achievement test performance........ 1  2  3  4
g. Self-discipline....................... 1  2  3  4
h. Social behavior...................... 1  2  3  4
i. Status among peers................... 1  2  3  4

26 In which area of computer use do you have the greatest need? (Circle ONE)

1 Hardware
2 Software/courseware
3 Personal knowledge
4 Administrative support
5 Other (please specify)__________________

27. Please use the space below to make any comment concerning the topics addressed by this survey.

........................................................................................................
........................................................................................................
........................................................................................................

The researcher would be happy to send you a summary of the survey results. If you would like a copy, please check the box below and return the completed questionnaire in the enclosed envelope.

Yes, send me a summary of the survey results.
Section I: Background Information.

1. What is your sex? (Circle one number.)
   1  Female
   2  Male

2. Please check below the number of years of full-time teaching experience you have completed. Include the current year. (Circle one.)
   1  Less than 5 years.
   2  5 to 10 years
   3  More than 10 years

3. Please check below the highest degree you have earned, and indicate the year in which you received it. (Circle one.)
   1  Bachelor's degree: 19.. 3  Doctor's degree: 19..
   2  Master's degree: 19.. 4  No degree

Section 2: Teacher Preparation

4. What is your opinion regarding school teachers' knowledge and skills about computer applications in classroom? Circle ONE number for each line, and use this scale:
   1  = Disagree  3  = Agree
   2  = Slightly agree  4  = Strongly agree
A school teacher should know how to use a computer for the following purposes:

a. Drill and practice for all students. 1 2 3 4
b. Remedial drill for low ability students......................... 1 2 3 4
c. Enrichment activities for high ability students.................. 1 2 3 4
d. Tutorials to teach students specific concepts or content........... 1 2 3 4
e. Simulations to enrich student understanding,..................... 1 2 3 4
f. Visual-technical aid to accompany my presentation.................. 1 2 3 4
g. Standardized presentation of difficult concepts................... 1 2 3 4
h. Monitoring of student mastery of difficult material................ 1 2 3 4
i. Testing to monitor student progress.............................. 1 2 3 4
j. Computer games to practice and to reward student performance...... 1 2 3 4
k. Maintenance of student records................................. 1 2 3 4
l. Development of student's problem-solving abilities................ 1 2 3 4
m. Other (please specify)........................................... 1 2 3 4
5. What subject related to computer applications in the classroom does a school teacher need to learn? (Circle ALL that apply.)

01 History of computer development
02 Operation of computer hardware
03 Computer programming
04 Development of educational software
05 Computer applications for instructional purposes
09 Implementation of computers in the classroom
06 Evaluation of educational software
07 Selection of computer hardware for the classroom
08 How to teach computer science
09 Integration of computers into the curriculum
10 Other (please specify).................................

6. To what extent do you believe the following will occur in the 1990s? Circle ONE number on each line, and use this scale:

1 = Unlikely to occur  3 = Very likely to occur
2 = Could possibly occur  4 = No opinion

a. Learning by computers in school
will be common ...................... 1 2 3 4

b. Learning by computers outside of school will be common .............. 1 2 3 4
1 = Unlikely to occur  
2 = Could possibly occur  
3 = Very likely to occur  
4 = No opinion  
c. Most public schools will have computers in classrooms ............  
d. Knowing how to use a computer will be regarded as a basic skill . .  
e. Schools without a computer curriculum will be regarded as inadequate ......................  
f. Teachers with computer skills will be in great demand ..................  
g. Computers will render many teaching skills obsolete .............  
h. Computers will stimulate innovative teaching .........................  
i. Computers will replace some teachers  
j. Instructional interest in computers will wane  

7. What is your opinion regarding teacher preparation program in a teacher college or university concerning computer applications in the classroom? (Circle ALL that apply)  
1 At least one course about computer applications in the classroom should be included in a preservice preparation program.  
2 Knowledge and skills about computer applications
should be integrated in a teaching method course for any subject area.

3 Knowledge and skills about computer applications should be a part of educational technology courses.

4 It is not necessary to include information about computer applications in classroom into a preservice teacher preparation programs.

9. What effect do you think computers have had on students? Circle ONE number on each line, and use this scale:

1 = Negative effect  3 = Positive effect
2 = Negligible or no effect  4 = Don't know

a. Motivation.........................  1  2  3  4
b. Subject interest....................  1  2  3  4
c. Attention span.....................  1  2  3  4
d. Self confidence.....................  1  2  3  4
e. Cognitive learning..................  1  2  3  4
f. Achievement test performance......  1  2  3  4
g. Self-discipline.....................  1  2  3  4
h. Social behavior....................  1  2  3  4
i. Status among peers...............  1  2  3  4

10. What is your opinion regarding the integration of computers into the school curriculum? Circle ONE number for each line, and use this scale:

1 = Negative effect  3 = Positive effect
2 = Negligible or no effect  4 = Don't know
1 = Negative effect  
2 = Negligible or no effect  
3 = Positive effect  
4 = Don't know

a. Computers should be integrated into teaching and learning any school subject ................. 1  2  3  4

b. Computers should be counted as instructional aids ............... 1  2  3  4

c. School curricula should be revised in order to fully integrate computers into teaching and learning each subject ...................... 1  2  3  4

11. Please use the space below to make any comment concerning the topics addressed by this survey.
.................................
.................................

The researcher would be happy to send you a summary of the survey results. If you would like a copy, please check the box below and return the completed questionnaire in the enclosed envelope. Yes, send me a summary of the survey results.
REFERENCES


