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Chandler, Anne L., Ph.D.

Andrews University, 1993

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Andrews University
School of Education

DESCRIPTIVE CASE STUDIES OF TRAINING, RESEARCH AND
DEVELOPMENT IN COMPUTERS AND RELATED INSTRUCTIONAL
TECHNOLOGIES FOR TEACHERS AT THREE
NCATE UNIVERSITIES

A Dissertation
Presented in Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

by
Anne L. Chandler

August, 1993

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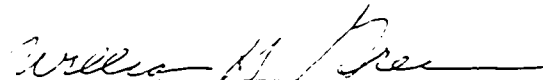
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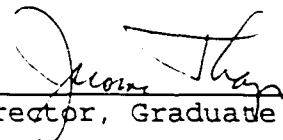
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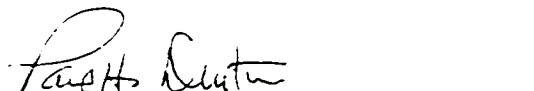
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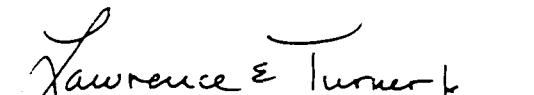

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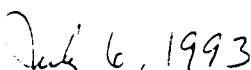

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Date approved

To the men and women of this nation who are
preparing our Schools of Education
to serve in the Information Age

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ACKNOWLEDGMENTS

First, I am grateful for the help of our Heavenly Father, who knows more about technology than anyone. His computers are living rather than mechanical creations.

Second, the love and support of my family—my son Ty Chandler, my parents James and Sara Langham, and my grandmother Betty Langham—have meant so much to me.

I would also like to thank my dissertation committee for their excellent feedback. My chairman, Dr. Bill Green, provided guidance and encouragement throughout this project. Dr. Paul Denton and Dr. Bruce Closser also provided valuable insights from their areas of expertise. I could not have asked for a better committee.

For help in developing the instruments for data gathering, I would like to thank Dr. Paul Denton, Dr. Lawrence Turner, and Dan Turk. For participating in the pilot study, thanks go to Ken Eichenger, Mary Chris Adams, Dr. A. Parelius, and Dr. Yee Ping Soon of Indiana University, South Bend.

A special thanks goes to Dr. James Pellegrino, Dean of Peabody College of Vanderbilt, Dr. George Uhlig, Dean of the School of Education at the University of South Alabama, and Dr. Donald Warren, Dean of the School of Education at

Indiana University, Bloomington, for granting me permission to conduct the case studies in their institutions.

Remembered with special fondness and appreciation are: Dr. Gerald Marker, Chairman of Teacher Education, and Dr. Guy Hubbard, Director of Undergraduate Computing at Indiana University, Bloomington, (2) Dr. John Lane, Chairman of Behavioral Studies and Educational Technology at the University of South Alabama, and (3) Dr. Bob Sherwood, Chairman of Teaching and Learning at Peabody College of Vanderbilt. Each of these gentlemen was so friendly and helpful to this struggling graduate student. Their kindness will always be remembered.

So many people participated in my study, it is impossible to convey to each individual what an important part they played, and how deeply grateful I am for their help. Let me just say that I am indebted to the following people:

Peabody College of Vanderbilt:

Dr. William Corbin, Dr. John Bransford, Dr. Charles Kinzer, Dr. J. Olin Campbell, Dr. Ted Hasselbring, Dr. Neal Nadler, Dr. Elizabeth Goldman, Cathy Randolph, and Michael Gaines

The University of South Alabama:

Dr. Richard Daughenbaugh, Mary Ann Robinson,
Dr. John Morrow, Dr. John Strange, Dr. John Dempsey, Dr.
Marilyn Shank, Dr. Brenda Litchfield, Dr. Gayle Davidson,
Dr. Phil Feldman, Dr. Susan Tucker, Dr. Dianne Kenney,
Dr. Tom Chilton, Dr. Eddie Shaw, Dr. Roger Turner,
Dr. William Gilley, Dr. John Le Duc, Dr. Evelyn
Vandevender, Dr. Carolyn Castell, Mary Michael Campbell,
Dr. Robert Doan, Dr. Thomas Russell, and Jean Vincent

Indiana University, Bloomington:

Dr. Ted Frick, Dr. Jerry McIntosh, Dr. Lee Ehman,
Dr. Jim Pershing, Kelly Murphy, Buck Brown, Tom Benjey,
John Baker, Dr. Charles Reigeluth, Dr. Howard Mehlinger,
Dr. Martin Siegel, Dr. Gerald Sousa, Elizabeth Boling,
B. J. Eib, Dr. Jack Cummings, Dr. Denise Lessow, Dr. Peter
Kloosterman, and Dr. Richard Pugh.

ABSTRACT

DESCRIPTIVE CASE STUDIES OF TRAINING, RESEARCH AND
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NCATE UNIVERSITIES

by

Anne L. Chandler

Chair: William H. Green

ABSTRACT OF GRADUATE STUDENT RESEARCH

Dissertation

Andrews University

School of Education

Title: DESCRIPTIVE CASE STUDIES OF TRAINING, RESEARCH,
 AND DEVELOPMENT IN COMPUTERS AND RELATED
 INSTRUCTIONAL TECHNOLOGIES FOR TEACHERS
 AT THREE NCATE UNIVERSITIES

Name of researcher: Anne L. Chandler

Name and degree of faculty chair: William H. Green, Ph.D.

Date completed: August 1993

Topic

The initial focus of this study was the computer and related instructional technology training of preservice teachers. Two areas related to the study, (1) graduate-level instruction in computers and related instructional technologies and (2) research and development in the area of computers in instruction, were also surveyed, with the intent of exploring their relationship to the training of preservice teachers and their influence on instruction in general.

Purpose

The purpose of this study was to describe training, research, and development in computers and related instructional technologies at three NCATE universities which were identified as doing a good job of preparing teachers to teach in the Information Age.

Sources

Using a qualitative case study research method, five research questions concerning the computer and related instructional technology training of preservice teachers were addressed. Semi-structured interviews, informal interviews, observations, questionnaires, NCATE documents, school of education bulletins, class syllabi, and handouts were used in the cross-case analysis.

Conclusions

The findings from the research questions provide other teacher preparation programs with models for development, new ideas, and fresh approaches.

Findings from an exploration of the two areas related to the study support the opinions of many educators who think that the delivery of instruction is changing and that technology is playing an important role in that change. Distance education, multi/hyper/interactive media, and technical skills necessary to access, manipulate, store, and retrieve information are perceived as growing in importance, due to the demands of the Information Age.

CHAPTER I

INTRODUCTION

In 1988, George Bush expressed his ideas on excellence in education for The Kappan. He believed that the workplace is changing and that education must change with it. He saw the ability to use computers as invaluable for competing in tomorrow's job market, and he recommended strengthening the curriculum in the computer fields.

In 1992, Bill Clinton told The Kappan, "In the Nineties and beyond, the universal spread of computers and high-speed communications means that what we earn depends on what we can learn and on how we can apply what we learn to the workplaces of America" (p. 131).

The change in our work environment has been noted by others as well. According to John Naisbitt (1982) the United States officially entered the Information Age when the number of white-collar workers first exceeded the number of blue-collar workers in 1956. Dizard (1989) defined Information Age as the term often used to describe the present shift of society from an industrial base to one in which the production, storage, and distribution of information are primary economic and social activities.

This shift was made possible in part by the invention of the computer, improvements in size and cost made possible by the development of the microchip, and the rapid growth of telecommunications.

Foley (1993) states that during the Information Age, the world's information base doubles every three years. Increasingly educators and members of society at large are recognizing that students in such an environment need a knowledge of computers and their telecommunications capabilities as ordinary, everyday tools. Accomplishing this requires quality training of teachers in the use of computers and related instructional technologies. How preservice teachers are taught, and what they are taught about computers and related instructional technologies, was thus the initial focus of this study. As the study progressed, however, it became apparent that the following two areas were also related to the training of teachers.

Areas Related to the Study

Realizing that a combination of other factors have made important contributions to the field of computers and related instructional technologies which would benefit teachers, the study was expanded to include (1) graduate-level computer instruction and (2) research and development (R & D) in the area of computers in instruction. Graduate programs which offer computer instruction were chosen because what happens at the graduate level affects

requirements at the undergraduate level, and R & D also affects how teachers are trained.

On the graduate level, computer education often consists of an entire program, rather than just one course. For example, a graduate student is able to major in Instructional Computing, Computer Education, Computers in Education, or a program with a similar title.

Three sites were visited for the purposes of this study, none of which had a graduate computer education program with the emphasis mentioned above. However, graduate programs with a strong computer component were identified and chosen for description. These programs dealt with designing and delivering instruction, particularly for business and industry, the military, and medical fields.

Dr. Charles Reigeluth of Indiana University made the following observation concerning programs that deal with designing instruction:

One of the interesting things about our society as it is evolving in the Information Age is that there is much greater incidence of education in settings outside of the traditional K-12 and Higher Education. For instance, today, corporations spend more money on education and training than all institutions of Higher Education combined. Education is no longer something that just occurs in schools. And therefore, Schools of Education need to wake up to this fact and prepare educators for many contexts, not just for public schools. (Data Vol. III, p. 92)

Graduate programs which emphasize the design and delivery of instruction often have a strong computer

component because their graduates are often required to plan computer-based, or multimedia modes of instruction. Many teachers pursue graduate degrees and need to be made aware that a degree exists which offers instructional opportunities outside of traditional academic settings. These programs are more prevalent today than they were 10 years ago, and a look at how they are evolving should prove informative and beneficial to teachers and others involved in education.

If programs of excellence within Schools of Education are to be developed with strong computer components, then the educational potential of computers must be explored through research and development. A description of the R & D efforts at the three sites under study should thus prove beneficial to those wishing to develop excellent programs.

Data gathering techniques for the areas of graduate level computer instruction, and R & D involving computers in instruction, are less structured than the data gathering techniques for the initial study. Therefore, information about these related areas is not intended to be exhaustive. Rather, their exploration is seen as supportive of the initial focus of the study—the training of preservice teachers in the use of computers and related instructional technologies. Connections between graduate programs with a strong computer component, research and development

involving computers in instruction, and the training of preservice teachers in computers and related instructional technologies, were observed and are discussed further in chapter 7.

Background of the Problem

In 1988, the United States Congress Office of Technology Assessment (OTA) reported the results of its first comprehensive study on the state of educational technology in America. From a survey of over 1,500 private and public institutions with teacher preparation programs, the OTA found that graduates of teacher institutions do not feel prepared to use computers in teaching (Scrogan, 1989).

According to the above OTA study, more Schools of Education are being required by state mandates to revise their teacher education curriculum in order to meet the needs of teachers faced with new technology (Scrogan, 1989). Gubser reported in 1985 that only 5 States required computer training in teacher education programs. In 1992 Hunt found that 23 States required teachers to demonstrate competence in educational computing before receiving certification (see Mernit, 1992, pp. 6-7 for skills which define the term "educational computing"). This indicates that a trend is rapidly developing toward state mandates requiring teacher education programs to include computer-training.

The OTA report recommended the following college-level initiatives:

1. Provide proper training for education school faculty members.
2. Improve the facilities and equipment available to undergraduates.
3. Articulate expected competencies on the use of new technologies for all School of Education undergraduates.
4. Encourage teaching internships with strong technology-using teachers.
5. Increase research projects and innovative pilot programs. (Scrogan, 1989, pp. 84-85)

The OTA report further recommended that future investment in technology for education must factor in training and support for teachers as they endeavor to apply what they have learned in their classrooms (Scrogan, 1989).

Accreditation Efforts

The National Council for Accreditation of Teacher Education (NCATE) has been responsible for the accreditation of teacher education since 1952. NCATE is an independent, nongovernmental body which sets general requirements for teacher preparation and applies standards pertinent to areas of professional specialty (Gubser, 1985).

A recent issue of Electronic Learning (Mernit, 1992) reported that NCATE has added educational technology to its set of national accreditation standards. Graduates of teacher training institutes which are accredited in educational computing and technology must be able to:

Operate a computer;
Support instruction with software;
Use word processing, database, spreadsheet, and
desktop publishing programs;
Apply appropriate assessment practices to the use
of computers and related technologies;
Design and develop student learning activities that
incorporate technology;
Use computer-based technologies to access
information for class and professional
development;
Facilitate learning with technology. (p. 7)

Standards for master's degree programs in educational computing and technology leadership were established as well. Institutions with these programs were to demonstrate their institutions' response to meet the standards by April, 1993 (Carlson, 1992).

Although states are beginning to require computer training for regular classroom teachers at the elementary and secondary levels, no computer training standards have been established by NCATE for these teachers, other than the following, identified by Gubser (1985):

It [NCATE] requires that all teacher candidates have experience with modern instructional technology and that institutions preparing teachers maintain adequate learning-resource centers to provide appropriate equipment and software to train prospective teachers. (p. 15)

As further background to the problem, a brief history of computers in education is given.

History of Computers in Education

The following history of computers in education is intended to give a general outline that highlights some of the main events in the development of this field. It is not intended to be exhaustive.

In the 1920s, early precursors of computers in education were known as teaching machines. Niemiec and Walberg (1989) recognize Sidney Pressey of Ohio State University for developing a testing and teaching machine called the Drum Tutor in 1924. They point out that he was the first educator to try to build a teaching machine based upon learning theory. He relied heavily on the work of E. L. Thorndike, an educational psychologist at Columbia University. Thorndike had formulated a set of laws that he believed would maximize learning. Work on teaching machines was retarded by the Great Depression of the 1930s.

In his study of computers in education, Molnar (1990) found that American universities designed and built the first large-scale computers in the 1940s. The Mark I, built at Harvard, became operational in 1944, and ENIAC, the first electronic computer, was developed at the University of Pennsylvania in 1946. Computers were initially used in education for research purposes. There were no teaching applications.

Molnar noted that there were only 12 computers in the United States in 1950. Because computers were so

massive and expensive, few realized their potential in education. The 50s saw great strides in educational computing, however. Two Princeton graduates, Dr. John Kemeny (once research assistant to Albert Einstein) and Dr. Tom Kurtz, were cited by Molnar as deserving much of the credit for extending computers to faculty and students who were not involved in research. While employed at Dartmouth, they developed the Dartmouth Time Sharing System, the BASIC programming language, and an operating system with a simple user interface. This changed the computing environment by providing "user-friendly" tools.

The 1950s also witnessed the pioneer work Dr. Donald Bitzer of the University of Illinois did in the area of systems. He did much to provide low-cost computing to many students regardless of their location (Molnar, 1990).

PLATO, a mainframe-based computer assisted instruction system developed in 1959 at the University of Illinois, was an early effort to use computers for academic purposes (Molnar, 1990). It has been extensively implemented and is directed primarily toward college-level instruction (Niemic & Walberg, 1989).

In 1954 at the University of Pittsburgh, Skinner (1986) demonstrated a machine he designed to teach arithmetic. His work contributed to the eventual development of linear programming. Niemic and Walberg

cite Norman Crowder for further development of programming by introducing the concept of branching in 1959.

Simon Ramo was also recognized by Niemiec and Walberg for his development of CMI (Computer Managed Instruction) in the 1950s. His work, which was intended to manage information about students, grew out of business management theory and application concepts.

In 1963 Dr. Patrick Suppes, a pioneer in the area of Computer Assisted Instruction (CAI), developed a computer-based laboratory for teaching and learning at Stanford. He has since developed a wide variety of CAI courses. Computer Assisted Instruction is rooted in pre-computational programmed instruction concepts (Niemiec & Walberg, 1989). In other words, it is based on the work of early pioneers such as Thorndike, Pressey, and Skinner.

In 1967, the Computer Curriculum Corporation was formed to market CAI materials developed by IBM in cooperation with Stanford University (Molnar, 1990).

In 1970, the first Conference on Computers in Undergraduate Curriculum (CUCC) was held at the University of Iowa. This evolved into the National Educational Computing Conference (NECC) in 1979 (Molnar, 1990).

PLAN (Program for Learning in Accordance with Needs) was a CMI (Computer Managed Instruction) system marketed commercially by the Westinghouse Educational Corporation in 1975. In trying to meet the individual

needs of students, the computer assumed the burden of file management (Niemic & Walberg, 1989).

The development of the microcomputer, first available in 1975 in ready-to-assemble kits, gave Computer Assisted Instruction a boost in that it became accessible to school districts which previously could not afford the expensive mainframe-based CAI systems (Niemic & Walberg, 1989).

Molnar (1990) recognizes Dr. Seymour Papert of MIT for his work in the development of the LOGO programming language for children. His book, Mindstorms: Children, Computers, and Powerful Ideas, was published in 1980.

The 1980s saw another computer-related effort in education in the Time-Shared Interactive Computer Controlled Information Television (TICCIT) system. TICCIT was developed at Brigham Young University and was influential in the development of teaching "higher-order" concepts (Niemic & Walberg, 1989).

In more recent developments, the World Institute for Computer Assisted Teaching (WICAT) "has developed a series of interactive programs which allow students to question the computer in natural language" (Niemic & Walberg, 1989, p. 273).

At the University of Arizona, Stanley Pogrow has developed the HOTS (Higher Order Thinking Skills) program. It has proven beneficial in improving the thinking skills

of disadvantaged, learning disabled, and even gifted students (Niemiec & Walberg, 1989).

Finally, the more recent work of Dr. Donald Bitzer in the development of NovaNet '89 should be mentioned. This is a mainframe-based education system that allows up to 8,000 terminals to be used interactively (Molnar, 1990).

Conclusion

Looking back over the history of computers in education, it is evident that tremendous developments have been made in a short period of time. Computers are now more accessible to teachers and students. An explosion of educational applications exists, with new ones being developed every decade. Computers have the facility to affect education in a powerful way, and a trend exists in that direction. Yet it is possible that this trend could fail to reach its full potential because teachers cannot or do not use the technology. Adequate teacher training is essential. A statement of the problem follows.

Statement of the Problem

Fulton (1989) found that according to research, the vast majority of today's teachers have had little or no training in how to apply computers in their teaching. Henderson (1992) also noted that, traditionally, computer literacy courses have focused on "knowing about" and "how to operate" the technology, with limited hands-on

experiences, limited focus on appropriate instructional use, and therefore limited transfer potential.

A survey conducted by the Center for Information and Communication Sciences at Ball State University (R. Stowe, personal communication, December 17, 1990) identified the teacher education programs that are doing the best job of preparing preservice teachers to function in the Information Age. The term Information Age was deliberately left undefined so as not to inhibit responses. Following are some of the questions the survey attempted to answer.

Are the teacher-preparation institutions aware of the advent of the Information Age? Are they changing to meet the emerging needs? Are they adapting their practices rapidly enough to respond to one of the most significant challenges of the decade? (R. Stowe, personal communication, December 17, 1990)

Over 40% of the approximately 700 AACTE institutions replied. All but 19 of the respondents agreed that "teacher preparation must include instruction in how to deal successfully with the Information Age."

It is from the list of schools identified by the above survey that the subjects of the three case studies included in this dissertation were selected. The first case selected was that of a private university with an enrollment of approximately 9,000. The second was a public university with an enrollment of approximately 12,000, and the final case was that of a large public university with

an enrollment just over 36,000. A study of each case, identified as exceptional rather than typical, will be beneficial to other universities offering or developing similar courses and programs, and involved in computer-related R & D efforts.

Focus of the Study

In a study of computer education in NCATE colleges, Daniels (1982) recommended that institutions having successful computer-awareness programs be identified and their methods of program initiation and implementation be described. This study has endeavored to identify and describe programs that are not typical. Rather, the programs under study were identified as doing an excellent job of training teachers to serve in the Information Age.

The initial focus of this study was the training of preservice teachers in the use of computers and related instructional technologies at three NCATE universities. The graduate-degree programs with the strongest computer education component, and research and development involving computers in instruction were explored as areas related to the study. See chapter 3 for information on the method used in selecting these two related areas.

From a review of the literature on computer education for preservice teachers, a number of research questions were identified which narrowed the focus of the study.

Research Questions

The following research questions were used to guide the study of undergraduate computer and related instructional technology training within the chosen NCATE universities:

1. What content is currently included in computer education courses?
2. What are the probable trends or shifts in content emphasis in the future, according to the computer instructors surveyed?
3. How is computer education organized or structured within the existing programs?
4. How are the expenses of computer education being met?
5. How could this study benefit other Schools of Education?

Study of the two related areas (i.e., the graduate program with the strongest computer education component, and research and development involving computers in instruction) was more exploratory in nature. The following questions were used to guide the study of graduate programs with a strong computer component:

1. Background:
 - a. When did the program begin?
 - b. How did it develop?
2. Who enrolls in the program?
3. When graduates exit the program, what are their job options?

4. What is unique or different about this program?
5. Do you see any trends developing in this field?
6. What are your current research efforts and/or plans?

The study of research and development involving computers in instruction relied heavily on informal interview. A look at current definitions of computer literacy follows and is appropriate for a study concerning the need to train computer literate teachers.

Computer Literacy

The term "computer literacy" was coined in 1972 by Arthur Luehrmann, and a variety of definitions has evolved for the term over the past 20 years (Moursund, 1992). Although the need for computer literate teachers is widely recognized today, there is still debate over exactly what skills should be included in a definition of computer literacy for teachers. Thompson and Friske (1988) adopted the following as appropriate computer literacy topics for teachers to study: "(a) computer operations, (b) issues in educational computing, (c) integration of computer applications in the curriculum, (d) programming, (e) evaluation of software and hardware, and (f) developing a school system's plan for integration of educational computing" (p. 369).

Ingram (1992) used a definition of computer literacy that expanded upon the 1988 guidelines given by

the Office of Technology Assessment (OTA). She listed the following skills as needed by teacher educators:

computer use as a tool for problem solving; experience of using computers in the learning of subject matter; knowledge of computer related terms; computer use as tool (using applications such as wordprocessing, spreadsheet analysis, or database management; familiarity with computer hardware; a practical operational knowledge of more than one machine; theoretical knowledge of computer aide [sic] instruction. (p. 17)

Stell (1986) assessed the content, status, and implementation of computer literacy curricula in higher education. She found that, although authors disagree on a definition of computer literacy, there is substantial agreement on what constitutes a computer-literacy course. The following topics are commonly addressed in such courses, according to Stell.

1. computer terminology
 2. computer organization (hardware)
 3. programming and algorithms with BASIC the most often cited language preference
 4. software and data processing
 5. applications for personal, business, and educational uses
 6. capabilities and limitations of the computer
 7. impact on society; values and ethics.
- (Stell, 1986, p. 33)

Dave Moursund, Executive Officer of the International Society for Technology in Education (ISTE), expressed his ideas on what Colleges of Education should require of themselves and their students in the area of computer literacy. In an open letter to teacher educators (1991) he recommended the following:

1. Every preservice educator in a teacher training program should do at least one major multimedia term project each term, where the multimedia include a range of computer based technologies. . . .
2. At least one term each year, and preferably each term, each teacher education faculty member should directly supervise a number of students who are doing multimedia term projects. . . .
3. Every College of Education faculty member and every preservice teacher should learn to make routine and effective use of computerized information retrieval and communication systems. . . .
4. At least once each year, and preferably once each term, each teacher education faculty member should present a unit of study in which the primary mode of instruction is computer-based multimedia. . . .
5. Every College of Education should provide its students substantial experience in learning from and teaching with Integrated Learning Systems and distance education. . . . (p. 4)

Teachers need to be trained in the above manner in order to facilitate Moursund's recommendations for the computer literacy of students on the pre-college level. His recommendations for this level (1992) are as follows:

1. Within each discipline, students need to routinely use the computer and computer-based multimedia tools of the discipline. . . .
2. In addition, students need specific, broad-based instruction in computer-based multimedia and in use of computers as an aid to problem solving. Computer literate students are competent in using camcorder, audio and video tape, videodisc, and a broad range of computer facilities to create, edit, and display hypertext documents that incorporate text, sound, and motion graphics. Computer literate students use computer facilities to help solve the types of problems being studied in the

course they are taking. They have learned to represent problems on a computer, make use of procedures and procedural thinking, and know how to test and debug their computer-based problem solving efforts. (p. 4)

Moursund believes that "the computer-based multimedia definition of computer literacy fits the needs of students being educated for life in our Information Age society" (1992, p. 4).

Familiarity with computer hardware and educational software, particularly word processor, spreadsheet, and database, seems to be at the core of many definitions of computer literacy. Moursund's emphasis on multimedia, telecommunications, and information accessing are more recent skills suggested as necessary for the computer-literate teacher.

Significance of the Study

This study focused initially on computer and related instructional technology training for preservice teachers. Graduate programs with a strong computer component (i.e., which prepare educators or trainers to use computers and related instructional technologies in non-school settings) and research and development involving computers in instruction were areas also explored which were related to the study. Research in all these areas is minimal due to the infancy of the field. By describing good programs, this study will contribute to a new and

developing body of knowledge concerning the use of computers in instruction within these three contexts.

There is a critical need for knowledge concerning what constitutes good computer (and related instructional technology) training at the undergraduate level. Also, graduate level preparation of educators to use computers and related instructional technologies in non-school settings, as well as research and development involving computers in instruction, is just emerging. An examination of both reveals implications for education that are further explained in chapter 7. Connections between graduate computer and related instructional technology training for educators in non-school settings and the traditional graduate degree in the field of curriculum and instruction are also discussed in chapter 7.

In addition to providing a description of the training of preservice teachers in computers and related instructional technologies at three NCATE universities with excellent computer programs, this study will be useful to professors and directors of programs who would like to develop new computer courses and programs in education, as well as add computing components to existing courses. An exploration of the computer-related research and development efforts of these outstanding universities should also prove beneficial to K-12 teachers and

instructors/professors of higher education who wish to develop multimedia materials for instructional purposes.

By looking at the best computer training and computer research and development efforts within technologically outstanding Schools of Education in the United States, and trying to synthesize components, recommendations are made that will provide others with models for development, new ideas for further research, and fresh approaches. Other Schools of Education offering or developing similar courses and programs and involved in computer-related research and development efforts will also be benefited.

Organization of the Study

Chapter 1 introduced the initial focus of the study and the two related areas that were explored. The background of the problem was stated, including accreditation efforts and highlights in the history of computers in education from the 1920s to the 1980s and beyond. Conclusions were drawn concerning the background of the problem, and a statement of the problem was given. The focus of the study was established and specific research questions were outlined. A discussion of computer literacy followed. The significance of the study was clarified, followed by an organization of the study.

Chapter 2 presents a literature review of computer and related instructional technology training within

teacher preparation programs, as well as brief literature reviews of the two related areas (i.e., graduate programs with a strong computer component, and research and development involving computers and related instructional technologies in instruction).

Chapter 3 gives an explanation of the development of the study, particularly concerning the two areas related to the training of preservice teachers in computers and related instructional technologies. Also included are a description of the sample selection, type of research, descriptive framework, the unit of analysis, the research instruments, the chronology of research procedures, and a discussion of validity and reliability issues.

Chapters 4, 5, and 6 are the case studies, and chapter 7 consists of a cross-case analysis of the above three cases, with findings, conclusions, recommendations for further research, and implications of the study.

CHAPTER II

LITERATURE REVIEW

Introduction

The review of literature was accomplished through a computer search of the following databases: (1) Books in Print from 1980 to 1993, (2) Dissertation Abstracts International, from July, 1980 to December, 1991 and (3) Educational Resources Informational Center (ERIC), from 1980 to 1993. All databases are available on CD-ROM at the James White Library of Andrews University. The ACM Guide to Computing Literature for the years 1988-1992 was searched, as was Phi Delta Kappan, published from 1970-1992. The latter was accessed via the free database search service provided for Kappans by PDK's Center for Evaluation, Development, and Research.

Use was also made of the online catalog at the James White Library of Andrews University, Indiana University, Bloomington, and Indiana University, South Bend. The inter-library loan program and the On-Line Computer Library Center (OCLC) facilities at Andrews University were used as needed.

Although the searches were limited to the past 13 years, the literature review drew most heavily from material published in the past 5 to 7 years. Due to the sweeping advances made in computer and related instructional technologies during this time, earlier material seemed rather archaic. Only literature published in the continental United States was reviewed.

Since the initial focus of this study was the training of preservice teachers in computers and related instructional technologies, a large body of the literature review deals with that topic. From the two areas related to the initial focus, (1) graduate programs which prepare educators/trainers to use computers and related instructional technologies in designing and delivering instruction in non-school environments, and (2) research and development (R & D) on the use of computers in instruction, a brief literature review of each topic is included. The research and development review focuses on inter/multi/hyper media, as that was the R & D effort most often observed at the three sites visited. Karlin (1992) pointed out that "inter/multi/hyper media" are means of gaining immediate access to text, visual images, and audio through electronic means.

Most of the literature was published in the form of journal articles. Few of the articles are research based. In the following review of preservice teacher training

literature, a brief summary of research articles is given, followed by articles which reflect the author's opinions on the topic. These articles are summarized as recommendations on various topics. Articles or papers which propose models or which describe the implementation of computer courses are summarized under the heading of models and implementations.

The Training of Preservice Teachers in the Use
of Computers and Related Instructional
Technologies

What content should be included in computer education for teachers? How can we best structure or organize the curriculum in this area? These and related issues are addressed in the following review of the literature.

Research Identifying Problems

A number of problems were identified by four studies on the computer training of preservice teachers. Peterson (1989) identified the most frequently encountered problems in expanding computer use in teacher education departments. They are: (1) lack of finances, (2) shortage of computers, (3) shortage of computer-trained faculty, (4) problems of integrating computer components into the present curricula, and (5) inadequate software holdings.

Walker, Keepes, and Chang (1992) surveyed computer use by California high-school teachers. Major problems

identified by the study included insufficient resources (money, equipment, facilities), teacher indifference or resistance to technology use, and insufficient training of teachers.

Kennedy (1987) found that "computer courses currently required or recommended in teacher education are taught in departments or sub departments outside of the field of education" (p. 150). His study revealed that few computer education programs were designed to meet the needs of elementary and secondary classroom teachers, because they were taught by individuals from other disciplines.

A report on computer education within the teacher preparation programs of eight midwestern colleges and universities (Ingram, 1992) revealed similar findings. It was found that a large percentage of the instructors who teach computer courses were not full-time faculty members. "Instead, they were either graduate assistants, parttime, or adjunct faculty, some of whom were hired for the sole purpose of computer instruction" (Ingram, 1992, p. 18). Ingram also found that few program directors and full-time instructors have computer training, and there are few computer integrated curricula within teacher preparation programs. She concluded that "the use of computers in elementary teacher education programs is not adequate to support or develop educational and technological change in America's classrooms" (p. 19).

Research on Structure
Within Program

Although a number of opinions abound in the literature as to exactly where computer training for preservice teachers should be placed in the program, only one study was found to address the issue. In a study of computer literacy curricula in seven northwestern states, Stell (1986) concluded that there is a shift away from a single computer literacy course toward integration of the computer as a tool into the disciplines.

Research on Appropriate
Course Content

Studies on content considered appropriate in a computer course for preservice teachers are equally scarce. The two studies below produced very general findings. Nevin (1987) studied teachers' computer preparation and found that teachers should have hands-on experiences with computers, which should be structured to emphasize computer use in the classroom. A survey of computer use by California high-school teachers (Walker et. al., 1992) revealed that the computing component of teacher education programs should be tailored to the teacher's subject. The researchers also suggested that teacher education programs prepare teachers to assume a share of the responsibility for securing funds to finance technology projects in their schools.

Recommendations Concerning Problems

The four articles summarized below give a good overview of the kinds of solutions most often recommended in the literature concerning the computer training of preservice teachers.

The National Task Force on Educational Technology (1986) investigated the potential of integrated technology to improve learning in our schools. The Task Force studied technology integration primarily on the elementary and secondary levels, but did make some recommendations concerning higher education. The Task Force recommended that colleges and universities should:

redesign pre-service teacher education programs to include the effective uses of technology, including its uses in teaching for subject-matter mastery[,] and ensure that those who prepare our teachers themselves are fully competent in applying technology to education. (p. 64)

Futrell (1989) says that recent reports of the computer revolution that is supposed to "transform" our K-12 schools differ very little from those issued as much as 15 years ago. Schools are still purchasing more hardware. Software continues to improve, yet the impact on classroom instruction remains negligible. She believes that computers will be successfully integrated into the K-12 curriculum when teacher educators possess a firm research base that specifies "how to teach computer-assisted teaching" (p. 45). She states that presently the

research base is fragile, and will remain so until "teachers and researchers establish a network of collaboration that is more active and more comprehensive than at any time in our history" (p. 46). Futrell recommends that teacher educators hold joint appointments as university professors, researchers, and K-12 classroom teachers. Her conclusion is that the crisis in computer education will not abate until the system is reorganized, with more collaboration and more research than currently exists.

The lack of consistent and structured computer training during the student teaching experience was identified as a problem by Criswell (1989). He made the following recommendations for the computer training of preservice teachers:

1. Develop a sequence of instruction that brings all teacher education students to a specified level of basic 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 classrooms as an instructional tool . . .
3. Sequence additional microcomputer courses [or] experiences beyond the basic entry level course . . .
4. Provide training for cooperating teachers so that clinical experiences include the actual utilization of microcomputers in the classroom. (p. 42)

Fulton (1989) noted that the national teacher education reform movement recommends more coursework on subject matter content specialization and general studies.

with fewer education courses. This causes a dilemma for Schools of Education. They must develop a curriculum which meets initial licensure requirements, therefore there is little room left for technology training.

Recommendations on Structure
Within Program

Fulton (1989) recommended that the problem mentioned above could be resolved by integrating technology training into the methods and theory courses, yet many teacher educators are reluctant to use computers in their own teaching. The opportunity to influence prospective teachers through the modeling of computer instructional applications is lost, and the problem of how to structure technology training continues to exist. Others who agree with Fulton about integrating the college curriculum and having college professors model technology use include Turkel and Chapline (1984), Wholeben (1985), Criswell (1989), Gooler (1989), Monnen (1989), and Munday, Windham, and Stamper (1991).

A modified approach suggested by Turkel and Chapline (1984) consists of an introductory computer literacy course placed early in the teacher training program, before the methods courses. That way the methods courses could pursue detailed applications of computers and how they can best be integrated into the curriculum.

Bitter and Yohe (1989) recommended that technology training should be structured within the teacher preparation program to include:

1. An individualized, skills-based introductory course
2. Specific integration techniques within methods courses
3. Advanced instruction through elective coursework
4. Continuing education after graduation through workshops, conferences, etc.

Wetzel (1992) studied the computer/technology goals that the International Society for Technology in Education (ISTE) recommended to NCATE as a guide for evaluating the educational computing and technology preparation component of education programs. He concluded that in order for all goals to be met, both the computer literacy course and the integration paradigm are needed (i.e., the use of technology is modeled in the methods courses).

Wholeben (1985) proposed that computer literacy be addressed on the undergraduate level during the final two semesters of the teacher education major's program. The first semester would consist of a 3-hour awareness session, or a 6-hour practicum session, followed by a 3-day workshop on computer activities. For the remainder of the semester, students would be expected to implement these computer activities during their methods courses. This approach would necessitate correlating the computer training and the methods work during the same semester.

During the second or final semester, students would take a 36-hour computer training course which is offered in conjunction with the student internship. Initially the students would learn instructional strategies for using the computer in an actual classroom environment. During the remainder of the semester, students would be expected to implement these strategies as part of their student internship.

Callister and Burbules (1990) recommended that a course should be developed which addresses the theoretical basis for the use of computers. Proposed placement of the recommended course is toward the end of the teacher education program.

Recommendations on Appropriate Course Content

The following six articles give a good idea of the computer skills and concepts frequently recommended in the literature concerning the computer training of preservice teachers.

Bitter (1989) recommended the use of applications software as the core of a teacher-training course. Munday et. al. (1991) noted that application software, multimedia, telecommunications, computer-assisted instruction, and interactive video are appropriate topics to include in teacher technology training. Thompson (1989) concluded that teachers need to experience computer applications as

learners and problem solvers, then relate these experiences to existing psychological and educational theory. Teachers should then attempt to create plans for integration of computers into the curriculum, based on insights gained from the first two approaches to computer training.

Foliart and Lemlech (1989) suggested that preservice teachers should be exposed to ways in which the computer can be used in conjunction with the various teaching strategies. One example cited was the use of the computer for constructing a database during group investigation. This approach would benefit teachers who are concerned with ways to use the computer in instruction.

Marshall (1983-84) recommended that each teacher candidate be made aware of State and/or district policies regarding computer literacy. Teacher educators can obtain documents from appropriate agencies and discuss them with their classes.

Callister and Burbules (1990) believe that the following content, which is currently addressed in many computer literacy courses for teachers, should be deleted:

1. Technical knowledge about what is going on inside the machine
2. How to operate the machine (Students should enter the course with this knowledge.)
3. When to use the computer in instructional contexts
4. How to program.

They recommend that much of what remains of current content should be integrated into specific content areas, and an entirely different course should be developed. This course, according to Callister and Burbules, should address the theoretical basis for the use of computers. Research should be included about the effects computers have on learning and schooling from sociological, psychological, and conceptual perspectives.

Models and Implementations

A search of the literature revealed a number of models and implementations describing how the training of preservice teachers in computers and related instructional technologies should be structured. The implementations (i.e., models put into practice) may experience different content and/or structure configurations in a year or two, or even next semester. The implementations, therefore, are presented as "snapshots" of computer and related instructional technology training at different universities or colleges as they existed at a particular point in time.

Akron University, Ohio

The OPEN model presented by Hess (1990) is a computer literacy curriculum for preservice teachers. OPEN is an acronym for Overcome anxiety, Practice until mastery, Educate beyond, and Network for survival. Listed below are the appropriate activities for each stage of the model.

Stage 1: Overcome anxiety. A forum is conducted in which preservice teachers are expected to express their opinions and feelings regarding computer technology. Those who are comfortable with computers exert a positive influence, while those who are anxious become less concerned when they realize that many of their classmates are apprehensive as well. The instructor guides a discussion about the strengths and weaknesses of computer use in education, and the session closes with a motivational film about the possibilities for computers in education.

Stage 2: Practice until mastery. During this stage the preservice teachers are exposed to programming in BASIC, programming in LOGO, and AppleWorks—an integrated package containing word processing, database, and spreadsheet applications. The programming component of the model is to be covered in 3 weeks. During this time the preservice teachers are expected to create a quiz, present it to the class, and explain their coding procedures. An objective exam is given and they are introduced to AppleWorks.

Using a word processor, the preservice teachers write resumes and cover letters. For the database portion of the curriculum, the preservice teachers use the Ohio Educational Directory to search for possible job openings

in the State. Finally, they use the spreadsheet to create gradebooks.

Stage 3: Educate beyond. Using a computer system other than the one they were trained on, preservice teachers are expected to create an in-class handout, a tutorial worksheet, a parent/student address database, a spreadsheet accounting lesson, or some other unique instructional item.

Stage 4: Network of survival. The instructor shares information about professional computer publications, computer workshops, computer consortiums, etc. A lecture is given on copyright laws, and several case studies involving copyright violations are examined.

University of Wisconsin,
Whitewater

Gartmann (1992) describes a three-stage model of a computer education component for preservice teachers. The model, which includes entry skills, a delivery system, and exit abilities, was developed with the help of a grant from IBM.

Under stage 1, students are informed of the computer skills they are expected to have before they can be admitted to the College of Education. It is their responsibility to acquire these skills if they are deficient.

Under stage 2, all students are required to take a one-credit course, *Individualized Production of Instructional Materials*. In this course they are introduced to word processing, desktop publishing, databases, CD-ROM, videodisc, and telecommunications. Some activities are done on both the Apple IIe/Macintosh and IBM platforms.

During the nine-credit methods block classes on reading, mathematics, and language arts, students receive a presentation on software relevant to each content area, and are given suggestions for integration of computer activities into their instruction. All lesson plans required by the block classes are to be word processed.

Stage 3 involves the assessment of exit abilities and is not yet fully developed. Stages 1 and 2 are in the initial phases of implementation. Plans are also being made for the development of an *Individualized Production of Instructional Materials* course for secondary preservice teachers, and for the expansion of graduate-level offerings.

St. Mary's, Notre Dame

The approach to computer training for preservice teachers recommended by Dr. Eugene J. Nuccio of St. Mary's College, Notre Dame (1990), is an integration of coursework and fieldwork. The introductory computer course content includes computer languages, the use of hardware and

software, software evaluation, the use of database, spreadsheet, word processor, materials generator and gradebook software.

A great deal of emphasis is also placed on learning to develop computer-related lesson materials and incorporating them into the curriculum. Using the BASIC language, students modify existing public-domain software and create lesson plans and supplementary materials for a week of instruction. A second course activity requires them to work cooperatively in groups of two to four. In their groups they develop an original piece of software (a 10- to 20-minute program) using the PILOT authoring language. This is also incorporated into a week-long unit plan with supplementary and support materials.

During their fieldwork, students teach the computer-related lesson plans and unit plans that they were required to develop during their coursework. Dr. Nuccio recommends that careful attention be given to the creation of clear, appropriate, and achievable assignments for the students and fieldwork instructors to execute.

Arizona State University

Rosberg and Bitter (1988) describe Arizona State University's efforts to develop adequate computer literacy training within their Teacher Preparation Program. Initially two self-instructional modules were developed with a mastery learning approach. Students were to

complete the computer literacy requirement while enrolled in the first semester of a three-semester program of foundations for teachers in training. The computer component, which was adjunct to but not included in the foundations class, had to be completed before students could advance in the program. Students expressed dissatisfaction with this approach on occasion because it was time consuming, yet no credit was given.

Module 1 was based on the integrated Appleworks program with assignments in word processing, spreadsheet, and database. Module 2 covered software packages entitled *Print Shop*, *All of the Above*, *Stickybear Printer*, *Crossword Magic*, and *EA Gradebook*. Students were permitted to take the competency test as many times as they wished until the desired level of proficiency was reached.

Rossberg and Bitter recommended that Teacher Education Programs wishing to try this approach to computer literacy training begin the program at the start of fall semester. This provides more time for slower students who are unable to finish the requirement in one semester. A number of problems were experienced with the project, resulting in a change in the mode of delivery to a one-semester credit course taught by an instructor.

The College of Charleston,
South Carolina

Coleman (1992) describes the course *EDUC326, Computers for Teachers*, which is required for preservice teachers at the College of Charleston. A unique approach is taken in this computer class, due to the influence of the writing-across-the-curriculum movement. A number of writing assignments are required in the class as a means of connecting the reading and lecture material to practical applications. Students are asked to envision their future classrooms and write about how they will use technology to its best advantage. For instance, they are asked to write about how they will use word processing and databases to accomplish objectives in their future classrooms. After the assigned reading on telecommunications, they must write about how telecomputing will be used in their future classrooms. In addition, students must conduct an ERIC search to identify articles related to class content, then read, summarize, and evaluate two of them. All writing assignments are word processed using Appleworks.

Students are required to become familiar with adaptive hardware, laser discs, scanners, digitizing software, and additional hypermedia programs. They are also required to review software and produce a hypermedia stack using TutorTech.

University of Michigan,
Dearborn

A computer methods course which emphasizes cooperative learning strategies in training preservice teachers is reported by Brown (1992). The focus of the course is on the integration of computers into classroom teaching. With a class limit of 20, the students pair up and cooperatively work on several projects. They are required to evaluate educational problem-solving software, develop a computer-based problem-solving unit plan for a particular grade and subject, and design two problem-solving LOGO exercises.

Another important project they must complete involves the design and presentation of a computer-based drill and practice lesson for elementary or secondary students in a local school district. The project timeline is as follows:

Class 1: The students are assigned to their groups and a piece of software is demonstrated. The students brainstorm ideas of activities to complement the program.

Class 2: A video is shown in which the instructor and a colleague use the above software in teaching a class of children. The students discuss their observations and suggestions.

Class 3: Students are given handouts and instructions on how to work cooperatively in fulfilling the requirements of the project.

Class 4: Students begin previewing software and brainstorming learning activities.

Class 5: Cooperative work on the project continues.

Class 6: Cooperative work on the project nears completion.

Class 7: The computer resource teacher for the local school district speaks to the class, offering assistance and giving her perspective on the project.

Class 8: This is a debriefing session, held after all student groups have presented their lessons.

MECC software is used in the project, since the school district has a MECC site license and multiple copies can easily be made. The computer resource teacher for the school district plays a key role in making the arrangements for these learning experiences. She makes the necessary contacts with cooperating teachers and building principals, and arranges for the needed hardware and software.

University of Texas,
Austin

Savenye, Davidson, and Smith (1991) describe efforts to integrate instructional design principles into a computer literacy course for preservice teachers. The course is divided into four instructional units. In the first unit, students learn the basics of computer operation and terminology. The second unit covers the use of

computer tools such as word processors, database, spreadsheet, and graphics packages. In the third unit, instructional design principles are introduced. Students are required to use these principles to evaluate computer-assisted instruction (CAI) software and to develop a lesson plan that integrates a CAI computer program into the curriculum.

The fourth unit requires students to learn BASIC programming and develop a computer-based concept lesson which includes objectives, a description of the learners and context, and descriptions of lead-in and follow up activities. A more detailed description of the exercise follows.

Preservice teachers are given a disk containing a computer-based concept lesson that models effective instructional strategies. Along with the disk, they receive a printout of the BASIC program, sample storyboards, and a sample lesson plan. Using this lesson template, pairs of students are asked to create a concept lesson appropriate for their content area and grade level using BASIC as the programming language. Before they begin programming the lesson, they develop storyboards that reflect their analysis of content, situation, and learners, and that incorporate the nine events of instruction. (p. 51)

From this brief review of models and implementations, unique approaches based on current research are noted (i.e., mastery learning, cooperative learning, writing-across-the-curriculum, and the integration of instructional design principles). Following is a review of the literature on instructional design

programs which prepare educators or trainers to deliver instruction via computers and related instructional technology in non-school settings.

Graduate Degree Programs With a Computer Component

At the three sites visited, the graduate degree programs with a computer component were programs involved in preparing educators or trainers to use computers and related instructional technologies for designing and delivering instruction in non-school settings. There is a paucity of case study research describing such programs. Therefore, included in this literature review are articles that describe the field of instructional design in general, and the use of computers and related instructional technologies for the delivery of instruction in non-school settings in particular. The following articles review the literature related to these topics.

Instructional Design

Instruction, according to Dick (1991), is an organized set of methods, materials, and assessments designed to promote competence in defined outcomes. Hannafin (1992) states that basically an instructional designer's job is to structure both the content and the methods used to convey lesson content.

Instructional designers are often required to design instruction that utilizes the computer and/or

related instructional technologies as a delivery system, though their skills are not limited to this area. Since the use of computers and related instructional technologies for the delivery of instruction is central to this study, that aspect of the work and training of instructional designers will be highlighted.

Trends

Bowsher (1992) makes the following observation:

From almost no training prior to World War II, American companies are now annually investing \$40-50 billion in operating expenses for various courses for employees. If you add the cost of salaries and benefits for being away from the job, the investment exceeds \$100 billion a year. (p. 51)

A trend toward increasing opportunities for educators or trainers in the business sector is evident, beginning shortly after World War II and continuing to the present. Concerning the future of this trend, Bratton (1988) predicts, "Qualified persons will [continue to] find jobs in every sector of society where education and training are valued, for example, business, industry, military, government, social services, education, and health care" (p. 7). He further predicts that instructional designers will find increasing opportunities to work in foreign countries.

Reiser (1988) and Bowsher (1992) note a shift from training given in the traditional classroom manner to training given through new cost-effective advanced

technology delivery systems. Computer-based training and interactive videodisc systems are two of the new delivery systems Bowsher mentions.

Concerning the future use of computers and related instructional technologies for providing instruction in corporate environments, Piskurich (1993) made the following predictions:

Software based on HyperCard, its clones, and its descendants will shape our instructional-design abilities and possibilities for some time to come.

Certain concepts will change the way we define training and learning in the future. . . the development of on-line expert systems not only for performance-support tools, but also for instructional design itself. . . .

The use of sound and video in the form of multimedia will help us deal with some of the reading and literacy problems we'll encounter while attempting to retrain the workforce. . . .

The whole process of using virtual reality as an instructional tool . . . will represent a common training design by the end of the decade.

In the 21st century we will see artificial intelligence become a major training technology.
(pp. 51-52)

As stated earlier, instructional designers traditionally work in non-school settings. Following are some examples of technology-based delivery systems that instructional designers are often expected to develop in their work.

Applications in Non-school Settings

Arthur Andersen Worldwide Organization, the world's third-largest accounting and consulting organization, hires many instructional designers to provide training for its employees. Galagan (1993) states that each employee gets approximately 138 hours of training every year, and it is delivered in a variety of formats, ranging from basic classroom courses to multimedia programs on computer workstations. A multimillion-dollar training-management support system tracks the curriculum plans of each individual and monitors who gets what training. Recently a new technology-based business practices course was developed. Galagan describes it in the following manner:

The business practices course is a highly interactive self-study program that uses multimedia to teach basic business functions. . . . The 15-module course includes more than 180 minutes of audio and video segments stored on CD-ROM disks. DVI [digital video interactive] technology lets the user select at random among video segments. Through their PCs, users can access many levels of support systems and navigational tools. (p. 35)

Piskurich (1993) suggested two possible uses of technology in preparing businesses for a global economy: (1) foreign language training by computer, and (2) multicultural instruction through multimedia.

From a review of literature, Weber (1992) found a number of non-school settings mentioned in which interactive video was used successfully in instruction. They include: (1) to teach Cardio-Pulmonary Resuscitation,

(2) to train computer technicians, (3) to train hourly workers in the fast-food industry, (4) to teach mathematics to plant workers, and (5) to study the cognitive achievement and attitudes of nursing students toward interactive video (p. 12). Foley (1993) mentions two additional areas which are using multimedia for instruction (i.e., museums and the entertainment field).

These are only a few of the uses made of technology-based instructional design in non-school settings. A brief discussion of the future of instructional design within the field of education follows.

Applications in School Settings

Reiser (1988) described the role that instructional designers are likely to play in public schools and higher education in the year 2001. He states that, though there are a few instructional designers working in school systems, the likelihood of their number increasing significantly by 2001 is not very great, because more instructional designers is rarely mentioned in education as a solution to instructional problems. Instead, more time in school, more teachers, and more computers are often proposed as solutions.

Reigeluth (1989) disagrees. He believes that the public schools need to be restructured (using technology) and that educational technologists within Colleges of

Education are uniquely qualified to help public schools make that transition. He states:

Along with this unique qualification comes a certain responsibility, and there is evidence that our field is beginning to awaken to this responsibility. A recent special issue of the Journal of Instructional Development (Vol. 10, No. 4) was devoted to ID in the schools.

He further states that educational technologists at Indiana University are "involved in helping the Indiana Department of Education to plan better ways to structure the Indiana public schools to meet the needs of an information society" (p. 78).

Research and Development With Computers and Related Technologies in School Settings

Since research and development involving the use of computers in instruction is such a broad area, R & D literature was reviewed concerning the project which excited the most faculty interest at the three sites visited. By far, multimedia/interactive video projects were most frequently under development at each site.

Multi/Hyper/Interactive Media

Galbreath (1992) pointed out that the term multimedia once referred to a slide presentation with audio. Today, however, it has come to describe "the fusion of the computer and various media formats" (p. 15). Text, video, graphics, animation, and sound can all be controlled and accessed quickly by the computer in a single

presentation. The term *hypermedia* is often used interchangeably with multimedia in the literature. However, some argue that hypermedia should be used exclusively to differentiate the modern, computer-driven presentation from the earlier *slide show* presentations of the past (Galbreath, 1992).

Interactive video is a term used to describe a hypermedia presentation in which a videodisc is used as a storage platform for still frames, motion video, and sound. The computer controls a videodisc player, randomly accesses information on the videodisc and displays it during the presentation. "The term 'interactive' means that the computer and learner must interact, or exchange information, for the program to continue" (Foley, 1993, p. 32).

There is little research to date on the effect of hypermedia on learning. Amthor (1991) reports a Department of Defense study which indicates that interactive video instruction improves achievement by an average of 38%, and the time to reach competency is reduced 31% over traditional instruction. Foley (1993) says that 30 studies have been compiled to date which indicate that "interactive technologies reduce learning time requirements by an average of 50 percent" (p. 32).

Weber (1992) states that the research regarding interactive video as an instructional tool is generally

favorable, but the expense often proves a significant barrier to adoption. According to Foley (1993), the main expense in interactive instruction lies in design and production rather than replication, distribution, and delivery. "A typical cost-per-student break-even point occurs when 100-200 students are using the program. Beyond that number, savings build dramatically" (p. 32).

In addition to the cost, Jafari (1992) identified the following shortcomings of multimedia technologies in instruction—poor reliability, time-consuming preparation, and operating difficulties.

From a research project which introduced interactive videodisc technology to 525 university students in 16 classes and eight different subjects, Weber (1992) concluded that (1) interactive videodisc technology can be used effectively for small groups, large groups, and for individual instruction, (2) interactive technology in a university setting is a supplement, not a replacement for conventional instruction, and (3) interactive technology will not replace teachers, but will "relieve instructors of repetitive tasks and free them to assist learners in more significant ways" (p. 16).

Karlin (1992) points out that interactive multimedia enables the student to construct his or her own understanding. This personalizes learning, which in turn affects motivation. He also notes that "interactive

multimedia technology appeals to multiple modalities and intelligences" (p. 7). Following are some applications of interactive hypermedia technology in the training of preservice teachers.

Applications Within Teacher Education

Reilly, Hull, and Greenleaf (1992) have developed a hypermedia tool called *Virtual Portfolio* to be used in training preservice teachers of remedial reading and writing. Their work is based on two trends that are currently popular in educational reform, case methods for teacher education and portfolio assessment.

Electronic portfolios have been created which contain "collections of students' writing, interviews with students and teachers in sound and text formats, images, and video clips of classroom interaction, student-teacher conferences, and individual reading and writing performances" (p. 28). Cases of individual students are used to provide practice in assessing reading and writing skills, problems, and solutions, and in supplementing the observation of teaching practice.

Abate (1992) tells of efforts to integrate multimedia technology into the preservice teacher education program at Cleveland State University. A multimedia database of research-based teaching strategies with videodisc illustrations of each strategy was created and is

"currently being implemented into the undergraduate core teaching curriculum" (p. 272). Other efforts at multimedia development at Cleveland State are directed towards the reading methods class. A simulation was developed which gives students needed practice in conducting an informal reading inventory. A database of 11 reading lessons was also developed which connects text and lecture materials to video demonstrations of teaching. Following are the components of each lesson in the database:

an overview of the lesson methodology, how the instructor prepared for the lesson, what prior knowledge was required by the students to effectively participate in the lesson, a complete lesson plan with links connecting the plan to what actually occurred in the classroom, examples of work done by the students during the lesson, and references. In addition to the information listed above, comments by the teacher who implemented the lesson are embedded within the text materials to provide a connection between theory and practice.
(p. 274)

Merideth and Lotfipour (1992) describe a HyperCard based tutorial (which accesses a laserdisc) used to teach the theory and practice of cooperative learning. The laserdisc features secondary, middle school, and elementary classrooms where teachers model cooperative learning strategies while teaching math, social studies, and computer applications lessons. The following options are available on the main menu:

1. Definition and Rationale
2. Essential Elements--Johnson & Johnson Model
3. Jigsaw Structure and Activity
4. Group Social Skills
5. Group Roles

6. Teachers' Roles
7. Outcomes of Cooperative Learning
8. Credits, References, & Resources. (p. 268)

Option 1 provides definitions from such experts as Johnson and Johnson, Slavin, and Kagan. Each menu topic has laserdisc visuals used to clarify the concepts as they are taught. Option 7 (Outcomes of Cooperative Learning) shows video segments of students and teachers as they give their reactions to cooperative learning, and teachers explain implementation problems. Options 1-7 also provide a list of objectives and an interactive quiz which gives immediate feedback.

Goldman and Barron (1990) tell of efforts to develop videodiscs of teaching vignettes and HyperCard "stacks" or programs to improve the preparation of elementary math teachers at Peabody College of Vanderbilt University. One videodisc shows vignettes in which the same lesson on measurement (prepared by a preservice teacher) is taught to two different fourth grade classes. One class is taught by the preservice, novice teacher, and the other is taught by an experienced teacher. The following results are reported:

Although the preservice teacher's lesson was well-planned and successful for a novice teacher, there were striking differences in certain aspects of the two lessons . . . such as treatment of decimal notation during the development part of the two lessons, questioning techniques the two teachers used, and directions the teachers gave for a measuring activity in which the students rotated to different stations. (p. 16)

Another videodisc of vignettes dealing with the teaching of meaning in subtraction was also developed. In evaluating the effectiveness of the videodisc materials, it was found that (1) students' reactions to the videodisc materials were favorable, (2) the use of videodisc materials did not make a difference in student performance on traditional test items, and (3) there were "significant differences favoring the video treatment group in four teaching performance categories (basic skills development, development of higher-order cognitive and problem-solving skills, management practices, and development of positive attitudes toward mathematics)" (p. 19).

From the literature on research and development regarding computers and related instructional technologies in school settings, it was found that hyper/interactive media has been successfully used for training preservice teachers in the areas of (1) remedial reading and writing, (2) research-based teaching strategies, (3) conducting an informal reading inventory and reading lessons, (4) cooperative learning, and (5) elementary math.

Following is a discussion stating the significance of each section of the literature review.

Discussion

The results of this study contribute (1) to the body of knowledge on the training of preservice teachers in the use of computers and related instructional

technologies, (2) to the body of knowledge on graduate programs that prepare educators or trainers to use computer-based technologies for designing and delivering instruction in non-school settings, and (3) to the body of knowledge on research and development of hyper/interactive media for providing instruction in both school and non-school settings.

From the first body of literature, appropriate content for an undergraduate course in computers and related instructional technology (for teachers) was identified as a key issue, as well as how best to structure technology training for teachers within the curriculum.

The second body of literature revealed that (1) opportunities for educators to instruct in non-school settings are increasing, and (2) the need for skills in the use of computers and related instructional technologies (in non-school settings) is also increasing.

From the third literature review, it was found that the use of multimedia as an instructional tool is escalating within both school settings, and non-school settings.

The research base proving the effectiveness of this new technology, however, is weak. Foley (1993) states that 30 studies have been compiled to date which indicate that "interactive technologies reduce learning time requirements by an average of 50 percent" (p. 32). No details are given

however, as to level, subject, content, research methodology, etc., which would add credence to this finding.

Finally, this literature review, which has spanned the past decade, revealed that a study similar to this one has never been conducted. Therefore, this study should make a significant contribution to the three bodies of knowledge mentioned above.

Conclusion

The review of literature on the computer and the related instructional technology training of preservice teachers reveals that this is a new area of training for teachers, with most courses having their initial development in the early 1980s. There has been little research on this topic, with most of the literature being in the form of opinions and recommendations. More research needs to be done in the area of the two key issues that were most frequently discussed in the literature—structure within the teacher preparation program and content.

From the literature, it appears that preservice teachers as well as educators in non-school settings will increasingly use computers and related instructional technologies in their work. In the future their training will need to be in greater depth as software and technologies advance, and as employers increasingly expect them to use technology skills in their teaching.

Additional research also needs to be conducted on the use of hyper/interactive media, although initial findings are promising. The extent of the use of this media as noted in the literature seems to indicate that it will have a significant impact on education in both school and non-school settings in the future.

Finally, in considering the literature and relating the two additional areas studied to the field of education and the training of preservice teachers, two observations stand out: (1) educators who are prepared to work in non-school settings have the skills necessary to work in school systems which are attempting to restructure through technology, and (2) hyper/interactive media has tremendous potential in the training of preservice teachers.

Chapter Summary

An introduction to the chapter explained the sources and procedures used in conducting the literature review. Three bodies of literature were reviewed. The first and most extensive review was on the topic of the training of preservice teachers in the use of computers and related instructional technologies. Literature concerning research and recommendations on this topic was discussed. Models and implementations from seven colleges or universities were described.

The second body of literature involved graduate-degree programs with a computer component. At all three

sites visited, these programs were preparing educators or trainers to use computers and related instructional technologies to design and deliver instruction in non-school settings. Therefore, a brief review of literature defining instructional design was given, followed by a discussion of trends in the field of instructional design, applications of technology-based instructional design in non-school settings, and the future of instructional design in school settings.

The final body of literature involved research and development regarding computers and related instructional technologies in education. Since hyper/interactive media was the R & D project most frequently under development at the three sites visited, it was chosen as the subject of this literature review.

Hyper/interactive media was defined, and examples of its use in the training of preservice teachers were described. A discussion of the significance of the literature review was followed by a conclusion and a summary of the chapter.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

Development of the Study

Chapter 1 includes much information on the development of the study. This chapter attempts to elaborate further. By way of review, two studies were cited in chapter 1 (Fulton, 1989; Henderson, 1992), and a number of others in chapter 2 (the literature review), which identified as a problem area the training of teachers in the use of computers.

One study (Daniels, 1982) looked at computer education in NCATE (National Council for Accreditation of Teacher Education) colleges. Daniels recommended that institutions having successful computer awareness programs be identified and their methods of program initiation and implementation be described.

Considering the findings of the above studies, I decided that a possible solution to the problems of teacher training in the use of computers could be found in a study which endeavors to identify and describe good programs (involving training in computers and related instructional technologies) that are fully operational.

How preservice teachers are taught, and what they are taught about computers in instruction (within a good program), became the initial focus of this study. In order to give a more detailed description of this subject, I chose to address the following questions:

1. What content is currently included in computer education courses?
2. How is computer education organized or structured within the existing programs?
3. How are the expenses of preservice computer education being met?
4. What are the probable trends or shifts in content emphasis in the future, according to the computer instructors surveyed?
5. How could this study benefit other Schools of Education?

Because the subject investigated is complex, a qualitative multiple case study design was chosen as the appropriate method of research. In the past, complex situations have been successfully investigated by the use of this research design. Also, this methodology is appropriate for answering the questions the study addresses, and it affords opportunity for a rich description of the subject.

From a survey which identified schools with programs that are doing an excellent job of training

teachers to serve in the Information Age, the sites for the 3 case studies were chosen.

A review of the literature (see chapter 2) revealed that typically only one computer course is offered for preservice teachers. In keeping with the developmental nature of qualitative research, I decided to see what computer courses were offered at the graduate level. The findings proved to be fruitful, so the decision was made to expand the study to include two related areas, the graduate degree program with a strong computer component, and research and development (R & D) involving computers in instruction. Further elaboration on the development of the two related areas follows.

Graduate Program with a Computer Component

A review of the literature disclosed that there are graduate programs in some Schools of Education which deal exclusively with computer education (i.e., Instructional Computing, Educational Computing, Computers in Education, etc.). The Educational Media and Technology Yearbook (Broadbent & Wood, 1991) listed 82 graduate programs in educational computing in existence in 1990.

However, none of the sites visited had a graduate computer education program as described above. They each offered a graduate program which prepares educators for other contexts. One component of this graduate program

involved training educators in the use of computers for the delivery of instruction.

The last site visited had a well-established program of this nature, one of the oldest in the country. I spent a day in the library at this site, taking the opportunity to peruse back issues of a few professional journals (i.e., Journal of Instructional Development, Association for Educational Communication and Technology, and National Society for Performance and Instruction). This brief search revealed that programs which prepare educators for other contexts (i.e., business, industry, military, and medical fields) are rarely described, at least in these professional journals. Nor did a search of ERIC reveal much information on these programs in the educational literature.

This finding strengthened the rationale for including a description of graduate programs for educators in other contexts (i.e., business, industry, military, and medical fields) in the study. Each site had a graduate program with a computer component, and it appeared that a description of these programs would make a meaningful contribution to the literature. Schools of Education could learn about new job opportunities for graduates, new programs needed to train those graduates, and the new skills graduates need to function in the workplaces of the Information Age.

Research and Development--
Computers in Instruction

It became evident during site visitation that there are connections between research and development involving computers in instruction and the computer training of preservice teachers. Hypermedia, and/or interactive videodisc technology were being used extensively in order to create and communicate information for instructional purposes. Karlin (1992) observed that:

What characterizes the Information Age is our relationship to information. With technology, we can greatly affect the quantity and quality of teacher and student performance by offering access to an enhanced knowledge base, search capacity, organizational ability and presentation possibilities. (p. 6)

A look at research and development involving computers in instruction logically seemed related to a study of the preparation of preservice teachers to serve in the Information Age.

Outcome

From the previous discussion, it can be seen that there was a need to expand the scope of the study. The original focus of the study proved too limiting, and site visitations revealed more fruitful areas of investigation. After visiting each site, connections between the computer training of preservice teachers and graduate programs that train educators for other contexts began to emerge. Also it became apparent that connections exist between the

computer training of preservice teachers and research and development involving computers in instruction. These two additional areas—(1) graduate programs for educators in other contexts, with a strong computer component, and (2) research and development involving computers in instruction—were included in the study, and are discussed at length in the analysis chapter. The description of the two related areas is not intended to be exhaustive, but rather, is intended to give an overview of the graduate program and the R & D efforts as they exist at each institution.

Connections between the graduate preparation of educators for other contexts and the traditional graduate degree in curriculum and instruction were also noted and are discussed in chapter 7.

Changes of this nature are consistent with the developmental nature of qualitative research. As the researcher proceeds through the study, other factors may emerge that are seen to affect the original focus of the study. Their inclusion in the study can provide useful additional information, valuable insights, and can possibly even detect developing trends.

More detailed information on the research methods used in this study follows.

Sample Selection

A survey conducted by Dr. Richard Stowe of the Center for Information and Communication Sciences at Ball State University identified the universities that are doing the best job of preparing preservice teachers to function in the Information Age. On the basis of this survey, the three cases described in this study were selected.

Purposive sampling was the method of sample selection. This is a common sampling strategy associated with qualitative case study research. It is "based on the assumption that one wants to discover, understand, gain insight; therefore one needs to select a sample from which one can learn the most" (Merriam, 1988/1991, p. 48).

With this in mind, a large public university with an enrollment just over 36,000 was selected, as was a private university with an enrollment of approximately 9,000, and a public university with an enrollment of approximately 12,000. A sampling of universities of different sizes and types (public/private) yielded greater insights and more understanding of the subject.

Type of Research

The approach taken was a qualitative multiple case study research design, largely descriptive in nature. Further clarification of the meaning of the terms research design, qualitative, case study, and descriptive follows.

Merriam (1988/1991) broadly defined research as systematic inquiry. She further states that "A research design is similar to an architectural blueprint. It is a plan for assembling, organizing, and integrating information (data), and it results in a specific end product (research findings)" (p. 6).

In considering qualitative research, Bogdan and Biklen (1982) identified the following five distinguishing features:

1. Data is collected in the natural setting and the researcher is the principle instrument in data collection.
2. Qualitative research is descriptive, using words or pictures rather than numbers.
3. Processes as well as outcomes and products are considered.
4. Data is analyzed inductively, examining the particulars, then building abstractions.
5. Consideration of participant perspectives is essential for an understanding of the meaning of the subject under study.

Merriam (1988/1991) points out that "there is little precision in the use of the term 'case study'" (p. xii). It means different things to many different people. However, she suggests that "a qualitative case study is an intensive, holistic description and analysis of

a bounded phenomenon such as a program, an institution, a person, a process, or a social unit" (p. xiv). The term descriptive, according to Merriam, means that "the end product of a case study is a rich, 'thick' description of the phenomenon under study" (p. 11).

The qualitative case study research design was selected as the most appropriate method for this study because the subject is complex and research in this field is limited. In the past, situations with these characteristics have been successfully investigated by the use of this research design.

Descriptive Framework

In the absence of theoretical propositions, a descriptive framework was developed for organizing as well as analyzing the case studies, as recommended by Yin (p. 107). From the research questions, five broad categories were identified and used as the descriptive framework for gathering information about undergraduate computer and related instructional technology training at NCATE universities. The categories of the descriptive framework are:

1. content
2. structure within program
3. funding sources
4. trends in content emphasis
5. benefits.

The descriptive framework is mentioned in the methodology chapter because it played a primary role in the method of data gathering.

Concerning trends in content emphasis, I developed a questionnaire for the instructor(s) who teach the computer class for preservice teachers. They were asked for their opinions concerning the importance of training in various computer skills for preservice elementary and secondary teachers today and 5 years from now.

Since some sites had only one or two instructors responsible for teaching these classes, it was thought best to combine responses from all 3 cases and discuss the results in the analysis chapter. The other four categories (content, structure within program, funding sources, and benefits) are addressed within each individual case and are further elaborated on in chapter 7, which deals with their use in the data analysis.

The Unit of Analysis

Merriam (1988/1991) says that "the unit of analysis, or 'the case' can be an individual, a program, an institution, a group, an event, a concept" (p. 44). According to Patton (1980/1990), "The key issue in selecting and making decisions about the appropriate unit of analysis is to decide what it is you want to be able to say something about at the end of the study" (p. 168). Therefore, the initial focus of the study was on

undergraduate computer and related instructional technology training within Schools of Education. The unit of analysis consisted of a single computer course for preservice teachers.

On the graduate level, the program was chosen as the unit of analysis. Graduate degree programs with a strong computer component were described.

A project was chosen as the unit of analysis for the second related area of study. In this case, projects involving research and development with computers in instruction were also described.

To summarize, this study was conducted within Schools of Education at 3 NCATE universities and involved three units of analysis: (1) a computer course for preservice teachers, (2) a graduate degree program with a strong computer component, and (3) research and development projects involving the use of computers in instruction.

Research Instruments

The Training of Preservice Teachers in Computers and Related Technologies

The following research instruments were developed for the study of the computer course for preservice teachers: (1) checklist of data to be gathered concerning the computer and related instructional technology training of preservice teachers, (2) interview guide for professors/instructors of the computer course for

preservice teachers, and (3) questionnaires concerning the assessment of trends in computer skills needed by elementary and secondary teachers. Topics explored by the research instruments were identified through a comprehensive review of the literature.

All instruments were designed in consultation with media specialist, Dr. Paul Denton, as well as Dr. Lawrence Turner and Mr. Dan Turk, two instructional computing professors at Andrews University. The consultants were asked to evaluate for clarity of purpose and language and to make recommendations for the improvement of the instruments.

Checklist

A checklist was developed detailing procedures and areas to be investigated concerning undergraduate computer and related instructional technology training. The checklist is described below.

1. Interview guide for professors/instructors of the computer course for preservice teachers
2. Questionnaire concerning current and future computer training needs of elementary teachers
3. Questionnaire concerning current and future computer training needs of secondary teachers
4. Facilities and resources that support the computer course
 - a. Lab configurations
 - b. Hardware
 - c. Software

5. Documents

- a. Demographics from NCATE report
- b. Class syllabi
- c. Handouts.

Interview guide

An interview guide was designed for the instructors/professors who teach the computer course for preservice teachers. The questions on the interview guide are core questions. Other probing questions were asked, depending on the responses.

The interview guide was used primarily to gather comparable data across sites. An example of the interview guide can be found in Appendix A.

Questionnaires

Two questionnaires were developed to probe the opinions of the computer class instructors on the importance of various computer skills in the training of elementary and secondary teachers and to identify future trends in training. An example of the questionnaire developed to assess the current and future computer training needs of elementary preservice teachers can be found in Appendix A. An identical questionnaire posed the same questions concerning the computer training needs of secondary teachers.

First Related Area of Study—
Interview Guide

From the first related area of study, graduate programs which prepare educators for other contexts were described. While all three programs prepare professionals to design and deliver instruction in other contexts, the program in Human Resource Development (HRD) also taught professionals to design ways to improve the quality of work life, to facilitate change, and to develop programs to increase productivity and satisfaction for all organization employees (Peabody College: The Bulletin of Vanderbilt University, 1992/93, p. 75).

Unlike the HRD program, the other two programs focused entirely on the design and delivery of instruction in other contexts and had a stronger computer component in the program. One program was entitled Instructional Design and Development (ID&D) and the other was entitled Instructional Systems Technology (IST).

An interview guide was prepared to explore the first related area of study. The following questions were asked of the HRD, the ID&D, and the IST professors at the three sites:

1. Background:
 - a. When did the program begin?
 - b. How did it develop?
2. Who enrolls in the program?

3. When graduates exit the program, what are their job options?
4. What is unique or different about this program?
5. Do you see any trends developing in this field?
6. What are your current research efforts and/or plans?

Congruencies in training offered by these 3 programs, as well as traditional curriculum and instruction programs, is discussed in chapter 7.

Second Related Area of Study— Informal Interviews

Informal interviews were held with professors involved with research and development projects. Questions were open-ended and probing, as project topics were too diverse for a more structured approach.

Chronology of Research Procedures

Contacts and Permissions

The chairman of each Teacher Education Program was contacted initially by letter. Each letter explained the nature of the study and the projected length of involvement at each campus (approximately 7 to 10 days). An example of the letter can be found in Appendix B.

Also enclosed were a letter of introduction from the dissertation chairman, a letter from the Human Relations Review Board approving the research, and the researcher's vita. Duplicate copies of all paperwork were sent to the Deans of the Schools of Education as well.

Two weeks after these were mailed, the chairmen were contacted by phone. After a discussion of the study with their deans and the appropriate faculty, those who were willing to participate gave their consent by phone and sent a letter of permission to the dissertation chair. Tentative dates for site visitations were made for the fall semester of 1992.

Once at the site, a consent form was signed by those who participated in interviews and who allowed the observation of their classes. This form gave the participant an overview of the purpose of the inquiry, the data-gathering techniques, an assurance of participant anonymity if so desired, a description of benefits to participating institutions, and an opportunity to withdraw from the study. The researcher's phone number was also given for those who might have further questions. See Appendix B.

Upon completion of the case study report, the Dean of the School of Education at each site received a copy. Permission to forego anonymity and allow their schools to be identified as the institutions under study was given by those who approved (Data Vol. III, pp. 145-147).

Data Collection

A pilot study was conducted summer session of 1992 at a nearby university campus. All computer instructors were interviewed, as well as the Director of the Computer

Lab, who was responsible for the articulation and staffing of the classes required for the computer endorsement. A number of classes were observed and appropriate documentation was collected. As a result of the pilot study, minor adjustments were made in the instrumentation.

Site visitations for the 3 cases were conducted fall semester of 1992. Data was analyzed as collected in order to ascertain where to go, whom to interview next, and what new probing questions to ask.

Interviews

Participants who were interviewed included the heads of the departments involved with computer education and related instructional technology training at both the graduate and undergraduate levels, the professors and/or instructors of computer classes, and those involved with research and development in the field of computers in instruction. There were informal as well as semi-structured interviews, generally lasting from 30 minutes to 1 and 1/2 hours. Interviews were taped when participants gave consent, and hand-written notes were taken as well. Transcriptions of the tapes, hand-written notes, and observations were later recorded in field diaries that included the dates, times, and names of the participants.

Observations

Computer classes were the main focus of observation, although some computer committee meetings were observed, as well as a few demonstrations of R & D projects under development. In all observations, the observer acted in a nonparticipant mode.

In visiting the classes, the observation format included attention to course content, to teaching methods, and to contexts such as lab configurations and equipment.

Documentation

A number of documents were gathered in order to add more detail and accuracy to the description of each case. Bulletins and written statements of goals and objectives were used to study the structure of the graduate programs and the computer course for preservice teachers. Content was extracted from the course descriptions found in bulletins, course syllabi, and handouts; NCATE accreditation materials yielded demographic data.

Analysis of Data

A cross-case analysis was conducted. Patterns which emerged from the data were transformed into categories. Using these and the descriptive framework, a matrix of categories was developed. The resulting analysis of the content of each category was used to guide the recommendations and conclusions of the research.

Patton (1980/1990) says that "content analysis is the process of identifying, coding, and categorizing the primary patterns in the data" (p. 381). Merriam states that "content analysis is a systematic procedure for describing the content of communications" (p. 116).

In analyzing for content, Lincoln and Guba (1985) recommend that a basic unit of information be chosen. They state that units can come from interview transcripts, observation notes, or documents, and can consist of a phrase, a sentence, or a paragraph. These later serve as a basis for identifying categories. For the purposes of this study, the sentence was used as the basic unit of information (i.e., the content was looked at sentence by sentence).

Interviews, observations, and documents were all analyzed for content, though not in the ethnographic sense. In other words, no cultural meaning was sought. Rather, the communications were analyzed and assigned to the appropriate categories in the matrix which was developed from the descriptive framework and the patterns that emerged from the data. This was accomplished in the following manner.

A database of observations, field notes, and interviews was created. Researcher comments were made in the margins as the data was read through twice, and a list of tentative category designations was made. As the data

was read for the third time, the category designations were placed in the margins of the database and the documents. Notes, and comments were written down as each category was studied.

Establishing Trustworthiness

Lincoln and Guba (1985) state that

The basic issue in relation to trustworthiness is simple: How can an inquirer persuade his or her audiences (including self) that the findings of an inquiry are worth paying attention to, worth taking account of? What arguments can be mounted, what criteria invoked, what questions asked, that would be persuasive on this issue? (p. 290)

Following is a discussion of validity and reliability, which attempts to address these questions.

Construct Validity

Yin (1984/1989) says that the construct validity of case studies is often questioned by those who claim that the case study investigator "fails to develop a sufficiently operational set of measures and that 'subjective' judgments are used to collect the data" (p. 41). As recommended by Yin, the following tactics were used to increase the construct validity of this study:

1. Triangulation—Observations, interviews, and documents were used as multiple sources of evidence to support the findings and conclusions.
2. Chain of Evidence—This is also referred to by some qualitative researchers as "maintaining an audit trail"

(Lincoln & Guba, 1985; Merriam 1988/1991). It simply means that the datum reported in the case study can be traced back to its original sources in the documents, interviews, and observations, etc.

3. Member Checking—Key informants were asked to review the case study report to verify accuracy of content and interpretation.

Internal Validity

In a descriptive study, it is important to establish whether the researcher is observing what he thinks he is observing. Merriam (1988/1991) says: "Internal validity deals with the question of how one's findings match reality. Do the findings capture what is really there? Are investigators observing or measuring what they think they are measuring?" (p. 166). Since qualitative research assumes that reality is holistic and multidimensional, the study is internally valid only to the degree that the views of the informants regarding reality are accurately presented. Triangulation, member checking, the use of an audit trail, and repeated observations were used to ensure an accurate presentation of reality in this study.

External Validity

How generalizable are the results of the study? That is the question addressed when the external validity

of a study is considered. The results are not generalizable in the statistical sense, as the cases were selected through purposive rather than random sampling.

Merriam (1988/1991) suggests a way of viewing generalizability that is particularly suited to case study research. She uses the term "reader or user generalizability" (p. 177), meaning that the reader gleans from the study what he can apply to his own situation, and discards what he cannot use.

The external validity of this study was strengthened (1) by replication (i.e., conducting the same study in three different locations), (2) by providing a rich, thick description of each case and its context, and (3) by conducting a cross-case analysis. It is expected that these measures will afford the reader adequate information with which to make a number of applications in her own setting.

Reliability

According to Merriam (1988/1991), "Reliability refers to the extent to which one's findings can be replicated" (p. 170). The following measures were taken to strengthen the reliability of this study:

1. Protocol—According to Yin (1984/1989) a case study protocol not only "contains the instrument, but also contains the procedures and general rules that should be followed in using the instrument" (p. 70). He further

elaborates on the necessary components of a good case study protocol:

overview of the case study project (project objectives and auspices, case study issues, and relevant readings about the topic being investigated);

field procedures (credentials and access to the case study "sites," general sources of information, and procedural reminders);

case study questions (the specific questions that the case study investigator must keep in mind in collecting data, "table shells" for specific arrays of data, and the potential sources of information for answering each question); and

guide for the case study report (outline, format for the narrative, and specification of any bibliographical information and other documentation). (p. 70)

Although a formal document entitled the "protocol" was not prepared for this study, all of the above components of a formal protocol were prepared and included in the dissertation proposal.

Yin (1984/1989) identifies the protocol as a major tactic in increasing the reliability of case study research (p. 70). Therefore, since all of the work involved in the preparation of a formal protocol was done, the reliability of this study has been strengthened.

2. Checklist—A checklist or framework was developed in order to document the procedures followed. The same checklist was used at each of the 3 sites visited.
3. Case Study Database—A database of documents and field notes (i.e., interviews, tabular materials,

observations, and observer comments) was developed.

These materials increase the reliability of the study in that other researchers can review the evidence directly, rather than relying only on the written case study report.

4. Triangulation and the use of an audit trail (described previously) were also used and are credited by Merriam (1988/1991) as a means of strengthening reliability as well as internal validity.

Chapter Summary

This chapter described (1) the development of the study, (2) the process of sample selection, (3) the type of research, (4) the descriptive framework utilized for data collection and analysis, (5) the unit of analysis, (6) the research instruments, and (7) the chronology of research procedures.

Under the development of the study, I explained how data on (1) a graduate program with a computer component and (2) research and development projects involving computers in instruction came to be included.

In discussing the research instruments, the development of a checklist, an interview guide, and trend assessment questionnaires for the undergraduate computer and related instructional technology training course are described. Core questions are given which were used to explore the graduate program with a computer component, and

unstructured interviews were used to explore research projects.

The chronology of research procedures presented a discussion of how contacts were made and permissions obtained, how data was collected through documents, interviews, and observations, and how the data was analyzed.

In a discussion of how the researcher can persuade his audience that the findings of an inquiry are worth noting, the issues of construct validity, internal validity, external validity, and reliability were addressed.

CHAPTER IV

CASE STUDY I

In this chapter, and in the following two chapters, I present the case studies in the order in which they were visited. Following is a description of the first case.

Context

Nashville, Tennessee, a city with a population of approximately 455,651, is the home of Vanderbilt University. Vanderbilt is a private, research-oriented institution which has placed 25th in the U. S. News & World Report ranking of national universities for 1992 (Vanderbilt Register, September 21-27, 1992, p. 1). Situated on a 333-acre campus about one and one-half miles from the downtown business district of the city, Vanderbilt reported a total student body enrollment of 9,236 for the fall of 1991 (Peabody College: The Bulletin of Vanderbilt University, 1992/93, p. 10; NCATE Institutional Report, Category I, p. 2).

Peabody College merged with Vanderbilt University in 1979 and serves as Vanderbilt's School of Education and Human Development (Peabody College: The Bulletin of Vanderbilt University, 1992/93, p. 7). Peabody College of

Vanderbilt has ranked first in recent years as an institution recommended for those wishing to pursue a degree in education (Rugg, 1990).

For the 1991-92 school year, Peabody's total enrollment equaled 1,597, with 844 undergraduate students, 294 of which were enrolled in teacher education, and an additional 60 pursuing teacher certification while enrolled in the College of Arts and Science (NCATE Institutional Report, Category I, p. 7).

Background of Computer Course Development

In 1983, the first undergraduate computer course, HR1600, was developed at Peabody College of Vanderbilt and required of the entire student body (Data Vol. I, p. 3).

It is described as follows:

Computing: An Introduction to Applications and Issues

Acquaints the student with the functional units of computer systems, fundamental programming constructs in a microcomputer implementation of a high-level language, and applications of particular significance in the emerging post-industrial information society. The student is expected to participate in a critical view of benefits and problems associated with the development of computing [3]. (Undergraduate Catalog: The Bulletin of Vanderbilt University, 1992/93, p. 521)

A recent study revealed that half or more of the students at Peabody took a computer literacy course in high school, therefore the HR1600 course is being phased out (Data Vol. I, p. 1).

As of the fall of 1992, the Department of Teaching and Learning created a new, one-credit course especially for all teacher certification students to take, instead of the HR1600 course. It is currently assigned a special topics number, EDUC 2690.02, and will be assigned a regular number at a later date. Unlike the previously required HR1600 course, which was more along the lines of general computer literacy, this course is specifically designed to cover the knowledge and skills recently mandated by the State of Tennessee as necessary for teacher education in the area of computers and technology (Data Vol. I, p. 1).

The Computer Class for Preservice Teachers

Five analytical categories were developed from the initial research questions concerning the computer and related instructional technology training for preservice teachers. Their development and use as a descriptive framework are discussed in chapter 3. Four of the five categories are discussed below. A discussion of the category "Trends in Content Emphasis" has been relegated to chapter 7, where responses from all subjects were combined and the findings examined. Within each category are the findings relative to the newly created one-credit course for teacher certification students.

Structure Within Program

Presently teacher education students can meet the computers and technology requirement by taking the new one-credit hour EDUC 2690.02, or substituting one of two other computer classes that are offered periodically by the Department of Teaching and Learning. For those who already possess a knowledge of computers, a test out option is available.

Test Out Procedure

A 1 1/2-hour test is offered four times during the school year (December, January, April, and July) for those who feel proficient enough to bypass the required coursework. The test consists of two parts: (1) a lab practical in which the student is expected to exhibit a working knowledge of both the Macintosh and the IBM PC platforms by performing particular activities and (2) a written exam on technology applications, based on readings which are held on reserve in the Education Library.

Following are the objectives for both the lab practical and the written exam, as described in the test out guidelines.

A. Objectives for the Lab Practical

The student should be able to:

Conduct basic operations on a computer disk given to the student on both Mac and IBM such as:

1. Determine what files are on the provided disk.

2. Create and print a one paragraph document on either the IBM or Mac machine.
3. Take a commercial software disk and successfully start it running on both the IBM and Mac.
4. Send an E-mail message to [professor] from any of the Mac computers in the lab.
5. Use the HyperCard program "Educator's Home Card".

B. Objectives for the Written Portion

The student should be able to:

1. Outline or describe one or more models of computer use in instruction based upon the literature.
2. Prepare a short [paper] (less than two hand written pages) on what types of programs (with examples) they would use in their expected teaching area.
3. Describe one or more applications of technology other than computer (e.g. videodisc) that could be used in instruction. (Test Out Procedure for State of Tennessee Technology Competencies, Department of Teaching and Learning, Vanderbilt University, August 27, 1992)

Tips on how to prepare for the exam, with reference to various tutorials and other materials that are available from the lab assistant, conclude the test out procedure guidelines. The test out option was made available to students for the first time in the fall of 1992.

Content

The State of Tennessee has mandated the following knowledge and skills in computers and technology for all persons seeking teacher licensure:

- A. Understanding of the appropriate use of computers and other technology in instructional programming; ability to integrate the use of technology into the on-going instructional program; and ability to assist students in using technological devices.
- B. Ability to use the computer for computer assisted instruction (e.g., problem solving, locating information, drill and practice, simulations, tutorials, and other learning experiences).
- C. Understanding the use of the computer for management of school data (e.g., student enrollment, student performance, and grade reporting), ability to use the information generated. (Teacher Education Policy Implementation: Licensure Standards and Induction Guidelines, Tennessee State Board of Education, November 18, 1988 p. 3-3 Professional Education Section)

In addition to using the State mandates as a guideline in deciding on the content for the new 1-hour course, Dr. Bob Sherwood, Chair of Teaching and Learning stated:

We're fairly heavily into research and development, using videodisc and hypermedia and some of those kinds of things. So I needed to make sure that these are in the course. You use the strengths of [your] institution . . . so there are sessions where they will see some of our videodisc products, and get a chance to work with some of the software. . . . It is pretty much cutting edge . . . and they need to see those kinds of things."
(Data Vol. I, pp. 3-4)

In order to clarify Dr. Sherwood's comments about content, a definition of hypermedia follows: "At its most basic level, hypermedia is simply the concept of linking any two pieces of information and providing a

computer-aided mechanism for navigating between them" (Bieber, 1992, p. 86).

Other content topics listed in the course syllabus include the usual productivity software (i.e., word processors, spreadsheets, databases, and graphics). Telecommunications and the use of Internet and E-mail are covered, as well as instructional software reviews, HyperCard fundamentals, video technologies, and future technologies. Within the limits of a 1-hour course, HyperCard expertise is focused mainly at the user level, rather than in creating stacks (Data Vol. I, p. 4).

Resources—Hardware and Software

Hardware emphasis at Peabody College of Vanderbilt is on the Macintosh platform, with additional instruction on the MS DOS platform. There is some exposure to Apple computers because there are so many in the school systems, but Apple capabilities are very limited compared to the other two platforms; therefore, they are not an emphasis of the program (Data Vol. I, p. 6).

Software is very dynamic, changing frequently. Microsoft Works is an integrated package used in database, word processing, spreadsheet, and graphics assignments. Telecommunications and the use of electronic mail are taught, and a variety of instructional software is demonstrated in class as well. Table 1 shows a

representative sampling of some of the software that is used.

Table 1

Software for the EDUC 2690.02 Class

Name	Type of Software
<u>Macintosh</u>	
MicroSoft Works	Integrated Software
HyperCard 2.1	Multimedia
Macintosh tutorial	Tutorial
<u>MS DOS</u>	
MicroSoft Works	Word Processor
Linkway	Multimedia

Note. Data Vol. I. pp. 78-79

Funding Sources

Expenses for hardware, software, and lab requirements come out of the regular budget, which is tuition driven.

Benefits

The following discussion of the problems encountered and solved, as well as the strong points of the computer class, is expected to benefit others by providing a model from which others can learn. A look at how instructors attempt to strengthen transfer of training so

that the training carries over into future classroom practice is also discussed. Finally, efforts to strengthen the use of computers during the student teaching experience are described.

Problems

Probably the biggest challenge is compressing the necessary content into the limitations of a 1-hour course (Data Vol. I, p. 4). The number of class sessions is counted and the course content is distributed according to areas of emphasis. The breakdown for the content of EDUC 2690.02 is listed in the class syllabus as shown in Table 2.

Table 2

Content of the EDUC 2690.02 Class

Content	Three Hour Sessions
Word processing	1
Spreadsheets	1
Databases	1
IBM platform	1
Telecommunications	1
Instructional software	2
Lab quiz	1
HyperCard in schools	1
HyperCard fundamentals	2
Anchored instruction & video technologies	2
Future technologies	1

Strengths

A strong point is that the class gives enough breadth to get started, and the sessions on HyperCard, anchored instruction, and video technologies strengthen those components of the methods classes (Data Vol. I, p. 4). Other strong points include lots of hands-on experience with reduced lecture time and an emphasis on making students comfortable with both the Macintosh and MS DOS platforms (Data Vol. I, p. 12).

Transfer of training

Transfer of training is strengthened by using examples that show the use of the hardware and software in instruction. For instance, the database assignment requires the students to create a database of resource materials in their particular content area (Data Vol. I, p. 12).

Student teaching

The use of computers and related instructional technologies in the student teaching experience is dependent upon placement. Few sites have cooperating teachers with access to computers and/or an interest in them. Where cooperating teachers are computer literate, the student teacher may use a computer during fieldwork, but this is rare and totally at the discretion of the cooperating teacher. Due to a scarcity of equipment and

expertise in the field, student teachers are not required by the university to integrate computers and related instructional technologies into their student teaching. For those student teachers who are advantageously placed, a software library is available. Instructional software can be checked out and used during the student teaching experience.

Conclusion

Due to the strong research and development emphasis of this institution in the area of computers and related instructional technologies, the required computer class for preservice teachers is cutting edge, but limited due to the time constraints of a 1-hour course. This may prove sufficient for this institution, however, since there is considerable integration of computers and related instructional technologies in the methods classes, and a number of professors have developed multimedia components to augment the courses they teach. A more detailed description of the development and integration of multimedia and/or videodisc technology is found in the following discussion of the Learning Technology Center at Peabody. This information is introductory to a discussion of computer and related instructional technology training at the graduate level.

The Corporate Learning Institute

The Corporate Learning Institute at Peabody College of Vanderbilt was founded in 1981 and focuses on learning within corporate settings. The Institute offers research and teaching opportunities for students in the master's and doctoral programs in Human Resource Development, and it designs, develops, and delivers innovative programs to train adult educators. The IBM Train-the-Trainer courses and the Bell and Howell program to train technical faculty at the DeVry Institute of Technology are examples of work that the Institute has done on a contract basis (Human Resources Development, [1992], p. 8).

Graduate Program for Educators in Other Contexts

According to Dr. J. Olin Campbell of the Corporate Learning Institute, the name of the place in a corporation where leadership and corporate-wide introductory training often happens is the human resource development (HRD) group. HRD professionals are skillful in delivering instruction, facilitating change, and developing programs to increase productivity and satisfaction for all organization employees (Human Resources Development, [1992], p. 1).

Dr. Campbell states that:

Typically HRD people do stand-up training on how to get along with other people. . . . The operations groups are usually the ones who do the technical training . . . not the HRD departments.

But, if you look in schools for where those kinds of skills are taught, they're very difficult to find. (Data Vol. I, p. 59)

Dr. Campbell named several universities around the country where people are trained to help design a school system or help design a commercial computer-based training lab. "The work that we're doing here is specifically to develop those sorts of courses at Vanderbilt," he states. "And we are now beginning to graduate some very strong people who are doing that in major organizations" (Data Vol. I, p. 59; personal communication, April 12, 1993).

Dr. Campbell currently teaches a course entitled *Advanced Instructional Strategies*, which addresses the use of computers and related technologies in the delivery of instruction in corporate settings.

In describing Vanderbilt's programs for educators in other contexts, Dr. Campbell says:

We are starting with what are the best ways to help people learn. If it happens that by using some of the new technologies, we are able to accomplish the goals that we have to help these students, then we'll use them. . . . But that is by no means the thrust . . . of what we are doing at Corporate Learning Institute. (Data Vol. I, p. 65)

Background of Program Development

According to a brochure on the HRD program published by the Office of University Publications (Human Resource Development, [1992], p. 1) an HRD program leading to a master's degree in education (M.Ed.) was initiated at

Peabody College of Vanderbilt in the fall of 1983. In 1984, a doctoral program (Ed.D.) was added.

Clientele

Approximately 20 students are admitted to the HRD master's program each year, and approximately 5 are admitted to the doctoral program (Dr. J. Olin Campbell, personal communication, February 22, 1993).

Until recently, incoming students have been those with many years of experience in the field of human resource development. In the last 2 years, however, a few undergraduates have been allowed to come into the master's program directly from a very strong and related undergraduate program. The majority of these come from an undergraduate Human Resource Development Program or undergraduate Human and Organization Development Program.

Many who enter the HRD graduate programs are still employed in industry. For instance, there are a couple of people from Federal Express, and some others from the Saturn Corporation who are full-time workers, attending classes on the weekends. Dr. Campbell explains an additional benefit these students have: "They can do projects that are related to their own jobs; they bring their experiences here to other students, and when they go back, they have much to bring from this program into their own day-to-day operations" (Data Vol. II, p. 61).

Unique Characteristics
of the Program

Dr. Campbell mentioned the combination of stand-up training (i.e., predominately small group and guided discussion-oriented) with an emphasis on new technologies as a unique feature of the HRD programs at Peabody College of Vanderbilt. The programs also have a major research component, and prepare people to think critically and develop new approaches for the future (personal communication, February 22, 1993).

Dr. Neal Nadler, Associate Professor of the Practice of Human Resource Development, sums up their approach to HRD at Peabody by rewording a quote from hockey player Wayne Gretsky, "We are trying to go where the puck is going to be, rather than where the puck is." At Peabody, HRD professionals are studying the emerging needs of organizations, looking for new ideas that solidly promote learning (personal communication, February 23, 1993).

Although Dr. Campbell does not consider this aspect of their program as unique in the HRD field, perhaps a well-rounded description of the HRD graduate programs at Peabody of Vanderbilt should mention that international consulting is a major area of emphasis, with students accompanying their professors to design and deliver training and organizational development interventions (personal communication, February 22, 1993).

Trends

As it currently exists, Dr. Nadler thinks the old-style HRD field in general is dying, partially because it is not meeting the needs of its customer base. "We need to rethink how we identify the needs of the customers, how we evaluate, and what delivery systems we use," he said. Dr. Nadler feels the HRD field could benefit from a total restructuring.

Another contributing factor in Dr. Nadler's opinion is that the field has drawn people from a variety of fields who are not grounded in learning theory. Consequently, the field can be more entertaining than substantive. He also sees a move toward instructional delivery systems which increasingly utilize some form of technology; consequently, he sees a decline in stand-up training (personal communication, February 23, 1993).

Job Options

Graduates of Human Resource Development programs traditionally work in business and industrial settings. A recent study by the American Society for Training and Development (ASTD) identified certain roles within this context as most important. Peabody has designed its HRD programs with this study in mind; consequently, its graduates are able to work in the following capacities:

Change agent	Needs analyst
Evaluator	Program administrator
Group facilitator	Program designer

Instructional writer	Strategist
Manager of training and development	Task analyst
Marketer	Theoretician

(Human Resources Development, [1992], p. 2)

Following is a description of the work of the Learning Technology Center at Vanderbilt.

The Learning Technology Center

The Learning Technology Center (LTC) was established in the early 1980s, with the primary purpose being research and development in the application of technologies to education. Approximately 60 people are involved in the work of the LTC, including full-time staff researchers, faculty from a wide range of disciplines, and graduate assistants (Data Vol. I, p. 44). Many articles concerning the work of the LTC are published under the name of "The Cognition and Technology Group at Vanderbilt" (CTGV). Members listed under this group name may vary from article to article, depending on who contributed to the research project being described. Currently the LTC has approximately 15 funded R & D projects, with proposals for a number of others in the works (Data Vol. I, p. 44).

Research and Development

Several of the areas in which the Learning Technology Center conducts research include interactive videodisc technology, instructional computer software design, and technological environments for teachers and

students (Peabody College: The Bulletin of Vanderbilt University, 1992/93, p. 14). Following is a description of several of the R & D efforts with which the LTC is associated, either in a supervisory or supportive capacity. This listing is intended to be representative, rather than exhaustive. Since computers and related instructional technologies are the focus of this study, research efforts of the LTC involving other technologies are not described.

Videodisc technology

A major project currently being developed by the LTC is the Jasper Woodbury Problem Solving Series, funded by the McDonnell Foundation, the National Science Foundation, Vanderbilt University, and numerous corporations. This is a set of 12 video-based adventures that allows middle-school students and teachers to integrate knowledge from a variety of areas. Six adventures are completed, and six more have been funded and will be produced. The primary emphasis is on math, specifically problem identification and problem-solving skills.

The instructional design approach is called "anchored" instruction, meaning that the instruction is provided within the context of an engaging, problem-rich environment, which invites multiple avenues of exploration by both students and teachers.

Concerning anchored instruction, Dr. John Bransford, a cognitive psychologist who is co-director of the LTC, states:

We are not doing lectures on video. We are creating stories to be explored. . . . [I]nstead of just learning facts out of context, we try to recreate the advantages that people had in apprenticeship situations. When you learn it in context, you know why you are learning things. . . . [O]ne can use this videodisc technology to recreate these very rich environments, and in that context a lot of learning can occur. (Data Vol. I, p. 41)

The series is available through optical data in videodisc format. The videodisc can be randomly accessed. In contrast, videotape is sequential, and must be played forwards or backwards in order to access a particular segment.

The information needed to solve the problems in the Jasper Series is embedded in each adventure. Because students must conduct multiple searches in order to find this information, the videodisc version is preferred. Special software has been developed to work in conjunction with the videodisc version permitting teachers and students to create multimedia products for teaching others (Cognition and Technology Group at Vanderbilt, 1992).

Dr. William Corbin, an administrator with the LTC who also serves on the Music City Chamber of Commerce Task Force on Education and Technology, said of the multimedia version of Jasper:

The real beauty of it is, it allows the kids to be producers of knowledge, not just consumers. They can go out and do research, then add text, scan pictures, bring in sections of videodisc, . . . digitize sound. All of this can be added to the database. So the computer really enriches what's going on in the adventures. (Data Vol. I, p. 46)

Using the principles of anchored instruction developed through the Jasper Series, the LTC has plans to develop other projects involving videodisc technology, specifically in the areas of science and health. One project concerning diabetes management has been completed, and proposals are being written to fund projects on AIDS and nutrition.

Although the videodisc multimedia materials developed at Peabody are used in the methods classes and other content-relevant classes for demonstration purposes, two proposals were recently funded that deal specifically with teacher preparation. The National Science Foundation recently awarded Dr. Elizabeth Goldman, project director, a grant to integrate hypermedia technology with elementary mathematics teacher-education instruction (Vanderbilt Register, June 22-July 5, 1992, p. 3). On-site classroom observations of elementary mathematics lessons will be accessed from a videodisc and used to complement the teaching of educational theory to future elementary math teachers. Dr. Goldman and Dr. Linda Barron have already completed several research and development projects in this area (chapter 2).

Dr. Victoria Risko and Dr. Charles Kinzer were recently awarded a federal grant that will enable them to explore ways of improving undergraduate teacher education with technology and case-based instruction (Vanderbilt Register, September 21-27, 1992 p. 9). Videodisc-based cases will be developed to help improve the problem-solving and decision-making strategies of preservice teachers enrolled in classes which involve reading instruction (Data Vol. I, p. 32).

Kinzer and Risko developed a videodisc version of the movie Young Sherlock Holmes as a context to explore multimedia applications in literacy. From this prototype, the research on literacy has been extended by a number of faculty and staff of the LTC to include multimedia applications in the area of adult literacy and literacy for children at-risk.

Another example of videodisc and HyperCard use in the training of teachers at Vanderbilt involves a problem-solving approach to classroom management, used in the secondary methods class (Randolph, Smithey, & Evertson, 1991).

Ted Hasselbring, Laura Goin, and Linda Bishop are using the same technology to develop materials for special educators. A videodisc is being created on which all the adaptive devices are demonstrated. Dr. Hasselbring explains:

Suppose you are teaching a course on technology applications for special needs students, and you don't have all the adaptive devices that you need to demonstrate readily accessible. In this case, you can use the adaptive technology, a videodisc and accompanying HyperCard stack to demonstrate what each of the adaptive devices looks like and how they are used. (personal communication, April 2, 1993)

Other projects involving videodisc technology include such topics as gender and ethnic issues, implications of basic research on learning, teaching thinking, and early-childhood education.

Implementations

Research proposals are routinely written to include plans for dissemination of the knowledge and/or products produced. Therefore, most of the projects described above either have or will be implemented in schools locally and in other states. A number of them may be in the prototype stage and therefore are currently used by faculty in their classes to introduce students to both course content and technology, as well as to identify areas where improvements can be made in the product.

A unique implementation effort recently involved a Jasper summer institute which received strong financial support from the business sector. Eleven corporations sponsored two teachers from each of 11 schools, sending them to Vanderbilt for 2 weeks of training. A computer-literate employee from each corporation also took part in

the training, with the expectation that they would later act as resource personnel in the participating schools.

All participants were given training on the use of the first two episodes in the Jasper Woodbury Series, the use of Macintosh computers, and development of multimedia products. When the teachers returned to their schools, the corporations provided each of them with a Macintosh computer, a videodisc player, a 27-inch monitor, a scanner, a voice recorder, the Jasper videodiscs and all the software. They were also given liquid crystal display panels (LCD) for projection purposes.

The corporate employees involved in the institute were committed to spending 20 hours a week in the schools for that school year, working with the teachers and their new multimedia systems. This effort has served to create lasting relationships between the corporations and the schools (Data Vol. I, p. 48).

Conclusion

A primary research emphasis of the Learning Technology Center is currently (and probably will continue to be for some time) the development of videodisc-based, multimedia products for use in instructional settings (Data Vol. I, p. 49). A look at the R & D efforts of this institution alone gives a good idea of the vast potential of videodisc technology and/or multimedia uses in instruction across disciplines. These impressive

accomplishments have been made possible through the collaborative efforts of a diverse community of educators, researchers, and scholars (Data Vol. I, p. 48).

Speaking of the work of the Learning Technology Center, Dr. John Bransford said:

It has been great to have the chance to collaborate with all these different disciplines. I think that this is a step that universities need to teach. That is, getting people within the university to start listening to one another. . . . and to start interacting with teachers and kids in the schools. (Data Vol. I, p. 43)

Chapter Summary

This chapter described the context of the case under study. A brief background of computer course development at Peabody College of Vanderbilt was given, and the undergraduate computer class for preservice teachers was described. The five categories identified from the original research questions were used as a descriptive framework. Four of the categories (i.e., (1) structure within program, (2) content, (3) funding sources, and (4) benefits) were discussed in this chapter. A discussion of trends in content emphasis was relegated to the analysis chapter.

The test out procedure, a topic closely related to structure within program, was described and hardware and software resources were discussed as topics closely related to the content category. Under the category of benefits, problems and solutions were described, and strengths of the

undergraduate computer and related instructional technologies class were identified. Efforts to strengthen the transfer of training were discussed, as well as the integration of computer skills into the student teaching experience. A conclusion followed.

The two areas related to this study were graduate-level computer and related instructional technology training and research and development in the area of computers in instruction. Under the first related area of study, the Corporate Learning Institute was briefly described. The background of program development, clientele, unique characteristics of the program, trends, and job options were all addressed in the description of the program.

Under the second related area of study, the Learning Technology Center and its involvement with research and development were briefly described. A representative number of videodisc technology projects were described, as well as one unique implementation effort. A conclusion concerning the final related area of study was given and the chapter was summarized.

CHAPTER V

CASE STUDY II

Context

Mobile, with a population of more than a million people within a 100-mile radius, is the largest city on the Gulf Coast between New Orleans and Tampa. It is the oldest city in Alabama and is the birthplace of public education in the State. It is here that the University of South Alabama first opened its doors in June of 1964 (University of South Alabama: Undergraduate Bulletin, 1992/93, p. 5). In its short history of approximately 20 years, the initial enrollment of 276 students has grown to over 12,000, and today the main campus occupies 1,200 acres in west Mobile (Campus Map, April, 1992).

According to an NCATE report for fall of 1991, the College of Education at South (as they commonly refer to themselves) had 985 full-time students enrolled in undergraduate professional education programs and 248 enrolled in graduate-level professional education programs. Part-time students for the same quarter numbered 287 at the undergraduate level and 420 at the graduate level

(AACTE/NCATE Enrollment, Productivity, Faculty Resources, 1992 JDCS Form B, p. 1).

Background of Undergraduate Computer Course Development

The first computer class for preservice teachers was offered in 1981, and remains in existence today. EDM 310 is a 4-hour course (quarter credits) and is currently described as follows:

Microcomputing Systems in Education

Basic understanding of microcomputing hardware and software for instructional purposes.
(Undergraduate Catalog: The Bulletin of the University of South Alabama, 1992/93, p. 247)

The class has evolved gradually. As hardware and software have become more sophisticated over the years, class instruction has endeavored to keep pace with technological advances by giving students the most current computer knowledge and training.

The Computer Class for Preservice Teachers

Five analytical categories were developed from the initial research questions concerning the computer and related instructional technology training for preservice teachers. Four of them (i.e., Structure within Program, Content, Funding Sources, and Benefits) are listed below. Within each category are the findings relative to the EDM 310 class. The fifth category, Trends in Content Emphasis, is discussed in the analysis chapter.

Structure Within Program

Presently the State of Alabama does not require preservice teachers to receive computer training. However, a computer course (EDM 310) is required by the elementary and secondary programs at South (Data Vol. II, p. 17). No test out option was observed by the researcher during the course of the study.

The EDM 310 class is also cross-listed with the computer science department (Data Vol. II, p. 28). For those computer science students who think they will eventually be employed in a school system, this class provides a background in educational theory as related to the computer (Data Vol. II, p. 16).

Content

Two instructors usually teach the EDM 310 class, and they both cover basically the same material. The content of the course is driven by the objectives in the class syllabus, as listed below.

1. Trace the development of computer technology as it applies to education.
2. Gain experience with the operation of microcomputers (Apple IIe, IIc, Macintosh, and IBM PS/2 Model 25).
3. Use software as a tool to manage or present information.
4. Evaluate computer-assisted learning software (drill and practice, simulations, tutorials, and problem solving).

5. Examine pertinent research in the educational applications of microcomputers.
6. Identify ways to integrate computer technology into the curriculum.

Content topics listed in the course syllabus include software evaluation and the use of a word processor, database, spreadsheet, graphics package, telecommunications, and various instructional software packages. The individual instructors vary the content slightly, as some classes are exposed to hypermedia (see chapter 4, page 6 for definition) and are required to produce a short hypermedia lesson, while others explore the use of videodisc technology in instruction. The breakdown for the content of EDM 310 as listed in one class syllabus is given in table 3.

Resources—Hardware and Software

Hardware emphasis is on the Apple platform, with some exposure to the others mentioned in objective 2 of the class syllabus. Although Apple computers have been discontinued by the Apple Company, a lab of upgraded Apple computers is still used by South in the training of preservice teachers because Apples predominate in the schools of the region served by South (i.e., Alabama, Mississippi, the Florida panhandle, parts of Georgia and Louisiana) (Data Vol. II, p. 16).

Table 3

Content of EDM 310 Class

Content	Two Hour Sessions
Overview, History, Terminology	2
Apple hardware operation	1
Apple educational software operation	1
Apple word processing	2
Types of educational software	2
Mid-term	2
Software evaluation	1
Macintosh operating system	1
Telecommunications	1
Macintosh database	1
Macintosh spreadsheet	1
MS DOS operating system	1
IBM educational software	3

Note. From class syllabus.

Software is very dynamic, changing frequently. AppleWorks is an integrated package, meaning that the program consists of three parts: word processing, spreadsheet, and database management. Students are also familiarized with telecommunications, database, and spreadsheet software on the Macintosh platform (Class syllabus). Hypermedia is taught on the Apple platform using Tutor-Tech and HyperStudio, and a variety of instructional software is explored on the IBM and Macintosh platforms as well (Class syllabus). Table 4 gives a representative sampling of some of the software that is used in the EDM 310 class.

Table 4

Software for the EDM 310 Class

Name	Type of Software
Apple	
AppleWorks	Integrated Package
PFS Write	Word Processor
Printshop	Graphics
Milliken Math	Educational Software
Crossword Magic	Educational Software
Hartley's Word Search	Educational Software
Certificate Maker	Educational Software
Certificates and More	Educational Software
MECC Study Guide	Exam Construction

Note. From class syllabus.

Funding Sources

Technology expenses come out of the regular budget, which is tuition driven. Also, a \$10.00 computer assessment fee is paid by each student enrolled in a computer class (Data Vol. II, p. 24). An IBM grant provided a lab equipped with both hardware and software, and an Apple grant provided the hardware for the Macintosh lab (Data Vol. II, p. 24).

Benefits

A look at how instructors attempt to strengthen transfer of training, so that the training carries over into future classroom practice, follows. A discussion of the problems encountered and solved, as well as the strong

points of the EDM 310 computer class, is also given. Finally, the use of computers during the student teaching experience is discussed.

Transfer of training

Dr. Richard Daughenbaugh strengthens transfer of training by requiring the students to actually integrate the computer into a teaching lesson within their chosen content area. For instance, science students are required to go to the State curriculum guides, choose a topic, and find the specific objectives that they are going to teach. After listing those objectives in their lesson plan, they complete a very detailed outline of what they are going to do (Data Vol. II, pp. 21, 22). The format of the lesson as given in the class syllabus must be as follows:

- A. TITLE of the lesson—at the left top side of the page
- B. GRADE LEVEL
- C. TIME to complete the lesson (one 50 minute class period, 90 minutes, etc.)
- D. EQUIPMENT required. (Apple computer with one disk drive, printer, color monitor, mouse, overhead projector, chalkboard, etc.)
- E. PURPOSE of the lesson
- F. STATE OF ALABAMA OBJECTIVE(S) as listed in the Skills/Concepts Handbooks
- G. COMPUTER PROGRAM SPECIFICS
 - 1. TITLE of the program
 - 2. PUBLISHER
 - 3. TYPE OF SOFTWARE (Drill and Practice, Tutorial, and so on)
 - 4. CONTENT SUMMARY—at least two paragraphs
 - 5. CONTENT TIME LINE—state when and how you will teach each aspect of the lesson. For example:

- a. 5 minutes—introduction of the content
Specify how you will introduce the topic
- b. 5 minutes—to review and relate previous material
- c. 3 minutes—to review any new vocabulary—
will write on board or paper
- d. 3 minutes—for passing out handouts—Name these
- e. 15-30 minutes—to demonstrate the computer program and go over any and all handouts
- f. 7 minutes—for passing out disks and collecting computer disks and/or printouts
- g. 5-10 minutes—for possibly a short quiz or a homework assignment.

The completed lesson plan must be 5 to 10 pages in length and include the following:

- 1. A cover sheet with graphics on it
- 2. A computer generated exam
- 3. A computer generated crossword puzzle (related to topic or unit of study)
- 4. A computer generated word search (related to topic or unit of study)
- 5. A computer generated certificate. (Data Vol. II, pp. 21, 22)

Teaching students to use software that will increase their personal productivity, giving demonstrations, and providing lots of direct hands-on experience for the students were all cited as additional means of strengthening the transfer of training (Data Vol. II, pp. 23, 32).

Problems

Dr. Daughenbaugh identified the teaching lesson as a problem area. "Initially the teaching lesson didn't work well because, it was me," said Dr. Daughenbaugh. "I didn't

know what I wanted them to do. But I gave it three quarters, three tries. The third time, it worked great" (Data Vol. II, p. 23). Dr. Daughenbaugh persevered in trying to teach students how to integrate the use of computers into instruction, and in this case, perseverance proved to be the key to success.

Another problem mentioned was lack of time. The problem was solved by deleting course content which was good, but not considered as essential as some other topics. In this case, LogoWriter was deleted (Data Vol. II, p. 32).

Often in the EDM 310 class, a large number of students will have difficulty and need assistance at the same time. A trained lab assistant to assist the instructor, as provided in some computer classes offered by the School of Education, was a solution proposed by one instructor (Data Vol. II, p. 34).

Strengths

Ms. Mary Ann Robinson found that the use of mastery learning worked well in her EDM 310 class. Students were permitted to correct and resubmit their work as many times as necessary to get full credit.

Ms. Robinson also found that acquainting students with different lab configurations was helpful. For instance, in the Apple lab the computers have no hard drives. All the machines stand alone and the instructor has to bring in all the software.

However, in the IBM lab, only one machine has a hard drive and it acts as a file server. All software is the network version and must be accessed from the file server.

In the Macintosh lab, the file server and all the other machines have hard drives, so students can pull down the software from the file server onto their hard drives and operate that way (Data Vol. II, pp. 28, 29).

"Since we have all of these situations out in the schools, I thought it would be helpful to give them a broader view of the most common situations with labs," said Ms. Robinson (Data Vol. II, p. 29).

Other strong points mentioned by instructors include lots of hands-on experience for students, and an emphasis on making students familiar with Apple, Macintosh, and MS DOS platforms (Data Vol. II, pp. 20, 23, 28).

Student teaching

The use of computers and related instructional technologies in the student teaching experience is dependent upon placement. Few sites have cooperating teachers with access to computers and/or an interest in them. Where cooperating teachers are computer literate, the student teacher may use a computer during fieldwork, but this is rare and totally at the discretion of the cooperating teacher. Due to a scarcity of equipment and expertise in the field, student teachers are not required

by the university to integrate computers and related instructional technologies into their student teaching.

Thus concludes the discussion of the training of preservice teachers in computers and related instructional technologies. Following is a discussion of the graduate program at South which has a strong computer component. Graduates of this program work as educators or trainers in business and other non-school settings.

Graduate Program for Educators in Other Contexts

The graduate program for educators in other contexts at South emphasizes the teaching of principles and procedures to design and develop instructional material (Data Vol. II, p. 62). Dr. Gayle Davidson, who teaches instructional design at South, stated, "Our field cuts across any sector of society, any age level, because . . . the emphasis is on the process, rather than on product" (Data Vol. II, p. 62).

Dr. Davidson explained that in designing instruction, various delivery systems can be used. The designer can plan the use of low-tech technologies, such as overheads and print-based materials, or emerging technologies, such as multimedia, which includes interactive video, CD ROM, etc. The designer can also plan for the use of live teachers or trainers (Data Vol. II, p. 62).

Dr. Davidson further explained that trying to identify graduate programs with an emphasis in instructional design can be confusing because they go by different names at different schools. By way of example, Table 5 gives a partial listing of universities and programs.

Background of Program Development

In discussing the development of the new doctoral program in Instructional Design and Development (ID&D), Dr. John Morrow, Director of Graduate Studies at South, said that a committee was appointed in the early 80s to consider what could be done that was unique in the way of training people for the future. "We talked with a lot of people across the country about where education or instruction is going in the twenty-first century," said Dr. Morrow. "And most people that we dealt with seemed to think that the delivery of instruction is going to change, and that technology is going to have a big impact on that delivery" (Data Vol. II, p. 2).

Table 5

Graduate Programs in Instructional Design

University	Name of Program
Florida State	Instructional Systems
Indiana	Instructional Systems Technology
Minnesota	Curriculum and Instructional Systems
Oklahoma	Educational Psychology and Technology
San Diego State	Educational Technology
South Alabama	Instructional Design and Development
Syracuse	Instructional Design, Development and Evaluation
Texas	Instructional Technology

Note. From Data Vol. II, pp. 62, 66; Broadbent and Wood, 1991.

A master's program in Instructional Design and Development began at South in 1983. The new Ph.D. program in ID&D was approved in 1991, and the first students were admitted to the program in the fall of 1992 (Data Vol. II, pp. 3, 6; Dr. John Dempsey, personal communication, April 20, 1993).

Clientele

As of the fall of 1992, over 50 students were enrolled in the master's program in ID&D at South, and over 20 were enrolled in the new Ph.D. program (Data Vol. II, p. 85). The clientele at this particular location come from business, military, and education backgrounds, with the smallest number of incoming students representing

the field of education (Dr. John Dempsey, personal communication, February 1, 1993).

Several incoming students are sponsored by the Coast Guard, receiving 75% reimbursement of their tuition expenses when enrolled in the ID&D master's program (Data Vol. II, p. 123). Although students with a business background predominate (Dr. John Dempsey, personal communication, February 1, 1993), clearly there is potential for a strong military clientele as well, since there is a large military presence in the area which includes the Coast Guard, the Pensacola Naval Air Station in Florida, and Keesler Air Force Base in Mississippi (Data Vol. II, p. 103).

Unique Characteristics of the Program

The ID&D programs at South prepare educators to design instruction within business and industry, the military, health care areas, and traditional academic contexts. Students who choose the business area usually go into Human Resource Development positions, whereas the military area is mainly focused on training (Data Vol. II, p. 103).

Dr. George Uhlig, Dean of the College of Education at South, points out a number of things that, taken together, make their new doctoral program unique. First, the new program prepares people to work in the field of

education, both in higher education and in the K-12 arena (Data Vol. II, p. 69). Many programs across the country focus primarily on preparing people for business, industry, and the military. They do not usually prepare people to work in education, and when they do, the emphasis is higher education (Data Vol. II, p. 14). Inclusion of the K-12 arena is certainly a unique aspect of the program at South.

Second, there is a very strong commitment to technology within the new Ph.D. program. This is unique in that there are a number of good instructional design programs which have chosen another area for their emphasis. Florida State, for example, has chosen to emphasize international development rather than technology (Data Vol. II, p. 87).

Finally, any faculty member in the College of Education can participate in the new program, either as an advisor or as a member of a committee (Data Vol. II, p. 70).

Trends

The following trends were identified by Dr. John Dempsey, who was responsible for developing the scope and sequence of the new Ph.D. ID&D program at South:

1. Instructional designers will have to become more multifaceted than they have been in the past, due in part to the influence of the constructivist movement in education (Data Vol. II, pp. 92,93).

2. Medical education will switch increasingly to a technologically oriented approach to instruction. This is possible because the health care area has traditionally been supported very well financially by the federal government (Data Vol. II, p. 94).
3. Tools (hardware and software) are getting cheaper and their capabilities will increasingly be used in improving instruction (Data Vol. II, p. 95).

Job Options

The job market potential for graduates of the Master of Science degree program in Instructional Design and Development includes the management of in-service education in business and industry, health-related institutions and agencies, military agencies, institutions of higher education, and related self-employed activities (University of South Alabama: Graduate Bulletin, 1992/93, p. 122).

Graduates of the Ph.D. program in ID&D at South are prepared to function in school districts, colleges and universities, business and industry, health care organizations, and the military with responsibility for planning, implementing, and evaluating instructional programs (University of South Alabama: Graduate Bulletin, 1992/93, p. 106).

As an example, Dr. Gayle Davidson worked at one time in the business sector as an instructional systems

specialist for a lending institution. "I built courses on mortgage loan accounting and credit analysis. . . . I didn't know anything about that, so I worked with content people, but I just shaped it so that it was good instruction, and appealing to the people, the participants," she said (Data Vol. II, p. 67). She concluded with the observation that the salary is much better when you are working in business than when you are working in the education setting (Data Vol. II, p. 68). Those who are attracted to the field of education, yet discouraged by the salaries at the K-12 level, should be informed of this option which gives educators better financial rewards for the delivery of instruction.

Research and Development

The second area related to this study involves research and development (R & D) efforts in the use of computers in instruction. Following is a description of several of the R & D efforts at South. This listing is intended to be representative, rather than exhaustive.

Alabama/Vanderbilt Consortium

Dr. Phil Feldman, Director of the South Alabama Research and Inservice Center, is principal investigator for a National Science Foundation 3-year development grant through the division of teacher preparation and enhancement. The grant funds a consortium approach to

integrating technology into higher education methods courses (Data Vol. II, p. 97).

Dr. Elizabeth Goldman, co-principal investigator, of Peabody College of Vanderbilt did the initial development work involving the use of hypermedia in elementary mathematics education. Two of the videodiscs developed at Peabody have been distributed throughout the State of Alabama to the 11 inservice centers which are housed at various universities. One videodisc is on how to teach subtraction and the other is on geometry (Data Vol. II, p. 49).

In addition to the two videodiscs, each site was given a computer, a videodisc player, and a color monitor, with the understanding that these hypermedia lessons be integrated into the math education courses (Data Vol. II, p. 50). The project will not only infuse the use of hypermedia into the elementary math methods classes, but will provide valuable data to Vanderbilt by field testing the two videodiscs which were developed there (Data Vol. II, p. 72).

In addition to validating the two videodiscs from Peabody College of Vanderbilt, four of the universities in the consortium will also develop videodiscs. Again, elementary math education will be the content area. Upon completion, these four videodiscs will also be distributed to the other inservice centers around the State. The

University of South Alabama will be developing a videodisc on entries and closures to eight different math lessons (Data Vol. II, pp. 49, 50).

Videodisc or Multimedia Development

Dr. John Strange teaches a number of technology classes at South. For several years prior to his current position, he lectured all over the world about the impact of technology on society and education (Data Vol. II, p. 36). He believes that many jobs of the future will require people to develop multimedia products using seven data types (i.e., words, numbers, sounds, graphics, motion graphics, still frame pictures, and motion pictures) (Data Vol. II, pp. 44, 45). Students in the ID&D program at South are given thorough training in the development of such products. Listed below are a number of efforts in multimedia product development by both faculty and students. The variety of uses and approaches to instruction through multi/hypermedia is a strong testimony to the extent of its potential.

Faculty

Dr. Brenda Litchfield, Dr. John Dempsey, and Dr. Susan Tucker have worked with the Family Practice Department in the medical school at South, developing multimedia products to aid in the training of physicians. Following are several projects they have worked on,

individually or with others: (1) A Family Practice Intern/Resident recruitment videodisc for all the programs operating in the State of Alabama (Data Vol. II, p. 49; Dr. Susan Tucker, personal communication, March 29, 1993), (2) an interactive videodisc of patient simulations to aide in teaching clinical problem solving (Data Vol. II, p. 84), (3) a videodisc on sports medicine, and (4) a videodisc on somatic disorders (Marousky & Mellone, p. 3).

Dr. Litchfield is also working on a project to design, develop, and produce four interactive videodiscs for the training of correctional officers with the Florida Department of Corrections (Marousky & Mellone, p. 2).

Dr. Turner Rogers, an art educator, has developed a teaching aid for his classes using the HyperCard program. The subject is the painting *Flemish Proverbs*, which illustrates approximately 120 popular sayings. History and language, as well as the proverbs and some music, are incorporated (Data Vol. II, pp. 82, 83).

Dr. Dianne Kenney has developed a videodisc and hypermedia program which deals with ethical decision making. It is used to train students who are learning to be group counselors, and it helps them recognize violations of their professional code of ethics (Data Vol. II, pp. 109, 114). She also uses other videodiscs in courses for counseling skills training, which she produced while a

doctoral student at the University of Iowa (Dr. Dianne Kenney, personal communication, April 18, 1993).

Dr. Richard Daughenbaugh has created a multimedia program on the Anasazi, a Pueblo Indian tribe of Arizona. The Anasazi are interested in using the program in their heritage center, to educate visitors about their culture (Data Vol. II, p. 27).

Student

In a technology class taught by Dr. Strange, students were learning to use HyperCard, and were required to create a multi/hypermedia final project. Their projects are mentioned here to illustrate the diversity of instructional use of this medium. Most of the class members were ID&D students with no specific need for their final project. Their main objective was to learn HyperCard skills (i.e., how to include graphics and animation, how to edit and change clip art, how to include voice, and how to make the program interactive).

Others enrolled with specific needs in mind, however. The chair of the science department at a local high school needed to learn to use the new equipment her school had purchased. She planned to then teach these skills to her staff, who would in turn teach the skills to their students.

A training specialist for a laser printer company was creating a program to train technicians. His final product would show them how to repair laser printers.

A maternal-child nursing instructor in the RN program at a local college was creating a program for nursing students. It was intended to reduce students' anxiety when taking State board exams, and increase their test-taking skills.

A former biology teacher was creating a program on nature study to be used in a high-school biology class.

Three class members were working on projects for children. They planned to write children's books, and use the HyperCard skills to create graphics for the books (Data Vol. II, pp. 122, 123).

Again, the power and potential of this medium of instruction can be seen in the above examples.

Related Research and Development

Dr. George Uhlig, Dr. John Strange, Dr. Phil Feldman, and Dr. Susan Tucker, as subcontractors and researchers for the Office of Technology Assessment (OTA), contributed to the first comprehensive study on the state of educational technology in America. They conducted eight case studies, looking at how effectively organizations have developed a cadre of technology specialists (Data Vol. II, p. 74).

In 1989, Dr. George Uhlig, Dr. Richard Daughenbaugh, Dr. Phil Feldman, and Ms. Mary Ann Robinson in cooperation with the Alabama Commission on Higher Education, the Alabama State Department of Education, and classroom teachers from school systems throughout the State, developed the Computer Education Curriculum Guide series of computer activities for K-8 classroom teachers (CECG, No. 87, p. iv). In the same year, several faculty members from South also assisted in developing high-school course outlines in computer applications and computer science (CECG, No. 91, p. ii).

In another research effort involving the computer, Dr. Eddie Shaw is studying the effect of word processing and keyboarding skills on children's writing, looking specifically at how their composition skills are affected (Data Vol. II, p. 76).

Ms. Mary Ann Robinson is developing a videodisc evaluation project (Data Vol. II, p. 24), and Dr. William Gilley is developing units that teach statistical concepts by computer. He plans to develop an entire introductory series to statistics and research design (Data Vol. II, p. 120).

Implementations

Recently several University of South Alabama faculty have worked with two projects involving technology in the public schools. Both are briefly described below.

Calcedeaver

Calcedeaver, located about an hour's drive north of Mobile, is an elementary school where over 65% of the student body are Choctaw Indian (Data Vol. II, p. 61). Several faculty members from the University of South Alabama have been involved in training the teachers at Calcedeaver in the use of technology. Dr. Susan Tucker and Mr. Gray Prewitt have also recently received a grant to assist the staff at Calcedeaver in the development of instructional hypermedia for the Choctaw Indian curriculum integration project (Marousky & Mellone, 1992, p. 2).

Even though financial support was lean, and administrative support at some levels was poor, teachers at Calcedeaver have accomplished much in the way of integrating technology into instruction. For example, they have been able to teach second, third, fourth, and fifth graders how to develop their own HyperCard stacks (Data Vol. II, p. 55).

Moss Point

Moss Point High School is located 35 miles from Mobile, just over the State line in Mississippi. A relatively poor school, with over 70% minority students (Data Vol. II, p. 71), Moss Point has gone from virtually no computers in the school 2 1/2 years ago, to over 110 computers in the school today (Data Vol. II, p. 98). The school is using technology in a restructuring effort,

changing from a regular six-period (1-hour class) day to a three-period (2-hour) class day (Marousky & Mellone, p. 7).

To assist in the transition at Moss Point, Dr. Brenda Litchfield is conducting a series of workshops for the individual departments, providing information on how to plan for the 2-hour class. These workshops will be followed by training sessions in cooperative learning and critical thinking skills (Marousky & Mellone, p. 7).

Dr. Litchfield is also working with the science teachers and their students, helping them create computer and interactive video-based student projects in chemistry and biology (Marousky & Mellone, p. 7). Most of the teachers at Moss Point use HyperCard in their teaching (Data Vol. II, p. 99).

Chapter Summary

Chapter 5 described the context of the case under study, and gave a background and description of preservice computer course development at the University of South Alabama. Four of the categories identified from the original research questions were used in this chapter to describe the EDM 310 class. They are (1) structure within program, (2) content, (3) funding, and (4) benefits.

Hardware and software resources were described as they are closely related to the content of the class. Under the category of benefits, efforts to strengthen the transfer of training were discussed, problems and solutions

were described, and strengths of the preservice computer education class were identified. The integration of computer skills into the student teaching experience was also discussed.

The two areas related to this study were graduate-level training in computers and related instructional technologies and research and development in the area of computers in instruction. Under the first related area, the graduate program for educators in other contexts was briefly described, since it was identified as the graduate program with a strong computer component. The background of program development, clientele, unique characteristics of the program, trends, and job options were all addressed in the description of the program.

Under the second related area, research and development, the Alabama/Vanderbilt Consortium was described. A number of videodisc multimedia projects developed by both faculty and students were described, as well as several other computer-related R & D efforts. Two implementation efforts were described, and the chapter was summarized.

CHAPTER VI

CASE STUDY III

Context

Situated in the rolling hills of southern Indiana, the city of Bloomington, with a population of approximately 60,000, is the home of Indiana University. Founded in 1820, the university is a nationally and internationally recognized research and teaching institution (Beckwith, 1991). The Fiske Guide to Colleges: 1991 identified Indiana University as in the top 10% of this country's 2,000 four-year colleges ("New Fiske," 1991).

Known as the university with eight front doors, Indiana University, with eight campuses and approximately 96,064 students enrolled throughout the State, has grown to be one of the largest higher education institutions in the United States. The main campus at Bloomington occupies 1,862 acres and the total enrollment at Bloomington for the fall of 1992 was 36,076 (IU Facts: 1992-1993, pp. 8, 10, 12).

The School of Education at Indiana University is ranked among the top five in the nation by the Conference Board of Associated Research Councils (Beckwith, 1991).

According to an NCATE report for fall of 1991, 24,842 full-time students enrolled in undergraduate professional education programs, and 3,714 enrolled in graduate-level professional education programs. Part-time students for the same semester numbered 1,844 at the undergraduate level and 2,546 at the graduate level (AACTE/NCATE Enrollment, Productivity, Faculty Resources, 1991 JDCS Form B, p. 1).

The New Wendell W. Wright
Education Building

Fall of 1992, the School of Education at Indiana University moved into its new \$22 million home (Daniels, 1992). Speaking of their new facility, Dean Donald Warren said, "It has been designed to house the latest technology; its infrastructure will enable us to use multimedia equipment in new ways; and certainly it provides an environment appropriate for the Information Age" (1992, p. 1).

The 110,000-square-foot limestone structure is the home of the Education Library, the Center for Excellence in Education, and the School of Education (Daniels, 1992; Gilbert, 1992). In the Education Library, the study carrels are wired so that students can bring in laptops and access the campus network. There are 28 terminals which offer access to a variety of databases, as well as search capabilities for the library on campus, the libraries at the seven branch campuses across the State, and various departmental holdings. Eventually 64 terminals will be

available in the Education Library for student use (Data Vol. III, p. 134).

The Center for Excellence in Education (CEE), while housed in the Wendell W. Wright Education Building, is not a part of the School of Education administratively (i.e., the center does not report to the Dean of the School of Education). Being involved primarily with research and development, with a mission to explore appropriate applications of technology to education, the CEE reports to the vice president for research for the university (Data Vol. III, pp. 123, 124). The work of the CEE is more fully described under the discussion of research and development.

The School of Education will be using the new facilities to provide up-to-date instruction for its students, preparing teachers to work with the technology of the future (Indiana Alumni Magazine, 1992, p. 8).

Following is a brief history and description of how preservice teachers at Indiana University are being prepared to work with computers and related instructional technologies.

Background of Undergraduate Computer Course Development

The first computer class in the School of Education was offered in the early 80s as an elective (Data Vol. III, p. 33). It has evolved into the current 1-hour course (semester credits), which is described in the Indiana University Bulletin: 1992-1994, as follows:

W200 Microcomputing for Education: An Introduction

Required of all students pursuing teacher certification. Introduction to instructional computing and educational computing literature. Hands-on experience with educational software utility packages and commonly used microcomputer hardware. (p. 108)

An experimental 3-hour course (semester credits) is being offered for the first time, fall of 1992. Two sections are taught, one on the MS DOS platform and the other on the Macintosh (Data Vol. III, p. 50). The feasibility of dropping the required 1-hour course and going to a required 3-hour course is being explored (Data Vol. III, p. 50).

The Computer Class for Preservice Teachers

Five categories were developed from the initial research questions concerning computer education for preservice teachers. Four of them are listed below. Within each category are the findings relative to the W200 required 1-hour course and the experimental 3-hour course. The fifth category (i.e., Trends in Content Emphasis) is discussed in the analysis chapter.

Structure Within Program

The State of Indiana requires all preservice teachers to have experiences using microcomputers before they graduate (Data Vol. III, p. 22). The 1-hour W200 course has been developed for this purpose. Students who

have a greater interest in computers may opt for the experimental 3-hour course instead.

"In 1982 the School of Education at Indiana University embarked on the development of an undergraduate teacher endorsement sequence in instructional computing" (White & Hubbard, 1988, p. x). Preservice teachers are not required to include the computer endorsement in their certification, but they may choose this as an option if they wish. The W200 class, which is required of all preservice teachers, must be taken first before enrolling in the endorsement series (Data Vol. III, p. 75).

Dr. Guy Hubbard, an art educator who teaches computer classes as well, serves as the endorsement program coordinator. He explains why the endorsement classes are well attended: "[T]he kids are realizing that they can't get by without it. Numbers of them are seeing that in the competitive environment of the work place now, that if they can show that they've got a computer endorsement, they may get the job and the other person may not" (Data Vol. III, p. 23).

The computer endorsement consists of 19 to 23 semester hours (Indiana University Bulletin: 1992-1994, p. 41). More information, giving a more complete description of the computer endorsement, is included in Appendix C.

No test out option for the W200 class was observed by the researcher during the course of the study.

Content

Eight instructors, four professors, and four associate instructors, or AIs, teach the W200 class. Each professor teaches one section, and each associate instructor can teach up to three sections per semester (Data Vol. III, p. 17). One of the professors and all of the AIs, or graduate students, are from the Instructional Systems Technology (IST) Department.

The professors and associate instructors have a committee meeting each week to discuss the content of the course. This ensures that the same skills are taught consistently across all class sections, regardless of differences in hardware and/or software. In the meeting I observed, the committee was working on articulation between the Macintosh and MS DOS platforms. Future plans were made to improve the print materials and discuss possible textbook adoption (Data Vol. III, pp. 143, 144).

An example of course objectives, taken from a class syllabus for the 1-hour W200 course, is given below.

1. The student will be able to produce an error free word-processed document.
2. The student will be able to use a graphics program to display information in a visually appealing fashion.
3. The student will be able to use a spreadsheet program to generate data in an organized fashion.
4. The student will generate a bibliography using Silver Platter.

5. The student will be able to send and receive Electronic Mail.
6. The student will evaluate educational software in a systematic method.
7. The student will write a word-processed essay addressing contemporary educational concerns related to instructional computing.
8. The student will complete a final examination covering the course.

An example of the content breakdown for the 1-hour W200 course as listed in a class syllabus is found in Table 6.

Table 6

Content of the W200 Class

Content	One Hour Sessions
Course overview	1/2
Macintosh tutorial and overview	1
Word processing and printing	2 1/2
Intro to silver platter	1
How computers work	1/2
Intro to E-mail	1/2
Software evaluation	1/2
PLATO, Compton's Multimedia Encyclopedia	1/2
Mid-term	1
Graphics	2
Multimedia	1
Spreadsheet	3
Review for final	1
Final exam	1

The 3-hour experimental W200 course covers basically the same content, but more in depth. Additional content that is being explored in one section or the other

includes batch file creation, database creation, telecommunications, information on local area networks, and integrated learning systems (Class syllabi).

Multimedia development using HyperCard is also taught in one section. Whereas the 1-hour course allows time only for a demonstration of multimedia, students are given three HyperCard assignments in the 3-hour course (Class syllabi).

Both sections of the experimental 3-hour course also include guest speakers who talk and demonstrate the use of computers in their area of expertise (i.e., art education, music education, science education, special education, social studies, and math education) (Class syllabi).

Resources—Hardware and Software

Two labs are available for the W200 class. One is a Macintosh lab and the other contains MS DOS machines. Students may sign up for either platform.

Instructional software is more limited than in previous years, because the School of Education has just moved into a new building with new labs and new machines. Apple computers and Apple software have been replaced by more powerful machines and more sophisticated software. Table 7 contains a representative sampling of some of the software that is used in the W200 class.

Table 7

Software for the W200 Class

Name	Type of Software
Macintosh	
WordPerfect	Word Processor
Microsoft Excel	Spreadsheet
File Maker Pro	Database
HyperCard	Multimedia
MacDraw II	Graphics
DrawPerfect	Graphics
Math Blaster	Educational
MS DOS	
DrawPerfect	Graphics
WordPerfect	Word Processor
PlanPerfect	Spreadsheet
Paradox	Database
Linkway	Multimedia
Derive	Educational

Note. From class syllabi.

PLATO, located at the University of Illinois, is a resource or collection of over 5000 pieces of educational software. For their software evaluation assignments, students are encouraged to access PLATO through the network and choose two pieces of educational software.

"Understanding How Computers Work" is a computer tutorial that shows how a computer functions inside and familiarizes the student with terminology. It is another software resource that is used in the W200 class, developed

by Dr. Ted Frick of the IST Department at Indiana University (Data Vol. III, pp. 48, 103).

Funding Sources

A large portion of the funding for technology at Indiana University comes from a technology fee of \$75.00 a semester, which every student is required to pay. Some income from the technology fee helps pay support staff people who work for the university computing service (UCS), and it also pays for computer labs where students have public access (Data Vol. III, p. 82).

Most of the technology fee money is pooled, and each department is required to submit their departmental computing plans, or proposals for needed equipment, supplies, and lab personnel. The pooled money is divided among the departments and much, though usually not all, of the requested equipment is purchased (Data Vol. III, p. 82).

A fair amount of equipment is brought in through research grants and IBM has contributed some equipment. Recently, AT&T gave approximately \$7 million in hardware and communications equipment, including 150 to 170 new computers (Data Vol. III, pp. 25, 78).

Benefits

A look at how instructors attempt to strengthen transfer of training so that the training carries over into future classroom practice is discussed. A discussion of

the problems encountered and solved, as well as the strong points of the W200 computer class, is also discussed. Finally, the use of computers during the student teaching experience is described.

Transfer of training

A number of ideas on how to strengthen the transfer of word-processing skills were shared. Dr. Guy Hubbard has students write a statement about why they think computing is useful in their subject area. The hope is that after students have done their reading, they will come up with a rationale which includes the strengths and weaknesses of this kind of technology in their particular content area (Data Vol. III, p. 36).

One associate instructor told of a word-processing assignment he requires:

I have them choose a topic from another class, a paper or some other assignment that they have to do for another class, and do that on the word processor. And then I give them a list of criteria that I want them to use, or a list of functions that I want them to use in writing that paper. The content itself is determined by another course. So that when they finish the assignment for me, they've also finished the assignment for another course. And they feel like they've actually done something worth having instead of my giving them two pages of junk to write as a paper, just so I can see that they know how to use a word processor. (Data Vol. III, p. 64)

The associate instructor mentioned that he only requires 2 pages on this assignment, yet many turn in an 8- or 10-page paper. Students seem to be getting more practice with

this approach, and are impressed with the usefulness of word-processing skills in other contexts.

Mr. John Baker and another associate instructor mentioned the value of requiring a useful word-processing assignment. For one of the assignments, they require students to write a resume (Data Vol. III, pp. 42, 64).

In discussing the transfer of training in the area of databases when databases were still a part of the content of the course, two instructors said that they have the students create databases that are class lists, with the data about the students (Data Vol. III, pp. 36, 59). Classroom teachers are often required to keep a certain amount of background information on each student, and this exercise gives preservice teachers experience in organizing such information in an efficient and easily accessible manner.

Concerning spreadsheets, the most common approach was to teach the students how to use them as gradesheets (Data Vol. III, pp. 36, 66, 70). One instructor mentioned an optional activity sometimes used (i.e., teach the students to set up a budget for a club they have been asked to sponsor) (Data Vol. III, p. 66).

Associate instructor Kelly Murphy says that when he demonstrates educational software, he tries to demonstrate a piece from each content area (i.e., science, music, social studies, math, and so on) (Data Vol. III, p. 73). Dr. Guy Hubbard mentioned that when introducing the

software evaluation assignment, students are encouraged to evaluate software they can use in their content area (Data Vol. III, p. 37).

Another approach mentioned is the use of class discussions to point out how teachers could use various computer programs or skills in instruction. Dr. Lee Ehman says, "As freshmen and sophomores, their thoughts haven't yet turned to, 'how can I translate this into teachable ideas.' But we peck away at them" (Data Vol. III, p. 53). Finally, lots of hands-on experience was recommended by Dr. Jim Pershing for strengthening transfer of training (Data Vol. III, p. 59).

Problems

A number of the problems identified by the eight instructors for the W200 class have to do with time constraints. As one instructor put it, "The 1-hour class is not enough time to sufficiently cover the material" (Data Vol. III, p. 71). Another instructor explained why.

It [the W200 class] seems to draw more of the elementary, but their curriculum is more full and more prescribed, and I think they are the ones holding us up in terms of moving it to a 3-hour course also. There is resistance from the elementary ed. people because of the already compressed program and full program they have. . . . Now the secondary people have been urging us for some time to require a 3-hour course for secondary people. (Data Vol. III, pp. 60, 79)

As mentioned earlier, the solution of moving to a 3-hour course is being explored, in that two sections of the expanded class are being offered starting fall of 1992.

Whether the 3-hour course will be required of both elementary and secondary preservice teachers in the future, or whether it will be required only of secondary students, is still undecided.

Following are some solutions to time constraints currently used in the 1-hour course. One solution in particular has not been a favorite among students. Dr. Jim Pershing tells why: "They are doing at least 2 hours worth of work. . . . [T]hey are rushed and they aren't getting as much credit as they have to work" (Data Vol. III, p. 57).

Another solution to the time constraint has been to teach the basics of each application. One instructor expressed frustration at having powerful applications, yet limited class time prevents him from teaching the full potential of the software (Data Vol. III, p. 72).

Concerning the educational software, Dr. Hubbard expressed similar frustrations: "We do a lot more of the demonstrations to show people what does exist. When we might like to do some actual teaching of competence, we can't" (Data Vol. III, p. 34).

Due to limited time, some content has been deleted. Teaching programming was a problem. "There wasn't enough time to set it up and do it correctly," said Dr. Pershing (Data Vol. III, p. 58). Another reason programming was deleted is explained by Dr. Hubbard: "At one time we overemphasized programming, but have dropped it because it is becoming less and less necessary to know a high level

language" (Data Vol. III, p. 35). Database creation has also recently been deleted from class content, but how to access large databases is still taught (Data Vol. III, pp. 43, 59, 61, 63, 64, 143).

A rather creative approach to teaching some of the material outside of class was provided by Dr. Ted Frick of the IST Department. He wrote a tutorial program which teaches computer terminology and many of the concepts of how a computer works (Data Vol. III, pp. 48, 68, 80, 103). Early in the course, some instructors require students to access the tutorial on their own time, saving valuable class time for other topics.

Another problem identified by several instructors involves the print materials the students are required to read. Keeping a text or compilation of articles up to date and finding written material that is understandable to a beginner and reasonably priced were all problems that were mentioned (Data Vol. III, pp. 47, 48, 54, 67, 80).

Regarding print materials on software applications, Dr. Lee Ehman said, "We could ask them to buy manuals like this, but you know they are \$40.00 a pop, and since we are teaching five or six applications, that is just not the answer" (Data Vol. III, p. 54). Having the students use the tutorials for WordPerfect and PlanPerfect was a partial solution used by one instructor (Data Vol. III, p. 67).

Dr. Jerry McIntosh identified a problem involving the spreadsheet assignment: "The assignments I've found

have to be fairly well connected . . . because the students mimic well but they don't think well. And so, if the assignment isn't pretty close to the last assignment, they get tossed off track pretty easily. So I've had to watch that very carefully" (Data Vol. III, p. 46).

The customizing of E-mail accounts presented a problem for one instructor.

I wanted to change their accounts so that they were all the same. They all logged in the same, and they got the same things on the screen. So that when we talked about how to use E-mail, and I modeled it on the projector, on the screen at the front of the room, they would all have the same thing on their computers. They would be able to follow along and they would understand E-mail. And then the handout that I have for them on E-mail would make sense and they could just follow it straight through. (Data Vol. III, p. 65)

The instructor tries to do this in one class session, but rarely finishes. "I have to spend office hour time in the lab and they will come to me individually afterward to try and finish setting up their account," he says (Data Vol. III, p. 65).

Another instructor mentioned the need for a lab assistant to help solve the problems when so many students need help at once. He proposed the following creative solution: "If any students know their way around a Mac, [I could] give them extra credit, or let them out of another assignment if they would assist in trouble-shooting (Data Vol. III, p. 73).

The move to a new facility with new labs and computers has created a temporary problem in that the

software selection is limited. This will soon be resolved however, as there are plans to buy more software over the next few years (Data Vol. III, pp. 40, 54).

A miscellany of other problems were mentioned as well:

1. Large group presentation with a lecture did not seem to come off well, so it was abandoned (Data Vol. III, p. 35).
2. The discovery technique did not work well with computers. Letting them explore and try to discover how to do something on their own was time consuming and not very productive (Data Vol. III, p. 41).
3. A lack of specificity on the position papers was something that did not work well. That type of freedom was hard for the students to handle (Data Vol. III, p. 46).
4. Students felt they could use more printers (Data Vol. III, p. 81).
5. Students wanted the labs open for longer hours (Data Vol. III, p. 81).

Strengths

A number of instructors mentioned the practical aspects of the course. They felt that the course covers material that teachers are going to need. It gives them basic skills with computers they can draw upon in their teaching (Data Vol. III, pp. 33, 40, 44, 50, 56, 63, 70).

Another instructor felt that having the class taught by teachers (i.e., by people whose focus is as educators, was a strong point) (Data Vol. III, p. 33).

The fact that the course introduces students to a variety of educational software packages was considered a strength by instructors (Data Vol. III, pp. 40, 44, 50, 52, 63, 70). Concerning the educational software, Dr. Lee Ehman said, "Particularly I try to emphasize software that aims at some higher order problem-solving objectives, rather than drill and practice software, which they can look at too" (Data Vol. III, p. 50).

Kelly Murphy, an associate instructor who has taught W200 a number of times, tells of a particular piece of software he has the class access from PLATO.

[T]here is a simulation in there called *Tenure*, [which is] a simulation of the first year of teaching. . . . [T]hey are asked questions about how they would handle problems in the classroom. . . . [L]ike how do you grade? Are you going to set up a student chart? The principal wants you to [sponsor] the Drama Club, or they want you to join the teacher's union. It makes you make decisions on real life situations which teachers encounter in the first year. . . . [W]hen they get done with the simulation they are either hired, or they are fired, or they can be granted tenure, or even chairman of the department, depending on how well they go through the simulation. (Data Vol. III, p. 72)

Mr. Murphy finds that the simulation encourages group effort and relaxes the students, thus decreasing computer phobia. He uses this activity as an introduction to the software evaluation assignments (Data Vol. III, p. 72).

Cooperative learning is often used in the W200 class. Instructors find that grouping students to work on exercises in class provides an opportunity for those who have experience to help those who have little or no experience (Data Vol. III, pp. 41, 46, 47, 66).

Because Indiana has recently networked all the schools in the state, one instructor feels that the E-mail assignments in the course are especially relevant (Data Vol. III, p. 34). Another instructor pointed out that the computer skills taught in the course are important because school administrators look for computer-literate teachers when filling positions (Data Vol. III, p. 70).

Other aspects of the class that were mentioned as effective include:

1. Help sessions, working with students informally outside of class (Data Vol. III, p. 33)
2. Lots of hands on practice (Data Vol. III, p. 51)
3. The ERIC search assignment (Data Vol. III, p. 42)
4. The video projector, permanently mounted in the ceiling of every computer classroom, making software presentation easier (Data Vol. III, pp. 34, 40, 81).

Last, but not least important, one instructor pointed out that the class helps to alleviate computer phobia (Data Vol. III, p. 70).

Student teaching

The use of computers and related instructional technologies in the student teaching experience is dependent upon placement. Few sites have cooperating teachers with access to computers and/or an interest in them. Where cooperating teachers are computer literate, the student teacher may use a computer during fieldwork, but this is rare and totally at the discretion of the cooperating teacher. Due to a scarcity of equipment and expertise in the field, student teachers are not required by the university to integrate computers and related instructional technologies skills into their student teaching (Data Vol. III, p. 80).

Thus concludes the discussion of the training of preservice teachers in computers and related instructional technologies. Following is a discussion of the graduate program at Indiana University, Bloomington, which has a strong computer component. Graduates of this program work as educators or trainers in business and other non-school settings.

Graduate Program for Educators in Other Contexts

In the 1991 edition of the Educational Media and Technology Yearbook, 63 doctoral programs (Ph.D. and Ed.D.), and 189 master's and/or 6-year degree programs in instructional technology, educational communications /technology, and media services were found in existence in

the nation (Broadbent & Wood, 1991). Those programs involving instructional technology traditionally train educators to design and implement instruction in business, military, and medical contexts.

Instructional Systems Technology (IST) is the graduate program for educators in other contexts at Indiana University. In 1986, a survey of media professionals belonging to two major professional organizations, the Association for Educational Communications and Technology (AECT) and the National Society for Performance and Instruction (NSPI), identified Indiana University as being the most prestigious media training institution within the field of instructional technology ("News," 1988, p. 8). In existence for over 50 years, it is one of the oldest in the country (Data Vol. III, pp. 91, 101). Following is a brief overview of how this program has gradually evolved.

Background of Program Development

The Instructional Systems Technology Program grew out of an audiovisual center which originally emphasized film production (Data Vol. III, p. 91). According to Dr. Michael Molenda, former chairman of the IST Department, audiovisual courses were offered as early as the 1930s, then continued and expanded in the 1940s and 50s ("News," 1988, p. 8). Emphasis of the audiovisual department went from film to television, then to a focus on the "soft"

technologies such as instructional theory and the instructional systems design process.

In the 1950s, instructional systems technology was established as a separate program ("News," 1988, p. 8). In 1968 the IST program had one computer course entitled *Computer-assisted Instruction*. Originally the course was more theoretical than "hands-on." Additional courses involving the use of computers in instruction were developed in the early 1980s (Data Vol. III, p. 101). Increasingly advanced technologies such as computer-based instruction and multi/hypermedia are gaining in importance in the IST program (Data Vol. III, pp. 91, 92). According to Dr. Charles Reigeluth, current chairman of the IST Department in the School of Education, departmental offerings include graduate-level coursework leading to the following degrees: Master of Science (M.S.), Education Specialist (Ed.S.), Doctor of Education (Ed.D.), and Doctor of Philosophy (Ph.D.).

Fall of 1992 saw the IST master's program revised and a new curriculum implemented. The IST doctoral program is also undergoing revision (Data Vol. III, p. 93).

Clientele

From a document shared by Dr. Reigeluth which gives some general information about Instructional Systems Technology at Indiana University, I learned that the IST student body numbers approximately 200 men and women drawn

from all over North America and many other nations. The average incoming student has been working somewhere between 5 and 10 years after receiving their B.A. degrees. A variety of backgrounds are represented, including a surprising number of people with music backgrounds, a few teachers looking for a career change, and occasionally librarians and those with a computer-science background. Approximately 1/3 of the student body are international students (Data Vol. III, pp. 94, 95, 97, 100; Dr. Reigeluth, personal communication, April 27, 1993).

Noteworthy Characteristics of the Program

The Instructional Systems Technology Program at Indiana University has a number of unusual characteristics. As mentioned earlier, it is one of the oldest and largest instructional design programs in the nation. As a result, a large alumni provides a valuable network for more recent graduates (Data Vol. III, pp. 91, 95, 101).

The substantial size and quality of the faculty are also rare. Quality is evident in that the program has consistently had two or three of its faculty members ranked as the top researchers and idea people in the field (Data Vol. III, pp. 92, 98).

Indiana University has been able to develop one of the most comprehensive curricula of any instructional design program in the country (Data Vol. III, pp. 92). Says Dr. Reigeluth, "Due to our size, we're able to offer a

much broader range of offerings in the field than many programs are able to [provide]" (Data Vol. III, p. 95).

Two additional areas in which the Indiana IST program is unusual include (1) the incorporation of powerful new advanced technologies into the curriculum (Data Vol. III, p. 92), and (2) a study of the use of technology in the restructuring of schools (Data Vol. III, p. 93).

Finally, the new Wendell W. Wright Education Building also makes this program unique (Data Vol. III, p. 95). The new facility provides the IST department with access to a number of high-tech labs—facilities that few programs can provide.

Taken together, the above characteristics of the Instructional Systems Technology Program at Indiana University contribute to the status of this program as number one in the nation.

Trends

Dr. Reigeluth identified a number of trends that are developing in the area of instructional design. He states:

One that I feel is most important is that there is a paradigm shift occurring in the nature of education. A shift from the Industrial Age paradigm that I would liken to batch processing of students, to the Information Age paradigm, that I would characterize more as customized education, (i.e., meeting the needs of individuals, personalized learning, competency-based learning). That's one trend, and that has tremendous implications, not just for the instructional

strategies that are used, but all of the administrative systems and government systems that support the instructional systems. (Data Vol. III, p. 96)

Other trends identified by Dr. Reigeluth include:

1. Greater use of advanced technologies in instruction
2. Use of constructivist strategies for instruction
3. The affective domain—changing attitudes and values
4. Attending to emotional development, psychological development, social development
5. Greater attention to motivational strategies in instruction, making instruction interesting.

Dr. Jim Pershing, associate chairman of the IST Department, also identified several trends. He states:

We've moved away from what you might call more hands-on production of materials, away from graphic artists and away from attention to lettering and making things by hand and using low level machines, to computers and telecommunications devices. I think with the advent of telecommunications and computers, we are interested in distance education. (Data Vol. III, p. 98)

Dr. Pershing sees more emphasis on helping government and the private sector design efficient, cost-effective training in the future. He also says, "I think the field has evolved to the point where it is broader than just instruction. It is looking at human performance, and what role . . . instruction, training, and education play in improving human performance for economic and competitive purposes" (Data Vol. III, p. 98).

Dr. Pershing also feels that instructional design programs will play some significant role in the

restructuring of public schools, because technology is going to be part of the answer to making schools more economical, more efficient, and more productive, particularly in the area of distance education and computer technology in general (Data Vol. III, p. 99).

Other trends identified by IST faculty include:

1. Any practitioner in the field needs to be much more technically competent than before. (Data Vol. III, p. 128)
2. There is a splintering away from stand-up lecture type instruction to all varieties of other types of instruction. (Data Vol. III, p. 128)

Job Options

Most graduates from the IST master's program at Indiana University go into corporate training (Data Vol. III, pp. 92, 97, 100). One corporation which regularly hires Indiana graduates from the School of Business and the IST Department is Arthur Andersen, a world-wide accounting firm with approximately 60,000 employees who need to be retrained continually due to changing tax laws (Data Vol. III, p. 90; Green, 1990, pp. 8, 9).

According to Dr. Michael Molenda, IST graduates were initially employed in educational institutions as media specialists. During the late 70s, however, things began to change. Although some may still choose to work as media specialists, today the skills and abilities of the IST graduate cover a much broader range (Green, 1990, p. 7; Data Vol. III, pp. 92, 97).

From a document shared by Dr. Reigeluth which gives some general information about Instructional Systems Technology at Indiana University, I learned that IST graduates also find careers in higher education (Ed.D. and Ph.D.), hospitals and health agencies, government and military services, and schools. Museums and zoos are also beginning to hire IST graduates to assist them with educational programs (Data Vol. III, p. 92).

Research and Development

The second area related to this study involves research and development (R & D) efforts in the use of computers in instruction. Following is a description of the Center for Excellence in Education (CEE) and several of the R & D efforts of the CEE. This listing is intended to be representative, rather than exhaustive. Since the computer is the focus of this study, research efforts of the CEE involving other technologies are not described.

Distance education is briefly mentioned because of the strong emphasis in this area by the CEE, and because some forms of distance education do require a computer, a modem, and telecommunications software. Little description of distance education efforts is included, however, because it is considered peripheral to this study.

The Center for Excellence in Education

The Center for Excellence in Education (CEE) was established by Indiana University in 1983 for the purpose

of exploring ways to use technology to improve education, both in academic and corporate settings (Data Vol. III, p. 105). The following is a quote from a brochure about the work of the Center:

CEE was founded on the assumption that information age technologies will have a profound impact on teaching and learning. When used properly, these technologies can make instruction more powerful, more accessible, and more adaptable. These technologies will also change the institutions that provide instruction. CEE exists to participate in and assist the process of educational change. (Center for Excellence in Education, [1992], p. 1)

An additional brochure published by the Center lists the following services as provided by the CEE:

1. intensive briefing on state-of-the-art technology for school officials who visit the Center;
2. A Teacher Associates Program; and
3. a client-focused, professional staff development program through distance education technology. (Toward Educational Excellence Through Technology, [1992], p. 4)

Federal funds in support of the CEE were provided under condition that a national demonstration center be created where technology can be demonstrated to a national audience. Several hundred visitors, even some international groups, toured the new facility during its first few weeks in operation (Data Vol. III, p. 106).

The Teacher Associates Program provides an opportunity for a school system, school district, or university to send a teacher who has an interest in technology to work for 1 semester or 1 academic year at the CEE (Data Vol. III, pp. 124, 133, 134). A document by

Dr. Martin Siegel, Director for Research and Development at the Center, gives some general information about the CEE and suggests that teacher associates will be provided opportunities to develop skills, learn to use authoring packages, create products, and design programs they can apply upon returning to their school systems. The teacher associates are provided office space, computers, and staff support free of charge, but their sponsoring organizations are responsible for salaries and living expenses (Data Vol. III, pp. 124, 125, 133, 134).

According to a recent brochure published by the CEE, there are plans to experiment with a variety of distance education technologies in an effort to determine the most effective and most affordable method of instructional delivery to schools. The CEE also plans to develop and test its own distance education program. A Distance Education Institute has been set up which will be held during the summers. It is designed to teach beginners and professionals alike current distance technology strategies. In addition, the CEE plans to provide occasional teleconferences and mount a national video conference on technology use in schools at least once each year (Toward Educational Excellence Through Technology, [1992], pp. 4, 5).

The third responsibility of the Center for Excellence in Education (in addition to providing [1] a national demonstration site and training, and [2] distance

education) involves research and development in the area of technology as it relates to education on all levels.

Following are some of the most recent R & D efforts of the CEE.

Development Related to the New Education Building

Kiosk, a word often used in Europe, means a place to post information. The staff of the CEE has developed a number of electronic kiosks for the main lobby and the second floor of the new Wendell W. Wright Education Building (Data Vol. III, pp. 113, 116, 123). All of the kiosks house computers which access the information and display it on a screen. The nine kiosks give information on the following topics:

1. Building Directory—displays a picture of the faculty or staff member, the job description, office number, phone number, and a map of the building showing the office location
2. Campus Information—shows each building on campus and gives information about it (It also lists daily events on campus.)
3. AT&T Showcase—a display of technology, graphics, etc.
4. Library Information—information on the library's resources
5. Art Showcase—an exhibition kiosk where faculty and staff can display computer graphics art

6. World Information—CNN news, accessed from the campus network, is displayed by kiosks on the first and second floors.
7. Learning Showcase—two kiosks designed to showcase hallmark examples of educational software in all disciplines. Currently showcased are Authorware, a course authoring tool, and a music multimedia presentation on Beethoven (Data Vol. III, p. 142; Dr. Gerald Sousa, personal communication, April 6, 1993).

The staff of the CEE has also developed a multimedia presentation room that has an electronic lectern. Controls on the lectern allow the presenter to access video tapes, laser disks, a computer program, audio, CD's, cassettes, slides, and live video (Data Vol. III, p. 119). The lectern functions efficiently because of software that allows rapid movement from one medium to another (Data Vol. III, p. 120).

Research Projects of the CEE

A research project that is currently in the initial stages of development is the creation of an electronic textbook. Dr. Martin Siegel explains the significance of the textbook project:

If you wanted to have a major impact on what happens in schools; if you could change what's done with textbooks, you probably would reorganize the schools in that one step. And it is that kind of bold initiative that we are undertaking. (Data Vol. III, p. 108)

The concept of the electronic textbook is explained more fully by B. J. Eib, Director of the CEE Visitor's Center.

The thought on the electronic textbook project is not that it will be taking one of the textbooks that you currently have and putting it on a computer, and you click the mouse every time you want to turn a page. It would be much, much more interactive and individualized. You might think of it as an interface and a guide for exploring the world. Perhaps this textbook would be connected to all kinds of networks and databases, and information reservoirs. The interface would . . . guide you through the process of finding information and bringing that information together, analyzing it, and doing something with it. (Data Vol. III, p. 133)

According to Dr. Siegel, the staff of the CEE is trying to synthesize and produce a new concept for the textbook of tomorrow.

Another project the CEE is involved in is the International Arctic Project, an experiment in distance education and adventure learning (Data Vol. III, p. 113). Will Steger, an Arctic and Antarctic explorer, along with an international group of scientists and educators, will cross the Arctic in an effort to study the impact of environmental changes on that area of the world.

School children of all ages, from upper elementary through high school, will be clustered in groups of five or six schools. Each cluster will then contact the Arctic explorers through technology (Data Vol. III, pp. 113, 114, 117, 118, 133). Says Dr. Gerald Sousa, a member of the CEE R & D staff, "The idea is that students will follow that

expedition and communicate on a regular basis with the group, and carry on parallel experiments in their area that reflect what the explorers are doing" (Data Vol. III, p. 117).

Dr. Siegel explains the part that the CEE will play in this distance education effort:

Our role in this research project is to think about the kind of computer human interfaces that need to be designed to do this effectively. To help design the educational model that will be used in this kind of telecomputing environment. To perhaps arrange some distance education conferences, for there will be schools participating all over the globe. (Data Vol. III, p. 115)

Those are just two of the research projects the CEE has under development. A number of research projects are business related, with implications for the education of trainers in corporate settings. Only those projects which have implications for the K-12 arena have been described, as preservice teachers are trained to work in that context.

Following are examples of videodisc or multimedia development which have been used in the training of preservice teachers.

Videodisc or Multimedia Development

The CEE, in cooperation with several professors, the audiovisual department, and an IST graduate student design team, produced a videodisc product entitled *Keys to Instructional Clarity*. The product, used in teaching preservice teachers how to present clear instructions at

the junior high and high-school level, won an award from the communications industry in 1989 (Moss, 1989, p. 16; Data Vol. III, pp. 103, 104, 121).

Professor Kris Bosworth and graduate student Thomas Welsh received the Society for Technology and Teacher Education's 1992 award for best integration of multimedia into methods courses. They developed a videodisc product entitled *Teaching with Groups*, which preservice teachers use to study the process of group learning in a classroom ("News in Brief," 1992, p. 12; Data Vol. III, pp. 103, 104).

From the main menu of the program *Teaching with Groups*, students may choose to see an introduction or a number of content domains such as brainstorming, leadership skills, building rapport, role playing, and small groups (cooperative learning). Within each domain, students may choose to "see an overview, view examples of group activities, learn the logistics of leading a specific activity and, through the use of a challenge or self test, exercise knowledge gained" (Bosworth & Welsh, 1992, p. 263). Two different instructors may be viewed leading each activity. Also, students may view each instructor's own reflections regarding his or her performance, as well as the opinions of an expert.

Dr. Guy Hubbard has developed a multimedia product on the topic of art, entitled *An Electronic Playground for Education*. Dr. Hubbard uses the electronic playground in

art education classes to teach art, and in the W200 computer class for preservice teachers, to demonstrate the instructional possibilities of multimedia.

Implementation

Dr. Guy Hubbard directed a grant for disseminating knowledge of computer graphics to art teachers. In 1988-89, art educators with an interest in technology were brought to Indiana University and trained by Dr. Hubbard in the use of graphics packages. They in turn disseminated that information by conducting workshops at several different sites around the State. As a result, a special interest group was formed called the high-tech art cadre. Membership of the cadre consists of elementary and secondary teachers with an interest in using computer graphics in the teaching of art. Dr. Hubbard is the only member of the high-tech art cadre who teaches on the university level (personal communication, March 9, 1993).

Chapter Summary

Chapter 6 described the context of the case under study and gave a description of the new Wendell W. Wright Education Building. A background and description of preservice computer course development at Indiana University followed. Using the five categories identified from the original research questions as a descriptive framework, the current computer course for preservice teachers was described. The categories in the descriptive

framework were (1) structure within program, (2) content, (3) trends in content emphasis, (4) funding sources, and (5) benefits.

Hardware and software resources were also described, as they are closely related to the content of the course. A discussion of trends in content emphasis was relegated to the analysis chapter.

Under the category of benefits, efforts to strengthen the transfer of training were discussed, problems and solutions were described, and strengths of the preservice computer training course were identified. The integration of computer skills into the student teaching experience was also discussed.

The two areas related to this study were graduate-level computer and instructional technology training and research and development in the area of computers in instruction. Under the first related area, the graduate program for educators in other contexts was briefly described, since it was identified as a graduate program with a strong computer component. The background of program development, clientele, noteworthy characteristics of the program, trends, and job options were all addressed in the description of the program.

Under the second related area, research and development, the Center for Excellence in Education was described. A description of developments related to the new building, and research projects related to the use of computers in

instruction was given. A number of videodisc multimedia projects developed by the CEE and faculty were described as well as one unique implementation, and the chapter was summarized.

CHAPTER VII

ANALYSIS, CONCLUSIONS, AND RECOMMENDATIONS

Introduction and Overview

The three cases under study proved to be rich sources of information. Each case provided a window through which training, research and development (R & D) in computers and related instructional technologies could be viewed from a different perspective. Indiana University, Bloomington, was unique in that the faculty was in residence for their first semester at possibly the newest, most technologically advanced School of Education in the nation. State-of-the-art technology is incorporated into the entire building. Vanderbilt University made a valuable contribution in that a number of R & D projects were ongoing which explored the use of computers in instruction. The University of South Alabama was unique in that it was instituting a new doctoral degree program (the only one of its kind in the State) which has a large computer training component (ID&D, Instructional Design and Development).

When looking at any subject under study, the researcher considers a number of options. Perspective is one element in the mix. Researchers typically choose to

take one of two perspectives. Often they look very closely at the subject, putting it under a microscope so to speak and analyzing it, breaking it down to its most basic elements. They also may choose to stand afar off, getting the big picture, seeing the subject in relation to its environment or to other components. In this study it seems I have done a bit of both. I have taken a close look at the subject of the training of preservice teachers in computers and related instructional technologies. I have also taken a rather broad view of the two related areas of study: (1) what is going on at the graduate level involving computers and related instructional technologies in instruction and (2) research and development involving computers and related instructional technologies in instruction.

Following is an analysis of the findings regarding the computer (and related instructional technology) training of preservice teachers.

The Training of Preservice Teachers in Computers and Related Technologies

The Findings in Relationship to the Research Questions

From the research questions, five broad categories were identified and used as the descriptive framework for gathering information. The categories from the descriptive framework are (1) structure within program, (2) current content, (3) funding, (4) trends in content emphasis, and

(5) benefits. An analysis of the categories across cases serves to answer the original research questions.

Question 1: How is computer education organized or structured within the existing preservice teacher education programs?

Two of the three States visited during the study, Indiana and Tennessee, require computer and technology training for preservice teachers. This requirement is presently fulfilled by a 1-hour course (semester credits) at the sites visited in those States. Instructors at Indiana University, Bloomington, find the time inadequate and are working toward development of a 3-hour course (semester credits). Concerning structure, the current 1-hour W200 class is the first class required in a sequence of classes offered for those interested in including a computer endorsement on their teaching certificate.

Vanderbilt supplements the 1-hour course with the use of computers and related instructional technologies in the methods classes and other coursework. Students who already have computer and technology skills are given the option of testing out of the required 1-hour class. Both the 1-hour class and the test out procedure are experimental and only recently initiated. It is still too early to determine whether this structure will prove satisfactory.

Although the State of Alabama does not require computer and technology training for teachers, the Teacher

Preparation Program at the University of South Alabama requires a 4-hour course (quarter credits) for preservice teachers, which is cross referenced with the computer science department. Under this structure, computer science students who plan to teach on the high-school level can take this class to give them a background in educational theory as related to the computer.

Question 2: What content is currently included in computer education courses [for preservice teachers]?

The three cases under study were identified in a survey conducted by the Center for Information and Communication Sciences at Ball State University (R. Stowe, personal communication, December 17, 1990) as doing the best job among those preparing preservice teachers to function in the Information Age. Skills taught at the three sites which serve to strengthen a teacher's ability to function in the Information Age include the use of (1) E-mail, (2) database development and/or searching, (3) multimedia, and (4) telecommunications. All are valuable tools for accessing, manipulating, and/or storing information.

Terminology and operation of hardware/software and applications packages such as word processor, spreadsheet, and database remained core to the course in all cases. A variety of educational software was evaluated by students and/or demonstrated by instructors at each site as well.

Finding textbooks with appropriate content proved a problem across cases. A number of instructors pointed out that texts on computers in education are out of date by the time they are published. Two of the three sites solved this problem by using a compilation of articles taken from current journals and magazines in the computing field as content for the class.

Question 3: How are the expenses of computer education being met?

Three funding sources were identified by this study:

1. Many technology expenses came out of the regular, tuition-driven budget.
2. Special fees were charged, such as a \$10.00 assessment fee per computer class, or a \$75.00 technology fee per semester.
3. Equipment and research grants often provided much of the hardware and/or software that was available in the computer labs.

Question 4: What are the probable trends or shifts in content emphasis in the future?

Instructors of the computer class for preservice teachers answered a questionnaire regarding trends in content emphasis for both elementary and secondary teachers. The purpose of the questionnaire was to aid in describing the computer and related instructional technology training needs of preservice teachers, both now

and in the near future. The findings were not intended (nor large enough) to be generalizable to a larger population as in a quantitative research sense.

Twelve participants gave two responses to each item; one response to indicate the current importance of the tool or software skill in the preservice training of teachers, and the other response to indicate the importance of the tool/software skill 5 years from now. One respondent was from Vanderbilt University, two were from the University of South Alabama, and nine were from Indiana University, Bloomington. Figures 1 and 2 show the summary data for the training needs of elementary teachers; Figures 3 and 4 show the summary data for the training needs of secondary teachers.

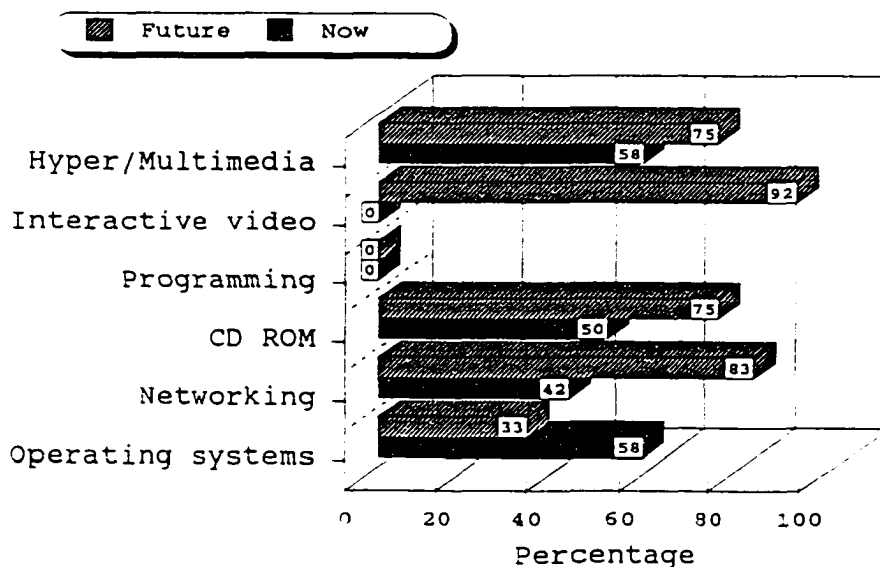


Fig. 1. The tools needed in the computer training of elementary teachers.

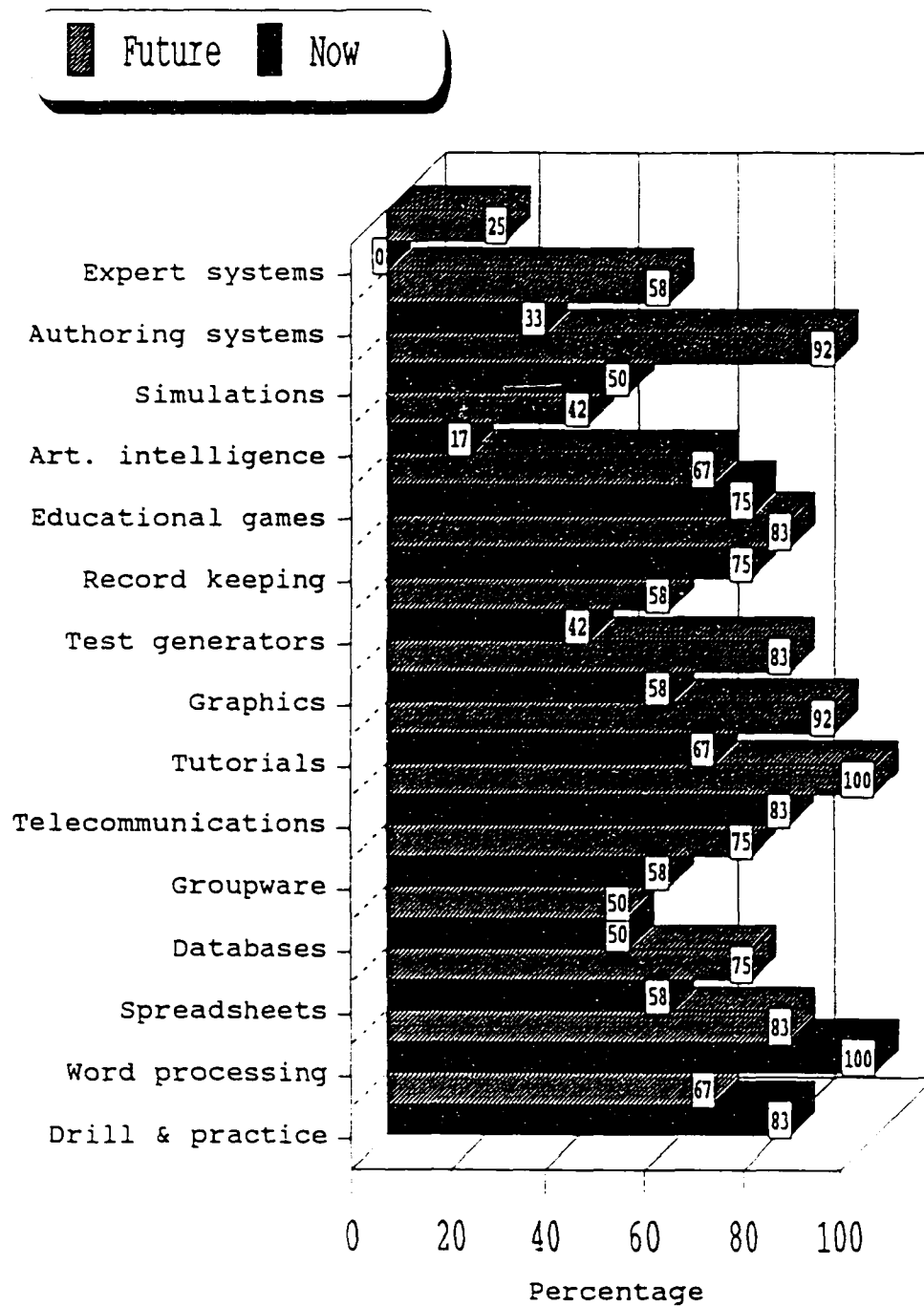


Fig. 2. Software needed for the computer training of elementary teachers.

From the summary of responses, the following are skills areas that were perceived as declining in importance for elementary teachers in the near future (within 5 years): (1) a knowledge of operating systems (58% important now vs. 33% important future), (2) drill and practice software (83% important now vs. 67% important future), (3) word processing (100% important now vs. 83% important future), and (4) educational games (75% important now vs. 67% important future).

A knowledge of operating systems is the area perceived most likely to be dropped from class content according to these findings, as (unlike the other skills identified as declining in importance) less than 50% of the responses indicated that it would be important in the future. Perhaps this is due to the development of the user friendly "Windows" application for DOS machines which enables the user to "click" on an icon rather than type in a specific DOS command. The operating system was not discussed when instruction was given on the Macintosh, since it is invisible. Responses also indicated that programming was not perceived as an important skill for elementary teachers either now or in the future (0% important now vs. 0% important future).

On the positive side, a knowledge of the following skills were perceived as increasing in importance for elementary teachers in the near future (within 5 years):

(1) telecommunications (83% important now vs. 100% important future), (2) graphics (58% important now vs. 83% important future), (3) interactive video (0% important now vs. 92% important future) (4) use of record keeping software (75% important now vs. 83% important future), (5) simulations (50% important now vs. 92% important future), (6) tutorials (67% important now vs. 92% important future), (7) networking (42% important now vs. 83% important future), (8) hyper/multimedia, spreadsheets, and groupware or cooperative learning software (each of these was rated as 58% important now vs. 75% important future), and (9) use of CD ROM (50% important now vs. 75% important future).

Although skill in using test generators was perceived as increasing in importance, the item did not generate much enthusiasm (42% important now vs. 58% important future). This finding could indicate that learning to use a test generator is considered of borderline importance for teachers. Knowledge of artificial intelligence (17% important now vs. 42% important future), expert systems (0% important now vs. 25% important future), and authoring systems (33% important now vs. 58% important future) all were perceived as increasing in importance, but low response levels may indicate that these skills would not be included as content for preservice elementary teachers in the near future, at least

at the three sites visited. Responses concerning database skills (50% important now vs. 50% important future) remained constant but low, reflecting that instructors might also consider this skill of borderline importance in the technology training of preservice elementary teachers.

The responses concerning the skills training of secondary teachers reflect the same trends noted in the questionnaire for skills training of elementary teachers. Operating systems and programming were perceived as declining in importance, whereas networking, knowledge of CD ROM, interactive video, and hyper/multimedia were perceived as increasing in importance.

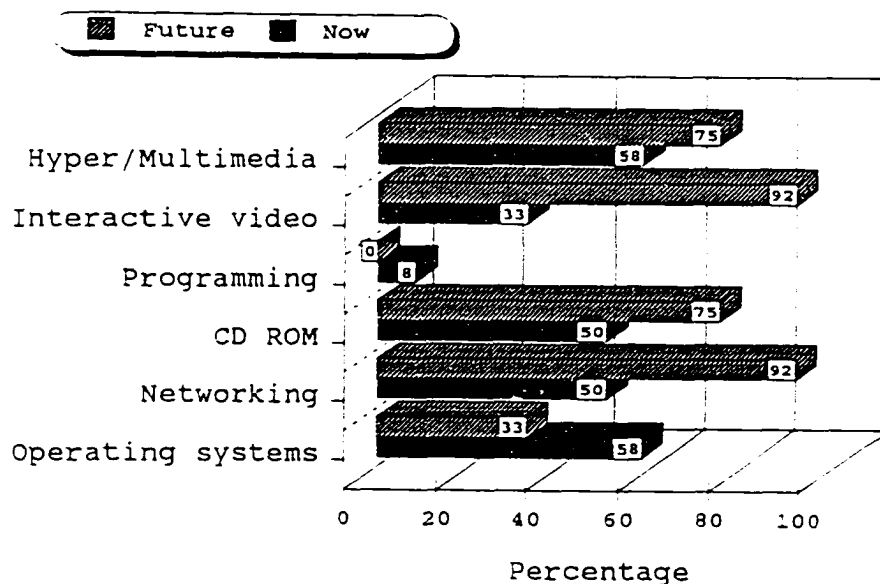


Fig. 3. The tools needed in the computer training of secondary teachers.

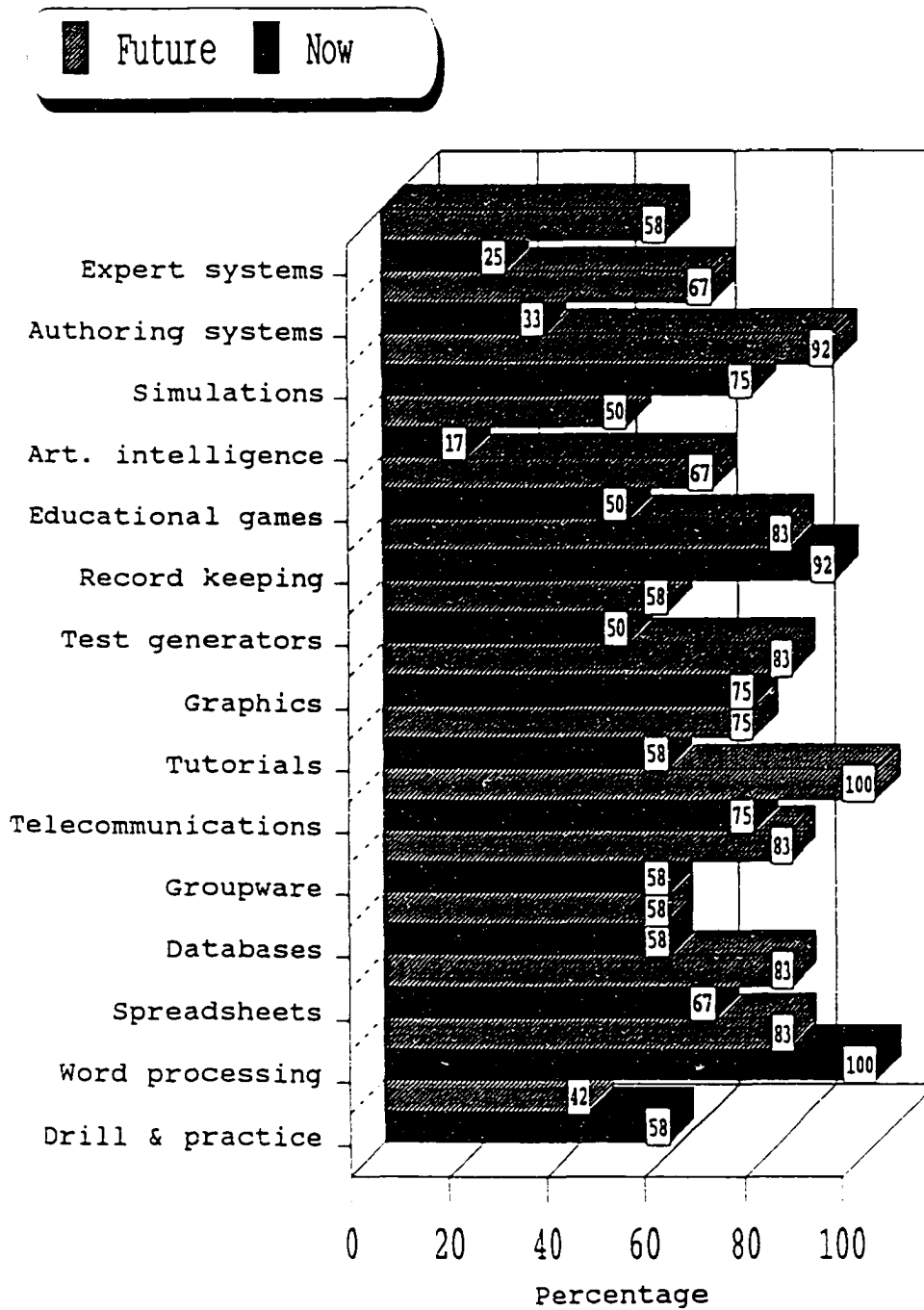


Fig. 4. Software needed for the computer training of secondary teachers.

The responses detailed in Figure 4 also reflect the same trends noted in the questionnaire for skills training of elementary teachers, except for record keeping software and educational games. Although the trends identified concerning these two areas differ for elementary and secondary teachers, they are off by only a response or two. This hardly indicates that computer instructors in this study perceive a need to differ the training for secondary preservice teachers from the training for elementary preservice teachers in these two areas. In fact, the findings indicate that the 12 instructors polled see little difference in the computer and related instructional technology training needs of elementary and secondary preservice teachers.

It is interesting to note that the instructors identified word-processing skills as decreasing slightly in importance for both elementary and secondary teachers (100% important now vs. 83% important future). Perhaps this finding results from the projected increase in telecommunications skills (75-83% important now vs. 100% important future) crowding out current content areas, rather than indicating that word processing will not be as important in the future as it is currently.

To summarize, 12 instructors were polled from three NCATE universities that have been identified as doing the best job among those training preservice teachers to serve

in the Information Age. These instructors perceived that telecommunications, networking, interactive video, word processing, spreadsheet, groupware or cooperative learning software, graphics, record keeping, simulations, tutorials, CD ROM and hyper/multimedia are most likely to be included as content in a computer class for preservice teachers within the next 5 years. Each topic received 75% to 100% of the "important future" responses to the questionnaire.

Topics which received 67% or less of the "important future" responses on the four figures include operating systems, programming, authoring systems, expert systems, test generators, artificial intelligence, databases, and drill and practice software. Computer instructors in this study perceive that skills in these areas are less likely to be taught in a computer class for preservice teachers in the near future.

Question 5: How could this study benefit other programs?

Or more specifically, what are the implications of this study? An implication is often thought of as a possible consequence or natural inference. As a consequence of this study, how will others benefit?

According to Merriam (1988/1991), "Whatever the area of inquiry, basic description of the subject being studied comes before hypothesizing or theory testing" (p. 27). It is expected, therefore, that as a possible consequence, this study will form part of a database for

future comparison and theory building in the area of computer and related instructional technology training for preservice teachers.

Information obtained from this study will also have implications for those who plan changes in teacher education programs. Trends indicate that State mandates and future NCATE requirements will increasingly necessitate the inclusion of computer and related instructional technology training in the curriculum for preservice teachers. Therefore, those involved in program and/or course development in Teacher Education can look at the problems, solutions, methods used to strengthen transfer of training, and strong points of each case described in this study and glean valuable ideas and insights they might apply to their own situation.

Recommendations Concerning Teacher Training

The following recommendations concerning the computer and related instructional technology training of preservice teachers are proposed by the researcher and originated with this study.

1. Regarding the required computer course for preservice teachers, a 3-hour course (semester credits), or 4-hour course (quarter credits) is recommended rather than a 1-hour course (semester credits), in order to give a more indepth coverage of the content.

2. The computer course for preservice teachers should be required before the student teaching experience. This would give students an opportunity to use computing skills in actual classroom practice.
3. Preservice teachers should be required to use computers and related instructional technologies in their fieldwork. This will increase the probability that technology training will transfer into classroom practice.
4. Teacher Education Programs that must place student teachers in environments which are not technology rich should provide computers, software, CD-ROM's, etc., that can be checked out by the student teachers and used in the classroom to fulfill technology training requirements.
5. The required computer course for preservice teachers should be developed and taught by instructors who have a background in education. Their insights into the instructional needs, problems, and solutions within K-12 classrooms would prove beneficial in this context.
6. A computer class that is preparing teachers to serve in the Information Age should include instruction on how to use the computer to access, manipulate, store and/or deliver information. Content should include the use of E-mail, how to create and search databases, how to access distant databases through telecommunications, and

how to develop and use multi/hypermedia for instructional purposes.

7. A computer class for preservice teachers should require students to write lesson plans which integrate the computers and related instructional technologies into instruction. Requiring students to write lesson plans has been used and found effective in other methods classes. Why not in the area of computers as well?
8. In order to defray the expense of computer and related instructional technology education, a technology fee (per quarter or semester) or a class assessment fee (per computer class) are viable options.
9. A test out option could be made available for students who already possess the computing skills required by the program and/or State. This would ensure that students entering the class have comparable ability levels.

Below are additional recommendations concerning the computer and related instructional technology training of preservice teachers. These were gleaned from the database of each case and the literature review.

1. In order to train preservice teachers in the use of computers and related instructional technologies, their use should be modeled by professors in methods classes and other courses (Criswell, 1989; Gooler, 1989; Monnen, 1989; Munday et. al., 1991; Turkel & Chapline, 1984; Wholeben, 1985).

2. Cooperating teachers should receive training in the utilization of microcomputers in the classroom prior to the assignment of student teachers (Criswell, 1989).
3. As an incentive for continued work with student teachers in the use of computers in the classroom, cooperating teachers could be permitted access to computer classes offered by the university (Criswell, 1989).
4. Teacher education faculty should be allowed paid summer-release time to plan and organize for the integration of the computer into existing courses (Brooks & Kopp, 1989; Kennedy, 1987).
5. Software vendors should provide texts written for their applications that are less technical and less expensive than the documentation manuals (Dr. Jerry McIntosh, Data Vol. III, pp. 47, 48).
6. The three core applications currently found in the introduction to computers class for teachers (i.e., word processing, database, and spreadsheet) should be taught instead in a computer literacy class for anyone who is planning to attend college, and probably should be mastered in high school (Dr. Guy Hubbard, Data Vol. III, p. 7).
7. The introduction to computers class for teachers should move away from application software into more educational software. In the future the class could possibly move to a combination of graphics and authoring

software, where students could learn how to make their own instructional materials . . . using the computer (Dr. Jim Pershing, Data Vol. III, p. 60).

8. Teaching labs should be configured in such a way that the instructor can see all screens at a glance and can easily reach any student needing help (Dr. Guy Hubbard, Data Vol. III, p. 18).

Insights relevant to the recommendation about lab configurations were gathered from the data and are shared below.

Lab Configurations

In a recent issue of The Chronicle of Higher Education, Wilson (1993) reported that universities are wrestling with the design of tomorrow's high-tech classroom. One design Wilson mentions is the double oval. Students sit with their backs to the computers when the professor is speaking, then turn to the machines for hands-on assignments. Another design mentioned is the "fractal" laboratory. This design involves dividing the room into sectors where the class can work together as a whole or in groups.

The following figures represent ideas on lab configurations gleaned during the course of the study. Some of the labs represented actually exist. Other figures incorporate ideas that various professors shared with me on the subject. There are advantages and disadvantages to

each configuration. Figure 5, the double U, is an idea shared by a professor from Indiana University, South Bend. Similar to the double oval talked about by Wilson (1993), it has the advantage of every screen being visible to the instructor. Students who are having difficulty can be immediately identified and assisted.

In the single U configuration, the instructor cannot see every screen from the teacher station, but s/he can move about the room to reach students without difficulty. For those who are concerned with putting the maximum number of computers on a table, this configuration has an advantage in that computers are placed on both sides of the table, rather than on just one side as in the double U configuration.

Dr. Bob Sherwood of Vanderbilt mentioned that a lab configuration similar to a chemistry lab set-up would be effective. An area where students could sit and listen to lecture and instructions before going to the machines would benefit those students who cannot resist the temptation to tamper with the computers while the professor is trying to convey important information. Such a lab configuration exists at one of the sites and is displayed in figure 7.

Figure 8 shows a combination student cluster and teacher station in the center of the lab. Other computers are placed about the room in such a manner as to facilitate group work. Finally, figure 9 shows a configuration for

those who wish to teach two platforms in the same room. Macintosh computers could be networked on the U, while the other three tables support IBM compatibles. Two color video monitors are also mounted, one on each side of the center screen used for liquid crystal display projection.

Recommendations for
Further Research

Concerning the computer and related instructional technology training of preservice teachers, the following recommendations for further research are made:

1. Other outstanding programs which train preservice teachers in the use of computers and related instructional technologies should be identified, described, and the results disseminated.
2. An expanded Delphi technique could be used to ascertain computer technology topics or skills needed by teachers in the near future, and therefore appropriate for inclusion as content in a course for preservice teachers. In addition to current instructors of the computer course for preservice teachers at outstanding universities, other experts polled could include educational software vendors and K-12 computer coordinators and teachers.

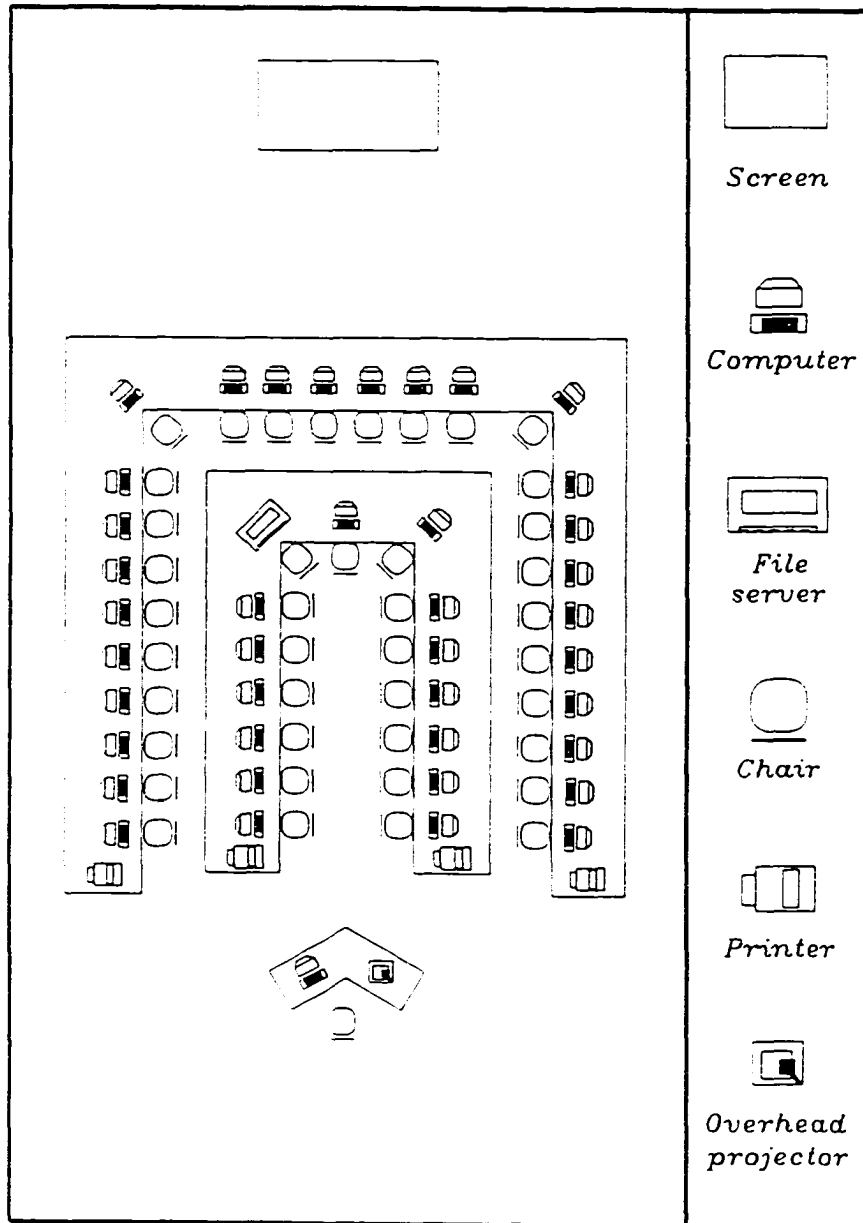


Fig. 5. The double U lab configuration.

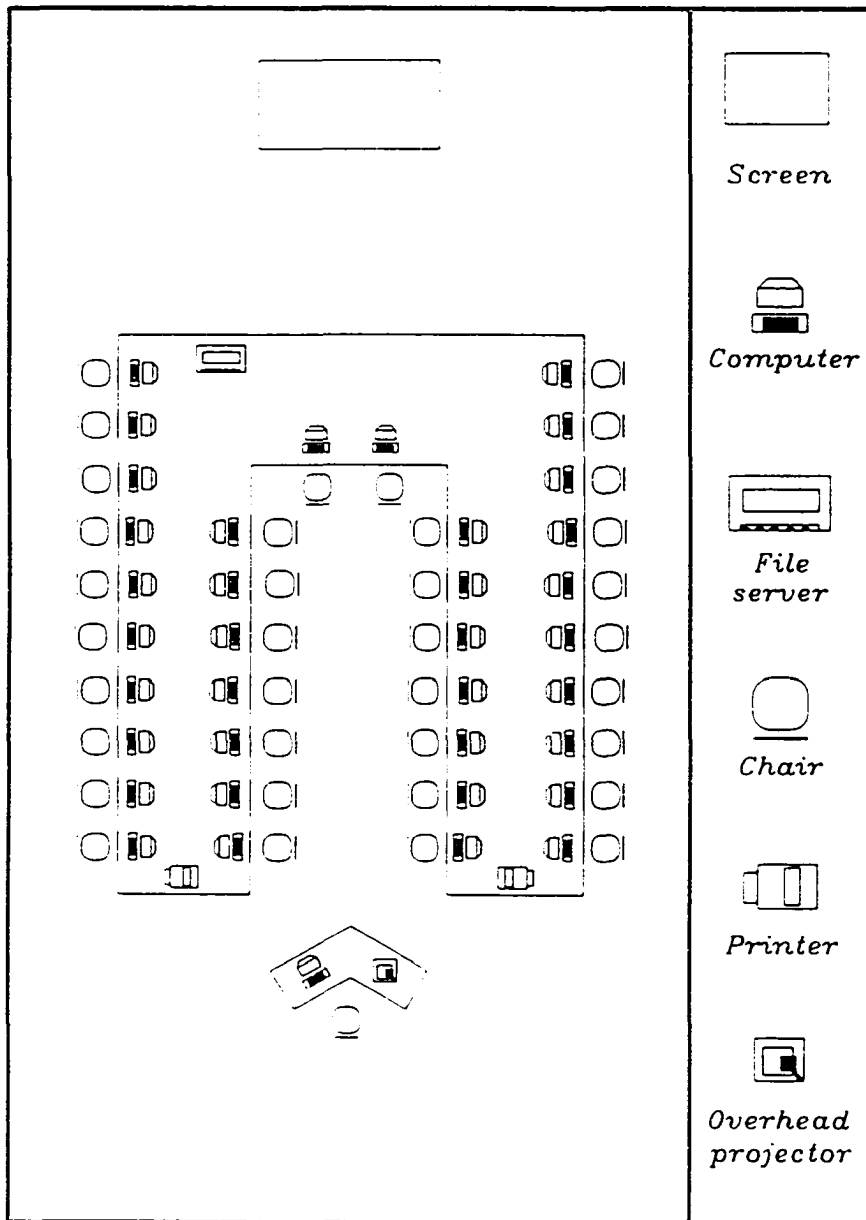


Fig. 6. The single U lab configuration.

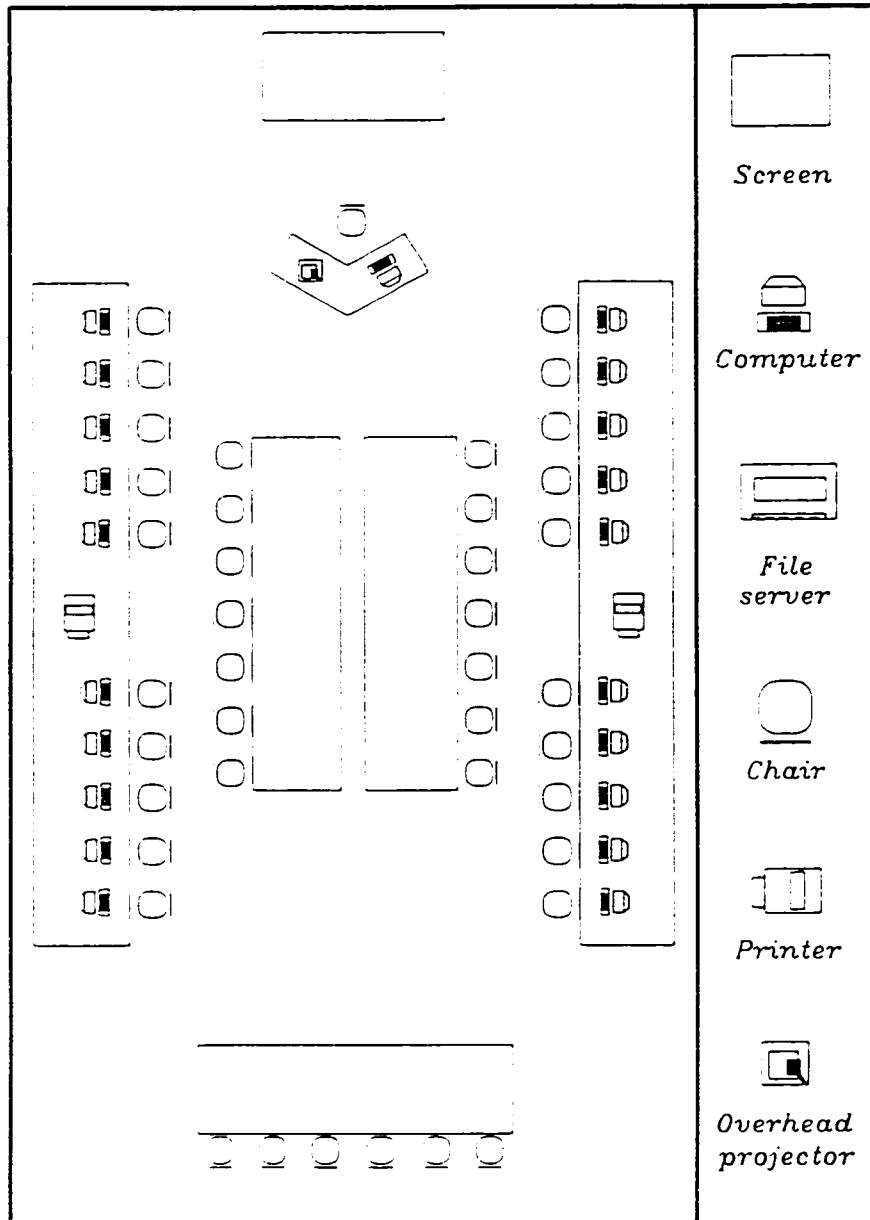


Fig. 7. The chemistry lab concept for a configuration.

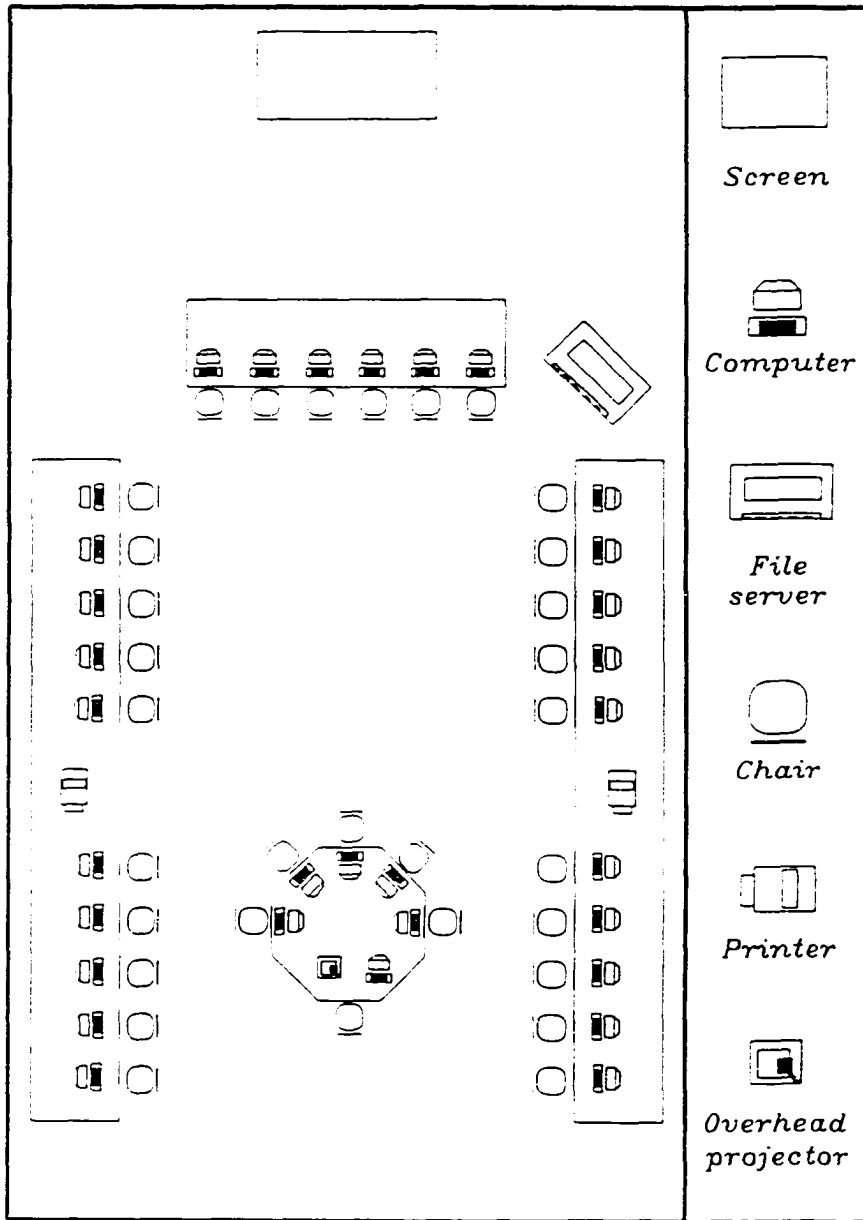


Fig. 8. The central cluster/teacher station lab configuration.

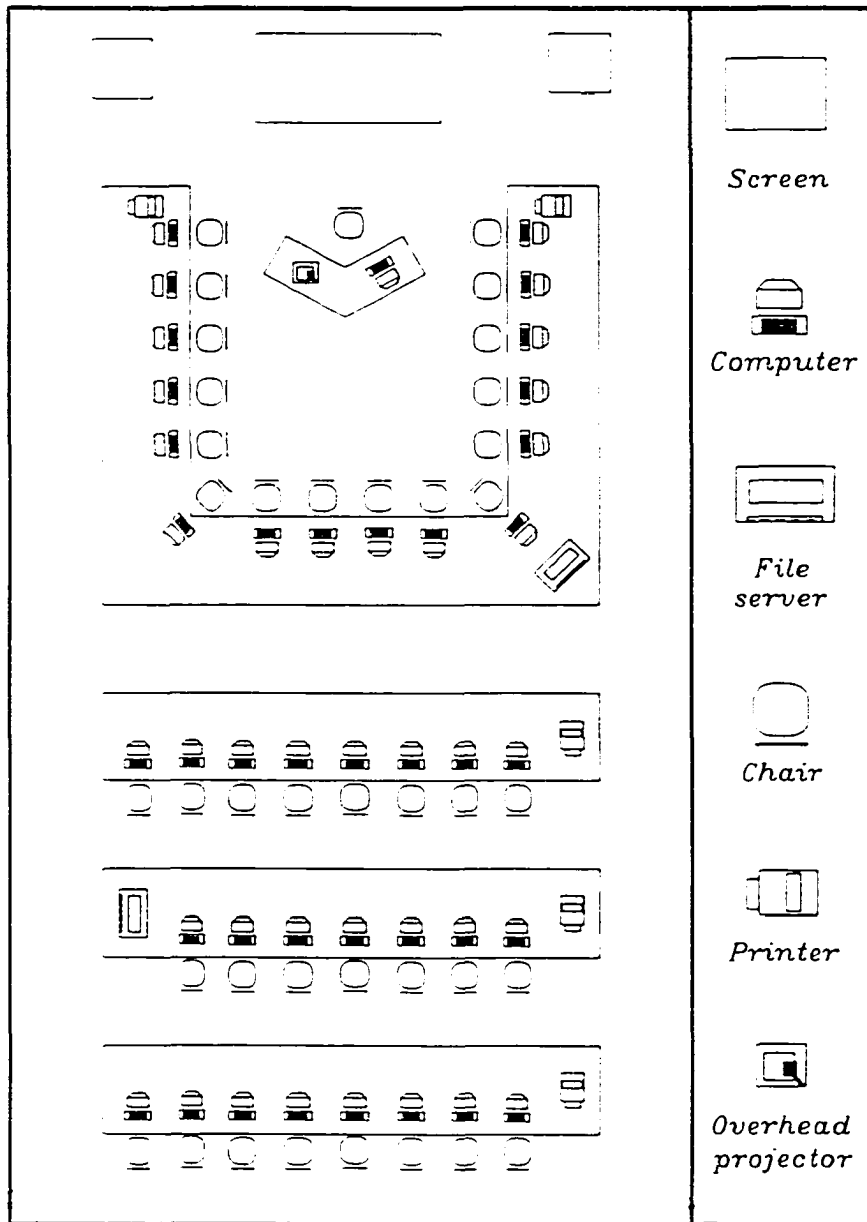


Fig. 9. The dual platform lab configuration.

3. A survey of teachers who have completed their first year of teaching, and who had access to computers and related instructional technologies during the year, could be conducted to see which skills from the required computer course transferred into classroom practice. Why or why not?
4. A descriptive study of lab configurations at universities with a high-tech approach to instruction could be conducted and the results disseminated.

Training in the Use of Computers and
Related Technologies at the
Graduate Level

Congruencies in Training

At the three sites visited, computer and related instructional technology classes were found in programs that were preparing educators to work in non-school settings such as business, industry, the military, and medical fields. Instructional Design Programs prepared these educators at two of the sites, whereas a component of a Human Resource and Development (HRD) Program prepared educators for non-school contexts at the third site. It appeared to me (and my observation was verified by an HRD professor and a professor of instructional design) that graduates of these three programs could compete for the same job slots in the workplace. There was considerable overlap in their training in the areas of how to design

instruction and how to use computers and related instructional technologies in providing instruction.

Considerable overlap was also noticed between the training of educators for non-school settings (mentioned above) and those receiving a traditional graduate degree in Curriculum and Instruction. Since there is so much overlap in the training of these groups, perhaps they will also compete for the future job slots in school settings. The American Association of Colleges of Teacher Education (AACTE) recognized in 1987 that specialists in educational technologies are needed for both school and non-school settings (Munday et. al., 1991, p. 30).

Traditionally graduate programs that train educators to work primarily in business and industry have been non-school directed, but will they remain that way? At the three sites visited, professors mentioned that their graduates are capable of working in school settings. Following is a discussion of the possible influence business and industry, and the educators who have been prepared to work in that context, may have on education.

Influences on Education in General

Regarding the influence of business and industry on education, Gubser (1985) identified a number of trends that will affect education and training in the future. He stated:

Schools and higher education institutions will look to private industry to provide training models as companies attempt to train employees for new jobs or retrain them for emerging ones. (p. 15)

In chapter 2, I mentioned that Arthur Andersen Worldwide Organization, the world's third-largest accounting and consulting organization, requires each employee to receive approximately 138 hours of training every year. The training is delivered in a variety of formats, ranging from basic classroom courses to multimedia programs on computer workstations (Galagan, 1993). Dr. Bill Green, Chairman of the Department of Teaching and Learning at Andrews University, pointed out that 138 hours is equivalent to the in-class hours required of approximately 3 1/2 college courses a year. The field of education does not require teachers to spend this amount of time annually in retraining. Perhaps they should. Perhaps Schools of Education should also present the material in a variety of formats, as the Arthur Andersen Company does. Dr. Green has taken these two significant ideas on retraining from business and industry, and suggested a possible application to teacher training, a practice Gubser (1985) identified as a possible trend.

In his study of schooling, Goodlad (1983) found an absence of instructional variability, partially because teachers tend to teach as they were taught. Unlike the business sector, which must continually retrain its employees in order to turn a profit, education does not

continually retrain its teachers. Perhaps this is one reason why instructional practice remains the same and therefore change is minimal.

Regarding the influence of educators prepared to work in other contexts, the current movement toward school restructuring provides ample opportunity for these educators to influence the field of education. Why? Because technology has tremendous potential in assisting with restructuring efforts. Numerous articles have been written which elaborate on this possibility. In fact, Dr. Ted Frick of the instructional design department at Indiana University has authored a Phi Delta Kappa Fastback entitled Restructuring Education Through Technology.

Certainly educators who work in non-school settings, and who have received training in the use of computers and related instructional technologies in designing and delivering instruction, have the skills necessary to assist in restructuring efforts that involve technology. Could this be the start of a trend?

Following is a discussion which further explores the possible influence of educators trained to work in non-school settings. This discussion explores their influence in the area of preservice teacher training.

Influences on Preservice Computer
Training of Teachers

At Indiana University, Bloomington, one of the professors and all four associate instructors who taught the W200 class for preservice teachers were from the department which prepares educators to work in other contexts. At the University of South Alabama, the program was new and it was too early for doctoral students to be given responsibilities. However, Dr. John Morrow, Dean of Graduate Studies stated:

Ultimately we will use our doctoral students to design instructional modules, operate technology labs, and help deliver instruction by teaching undergraduate courses. The EDM 310 class (i.e., the computer class for preservice teachers) is certainly an example of the type of instruction we would ask them to deliver. (personal communication, January 26, 1993)

Dr. Gayle Davidson of the University of South Alabama described the computer class for preservice teachers that she taught while at the University of Texas. A number of instructional design principles were incorporated (see chapter 2—the description of the implementation at the University of Texas, Austin).

Since educators prepared to work in non-school settings are or probably will be used to teach the preservice computer class for teachers at some sites (i.e., Indiana University, Bloomington, University of Texas, University of South Alabama), one notes the possibility of their future influence on classroom teachers. Of

particular interest is the computer class for preservice teachers which was developed at the University of Texas (mentioned above). This model clearly illustrates potential influence by incorporating instructional design principles.

Recommendations Concerning the
First Related Area of Study

The first area related to the initial focus of this study (i.e., the computer and related instructional technologies training of preservice teachers) involved graduate-level computer instruction. At the three sites visited, these classes were found in programs that were preparing educators to work in non-school settings. From a study of computer instruction within this context, the following recommendations are made:

1. Teachers should be made aware that their previous training and classroom experience could serve as a basis on which they could build a more financially rewarding career (i.e., designing and delivering instruction in non-school contexts) (Dr. Gayle Davidson, Data Vol. II, p. 67).
2. Traditional Curriculum and Instruction graduate programs should develop computer and related instructional technology components to their programs. This will give their graduates the skills necessary to work in/with schools involved in restructuring through technology.

Recommendations for Further Research

The following questions should be explored:

1. Are programs that train educators for other contexts shifting emphasis, or expanding their emphasis, with more of their graduates opting to work in traditional school settings? If so, in what capacity? What are the implications?
2. Will schools and higher education institutions look to private industry to provide training models?
3. What are some training models identified from private industry and how can they be applied to preservice teacher training?
4. Will the instructional design field influence the training of preservice teachers in computers and related instructional technologies? Does it now influence their training? To what extent?

Research and Development in the Use of Computers in Instruction

The second related area of study involved research and development (R & D) in the area of computers and related instructional technologies in instruction. The American Association of Colleges of Teacher Education (AACTE) recognized in 1987 that State Colleges and Departments of Education "must exert leadership in research and development activities related to educational technologies" (Munday et. al., 1991, p. 30).

Research and development in the area of computers and related instructional technologies in instruction was flourishing, particularly at the two sites which had established research organizations for that purpose. The R & D effort observed to be most frequently under development across cases involved the use of multi/hyper/interactive media in instruction. Research was scant, but generally indicated that the effect on learning was favorable.

Recommendations Concerning the Second Related Area of Study

The following recommendations in relation to preservice teacher training are made:

1. The use of multi/hyper/interactive media should be explored in training teachers how to teach in the various content areas.
2. Preservice teachers should learn how to develop multi/hypermedia lessons themselves.

Recommendations for Further Research and Development

In considering the use of multi/hyper/interactive media for instructional purposes, it is recommended that the following questions be explored:

1. What is the effect of the use of multi/hyper/interactive media on achievement?

2. Is motivation affected by the use of multi/hyper/interactive media?
3. To what degree is the time to reach competency affected by the use of multi/hyper/interactive media?

Conclusion

The results of this study are intended as suggestions of possible trends and relationships concerning preservice computer training for teachers, graduate programs which prepare educators for other contexts and have a strong computer training component, and research and development regarding the use of computers in instruction. The programs described are located at three universities which are very much oriented toward using technology in instruction. They are exceptional rather than typical. Therefore, their description may reflect the face of the future, rather than the current reality of other universities across the nation.

I personally believe that this study supports the opinions of many educators who think that the delivery of instruction is changing and that technology is playing an important role in that change. Multi/hyper/interactive media, distance education, and technical skills necessary to access, manipulate, store, and retrieve information are perceived as growing in importance, due to the demands of the Information Age. If this is so, then the teacher's role will increasingly become that of a facilitator, while

students become more involved in their own individualized instruction.

A final comment, given by Dr. Howard Mehlinger, director of the Center for Excellence in Education at the University of Indiana, Bloomington, makes an appropriate concluding summation.

Institutions must make the investment [in technology] if they are to remain relevant in an increasingly technologically oriented world. . . . Education is going to be washed over by these technologies, like every other sector of society. You're not going to be a modern university or secondary school unless you are using these technologies. (Wilson, 1993, p. A20)

APPENDIX A

RESEARCH INSTRUMENTS

INTERVIEW GUIDE FOR PROFESSORS/INSTRUCTORS
OF
THE PRESERVICE COMPUTER CLASS

UNIVERSITY CODE _____ Date _____

Please answer the following questions concerning the undergraduate computer class for preservice teachers:

1. What makes this a good class for teachers?
2. What changes have been made in this class since its inception?
3. What are some things you have tried in this class (i.e., teaching methods, activities for students, etc.) that have worked well?
4. What have you tried that hasn't worked well, and why do you think it wasn't successful?
5. How do you facilitate transfer of training? For example, if giving instruction on how to use a spreadsheet, it would be more useful to teachers in their work if they were taught how to use it as a gradebook rather than for budgeting purposes.
6. Do you have plans to revise or restructure the class? If so, how?
7. What additional or different materials would you choose in order to make this course better? (hardware/software/printed materials)
8. What software packages are you using in the class and which vendors provide it? Public domain/shareware?
9. Are student teachers required to integrate the skills they have gained from this course into their fieldwork?
10. In reference to regular elementary classroom teachers, what programming language, if any, do you think they need to learn that would help them in their work.
11. In reference to regular secondary classroom teachers who are not teaching in the areas of math or computer science, what programming language, if any, do you think they need to learn that would help them in their work.

UNIVERSITY CODE _____ Date _____

- A. How important is it for elementary teachers to receive training in the following computer software and tools today? How important will it be five years from now? Please give your opinion by circling the appropriate response.

Software	1 Unimportant	2 No Opinion	3 Important
1. Drill and Practice software			
a. present		1	2 3
b. future	1	2	3
2. Word processing			
a. present		1	2 3
b. future	1	2	3
3. Spreadsheets			
a. present		1	2 3
b. future	1	2	3
4. Databases			
a. present		1	2 3
b. future	1	2	3
5. Cooperative learning			
a. present		1	2 3
b. future	1	2	3
6. Telecommunications			
a. present		1	2 3
b. future	1	2	3
7. Tutorials			
a. present		1	2 3
b. future	1	2	3
8. Graphics			
a. present		1	2 3
b. future	1	2	3
9. Test generators			
a. present		1	2 3
b. future	1	2	3

10.	Grading, record keeping			
	a. present	1	2	3
	b. future	1	2	3
11.	Educational games			
	a. present	1	2	3
	b. future	1	2	3
12.	Artificial intelligence			
	a. present	1	2	3
	b. future	1	2	3
13.	Simulations			
	a. present	1	2	3
	b. future	1	2	3
14.	Authoring systems			
	a. present	1	2	3
	b. future	1	2	3
15.	Expert systems			
	a. present	1	2	3
	b. future	1	2	3

* * * * *

T O O L S

16.	Operating Systems			
	a. present	1	2	3
	b. future	1	2	3
17.	Networking			
	a. present	1	2	3
	b. future	1	2	3
18.	CD ROM			
	a. present	1	2	3
	b. future	1	2	3
19.	Programming			
	a. present	1	2	3
	b. future	1	2	3
20.	Interactive video			
	a. present	1	2	3
	b. future	1	2	3
21.	HyperCard or equivalent			
	a. present	1	2	3
	b. future	1	2	3

APPENDIX B

LETTER AND CONSENT FORM

April 10, 1992

Dr. Gerald Marker, Chair
Department of Teacher Education
School of Education
Bloomington, Indiana 47405

Dear Dr. Marker:

My name is Anne Chandler and I am a doctoral student in curriculum and instruction working on my dissertation. My area of interest is the training of teachers in the use of computers, both on the undergraduate and graduate levels.

The purpose of my research is to describe exemplary computer training programs for teachers, using the case study method. Some questions of interest concern what teachers are currently being taught about computers, and what trends may develop in this area in the future. I will also be looking at how computer training is structured within teacher education programs and how it is funded. A brief history of the programs, with descriptions of lab configurations and equipment will be a part of the study as well.

The case study description of your particular program would need to be reviewed by you and your program staff who are involved in teaching the computer classes for teachers before the report is put in its final form.

References in the final report would be such that confidentiality will be maintained. Names of programs and teaching personnel will be omitted.

The proposed data gathering techniques will include questionnaires and interviews of the program director (yourself), instructors of computer classes, observation of computer classes, and examination of documents, (i.e., course syllabi, handouts, course descriptions, NCATE materials, etc).

The data will be shared with those institutions participating in the study, and a copy of the dissertation will be sent upon completion. It is expected that this study will further our knowledge on the training of teachers in the use of computers.

I would like very much to do a case study of your program. My estimated time of involvement on your campus would be approximately one to two weeks. I will be contacting you in two weeks by telephone to see if you would be willing to participate in this project.

Thank you for your consideration in this research effort.

Sincerely,

Anne Chandler

cc: Dr. Donald Warren

PARTICIPANT CONSENT FORM

Consent form for participation in the research project entitled: Descriptive Case Studies of Training, Research and Development in Computers and Emerging Technologies at Three NCATE Universities.

The purpose of this research is to describe exemplary computer training programs within education, using the case study method.

The proposed data gathering techniques will include questionnaires and interviews of the program directors and instructors of computer classes, observation of computer classes, and examination of documents, (i.e., course syllabi, handouts, course descriptions, NCATE materials, etc.). The researcher expects to be involved at each site for approximately one to two weeks.

The case study description of the program will be reviewed by the chairmen of the departments involved and the staff members who teach computer classes. After review by those involved in the research, the case study will be written in its final form. References in the final report will be such that confidentiality will be maintained. Names of programs and teaching personnel will be omitted.

It is expected that this study will further the knowledge of computer education within schools of education. Your participation will benefit your institution in that a copy of the dissertation will be sent upon completion.

There are no known risks or discomforts associated with this research. You are free to terminate this consent at any time and withdraw from the project without any negative consequences. If you have any questions concerning this project or this consent, please call me at 616-471-6795.

Anne L. Chandler
Andrews University

.....

I, _____, hereby consent to participate in the project described above. I have read and understand this statement and I have had all my questions answered.

Date: _____ Signature: _____

APPENDIX C
INDIANA UNIVERSITY
UNDERGRADUATE COMPUTER ENDORSEMENT

PURPOSE OF THE ENDORSEMENT

The endorsement is designed to equip classroom teachers with a variety of instructional computing skills . . . (Handout, IU School of Education, Bloomington).

Teachers holding this endorsement will be sufficiently competent to incorporate computers in ongoing instruction in a variety of contexts. For the next few years, these teachers will likely be our building-level 'experts' knowing more about computers than anyone else on the staff. They will likely be called upon to advise their colleagues on hardware and software issues and conduct staff development activities, as well as teach computing to students. This endorsement should not, however, be confused with a secondary level teaching major or minor in computer science (Handout, IU School of Education, Bloomington).

The holder of the computer endorsement is eligible to teach a survey computer literacy course or serve as a building level computer advisor (State Board of Education, Teacher Training and Licensing, 511 IAC 10-1-13, Computer Endorsement).

The computer endorsement is not required for teaching classes in computer literacy. Individuals who plan to teach computer literacy courses are, however, strongly encouraged to complete requirements for this endorsement (State Board of Education, Teacher Training and Licensing, 511 IAC 10-1-13, Computer Endorsement).

COURSE REQUIREMENTS

COMPUTER ENDORSEMENT (19-23 credit hours)

- EDUC W200 Microcomputing for Education: An Introduction
(1 cr.) or CSCI A201 Introduction to Computer Science (3 cr.)
- EDUC W210 Survey of Computer-Based Education (3 cr.)
P: EDUC W200, EDUC W100, or permission of instructor.
- EDUC W220 Technical Issues in Computer-Based Education (3 cr.) P: EDUC W210 and CSCI A201 (Bloomington) or CSCI 206 (Indianapolis) or permission of instructor; or CSCI C335 Computer Structures (4 cr.)
- EDUC W310 Computer-Based Teaching Methods (3 cr.)
P: EDUC W210
- EDUC W410 Practicum in Computer-Based Education (6 cr.)
P: EDUC W30 (Indiana University Bulletin: 1992-1994, p. 41).

COURSE DESCRIPTIONS

COMPUTER ENDORSEMENT

W200 Microcomputing for Education: An Introduction

(1-3 cr.) B-I Required of all students pursuing teacher certification. Introduction to instructional computing and educational computing literature. Hands-on experience with educational software utility packages and commonly used microcomputer hardware.

W210 Survey of Computer-Based Education

(3 cr.) B-I The first course for the endorsement in educational computing. Proficiency in the use of application programs. Study of social, moral, and technological issues of educational computing.

W220 Technical Issues in Computer-Based Education

(2-3 cr.) B-I An examination of computer hardware and peripheral devices in classroom settings (e.g., networking, communications, and hypermedia). Understanding of educational applications of a programming or authoring language.

W310 Computer-Based Teaching Methods

(3 cr.) B-I Integration of educational technology into the school curriculum; methods of teaching computer literacy, computing skills, and programming at K-12 level; principles of educational software design and evaluation; staff development techniques.

W410 Practicum in Computer-Based Education

(6 cr.) B-I The culminating experience for the computer endorsement. Either six weeks of full-time fieldwork or 12 weeks of half-time fieldwork in an educational setting that incorporates instructional computing (Indiana University Bulletin: 1992-1994, pp. 108, 109).

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