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Technology Education Trends In Preservice Teacher Education Between 1980 And 1999 As Reflected In Dissertation Research

Mary Ann Kjetsaa

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TECHNOLOGY EDUCATION TRENDS IN PRESERVICE TEACHER EDUCATION
BETWEEN 1980 AND 1999 AS REFLECTED IN DISSERTATION RESEARCH

BY

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Submitted in partial fulfillment of the
requirements of the Degree of Doctor of Philosophy
Seton Hall University
2002
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TABLE OF CONTENTS

ACKNOWLEDGEMENTS ........................................... iii

LIST OF TABLES .................................................. vii

LIST OF FIGURES ............................................... viii

I THE RESEARCH PROBLEM ..................................... 1

Purpose of the Study ........................................... 14
Research Problem .............................................. 15
Research Question ............................................. 15
Subsidiary Questions .......................................... 15
Definition of Terms ............................................ 16
Limitations ...................................................... 18
Study Summary .................................................. 19

II REVIEW OF THE LITERATURE ............................... 22

Diffusion of Innovations Theory ................................ 23
Innovations ....................................................... 25
Communication Channels ....................................... 26
Time ............................................................... 27
Social System ..................................................... 31
Diffusion Study in an Educational Setting .................... 33
National Technology Studies and Reports ..................... 34
Office of Technology Assessment Reports .................... 34
National Center for Educational Statistics Report ............ 36
Trend Analysis Research ......................................... 37
Summary .......................................................... 41

III METHODOLOGY ............................................... 44

Data Source ....................................................... 44
Content Analysis Data Collection Sheet (CADCIS) ............ 50
Content Analysis — General Background ....................... 50
Content Analysis Data Collection Sheet Development ....... 52
Reliability and Validity Testing ................................ 53
Data Analysis ..................................................... 56
Delimitations of the Study ...................................... 57
Summary .......................................................... 57

IV FINDINGS ....................................................... 59

Descriptive Trend Findings .................................... 61
What Did the Dissertation Population Look Like? ............. 61
Who Were the Researchers? .................................... 62
Gender ........................................................... 62
<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Percent of Public School Teachers Reporting Computer Availability in the Classroom and Elsewhere in Schools, By School Characteristics: 1999</td>
<td>6</td>
</tr>
<tr>
<td>2.</td>
<td>Distribution of Identified UMI ProQuest Digital Dissertations - Search Results</td>
<td>45</td>
</tr>
<tr>
<td>3.</td>
<td>Distribution of Dissertation Abstracts For Study By Year</td>
<td>49</td>
</tr>
<tr>
<td>4.</td>
<td>Trends in Degrees Earned and Gender By Five Year Periods</td>
<td>64</td>
</tr>
<tr>
<td>5.</td>
<td>Trends in Research Methods, Degree, and Gender By Five Year Periods</td>
<td>67</td>
</tr>
<tr>
<td>6.</td>
<td>Trends in Populations Studied By Five Year Periods</td>
<td>69</td>
</tr>
<tr>
<td>7.</td>
<td>Trends in Research Methods By Five Year Periods</td>
<td>70</td>
</tr>
<tr>
<td>8.</td>
<td>Trends in Data Collection Methods By Five Year Periods</td>
<td>72</td>
</tr>
<tr>
<td>9.</td>
<td>Trends in Innovations Studied by Five Year Periods</td>
<td>75</td>
</tr>
<tr>
<td>10.</td>
<td>Trends in Innovation Themes By Five Year Periods</td>
<td>77</td>
</tr>
<tr>
<td>11.</td>
<td>Trends in Major Findings Data By Five Year Periods</td>
<td>79</td>
</tr>
<tr>
<td>13.</td>
<td>Trends in Communication Channel, Setting, Delivery System By Five Year Period</td>
<td>86</td>
</tr>
<tr>
<td>14.</td>
<td>Trends in The Innovation-Decision Process By Five Year Periods</td>
<td>88</td>
</tr>
<tr>
<td>15.</td>
<td>Trends in Social System Structure, Norms, Innovation-Decision Type By Five Year Periods</td>
<td>91</td>
</tr>
<tr>
<td>16.</td>
<td>Trends in Consequences By Five Year Periods</td>
<td>94</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

1. Technology Penetration in U.S. Public Schools, 1995-96 .............................................. 4

2. Availability of Technology For Instructional Purposes .................................................... 5

3. Percent of Public School 4th, 8th, and 12th Grade Students Who Had School
   Administrators Reporting Computer Labs at School, Computers in Classrooms or
   Computers Available to Bring to Class: 1998 ..................................................................... 8


5. Percent of Public School Teachers Reporting Feeling Prepared to Use Computers
   and the Internet to a Small, Moderate, or Large Extent, by Various Sources of
   Training: 1999 ...................................................................................................................... 11

6. Percent of Public School Teachers Reporting Whether College/Graduate Work
   Prepared Them Not at All or to Any Extent to Use Computers and the Internet,
   By Years of Teaching Experience: 1999 .............................................................................. 12

7. States Requiring Courses in Educational Technology for a Teaching License .................... 13

8. Adopter Categorization on the Basis of Innovativeness ..................................................... 30

9. The Number of New Adopters Each Year, and the Cumulative Number ............................ 30

10. Dissertation Population by Years ..................................................................................... 62


12. Identified Trends Chart ...................................................................................................... 120

13. What Works According to Rogers – Suggestions for Inclusion in Preservice Teacher
    Education Programs ............................................................................................................. 128
CHAPTER 1

The Research Problem

The information age is upon us. The use of technology has become a part of our daily lives at home, at work, and at school. The curriculum and educational methodology in schools, colleges and departments of education (SCDEs) have been impacted by technology. The teaching profession must be trained to enter an educational setting that includes the use, application, and integration of technology. Research supports the inclusion of technology education in preservice teacher education (Johnson & Harlow, 1993; Munday, Windham, & Stampler, 1991; Oke, 1992; Summers, 1990; Vagle, 1994). Training teachers to integrate technology into the curriculum and to use it as a tool for learning is an important component of teacher education (Barker, 1993; Handler & Marshall, 1992; Munday, Windham & Stampler, 1991; Newren, Waggener & Kopp, 1991; Oke, 1992; Vagle, 1994; Weihe & Taylor, 1997). More and more teachers are expected to possess computer competencies and be able to use computer-related technologies (Carlson, 1991; Maddux, 1993; National Council for Accreditation of Teacher Education, 1997; Novak, & Berger, 1991; Office of Technology Assessment, 1988). The need to include technology training in teacher preparation was identified in both Power On! New Tools for Teaching and Learning (Office of Technology Assessment, 1988) and Teachers and Technology: Making the Connection (Office of Technology Assessment, 1995). The National Center for Educational Statistics (2000) Fast Response Survey System has reported that some progress has been made with less experienced teachers in that they feel more prepared to use technology in the classroom than
previously trained older teachers. However, the Office of Technology Assessment (1995) reported that technology was still not central to the teacher preparation experience.

This study looked at technology education in preservice teacher education from 1980 to 1999 using Everett Rogers’ Diffusion of Innovations Theory as a framework. Rogers (1995) stated that “diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system (p. 5)”. This study identified the innovations, looked at the communication channels used over time as well as identified the social system in which the diffusion took place. The resulting data from this study allowed a picture to emerge of some of the changes in technology education of preservice teachers in schools, colleges, and departments of education (SCDEs) over time as reflected by the dissertation research of this sample population and to identify some possible directions and/or areas of needed emphasis for future development. This study added to the body of knowledge in teacher education and teacher education research in the United States. This information has the potential to be a valuable resource for SCDEs when planning future programs.

The starting date of 1980 was selected because it coincides with two significant events in education and the development of technology. The first event, in the 1980s’ was an increase in the amount and volume of public criticism of the educational system and a call for change. These factors paved the way for the report, “A Nation at Risk,” in 1983. This report made public the perceived problems and concerns relating to the educational system of the United States. It was and is a significant report frequently quoted in literature, even today.

The second event in 1980 that impacted education was the development of the computer chip that made the production and availability of personal computers to everyone. This development resulted in the proliferation of the personal computer. Computers, hardware and software, began to show up on desktops at work, at home, and at school. The proliferation of computers and related technologies everywhere increase the demand for inclusion into the
educational system. Coley, Cradler, and Engel (1997) using information from Quality Education Data, inc. in their publication *Computers and classrooms: The status of technology in U.S. schools* graphically depict the percentage of penetration of various technologies in schools during 1995-96 (Figure 1). Computers at 98% are by far the highest concentration followed closely by VCRs at 97 percent. Other technologies were identified as follows: Multimedia computers (85%), Cable Television (76%), Internet access (64%), Networks (38%), Videosources (35%), and Satellite (19%).

Coley, Cradler, and Engel (1997) reported that 4.4 million computers in 1997 were located in schools throughout the United States. On average a school owned 21-30 computers with Macintosh (41%) and Apple II and IIGS (19%) leading the market for a total of 60 percent. The National Center for Educational Statistics report *Teachers’ tools for the 21st century: A report on teachers’ use of technology* (2000) identified the percentage of public school 4th, 8th, and 12th graders who had school administrators reporting varying numbers of computers at school in 1990 and 1998 (Figure 2). The numbers of computers and percentages increased substantially from 1990 to 1998. It should be noted that the 12th grade had the highest percentage (73%) as opposed to 33% for 4th grade and 51% for 8th grade in 1998. This also points to a concentration of computers in the high school setting.
Figure 1. Technology Penetration in U.S. Public Schools, 1995-96

Source: QED, 1997

Note. Coley, Cradler, & Engel, 1997,
Figure 2. Availability of Technology For Instructional Purposes

National Center for Educational Statistics (2000) analyzed data for 1998 that described the percentage of public schools reporting computer labs at school, computers in the classroom or computers available to bring to the class (Table 1). Computer labs at school for 4th, 8th, and 12th graders were reported as 78%, 90% and 94%, respectively. The 4th graders had the highest percentage (83%) in the category of computers available to them in the classroom. All groups were about equal in availability of computers to bring to class (39%, 42%, and 40%).

Table 1
Percent of Public School Teachers Reporting Computer Availability in the Classroom and Elsewhere in School, By School Characteristics: 1999

<table>
<thead>
<tr>
<th>School characteristics</th>
<th>Computers available in classroom</th>
<th>Computers available elsewhere in school</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>All public school Teachers</td>
<td>84</td>
<td>16</td>
</tr>
<tr>
<td>Instructional level</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elementary</td>
<td>89</td>
<td>11</td>
</tr>
<tr>
<td>Secondary</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Enrollment size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 300</td>
<td>87</td>
<td>13</td>
</tr>
<tr>
<td>300 to 999</td>
<td>88</td>
<td>12</td>
</tr>
<tr>
<td>1,000 or more</td>
<td>71</td>
<td>29</td>
</tr>
<tr>
<td>Locale</td>
<td></td>
<td></td>
</tr>
<tr>
<td>City</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Urban fringe</td>
<td>83</td>
<td>17</td>
</tr>
<tr>
<td>Town</td>
<td>92</td>
<td>8</td>
</tr>
<tr>
<td>Rural</td>
<td>87</td>
<td>13</td>
</tr>
<tr>
<td>--------------------</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>Percent minority enrollment in school</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 6 percent</td>
<td>85</td>
<td>15</td>
</tr>
<tr>
<td>6 to 20 percent</td>
<td>86</td>
<td>14</td>
</tr>
<tr>
<td>21 to 49 percent</td>
<td>89</td>
<td>11</td>
</tr>
<tr>
<td>50 percent or more</td>
<td>77</td>
<td>23</td>
</tr>
</tbody>
</table>

*Note. Detail may not sum to 100 due to rounding. As cited in *Teachers’ tools for the 21st century: A report on teachers’ use of technology*, (p.40), National Center for Educational Statistics (2000).*

National Center for Educational Statistics (2000) also reported survey data identifying where the computers could be found ‘in the classroom’ or ‘elsewhere in the school’ for 1999 (Figure 3). Figure 3 indicates that 84% of public schools reported having at least one computer ‘in their classroom’ and 95% reported computers available ‘elsewhere in the school’.

Access in schools to the Internet also experienced increasing availability. National Center for Educational Statistics (2000) reported that Internet access went from 35% in 1994 to 95% in 1999 and that Internet access in instructional rooms increased from 3% in 1994 to 63% in 1999 (Figure 4). Some of the increased numbers of computers previously noted also had access to the Internet. This data clearly shows the increased number of instructional technologies available in schools as well as the increased use of the Internet.
Figure 3.2.—Percent of Public School 4th-, 8th-, and 12th-Grade Students Who Had School Administrators Reporting Computer Labs at School, Computers in the Classroom, or Computers Available to Bring to Class: 1998

![Bar Chart]

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1998 Reading Assessment.

Figure 3. Percent of Public School 4th, 8th, and 12th Grade Students Who Had School Administrators Reporting Computer Labs at School, Computers in Classroom or Computers Available to Bring to Class: 1998

Figure 4. Percent of Public Schools and Instructional Rooms with Internet Access: 1994 to 1999

The how and what of education were changing with technology playing an increasing role. So how did teachers feel about their preparedness to use technology and where did they receive their training? The National Center for Educational Statistics (2000) arranged data according to the percentage of “feeling prepared to use computers and the Internet” as rated by teachers using the categories of ‘small extent,’ ‘moderate extent’ and ‘large extent’ (Figure 5). It can be seen that professional development activities, colleagues, and students were deemed to have contributed to a small extent (all at 36%). The biggest contributor (large extent category) to ‘feeling prepared’ was reported to be the category of independent learning at 39 percent. It should be noted that college/graduate work was ranked the lowest overall.

The National Center for Educational Statistics (2000) reported the percentage of public school teachers in 1999 who identified whether or not college and/or graduate work prepared them to use computers and the Internet. Respondents were asked to select from the categories of ‘not at all’ and ‘to any extent’ (Figure 6). Data were grouped by the years of experience of the teachers participating in the survey. The newer teachers (3 years or less of teaching experience category) reported that they had been prepared to ‘some extent’ by their college and/or graduate work (84% of respondents) while the more experienced teachers (20 years or more of teaching experience category) reported that their college and/or graduate work had not prepared them (69% of respondents) for the use of computers and the Internet. The data would seem to indicate that an important change took place about 10 years ago with regard to college and/or graduate work to assist teachers in preparing for the use of computers and the Internet.

Reports began to require technology education for teacher licensure in the United States. Education Week (1997, January) reported that of the 50 states the majority of states required courses in educational technology for a teaching license (Figure 7).
Figure 3. Percent of Public School Teachers Reporting Feeling Prepared to Use Computers and the Internet to a Small, Moderate, or Large Extent, by Various Sources of Training; 1999


Figure 6. Percent of Public School Teachers Reporting Whether College/Graduate Work Prepared Them Not At All or To Any Extent to Use Computers and the Internet, By Years of Teaching Experience: 1999

Figure 7. States Requiring Courses in Educational Technology for a Teaching License

Purpose of the Study

It can be seen from the introduction that the availability of technology in schools has increased. This increase fosters the need for teachers to know how to use and to feel confident when using the more available technologies in their classrooms and the general school setting. Training preservice teachers to use educational technologies has become essential and has become a pressing issue for teacher education programs.

How have SCDEs responded to this technology training challenge? How has technology been diffusing throughout teacher training programs? What technology innovations have been introduced? How has the diffusion of innovations progressed? One way to view preservice teacher education technology and/or training trends is to review original research in the form of dissertation studies. Once identified these studies can be viewed from a descriptive perspective over time. This study looked at technology education and/or training of preservice teachers as reflected in dissertation research.

A review of dissertations using UMI ProQuest dissertations online database indicated that a study of this type had not been done and that a significant amount of literature existed on the topic of preservice teacher technology education and/or training. Also, according to Rogers (1995) diffusion research in education makes up only 9% of the diffusion research indicating a gap in research in this area.

An initial review of the abstracts identified by the UMI ProQuest electronic search indicated that the studies were generally singular events not drawing on each other nor organized together in a cohesive, systematic way. The studies seemed to talk about individual institutions, programs, and/or individual situations. This study brought together previous research which served to broaden and to add to the knowledge base. Light and Pillemer (1984) supported the idea of bringing previous research together. Light and Pillemer reported in their book, Summing up: The science of reviewing research, that new studies need to build and incorporate the work of
previous studies. They conclude that other sciences do this on a regular basis and that the social sciences need to do more of it. Light and Pillemer (1984) stated further that the evaluation of innovation needed to be compared to its predecessors for a better understanding. Further, they identified the need for both numerical and qualitative information as key to a good synthesis. By conducting a review, one can bring together a broader range of information and study outcomes than can be made available under normal study conditions.

Light and Pillemer (1984) also reported that good reviews can identify trends that would not likely emerge in a single study and that research summaries can organize findings in unique and powerful ways. Finally, Light and Pillemer talk about the help that future research can gain through uncovering past research and what is known as a base to proceed to future studies. This study served to provide a synthesis of this body of knowledge on technology education and/or training in preservice teacher education using the diffusion of innovations as a framework and the application of that diffusion of innovation theory to an educational setting.

Research Problem

The Research Question

This leads us to the main research question and the subsidiary questions of this study. The main research question is as follows. What have been the trends, 1980-1999, in technology education and/or training in preservice teacher education as reflected in selected dissertations?

Subsidiary Questions

1. What innovations were studied? By whom? By male/female researchers? Ed.D. or Ph.D. candidates? At what institutions?

2. How was the research in the selected sample conducted? Which research methodologies were used? Populations identified and/or sampled?
3. What were the major findings reported in the selected dissertation abstracts?
4. Which innovation characteristics were present?
5. What communication channels were identified?
6. How was the innovation-decision process utilized?
7. Which adopter categories were studied?
8. Which social systems were identified and studied?
9. How has the diffusion of innovations progressed through colleges and schools of education between 1980-1999?
10. How have these trends changed over time?

Definitions Of Terms

Communication – Rogers (1995) “a process in which participants create and share information with one another to reach a mutual understanding” (p. 6). This is a process and implies an exchange of information (Rogers, 1995).

Communication channels – Rogers (1995) “the means by which messages get from one individual to another. The nature of the information-exchange relationship between a pair of individuals determines the conditions under which a source will or will not transmit the innovation to the receiver, and the effect of the transfer” (p. 18).

Computer/s – as an innovation category is more focused on the computer and computer literacy, computer instruction, and computer use. It includes innovations directly connected to computers and how they work.

Technology – is the broad-based term that began to appear with frequency in the early to mid 1990s and used in this study as an innovation category to categorize electronic and digital innovations beyond just computers and included such things as CD-ROM, Internet, laser disc, digital video, electronic media, ITV, etc. as well as technology literacy, technology instruction,
and technology use. Note: Some studies may be categorized under educational media or media and as such may not be included in this study and by virtue of their exclusion in the selection process, the study may appear to, or may actually, underestimate the previous research work in this area, especially prior to 1980.

Content Analysis – Berelson (1952) describes content analysis as a systematic and objective research method that quantifies and describes the content of communication. Weber (1985) defines content analysis as “a research methodology that utilizes a set of procedures to make valid references from text” (Weber, 1985, p. 9). Weber identifies among others that the uses and/or purposes of content analysis are: to reveal focus of groups, individuals, institutions and/or society; and to describe trends in communication content. Berelson adds that content analysis is a method to analyze “who said what to whom, how and with what effect” (p. 13).

Diffusion – Rogers (1995) “the process by which an innovation is communicated through certain channels over time among the members of a social system” (p. 5).

Educational Technology (The field of) – An emerging field that encompasses a variety of technologies and the uses of these technologies in a variety of settings and includes the policy, structural, organizational implications and legal ramifications of the uses of technology as it applies to educational settings and has an important component the training of teachers and teacher educators.

Electronic communication – as an innovation category includes e-mail, electronic writing and/or journaling, networking, and the use of the Internet for communication.

Innovation – Rogers (1995) “an idea, practice or object that is perceived as new by an individual or other unit of adoption” (p. 11). Newness is determined by the individual.

Innovation Theme – describes the category into which an innovation is placed based on its intended use with the study population.
Interactive Grouping – as an innovation category includes interactive video disc, interactive video simulations, and interactive CD-ROM.

Preservice teacher education – private and public undergraduate programs at schools, colleges & departments of education (SCDE’s) that prepare undergraduates to enter the field of teaching in the private or public K-12 setting.

Social system – Rogers (1995) “as a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal. The members or units of a social system may be individuals, informal groups, organizations, and/or subsystems” (p. 23).

Technology education – In this study this refers to exposure and training in technology. Computers and computer related hardware and software instruction and peripherals make up a large part of technology education. However, since this study proposes to uncover trends it will not be limited to only computer and computer related technologies but will include other technologies such as video discs, distance learning, etc.

Time – Rogers (1995) includes time as one of the four elements of diffusion of innovations theory. Time is part of diffusion as follows: (a) innovation-decision process (passing from first knowledge of an innovation through adoption and/or rejection); (b) the innovativeness of the adopter (early or later adopter) compared with others in the social system; and (c) innovation’s rate of adoption in the system.

Trend – “is considered to be a cumulative indicator of activities or products that shows directions” (Ely, 1988, p. 1).

Limitations

1. Determination of gender was determined by looking at the first and middle name of
the author. This classification then may not be 100% accurate since some names are difficult to classify. To assist in this process this researcher sought the help of foreign nationals for identification of the names of their countrymen.

2. Subjective decisions were made during content analysis. Therefore, reliability and intercoder and intracoder reliability were carefully examined and evaluated.

3. Some categories under Rogers’ Diffusion of Innovations Theory elements could not be clearly identified from the abstract. This was partially due to the length limitations of the abstract and to the fact that the studies were not diffusion studies.

4. Data collection was limited to the information given in the abstracts provided through UMI ProQuest which was assumed to be entered correctly for text and identification subject coding categories.

5. Some studies may be categorized under educational media or media and as such these studies may not be included in this study and by virtue of their exclusion in the selection process, the study may appear to, or may actually, underestimate the previous research work in this area, especially prior to 1980.

Study Summary

This study looked at the trends between 1980-1999 regarding technology education and/or training for preservice teacher education programs as reflected in dissertation research. This study used Rogers’ Diffusion of Innovations Theory as a lens to review research during this time frame. Both quantitative and qualitative data were collected.

This researcher conducted a content analysis on a sample of 119 dissertations identified using UMI ProQuest. The UMI ProQuest search, an online electronic dissertation database, using the following key word subject code “su(technology #0710)” yielded 19000+ dissertations; the researcher then, applied the following key word subject code “su(education,teacher #0530)” to
those identified dissertations which yielded 581 dissertations. When the years 1980-1999 were applied one dissertation was removed yielding 580 identified dissertations. Identified dissertations were then systematically reviewed for inclusion in this study using specific criteria. Coding categories and subcategories for the Content Analysis Data Collection Sheet (CADCS) were developed using the tenets of Everett Rogers’ theory. The CADCS was developed, refined, and underwent careful reliability and validity testing.

The results of this study identified discernible trends and directions in educational technology and/or training for preservice teachers between 1980-1999. Data suggested that innovations have diffused. Judging from the increase in the number of studies on technology education and/or training in preservice teacher education, the data suggested that the pace of diffusion has increased. A wide variety of innovations were identified in the studies from sixty-eight different institutions. Data on innovations suggested a shift from learning about computers to learning with computers and/or technology used as instructional tools. The broad-based term ‘technology’ as described in the definition of terms of this study began to appear with frequency in the 1990s and continued to increase in frequency of usage becoming a focus for study. Because of the changing and advancing nature of technology, the variety of innovations will probably continue to expand with the availability of new technologies.

Although the preservice teacher student was identified in this review as the most frequently used data source throughout the time period, an increase in frequency was noted in the use of two additional data sources. One additional data source identified in the early-to-mid 1990s was the faculty member; the second data source identified in the mid-to-late 1990s was the student teacher. SCDEs appeared most often as the social setting but an increase was noted in the number of studies making a connection to the K12 sector.

The data from dissertations included in this review suggested some of the areas being explored by SCDE programs for preservice teachers. Rogers’ Diffusion of Innovations Theory
provided an appropriate lens by which to view the diffusion of innovations in SCDEs allowing this picture of some of the trends in technology education and/or training in preservice teacher education as reflected in dissertation research to emerge.
CHAPTER II

Review of the Literature

To identify literature relating to technology education and/or training for preservice teachers, this researcher conducted a search using a variety of online services and databases which led to the reading and review of journal articles, dissertations, conference papers, and books. The Educational Resources Information Center (ERIC) database, UMI ProQuest, as well as the Seton Hall Library and consortium member libraries through the electronic catalog system were searched for information and studies for this review. Descriptors used for the ERIC search were: “teacher education,” “preservice teacher education,” “teacher educator education,” “technology,” “computer uses in education,” “information technology,” and “trends in educational technology.” These searches yielded journal articles, books, conferences, national reports, and dissertations which this researcher reviewed for information. Descriptors used for the UMI ProQuest dissertation online search and the library catalog electronic search were “technology” and “education, teacher.” This researcher also visited a number of websites for various educational and technological associations. The following is a partial listing of websites visited: National Center for Educational Statistics (NCES) http://nces.ed.gov, National Educational Association (NEA – Higher Education) http://nea.org, Association for the Advancement of Computing in Education http://www.aace.org, and International Society for Technology in Education http://wwwASTE.org.

The results of the searches described above were contained in the following literature review by the researcher. Since the framework and underpinnings of this study rested on the
diffusion of innovations theory, it was thoroughly described first followed by a relevant study in the area of educational technology. The national technology studies included in this review were considered primary works that functioned to focus public opinion on technology, to outline technology used in education, and to describe some of the impact of technology on the K12 educational and the preservice teacher education and/or training sectors. Finally, since part of the focus of this study was to look at trend analysis, the last section included a discussion of relevant trend analysis studies. The trend studies included a variety of trend analyses using content analysis for data coding and collection.

Diffusion of Innovations Theory

The theoretical guide and framework applied throughout this study was the one developed by Rogers – the Diffusion of Innovations Theory. Using Rogers’ Diffusion of Innovations as a framework this study looked at original research in the form of doctoral dissertations. As Harris (1997, April) in an article in Learning and Leading With Technology suggested that by applying Rogers’ Diffusion of Innovations Theory one would be better able to identify how to infuse information technologies into professional practice as well as increase one’s understanding of teacher adoption of said technologies. Harris further stated that this could help leaders develop strategies that supported the acceptance and adoption of technology innovations in educational settings.

Most studies were singular events and this study provided a synthesis of this body of knowledge and accounted for the importance of one in the diffusion of innovations by covering the time period from 1980 to 1999. Using content analysis, this study collected data that encompassed aspects of all four elements of the Diffusion of Innovations Theory as identified by Rogers (1995). The four elements described by Rogers included: (a) innovations, (b) communication channels, (c) time, and (d) social system. Content analysis was mentioned here
what appropriately related to the research methodology on trend analysis but will be fully
discussed as a methodology for collecting data in the methodology section.

Diffusion of Innovation Theory has a long history starting in the early 1900s with the
work of Gabriel Tarde. Following this early work diffusion research studies began to increase in
the 1940s and 1950s with an especially rapid growth between 1965 and 1968. According to
Rogers (1995), diffusion research in education, however, makes up only 9% of the diffusion
research in education as centering around teaching/learning innovations such as kindergartens,
modern math, programmed instruction, and team teaching.

Rogers told us that the diffusion of new ideas and/or innovations sometimes proceeded
slowly or quickly or sometimes not at all. The time lag between innovation and wide spread
acceptance varied widely but was generally considerable in the educational setting. Clearly more
research could be done in this area to learn more about the diffusion of educational innovations in
an educational setting. Studying and understanding this phenomenon could help to develop ways
to shorten the time lag for adoption and implementation of an innovation, and thereby, bringing
innovations more quickly into the educational setting for wide-spread adoption.

Everett M. Rogers has done a great deal of research and work in the area of the diffusion
of innovations. He worked alone and in collaboration with a number of other scholars. As a result
of his extensive work in the field, Rogers described diffusive of innovations as a process. Using
Rogers' theory of diffusive of innovations as the lens, this study reviewed and compared
technology education/training in schools, colleges, and departments of education (SCDE's) as
identified in selected dissertations by Ed.D. and Ph.D. candidates from 1980 to 1999.

Rogers (1995) defined diffusion as the "process by which an innovation is communicated
through certain channels over time among the members of a social system" (p. 5). Rogers named
the four elements of diffusion as innovation, communication channels, time, and social system.
According to Rogers, diffusion is a special type of communication. It was the communication of a new idea having a degree of uncertainty attached to it. He also cited diffusion as being very social.

**Innovations**

An innovation was defined by Rogers (1995) as “an idea, practice or object that is perceived as new by an individual or other unit of adoption” (p. 11). Newness was determined by the individual and could be expressed according to Rogers in terms of knowledge, persuasion, or decision to adopt.

Technology innovations represented two components – hardware and software. Rogers further clarifies that:

A technology innovation usually has at least some degree of benefit for potential adopters. This advantage is not always clear-cut, at least not to the intended adopters.

They are seldom certain that an innovation represents a superior alternative to the previous practice that it might replace. (p.13)

Software only innovations diffuse more slowly, stated Rogers’, because they were not as visible and/or observable as hardware and/or equipment. When the uncertainty of the innovation was reduced through information to a tolerable level, the adopter would adopt or reject. Technology clustering or the putting together of a couple of closely related technologies seemed to help in the adoption process making adoption easier and faster.

Rogers (1995) delineated the characteristics of innovations that made them more or less attractive to adopters. There were five characteristics: (a) relative advantage, (b) compatibility, (c) complexity, (d) trialability, and (e) observability. Relative advantage asked whether or not this was a better idea than the current idea. Rogers’ mentioned incentives to help the potential adopter adopt more quickly. Incentives could take many forms and could be intrinsic and/or extrinsic.
Compatibility asked whether or not the innovation fitted existing values, experiences and meets the current needs of potential adopters. Trialability asked whether or not the potential adopter could experiment with or try the innovation in installments. Observability asked whether or not the results were readily visible. If answers to the above questions were "yes" the innovation would diffuse and be adopted more quickly and easily. Complexity, however, related to the difficulty level that the innovator assigned to the innovation. How difficult was it to understand and use?

Complexity perceptions were negatively related to the rate of adoption.

In the 1970s Charters and Pellegrin (1972) first identified changes and modifications as a new dimension to the Diffusion of Innovations Theory. These changes and modifications referred to the degree to which an innovation was modified by the user during the adoption and implementation process. The user modified the innovation to fit his/her needs and experiences.

Rogers (1995) stated that an innovation is not fixed as it diffuses but uses the term "re-invention" as a term to describe the users' changed and modified innovation.

Communication Channels

Communication was the "process by which participants create and share information with one another in order to reach a mutual understanding" (Rogers, 1995, p.17). Rogers stated that the information exchange was at the heart of the diffusion process. The communication channel was the means of getting messages from unit A (with some knowledge of the innovation) to unit B (who has little or no knowledge), and the nature of the information exchange relationship determined if the message got through or not. Mass media was rapid and efficient but as purpose was more for informing a population about the existence of an innovation. It increased the awareness of an innovation.

According to Rogers (1995) the interpersonal channels were the most effective. Further, Rogers suggested that if you linked individuals with similar socioeconomic status, education, and
other important ways, it made the communication channels more effective. Interpersonal communication should be a face to face exchange. Innovators and early adopters could rely on scientific studies for innovation information but others relied on the experiences of near peers for their information. Rogers suggested that modeling and imitation were at the center of the diffusion process.

Diffusion was identified as a social process. Thus, a homophilous group of individuals who were alike or similar in beliefs, education, and social status could transfer ideas more easily to each other. Heterophilous described a group that was not alike or similar in beliefs, education, or social status. Often the group was homophilous but the change agent was heterophilous. He/she did not speak the same language as the group and might be more technical and probably used more technical language than the group. An excellent combination, Rogers (1995) suggested, would be a group that was heterophilous regarding the innovation and homophilous regarding all other variables. For example, a member of the group who had familiarity with the innovation leading the information exchange. Someone outside the group but with a great deal of empathy also had the ability to project more effective communication, and thereby became more homophilous with the group.

Time

Time was an important component to the diffusion of innovations. The innovation-decision process which took the potential adopter from first knowledge of an innovation to adopting or rejecting an innovation had five steps and took time (Rogers, 1995). These steps helped the adopter to search for information on the innovation process that informed and reduced the level of uncertainty and ultimately led the adopter to make the decision to adopt or reject the innovation. The five steps of the innovative-decision process were as follows: (a) knowledge, (b) persuasion, (c) decision, (d) implementation and reinvention, and (e) confirmation.
Rogers (1995) described each of the steps as follows:

1. Knowledge – occurred when the individual or decision-making unit found out about the existence of the innovation and learned a little bit about it;

2. Persuasion – occurred when the individual or decision-making unit developed an attitude regarding the innovation which could be positive or negative in nature;

3. Decisions – occurred when the individual or decision-making unit purposely participated in activities that led to the adoption or rejection of the innovation;

4. Implementation – occurred when the individual or decision-making unit used the innovation and/or re-invented the innovation for use;

5. Confirmation – occurred when the individual or decision-making unit re-affirmed and reinforced the uses of the innovation which could be reversed if conflicting data and/or messages were received.

Time also determined the innovativeness of the individual and/or unit of adoption as an early or late adopter when compared with the other adopters in the system. Innovativeness could be measured by Rogers’ adopter categories. The categories were as follows: (a) innovators (2.5%), (b) early adopter (13.5%), (c) early majority (34%), (d) late majority (34%), and (e) laggards (16%). Innovators were information seekers with interpersonal networks beyond their local system and were able to cope with high levels of uncertainty. Figure 8 from Roger’s Diffusion of innovations (1995) depicted the adopter categorizations on the basis of innovativeness.

The five adopter categories were developed and were described by Rogers (1995) as conceptualizations of ideal types. These categories were developed through observations of reality and were not averages of observations. The five categories were: (a) innovators (venturesome), (b) early adopters (respect), (c) early majority (deliberate), (d) late majority (skeptical), and (e) laggards (traditional). The innovator exhibited the following general characteristics: (a) to
be highly interested in new ideas, more cosmopolitan communicating frequently with people outside their peer group and with other innovators who might live great distances away, (b) to understand and apply complex technical ideas, (c) to tolerate high levels of uncertainty, and (d) to take set backs when they occur because an innovation does not work out. The innovator was an important part of the launching of an innovation idea and acted as a gatekeeper in that regard.

The early adopter was described as being more of a part of the local social system unlike the innovator who is a cosmopolitan. The early adopter exhibited the following general characteristics: (a) had respect of his/her peers, (b) functioned as an opinion leader and resource for others to check with for information regarding an innovation, (c) used innovations judiciously having a reputation to uphold, and (d) functioned as a role model for other members of the social system. Change agents sought out early adopters to assist in the diffusion of an innovation.

The early majority category was described as deliberate, did not hold opinion leader status, interacted frequently with his/her peers, and adopted just ahead of the average member of the social system. This group made up a large portion of the system approximately one-third and provided an important connection to furthering the diffusion process.

The late majority adopters also made up a large portion of the system, approximately one-third. They adopted after peer pressure and most of the risk or uncertainty factors had been addressed and removed by the social system. The laggards category was the last to adopt having a traditional view and looking to the past to make decisions. This category viewed innovations and change agents as suspect.

The rate of adoption in a system could be calculated by the numbers of members who adopt an innovation in a specific time frame. The plotting of the number of individuals adopting as a cumulative frequency over time resulted in an S-shaped curve. The adoptions were slow at first then increased as more and more adopted and finally began to level off. From Roger’s Diffusion of innovations Figure 9 graphically depicts the cumulative S-shaped adopter curve.
Figure 7-2. Adopter Categorization on the Basis of Innovativeness

The innovativeness dimension, as measured by the time at which an individual adopts an innovation or innovates, is continuous. The innovativeness variable is partitioned into five adopter categories by laying off standard deviations from the average time of adoption (z).

Figure 8. Adopter Categorization on the Basis of Innovativeness


Figure 7-1. The Number of New Adopters Each Year, and the Cumulative Number of Adopters, of Hybrid Seed Corn in Two Iowa Communities

Figure 9. The Number of New Adopters Each Year, and the Cumulative Number

Social System

Interestingly enough in an era of change and in a country as advanced as the United States, it was often the social structures that resist and slow down the diffusion of innovations (Rogers & Shoemaker, 1971). Rogers (1995) defined a social system as “a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal” (p. 23). Rogers further stated that the social system may be made up of individuals, groups, organizations, and/or subsystems. The social system’s structure and norms, opinion leaders and/or change agents’ roles, innovation decisions types, and innovations consequences, all influence the diffusion of an innovation within the system. Social system structure dealt with the pattern arrangement. An example of a formal example would be the hierarchy of positions such as in the government. Units in a system were not identical in their behavior. Structure could be formal or informal – who interacts with whom under what circumstances. Rogers identified this as the ‘communication structure.’

Rogers (1995) described system norms as established behavior patterns acceptable by members of the social system. The norms defined the range of acceptable behavior and set standards or guides for member behavior. Norms could be barriers to change or assist in the adoption of innovations. Behavior expectations of the group were affected by the instructional expectations of the teacher and/or leader and. The model could be traditional and/or cosmopolitan.

‘Opinion leadership’ was defined by Rogers (1995) as the “degree to which an individual is able to influence other individuals’ attitudes or overt behavior informally in a desired way with relative frequency” (p. 27). The informal nature of this type of leadership was governed by the individuals technical knowledge, social skill and access, and conformity to the system norms. It was not tied to a formal position or status in the system. Opinion leaders exemplified the system’s structure. Those systems that embraced change had opinion leaders who were innovative and
those systems that resisted change had opinion leaders who were not innovative; although a system could sometimes have two opinion leaders – one that embraced change and one that did not. Opinion leaders were members of the social system who may or may not be a change agent. Change agents were often professionals with technical skills or degrees and were therefore heterophilous from the clients or social system members. Change agents frequently employed change agent aides who were more homophilous with the potential adopters.

Rogers (1995) identified the types of decisions as follows: (a) optional innovation-decisions, (b) collective innovation-decisions, (c) authority innovation-decisions, and (d) contingent innovation-decisions. In the optional innovation-decisions the individual had the option to make the decision to adopt or reject. This might be influenced by the social system but it was still up to the individual. The collective innovation-decision was achieved by consensus of the system’s members. Generally, after the decision was made all the members had to abide by the consensus reached. The authority innovation-decisions was a result of a few members of the group who had the power, status, or the technical expertise making a decision to adopt. All members of the group then had to abide with that decision. The contingent innovation-decisions combined the individual decision to comply or not in relationship to and after a previously issued innovation decision to all the members of the system had been rendered.

The first three types frequently flowed on a continuum as follows: optional innovation-decisions leading to collective innovation-decisions leading to authority innovation-decisions. According to Rogers (1995) collective and authority innovation-decisions were more common in educational settings. Authority innovation-decisions resulted in the fastest rate of adoption but frequently had unique problems with implementation.

Finally, Rogers (1995) explained the consequences of innovations dividing them into categories: (a) desirable/undesirable; (b) direct/indirect; and (c) anticipated/unanticipated. Generally, a change agent wanted the diffusion innovation to be desirable, direct, and anticipated
but it was not always possible to predict all consequences especially the meaning that individuals and/or the system might attach to the innovation.

Diffusion Study in an Educational Setting

In 1985, Rogers, McManus, Peters, and Kim studied the diffusion of microcomputers in nine California high schools. This research used case study research to look at the decentralized diffusion of microcomputers.

Characteristics of the innovation, relative advantage, trialability, observability, compatibility, and complexity identified by Rogers in his early work, were studied. Findings show that relative advantage (the perception that the innovation is better than what is currently being used) seemed to offer more promise than actual performance. Trialability, observability, and compatibility (to a lesser degree) were innovation characteristics that fostered more rapid adoption. Complexity was identified as a disadvantage to adoption in this study.

Wide variations with respect to the degree of diffusion and adoption of microcomputers by faculty and administration were found. Computer technology in about half the schools was pressed on the school in the form of gifts and donations from the private sector as well as increased demand from parents and students. These schools reported that the computers were not viewed to be superior to the current means of instruction. When the computers were part of a plan for campus-wide implementation and improvement, diffusion of the microcomputers was more successful.

The characteristic contributing to the success of diffusion identified in this study for most of the schools in the study was the presence of an “innovative champion.” This person was most often a teacher who used the microcomputer successfully and who was an advocate to peers of the use of the microcomputer. The innovation champion typically was identified to be in the innovator adopter category.
Schools with the highest diffusion rates were those who had principals and other administrators who used microcomputers and advocated computer use to their teachers. The principals and administrators were identified as part of the early adopter category and shown to be representative of that category.

For teachers the availability of microcomputers and training has more influence on their decision to adopt than their attitude toward the innovation. Barriers to adoption included lack of funding, access, and adequate numbers of microcomputers. These barriers were identified in the study as infrastructure barriers.

The results of this study as previously described closely follow the tenets of Diffusion of Innovations Theory.

National Technology Studies and Reports

Some information about teachers and technology has been studied and identified in national studies. There are three important national studies that describe the status of teachers' use of technology from different perspectives and give a snapshot in time look at the progress toward the training of teachers to meet the challenge. First, this researcher will outline the two major reports from the Office of Technology Assessment (OTA), Power on! new tools for teaching and learning (1988) and Teachers & technology: Making the connection (1995) reports, and the National Center for Educational Statistics (NCES) report, Teaching in the 21st century: A report of teachers' use of technology (2000). All three reports are summarized in chart format and available as Appendix B.

The Office of Technology Assessment Reports

The Office of Technology Assessment (OTA) report, Power On! new tools for teaching and learning (1988), a widely read and often quoted report, was one of the initial reports that
gathered available data on technology assessment regarding the K12 sector and teacher training from a national perspective. This report was the result of a request by the House Committee on Education and Labor of the U.S. Congress to analyze and publish data collected by the Office of Technology Assessment. The OTA conducted a comprehensive analysis. The OTA reviewed literature, looked at survey data, conducted site visits at schools and research centers, interviewed publishers, vendors, researchers, policymakers, administrators, teachers and students, developed case studies, and reviewed cost-effectiveness issues.

Briefly, Power on! new tools for teaching and learning, the Office of Technology Assessment's report, (1988), identified that: (a) the vast majority of teachers currently teaching or planning to teach had little or no computer education or training (1/3 of K12 teachers had less than 10 hours of computer training); and (b) the focus of computer training centered on training about computers not teaching with computers.

The OTA published a follow up report in 1995, Teachers and technology: Making the connection. This report was more comprehensive, again elicited information from a variety of research sources, and gave an updated view of technology in our schools and in teacher education. The OTA reviewed literature; looked at survey data; conducted site visits at schools and research centers; interviewed publishers, vendors, researchers, policymakers, administrators, teachers and students; developed case studies; and reviewed cost-effectiveness issues.

In Teachers and technology: Making the connection (1995) the OTA identified that (a) video was the most common technology listed; (b) United States schools had 1 computer for every 9 students in 1995; (c) CD-ROM, video disc, modems, and LANS were on the increase; (d) technology still was not central to training teachers to use as an educational teaching tool; (e) hands-on technology was not part of the student teaching field experience placement process; (f) some teachers were using technology in a traditional teacher-centered model; (g) teachers who used technology were using it for everyday tasks and also to communicate to other
professionals in the field; and (b) there was some evidence of the appearance of model programs beginning to experiment with technology – Vanderbilt University’s Peabody College, University of Wyoming’s College of Education and Virginia’s Curry School of Education.

National Center for Educational Statistics Report

The National Center for Educational Statistics (NCES, 2000, September) using the Fast Response Survey system, NAEP data, and a survey as data sources compiled and released some interesting findings. The NCES report Teachers’ for the 21st century: A report on teachers’ use of technology (2000) stated that: (a) one half of the teachers with computers available to them used them for classroom instruction; (b) teachers used computers in the classroom rather than in a computer lab; (c) less experienced teachers reported that teacher education prepared them to use computers and the Internet; (d) teachers who reported feeling prepared were more likely to use technologies; (e) teachers had a perception that time and computer availability are a problem for the use of computers; (f) teachers reported that they needed time to practice with computers; and (g) a benefit was reported from learning technology from peers and sharing information with peers (Colby, Cradler, & Engel, 1997).

The three national studies on technology indicated that although clearly the K-12 sector had increased the number of computers and types of technologies available, the training of teachers had not kept pace. Some progress toward teacher training had been noted. The NCES report (2000), Teaching in the 21st century: A report on teachers’ use of technology, shows that less experienced teachers (recent graduates of preservice programs) feel more prepared to use computers and the Internet. The NCES report also points out that there is a need to connect training with the real-world. Moursund and Bielefeldt in the NCES report discovered from their 1999 research that half of the technology training occurs in methods and curriculum courses while the other half is part of stand alone courses. A number of exemplary programs were noted
and identified. However, the national studies reported that technology training, in general, appeared to still not be central to teacher training in SCDEs.

**Trends Analysis Research**

This section outlines a number of parallel trend studies including their application of content analysis to collect and analyze data.

Ely (1988, 1989, & 1996) studied trends and issues in the field of educational technology. He and his team using content analysis of selected literature, conference proceedings, and dissertations identified trends in the field of educational technology over the course of a year. In looking at the field as a whole he was able to identify broad-based general trends in a variety of areas within the emerging field of educational technology as well as specific topics relating to teachers.

After being criticized for not including the guidelines and methodology used in the first report published in ERIC, Ely included the guidelines and methodology in all future reports. The Ely studies (1988, 1989, 1996) used clear delineated guidelines for the content analysis and methodology. He also provided proof of reliability and validity checks for the coding and compiling of data. Coder training was provided to assure continuity and reliability.

In 1988 and in 1996, Ely identified two trends relating specifically to teachers and teaching. In the 1988 study Ely listed as "Trend #2 – Professional education of teachers in the use of educational technology is needed" (p. 5). Ely (1996) listed as "Trend #7 – There is a new insistence that teachers must become technologically literate" (p. 5). If technology is becoming more available and the demand to use it is increasing, one might wonder what has been going on in schools, colleges and departments of education (SCDEs) to prepare teachers in the area of educational technology training.
Coorough (1993) wrote her dissertation in partial fulfillment of a Ph.D. in higher education at the University of Idaho and was entitled, *An analysis of educational dissertations from 1950 to 1990*. She used a content analysis of dissertation abstracts to identify trends in topic, design, and statistical analysis. She used selected categories of education selected for their consistency over time and applied to the purposeful sample of dissertation abstracts. Intercoder and intracoder reliability were analyzed. Intercoder reliability was analyzed through the independent coding by the researcher and a committee member using 15 randomly selected dissertation abstracts. Intracoder reliability was analyzed by the coding and re-coding of 15 studies by the researcher. A 95% agreement was found for both. Areas of disagreement were discussed and clarified.

Some of Coorough's (1993) findings included increases in the number of Ph.D.'s earned by women. Her content analysis revealed that the dominant research design over time was descriptive with the use of a survey as the instrument of choice.

Duncan and Pryzwansky (1988) identified dissertations as an appropriate data source. They reasoned that dissertations reflect current emphasis and thinking in a research area and/or topic. Dissertations lead to publication by their authors that in turn produce journal articles and books allowing for the dissemination of knowledge. Duncan and Pryzwanski studied consultation research by reviewing dissertation research in the field. The reviewers delineated historical trends by reviewing and coding dissertation abstracts. They stated that although dissertation research generally makes up a narrow section of research and may in some cases be of questionable quality, it does represent and reflect the current emphases in research at the time.

The authors used Psychology Abstracts' electronic database and ERIC to identify studies between 1978-1985. This search yielded 77 dissertations that the authors noted was a decrease in the number of dissertations identified in comparison to a previously conducted study for the time period of 1970-1979. Dissertation abstracts were the main source of data. These study abstracts
were placed into categories by both authors. These results were compared and an inter-reliability score of .87 was calculated. All discrepancies were discussed and a final decision was rendered.

The Duncan and Pryzwansky (1988) study provided an analysis of historical trends in consultation research between 1978-1985. The authors noted that some topics remained the same over time and some new topics were added. They also identified that although the number of dissertations had decreased there was an increase in the complexity of variables studied and a refinement in the methodologies used.

Martin (1986) wrote this dissertation in partial fulfillment of a Ph.D., Graduate Department of Teacher Education from the University of Oregon and was entitled. A content analysis of issues and trends in secondary English curriculum & instruction as reflected in the changing focus of the English Journal, 1976-1985. She used the content analysis of journal articles for her study. Martin citing the work of previous researchers used the articles of the English Journal, a professional journal of the field of English, to gather trend data for her study. She identified five questions to answer from this analysis: (a) What topics were discussed? (b) Who had been doing the writing (trends in authorship, institutional affiliation, position, geographic location and sex)? (c) What have been the major instructional and curricular issues in secondary English education? (d) What positions were taken on the issues? (e) Were there differences in topics addressed by secondary education contributors and those of higher education contributors in the English Journal?

A sample issue was used for each year to develop a list of main categories and sub-categories when needed. These were reviewed and revised and clear category titles and explanations were developed. Bereelsohn (1952) and Holsti (1969) reason that validity is not a problem when clear categories and definitions are used for data collection.
Since the Martin study did not have multiple raters, a single-rater reliability analysis was conducted. This analysis using consistency over time resulted in a reliability coefficient of .97 which exceeded Berelson’s recommendation of .90.

Brammer (1994) wrote this dissertation in partial fulfillment of a Ph.D. degree from the Higher Education Department of the University of Miami at Coral Gables, Florida and was entitled Trends in the American community college 1979–1993: A content analysis of the community college ‘Journal’ (American Association of Community Colleges). He used a thematic content analysis of journal articles in the American Association of Community Colleges Journal for his study. Brammer’s study identified and categorized the issues and concerns of American community colleges. Thematic content analysis according to Holton (1973) and Merton (1975) expands the concept of content analysis to the use of whole text as units of measure. "Thema" as Holton described it identifies for each researcher the interests and work he/she will pursue and position he/she will take. Brammer (1994) used predetermined categories which were later collapsed into a smaller number of categories.

A pilot study using a sample of 20% (n = 150) of the total sample was used to analyze validity and reliability. The researcher had two independent coders who read, analyzed, and coded the content areas of the pilot sample. The independent raters were 88% in agreement with the original analysis. This was deemed appropriate and the categories were retained for the study.

All studies in this section looked to identify trends over time and provide a synthesis of these trends. It is clear that the use of dissertation abstracts indicating current research in the field is an appropriate source of data to identify trends and when viewed over time they can provide trend data. Also, it is clear that content analysis (a scientific and systematic approach to collecting and analyzing the data) is an appropriate methodology to collect and analyze trend data. All studies had methods to determine the validity and reliability of the coding instruments used.
Summary

Diffusion of Innovations Theory had a long history starting at the beginning of the 1900’s with the early work of Gabriel Tarde. Everett Rogers has devoted much of his professional life to diffusion of innovations research and study. He worked alone and with a number of colleagues to develop the theory to its present point. Rogers conducted numerous research studies on the diffusion of innovations and written and co-authored a number of books crossing various fields of study on diffusion. His most recent edition of the *Diffusion of Innovations* (1995) described in detail his Diffusion of Innovations Theory.

In 1985, Rogers, McManus, Peters, and Kim conducted a study of the diffusion of microcomputers in nine California high schools. The results closely followed the tenets of Rogers’ Diffusion of Innovations Theory. According to Rogers (1995) diffusion research in education makes up only 9% of the diffusion research tradition. This identified a gap in diffusion of innovations research in the field of education.

The use of Diffusion of Innovations Theory over the past four decades to study the diffusion of innovations in so many different fields demonstrates the applicability of this theory to the study of the diffusion of innovations wherever innovations may exist. It is, therefore, appropriate that Rogers’ Diffusion of Innovations provide the underpinnings of this study. This study uses the tenets of Rogers’ Diffusion of Innovations Theory to look at dissertation studies investigating technology education and/or training for preservice teachers. The components of Rogers’ Diffusion of Innovations Theory as identified by Rogers provided the framework to establish the coding schema for the content analysis data collection sheet (CADCS).

The national studies consistently reported that although some progress had been made over the last ten to twelve years, some teachers were still graduating and going out into the field not prepared and/or feeling not prepared to use technology as an educational tool to teach. While the number of computers and access to technology in the K12 and SCDE sectors have increased,
data suggested that the use and integration of those computers and that technology has not kept pace with teacher training. Some encouraging progress had been reported in the NCES - *Teaching in the 21st century: A report on teachers’ use of technology* (2000). This report identified that new teachers reported that they were more prepared to use technologies. Moursund and Diefeldt (1999) reported that half of technology training took place in methods and curriculum classes while the other half took place in stand alone courses. These findings suggested a shift from earlier reports.


These studies identified trends over time and provided a synthesis of those trends. It seemed clear then from this review that the use of dissertations indicating current research in the field appeared to be an appropriate source of data to identify trends and when viewed over time this data source could provide trend data. Also, it seemed clear that content analysis (a scientific and systematic approach to collecting and analyzing the data) appeared to be an appropriate methodology to collect and analyze trend data. All studies cited in this literature review included methods to determine the validity and reliability of the coding instruments used.
This study identified trends as reflected in original research in the form of dissertations on technology education and/or training of preservice teachers between 1980-1999 and used the tenets of Rogers’ Diffusion of Innovations Theory as a theoretical framework.

This study brought together dissertation studies that were for the most part singular events into a body of knowledge. Light and Pillemer (1984) supported the concept of bringing together previous studies. They reported that good reviews can identify trends that would not likely emerge in a single study and that research summaries can organize findings in unique and powerful ways. Light and Pillemer identified the need for synthesis of previous work to provide direction for future research.

This study identified the trends and directions taken by preservice teacher programs and departments in the area of technology education and/or training as reflected in dissertation research between 1980-1999. This important area of training and competency building research suggested was needed by teachers entering the field of teaching and beginning their careers as teachers in today’s educational environment. The results of this study are described and discussed in Chapters IV and V.
Chapter III

Methodology

This study gathered data from dissertation abstracts that were identified through a digital search using UMI ProQuest, a digital online database indexing of dissertations. This study used both quantitative and qualitative data. The methodology to be used is a content analysis of 119 dissertation abstracts that were identified through UMI ProQuest dissertations online. This chapter describes: (a) the systematic process by which the dissertation abstracts were identified, (b) the evaluation criteria for inclusion of dissertations in this study, (c) the development and testing of the Content Analysis Data Collection Sheet (CADCS) used to collect data from the dissertation abstracts for review in this study, and (d) the description of data analysis. Also, included in this chapter is a brief overview of content analysis as viewed by experts in the field.

Data Source

In an effort to get a better understanding of the size of the possible data pool for this study, this researcher divided the search into two phases. In phase one, this researcher performed an initial digital search using the UMI ProQuest Digital Dissertation electronic database. Using the following key word subject code "su(technology)" as the initial search word, this researcher identified 19,498 dissertations. From within those results a second search was conducted using the following key word subject code "su(education, teacher)". This subject category was applied to identify dissertations studying technology in teacher education since that was the focus of this study. This electronic search yielded 581 dissertations. When the years 1980 to 1999 were applied to the search parameters, one dissertation was removed yielding a total of 580 dissertations. This
umber was considered reasonable as an initial population sample and concluded phase one.

Table 2 depicts the results of this UMI ProQuest digital dissertation database search conducted in phase one. It should be noted that some studies may be categorized under educational media or media and as such may not be included in this study and by virtue of their exclusion in the selection process, the study may appear to, or may actually, underestimate the previous research work in this area, especially prior to 1980.

Table 2

Distribution of Identified UMI ProQuest Digital Dissertation – Search Results

<table>
<thead>
<tr>
<th>Year</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980-1983</td>
<td>0</td>
</tr>
<tr>
<td>1984</td>
<td>1</td>
</tr>
<tr>
<td>1985</td>
<td>0</td>
</tr>
<tr>
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<td>4</td>
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<td>1987</td>
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<td>1989</td>
<td>23</td>
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<td>1996</td>
<td>58</td>
</tr>
<tr>
<td>1997</td>
<td>78</td>
</tr>
</tbody>
</table>
1998  83
1999  50

Note: n = 580

Phase two consisted of a systematic review by this researcher of each of the 580 studies identified through the UMI Proquest electronic database in phase one. The title of each study was reviewed using the following criteria for inclusion and/or exclusion and using the following systematic procedures. If a clear determination could not be made using the title of the dissertation, the abstract for the dissertation was obtained and reviewed against the criteria as outlined in the following paragraphs. If the abstract did not give enough information when compared against the criteria, the document was included until a full copy of the dissertation could be viewed for comparison with the specifics of the inclusion/exclusion criteria.

The following paragraphs outline the specific criteria for the inclusion or exclusion of a dissertation in this study. This study analyzed technology education and/or training in pre-service teacher education in the United States between 1980 through 1999 as reflected in dissertation research.

Each of the 580 dissertations from the computer generated UMI ProQuest database listing, using the previously described procedure was systematically reviewed by this researcher using the following criteria for inclusion. Studies were included if they involved:

1. programs in the United States;
2. undergraduate preservice teacher education students, programs and/or faculty in colleges, schools and/or departments of education;
3. teacher preparation programs for elementary education; or secondary education;
4. student teaching and/or field experiences in teacher education undergraduate programs.
Since this was a review of scholarly work using original research in the form of dissertations, the following additional criteria were applied: EdD and PhD studies were included while MA and MS studies were excluded.

Studies covering technology education and preservice teacher education for science, mathematics, and/or language arts teachers were included. Since these disciplines represent large numbers of teachers in education, they were included as part of the core courses of study in private and public school curricular programs and settings, and were some of the disciplines to embrace and included technology usage early on, eliminating them might eliminate valuable data.

So, they were included.

Studies of technology education for the faculty in SCDEs were included since it is well documented that students frequently repeat the instructional methods used on them while they were students. Teachers were products of how they were taught and generally teach the way they were taught (Goodlad, 1994). Such studies then had clear implications for the training of preservice teachers in education technology.

This study did not look at specific products, brand name hardware or software, nor did it look at narrow and/or very specialized subject areas. In accordance with the previously stated guidelines, research studies covering the following topics were excluded from this study:

1. special education;
2. the study of a narrow discipline and/or subject area such as art, music, industrial arts education/technology, business, home economics, physical education/health, foreign languages, agriculture, nursing, and early childhood and pre-school programs;
3. Indian Nations studies;
4. IDEA funded programs;
5. specific company products such as Apple, Microsoft, or Macintosh and/or graphing calculators.
6. MA and MS studies.

Studies of in-service, professional development and graduate teacher training programs were excluded since this study looked at education technology and/or training in undergraduate preservice teacher education programs. When a study covers both preservice and in-service areas, a determination was made as to the inclusion of that study on a case-by-case basis. If the study’s emphasis was predominately on preservice technology education and/or training or the study produced strong implications for teacher education programs in the area of technology education, the study was included. Fourteen such co-mingled studies were identified. All fourteen were pulled and reviewed by the researcher according to the previously stated criteria. The studies were coded using the content analysis data collection sheet, and these results were used to make the decision for inclusion and/or exclusion. Ten dissertation abstracts were deemed appropriate and included while four were judged not suitable and were excluded. This resulted in a final dissertation abstract population of 119 to be reviewed for this study. This concluded phase two. Table 3 displays the results of the identified dissertations by year for review in this study.

For the purposes of this study, the researcher for this study reviewed 119 dissertation abstracts that were identified using a digital search of UMI ProQuest dissertations online database. The dissertations were systematically reviewed for inclusion or exclusion in this study as outlined in this sub-section.
Table 3

Distribution of Dissertation Abstracts By Year

<table>
<thead>
<tr>
<th>Year/s</th>
<th>Original # of Abstracts Identified</th>
<th>Number of Abstracts After Applying Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1980 - 1983</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>5</td>
</tr>
<tr>
<td>1991</td>
<td>41</td>
<td>5</td>
</tr>
<tr>
<td>1992</td>
<td>43</td>
<td>6</td>
</tr>
<tr>
<td>1993</td>
<td>43</td>
<td>11</td>
</tr>
<tr>
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<td>1998</td>
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<td>14</td>
</tr>
<tr>
<td>1999</td>
<td>50</td>
<td>9</td>
</tr>
<tr>
<td>Total (1980-1999)</td>
<td>580</td>
<td>119</td>
</tr>
</tbody>
</table>

Note. After criteria applied to $n = 580$ resulted in $n = 119$ dissertation abstracts for review in this study.
Content Analysis – General Background

Content analysis has a long history as a method of collecting data. It was used in the early 1600s by the church to review songs for non-religious content. Large studies reviewing newspapers and communication materials for political material and symbols, propaganda, and myths occurred during the first and second world wars. In 1980, Krippendorff in his book, *Content analysis: An introduction to its methodology*, identified content analysis as one of the most important research techniques in the social sciences and further stated that the field had evolved into a scientific method which was exhibiting signs of increased maturity. The writing center on Colorado State’s website [http://www.colostate.edu/Depts/WritingCenter/references/content/page2.html](http://www.colostate.edu/Depts/WritingCenter/references/content/page2.html) accessed 6/7/00), states that a shift from word counts to more sophisticated methods of analysis focusing or linguistic, affective, cognitive, social, cultural, and historical significance has occurred.

Content analysis can be used to collect both quantitative and qualitative data. First, we need to take a look at definitions of content analysis by leaders in the field. From this, we see some common threads as well as a listing of positives and negatives relating to content analysis work. Berelson (1952) described content analysis as a systematic and objective research method that quantifies and describes the content of communication. Berelson added that content analysis was a method to analyze “who said what to whom, how and with what effect” (p. 13).

Holsti (1969) stated that content analysis was a “basic research tool which may be useful in various disciplines and for many classes of research problems” (p. 3). He further delineated that there must be three requirements: (a) objectivity – one step follows explicit rules and procedures, (b) systematic – inclusion and exclusion of content or categories follow consistently applied rules, and (c) generality – findings have a theoretical relevance linking it to a comparison as dictated by the theory selected by the investigator.
Carney (1972) described content analysis as a technique which aims to improve the quality of the inferences we make when analyzing verbal, written, and sometimes pictorial communications (p. xxv). Carney postulated that content analysis was applicable to any discipline dealing with written material and was a technique that can be used and mastered by a non-expert.

Krippendorff (1980) defined content analysis as a "research technique for making replicable and valid inferences from data to their context" (p. 21). Krippendorff further explained that:

as a research technique, content analysis involves specialized procedures for processing scientific data. Like all research techniques, its purpose is to provide knowledge, new insights, a representation of "facts," and a practical guide to action. It is a tool. (p. 21)

Weber (1985) defined content analysis as "a research methodology that utilizes a set of procedures to make valid references from text" (p. 9). Weber also stated that the uses and/or purposes of content analysis were to reveal the focus of groups, individuals, institutions, and/or society and to describe trends in communication content.

All of these definitions of content analysis described it as a scientific research tool that requires specific and carefully delineated procedures applied consistently to data with the results being replicable and from which one can make inferences. All leaders also mention that content analysis was time consuming and labor intensive eased slightly in some ways by the use of computers to compile results.

The uses of content analysis as described by Weber (1985) were many and varied. Content analysis was defined as "central to social interaction and content analysis procedures, operate directly upon text or transcripts of human communication" (p. 10). Holsti (1969) in a discussion of the quantitative and qualitative aspect of content analysis stated that the qualitative generally links to the inferences and that the two (quantitative and qualitative) move along a continuum. Holsti suggested that one needs to move back and forth between the quantitative and
qualitative to gain insights into both. Berelson (1952) developed a listing of study areas that would be appropriate for the use of content analysis. They were identified as follows: (a) to reveal international differences in communication content, (b) to detect the existence of propaganda, (c) to identify the intentions, focus or communication trends of an individual, group or institution, (d) to describe attitudinal and behavioral responses to communications, and (e) to determine psychological or emotional state of persons and/or groups.

Content Analysis Data Collection Sheet Development

The Content Analysis Data Collection Sheet (CADCS) for this study was developed by this researcher and was divided into two sections. The two sections were organized to collect the data needed to answer the main research and the subsidiary research questions identified in this study. Section I of the Content Analysis Data Collection Sheet (CADCS) was organized to collect descriptive data and Section II was organized to collect data relating to the four elements of Rogers’ (1995) Diffusion of Innovations Theory. The four elements were: (a) innovation, (b) communication channels, (c) time, and (d) social system. The components of Diffusion of Innovations Theory as identified by Rogers provided the framework for the establishment of the coding schema for Section II of the CADCS. Rogers’ theory as outlined in his book, Diffusion of innovations (1995), covered in the literature review of this study and depicted as a diagram found as Appendix A, provided the organizational structure for Section II. The coding schema closely follows the tenets of Rogers’ theory. Beginning drafts of the CADCS were developed and refined by this researcher. Conferences and input from Dr. Finkelsstein resulted in further refinements of the CADCS. Dr. Finkelstein’s book, The American academic profession (1984), was very helpful to this researcher’s development of an understanding of how to systematically collect, code, and retrieve data for this study. This researcher subsequently established specific and mutually exclusive categories on the coding instrument.
Pilot testing procedures of the CADCS were conducted by this researcher using eight randomly selected abstracts. The random sample included two studies from each of the following clusters 1980-1984; 1985-1989; 1990-1994; and 1995-1999. Data were collected by applying the developed coding techniques as well as the directions for the CADCS to each of the studies in the random sample. This allowed for a check of the application of the coding protocols as well as to check for "goodness of fit" of the categories on the coding sheet. Some modifications were made as a result of that process. This researcher again met with her mentor for feedback. Feedback at that meeting helped to clarify the next steps. Definitions and the coding protocol were further developed and refined. The finalized version of the CADCS, directions to the coder, and the coding protocols are contained as Appendices C and D.

Reliability and Validity Testing

Reliability and validity testing were then applied by this researcher and a second coder. Holsti (1969) stated that reliability is the weaker requirement and that reliability is necessary for validity, but validity is not sufficient proof of reliability. According to Krippendorff (1980):

An instrument of science is expected to be reliable. More specifically when other researchers at different points in time and perhaps under different circumstances, apply the same technique to the same data, the results must be the same. This is the requirement of a content analysis to be replicable. (p. 21)

Krippendorff (1980) further categorized three types of reliability: (a) reproducibility, (b) stability, and (c) accuracy. Each was described as follows: (a) reproducibility or intercoder reliability – content classifications yield the same results when coded by more than one coder; (b) stability – the content classifications do not vary over time (the same results when the same data coded once again by the same coder); and (c) accuracy refers to the extent that content classification correspond to standards or norms. Accuracy was identified as the strongest
reliability and is the most difficult to do because it required standards or norms to be established on the content text. It was used mostly for human training programs. This researcher performed reproducibility and stability testing on the CADCS.

Recommended pilot sample sizes for reliability testing vary from 5% to 10% of the total content analysis population (Berelson, 1952; Carney, 1972; Holsti, 1969; Weber, 1985). This researcher used six abstracts or 5% of the total population of the study for reproducibility testing. The six dissertation abstracts were identified from the total population using a random numbers table produced by an excel software random numbers generator. Reproducibility or intercoder reliability testing was conducted by this researcher and Dr. Barbara Goldberg, professor and a Department Chair at DeVry. Areas of disagreement were discussed and clarified.

Rosengren (1981) described replicable coding as part of reliability calling it intersubjective testability and suggesting that it was a result of persons properly trained and equipped with the skills needed to be coders to make measurements yield similar results. This definition takes into account the removal of the individual person doing the coding and places the focus on the instrument used for coding. Holsti (1969) stated that to improve reliability one typically had to improve the coders, the categories, and/or both. Therefore, training of the coder and improving the coder or the categories or both, improves the reliability and strengthens the study results.

In accordance with Rosengren (1981) and Holsti (1969), the researcher conducted a training session and familiarization session with the second coder before the six abstracts were coded. This researcher using the coder direction and coding protocol sheets contained in Appendices C and D, conducted a training session before coding took place. The training session included a familiarization of Rogers' Theory of the Diffusion of Innovations, an explanation of terms and definitions needed to make coding decisions, and a description of the format and
organization of the CADCS. The training session took about 40 minutes and included a question and answer opportunity before coding began.

Then the abstracts were coded by each coder and the results were compared. The pilot testing of the six abstracts and the discussion that followed resulted in the modification of the order of two items on the Content Analysis Data Collection Sheet (one in Section I and one in Section II) as well as the clarification of several definitions on the coder direction sheet. This result was perceived by both coders to improve the quality and reproducibility reliability of the CADCS developed and tested for this study.

This researcher used nine abstracts or 7% of the population for stability testing. Stability testing by this researcher was conducted using nine randomly selected sample dissertation abstracts from the study population. The nine dissertation abstracts were identified from the total population using a random numbers table produced by an excel software random numbers generator. The identified dissertation abstracts were coded and then re-coded at two different points in time by this researcher. This researcher reviewed each category and/or area of disagreement to determine the cause. From this process the CADCS categories and the definitions were tightened and strengthened, and this coder gained more coding experience. This strengthened reliability of the instrument and was in line with Holsti (1969) who stated that to improve reliability one typically has to improve the coders, the categories and/or both.

Validity refers to how well the instrument measures what it is supposed to measure. Berelson (1952) stated the following relative to validity:

However, in most cases validity does not seem to be a major problem in content analysis.

Most of the time, careful definition of categories and judicious and alternative selection of indicators will take care of the matter. (p. 171)

Holsti (1969) identified content validity or face validity as the most frequent choice of content analysts and that it was appropriate and sufficient for descriptive data.
Content or face validity was evaluated by this researcher with feedback from her mentor during the initial stages and during reliability testing with the second coder. Section I collects data to answer who studied what, where, how, and with what results to answer subsidiary questions #1, #2, and #3. The descriptive nature of Section I was similar to other such sections in data collection instruments (Coorough, 1993; Martin, 1986). Section II followed the framework of Rogers’ Diffusion of Innovation Theory to answer questions #4 - #10. Section II followed the tenets of Rogers’ Diffusion of Innovations Theory as outlined and explained in the literature review as well as in diagram format as Appendix A - topic by topic and category by category. Therefore, the CADCS appears to be structured to measure what it was supposed to measure. The Content Analysis Data Collection Sheet (CADCS) is contained in this dissertation as Appendix C; Appendix D, of this dissertation, contains the coder direction, definition of terms, and the data collection sheet protocols. During pilot testing both coders were able to identify from the dissertation abstracts the descriptive categories in Section I as well as the elements relating to Rogers’ Theory of the Diffusion of Innovations and code the abstracts using the CADCS.

Data Analysis

Content analysis was used to collect the data using the Content Analysis Data Collection Sheet (CADCS). Section I of the CADCS collected descriptive data regarding the dissertation researchers, their gender and institutions, methodologies used, populations studied, innovations studied, and major findings. Section II of the CADCS collected data on the four elements of Rogers’ Diffusion of Innovation Theory. Data were then entered into an electronic database developed by this researcher and named ‘Dissertation.’ From that database, this researcher developed queries and produced reports to answer the research questions of this study. Since time was an important variable in this study, time was used frequently throughout the study as a category to sort by reporting in frequency distribution and bi-variate distribution tables.
Graph information was developed by exporting database information into an electronic excel spreadsheet program. From these two electronic resources, frequency tables, graphs, and tables were prepared as well as narrative reports of topics to be compared for further coding and analysis. Krathwohl (1998) identified and commented on the importance of using simple analysis applications to allow for easy understanding to the broad audience. The data were analyzed to answer the main research question and subsidiary questions that are discussed thoroughly in Chapter IV – Findings.

Delimitations of the Study

1. This study was limited to dissertation abstracts indexed in the electronic database of UMI ProQuest and identified through that online database service as described and outlined in the data source sub-section of this study.

2. Studies covering in-service and/or staff development were not included since this study proposes to look at preservice or undergraduate teacher education in the area of technology education and/or training.

3. For the purposes of this study dissertation abstracts were included or excluded as guided by the definitions delineated in the “Definition of Terms” section and outlined in the “Methodology” section of this study.

Summary

This chapter included a discussion of the process by which the dissertations were identified, the methodology used was identified, and the description of the data analysis procedures were delineated. The abstracts were identified using the UMI ProQuest dissertations online electronic database and then were subjected to carefully delineated procedures for inclusion or exclusion in this study. That process identified 199 dissertations to be reviewed in this study.
The content analysis data collection sheet (CADCS) was developed by this researcher. It was refined and underwent careful reliability and validity testing procedures. The CADCS was divided into two sections. Section I of the CADCS was organized to collect descriptive data answering subsidiary questions #1 – #3, and Section II was organized to collect data relating to Rogers’ Diffusion of Innovations Theory answering questions #4 - #10.

Data were collected using the CADCS and then placed into an electronic database developed by this researcher. The data were then analyzed through the use of queries and report requests of the electronic database. Graphs and frequency and bi-variate distribution tables were used to present the results of data collected for this study.

The main research question of this study was as follows. What have been the trends, 1980-1999, in technology education and/or training for preservice teachers as reflected in selected dissertations? This broader question was answered by analyzing data collected to answer the ten subsidiary questions.
CHAPTER IV

Findings

The purpose of this study was to identify the trends in technology education and/or training for preservice teacher education as reflected in dissertation research between 1980 and 1999. The study looked at technology education and/or training in preservice teacher education using Everett Rogers' Diffusion of Innovations Theory as a theoretical framework. Both quantitative and qualitative research methodologies were used to organize, describe, and delineate the characteristics of the populations studied, the methodologies used, and the elements of the diffusion of innovations theory with regard to technology education and/or training in preservice teacher education programs as reported in the selected dissertations. Having made the previous statement, it is prudent to also state that this study clearly leans more heavily on qualitative methodology and qualitative data. One hundred and nineteen (119) dissertation abstracts were identified for review in this study using the UMI ProQuest dissertations online electronic database. The systematic selection process and the evaluation criteria for inclusion of dissertations in this study are clearly delineated in the methodology chapter.

Content analysis was used to collect the data from the selected dissertations. The Content Analysis Data Collection Sheet (CADCS) for this study was developed by this researcher. The CADCS was divided into two sections. The two sections were organized to collect the data needed to answer the research and the subsidiary questions identified for this study. Section I of the CADCS was organized to collect descriptive data and Section II was organized to collect data relating to the four elements of Rogers' Diffusion of Innovations Theory – (a) innovation; (b)
communication channels; (c) time; and (d) social system. These four elements provided the framework for the establishment of the coding schema for Section II of the CADCS. Rogers’
Diffusion of Innovations Theory, as outlined in his book *Diffusion of innovations* (1955), was described in the literature review of this study and depicted in diagram format as Appendix A.
The CADCS was developed, refined, and underwent careful reliability and validity testing procedures that were outlined as part of the methodology chapter of this dissertation. Data were collected using the CADCS. Data were then entered into an electronic database developed by this researcher and named "Dissertation." From that database this researcher developed queries and produced reports to answer the research questions of this study. Some graphs were developed by exporting database information into an electronic excel spreadsheet program.

The research question and subsidiary questions of this study sought to identify trends in the technology education and/or training of preservice teachers. It is appropriate at this juncture to review the questions as originally posed.

The main research question of this study was as follows. What have been the trends, 1980-1999, in technology education and/or training in preservice teacher education as reflected in selected dissertations?

The subsidiary questions were:

1. What innovations were studied? By whom? By male/female researchers? Ed.D. or Ph.D. candidates? At what institutions?

2. How was the research in the selected sample conducted? Which research methodologies were used? Populations identified and/or sampled?

3. What were the major findings reported in the selected dissertation abstracts?

4. Which innovation characteristics were present?

5. What communication channels were identified?

6. How was the innovation-decision process utilized?
7. Which adopter categories were studied?
8. Which social systems were identified and studied?
9. How has the diffusion of innovations progressed through colleges and schools of education between 1980-1999?
10. How have these trends changed over time?

Descriptive Trend Findings

What Did the Dissertation Population Look Like?

The population for this study consisted of one hundred and nineteen (119) dissertation abstracts. These abstracts were identified for inclusion in this study as described in the methodology chapter of this dissertation. The dissertations represented by the dissertation abstracts covered a selection of innovations, consisted of researchers seeking Ed.D.’s and Ph.D.’s, represented research by both genders from a wide variety of institutions using a limited number of methodologies gathering data predominantly from the preservice teacher student population yielding a variety of results some positive and some indicating no effect or little change or improvement. Figure 10 displays in a frequency bar graph the number of dissertations in this sample and how they are spread out over time. Data suggested that the number of dissertations had increased over time (Figure 10). As displayed in the bar graph, there were 0 dissertations identified in this review for 1980-1984; 10 dissertations identified in this review for 1985-1989; 40 dissertations identified in this review for 1990-1994; and 69 dissertations identified for 1995-1999.
Who Were the Researchers?

Gender. The gender of the researchers represented by the 119 dissertation abstracts was identified using Section 1 item #4 and #5 of the CADCS. These items asked for the name of the researcher and from that a determination was made regarding gender. The initial coding resulted in twenty-three (23) names listed as unknown by this researcher. This list of names was reviewed by a number of foreign born nationals covering a wide variety of nationalities. This review process identified the gender for 22 of the 23 names. Because of the nature of some names, this process may be flawed but was believed to be as accurate as humanly possible given the previously stated parameters.

Table 4 displays the results of the compilation of the gender represented by the 119 researchers in this study. Overall, there were 65 females representing 54.6% of this reviewed population and 53 males who made up 44.5% of this reviewed population, and 1 unknown. (Percentages do not equal 100% due to rounding.) In 1985-1989, 11.3% of dissertations in this review were written by males and 6.2% were written by women. In 1990-1994, 35.8% of dissertations in this review were written by males and 30.8% were written by women. In 1995-1999, women wrote 63.1% of the dissertations in this review while men wrote 52.8% of the
dissertations. This data suggested a switch from male dominance from 1985-1994 to female dominance in 1995-1999.

**Degree Earned.** The degree earned by the researchers represented by the 119 dissertation abstracts were identified using Section I item #3 of the CADCS. This item coded by marking Ed.D. or Ph.D. elicited from the information on the dissertation abstract.

Table 4 displays the results of the compilation of the type of degree earned by the researchers represented in the 119 studies. Of the 119 researchers 41 (34.5%) earned an Ed.D. while 78 (65.5%) earned a Ph.D. This data suggested that a much higher number of Ph.D. candidates selected to investigate technology education and/or training of preservice teachers.

Table 4 displays degrees earned by gender and year. Data indicates that the number of women earning degrees increased steadily over the years and that women outpaced men in both Ed.D.s and Ph.D.s during 1994-1999. This was in line with the Coorough (1993) study where she noted that the number of females earning Ph.D.’s had increased.
Table 4

*Trends in Degrees Earned and Gender By Five Year Periods*

<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
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<td>N</td>
<td>N = 10</td>
<td>N = 40</td>
</tr>
<tr>
<td>EdD</td>
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<td>22.0</td>
</tr>
<tr>
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</tr>
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<td>20.0</td>
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<td>8.1</td>
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<tr>
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<td>30.8</td>
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<tr>
<td>Unknown</td>
<td>1</td>
<td>0.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Note: Percentages do not equal 100% due to rounding.

*Institutional Affiliation.* The institutions represented by the researchers contained in this study were identified using Section I item #6 of the CADCIS. The coder recorded the university name from the dissertation abstract. The complete listing of institutions and the frequency of dissertations between 1980 and 1999 on the topic of technology education and/or training for preservice teachers is displayed as Appendix E. There were 68 institutions represented in this review. Many institutions had only one dissertation in the area of technology education and/or training for preservice teachers. Iowa State University had the highest frequency
count at seven studies. The University of Virginia followed with six studies. Ohio State University, the University of Illinois at Urbana-Champaign, and the University of Northern Colorado followed with five studies each. This data suggested no clear dominance by any specific institution as reported in these findings for this study population.

How Was the Research Conducted?

Methodologies Used. The methodologies used by the researchers represented in the 119 dissertation abstracts were identified using Section 1 item 49 of the CADCS. The coder checked quantitative, qualitative, combination of quantitative/qualitative or ‘Do not know’ as indicated by reading the dissertation abstract. The determination was made through a review of the focus of the study, the declaration of the researcher and/or the analysis and/or results described in the study abstract. If no clear determination could be made, ‘Do not know’ was recorded. Figure 11 displays the results of the compilation of ‘methodology used’ in the dissertations reviewed in this study. Forty-seven researchers (39%) of the studies used a combination of quantitative and qualitative methodologies. ‘Quantitative’ alone represented 21 (18%) of studies reviewed. ‘Qualitative’ alone represented 27 (23%) of studies reviewed. Twenty-four studies (20%) were identified as ‘Do not know’.
Using information from the previous findings and cross tabulating ‘Methodology’ with ‘Degree’ and ‘Gender’ yielded the results displayed in Table 5. In 1985-1989, both Ed.D. and Ph.D. candidates most frequently used quantitative methodology. In 1990-1994, quantitative methodology remained the choice of Ed.D. candidates, but Ph.D. candidates switched to the use of a combination of quantitative and qualitative methodologies. The data appeared the same for both male and female Ph.D. candidates. In 1995-1999, data suggested that male and female Ph.D. candidates appeared to continue to favor the use of a combination of quantitative and qualitative methodologies while male and female Ed.D. candidates switched to an even split of the use of a combination of quantitative and qualitative methodologies and the use qualitative only methods.
<table>
<thead>
<tr>
<th>N</th>
<th>Qualitative</th>
<th>Quantitative</th>
<th>Comb</th>
<th>DKN</th>
<th>Qualitative</th>
<th>Quantitative</th>
<th>Comb</th>
<th>DKN</th>
</tr>
</thead>
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<td>1988 – 1989</td>
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<td></td>
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<td></td>
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<tr>
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<td>6.3</td>
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<td>0.0</td>
</tr>
<tr>
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<td>8.1</td>
<td>0.0</td>
<td>0.0</td>
<td>54</td>
<td>8.1</td>
<td>0.0</td>
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<tr>
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<td>0.0</td>
<td>0.0</td>
<td>119</td>
<td>8.8</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>All</td>
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<td>0.0</td>
<td>0.0</td>
<td>161</td>
<td>7.5</td>
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<td>0.0</td>
</tr>
<tr>
<td>1995 – 1999</td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>16</td>
<td>6.3</td>
<td>0.0</td>
<td>0.0</td>
<td>25</td>
<td>6.3</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Female</td>
<td>37</td>
<td>8.1</td>
<td>0.0</td>
<td>0.0</td>
<td>54</td>
<td>8.1</td>
<td>0.0</td>
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<tr>
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<tr>
<td>All</td>
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<td>7.5</td>
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<td>161</td>
<td>7.5</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Note: One study could not be identified for gender. Percentages do not equal 100 percent due to rounding.
Populations Studied. To identify the populations studied in the dissertations reviewed in this study, ‘Methodology’ findings were combined with information from the CADCS – Section I item #10 – ‘Unit of Analysis’. Table 6 displays the resulting data on population.

The individual preservice student population was the most frequent data source with 69 out of 119 (58%) of the studies. Faculty members were the next most frequent population to be studied with 20 out of 115 (16.8%) of the studies. By frequency data student teachers as a population to study appeared to be in third position with 18 out of 119 (15.1%) of the studies. By frequency data institutions, experts in the field, and state departments of education as a population grouping were last on the list with 7 studies identified making up 5.9% of the study population. Five studies in this review were categorized as ‘Do not know’ for population data source.

Consistently over time the preservice student population appeared as the most frequently studied group. In the early to mid 1990’s, two additional data sources appeared with frequency. These data sources were identified as faculty members and student teachers. Both of these data sources increased in frequency of use as a study population between 1990 and 1999. Data by institutional category made up a small percentage of the dissertations in this study and suggested no significant increase in number.

Table 7 combines research methodologies used and the populations studied. A review of this table identifies that the individual preservice student was the most frequently used population for study and was most often studied using a combination of quantitative and qualitative methodologies throughout the 1990s. The faculty population appeared to increase in frequency starting in the early-to-mid 1990s and continued to increase substantially in the mid-to-late 1990s. Faculty populations appeared to be most often studied using a combination of quantitative and qualitative methodologies. The student teacher population appeared to be most often studied using quantitative methods in the early-to-mid 1990s and then a combination of quantitative and
 qualitative methodologies in the mid-to-late 1990s. Seven studies from the 119 studies were identified as using institutions as the data source. These results suggest no clear dominance in methodology emerged for institutional populations.

To summarize, in this review sample preservice student and faculty populations were studied most frequently with a combination of quantitative and qualitative methodologies throughout the 1990s. Student teachers appeared to be studied most frequently using qualitative methodology throughout the 1990s. Data suggested that the study of the student teacher population shifted from quantitative methods in the early-to-mid 1990s to a combination of quantitative and qualitative in the mid-to-late 1990s. Data on the institutional population made up a very small number in this study and suggested no clear dominant methodology identified. It should be noted that 20 (16.8%) of the total 119 studies could not be identified as to methodology used.

Table 6
*Trends in Populations Studied By Five Year Periods*

<table>
<thead>
<tr>
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</tr>
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<tbody>
<tr>
<td>All</td>
<td>N</td>
<td>N = 10</td>
<td>N = 40</td>
</tr>
<tr>
<td>Preservice Student</td>
<td>119</td>
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<td>33.6</td>
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<tr>
<td>Faculty</td>
<td>69</td>
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<td>37.7</td>
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<tr>
<td>Student Teacher</td>
<td>20</td>
<td>5.0</td>
<td>25.0</td>
</tr>
<tr>
<td>Institutions, Experts,</td>
<td>18</td>
<td>5.6</td>
<td>27.8</td>
</tr>
<tr>
<td>And State Departments</td>
<td>7</td>
<td>28.6</td>
<td>14.3</td>
</tr>
<tr>
<td>Do not know</td>
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<td>60.0</td>
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</table>
Table 7
Trends In Research Methods By Five Year Periods

<table>
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<tr>
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<td>N = 10</td>
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</tr>
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<td>Combo</td>
</tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Student</td>
<td>69</td>
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<td>5.8</td>
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<tr>
<td>Faculty</td>
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<tr>
<td>Student Teacher</td>
<td>18</td>
<td>5.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Institutions,</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>State Departments</td>
<td>7</td>
<td>0.0</td>
<td>28.6</td>
</tr>
<tr>
<td>Do Not Know</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Five studies were not identifiable for population studied.
Researchers represented in this study collected data from the previously identified populations using a limited variety of methods. The data collection methods were obtained by using information from the CADCS - Section I item #1, #10, and #13, which had been entered into the ‘Dissertation’ database. Using a database ‘query’ this researcher generated an electronic database generated report that included the following fields of information – ‘Year’, ‘CaseID’, ‘Data Collection’, and ‘Unit Analysis.’ This data was used to describe how researchers gathered their data from previously identified study populations.

Table 8 displays the results of this review. During the mid-to-late 1980s (1985-1990), ten dissertations were reviewed. The dominant data collection method was experimental followed by collection of data by questionnaires/surveys.

In the early-to-mid 1990s (1990-1994), forty dissertations were reviewed. Data collection appeared to continue to be done via experimental but questionnaires/surveys data collection increased in frequency of use with interviews/observations for data collection next in frequency.

In the mid-to-late 1990s (1995-1999), sixty-nine dissertation abstracts were reviewed. Data suggested a shift occurred in which questionnaires/surveys become the dominant data collection method. Data suggested a decrease in the use of experimental during this time moving it to second position based on frequency data.
### Table 8

**Trends in Data Collection Method By Five Year Periods**

<table>
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<td>33.6</td>
<td>58.0</td>
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</tr>
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</tr>
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<td>Case Study</td>
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<td>9.0</td>
<td>18.2</td>
<td>72.7</td>
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</table>

**Summary.** Data suggested that the dominant population to be studied consistently over time appeared to be the preservice student. Faculty members and student teachers appeared to be two additional data sources added in the early-to-mid 1990’s. The use of these two additional data sources continued to increase through the mid-to-late 1990’s.

Data collection methods reflect a shift over time. Data suggested a shift of data collection methods from extensive use of experimental in the mid-to-late 1980’s and early-to-mid 1990’s to the use of questionnaires/surveys. Experimental appeared to decrease in number and dropped to second place in frequency of use in the mid-to-late 1990’s. Also, data on interviews/observations and case study usage appeared to increase slightly in the mid-to-late 1990’s.
In the 'Dissertation' database, the field of 'Innovation Type' delineates the specific innovations studied in this review. Innovations ranged from the general study of computers and computer related software and technologies such as word processing, spreadsheets, database, and presentational software to computer-based simulations and interactive video. Other technologies studied were e-mail, the Internet, a wireless ear device, distance education, media, and video.

To focus on the innovations studied, the researcher using data from the CADCS – Section I-Item #1 and Section II – Item A queried the 'Dissertation' database using the following fields to analyze what innovations were studied: (a) ‘Year’ and (b) ‘Innovation Type’. Table 9 displays the results.

During the mid-to-late '80s (1985-1989), data suggested that computers were the main innovation studied. The computer category included computer instruction about computers and/or how to use computers. Two studies looked at ‘interactive video simulations,’ one study at a ‘video disc,’ one study at ‘e-mail,’ and one study at a variety of types of ‘media.’

During the early-to-mid 1990s (1990-1994), data suggested that computers continued to be an innovation study focus. However, studies appeared to add the use of computers as educational tools to get across subject matter at the same time as the participant population was being exposed to the computer and the use of the computer. Data suggested that at this time the use of the broad-based term ‘technology’ as defined in the definition of terms sub-section of this study began to appear with frequency. Data suggested that ‘technology’ became an innovation classification to study, and that these studies talked about technology literacy and technology use. Also during this time, the innovation of electronic communication appeared to increase along with the study of interactive/videodisc innovations.
During the mid-to-late 1990s (1995-1999), computers, computer, computer literacy, instruction, and the use of the computer as an educational tool appeared to continue to be studied. Technology, as an innovation to study, continued to increase in frequency of study. Electronic communication as an innovation category increased in frequency of study especially during the mid-to-late 1990s. This group included e-mail, electronic writing/journaling, networking, and the use of the Internet for communication and included technology literacy, technology use, and instruction. The Interactive Grouping innovation category increased from the previous time frame including such things as interactive multi-media (CD-ROM), interactive environment (ClassNet), simulations, and the interactive video disc. Videotaping appeared in a few studies as an innovation category of study. Hypermedia data demonstrated an increase in frequency from the previous time frame. The data suggested that distance education appeared to be given little attention as an innovation by the researchers in this review. Data en singular studies covering more unique innovations such as an electronic textbook, interactive television, and a website were identified during this timeframe.

From this analysis, data suggested the following trends for 1984-1999. Data suggested that computers remained a focus for research but shifted from instruction about computers to computer literacy and the use of computers as an instructional tool for subject matter starting in the early-to-mid 1990s. Data on the broad-based term 'technology' as described in the definition of terms in this study began to appear with frequency in the early 1990s and appeared to increase as an innovation for study through the 1990s. In the mid-to-late 1990s, data on the study of electronic communication innovations appeared to increase substantially. Electronic communication looked at the innovation as a way to connect the preservice teacher student with subject matter content development as well as with each other both during course work and while student teaching.
During the 1990s data on videotape, although limited, appeared to be consistently used as a medium to present information to help students to evaluate material and/or information and to evaluate their student teaching experiences. Also throughout the 1990s, data on a number of singular studies appeared to focus on more specialized and unique innovations such as a wireless ear device, an electronic textbook, and a web site.

Table 9

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N)</td>
<td>(F)</td>
<td>(F)</td>
</tr>
<tr>
<td>All</td>
<td>119</td>
<td>8.4(10)</td>
<td>33.6(40)</td>
</tr>
<tr>
<td>Commuters</td>
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<td>49.8(24)</td>
</tr>
<tr>
<td>Interactive/videdisc</td>
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<td>23.0( 3)</td>
<td>23.0( 3)</td>
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<tr>
<td>Video tape</td>
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<td>50.0( 3)</td>
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<td>20.0( 4)</td>
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<td>Electronic Communication</td>
<td>20</td>
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<td>15.0( 3)</td>
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<tr>
<td>Distance Education</td>
<td>4</td>
<td>0.0( 0)</td>
<td>50.0( 2)</td>
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<tr>
<td>Media</td>
<td>1</td>
<td>100.0( 1)</td>
<td>0.0( 0)</td>
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</table>

Special Innovations –
(Hypermedia, Wireless 
Ear Device, Electronic 
Textbook, Website)

<table>
<thead>
<tr>
<th></th>
<th>(N)</th>
<th>(F)</th>
<th>(F)</th>
<th>(F)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
<td>0.0( 0)</td>
<td>14.3( 1)</td>
<td>15.7( 6)</td>
</tr>
</tbody>
</table>
Innovation Themes. The innovations studied were analyzed further for innovation themes. Using data from the CADCS Sections I - Item #1, #14, #15 and #16 and Section II – Item A, this researcher queried the 'Dissertation' database using the following fields: (a)'Year', (b)'Study Topic', (c)'Innovation Type', and (d)'Major Findings'. All fields of this database report were compared and coded into themes.

The review of this database-generated report by the researcher yielded five themes regarding innovations. The innovation themes described the innovations' intended use with regard to the study population. The themes were as follows - Computer Literacy/Computer Instruction, Instructional Tool, Technology as Instructional Tool, Technology – Communication, and Technology Literacy/Technology Instruction. Table 10 reported the data gathered for each of the 'Innovation Themes.' The data in this table suggested that computers as a topic for study continued over time and that the technology literacy/technology instruction began to appear with frequency in the early 1990s and increased as an innovation theme through 1999. It should be noted that the Instructional Tool category was developed to include those studies that were beyond computers and computer topics during 1984-1989 but were not yet referred to using the broad-based term 'technology.'

Data suggested that technology as an instructional tool, an innovation theme, increased tremendously during 1990-1999 and appeared to shift from instruction about technology to the use of technology for instruction. This was consistent with the findings of the National Center for Educational Statistics (2000, September) report.
Table 10
**Trends in Innovation Themes By Five Year Periods**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N = 10)</td>
<td>(N = 40)</td>
<td>(N = 69)</td>
</tr>
<tr>
<td>All</td>
<td>119</td>
<td>8.4(10)</td>
<td>23.6(40)</td>
</tr>
<tr>
<td>Computer Literacy/Computer Instruction</td>
<td>34</td>
<td>14.7(5)</td>
<td>44.1(15)</td>
</tr>
<tr>
<td>Instructional Tool</td>
<td>3</td>
<td>6.3(3)</td>
<td>0.0(0)</td>
</tr>
<tr>
<td>Technology Literacy/Technology Instruction</td>
<td>20</td>
<td>5.0(1)</td>
<td>25.0(5)</td>
</tr>
<tr>
<td>Technology as Instructional Tool</td>
<td>48</td>
<td>0.0(0)</td>
<td>35.4(17)</td>
</tr>
<tr>
<td>Technology – Communication</td>
<td>14</td>
<td>7.1(1)</td>
<td>21.4(3)</td>
</tr>
</tbody>
</table>

In conjunction with the themes, it was noted that 22 of the 119 research studies (18%) of the studies looked at and/or measured attitude and/or anxiety relating to computers and/or technology innovation use as a study variable. Of the twenty-two studies looking at attitudes and/or anxiety, sixteen involved the application of an experimental treatment to reduce anxiety. The remaining six studies looked at the measurement of anxiety as a status report or as a way to prescribe the level of future technology training needs.

**What Were the Major Findings of The Study Population?**

Coded data from the CADCS, Section I – Items #1, #2, and #15 were used to retrieve information on major findings. Using a report generated from the database ‘Dissertation’ and including fields ‘Year’, ‘Case ID’, ‘Major Findings’, this researcher reviewed the major findings of each study and coded these major findings. The major findings fit into 5 categories – No
Result, Positive Result, Mixed Results, Status Report, and/or Unknown. Table 1 displays the frequency results for each category.

The coding category of 'No result' was assigned to studies that reported no difference and/or no effect after the use and/or introduction of a technology innovation as reported in the study. The coding category of 'Positive result' was attached to studies that reported a positive outcome in relationship to the technology innovation being used and/or introduced to the participants. The coding category of 'Mixed results' was attached to studies indicating any combination of positive and/or no result in relationship to the technology innovation being used and/or introduced to the participants. The coding category of 'Status Report' was assigned to studies that looked at and/or tried to describe the state of technology education and/or training with regard to SCDEs, preservice students, and/or education faculty at a particular point in time. The coding category of 'Unknown' was assigned to any study that did not give their findings in the reviewed dissertation abstract.

Data suggested that approximately 50% of the studies reported positive results while 12.6% reported having no result. Approximately 7% had mixed results to report. Of the studies reviewed 26% looked at and reported on the status of technology education and/or training with regard to preservice students, faculty, and/or institutions at specific point in time. So, data suggested that positive results followed by status reports dominated the 'major findings' results and appeared to show no substantial changes and/or shifts over time.
Table 11

Trends in Major Findings Data By Five Year Periods

<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>N = 10</td>
<td>N = 40</td>
</tr>
<tr>
<td>All</td>
<td>119</td>
<td>8.4</td>
<td>33.6</td>
</tr>
<tr>
<td>Positive Result</td>
<td>60</td>
<td>8.3</td>
<td>30.0</td>
</tr>
<tr>
<td>No Result</td>
<td>15</td>
<td>6.7</td>
<td>40.0</td>
</tr>
<tr>
<td>Mixed Results</td>
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<td>55.6</td>
</tr>
<tr>
<td>Status Report</td>
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<td>9.7</td>
<td>32.3</td>
</tr>
<tr>
<td>Unknown</td>
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<td>25.0</td>
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</table>

Summary of Findings

Summarizing results from Section I of the CADCS contains information covering 'gender', 'degree earned', 'institution', 'methodology', 'data source', 'innovation studied', and 'major findings'. The study population for this review consisted of 119 dissertation abstracts. Data suggested that the number of dissertations on technology education and/or training for preservice teachers increased between 1980-1999. The identified dissertations broke down as follows: 1980-1984, no identified studies in this review; 1985-1989, 10 identified studies in this review; 1990-1994, 40 identified studies in this review; and 1995-1999, 69 identified studies in this review.

Approximately, 55% of the dissertations in this review were written by female researchers while 45% of the population consisted of male researchers. Overall, the data suggested that women outpaced men in both Ed.D. and Ph.D. degrees earned. There were almost
twice as many Ph.D.'s (66%) as there were Ed.D.'s (34%) earned by researchers in the population. Frequency data suggested that men dominated dissertation writing until the mid-to-late 1990s in this review sample when a shift occurred and women researchers appeared with more frequency. This increase in women earning Ph.D. degrees was in line with the findings of the Coorough (1993) study. Data suggested no clear dominance in the institutions represented in the review population.

Preservice student and faculty populations appeared to be studied most frequently with a combination of quantitative and qualitative methodologies while the student teacher population was studied using qualitative methodology. Data on institutional populations suggested no clearly dominant methodology identified. It should be noted that 24 (20%) of the total 119 studies could not be identified as to the methodology used.

Data collection and data source populations data suggested an interesting shift over time. The 'individual preservice student' data group appeared the most frequently used population for study consistently over time. In the 1990s faculty and student teacher populations appeared to be added as additional data sources used for study. In 1985-1989 the data collection most frequently used was experimental. In 1990-1994 the data collection focused once again on experimental but data suggested an increase in the use of questionnaires and surveys to gather data. In 1995-1999, data on data collection methods suggested a shifted from predominately experimental to questionnaires and surveys.

From the analysis of 'innovations studied' data, data suggested the following trends for 1980-1999. Computers remained as a focus for research over time but shifted from instruction about computers to computer literacy and the use of the computer as an instructional tool for subject matter instruction while exposing the participant population to the computers. Data suggested that the broad-based term 'technology' began to appear with more frequency and became an increasing focus for study in the 1990s. In the mid-to-late 1990s, researchers began to
study 'Electronic Communication' more frequently especially in the mid-to-late 1990s. Electronic
communication looked at the innovation as a way to connect the preservice teacher student with
subject matter content development as well as with each other both during course work and while
student teaching.

Data on videotape during the 1990s suggested consistent use as a means to present
information and help students to evaluate material and/or information as well as to evaluate
themselves during student teaching experiences. Distance education as an innovation received
little attention by the researchers in this review sample. Throughout the 1990s, a number of
singular studies appeared on very specialized and unique innovations such as a wireless ear
device, an electronic textbook, and a web site.

Data on the analysis of innovation themes also suggested a shift from computer
instruction to computer literacy and the use of computers as instructional tools. Data suggested
that 'Technology as an Instructional Tool' innovation theme increased tremendously in the 1990s
and suggested a shift from learning about computers and/or technology to the use of it for
instruction.

Data on major findings seemed to center predominately around positive results. 50% of
the 119 studies, as opposed to approximately 13% of the studies having 'no result'. Researchers
in this review reported that the innovation and/or innovative treatments were successful in a
variety of ways and/or to a level of significance. The other category of major findings clustered
around the status report. Twenty-six percent of the 119 studies centered their major findings on a
descriptive status reports' perspective or a snapshot in time view. Data collected from these status
reports generally included a description of the skills and the knowledge currently held and/or
used, a series of recommendations for improvement, and a list of the barriers to overcome for
more and/or better computer or technology use. So, data suggested positive results followed by
status reports dominated the 'major findings' results and appeared to remain stable over time.
Diffusion of Innovations Trend Findings

Which Diffusion Elements Were Present?

This study used Rogers’ Diffusion of Innovations Theory as a lens to view technology education and/or training for preservice teachers between 1980-1999 as reflected in dissertations. This section looked at those findings. Rogers stated in his book *Diffusion of innovations* (1995) that there were four elements to the Diffusion of Innovation Theory – innovation, communication channel, time, and social system. Further, Rogers explained that these elements helped diffusion and/or hindered the diffusion process according to indicators within each of these elements. The presence of the elements in the reviewed studies did not guarantee diffusion nor the lack of diffusion but allowed this researcher to look more closely at each element to form a better picture regarding diffusion as identified in the dissertations of this study.

The coded information from the CADCS – Section II, Items A, B1, C, and D, corresponding to the four elements of Rogers’ Diffusion of Innovation Theory in the database was used to extract information on the presence of the four elements in the review dissertation abstracts. All studies in this review included the element identified by Rogers as ‘innovation.’ Thus, information was analyzed for the fields of ‘communication’, ‘social system’ and ‘time.’ All four elements were identified in 104 studies out of 119 studies or 87.4 percent. Fourteen studies (11.8%) had three of the four elements. Presence of the elements did not necessarily indicate and/or guarantee diffusion. To get a better picture, one must examine more closely each of the four elements.

Which Innovation Characteristics Were Present?

As described under “What innovations were studied” in the descriptive findings sub-
section, the innovations were diverse and included computers as well as the broader grouping of technology.

Rogers identified that the characteristics of the innovation were important to the diffusion of the innovation. Innovation characteristics helped the potential adopters develop a positive or negative attitude or view of the innovation. Using information recorded in the 'Dissertation' database from the CADCS Section II, Item # A2, this researcher generated a report using the following fields – 'Relative Advantage,' 'Incentive,' 'Trialability,' 'Compatibility,' 'Complexity,' 'Observability,' and 'Re-invention.' Table 12 displays the individual results for the innovation characteristics.

An analysis of this data yielded the following general results. Overall, one hundred and eleven studies (93.3%) of the studies included innovation characteristics as part of the study while only eight studies did not include characteristics. Data suggested that the vast majority of studies included information on all characteristics except 'Re-invention.'

Relative advantage was most frequently identified as present (93% of the 119 studies). Trialability, compatibility, and observability were identified slightly less frequently than relative advantage between 88% and 91.5% of studies. Rogers stated that these innovation characteristics fostered diffusion and assisted in adoption of an innovation. Complexity, however, related to the difficulty level that the innovator assigned to the innovation. How difficult was it to understand and use? Complexity perceptions were negatively related to the rate of adoption. Complexity was less evident but still present in 120 studies (84%) of the studies reviewed. Rogers (1995) used "re-invention" as a term to describe the users' changes and modification to the innovation to allow the potential adopter to adopt it. Re-invention was not frequently identifiable in the reviewed studies. Only 10% of the studies identified 're-invention.'

Incentives were identified in 71% of the 119 studies reviewed. The most common incentive was a course grade or the desire to do well. A few studies mentioned specifically
NCATE standards and institutional incentives. Re-invention was not identified in large numbers in this study.

Table 12

Distribution of Innovation Characteristics, 1980-1999

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative Advantage</td>
<td>93.3</td>
<td>2.5</td>
</tr>
<tr>
<td>Incentive/s</td>
<td>71.4</td>
<td>22.7</td>
</tr>
<tr>
<td>Trialability</td>
<td>89.0</td>
<td>7.6</td>
</tr>
<tr>
<td>Compatibility</td>
<td>91.6</td>
<td>5.0</td>
</tr>
<tr>
<td>Complexity</td>
<td>84.0</td>
<td>4.2</td>
</tr>
<tr>
<td>Observability</td>
<td>88.2</td>
<td>8.4</td>
</tr>
<tr>
<td>Re-Invention</td>
<td>10.1</td>
<td>86.6</td>
</tr>
</tbody>
</table>

Note. \( n = 119 \) Eight studies could not be identified for innovation characteristics.

What Communication Channels Were Used?

Communication Channels, in general, were included in 104 out of the 119 (87.4\%) of studies reviewed while 15 studies (12.6\%) of studies did not include communication channels. Using information recorded in the ‘Dissertation’ database from the CADCS Section II, Item \# B1, this researcher generated a report using the following fields – ‘Mass media,’ ‘Interpersonal,’ ‘Homophilous setting,’ and ‘Heterophilous setting.’ Table 13 reports data on channels and settings.

No study was identified as using ‘Mass Media’ as a channel of communication in this review. Since computers and technology were not totally unheard of ideas, and people, in general,
have knowledge of their existence, it was not surprising that the mass media channel was not used.

The most popular channel was interpersonal. The interpersonal communication channel appeared in 101 studies of the 119 studies reviewed (84.9%) of the reviewed studies. Over time, the frequency data of the use of the interpersonal channel dominated. Rogers delineates 'Interpersonal' as a channel that assists in the diffusion of innovations.

The homophilous setting appeared most frequently throughout the time frame reviewed. The heterophilous setting appeared to increase over time but made up a very small percentage of the total population. Rogers reported that the homophilous setting is the optimal setting for the diffusion of innovations. To summarize, most studies in this review appeared to use the interpersonal communication channel as a homophilous setting which Rogers identified as one of the combinations that would promote the diffusion of innovations.

Delivery System. Delivery System was a category within the communication channels and was the system by which the innovation-message was delivered and discussed. Using information recorded in the 'Dissertation' database from the CADCS Section II, Item # B2, this researcher generated a report using the following fields - 'Formal stand alone course,' 'Integrated course,' 'Faculty models,' 'Field experience,' 'Partnership,' and 'Other.' Data contained in Table 13 suggested that in 1984-1989, formal-stand-alone courses and integrated courses were fairly evenly split in use. Faculty modeling was the next most used delivery system. In 1990-1994, data suggested that the formal-stand-alone courses and integrated courses still stayed evenly distributed with faculty modeling and field experience increasing in frequency of use as delivery systems. In 1995-1999, data suggested that the integrated course clearly dominated the time period and faculty modeling and field experience substantially increased in frequency of use. This data suggested support for the identification of a shift from learning about computers to learning with computers and technology as noted in the 'innovations studied' sub-
section of this dissertation and the National Center for Educational Statistics report (2000). This data appeared to suggest the use of multiple delivery systems to communicate innovations. No data in this review identified the use of a partnership as a delivery system.

Table 13

*Trends in Communication Channel, Setting, Delivery System By Five Year Periods*

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N N = 10 N = 40 N = 69</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel</td>
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<tr>
<td>All</td>
<td>119</td>
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<td>33.6</td>
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<td>Mass Media</td>
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<td>0.0</td>
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<tr>
<td>Interperson*4</td>
<td>101</td>
<td>8.9</td>
<td>31.7</td>
</tr>
<tr>
<td>Setting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>119</td>
<td>8.4</td>
<td>33.6</td>
</tr>
<tr>
<td>Homophilous</td>
<td>88</td>
<td>9.1</td>
<td>29.5</td>
</tr>
<tr>
<td>Heterophilous</td>
<td>16</td>
<td>6.3</td>
<td>43.8</td>
</tr>
<tr>
<td>Delivery System</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>119</td>
<td>8.4</td>
<td>33.6</td>
</tr>
<tr>
<td>Formal Stand Alone Course</td>
<td>38</td>
<td>13.2</td>
<td>42.1</td>
</tr>
<tr>
<td>Integrated Course</td>
<td>53</td>
<td>11.3</td>
<td>32.1</td>
</tr>
<tr>
<td>Faculty Models</td>
<td>25</td>
<td>12.0</td>
<td>24.0</td>
</tr>
<tr>
<td>Field Experience</td>
<td>18</td>
<td>5.6</td>
<td>27.8</td>
</tr>
<tr>
<td>Partnership</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

*Note. Some studies used two or more communication channels, settings, and/or delivery systems.*
How Was the Element Time Used?

Innovation-Decision Process. Time was part of 117 studies with only two studies not including the element 'time.' It is appropriate now to look at the specifics of this element.

Using information recorded in the 'Dissertation' database from the CACCS Section II, Item # C1, this researcher generated a report using the following fields – 'Innovative-Decision Process,' 'Knowledge,' 'Persuasion,' 'Decision,' 'Implementation,' 'Re-Invention,' and 'Confirmation.'

Table 14 displays the resulting data. The innovation-decision process contained five steps. Successful diffusion hinged on working successfully through the steps. One hundred and seventeen studies had the knowledge, persuasion, decision, and implementation steps present in the study. Data on re-invention which is part of the implementation step of the innovation-decision process appeared in only 19 of the 119 studies (16.8%) of studies. These studies most often described the status of computer use or technology in a setting where the data source population would have had the power and the opportunity to use, evaluate, and change the system. Data on confirmation appeared in 35 of the 119 studies (29.4%) of studies. Data in these studies most often reported on what was actually occurring and would, therefore, include the 'confirmation' step of the Innovative-Decision Process.
Table 14

*Trends In The Innovation-Decision Process By Five Year Periods*

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(N)</td>
<td>(N = 10)</td>
<td>(N = 40)</td>
</tr>
<tr>
<td>All</td>
<td>119</td>
<td>8.4</td>
<td>33.6</td>
</tr>
<tr>
<td>Knowledge</td>
<td>117</td>
<td>10.0</td>
<td>38.0</td>
</tr>
<tr>
<td>Persuasion</td>
<td>117</td>
<td>10.0</td>
<td>38.0</td>
</tr>
<tr>
<td>Decision</td>
<td>117</td>
<td>10.0</td>
<td>38.0</td>
</tr>
<tr>
<td>Implementation</td>
<td>117</td>
<td>10.0</td>
<td>38.0</td>
</tr>
<tr>
<td>Re-Invention</td>
<td>117</td>
<td>0.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Confirmation</td>
<td>117</td>
<td>3.0</td>
<td>10.0</td>
</tr>
<tr>
<td>De Not Know</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Adopter Categories.* Innovativeness of the participants was analyzed through a review of the coded adopter category information contained in the CADCS, Section II-Item #C3. Forty-three of the 119 studies (36.1%) of the studies were identified as having participants who were innovators (venturesome and interested in new ideas) and early adopters (respected by peers and resource for others). Twenty of the 119 studies (16.8%) of the studies appeared to have participants who were innovators only, and two of the 119 studies (1.7%) of studies had participants who were early adopters only. It should be noted that in this review 54 of the 119 studies (45.4%) of the studies had participants that were unable to be identified with regard to adopter category. Since almost half of the studies in this review had data that was not identifiable as to adopter category, this area of the element of time was not able to be successfully assessed from the dissertation abstracts and was not a useful category for diffusion theory in this review.
Which Social Systems Were Identified and Studied?

Social System. Social System was a part of every study in this population. It is appropriate now to look at the details of this element. Using information recorded in the 'Dissertation' database from the CADCS Section II, Item D #1, #2, #3, and #6, this researcher generated a report using the following fields - 'Setting,' 'Structure,' 'Norms,' and 'Decision type.' Overall, data indicated that 100 studies (84%) of the studies appeared to use a schools colleges and departments of Education (SCDE) setting while 19 studies (16%) the of studies used a combination of the SCDE and the K12 setting. This data suggested that these studies predominately looked at the higher education setting. This was to be expected since this study's focus was on technology training of preservice teachers who by definition were in undergraduate training programs at SCDEs. However, data suggested that the number of studies that were being done using 'student teachers' during student teaching increased substantially over time and appeared to demonstrate the beginnings of an interest in connecting the SCDE and the K12 school setting using innovations. Data on this connection appeared bringing together of the student teacher and the real-world teaching environment together.

Structure, Norms and Innovation-Decision Type. Social system included the setting and the behavior expectations of these settings as well as the decision to adopt and/or reject an innovation. The findings for structure, norm, and innovation-decision type are discussed next. Structure, norms, and innovation-decision type findings are included in Table 15. Structure was coded as formal or informal. Studies introducing the innovation as part of a course or program were coded formal and those studies introducing the innovation in a pilot program and/or students working with other students and/or faculty but not as part of a prescribed required program were coded informal. Data suggested that the formal structure appeared most frequently over time. However, data also suggested that the informal structure increased substantially over time. The
frequency of use of a combination of formal and informal structures increased in over time. So, from this analysis, innovations appeared most often introduced in the social system as part of a program and/or course but the informal structure was increasing to a close second place.

Norms as part of the social structure were analyzed and related to the delivery as a pattern of behavior that could be traditional or cosmopolitan. The traditional norm existed when the instructor provided the information as part of a course or program. The cosmopolitan norm existed when instruction was given in a non-traditional way either in methodology used and/or the type of training site used. This meant that the behavior patterns were more open. Findings are displayed in Table 15. Data on cosmopolitan appeared most frequently used and clearly dominated consistently over time. This suggested that innovations were most frequently presented in a non-traditional way either in methodology used and/or the type of training site used.

Diffusion may be encouraged and/or discouraged depending on the group norm expectations for behavior and/or the participants’ tolerance for new and different methods and/or sites.

Innovation-decision type provided the means by which a system and/or some of its members would decide to adopt and/or reject an innovation. This process, of course, influences the diffusion of innovations. Table 15 displays the findings for the innovation-decision types found in the reviewed studies. The authority innovation-decision type appeared most frequently in the reviewed population throughout the time frame. The ‘Optional’ innovation-decision type appeared as the second most frequently identified innovation-decision type in this review population. The authority innovation-decision as described by Rogers was an innovation-decision that resulted from a meeting of a few members of a group who have the power, status, and/or the technical expertise regarding the innovation to decide to adopt an innovation. Then, all group members would have to abide by their decision.

The result that the authority decision appeared most frequently used was not surprising since a large majority of the reviewed studies were experimental and/or treatment in nature where
the researcher decided on the technology to be used with the participants. While the participants had some say in whether or not to participate, many studies were part of a required program and/or course work and not really optional. Authority innovation-decisions as Rogers points out are not favorable to diffusion since individuals may resist this top-down directive.

Optional innovation-decisions occurred when the individual had the option to make the decision to adopt and/or reject. This decision could be influenced by the social setting but was still a decision that was up to each individual. In this review, the studies that used optional innovation-decisions appeared to be with participants who were the experts and/or leaders, institutional administrators, and/or faculty making the decisions regarding technology education and/or training for their preservice teacher programs. This population had the position, the ability, and the freedom to make such an optional decision to include the use of innovations.

Table 15
*Trends In Social System Structure, Norms, and Innovation-Decision Type By Five Year Periods*

<table>
<thead>
<tr>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(N)</td>
<td>(N = 10)</td>
<td>(N = 40)</td>
</tr>
<tr>
<td>All</td>
<td>119</td>
<td>8.4 (10)</td>
<td>33.6 (40)</td>
</tr>
<tr>
<td>Setting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCDE</td>
<td>100</td>
<td>9.0 (9)</td>
<td>36.0 (36)</td>
</tr>
<tr>
<td>SCDE-K-12</td>
<td>19</td>
<td>5.3 (1)</td>
<td>21.1 (4)</td>
</tr>
<tr>
<td>Structure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formal</td>
<td>58</td>
<td>19.3 (6)</td>
<td>32.8 (19)</td>
</tr>
<tr>
<td>Informal</td>
<td>36</td>
<td>11.1 (4)</td>
<td>30.6 (11)</td>
</tr>
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<td>Combination</td>
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</tr>
<tr>
<td>Norms</td>
<td>Unknown</td>
<td>9</td>
<td>0.0 ( 0)</td>
</tr>
<tr>
<td>---------------</td>
<td>---------</td>
<td>-----</td>
<td>----------</td>
</tr>
<tr>
<td>Traditional</td>
<td>23</td>
<td>13.0 ( 3)</td>
<td>30.4 ( 7)</td>
</tr>
<tr>
<td>Cosmopolitan</td>
<td>74</td>
<td>9.5 ( 7)</td>
<td>33.8 (25)</td>
</tr>
<tr>
<td>Combination</td>
<td>9</td>
<td>0.0 ( 0)</td>
<td>33.3 ( 3)</td>
</tr>
<tr>
<td>Unknown</td>
<td>17</td>
<td>0.0 ( 0)</td>
<td>29.4 ( 5)</td>
</tr>
<tr>
<td><strong>Innovation-Decision Type</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Authority</td>
<td>71</td>
<td>11.3 ( 8)</td>
<td>33.8 (24)</td>
</tr>
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<td>Collective</td>
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<td>0.0 ( 0)</td>
</tr>
<tr>
<td>Contingent</td>
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<td>0.0 ( 0)</td>
<td>100.0 ( 1)</td>
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<td>Optional</td>
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<td>36.7 (11)</td>
</tr>
<tr>
<td>Unknown</td>
<td>15</td>
<td>0.0 ( 0)</td>
<td>26.7 ( 4)</td>
</tr>
</tbody>
</table>

*Note. Percentages may not equal 100 due to rounding.*

_Opinion Leaders and Change Agents._ ‘Opinion Leader’ was not identified with any frequency in this review. Out of 119 studies, only 4 studies were identified as having an opinion leader. One study stated that the researcher was a participant and a researcher in the study. This identified that researcher as a peer of the participants, but it was not clear what status in the group the researcher held. One study identified that the researcher was an observer participant. This made that researcher a peer of the participant group, but again there was no way to identify the status of that person within the group or to see how the group regarded that person. The other two studies identified a leader but not much detail was given. This category was not readily identifiable and did not prove useful in this review.

_Change Agent in this study was most frequently identified as the researcher in the reviewed studies and for the most part was someone from outside the participant group. In 113 studies (95%) of the studies, the researcher was identified as outside the participant group._
Because of the nature of dissertation studies, the fact that the change agent was outside the group was not a surprising result. Rogers identifies change agents from outside the group of participants as a possible barrier and/or deterrent to diffusion.

Consequences and Meaning. Information on consequences and meaning was identified from the explicit mention in the text of the abstract and/or the implied consequences demonstrated by the results and/or outcomes of the study. Consequences and meaning identified from the outcomes of the innovation's use were entered on the CADCS and then entered in the 'Dissertation' database. The positive and/or negative nature of the consequences if identifiable were also coded and entered into the database. Using the 'Dissertation' database with information from the CADCS, Section I – Item #1, and Section II – Item #7, #8, and #9, this researcher generated a report. Table 16 displays the results. In this review approximately 48% of the 119 studies had 'intended and desirable' consequences. Intended/desirable consequences increased consistently over time. Approximately 19% of the 119 studies in this review had 'unintended and undesirable' results which increased over time but remained low in frequency of occurrence. Twenty-four percent of the 119 studies in this review had mixed consequences including a combination of some 'positive' and some 'no result' consequences and also showed an increase over time but remained low in frequency of occurrence. The high frequency of 'intended and desirable' can be seen as an indicator of participants' being able to attach positive meaning to their experiences with the innovation and/or learning from the interaction with the innovation.
Table 16

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
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<td>119</td>
<td>33.6</td>
<td>58.0</td>
<td></td>
</tr>
<tr>
<td>Intended/Desirable</td>
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<td>36.8</td>
<td>54.4</td>
</tr>
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<td>Unintended/Undesirable</td>
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<td>26.1</td>
<td>65.2</td>
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<td>34.5</td>
<td>62.1</td>
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<td>Do Not Know</td>
<td>10</td>
<td>20.0</td>
<td>30.0</td>
<td>50.0</td>
</tr>
</tbody>
</table>

Summary of Findings

Summarizing data from Section II of the CADCs on Rogers Diffusion of Innovation Theory includes information on the four elements - innovation, communication channel, time, and social system, as described by Rogers in his book *Diffusion of Innovations*, 1995. In general, the 104 of the 119 studies in this review or approximately 87% of the studies appeared to have had all four elements present to some extent. Fourteen studies or approximately 12% had three of the four elements present to some extent. The presence of the four elements of the diffusion of innovations is a study did not guarantee diffusion since social interactions of human subjects are complicated given the number of variables and the intricacies of human interaction but Rogers suggested that it assisted in diffusion. Rogers identified conditions that do advance and/or hinder diffusion, and it is important then to look at data for each area under each of the four elements.

The 'innovations studied' findings were reported with Section I findings since it seemed appropriate to include them with the 'major findings' and 'research themes' analyses. Rogers stated that innovation characteristics were important to diffusion. The findings for this review are reported here. Innovation characteristics were reported in 111 out of the 119 studies (93%) of the
reviewed studies. Relative advantage, trialability, compatibility, complexity, and observability were all identified with high percentages. Rogers stated that relative advantage, trialability, compatibility, and observability as innovation characteristics were important to foster diffusion. Incentives when studies identified them were most frequently intrinsic in nature such as grades, doing well, and wanting to learn; only a few studies mentioned specifically meeting accreditation, technology standards, and/or institutional incentives. Incentives, Rogers reported, assist in diffusion. Re-invention was most often not identified in the abstract information of this review population.

Mass media as a communication channel was not identified in any studies in this review population. This was not surprising since computers and technology were not unknown to the study populations. Over time the frequency of use data on 'interpersonal' channels suggested that it dominated as a communication channel. The 'homophilous setting' appeared to dominate over time. Thus, from this analysis, the reviewed studies appeared to communicate the innovation most frequently using an interpersonal channel in a homophilous setting. This finding was in line with what Rogers stated would promote diffusion - interpersonal communication in a homophilous setting.

Communication channels also included the delivery systems. It is now appropriate to look at the delivery system by which this message was delivered. This particular area also had social system connections. Data suggested that the formal stand-alone course and the integrated course as delivery systems appeared evenly split from 1985-1995. Then, in 1995-1999 the data suggested a shift to the use of the integrated course. This data suggests support for the shift from learning about computers and technology to learning with computers and technology as noted in the innovations studied section of this dissertation and National Center for Educational Statistics report, Teachers' tools for the 21st century: A report on teachers' use of technology (2000). Also, data on faculty modeling and field experience delivery systems appeared to increase between
1990-.999. This suggested the addition of multiple delivery systems for the communication of innovations. Rogers identified modeling and imitation at the center of the diffusion process. The integrated course, faculty modeling, and field experience data suggests support for that concept.

Time appeared as part of 117 of the 119 studies (98.3%) of the reviewed studies. With regard to the innovation-decision process, 117 of the 119 reviewed studies included the following innovation-decision steps - knowledge, persuasion, decision, and implementation. These steps Rogers pointed out are favorable to diffusion. Complexity, however, relates to the difficulty level that the innovator assigned to the innovation. How difficult was it to understand and use?

Complexity perceptions were negatively related to the rate of adoption. Complexity frequency data appeared less evident in the reviewed studies but still appeared in 100 studies (84%) of the studies reviewed. Rogers (1995) used “re-invention” as the term to describe the users' changes and modification to the innovation to allow the potential adopter to adopt it and placed it in the implementation step. Re-invention was not identified with any frequency in this review. Only 10% of the 119 reviewed studies identified ‘re-invention.’ Overall the data suggested that the majority of studies included the innovation-decision process. Rogers pointed out from his research that time was needed for the potential adopter to work through the steps of the innovation-decision process and that successful adoption hinged on working successfully through the steps.

Innovativeness was analyzed by looking at the adopter categories of the participants. Innovators made up approximately 17% of the 119 studies in this review and approximately 36% of the 119 studies in this review had a combination of innovators and early adopters. Rogers stated that innovators and early adopters could rely on study information and their own experience while others needed more concrete information, experience, and the help of peers. It should be noted that 54 (45.4%) of the 119 studies of the studies in this review had participants that were unable to be identified with regard to adopter category. Since almost half of the studies
in this review were not identifiable as to adopter category, this area of the element of time was not able to be successfully assessed from the dissertation abstracts and was considered not to be a useful category for diffusion theory in this review.

Social system, Rogers defined, "as a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal" (1995, p. 23). The social system included setting, structure, norms, innovation-decision types, opinion leaders/change agents, and consequences. Data indicated that the majority of studies or 84% of 119 studies in this review used the SCDE setting. Sixteen percent of 119 studies in this review used a combination of SCDE and K12 settings generally done using 'student teachers' during their student teaching and/or during teaching methods courses. Although the SCDE setting appeared most frequently over time, the data suggested that use of the SCDE and K12 setting increased between 1990-1999. This data suggested evidence of the beginnings of making a connection between the preservice teacher student and the K12 school setting. This connection could help to add to what Rogers identified as the important exposure to modeling and imitation of the innovation as a part of the integrated picture.

Social system structure describing who interacts with whom was important to the communication of an innovation. Data suggested that the formal structure dominated over time, but that the informal structure appeared with increasing frequency over the time frame. The cosmopolitan category for norms appeared most frequently over time. So from this analysis, data suggest that the innovations in this review were presented as part of a course and/or program using a non-traditional methodology and/or training site.

With regard to innovation-decision type, frequency data suggested that the authority innovation-decision type dominated throughout the time frame. This was probably due to the nature of the dissertation research in that a researcher decides to introduce an innovation and to study the effect of that introduction and/or treatment protocol. Although the students had the
opportunity to agree to participate or not, many of the studies were part of the required programs and/or courses. The optional innovation-decision type was the next most frequently used innovation-decision type to be identified in this review but did not come close to the authority innovation-decision type in frequency numbers. The studies identifying the optional innovation-decision type appeared generally as surveys of institutional leaders and/or faculty who had the position and/or freedom to make optional decisions. Rogers stated that collective and authority decisions were generally more popular in educational settings. Certainly the data in this study suggested support for the authority innovation-decision usage in this educational setting.

Opinion leaders were not identified with any frequency in this review seemingly not to be present in the majority of studies in this review. The researcher as change agent appeared most often to be from outside the group of participants 95% of the time. Rogers reported that change agents from outside the group of participants could be a possible barrier and/or deterrent to diffusion. Rogers stated that change agents from within the group have an advantage over change agents from outside the group. Rogers also stated that if the change agent was from outside the group, in order to be effective, they would need to be heterophilious with regard to the innovation but homophilious with regard to the participant group.

Data suggested that consequences appeared mostly intended and desirable and remained so over time. Forty-eight percent of the 119 reviewed studies identified consequences as intended and desirable. Rogers reported that diffusion, in general, was expected to have intended and desirable consequences. The data in this study suggested support for that concept. This result was not surprising since the majority of the 119 studies reported positive results in the sub-section of this dissertation labeled as 'major findings.' Mixed consequences and unintended/undesirable consequences increased over time but did not approach the frequency level of the intended/desirable consequences category.
The actual consequences, as Rogers defined them, were "changes that occurred to the individual or to the social system as a result of the adoption or rejection of an innovation" (1995, p. 30). Consequences were most often implied from the results and/or outcomes. Specifics about meaning were frequently not discernible from the study abstract. The majority of studies did not mention polling their participants for direct feedback. Those studies that did give polling results generally received positive feedback. With the positive results of the studies and the intended/desirable consequences of the studies, the data suggested that the participants in the majority of the reviewed studies were able to attach positive meaning to the innovation.

Summary

Descriptive Trend Findings

The combined findings from the CADCs described the dissertations reviewed and the trends between 1980-1999 as reflected by the 119 dissertations reviewed in this study. The number of studies on the topic of technology education and/or training as identified and as described in Chapter III of this dissertation increased substantially from 1980 to 1999. The increase breaks down as follows – 1980-1984, no studies; 1985-1989, 10 studies; 1990-1994, 40 studies; and 1995-1999, 69 studies. Overall, approximately 55% of dissertations were written by female researchers while 45% of dissertations were written by male researchers. Males appeared to dominate from 1985-1994 and then in 1995 to 1999 data suggested that a shift occurred and female researchers dominated. There appeared to be, in general, almost twice as many Ph.D. candidates (66%) as there were Ed.D. candidates (34%) in the reviewed population. Data suggested that women earned more Ph.D.'s than the men. Data suggested no clear dominance by institutional representation in the reviewed population.

Ph.D. researchers shifted to the use of a combination of quantitative and qualitative methodologies. Similar findings appeared for both males and females during this timeframe. In 1995-1999, data indicated that Ed.D. researchers appeared evenly split between the use of a combination of quantitative and qualitative methodologies and qualitative only methods. This finding appeared for both males and females. Data suggested that Ph.D. researchers continued to use a combination of quantitative and qualitative methodologies.

Data suggested that a shift occurred over time with regard for data collection method. Data collection appeared to shift focus from extensive use of experimental in the mid-to-late 1980s and early-to-mid 1990s to the use of questionnaires/surveys to collect data in the mid-to-late 1990s. Data on experimental use dropped in frequency and shifted to second place in the mid-to-late 1990s. Data suggested a increase in usage between 1990-1999 for interviews/observations and case studies.

Data suggested that the most frequent population to be studied consistently over time was the preservice student. Faculty members and student teachers appeared as two data sources added with frequency in the early-to-mid 1990s. Frequency data on these two additional data sources continued to increase throughout the mid-to-late 1990s.

Preservice student and faculty populations were most frequently studied using a combination of quantitative and qualitative methodologies. Data suggested that student teachers appeared to be studied using quantitative methods in the early-to-mid 1990s and then researchers appeared to shift to the use of a combination of quantitative and qualitative methodologies in the mid-to-late 1990s.

The innovation trends for 1980-1999 were identified from the analysis of ‘innovations studied’ data. Data suggested that computers as an innovation remained a focus throughout the time frame shifting from instruction about computers to computer literacy and use as an instructional tool. The broad-based term ‘technology’ as an innovation to study appeared and
became a more frequent focus for study in the 1990s. In the mid-to-late 1990s, data on the researchers in this review suggested an increasing interest in the study of the innovation electronic communication identifying it as a resource to connect the preservice teacher student with subject matter content as well as with each other both during course work and while student teaching. During the 1990s data on studies of videotape consistently explored it as a means to present information and help students to evaluate material and/or information and themselves during student teaching experiences. Data on distance education in this review received little attention by researchers. Throughout the 1990s, a number of singular studies on specialized and unique innovations such as a wireless ear device, an electronic textbook, and a website appeared.

Innovation themes suggested the shift from computer instruction to computer literacy and the use of computers as instructional tools. Innovation themes suggested support for the increase in appearance of the broad-based term ‘technology’ in the early-to-mid 1990s and an increase in the study of the innovation labeled ‘technology.’ The most frequently identified, innovation theme in this review appeared as ‘technology as an instructional tool’ throughout the 1990s. Electronic communication study data appeared to increase in the mid-to-late 1990s.

Data suggested that major findings clustered predominately around positive results, 50% of the 119 reviewed studies, as opposed to only approximately 13% of the 119 reviewed studies having no result. Data from the researchers in this review suggested that the innovation and/or innovative treatment appeared successful in a variety of ways and/or to a level of significance. Twenty-six percent of the studies centered their major findings around a descriptive status report perspective or a snapshot in time view. In this review the data from the status report grouping generally appeared to include a description of the skills and knowledge currently held and/or used, the recommendations for improvement, and the identification of the barriers to overcome.
Diffusion of Innovations Trend Findings

The data collected with regard to Rogers' Diffusion of Innovation Theory indicated that 87% of studies had all four elements of diffusion – innovation, communication channel, time and social system. With regard to the innovation as previously stated, data suggested that computers remained as an innovation to be studied throughout the time frame and that a shift occurred from instruction about computers to computer literacy and the use of computers as an instructional tool for subject matter. Data suggested that the broad-based term 'technology' began to appear with frequency and became a focus for study. The innovative electronic communication appeared more frequently in the 1990's and frequently used as a source to connect preservice teacher students to subject matter content and/or to each other during course work and/or student teaching. Data on video taping although not identified in this review with great frequency did appear in studies throughout the 1990's and appeared to be used for instruction and evaluation. Data from this review suggested that distance education received little attention by the researchers in this review. A number of unique innovations appearing as singular study events occurred between 1987-1999.

The characteristics of an innovation appeared in 93% of studies in this review. This covered the characteristics of relative advantage, trialability, compatibility, complexity, and observability. Rogers reported that relative advantage, trialability, compatibility, and observability were characteristics that foster diffusion and assisted in the adoption of an innovation. The most popular incentive to try and/or use the innovation was intrinsic in nature although a few studies mentioned NCATE standards and/or institutional standards. Re-invention was not reported in most studies. Complexity, however, related to the difficulty level that the innovator assigned to the innovation. How difficult was it to understand and use? Complexity perceptions were negatively related to the rate of adoption. Complexity was less evident but still present in 100 studies (84%) of the studies reviewed. Rogers (1995) used "re-invention" as a term
to describe the users' changes and modification to the innovation to allow the potential adopter to adopt it. Re-invention was frequently not evident in the reviewed studies. Only 10% of the studies identified 're-invention'.

Data suggested that no study in this review used mass media as a communication channel. This was not surprising since computers and technology were not totally unknown to the study populations. Rogers identified mass media as a form of communication to inform potential adopters of the existence of an innovation. Interpersonal channels were used most frequently and consistently over time as was the homophilous setting. Rogers reported that interpersonal communication done within a homophilous setting was important to the advancement of diffusion.

The formal stand-alone course and the integrated course in this review appeared most frequently used as the delivery systems for communication of an innovation between the mid-to-late 1980s and early-to-mid 1990s. In 1994-1999, the data suggested that a shift occurred and the integrated course moved into dominance. Faculty modeling and field experience began to appear with more frequency in the early-to-mid 1990s and increased the frequency of use through 1999 as communication channels. This data suggested support for the shift from learning about computers and technology to learning with computers and technology as identified in the innovations studied sub-section of this dissertation and in the NCES data in Teachers' tools for the 21st century: A report on teachers' use of technology (2000). Rogers identified modeling and imitation as central to the diffusion process. The integrated course, faculty modeling, and field experience support the Rogers' concept of modeling and imitation.

Time was a part of 117 out of the 119 studies reviewed. One aspect described by Rogers under the element of time looked at the innovation-decision process that has five steps. Successful diffusion hinges on working through the steps. One hundred and seventeen studies had the steps of knowledge, persuasion, decision, and implementation present in the study. Re-
invention which is a sub-category of the implementation step was only identified in 19 of the 119 studies (16.8%) of studies. These studies most often were describing the status of computers and/or technology where the data source population had the power and the opportunity to use, evaluate, and change the system. Confirmation was identified in 35 of the 119 studies (29.4%) of studies. These studies appeared most often and reported on what actually occurred and would, therefore, include the ‘confirmation’ step of the Innovative-Decision Process.

Adopter categories were reviewed to judge innovativeness. The participants were rated as to their innovativeness based on descriptions from the abstract text. Seventeen percent were judged to be innovators while 36% of studies were judged to have a combination of innovators and early adopters. Rogers stated that innovators and early adopters can rely on study information and their own experience while others need the help of information, experience and the help of their peers. It should be noted that 54 of the 119 studies (45.4%) of the studies had participants that were unable to be identified with regard to adopter category. Since almost half of the studies in this review were not identifiable as to adopter category, this area of the element of time was not able to be successfully assessed from the dissertation abstracts and was not a useful category for diffusion theory in this review.

The social system includes setting, structure, norms, innovation-decision types, opinion leaders/change agents, and consequences. Overall, 100 of the 119 reviewed studies were in a SCDE setting. However, the number of studies that were being done using ‘student teachers’ during student teaching increased substantially over time and suggested the beginnings of an interest in connecting the SCDE and the K12 school setting using innovations. This connection brings the student teacher and the real-world teaching environment together. This connection also helped to foster the importance of exposure to modeling and imitation of the innovation as a part of the integrated picture; this is in line with Rogers’ Theory.
Rogers identified that the social system structure describing who interacts with whom was important to the communication of an innovation. Forty-nine percent of the 119 studies used the introduction of innovations as part of a course or program. Formal structure appeared to be the dominant structure over time. The informal structure increased substantially over time. Data suggested that the use of a combination of formal and informal structures increased in frequency of use over time. So, from this analysis, data suggested that innovations appeared most often introduced in the social system as part of a program and/or course and that the informal structure began to increase and moving into second place.

Cosmopolitan norm category appeared most frequently used and dominated consistently over time. The cosmopolitan norm was recorded when instruction was given in a non-traditional way either in methodology used and/or the type of training site used. This suggested that the behavior patterns were more open. This suggested that innovations were most frequently presented in a non-traditional way either in methodology used and/or the type of training site used.

Innovation-decision type provided the means by which a system and/or some of its members would decide to adopt and/or reject an innovation. This process, of course, influences the diffusion of innovations. The authority innovation-decision type was most frequently identified in the reviewed population and clearly dominated throughout the time frame. The authority innovation-decision was described by Rogers as an innovation-decision that resulted when a few members of a group who have the power, status, and/or the technical expertise regarding the innovation got together and decided to adopt an innovation. Then, all group members would have to abide by their decision. The optional innovation-decision type was the second most frequently identified innovation-decision type in the reviewed population. Optional innovation-decisions occurred when the individual had the option to make the decision to adopt and/or reject. This decision could be influenced by the social setting but was still a decision that
was up to each individual. In this review, the studies that used optional innovation-decisions appeared to include those participants who were the experts and/or leaders, institutional administrators, and/or faculty making the decisions regarding technology education and/or training for themselves. This population had the position, the ability, and the freedom to make such an optional innovation-decision to include the use of an innovation. Rogers identified that ‘authority’ and ‘collective’ decisions were generally more popular in educational settings. Data from this study suggested support for the authority innovation-decision.

Opinion leaders were not identified with any frequency in this review and change agents appeared as being from outside the group 95% of the time. Rogers stated that change agents from outside the group of participants were a possible barrier and/or deterrent to the diffusion of an innovation. Change agents from within the group have an advantage over those from outside the group. To be effective Rogers’ stated that the change agents should be heterophilous with regard to the innovation and homophilous with regard to the participant group. The data suggested that although the change agents in this review appeared to be from outside the group, they possessed enough empathy with the participants to be successful as evidenced by the large percentage of positive study results reported by researchers in the reviewed studies. Rogers reported that an outside change agent could be successful if they had sufficient empathy with the participant group.

Data suggested that consequences appeared mostly intended and desirable at 48% of the 119 reviewed studies. Twenty-four percent experienced a combination of consequences and showed an increase over time but remained low in frequency of occurrence. Nineteen percent of reviewed studies experienced unintended/undesirable consequences such as not being able to use the innovation and/or learn by using it. The high frequency of ‘intended and desirable’ can be seen as an indicator of the ability of the participants to attach positive meaning to their experiences with the innovation and/or learning from the interaction with the innovation
Although the studies reviewed were not diffusion studies, they were found to contain the elements described by Rogers in his Diffusion of Innovations Theory. The studies in this review were able to be reviewed using Rogers’ Theory as a lens. Some elements were more comprehensively covered by the studies than other elements but a great deal of data was collected and placed in the electronic database for retrieval. The discussion in the next chapter will bring all information and data together to form the big picture.
CHAPTER V

Discussion, Conclusions, and Recommendations

The information age is upon us. The use of technology has become a part of our daily lives at home, at work, and at school. The curriculum and educational methodology in schools, colleges and departments of education (SCDEs) have been impacted by technology. The teaching profession must be trained to enter an educational setting that includes the use, application, and integration of technology. Research supports the inclusion of technology education in preservice teacher education (Johnson & Harlow, 1993; Munday, Windham, & Stampler, 1991; Oke, 1992; Summers, 1990; Vagle, 1994). Training teachers to integrate technology into the curriculum and to use it as a tool for learning is an important component of teacher education (Barker, 1993; Handler & Marshall, 1992; Munday, R., Windham, R. & Stampler, J., 1991; Newren, Waggner, & Kopp, 1991; Oke, 1992; Vagle, 1994; Weibe & Taylor, 1997). More and more teachers are expected to possess computer competencies and be able to use computer-related technologies (Carlson, 1991; Maddux, 1993; National Council for Accreditation of Teacher Education, 1997; Novak, & Berger, 1991; Office of Technology Assessment, 1988). The need to include technology training in teacher preparation was identified in both Power on! New tools for teaching and learning (1988) and Teachers and technology: Making the connection (1995) Office of Technology Assessment reports.

The National Center for Educational Statistics (2000) Fast Response Survey System has reported that some progress has been made with less experienced teachers in that they feel more prepared to use technology in the classroom than previously trained older teachers. However, the
Office of Technology Assessment (1995) reports that technology is still not central to the teacher preparation experience.

The purpose of this study was to look at original dissertation research on technology education in preservice teacher education from 1980 when the computer chip hit the market and made computers widely available to the public to 1999. Everett Rogers' Diffusion of Innovations Theory was used as the theoretical framework for this study. Rogers (1995) states that "diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system" (p. 5). This study identified the innovations, looked at the communication channels used over time, as well as identified the social system in which the diffusion took place. The resulting data has allowed a picture to emerge of how technology education of preservice teachers in schools, colleges, and departments of education (SCDEs) has changed over time.

The study used both quantitative and qualitative research methodologies to organize, describe, and delineate the characteristics of the population studied and the methodologies used as well as the use of Rogers’ theory as a lens to look at the elements of diffusion of innovations theory with regard to technology education in preservice teacher education programs as reported in the selected dissertations. Having made the previous statement, it is prudent to also state that this study clearly relies more heavily on qualitative methodology and qualitative data.

Using the UMI ProQuest dissertations online electronic database one hundred and nineteen (119) dissertation abstracts between 1980 and 1999 were identified and reviewed in this study. The systematic selection process and the evaluation criteria for inclusion of dissertations into this study were clearly delineated in the methodology chapter of this dissertation. It should be noted that some studies may be categorized under educational media or media and as such, these studies may not be included in this study and by virtue of their exclusion in the selection process,
the study may appear to, or may actually, underestimate the previous research work in this area, especially prior to 1980.

Content analysis was used to collect the data from the selected dissertations. The Content Analysis Data Collection Sheet (CADCs) for this study was developed by this researcher. The CADCs was organized to collect the data necessary to answer the main research question as well as the subsidiary questions identified for this study. Section I of the CADCs was organized to collect descriptive data and Section II was organized to collect data relating to the four elements of Rogers’ Diffusion of Innovations Theory: (a) innovation, (b) communication channels, (c) time, and (d) social system. These four elements provided the framework for the establishment of the coding schema for Section II of the CADCs. Rogers’ Diffusion of Innovations Theory as outlined in his book the *Diffusion of innovations* (1995), and covered in the literature review of this study and depicted in a diagram as Appendix A provided the organizational structure for Section II as well as the coding schema. The CADCs was developed, refined, and underwent careful reliability and validity testing procedures outlined in the methodology chapter of this dissertation.

Data were collected using the CADCs. Data were then entered into an electronic database developed by this researcher and named ‘Dissertations.’ From that database this researcher developed queries and produced reports to answer the research questions of this study. Some charts and/or graphs were developed by exporting database information into an electronic excel spreadsheet program. From these two electronic resources frequency tables, graphs/charts, and cross-tabular tables were prepared.
Discussion of Findings

Descriptive Trend Findings

The answers to the questions of this study included a wide variety of information. The main research question of this study was as follows: What have been the trends, 1980-1999, in technology education and/or training in preservice teacher education as reflected in selected dissertations? The answers to the main research question and to the subsidiary questions were developed by analyzing the collected data as described in Chapter IV of this dissertation. What innovations were studied? By whom? At what institutions? How did the researchers collect their data? What methodologies were used? What were their findings? What innovation characteristics were present? Did the reviewed dissertations use communication channels? Which ones? How was the innovation-decision process used? What adopter categories were studied? Which social systems were identified and studied? How has the diffusion of innovations progressed and did the trends change over time?

Data suggested that the number of studies between 1980-1999 increased over time. In 1980-1984 there were zero studies identified in this review. In 1985-1990 there were 10 studies identified in this review. In 1991-1994 there were 40 studies identified in this review and in 1995-1999 there were 69 studies identified in this review. The total population of 119 dissertations that were identified and used in this study consisted of 55% female researchers and 45% male researchers who were conducting research in partial fulfillment of the requirements for a Ph.D. (66%) and Ed.D. (34%). Data suggested that female researchers shifted from being a minority in research production to catching up to males in the early-to-mid 1990's and passing them in production in the mid-to-late 1990s. Data suggested no clear dominance regarding institutional affiliation of the researchers.

methods and that Ph.D. researchers shifted to the use of a combination of quantitative and qualitative methodologies. The data appeared the same for both males and females. In 1995-1999, data suggested that Ed.D. researchers were evenly divided between the use of a combination of quantitative and qualitative methodologies and qualitative only methods. Ph.D. researchers appeared to continue the use of a combination of quantitative and qualitative methodologies. The data appeared the same for both males and females.

Frequency data suggested that the dominant data collection focus was experimental during 1985-1994. Then, data suggested that a shift to the use predominantly of questionnaires/surveys in 1995-1999. Preservice teacher students appeared to dominate as the most frequently used data source throughout the time span with data suggesting a shift to an increase in the frequency of use of faculty and student teachers as additional data sources between 1990-1999. Data suggested that the most frequently studied population consistently over time appeared to be the preservice student. Faculty members and student teachers appeared as two data sources increasing in frequency in the early-to-mid 1990s. These two additional data sources continued to increase through the mid-to-late 1990s.

Preservice student and faculty populations appeared most frequently studied using a combination of quantitative and qualitative methodologies. Student teachers appeared most frequently studied using qualitative methods.

What innovations were studied over time? What trends were identified? Data suggested that computers remained as a focus for research and that they shifted from instruction about computers to computer literacy as well as the use of computers as an instructional tool for subject matter instruction. The broad-based term ‘technology’ as defined in the definition of terms of this study appeared and increased in frequency as a focus for study. In the mid-to-late 1990s, data suggested that researchers began to study electronic communication more frequently, identifying it as an innovation that could be used to connect the preservice teacher student with subject matter
content development, as well as with each other both during course work and while student teaching.

During the 1990s, data on videotape appeared consistently used as a means to present information and help students to evaluate material and/or information as well as themselves during student teaching experiences. Data on distance education suggested little attention by the researchers in this review. Throughout the 1990s, a number of singular studies appeared on very specialized and unique innovations such as a wireless ear device, an electronic textbook, and a web site.

Data on the analysis of innovation themes suggested a shift from computer instruction to computer literacy and the use of computers as an instructional tool. Innovation themes data appeared to suggest an increase in the study of the broad-based term ‘technology’ as defined in the definition of terms in this study. Technology included electronic and digital innovations beyond just computers and included such things as CD-ROM, Internet, laser discs, digital video, electronic media, ITv, etc. as well as technology literacy, technology instruction, and technology use. Thirty-four of the 119 studies (28.6%) of the studies were classified under computer themes while 82 studies (69%) of studies were classified under technology categories.

Data suggested that major findings centered predominately around two categories – positive results and status reports. Data on researchers who introduced an innovation suggested positive results throughout the 1990s. Researchers reported that the innovation and/or innovative treatments were successful in a variety of ways and/or to a level of significance. The status report findings that made up 26% of the 119 studies centered their major findings around a descriptive view or a snapshot in time. The frequency of these status report findings increased throughout the 1990s. In this review the data from the status reports appeared generally to include a description of the skills and the knowledge currently held and/or used, recommendations for improvement, and identification of the barriers to overcome.
Diffusion of Innovations Theory and Trend Findings

Rogers defined diffusion as the "process by which an innovation is communicated through certain channels over time among the members of a social system" (p. 5). Rogers further stated that diffusion was a special type of communication of a new idea having a degree of uncertainty attached to it. The data from this review of studies suggested the presence of the four elements as Rogers' describes them in the Diffusion of innovations (1995): (a) innovation, (b) communication channel, (c) time, and (d) social system. Eighty-seven percent of the 119 studies in this review had evidence of all four elements and almost 12% of the 119 studies in this review had evidence of three of the four elements. Rogers defined an innovation as "an idea, practice or object that is perceived as new by an individual or other unit of adoption" (p. 11). Newness was determined by the individual and was expressed according to Rogers in terms of knowledge, persuasion, or decision to adopt. All studies included in this review contained an innovation as defined by Rogers.

Rogers (1995) delineated the characteristics of an innovation that make it more or less attractive to adopters. There were five characteristics described by Rogers: (a) relative advantage, (b) compatibility, (c) complexity, (d) trialability, and (e) observability. Was this a better idea than the current idea (relative advantage)? Was there an incentive to try and/or adopt? Was it compatible with a potential adopter's values and/or way of doing things (compatibility)? Could a potential adopter try it out (trialability)? Could a potential adopter see the results (observability)? Rogers (1995) stated that relative advantage, compatibility, trialability, and observability promote diffusion. The data in this study suggested that a large percentage of the reviewed studies (88% to 93% of the reviewed study population) had relative advantage, trialability, compatibility, and observability. Complexity, however, related to the difficulty level that the innovator assigned to the innovation. How difficult was it to understand and use? Complexity perceptions were negatively related to the rate of adoption. Complexity was less evident but still present in 100
studies or 84% of the studies reviewed. Rogers (1995) used "re-invention" as a term to describe
the users' changes and modification to the innovation to allow the potential adopter to adopt it.
Data on re-invention most often was not identifiable from the abstracts in the reviewed studies.
Only 10% of the studies identified 're-invention.' Re-invention data was not mentioned most of
the time in the abstracts. Re-invention therefore may or may not have occurred during the study
but was not recorded and/or reported in the abstract probably because diffusion was not the focus
of the study.

Communication was defined by Rogers (1995) as the "process by which participants
create and share information with one another in order to reach a mutual understanding" (p. 17).
Rogers stated that the information exchange was at the heart of the diffusion process. The
communication channel was the means of getting messages from unit A (with some knowledge of
the innovation) to unit B (who had little or no knowledge) and the nature of the information
exchange relationship determined if the message got through or not. Diffusion was identified as a
social process. Communication channels included type of communication, group setting, and
delivery system. No study in this review appeared to use mass media as a communication
channel. This was not surprising since computers and technology were not totally unknown to the
study populations. Rogers identified mass media as a form of communication to inform potential
adopters of the existence of an innovation. Interpersonal channels were used most frequently and
consistently over time.

A homophilous setting was defined as a group of individuals consisting of individuals
who were alike or similar in beliefs, education, and social status. This group would transfer ideas
more easily to each other. Heterophilous setting was defined as a group of individuals that was
not alike or similar in beliefs, education, or social status. Data from this study suggested that the
interpersonal communication channel appeared most frequently and consistently over time.
Similar data appeared for the homophilous setting. This was in line with what Rogers stated fostered diffusion – interpersonal communication in a homophilous group setting.

Time appeared in 98% of studies reviewed. Rogers (1995) outlined the five steps of the innovation-decision process and said that these steps require time to complete. Knowledge, persuasion, decision, implementation and re-invention, and confirmation were delineated as the steps in the innovation-decision process. Knowledge occurred when someone found out about the innovation. Persuasion occurred when someone developed an attitude either positive or negative about an innovation. Decision occurred when someone participated or not in the activities involving the innovation. Implementation occurred when someone used the innovation and/or re-invented it for use. Confirmation occurred when someone re-affirmed the innovation. Twenty-nine percent of the 119 studies reviewed went on to include confirmation. Only 17% of the 119 studies included re-invention.

Adopter categories were used to review and judge innovativeness. The participants were rated as to their innovativeness based on descriptions from the abstract text. Seventeen percent of the 119 studies in this review were judged to have innovators while 36% of 119 studies reviewed were judged to have a combination of innovators and early adopters. Rogers stated that innovators and early adopters could rely on study information and their own experience while others need the help of information, experience and the help of their peers. It should be noted that 54 of the 119 studies (45.4%) of the studies could not that be identified with regard to adopter category. Since almost half of the studies in this review were not identifiable as to adopter category, this area of the element of time was not able to be successfully assessed from the dissertation abstracts and was deemed not useful as a category for diffusion theory review in this study.

Social system was defined by Rogers (1995) as “a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal” (p. 23). Rogers, further,
described that the social system may be made up of individuals, groups, organizations, and/or sub systems. The social system's setting, structure, norms, innovation-decision types, roles of opinion leaders and/or change agents, and consequences of the innovation, all influence the diffusion of an innovation within the system. Structure could be formal or informal - who interacts with whom under what circumstances. Rogers identified this as the 'communication structure.' Rogers further stated that modeling and imitation are important to diffusion. This suggested that the delivery of the innovation communication was important. Data suggested that the formal structure appeared as the dominant structure over time and that the informal structure increased over time.

Data also suggested that the use of a combination of formal and informal structures appeared to be increasing in frequency of use over time. So, from this analysis, data suggested that innovations appeared most often introduced in the social system as part of a program and/or course and that the informal structure appeared to be increasing.

Data on cosmopolitan category of norms appeared most frequently and dominated consistently over time. The cosmopolitan norm was recorded when instruction was given in a non-traditional way either in methodology used and/or the type of training site used. This suggested that the behavior patterns were more open. This also suggested that innovations appeared to be introduced most frequently in a non-traditional way either in methodology used and/or the type of training site used.

Authority and optional decisions appeared to be identified in this study as the most frequent innovation-decision types. Rogers reported that authority and collective innovation-decision types were the most frequently used innovation-decision types found in educational settings. Authority innovation-decisions, as Rogers pointed out, might not be favorable to diffusion since individuals might resist in a number of ways this top-down directive. This study suggested support for previous research findings by Rogers that the authority innovation-decision was used in these educational settings but the data of this study did not support the use of the
collective innovation-decision type in the educational settings of this review.

Optional innovation-decisions were described by Rogers to have taken place when the individual had the option to make the decision to adopt and/or reject. This type of decision could be influenced by the social setting but was still up to the individual. In this review, the studies that used optional innovation-decisions appeared to generally include those participants who were the leaders in the field, institutions, and/or the faculty. Those groups had the power and autonomy to decide to participant or not and/or to adopt or not.

Opinion leaders could not be identified with any frequency in this review. Out of 119 studies only 4 studies were identified as having an opinion leader. One study stated that the researcher was a participant and the researcher in that study. This made that researcher a peer of the participants but it was not clear what status in the group the researcher held. One study identified an observer participant. This made that researcher a peer of the participant group but again there was no way to identify the status of that person within the group or to see how the group regarded this individual. The other two studies identified a leader but not much detail was given. This category was not readily identifiable and did not prove useful in this review.

The change agents in this review were from outside the group 95% of the time. It was unknown as to whether the change agents were homophilous with the group or heterophilous. Rogers remarked that often the group was homophilous but the change agent was heterophilous. Rogers reported that an excellent combination for favorable diffusion would be a group that was heterophilous regarding the innovation and homophilous regarding all other variables. For example, a member of the group who had familiarity with the innovation could conduct the information exchange. Someone outside the group but with a great deal of empathy also could have the ability to project more effective communication; thereby, become more homophilous with the group. Rogers identified change agents from outside the group of participants as a possible barrier and/or deterrent to diffusion.
Data on consequences in this review appeared mostly as intended and desirable at 48% of the 119 studies reviewed. This was in line with Rogers definition of consequences and with the overall aim of the diffusion of the innovation. Data on meaning was frequently not identifiable but sometimes could be inferred from the results of the study. Since 50% of the studies reported positive results, this data would seem to suggest that participants appeared to be able to attach positive meaning to the innovation.

Summary of Identified Trends

Figure 12 contains a chart summarizing the trends identified in this study through the review of the identified dissertation population.

<table>
<thead>
<tr>
<th>Category</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Number of female researchers increased shifting from male dominance in 1985-1989 to female dominance in 1995-1999.</td>
</tr>
<tr>
<td>Degrees Earned</td>
<td>More researchers studying this topic earned a Ph.D.</td>
</tr>
<tr>
<td>Methodology Used by Ed.D. and Ph.D. researchers</td>
<td>In 1984-1989, Ed.D. and Ph.D. candidates preferred to use quantitative methods. Then, Ed.D. candidates continued to use quantitative methods and Ph.D. candidates shifted to the use of a combination of quantitative and qualitative methods. However, through the rest of the 1990s, Ed.D. candidates shifted to the use of qualitative and quantitative research methods.</td>
</tr>
<tr>
<td>Category</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Populations Studies</td>
<td>Preservice students were the most often studied throughout time frame. Student teacher and faculty were additional data sources added in the 1990s.</td>
</tr>
<tr>
<td>Innovations</td>
<td>Computers consistently studied over time. Technology as a broader term for innovation study appeared in early to mid 1990s and continued to grow in interest throughout the 1990s.</td>
</tr>
<tr>
<td>Innovation Themes</td>
<td>Most popular theme was “Technology as an instructional tool” throughout the 1990s.</td>
</tr>
<tr>
<td>Major Findings</td>
<td>Split predominantly into two categories – positive results and status reports. Positive results increased dramatically in the 1990s.</td>
</tr>
<tr>
<td>Communication Channels</td>
<td>Most frequently used interpersonal channel in a homophilous setting. Delivery system shifted over time from an even split between stand-alone courses and an integrated course to the use of predominantly an integrated course. Faculty modeling and field experience increased in use throughout the 1990s.</td>
</tr>
<tr>
<td>Time</td>
<td>Innovative-decision process was included consistently over time.</td>
</tr>
<tr>
<td>Social System</td>
<td>SCDES most often used as setting but SCDE-K-12 setting use saw a substantial increase in the 1990s. Innovation introduced as part of a formal course and/or program but most often in a new and/or different way. The Innovation-decision type most frequently used was authority decision. Change agents were identified from outside the participant group consistently throughout the time span.</td>
</tr>
</tbody>
</table>

*Figure 12. Identified Trends Chart*
Conclusions

From the review of this literature, data suggested that innovations have diffused in a variety of ways between 1980-1999. Data suggested that from the increase in the number of studies on technology education and/or training in preservice teacher education, the pace appears to be increasing. A wide variety of innovations appeared in studies from sixty-eight different institutions. Data suggested that innovations appeared to shift from learning about computers and/or technology to learning with computers and/or technology. Data suggested that the broad-based term ‘technology’ began to appear with frequency and became a focus for study. Although the preservice teacher student appeared most frequently and consistently as a data source between 1980-1999, an increase in the number of faculty and student teachers appearing as data sources was noted. SCDEs appeared most often used as the setting but a substantial increase in data on the use of the SCDE-K12 setting suggested the beginnings of a connection to the K12 sector.

Data suggested that innovations continue to diffuse. Data suggested that the populations studied and the setting in which these innovations appeared to be introduced had expanded. Because of the changing nature of technology, the variety of innovations will continue to expand with the availability of new technologies. The review of dissertations in this study provided a reflection of some of the areas being explored by SCDEs programs for preservice teachers allowing this picture of diffusion between 1980-1999 as reflected in dissertation research to emerge.

The results of this study have contributed to the body of knowledge on trends in preservice teacher technology education and/or training as reflected in dissertation research. Some of the findings of this study are similar to the findings reported in the National Center for Educational Statistics report, Teachers’ tools for the 21st century: A report on teachers’ use of technology (2000).

The findings of this study provided a look at the use of Rogers’ Diffusion of Innovation Theory in an educational setting. According to Rogers (1995), diffusion research in education
makes up only 9% of the diffusion research traditions. Thus, Rogers identified a gap in diffusion research in educational settings. Rogers in his book, *Diffusion of innovations* (1995) identified diffusion research in education as centering on teaching/learning innovations such as kindergartens, modern math, programmed instruction, and team teaching. This study brought together a variety of technology innovations studied in the SCDE and SCDE-K12 sectors through dissertation research conducted between 1980-1999. This study focused on research in preservice teacher preparation education. This preservice teacher education clearly has a direct link to the preparation of future teachers as well as an impact on the classrooms of the future.

Data suggested that Rogers’ *Diffusion of Innovations Theory* appeared to be an appropriate lens to use in this study to look at the technology education and/or training innovations as studied in SCDEs and SCDE-K12 settings. Evidence suggested that although the studies were not diffusion studies, Rogers four elements of the Diffusion of Innovation Theory appeared to be present in the reviewed studies and could be used as a framework to view the reviewed studies to better understand innovation diffusion.

**Implications**

**Preservice Teacher Education**

The findings of this study have implications for preservice teacher education. Data suggested that the introduction of technology into teacher education although slow was increasing. Although the majority of studies reported positive results, we do not know whether or not the innovations had been continued beyond the study time frame. Did these innovations go on to be used by the participants and/or by the SCDEs after the study? The reviewed studies were individual studies from 68 different SCDEs around the United States. This review brought them together combining information from all of them into one document. The concept of bringing
together the findings of a number of studies to add to the body of knowledge was supported by Light and Pillemer (1984).

Data suggested that the diffusion elements appeared as being present in the studies reviewed. Rogers identified a number of categories within those elements that foster and/or advance the diffusion of innovations. Rogers identified characteristics that help potential adopters of innovations to decide to adopt. Rogers identified innovation characteristics, communication channels and settings, an innovation-decision process, and a social system that promote the diffusion of an innovation. Many of these were identified and shown to be present in this review.

The researchers of the studies in this review reported mostly positive results. This data suggested then that it would be a good idea to include what was known about diffusion of innovation theory into any plan for the introduction of new technology into teacher education. Harris (1997, April) also supported incorporation of the use of the diffusion of innovation theory into planning for the introduction of new technology into teacher training. The data from this study appeared to suggest a shift from learning about computers and/or technology to learning with computers and technology. This was in line with what works in diffusion theory. Also, the data in this study appeared to identify an increase in the use of faculty modeling and field experience connections to introduce an innovation resulting in a positive result. This information has implications for the training of faculty and for changes in the field experience for preservice teacher education programs.

Research

As I read the abstracts, I was sometimes frustrated by the lack of information. The abstract is an opportunity for the public at large, policymakers, and administrators with limited time to get an overview of new information in a field of study. This information can be used to help them to formulate future policy decisions. While reading, I found that many categories could
not be identified and I had to record ‘Do not know.’ A number of studies could not be identified for methodology used, population studied, data collection methods, and/or findings. Conclusions and/or suggestions for further study were often not available in the abstract. The abstract is one way for a researcher to disseminate information regarding preservice technology training advances. So, it would be prudent to prepare the abstract with the information details that will help administrators and policymakers get the information that they need or give them enough information to let them know how a copy of the full dissertation might help them gain more information.

Recommendations for Further Study

From this study some suggestions for further study emerged. Attitudes and anxiety variables were mentioned in a number of studies. This barrier to the adoption and use of an innovation bears further study. A meta-analysis of the studies identified in this dissertation dealing with some aspect of attitude and/or anxiety may give insights into the problem. These insights could then be used when introducing future innovations.

A second suggestion for further study would be in the area of barriers to innovation adoption and diffusion. A number of studies talked about barriers but not solutions. An in-depth study of barriers in the educational setting as well as solutions when applied would give information that could give data for use in other innovation introductions. If the barriers are a focus and perhaps prioritized, then possible solutions may be able to be formulated.

A third suggestion for further study would revolve around the use of the elements of diffusion as a framework to develop a plan to implement an innovation in an educational setting. Rogers identified a number of categories under each of the four elements of the Diffusion of Innovation Theory that advanced diffusion as well as the categories that did not advance diffusion. Using the categories that advance diffusion to organize an introduction of an
innovation, this would seem to suggest that this would help to advance that innovation. Research
could then be conducted on the effect of planning with diffusion of innovations theory as a
framework to introduce an innovation.

Suggestions for Practice and Policy

From this review, data suggested that the introduction of technology training was
increasing. Fifty percent of the studies in this review reported positive results. The successes as
outlined in this review could be used by preservice programs to introduce the next generation of
technology innovations and keep current. Using this information, policy makers and practitioners
could develop plans to implement technology training into the preservice teacher education
program.

Rogers identified the four elements of the Diffusion of Innovation as innovation,
communication channels, time, and a social system. Rogers has identified categories within the
four elements that foster and or advance diffusion and those that hinder diffusion. All four
elements were present in 87% of the 119 studies in this review. Combined with the positive
results reported by the reviewed studies, data would seem to suggest that the diffusion of
innovations theory could be used to help preservice teacher education programs plan and carry
out the integration of technology into their programs. What works according to Rogers? And
what areas were identified and supported in this study?

The following paragraphs identify what works according to Rogers and areas supported
in this review are noted. This information has a direct link to implementation in SCDEs. The data
would suggest and one might argue that it makes sense to use what works. Figure 13 identifies
what works in chart format.

Some innovation characteristics, Rogers stated, foster the adoption of an innovation with
potential adopters and advance diffusion. The innovation characteristics that foster adoption and
diffusion were: (a) relative advantage or identifying if this was a better idea than the current idea, (b) compatibility or judging how well the innovation fit with the potential adopters' values, experiences and characteristics, (c) trialability or trying out by the potential adoptor and/or experimenting with it, and (d) observability or looking to see if the results were easily visible. Each of these characteristics was identified as being present in a majority of the studies reviewed in this study. Rogers reported that relative advantage was important to successful adoption and ninety-three percent of the reviewed studies had relative advantage present.

Communication channels or as Rogers (1995) defined it as the "process by which participants create and share information with one another in order to reach a mutual understanding" (p. 17). Information exchanges were at the heart of the diffusion process. Interpersonal channels foster diffusion especially with individuals alike in socioeconomic status, education, and characteristics. The exchange should be face to face. In this review the studies were identified to use interpersonal communication in a homophilous setting predominantly and with more frequency throughout the 1990s.

Rogers identified that modeling and imitation are at the center of the diffusion process. In this review the trend shift from an even split of usage between stand-alone courses and integrated courses to the predominant use of integrated courses with successful results exemplifies the success of modeling and imitation. Data on the trends also suggested the positive result of using faculty modeling and field experience technology linkages. This was valuable data for practitioners and policymakers. If the faculty were to model for the preservice students, they must be trained and feel comfortable with technology. They must have the technology available and working to model for their students. They must be encouraged to think outside the box and be creative with technology linkages. Student teachers must also have the experience to use their technology skills during student teaching and selecting sites that include technology possibilities should be sought for the field experience.
Time as identified by Rogers includes time enough to complete the five steps of the innovation-decision process. These steps help the potential adopter to decide whether or not to adopt the innovation. The steps include knowledge, persuasion, decision, implementation, and confirmation. The trend identified in this review found that this process was included consistently in a majority of studies over time.

Social system as defined by Rogers (1995) was “a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal” (p. 23). The social system could be individuals, groups, organizations, and/or sub-systems. The identified trend in this review was a formal structure presentation as a part of a program or course in the preservice teacher education program. The identified trend in this review the expansion of the use of the innovations outside the SCDE linking innovation use to the K12 sector. This use met with success.

Finally, the change agent from within provides the best possibility for diffusion. So, identify that person in your system. That person with the positive attitude toward technology encourage and support them so that one day they can possibly function as the opinion leader within their social system and advance diffusion and adoption. This review identified the change agents as outside the group. However, since these innovations were introduced as part of graduate students’ dissertations there was probably student to student empathy at work. Rogers identified that a change agent outside the group but with sufficient empathy could be a positive force for diffusion.

Using these identified categories in the elements of the Diffusion of Innovation Theory could assist preservice teacher education programs to infuse current and future technology. Taking into account some things that advance diffusion, one could perhaps speed up the diffusion of innovations in the educational setting that Rogers identified as being slower than most other areas.
What Works According To Rogers – Suggestions for Inclusion in Preservice Teacher Education Programs

The following things are described by Rogers as favorable to diffusion.

Innovation characteristics – Present

Relative Advantage - this is a better idea than current idea.
Compatibility - fits values, experience, and characteristics of adopter.
Trialability - potential adopter can try out the innovation.
Observability - the results can be easily seen.

Communication Channels – How is the message sent and received?

Interpersonal Communication - Use face to face communication.
Homophilous Setting - Place participants in this setting.
Delivery System - Integrated, Modeling, Imitation

Time – Potential Adopter Needs Time to Decide

Innovation-decision Process - Be sure to include opportunities for potential adopters to go through steps.

Social System – The Units and Social Context That They Interact Within

Setting, Structure, and Norms In Line With Participants
Change Agent and/or Opinion Leader Within The Group or With Empathy for Group

Figure 13. What Works According To Rogers


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teachers: Design, development, and implementation of a basic course. Educational Technology,
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T.I.E. Journal, 18(9), 83-86.

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Office of Technology Assessment. (1995). Teachers and technology: Making the

Oke, L. (1992). The need for technology instruction in teacher education - Exit Project,
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References - Dissertation Abstracts Reviewed in Study
Dissertations from 1985-1989


Dissertations from 1990-1994


Dissertations from 1995-1999


Appendix A

Diffusion of Innovation Theory (Rogers, 1995)
Diffusion Of Innovations Theory (Rogers, 1995)

- Characteristics:
  - Relative Advantages
  - Compatibility
  - Complexity

- Characteristics:
  - Trialability
  - Observability
  - Re-invention

- Communication Channels:
  - Mass Media
  - Interpersonal:
    - Homophilous
    - Heterophilous
    - Modeling/Imitation

- Delivery:
  - Stand Alone Course
  - Integrated
  - Faculty models
  - Field Experience
  - Partnership
  - Other

- Innovation Decision Process:
  - Knowledge
  - Persuasion
  - Decision to participate

- Adopter Categories:
  - Innovators
  - Early adopters
  - Early majority
  - Late majority
  - Laggards

- Social Structure:
  - Formal/informal (communication and interaction patterns)
  - Norms (behavior patterns)
  - Opinion Leader
  - Change Agent (within/without)
  - Types of innovation decisions
    - Optional Innovation decisions
    - Collective Innovation decisions
    - Authoritative Innovation decisions
    - Contingent innovation decisions
  - Consequences (desirable/unintended)
  - Meaning
Appendix B

Literature Review – National Studies Summary Chart
<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Sample</th>
<th>Findings - General</th>
<th>Findings - Teacher education</th>
<th>Findings - Teacher related</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office of Technology</td>
<td>1988</td>
<td>Variety of surveys, data and review of research literature</td>
<td>Federal government must take an active role to move interactive technology forward</td>
<td>Need to improve – raise professional teaching standards and greater responsibility and autonomy but technology noted as not central to this theme but could be a &quot;lever&quot; for change.</td>
<td>Investment in technology not effective if not supported by teacher training: four conditions for use of computers by teachers: (1) skill training; (2) consideration for vision and state of the art developments; (3) support for experimentation and innovation; (4) time for training and practice.</td>
</tr>
<tr>
<td>Assessment – Power On: New tools for teaching and learning</td>
<td></td>
<td></td>
<td>States are key players and are beginning to be more involved in educational technology efforts in the state.</td>
<td>Vast majority of teachers currently teaching or planning to teach have had little or no computer education or training.</td>
<td>Barriers to use: lack of equipment; inadequate or inappropriate training; and anxiety about new technology.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>By 1987, most states had instituted an administrative position to plan, implement, and monitor educational technology programs in the state.</td>
<td>Current data show 1/3 of K-12 teachers have had 10 hours of computer training with focus mostly about computers not teaching with computers. As of '87 situation had not improved.</td>
<td>Varied uses of computers, labs, units in curriculum, whole class and/or individual; whole new curriculum.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Provisions for funding are an important aspect. Lack of funding was identified as a barrier.</td>
<td>OTA states that almost no Federal money available for the training of new teachers. Some money for in-service projects.</td>
<td>There is no one best use of computers or way to use computers.</td>
</tr>
<tr>
<td>Study</td>
<td>Year</td>
<td>Sample</td>
<td>Findings - General</td>
<td>Findings - Teacher education</td>
<td>Findings - Teacher related</td>
</tr>
<tr>
<td>-------</td>
<td>------</td>
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<td>--------------------</td>
<td>-------------------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Office of Technology Assessment - Teachers and Technology: Making the connection</td>
<td>1995</td>
<td>Variety of surveys, data, and review of research literature; Site visits to schools; interviews with teachers and administration; Case studies of exemplary programs.</td>
<td>Video most common technology. By 1995, U.S. schools will have 5.8 million computers (1 for every 5 students). Past two years have seen the growth of CD-ROM, video disc, modems and local area networks. Identified that hard data is missing on - Access and how technology used in schools; Impact of technology on teachers.</td>
<td>More attention given to technology in state certification, accreditation of COEs and efforts to reform and upgrade teacher education - overall wide spread variations from state to state and institution to institution. Technology not central to the teacher preparation experience. Most teachers graduate with limited knowledge of uses of technology in practice - Overall COEs do not prepare graduates in U.S. to use technology as a teaching tool. Most technology instruction in COEs is about computer not with computers. Teacher education students are not asked to prepare lessons using technology nor do COE faculty model technology use. Technology hands-on experience is not part of the student teacher placement criteria. K-12 frequently have more and better technology than COEs.</td>
<td>Technology is not a silver bullet to solve the educational concerns. Some teachers are using technology in a traditional &quot;teacher-centered&quot; model of drill and practice while others are using the &quot;student-centered&quot; model of allowing students to conduct their own investigations and projects with the teacher as facilitator. Technology used to record student progress as a &quot;living&quot; record in: video tape presentation. Technology used by teachers for record keeping and daily tasks. There is an increase in collegial communication. Technology used to foster professional development and bridge isolation gaps. Barriers: Access to appropriate technologies; technical and logistical problems that they cannot handle above - lack training and support; current standardized tests are paper/pencil tests; copyright and intellectual property issues as well as student access to objectionable materials.</td>
</tr>
</tbody>
</table>
Video of best teachers or live broadcasts can help broaden teacher education students' classroom experiences. Use of video case studies.

COE administrators, especially deans, key players but they frequently lack financial resources for equipment and faculty training and support.

Technology can connect mentor and student teacher and provide a safety net for new teachers and student teachers in the field.

Model Programs identified - Vanderbilt University’s Peabody College; University of Wyoming COE; and Virginia’s Curry School of Education.

Barriers:
COE faculty’s discomfort level and attitudes toward the use of technology; little institutional support or encouragement for the use of technology; faculty see technology as important but think it should be and is taught elsewhere; most faculty expressed anxiety over use of technology.
<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Sample</th>
<th>Findings - General</th>
<th>Findings - Teacher education</th>
<th>Findings - Teacher related</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Center for Educational Statistics - Teachers' Tools for the 21st Century: A report on teachers' use of technology</td>
<td>Sept 2000</td>
<td>Public school teachers using the Fast Response Survey System - Also, data from NAEP and current population survey</td>
<td>Half of teachers with computers available used them for classroom instruction. Teachers more likely to use when in their room rather than in computer labs. Teachers who reported feeling prepared were more likely to use technologies. Teachers perceiving a lack of computers and/or time for student use of them aid novice or assign student use of computers for instruction and/or activities.</td>
<td>Less experienced teachers more likely to indicate education prepared them for use of computers and the Internet. Identified as needed: Opportunities to learn about and practice instructional reforms (diffusion theory element trialability); connect teacher programs to real-world classroom experiences. Moreau and Batesfeld (1999) quoted. Half of technology training in methods and curriculum classes &amp; Half technology training in stand alone computer courses. Benefit when learnt technology from peers and share information (Coley, Crader, &amp; Engels, 1997). This is a diffusion theory element.</td>
<td>Approximately half of public school teachers have computer and Internet available in school. Low minority schools more likely to use computers and Internet for broader range of activities; whereas high minority schools less likely. Among teachers with computers at home, teachers with fewer years of experience were more likely to use technologies to create lessons and access model lessons at school and home. Most teachers responded that professional development was available at least at the beginning level to them. Gaps in follow-up and advanced training. Barriers as reported in 1999: Not enough computers (78%); Lack of release time to learn how to use computers and Internet (82%); Lack of time in schedule for students to use computers (80%). First two barriers indicated on survey as &quot;great&quot; barriers to use of computers and the Internet for instruction.</td>
</tr>
</tbody>
</table>
Appendix C

Content Analysis Data Collection Sheet (CADC5)
CONTENT ANALYSIS DATA COLLECTION SHEET - (01/16/02)

CASE #

Section I. Descriptive Data

1. Year of study ____________________
2. Title of the study: _______________________________
3. Degree: PhD ___ Ed.D ___ Do not know ___
4. Author/researcher name _____________________
5. Male ___ Female ___ Do not know ___
6. University _______________ Do not know ___
7. Location State __________ Country ___ Do not know ___
8. Department __________ Do not know ___
9. Study methodology: Quantitative ___ Qualitative ___ Combination ___ Do not know ___
10. Unit of analysis: individual faculty member ___ individual student ___ Department ___
    Institution ___ Others ___ Do not know ___
11. Data Sources: Faculty ___ Pre-service teacher students ___ Institutions ___
    Other specify __________ Do not know ___
12. Sample size: n = ______ Do not know ___
13. Data collection method(s): Questionnaire ___ Interview ___
    Phone survey ___ Case study ___ Experiment ___ Observation/s ___
    Other ______ Do not collected ___ Do not know ___
14. Studied: __________________________________________
15. Major Finding(s): __________________________________________
16. Study Topic: ____________________
Section II. Rogers’ Diffusion of Innovations –

A. Innovation- Studied

1. Type:
   - Hardware ___ Name - ______________________
   - Software ___ Name - ______________________
   - Technology Cluster ______________________ (Specify)
   - E-mail ___ Internet ___ Other __________________ (Specify)

2. Characteristics: Yes ___ No ___ Do not know ___ (Skip to Section B)
   - Relative advantage Yes ___ No ___
   - If yes, Incentive Yes ___ No ___ Specify ______
   - Trialability Yes ___ No ___
   - Compatibility Yes ___ No ___
   - Complexity Yes ___ No ___
   - Observability Yes ___ No ___
   - Re-invention Yes ___ No ___

Study looked at:

B 1. Communication Channels - Yes ___ (Continue) No ___

   Other (Specify) ________________ Do not know ___ (Skip to #2)

   - Mass media ______ Yes ___ No ___ Do not know ___
   - Interpersonal ______ Yes ___ No ___ Do not know ___
   - Homophilous setting ______ Yes ___ No ___ Do not know ___
   - Heterophilous setting ______ Yes ___ No ___ Do not know ___

2. Delivery System Yes ___ (Continue) No ___ Do not know ___ (Skip to C)

   - Formal stand alone course ______ Yes ___ No ___ Do not know ___
   - Integrated course ______ Yes ___ No ___ Do not know ___
   - Faculty models ______ Yes ___ No ___ Do not know ___
   - Field experience ______ Yes ___ No ___ Do not know ___
   - Partnership ______ Yes ___ No ___ Do not know ___
   - Other ____________________
Section II. Rogers' Diffusion of Innovations – (continued)

C. Time - Yes (Continue) No Do not know (Skip to next section)

1. Innovation- Decision process: Yes (Continue) No Do not know (Skip to #2)
   - Knowledge: Yes No Do not know
   - Persuasion: Yes No Do not know
   - Decision: Yes No Do not know
   - Implementation: Yes No Do not know
   - Re-invention: Yes No Do not know
   - Confirmation: Yes No Do not know

2. Innovativeness of Researcher:
   - Adopter Category: Yes (Continue) No Do not know (Skip to section D)
     - Innovator: Yes No Do not know
     - Early adopter: Yes No Do not know
     - Early majority: Yes No Do not know
     - Late majority: Yes No Do not know
     - Laggards: Yes No Do not know

3. Innovativeness of units of study or study participants:
   - Adopter Category: Yes (Continue) No Do not know (Skip to section D)
     - Innovator: Yes No Do not know
     - Early adopter: Yes No Do not know
     - Early majority: Yes No Do not know
     - Late majority: Yes No Do not know
     - Laggards: Yes No Do not know

4. Time frame of study and/or treatment
   - Weeks
   - Semester
   - Year(s)
   - Other
   - Do not know

Study looked at: Case #
Section II. Rogers' Diffusion of Innovations – (continued)  Case # ___

Study looked at:

D. Social System – Yes (Continue) No. Do not know (Stop)

1. Setting: SCDE _____ K-12 school ______ Partnership ______ Unknown ______
2. Structure: Formal ______ Informal ______ Both ______ Unknown ______
3. Norms: Traditional ______ Cosmopolitan ______ Unknown ______
4. Opinion leader ______ Unknown ______
5. Change agent: From within ______ Without ______ Unknown ______
6. Decision type: Collective ______ Authority ______ Contingent ______
   ______ Unknown ______
7. Consequence/s: Intended ______ Unintended ______ Combo ______ Unknown ______
   Desirable ______ Undesirable ______ Combo ______ Unknown ______
8. Description of consequences

______

9. Meaning

______

______
Appendix D

Coding Directions and Protocols
Directions and Coding Protocol

General Definition of Terms To Know Prior To Coding

Communication – Rogers (1995) “A process in which participants create and share information with one another to reach a mutual understanding (p. 6).” This is a process and implies an exchange of information (Rogers, 1995).

Communication channels – Rogers (1995) “The means by which messages get from one individual to another. The nature of the information-exchange relationship between a pair of individuals determines the conditions under which a source will or will not transmit the innovation to the receiver, and the effect of the transfer” (p. 18).

Computers – as an innovation category is more focused on the computer and computer literacy, computer instruction, and computer use. It includes innovations directly connected to computers and how they work.

Technology – is a term that began to appear in the early to mid 1990s and is used in this study as an innovation category to categorize electronic and digital innovations beyond just computers and included such things as CD-ROM, Internet, laser discs, digital video, electronic media, ITV, etc., as well as technology literacy, technology instruction, and technology use.

Content Analysis – Berelson (1952) describes content analysis as a systematic and objective research method that quantifies and describes the content of communication. Weber (1985) defines content analysis as “a research methodology that utilizes a set of procedures to make valid references from text” (Weber, 1985, p. 9). Weber (1985) identifies among others that the uses and/or purposes of content analysis are: to reveal focus of groups, individuals, institutions, and/or society; and to describe trends in communication content. Berelson (1952) adds that content analysis is a method to analyze “who said what to whom, how and with what effect” (p. 13).
Diffusion — Rogers (1995) "the process by which an innovation is communicated through certain channels over time among the members of a social system" (p. 5).

Educational Technology (The field of) — An emerging field that encompasses a variety of technologies and the use of these technologies in a variety of settings and includes the policy, structural, organizational implications, and legal ramifications of the uses of technology as it applies to educational settings and has an important component for the training of teachers and teacher educators.

Electronic communication — as an innovation category includes e-mail, electronic writing and/or journaling, networking, and the use of the Internet for communication.

Innovation — Rogers (1995) "an idea, practice or object that is perceived as new by an individual or other unit of adoption" (p. 41). Newness is determined by the individual.

Innovation Theme — describes the category into which an innovation is placed based on its intended use within the study population.

Interactive Grouping — as an innovation category includes interactive video disc, interactive video simulations, and interactive CD-ROM.

Preservice teacher education — private and public undergraduate programs at schools, colleges & departments of education (SCDE's) that prepare undergraduates to enter the field of teaching in the private or public K-12 setting.

Social system — Rogers (1995) "As a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal. The members or units of a social system may be individuals, informal groups, organizations, and/or subsystems" (p. 23).

Technology education — In this study this refers to exposure and training in technology. Computers and computer-related hardware and software instruction and peripherals make up a large part of technology education. However, since this study proposes to uncover trends it will
not be limited to only computer and computer-related technologies but will include other
technologies such as video discs, distance learning, etc.

Time - Rogers (1995) includes time as one of the four elements of diffusion of
innovations theory. Time is part of diffusion as follows: (1) innovation-decision process (passing
from first knowledge of an innovation through adoption and/or rejection); (2) the innovativeness
of the adopter (early or later adopter) compared with others in the social system; and (3)
innovation's rate of adoption in the system.

Trend - “is considered to be a cumulative indicator of activities or products that shows
directions” (Ely. 1988, p. 1).

Directions to Coder

General

The content analysis data collection sheet is divided into two sections with subsections
under each larger section. Section I is descriptive in nature. Section II begins with data collection
on the innovation studied. Subsections B, C, and D have an initial choice to make and then to go
on or skip parts of the section or the whole section depending on the initial response. Possible
responses include the following.

- A “Yes/No” response for presence of the element of diffusion is generally asked first.
  If the answer is “NO” check “no” and move on as indicated.
- If the answer is “Yes”, check “Yes” and fill in the answer to that subsection.
- If the answer is “other”, check and specify.
- If the answer is “Do not know”, check and move to next section or next part.
- You should be recording a data entry for each and every section. For each item there
  is at least one blank that must be filled in.

After you have read the general definitions, familiarize yourself with the data collection
form and the definitions for the terms within it, you are ready to begin. The data collection sheet
consists of "check off" and "fill in the blank" sections. Before entering data you must begin by reading the dissertation abstract twice—once for general content and a second time to obtain and enter information on the data collection sheet. Yellow paper was provided to the coder for the taking of notes during the reading of the abstract.

Specific section by section Definition of Terms and directions for Coder:

Section I—Descriptive Data

1. Year of study—Year that appears in the citation.
2. Title of the study—Copy directly word for word
3. Degree: check one
4. Author’s name—record surname and then first name.
5. Determine male or female from first name, if possible, using first name and middle initial.
6. University: ID from information in citation.
7. Location: if evident from text.
8. Department in which research conducted.
9. Study methodology: from text check one choice. Coder check quantitative, qualitative combination or ‘do not know’ as indicated by reading the dissertation abstract. The determination was made through focus of the study, the declaration of the researcher, and/or the analyses and/or results described for the study.
10. Unit of analysis: from text determine and check all that apply.
11. Data sources: from text check all that apply.
12. Sample size: from text fill in number or check do not know.
13. Data collection method(s): from text determine and check all that apply.
14. Studied: What was studied. May quote directly from abstract or paraphrase.
15. Major Finding(s): from text, use phrases, be brief. If necessary, may quote from
abstract.


Section II Rogers' Diffusion of Innovations theory

A. Innovation -

1. Type: Check one; fill in name if required.

   Hardware – any machine or device

   Software – programs that are written for computers and/or computer devices that
   allows the computer and/or device to function.

   Technology cluster – a group of technologies used together (i.e., computers,
   various software programs and perhaps the Internet.)

   E-mail Internet Check Other (fill in specifics)

2. Characteristics:

   Relative advantage – Asks the question: Is it better then the current idea?

   Incentive – something to increase the chance of someone adopting an innovation.

   May be obvious material incentive or a less obvious intrinsic reward.

   Trialability – Can the potential adopter experiment with or try the innovation in
   installments or increments?

   Compatibility – Does the innovation fit existing values, experiences, and meet
   current needs of the adopters?

   Complexity – Asks how difficult is the innovation to understand and use?

   Observability – Are results readily visible?

   Re-invention – Change or modification of the innovation by the user/s.

(Identified during study or mentioned in recommendations.)

2.1 Communication Channels – process by which participants create and share information.

   Mass media – rapid and efficient but used to let a population know about an innovation.
Interpersonal – person to person communication; face to face communication; computer to person in simulations and interactive programs and/or communications.

Homophileous setting – group of individuals who are alike or similar in beliefs, education, and social status.

Heterophileous setting – group of individuals who are not alike or similar in beliefs, education, and social status.

2. Delivery System

Formal stand alone course – learn how computers work and how to use software.

Integrated course – use technology within the confines of another discipline course.

Faculty models – instructor uses technology to teach course material.

Field experience – student teaching in a public or private school; real world experience.

Partnership – higher education institution forms a relationship with a public and/or private school and each uses technology services from each other.

Other – Used if system does not fit into other categories and/or needs clarification.

Be specific.

C. Time.

The innovation decision process which takes the potential adopter from first knowledge of an innovation to adopting or rejecting an innovation has five steps and takes time (Rogers, 1995).

1. Innovation decision process –

Knowledge occurring when the individual or decision-making unit finds out about the existence of the innovation and learns a little bit about it;

Persuasion occurs when the individual or decision-making unit develops an attitude regarding the innovation which can be positive or negative in nature;

Decisions occur when the individual or decision-making unit purposely participates in activities that lead to the adoption or rejection of the innovation;
Implementation occurs when the individual or decision-making unit uses the innovation and/or re-invents the innovation for use;

Confirmation occurs when individual or decision-making unit re-affirms and reinforces the uses of the innovation which can be reversed if conflicting data and/or messages are received. (After initial adoption and/or use.)

2. Innovativeness – Adopter Categories: – Answer to relation to the researcher. (Decision made by evaluation of information given in abstract text and/or indicators in the results of study.)

Innovator – venturesome; interest in new ideas; able to take risks; can understand complex technical ideas;

   Early adopter – respected by peers; opinion leader and resource for others; role model.

   Early majority – deliberate; not opinion leader; interacts often with peers; adopts just before average member of the group does.

   Late majority – skeptical; adopt after peer pressure and risk is removed.

   Laggards – traditional view, looks to the past to make decisions; views change agents and innovation as suspect.

3. Innovativeness – Adopter Categories: – Answer in relation to the unit/s of study and/or participants. (Decision made by evaluation of information given in abstract text and/or indicators in the results of study.)

Innovator – venturesome; interest in new ideas; able to take risks; can understand complex technical ideas.

   Early adopter – respected by peers; opinion leader and resource for others; role model.

   Early majority – deliberate; not opinion leader; interacts often with peers; adopts just before average member of the group does.

   Late majority – skeptical; adopt after peer pressure and risk is removed.

   Laggards – traditional view, looks to the past to make decisions; views change agents and
innovation as suspect.

D. Social System — "as a set of interrelated units that are engaged in joint problem-solving to accomplish a common goal (Rogers, 1995, pg. 23)."

1. Setting - check all that apply

2. Structure - check one.
   Formal - part of a course or program
   Informal - pilot program and/or students working with students and/or faculty but not part of a prescribed, required program.
   Combination - use of both structures

3. Norms - established patterns of behavior
   From text determine social system of the group studied and check one.
   Traditional - takes place in or as part of a program with instructor providing information.
   Cosmopolitan - instruction given in a non-traditional way either in methodology used and/or the type of training site used.

4. Opinion leader - someone respected in the group who leads the way. (Refers to researcher's status. Can be opinion leader and change agent.)
   Change Agent - one who is aware of the innovation and wants to change the rest of the group. (Refers to researcher's status.) From within or without the social system or unknown.
   (From text of the abstract check as appropriate)

5. Decision type -
   Optional innovation-decisions the individual has the option to make the decision to adopt or reject. This may be influenced by the social system but it is still up to the individual.
   Collective innovation decision is achieved by consensus of the system's members.
   Generally, after the decision is made all the members must abide by the consensus reached.
   Authority innovation decisions is a result of a few members of the group who have the
power, status, or the technical expertise and make the decision to adopt. All members of the group then must abide.

Contingent innovation decisions combines the individual decision to comply or not in relationship to and after a previously issued innovation decision to all the members of the system has been rendered.

6. Consequence(s of the innovation's use - Check each category as appropriate.

7. Description of consequences – describe nature of consequences positive or negative (May paraphrase or quote directly from abstract.)

8. Meaning – what meaning did the unit's and/or system attach to the innovation; determine from information given in abstract text or infer from results. (May paraphrase or quote directly from abstract.)
Appendix E

Institutional Data
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