

**Prediction of Educational Technology
to be Found in the Public Schools
of the Year 2000:
A Delphi Study**

by

Raymond T. Jones

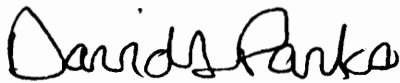
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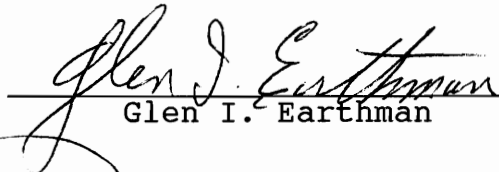
in

Educational Administration

APPROVED:



David J. Parks, Chairman



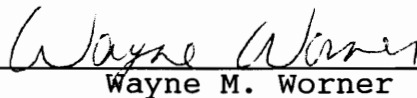
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by

Raymond T. Jones

Committee Chairman: David J. Parks

Educational Administration

(Abstract)

The world is shifting into an unprecedented technological age. Towns such as Blacksburg, Virginia, are now being called "electronic villages" with electronic infrastructure which not only ties together all aspects of the town but also connects the town to the world. Reality becomes "virtual" with information unimpeded by time and distance.

This rapid advancement in electronical technology is having an impact on world educational systems. Those planning the future of education have a need to know what directions this new technology might take in order to interface such technologies with the schools. The purpose of this study was to predict which present and emerging electronic technologies would be in significant use in the K-12 schools of the year 2000.

The Delphi technique was used to gather predictions from

an expert panel of teachers, administrators, electronic media specialists, and those working in the technology industries. The predictions were gathered from winter 1994 to fall 1995 for the year 2000, taking into account the need for a reasonably accurate prediction which could be used for those now engaged in short-term planning and those engaged in generating the appropriate technologies for the schools.

The types of present and emerging electronic technologies to be found in K-12 schools of the year 2000 were solicited in round one of the study. Rounds two and three identified which technologies would indeed be in significant usage. Using a scale of 1 to 4 (1= very unimportant, 2= unimportant, 3=important, 4= very important), a group mean and standard deviation were calculated for each identified technology. Those technologies with a mean score of 3.00 or higher in round three were predicted to be those likely or very likely to be used in the K-12 schools of the year 2000.

Two key strands of characteristics emerged: connectivity and multifunctionality. The technologies which rated highest had, as characteristics, the ability to be networked with other technologies and the ability to perform multiple tasks. The top five technologies were (1) desktop/laptop computers (2) telephone access to all classrooms (3) world

wide web (4) teacher work stations (5) Email.

Other important characteristics included the use of multimedia technology, strong graphic capabilities, and technologies dedicated to specific-use groups, with teachers, students, and administrators having their own dedicated work stations.

ACKNOWLEDGMENTS

The author wishes to acknowledge several people without whose help and guidance this study could have not been completed. Any study on this level is a daunting task which leaves its mark on the researcher and on those who know him or her. It is a task often worked on in isolation but never without an awareness of support and concern coming from those associated with the researcher.

First, my thanks to my committee. This project took far longer than I had planned, thanks to a career change in the middle of the process. To my chairman, Dr. David Parks, goes my profound appreciation for his insistence on achieving the highest level of professionalism in this study while at the same time being patient, available, and understanding. To my other committee members go my thanks for time, kind words, helpful suggestions, and the general sharing of extensive knowledge.

To the participants in my Delphi rounds, I appreciate ever so much the time taken to fill out lengthy surveys. Your contribution to this particular study and to education in general is most generous.

To my former colleagues in the Chesapeake Public Schools: Dr. Dan Graves, Dr. Bob Cowden and Dr. Lee Armistead (not to mention my committee member from

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To my wife Joan, immense gratitude for patience and understanding far beyond the call of duty. Having been a graduate student herself, she understands the rigors of academic pursuits but was still put to the test by the scope of my endeavors. From doing without me for weeks while I was on campus to braving fierce storms flying me to Blacksburg in her trusty airplane, she has made my success possible. I could not have done it without her. Finally, thanks to my beloved late golden retriever Ursula te Kanawa, who stayed at my feet as I typed and who gave me perspective.

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Chapter 1

INTRODUCTION TO THE STUDY

In this study, the author is interested in determining the extent to which present and emerging electronic technologies will be used in the K-12 schools of the year 2000. The findings should be of use to those who deal with such aspects of education as plant design, media use, availability of material for curriculum design, administration, and classroom operation. The author presents an overview of the evolution of electronic technology in education and uses a Delphi panel of experts drawn from schools, statewide organizations, and the industrial sector which manufactures these technologies.

History and Background

Acquiring and implementing new technology can be a task full of risk and expense. Potential users and suppliers need to be aware of the coming need for such technology. To exceed that which is essential can be costly, but to fail to meet essential needs brings with it dissatisfaction while reinforcing resistance to change (Mundt, Olsen, & Steinberg, 1982).

As noted in a presentation to the Chesapeake, Virginia, School Board by Haver (1991), The Federal Teacher of 1950

stated that ballpoint pens would be the ruin of education in our country, as the throwaway nature of these devices ~~went~~ went against the American traditions of thrift and frugality. She observed that the PTA Gazette of 1941 lamented the use of fountain pens, noting that writing with a straight pen and nib was the way writing was done in the real world. She pointed out that the Rural American Teacher (1929) warned of using store bought ink, cautioning that students who could not make their own ink risked not being able to write until ink was obtained on their next journey to the local settlement.

In that same presentation, Haver observed that the National Association of Teachers in 1907 went on record as predicting pen and ink would never replace the reliable pencil and that a geographically unspecified group called The Principal's Association decried in 1815 the dependence on paper, urging instead the use of slates. She concluded with observing that, at a teacher's conference in 1703, it was said that those who were unable to prepare bark on which to write would find themselves in dire straits if their slate were to break.

In the early 1980's, Naisbitt (1982) detected a transformation from an industrial society to an

informational society taking place. Higgins (1990) concluded that such a change was still going on, including a revolution in educational technology. Computers and telecommunications systems have brought to the school a wide array of resources.

How can educators get a grip on the changing field of educational technology? According to Stansberry (1993), many of the technological innovations in recent years such as computers and instructional television have perhaps led to overinflated expectations. He noted that the educator, not technology, was still the key to education but that the arrival of new technologies meant many more applications to educational purposes.

Ravitch (1993) observed that educational disappointment in technology may have stemmed from unimaginative application of that technology and from lack of consensus about how technology could be used to achieve educational goals. From this observation, one may ask if educators have accurate ideas about what types of technologies will be available to educators in the next few years.

A call for greater awareness of educational technology has gone out. Ambach (1992) noted the position of the Council of Chief State School Officers that school

administrators must close the gap between the opportunities provided by the new technologies and the actual use of these technologies. This council stressed actively embracing technology.

Problem Statement

Momentous changes are being brought about by the transformation of society from an industrial age to an informational and technological age. The educational infrastructure of the school is beginning to reflect this transformation. Education is on the verge of a technological revolution.

Those persons involved with the public schools, such as teachers, administrators, technicians, and representatives of industry producing the new educational technology, need to interact with present technologies and to be aware of emerging technologies which may be in use in the school of the year 2000 in order to be a part of this technological revolution.

Any one of these groups may have unacceptable expectations of the other groups. The manufacturers may expect the schools to line up and buy technologies with which they are unfamiliar. The administrators may be attracted by a low price and not consider the

interconnectivity of a technology. The teacher may see a single classroom application of a technology and not be aware of the importance of schoolwide application of a technology.

Noting that businesses are reinventing themselves, thanks to new opportunities provided by technological innovations, Gates (1995) stated that education, though seemingly reluctant to follow the example of business, must do so in order to improve educational opportunities within the schools. According to Ehrenkrantz and Eckstut (1994), our country starts a new technological cycle every four years. If users of educational technology are to implement technological changes in the year 2000, they must have a clear picture now as to what educational technologies are likely to be deployed in those schools of the year 2000.

Research Questions

The research questions in this study are these:

1. Considering the evolution of educational technology, what types of current electronic equipment or systems will be used by students, teachers, and administrators in the public schools of the year 2000?
2. Considering the evolution of educational technology, what types of emerging electronic equipment or

systems will be used by students, teachers, and administrators in the public schools of the year 2000?

Purpose and Significance of the Study

Emerging technological innovations in the public schools are confronting those responsible for shaping the school of the year 2000. This study sought to identify both existing and emerging technology that will be in use in public schools by the year 2000. By using the predictive Delphi method, the study aims at helping educators prepare for the types of electronic technologies that will most likely be accessible to them in the near future.

Why is it important to identify these technologies? Krebs (1993) pointed out that a wide array of educational institutions, including science and technology centers, media and library centers, and museums are working with the schools to implement new educational technologies within the schools, and that this effort reaches into every curriculum area. Resta (1993) added that technology is playing an increasingly important role in the ongoing restructuring of education. Are these technologies the best for the schools?

According to Rockman (1993), the expansion of educational technologies has provided a wider access to

educational opportunities such as enhanced staff development capabilities and an increase in the ability of school leaders to manage change. If so, will choices in educational technology made over the next few years enhance these opportunities?

Why is it important to have an accurate awareness of coming technologies and their application to education? Ward (1992) cited the benefits of technology awareness: the saving of funds spent on education, the saving of administrative task time, and the enhancement of the curriculum. Dempsey (1993) cautioned that school administrators who champion technology initiatives without understanding the technology are setting a dangerous precedent. Such managers of change need to use the technology and develop a better understanding of the nature of such technologies in order to adequately plan for future changes.

With the coming of these new technologies comes the need for informed school administrators providing technology leadership and motivation, translating a vision of technology into reality (Lumley, 1992). To provide that leadership, administrators must be aware of what technologies are likely to be found in the coming years.

It is not just administrators who must have a clear picture of coming technologies and their application to the schools. Liedtke (1993) noted the advanced integration of technology into education, pointing out that students are becoming more of a visually literate generation and that cross-sections of school employees, such as administrators and teachers, are becoming involved in a collaborative process to prepare for the evolution of electronic technology. Knowledge of what technology is most likely to be used is part of that preparation.

This study focused on electronic equipment or systems, foregoing such established but older non-electronic technologies as the printed page, the slate blackboard, and related chalk or ink writing implements. These electronic-based educational technologies encompass the equipment realm, including computers, communications devices, and a host of present and emerging digital equipment.

The "Delphi technique" was defined by Linstone and Turoff (1975) as "a method of structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem" (p. 3). As used in this study, the Delphi method allowed large groups of experts in separate locations

to come together as expert panels for the purpose of predicting the use of technologies in the schools of the year 2000.

Summary and Overview

In this first chapter, the researcher has presented the history and background of this study, the purpose and significance of this study, the statement of the problem, and the research questions to be answered by the study.

A synthesis of the literature related to this study follows in the second chapter. A review of the Delphi technique used to forecast educational technology usage is also included in the second chapter.

Chapter three contains the design of the study, including the selection of panelists, the collection of data, and the analysis of these data. A research chronology is outlined.

The results of this research and analysis of data are in the fourth chapter. A summary of these data and conclusions drawn from the study comprise chapter five. Implications of this research and resulting recommendations for future research are offered.

Chapter 2

REVIEW OF LITERATURE

The purpose of this review of literature is to gain an overview of how educational technology has developed, how it applies to educators and to society in general, and to gain a sense of where this technology is going in the near future.

Educational Technology Overview

In planning for the future of education, Mageau (1993) was of the opinion that educational technology must be an integral rather than a tangential element. The melding of education and technology is no new concept. According to Berkman (1992), a report issued in February 1923 by the U.S. Bureau of Education stated that the Navy was planning to broadcast educational programs a quarter of an hour in length two nights a week, asserting that continuous education was vital to the public and that radio could be the means for that continuous education. Berkman also noted that James Rowell Angell, who had joined the National Broadcasting Company in 1938 upon his retirement as president of Yale University, predicted that television would be in widespread classroom usage within five years.

Adams and Bailey (1993) asserted that schools have already been in the Information Age for more than half a century. They noted that the prevailing method of curriculum delivery for most of that time was by lecture and printed text with students exhibiting basically passive participation. They pointed out that technological advancements have moved students more in the direction of information literacy employing a more interactive involvement with electronic media.

Atkins (1993) stated that views on new interactive technologies appearing in the classroom ranged from praise for lifting the restraints of the traditional classroom to warnings that such initiatives pose a threat to the qualitative educational process. He pointed out that the previous history of educational technology was filled with grand claims and limited achievements.

Sydow and Kirkpatrick (1992) were of the opinion that the focus of educational technology should be on areas with clearly defined needs. Sullivan (1992) characterized the relationship of technology to education as an evolutionary process spanning the use of said technology to accomplish traditional tasks and reaching the point of using training in technology to do new tasks.

Ambach (1992) cited a position paper released in April 1992 by the Council of Chief State School Officers which indicated that technology needed to get the same kind of consideration textbooks received in the past if the schools of America were to achieve their educational goals. The paper called for broad scale technology integration into the schools, with this technology commitment boldly inserted into financial policies.

Scope of Educational Technology

To illustrate the expansion of the educational technology available to present and future students, one notes a prediction made by Prozano (1972). The author cited "four A-V wonders (school) boards will buy in the 70's" (p. 26). These four technologies include cassette audio tape recording devices, simplified video tape recording devices, random-access audio/video systems, and computer-assisted instructional systems.

The realm of classroom technology, once limited to devices such as computers and videocassette recorders, has expanded to electronic bulletin board networks, delivery of materials via fiber optic systems, and interactive two-way delivery of classroom instruction (Barker, 1990).

Higgins (1989) illustrated the scope of educational

technology by observing that students are motivated by new avenues of interactivity with courses of study, that clerical tasks are now handled more efficiently by computer systems, that telecommunications systems give access to vast arrays of databases, and that enhanced video systems bring new depth and power to educational materials.

Mayfield (1994) noted that Bell Atlantic Video was beginning an interactive video service which would present to the viewer a graphic image of a multistoried shopping mall. One floor of this graphic mall would be devoted to education, and offerings would be aimed at educational levels ranging from early childhood to adult learners.

Ward (1992) noted that what was currently in the air, video transmissions using airwaves, would be going underground on fiber-optic cable. Conversely, that which was underground, such as telephone communications, was going to be in the air via airwaves.

The scope of computer use was measured by Gilder (1993). He cited U.S. Census Bureau statistics showing that almost half of all American children between three and seventeen years of age regularly use computers at home or at school. He also noted that the computer is merging with the telephone and television to become a digital cellular device

that will function as a notebook, a communicator, and a personal computer.

According to Skolnick, Larson, & Smith (1993), the current generation of students has been raised on video, audio, and computer technology. Multimedia technologies capture the interest of this generation. The number of teachers who espouse multimedia technology as providing a more comprehensive education is growing.

According to Boucher (1993), students are no longer merely watchers of television. They now interact with the medium. The interaction via fiber optic lines would link computers at many schools and allow distance learning by computer and video along with the sharing of software, the use of CD-ROMS, and the transmission of electronic mail.

A proposal by Vice President Al Gore published by The Office of the Vice President at the White House (1994) espoused the concept of an information superhighway by calling for a national telecommunications reform that would offer free interconnects with the information superhighway for any classroom in the country. The report stated that new technologies have brought together previously divergent communications entities. This, according to the Vice President, could lead to an advanced communications and

information infrastructure that would bring together various computer systems and databases with related consumer electronics to form an information web available to all potential users. The target date for connecting all classrooms to this system is the year 2000 (Table 1).

Interconnectivity

Pope (1994) pointed out that the fast-developing Internet fiber-optic system has already combined computer, telephone, and television technology to literally bring education to one's fingertips. This multiple-use expansion even extends to the common notebook, which in its emerging electronic form is a hand-held device capable of incorporating a handwriting recognition program which can convert hand-written notes to print and can also hold a dictionary and a thesaurus, all in a case small enough to fit in the palm of the hand (Tibbs, 1993).

Careless (1994) pointed out that the old technology of radio was given a new outlet via the Internet. Cyber radio is a phrase coined to denote the transmission of radio programming through computer cyberspace. The Canadian Broadcasting Corporation has successfully converted radio programming into stored digital form in which it can be retrieved and reconverted to audio at a computer user's

Table 1

**Significant Dates in the Development of Educational
Technology**

Date	Event
1842	Invention of facsimile transmission by Alexander Bain (Mount & List, 1987).
1844	Invention of the telegraph by Samuel F.B. Morse (Blum et al., 1968).
1875	Invention of the telephone by Alexander Graham Bell (Burke, 1978).
1877	Invention of the phonograph by Thomas A. Edison (Burke, 1978).
1879	Invention of the electric lightbulb by Thomas A. Edison (Burke, 1978).
1895	Invention of the kinoscope by the brothers Lumiere (Burke, 1978).
1895	Invention of radio by Guglielmo Marconi (Mount & List, 1987).
1898	Invention of magnetic recording by Valdemar Poulsen (Mount & List, 1987).
1928	Invention of television by Vladimir Zworykin (Burke, 1978).
1938	Invention of xerographic photocopying process by Chester Carlson (Mount & List, 1978).
1945	Invention of digital computer ENIAC (Electronic Numerical Integrator and Calculator) by John Mauchley, J. Presper

- Eckert, Jr., and John Brainerd (Mount & List, 1987).
- 1945 Conceptualization of communications satellite by Arthur C. Clark (Cook & Vaughan, 1983).
- 1955 Fiber optics invented by Narinder S. Kapany (Mount & List, 1987).
- 1956 Invention of video recorder by Charles P. Ginsberg, Charles E. Anderson, and Ray M. Dolby (Mount & List, 1987).
- 1957 Launching of Sputnik 1 satellite by the Soviet Union (Cook & Vaughan, 1983).
- 1962 Launching of Telstar 1 communications satellite by the United States of America (Cook & Vaughan, 1983).
- 1969 ARPANET (Advanced Research Projects Agency Network) set up by the United States Department of Defense (Gibbs & Smith, 1993).
- 1971 Edward Roberts develops the first microcomputer (Mount & List, 1987).
- 1972 Philips of Holland introduces the laser disk (Mount & List, 1987).
- 1992 President Clinton and Vice President Gore announce plans to build an information superhighway (Elmer-Dewitt, 1993).
-

convenience.

Gibbs & Smith (1993) noted that the Internet probably originated in the ARPANET, a computer network set up in 1969 by the Advanced Research Projects Agency, a part of the Department of Defense. The uses of this early network were military in nature; the intention was to assure that information could travel from one computer to the next in as flexible a manner as possible. This flexibility involved the ability to send messages by a multitude of possible routes rather than by one fixed route. According to the authors, ARPANET began offering unclassified access. Computer users accessed this and other networks to form a loose confederation of computer networks generally known as the Internet. The Internet is owned by no one and is available to a multitude of users including students, teachers, and school administrators.

Dyrli (1993) described the Internet's educational impact by observing that all future scenarios depict a world that is linked totally by telecommunications. In this scenario, students and teachers are in daily interaction with great amounts of data conveyed through text, video, and sound images. He pointed out that over 5,000 networks are currently connected via the Internet and that over 50,000

teachers now use this system. He noted such educational applications of this system as messaging via electronic mail, discussion groups and newsgroups, remote log-in whereby students and teachers can enter the Internet from home as easily as in the school, and file exchange.

Hempel (1993) noted that the technology needed to interface with the Internet is a personal computer, a modem, and communications software. He observed that a great deal of public domain software is available for all types of computers and that a plethora of curriculum-related documents are easily obtained at no charge. Information and the sharing of resources, says Hempel, are main themes on the Internet.

Gibbs and Smith (1993) were of the opinion that students in the year 2000 who do not know how to use the Internet will be as deficient as current students who are unable to read. They noted the rapidly expanding growth of the Internet: 6,000 networks connected; around 1,000 computers added to the Internet on a daily basis; and the sum of data crossing the Internet growing by 10% monthly. Hobbes (1997) showed a growth of Internet users from around 130,000 in 1979 to nearly 13,000,000 by 1996 just seven years later and an increase in networks as well (Table 2).

Table 2

Number of Computers Connected to the Internet and Number
of Computer Networks

Date	Computers Connected	Networks
7/89	130,000	650
7/91	535,000	3,086
7/92	992,000	6,569
7/93	1,776,000	13,767
7/94	3,212,000	25,210
7/95	6,642,000	61,538
7/96	12,881,000	134,365

(Hobbes, 1997)

Present and Future Technologies

This study attempted to bring into focus the present and future facets of technology that require attention from school administrators. Sydow and Kirkpatrick (1992) noted that those who will be involved with planning for the educational use of technology need to be alert to future trends and directions in that technology, and that these planners cannot be limited in their thinking by what is currently available.

According to Liedtke (1993), the educational technology used to deliver instruction has evolved from 16 millimeter movies, 35 millimeter slides and filmstrips to VHS videotapes. Overhead projectors using plastic-based transparencies now show liquid crystal displays linked to personal computers. These types of media, noted Liedtke, are passive in nature. The user simply watches and listens. New types of educational media are more interactive in nature, offering manipulation of the texts and graphics. He gave as an example of expanding technology use the fact that only 30% of school districts in 1990 had laserdisc/CD-ROM players while 68% of school districts in 1993 had this type of technology.

Collins (1991) observed that technologies such as those

associated with computers and electronic networks have already found their way into the home and the workplace. What is used at work and at home will inevitably be used in the school.

It was about a decade ago that schools were getting their first microcomputer laboratories. Laboratories utilizing a variety of computer systems are now being developed in schools to encompass expanding technologies (National Association of Secondary School Principals, 1993).

Anderson (1993) added that peripheral devices used with computers led to the development of technology laboratories. Such peripherals include various types of printers, information storage devices such as the CD-ROM, hard drives, and tape drives, video accessories such as devices to convert television signals to computer screens and computer video to regular television screens, audiovisual equipment such as video cameras and laserdisc players, audio devices such as compact disc players and sound boards, telecommunications devices such as modems and facsimile (fax) machines, and scanners which can directly input text or images into a computer.

Bruder (1993) noted the development of laserdisc barcode technology that allowed interactive links between the

laserdisc and a computer. She also pointed out that a videodisc availability for high school students now accounts for nearly half of educational videodiscs. Hill (1993) drew attention to the "pocket power" of new computers under development. These computers, known as "palmtops," will be the size of a pocket notebook and will perform functions such as converting handwritten notes to text and transmitting a fax message from the palm of one's hand.

Murray (1993) referred to the hand-held digital units as PDA's (personal digital assistants). He noted the capability of such devices to send and receive fax messages, interface with electronic networks, and link with larger computers. According to Murray, the difference between the palmtop computer and the personal digital assistant is the latter's use of an electronic stylus to input information.

Hill (1993) drew attention to another technological innovation in preparation, the "whiteboard." An electronic replacement for the traditional blackboard, the so-called whiteboard would allow the educator or student to write on it as one would a traditional blackboard. The whiteboard would have additional capabilities such as calling up notes from the previous day and the ability to transmit notes to personal computers used by students. These computers would,

in turn, have the ability to send notes back to the whiteboard. An advanced model would even allow computer systems with color capability to save color illustrations used in the original lecture.

According to Pantelidis (1993), another technology that may impact upon education is virtual reality. This is a computer-based interactive system using multimedia to link the user with the computer to simulate a "virtually real" world. The computer screen is replaced by audiovisual inputs that give a sense of actual physical participation in the computer program. This can lead to the sensation of being in a remote environment with the ability to manipulate items at that remote site. Pantelidis cited educational uses such as interacting with real people in non-realistic ways, the creation and manipulation of abstract constructs, interaction with virtual beings such as historical figures, and having simulated access to remote locations not easily reached.

Kurshan (1991) pointed to the emergence of a global classroom. The school with such classrooms would span all ages, geographical areas, and all subject matter by using telecommunications networks. The explosion of knowledge and technology the world has experienced in the past few years

is on the way to the classroom of the near future. These global classrooms would necessitate the incorporation of many new technologies in the years ahead.

Administrators, Teachers, and Technology Integration

In a survey of principals and their use of computers for administrative tasks (Armistead, Cowden & Earthman, 1991), only half the principals questioned felt comfortable using their computers. The authors stressed the need for training in order to instill the comfort level necessary to effectively use computers. In a follow-up study, these same authors (1992) found principals increasingly using computers for administrative purposes. Roughly two-thirds of these principals had received computer training through college courses. Further, about 55% of those principals surveyed expressed a feeling of comfort in using the computers to handle administrative work.

Taking a more comprehensive view of the administrator and technology, Gillman (1989) described an administrative workstation involving both the reception and transmission of data via electronic communications. Such an administrative workstation is capable of plugging into what Kurshan (1991) characterized as an electronic network. She noted that such a network can offer electronic mail services,

teleconferencing abilities, electronic bulletin boards, and various databases from which administrators can draw needed information.

The fact that computer technology is not necessarily based in a single building or spot makes such technology much more applicable to administrative purposes. The New York State Education Department (1990) devised a long-range plan for pairing administrators with technology. In addition to calling for an administrative technology-based workstation to be provided at each school site and for the implementation of a network using computers and modems, the plan also called for portable workstations accessible by the administrators at home or at other locations beyond the school site. Further, the plan notes the need for the development of materials related to these media innovations aimed at training the administrators in the full use of these new technologies.

School administrators who look to the future face a meagre pool of technologically proficient teachers, according to Resta (1993). He feared that colleges of education have not kept up with the increasing integration of educational technology into the curriculum. Such limited training in this area has in turn led to a failure on the

part of some teachers to use technology in the curriculum and for personal productivity. Harrington (1993) said that many educators regarded effective technology training as essential to teacher education programs.

Society and Technology

Present and future administrators will be riding a societal wave of technological innovation. They will come from a society where technology is being used in shopping malls, libraries, businesses, homes, and other places outside the walls of academia, said Mecklenburger (1986). He observed that people tend to fear such change and thus postpone or fight that change. Nonetheless, such change is becoming an integral part of society's structure and, in the world of education, fiber optics and satellite systems are taking their places next to such traditional classroom tools as books and blackboards.

Indeed, entire towns have become electronically interactive. According to Schultz (1994), the Blacksburg Electronic Village project has linked homes, schools, civic offices, and the Virginia Polytechnic Institute & State University campus together with the local Bell Atlantic office and on into the Internet system. One educational benefit of the project is bringing the collected knowledge

of the world to schools. One of the goals of the project is to provide large amounts of information swiftly and inexpensively to anyone needing that information. Farragher (1995) noted that almost a third of Blacksburg's businesses and over 13,000 of the town's 36,000 residents have already connected to the network. One of the on-line features is the Blacksburg High School student newspaper. A school home page also is on-line, carrying information about various school departments and school schedules.

Educational Technology Summation

The expansion of multimedia technologies for education seems inevitable. Quality Educational Data, a research firm specializing in tracking the use of technology in school markets, measured a doubling of schools with interactive videodisc systems in 1992. In 1993, 21 per cent of all public schools in the United States were equipped with multimedia computers, videodisc decks, and other equipment capable of interactive audiovisual applications (Trotter, 1993). Baliles (1994) spoke of connecting education with what he called the technological information infrastructure.

Ravich (1992) observed that educational technology has a "relentless forward momentum" (p. 7). She also stated,

"Schools are all about projecting the world we want to live in." (p. 4). She emphasized the need for research in determining the future needs of education, including those needs in the area of educational technology.

Indicative of momentum in technology expansion is the expansion of CD-ROM technology. Shields (1994) pointed out that there were around 900,000 CD-ROM drives in use at the close of 1992. By the close of 1993, that figure had climbed to 10.5 million CD-ROM drives in use.

Sullivan (1992) asserted that educational planners of today have passed Alvin Toffler's "first wave" of technology, that being the treatment of technology as an object of instruction, and are now in the "second wave." The "second wave" uses technology as a means of accomplishing traditional educational objectives. He urged educational planners to reach the "third wave," that being the use of technology to enable learners and users to do new tasks as yet not thought of.

Technology is on the increase in the public schools of the United States (Bruder, 1993). As of October 1993, there was a computer for every sixteen students, and over half of all schools used computers in nearly every discipline. In addition, between half and three-quarters of

all school districts used cable television, satellite dishes, and telephone modems.

Delphi Technique

The Delphi technique was used to reach a consensus by experts in occupations and disciplines dealing with technology in the schools. A three-round Delphi study was conducted in order to reach a consensus among the panel of experts. A review of the literature relating to the efficacy of the Delphi technique was undertaken. Emphasis was placed on the educational applications of the Delphi technique and how the technique might be used in this study.

The Delphi technique originated in 1953, when Olaf Helmer and Norman Dalkey used of a group of experts to render opinions for a top secret military project being conducted by the Rand Corporation. The technique involved obtaining a reliable consensus from a group of experts. The model involved the repeated questioning of individuals using either interviews or questionnaires while at the same time avoiding having any confrontations between the experts. Such an approach promoted independent thought and avoided contamination of opinions by the persuasive advocacy of other experts (Helmer, 1983).

Croft (1989) pointed out that the Delphi technique

allows the researcher to gather information on a topic from both local and distant experts. He further stated that the method can be used to obtain information on current areas of interest as well as to make predictions about the future.

Weaver (1971) observed that the Delphi technique is intuitive in nature, with its original use being to harness the speculation of experts as to when an event might occur along a chronological timetable. Such a chronological approach to education must take into account the time lag between making a policy decision and having that decision make a measurable impact.

Weaver stated that education must become more future oriented. He cautioned that a statement on what the future holds cannot be proved false if it is critically accepted at the time it is made. Such speculation, no matter what the method used, can only be assessed as being reasonable at the time.

Even the most empirically sound assumptions are, at best, what Weaver termed items of rational persuasion. The use of the Delphi technique would hopefully generate a sound observation using controlled experts working toward a group norm using a compression of the group's estimates of the future as gathered through several rounds of inquiry.

In their early work in the area of the Delphi technique, Gordon and Helmer (1964) characterized prediction-making as a basic part of the technological and social worlds. They agreed with Weaver that no claims of reliability could be made of such future predictions.

They did note that such predictions decreased the chance of surprises and ultimately offered a sounder basis for decision-making than did pure intuition. This was not to say that such methodology was not without weaknesses. They pointed out the possibility of generating self-fulfilling or self-defeating predictions, the coloring of results based on the ambiguity of the questions, the problems with assessing the expertise of the participants, and the difficulty in accounting for the unexpected.

Snizek (1990) talked of judgmental forecasting as frequently being used by groups and, indeed, as being the favored forecasting approach used by organizations. The Delphi technique, being such a judgmental forecasting method, would overcome the unwelcome influence of variables such as status or confidence in favor of ability. This is accomplished through the Delphi practice of anonymity, thus sharply reducing data sharing and group interpretation. While the process led to group consensus, Snizek warned

that the inability to resolve differences generated by the process might be a weakness of the Delphi technique.

Dalkey (1967) identified several basic characteristics of the Delphi method:

1. Interaction and feedback: As each new stage of the Delphi is begun following the initial stage, the results of the previous stage are tabulated. Feedback to the Delphi group allows the individuals to reassess their responses in light of the feedback which informs the individual of the group's reaction.
2. Anonymity of individuals: There is no individual interaction among Delphi participants. Each response is confidential.
3. Statistical group opinion: An average of the responses to the final round of questions is calculated, incorporating the opinions of each group member into a final mass response.

Barnes (1987) cited a list of disadvantages formulated by Virginia Tech's Cooperative Extension Service relating to the Delphi method:

1. Judgments by a select group may not be representative of a larger population.
2. Extreme positions tend to be eliminated, thus forcing a

middle-of-the-line consensus.

3. The Delphi method consumes more time than does a normal group process.
4. It may be incorrect to view the Delphi results as a total solution.
5. The Delphi method requires written communication skills.
6. The Delphi method requires a good deal of time and commitment on the part of participants.

Helmer (1983) noted that the efficiency of the Delphi method applies well to the problems of planning public policy for education. He cited four characteristics of these problems:

1. Rapid technological change negates the luxury of slow changes from one generation to the next.
2. Problems tend to cut across several disciplines.
3. Future projections impacting public policy generally derive from individual expectations rather than from established theories.
4. Public policy implementation demands urgent action.

While Delphi studies were normally conducted through three successive rounds, some Delphi studies used four or five rounds (Shands & Levary, 1986). Delphi studies tended to be three-round constructs, as attrition became

a problem with too many rounds.

Brockhoff (1975) argued that the best results in a Delphi study were generally known by the third round. The addition of extra rounds might impair the results. Pfeiffer (1968), Halfin (1973) and Brooks (1979) concurred with Brockhoff about the efficacy of the three-round Delphi.

Summary of Review of Literature

The literature points to a rapid evolution in electronic educational technology. Current trends show a broad spectrum of increased use throughout the public education system.

Perlman (1990) was of the opinion that classroom technology usage was falling behind the usage curve of the world outside the public school. Brady (1993) looked back a decade to the time when \$1600 purchased a classroom computer with 48K memory with perhaps some audio from a tiny internal speaker. That same \$1600 would now buy a high-powered personal computer with capacious hard disk drive and high fidelity audio.

Eakin (1992) noted a widespead awareness among America's policymakers as to how technology could be used to strengthen education. She suggested that a seventh national educational goal should be added to the America 2000 plan: "By the year 2000, all schools will be supported

by sufficient telecommunications and electronic technology to provide efficient record keeping, customized instruction, distance learning, networking, and broad access to resources and data bases; and all students will leave school with a solid foundation of technological literacy" (p. 13).

The literature presented in this chapter would seem to indicate that the educational system is indeed moving in that direction. How far it may move by the year 2000 will, using the Delphi method of forecasting future trends, be the focus of this study.

Chapter III

METHODOLOGY

The purpose of this study was to identify those types of present and emerging educational technologies that would be used by students, teachers, and administrators in the K-12 schools of the year 2000. A Delphi study was devised to undertake this identification process. The conduct of the Delphi study is detailed in this chapter.

Delphi Questions

The Delphi technique was employed for this study. Field (1989) defined the Delphi technique as a means for reaching the consensus of a panel of experts in a particular field of study. Martorella (1991) noted the effectiveness of using the Delphi method in educational applications such as curriculum planning and goal setting. The technique is useful for initiating dialogue among anonymous experts.

Why is it important to determine what electronic technologies will be used in the K-12 schools in the near future? According to Reigeluth, Anelli, & Otto (1992), technology has evolved into a catalyst for restructuring schools. This technological revolution gives new powers to students, teachers, and administrators.

Because of the rapid evolution of electronic technology

now taking place, the researcher deemed it necessary to ask the Delphi panelists to consider both current and forthcoming electronic technologies. Two research questions were prepared to focus the Delphi panel on the answers:

1. What existing educational equipment or systems will be used by students, teachers, and administrators in the K-12 schools of the year 2000?
2. What emerging educational equipment or systems will be used by students, teachers, and administrators in the K-12 schools of the year 2000?

Identification and Choice of Panel Members

For the purposes of this study, a panel of educators and technologists was assembled. The task of the panel was to reach a consensus on the two research questions. Three rounds of questioning were devised in order to reach a consensus.

While Thurston and Chaves (1929) used 300 judges for their studies, Edwards (1957) contended that reliable data could be obtained with a smaller number of judges, though he did not numerically specify how smaller. In the study reported in this paper, the panel consisted of 57 persons for round one, 36 persons for round two, and 30 persons for round three.

The panel was drawn from members of state departments of technology in various states, public school system technologists and administrators, and from individuals and companies which deal in educational technologies. The companies ranged from computer manufacturers to electronics firms, and from communications companies to television stations). A list of such persons meeting the above criteria was obtained from The Yearbook of Experts, Authorities & Spokespersons (1991), through a review of literature related to the topic, through recommendations from faculty members of Virginia Polytechnic Institute & State University, and from the Virginia Department of Education. Members of the panel are listed in Appendix A.

Mailings to the Panelists

The individuals chosen by this process were contacted by mail or email (electronic mail via the Internet). They were told that they had been selected through criteria such as personal recommendations, their contributions to books or periodicals dealing with electronic technology, or by virtue of the positions they held in various organizations and businesses.

One hundred six prospective expert panelists were contacted by mail and an additional twenty seven were

contacted by email. Sixty-two accepted by mail the invitation to participate in this study and five accepted by email. Of them, 46 returned a preliminary questionnaire designed to gauge the panelists' awareness of present and emerging electronic technologies that might be used in the schools of the year 2000 (Table 3). The high percentages of recognition shown in the preliminary questionnaire satisfied the researcher as to the suitability of the respondents to participate on the Delphi panels. All demonstrated knowledge of electronic media and none were eliminated. The first round instrument was then mailed to the 67 respondents.

While the timing of each Delphi mailing was important to the study, two factors contributed to the need for a longer period of time than originally planned: (a) the study was conducted during the summer between traditional school years, and (b) extra time was needed to transmit complex information via the Internet to the foreign panelists. Because of the extraordinary amount of data generated by the second and third rounds and the limited capacity for electronic response by e-mail, the international panelists participated fully in round one but did not participate in the second or third rounds of the study. It was determined by the researcher that the amount

Table 3

**Number and Percentage of Panelists Who Were Aware of
Specific Current and Emerging Technologies (N=46) 1**

Technology Type	Awareness of Technology	
	<u>N</u>	<u>%</u>
Audio technologies		
Audio cassettes	40	86
Compact discs	40	86
Digital recording devices	20	43
Communications technologies		
Cellular telephones	35	76
Facsimile (FAX)	44	95
Voice mail	38	82
Computer technologies		
CD-ROM	43	93
Internet	41	89
Local area networks (LANs)	36	78
Modems	44	95
Personal computers (PCs)	46	100
Personal digital Assistants (PDAs)	23	50
Video technologies		
Cable television	42	91
Laserdiscs	40	86
Microwave television	25	54
Satellite television	36	78
Videocassettes	42	91

1

This survey was conducted prior to the three Delphi rounds in order to gauge the awareness of prospective panel members about current and emerging electronic technologies that are applicable to K-12 schools. Each panelist was asked to put a check mark beside each technology with which they were familiar. Forty-six panelists responded. The number to the right of each technology indicates how many panelists indicated a familiarity with that particular technology.

of typing necessary for a fully detailed response by e-mail would have been a disincentive for participation at this level by foreign panelists using e-mail. High cost for transmission of the large amount of information involved also was a disincentive for the use of facsimile (fax) transmission.

All members of the panel were requested to answer the questions presented to them with the assurance that their individual responses would be treated confidentially. The researcher was the panel coordinator and sent by mail the appropriate questions and tabulated responses to each individual panel member (Table 4).

Derivation of Seed Questions

It should be noted that a number of technological trends which might be of value when considering technology in the school of the year 2000 were identified in the review of literature pertinent to this study. It was from this review of literature that a list of seed questions was devised to initiate round one of the study. As recommended by Pfeiffer (1968), this first-round instrument did not specify a minimum or maximum number of responses.

Conduct of the First Delphi Round

The first round provided the panel with the seed

Table 4

Questionnaires Mailed and Returned by Delphi Round

	Round		
	One	Two	Three
Questionnaires Sent	67	52	36
Responses Received	57	36	30
Percentage Received	85	69	83
Removal Requested	4	0	0

questions (Appendix F). Panelists were asked to respond to the seed questions. Present and emerging educational technologies that might be used in the K-12 schools of the year 2000 were listed by the panelists.

It is important to stress that panel members had no knowledge of who proposed, lauded, criticized, or changed any original responses. All responses were treated in a confidential manner. Personality was excluded by use of the Delphi technique.

Conduct of the Second and Third Delphi Rounds

Based on a model by Foster and Kozak (1986), the list of identified educational technologies generated by the seed questions was edited to eliminate redundancy and to assure consistent phrasing. One hundred sixty-three listed technologies were edited to 116 items for the second round.

The second round of the Delphi allowed panelists to assign numerical ratings (one through four) which allowed means and standard deviations to be calculated for the various identified educational technologies. The ratings were on a scale of one to four expressing the panelist's opinion of how important a named electronic technology was likely to be in the K-12 schools of the year 2000.

Panelists were then provided with their individual round-two statement-by-statement ratings and the mean ratings of the panel as a whole. With the individual and group ratings in hand, they were asked again in round three to rate the importance of the educational technologies in K-12 schools of the year 2000.

Following the conclusion of round three, the results of the study were mailed to all of the panelists who participated in the study. A tabulation of the results was also electronically mailed to international participants via the Internet.

Research Chronology

1. Identify members of the expert panel.
2. Receive commitments by panel members volunteering to serve.
3. Mail/email Delphi round-one instrument along with instruction sheet to each panel member.
4. Send follow-up postcard to each panel member one week after sending Delphi round-one instrument.
5. Telephone nonrespondent panelists two days after return-date deadline of Delphi round-one instrument.
6. Analyze responses to Delphi round one. Create Delphi round-two instrument.

7. Mail Delphi round-two instrument along with instruction sheet to each panel member.
8. Send follow-up postcard to each panel member one week after sending Delphi round-two instrument.
9. Telephone nonresponding panelists two days after return-date deadline of Delphi round-two instrument.
10. Analyze responses to Delphi round two. Create Delphi round-three instrument.
11. Mail Delphi round-three instrument along with instruction sheet to each panel member.
12. Send follow-up postcard to each panel member one week after sending Delphi round-three instrument.
13. Telephone nonrespondent panelists two days after return-date deadline of Delphi round-three instrument.
14. Analyze responses to Delphi round three.
15. Write results of the study.
16. Provide all panel members with follow-up report of findings.

Analysis of the Data

In an interview conducted by Seevers (1993), J.C. Fortune, professor of educational research at Virginia Polytechnic Institute & State University, observed that the median and frequencies constitute the statistical analysis

of most Delphi studies. Barnes (1987) noted that means were also calculated in a number of Delphi studies. Means were used in this study. Mean scores were calculated on data collected with a four point scale: 1 = Very Unimportant, 2 = Unimportant, 3 = Important, 4 = Very Important. Scores below 3.00 were not eliminated from the third Delphi round but were included in the round-three instrument to ensure that panelists could reconsider all listed technologies, thus allowing for a further deliberation on the potential of these technologies.

The items were ordered from highest to lowest scale value after each Delphi round. Since this study used a rating of "3" to indicate a technology as "important," the researcher determined that any technology receiving a mean score of 3.00 or higher would likely be used.

Summary

In this chapter the design of the study has been described. Included in that description were the two seed questions and descriptions of the Delphi technique used to conduct the study and the analysis of the data.

A three-round Delphi procedure was used to collect data. An initial panel of sixty-seven members was chosen. The panelists were members of departments of technology from

state school systems across America, public school technologists and administrators, employees of companies dealing with educational technology, and international experts in the field of electronic technology.

These panelists were drawn from lists of such professionals provided by professional listing services, by faculty and professional recommendations, and by contacting persons identified through a review of the literature pertinent to this study. The panel members were chosen by postal query and asked to participate.

A short technology awareness survey questionnaire was included in the initial query. This simple preliminary survey was used to obtain an overall sense of the panelists' awareness of various electronic technologies (Appendix D). Based on the preponderance of high percentages of recognition of the various technologies, the researcher was able to demonstrate that the Delphi panel had an sufficient knowledge of these electronic technologies to have faith in the validity of their responses with respect to their use.

Chapter IV

FINDINGS OF THE STUDY

The purpose of this study was to identify present and emerging electronic technologies that would be likely or very likely found in the schools of the year 2000. A three-round Delphi was used as the appropriate research tool for conducting the study.

Results of Round One

The questionnaire (Appendix F) for round one asked panelists to identify existing or emerging technologies likely to be found in the K-12 schools of the year 2000. This produced 72 named current electronic technologies and 91 named emerging electronic technologies. These fifty current electronic technologies were retained and the seventy-three emerging electronic technologies were reduced to sixty-six to eliminate redundancies when used in round two (Table 5).

Results of Round Two

The second round instrument (Appendix G) containing the 50 current electronic technologies and 66 emerging electronic technologies identified by the panelists in round one was mailed to the 52 panelists who participated by post in round one. Thirty-six members completed and

Table 5

**Present and Emerging Technologies Named in Round One and
Number of Panelists Naming Each Technology**

Present Technologies	N
Audiovisual	
Videotape player	17
Laserdisc player	13
Liquid crystal display (LCD) projector	13
Camcorder	8
Overhead projector	7
Compact disc (CD) player	5
Digital camera	4
Video projector	4
Scan converter	3
Slide projector	3
Television production facility	3
Audiotape recorder/player	2
Compact disc (CD) recorder	1
Film projector	1
Phonograph	1
Communications	
Local-area network (LAN)	17
Satellite television receive only (TVRO)	13
Television	13
Modem	11
Cable television	7
Internet	7
Microwave audiovisual	7
Wide-area network (WAN)	7
Telephone (wired)	3
Wireless communications	3
Fiber optics	2
Video on demand	2
Pager	1
Quick time digital video	1
T1 voice/data/video transmission	1
Electronic/Mechanical	
Printer	5
Scanner	4
Copier	2
Probeware	2
Adaptive devices for special needs population	1

Autocad	1
Key response pad	1
Robotics	1
Information systems	
Desktop/laptop personal computer (PC)	24
CD-ROM (compact disc read only memory)	23
Multimedia interactive	9
Fax (facsimile)	7
Email	5
Personal digital assistant (PDA)	4
Voice mail	4
White board	4
Calculator	1
Compact disc interactive (CDI)	1
Hypertext/hypermedia	1
Optical disc	1
<hr/>	
Emerging Technologies	<u>N</u>
<hr/>	
Audiovisual	
Large video screen	3
Digital camera (still)	3
Video editing	2
Videodisc player	2
Videotape recorder (VCR)	2
Digital camera	1
Live class-to-class audiovisual feed	1
Communications	
Wireless connectivity	12
Satellite downlink	11
Internet	10
Wide-area network (WAN)	8
Local-area network (LAN)	6
Modem	5
Cellular telephone	4
Very small aperture terminal (VSAT)	4
Video conferencing	4
Desktop video conferencing	3
Fax (facsimile)	3
Fiber optic LAN/WAN (local-area network/wide area network)	3
Telephone access to all classrooms	2
Cable television	2
Interactive television	2
Networking in all classrooms	2

Online connections	2
World-wide web (WWW)	2
Broadband network	1
Desktop computer/video conferencing	1
Direct broadcast satellite (DBS)	1
Ethernet	1
Global computing/telecommunications	1
Multicast television (Internet M-Bone)	1
Quick-time digital video	1
Video compression	1
Electromechanical	
Autocad	1
Copier	1
Covert/overt surveillance	1
Identification chips (in teeth or other body parts)	1
Knowbots	1
Non-keyboard input devices	1
Scanner	1
Thumb print/voice print/retinal scanner	1
Transparent multifunctional video system via infrared with point and click capacity and voice activation (VOX)	1
Voice-to-text transcription	1
Information Systems	
Multimedia computer systems	14
CD-ROM interactive	9
Personal digital assistant (PDA)	7
Virtual reality	7
White board	4
Centralized retrieval systems	3
Compact disc (CD) interactive	3
Fax (facsimile)	3
Teacher work stations	3
Voice-to-computer technology	3
Administrative management systems	2
Building-wide data retrieval	2
Data access systems	2
Electronic bulletin board	2
Email	2
Student work stations	2
Voice mail	2
Computer two way	1
Electronic publishing	1
Electronic university	1

Full motion computer/CD-ROM	1
Handheld computer	1
Hypertext/hypermedia	1
Improved graphics	1
Interactive media	1
Laptop personal computer (PC)	1
Panaboard	1
Power-enhanced computer	1
Simple text sound	1
Single-box laser printer/scanner/copier/fax	1

returned the instrument for round two. No further members indicated the need for removal from the panel.

A standard for consensus was established for the final round: Each criterion would need to achieve a round-three mean of 3.00 ("Important" usage in the year 2000) or above to be considered as being likely or very likely to be used in the K-12 schools of the year 2000. For round two, 40 of the 50 current electronic technologies on the list achieved a score of 3.00 or higher, while 58 of the 66 emerging electronic technologies achieved a score of 3.00 or higher. The group mean was calculated for each present and emerging electronic technology (Table 6).

Results of Round Three

The third-round instrument (Appendix H) containing 50 present electronic technologies and 66 emerging electronic technologies was mailed to the 36 members of the expert panel who participated in round two. Thirty panelists participated in the third round.

In order to be considered as being likely or very likely to be used in the K-12 schools of the year 2000, each technology had to achieve a mean score of 3.00 out of a possible 4.00.

Of the 50 present technologies listed in round three,

Table 6

Importance of Present and Emerging Technologies in the Year 2000--Round Two Number of Respondents, Mean, and Standard Deviation by Technology

Present Technologies	<u>N</u>	<u>M</u>	<u>SD</u>
Audiovisual			
Compact-disc player	36	3.41	.692
Camcorder	36	3.38	.640
Scan converter	32	3.37	.667
Digital camera (still motion)	35	3.31	.586
Flex cam	36	3.19	.627
Video projector	36	3.16	.776
Compact-disc recorder	36	3.14	.758
Television production facility	35	3.14	.733
Video player/recorder (VCR)	36	3.08	.633
Liquid-crystal display (LCD) projector	36	2.97	.813
Overhead projector	36	2.77	.902
Laserdisc player	36	2.72	.915
Audiotape player/recorder	36	2.30	.749
Slide projector	36	1.77	.678
Film projector	36	1.55	.505
Phonograph	36	1.36	.593
Communications			
Local-area network (LAN)	35	3.74	.855
Wide-area network (WAN)	35	3.74	.855
Internet	36	3.72	.456
Fiber-optic interconnect	36	3.61	.597
Modem	36	3.58	.557
Cable television	36	3.47	.559
Satellite television receive only (TVRO)	36	3.44	.687
Telephone (wired)	36	3.41	.556
Television	36	3.41	.605
T1 voice/data/video transmission	34	3.40	.670
Quick-time digital video conferencing	35	3.34	.595
Facsimile (fax)	36	3.30	.716
Microwave audio/visual	35	3.14	.648
Pager	35	2.42	.980
Electromechanical			
Adaptive devices for special needs population	36	3.72	.413
Printer	36	3.66	.482

Probeware	30	3.36	.556
Scanner (print)	35	3.25	.596
Robotics	35	3.11	.674
Copier machine	36	3.08	.734
Key-response pad	36	2.91	.693
Autocad	31	2.90	.650
Information systems/devices			
Desktop/laptop personal computers	36	3.91	.371
Email	35	3.85	.351
Multimedia interactive	36	3.80	.401
CD-ROM (interactive)	36	3.66	.538
Hypermedia/hypertext	35	3.51	.507
Calculator (electronic)	36	3.44	.649
Word processor	36	3.44	.649
Voicemail	36	3.36	.600
Video on demand	35	3.28	.715
Whiteboard	34	3.11	.767
Virtual reality	36	3.05	.859
Personal digital assistant (PDA)	33	3.00	.661

Emerging Technologies

N M SD

Audiovisual

Large screen projection	35	3.62	.485
Digital video editing/storage/playback	34	3.44	.555
Digital camera (still motion)	34	3.26	.667
Video editing	35	3.25	.655
Videodisc player	36	2.86	1.04
Videotape player/recorder (VCR)	35	2.82	.921

Communications

Telephone access to all classrooms	35	3.82	.450
Building-wide data network	36	3.80	.401
World-wide web (WWW)	36	3.77	.418
Local-area network (LAN)	34	3.76	.413
Internet	36	3.75	.436
Fiber-optic LAN/WAN	34	3.70	.524
Global communication/telecomputing	36	3.66	.585
Wide-area network (WAN)	35	3.63	.448
Wireless connectivity (modem/LAN)	36	3.58	.652
Video compression	34	3.55	.663
Video conferencing	36	3.54	.658
Broadband network	32	3.53	.680
Modem	34	3.52	.563
Satellite television receive only (TVRO)	35	3.51	.554

Cable television	36	3.44	.712
Interactive television	36	3.38	.689
Ethernet	35	3.37	.767
Interactive television	36	3.37	.690
Multicast television (Internet M-bone)	33	3.36	.699
Facsimile (fax)	36	3.27	.657
Quick-time digital video conferencing	34	3.26	.812
Desktop computer video conferencing	34	3.23	.901
Cellular telephone	35	3.22	.771
Desktop video/audio conferencing	34	3.14	.926
Very small aperture terminal (VSAT)	28	3.03	.885
Electromechanical			
Non-keyboard input devices	35	3.34	.768
Scanner (print)	35	3.20	.584
Voice-to-text transcriptions	35	3.20	.677
Autocad	30	3.12	.667
Transparent multifunctional video via infrared with point & click and voice activated (VOX) commands	30	3.06	.874
Copier	36	3.00	.676
Knowbots	27	2.88	.698
Covert/overt video surveillance	34	2.79	.842
Thumbprint/voiceprint/retinal readers	34	2.44	.925
Identification chip in tooth or other body part	33	1.90	.947
Information systems/devices			
Centralized retrieval system (home/school/office)	33	3.78	.417
Multimedia computer systems	35	3.77	.487
Email	36	3.75	.436
Teacher work stations with delivery to classrooms	35	3.74	.446
Laptop computers	36	3.72	.442
Full-motion video on computer	36	3.66	.539
Student work stations	35	3.65	.488
Administrative management systems	36	3.61	.492
Hypermedia/hypertext	35	3.60	.497
Optical disc (combines CD-ROM and laserdisc)	34	3.52	.540
CD-ROM (play/record)	36	3.50	.655
Electronic bulletin board	35	3.48	.507
Data-access systems	32	3.46	.505
Compact disc (CD interactive)	36	3.44	.770
Power-enhanced computer/printer/modem	32	3.39	.648
Single-box laser/scanner/copier/fax	35	3.31	.707

Voice mail	35	3.31	.743
Improved graphics	35	3.30	.511
Personal digital assistant (PDA)	34	3.29	.716
Electronic university	34	3.26	.620
Electronic publishing	35	3.22	.576
Video on demand	36	3.20	.715
Virtual reality	36	3.19	.824
Whiteboard	35	3.05	.804
Videotext	34	2.97	.732
Simple text sound	32	2.90	.641

39 of the 50 (78%) achieved a score of 3.00 or higher, while of the 66 emerging technologies in round three, 55 of 66 (83%) achieved a score of 3.00 or higher. The results are listed in Table 7. The third-round instrument is contained in Appendix H.

The various technologies were placed in one of four categories: (1) Audiovisual, (2) Communications, (3) Electromechanical, and (4) Information Systems/Devices. These four categories encompass four major functions of electronic technology.

"Audiovisual" involves that technology used to record/reproduce audio and video material. "Communications" deals with that technology used to send information from one point to another. "Electromechanical" involves equipment that is electronically assisted to perform a physical task. "Information Systems/Devices" deals with technology used to store and retrieve data.

Table 7

**Importance of Present and Emerging Electronic Technologies
in the Year 2000--Round-three Number of Respondents, Mean,
and Standard Deviation by Technology**

Present Technologies	<u>N</u>	<u>M</u>	<u>SD</u>
Audiovisual			
Camcorder	29	3.39	.620
Digital camera (still motion)	30	3.30	.535
Scan converter	29	3.28	.552
Compact-disc player	30	3.26	.741
Flex cam	30	3.26	.642
Compact-disc recorder	30	3.13	.762
Video projector	30	3.13	.546
Video-cassette player/recorder (VCR)	30	3.10	.607
Television production facility	30	3.06	.642
Liquid crystal display (LCD) projector	30	2.90	.759
Laserdisc player	30	2.80	.761
Overhead projector	30	2.73	.800
Audiotape player/recorder	30	2.13	.711
Slide projector	30	1.56	.623
Film projector	30	1.33	.548
Phonograph	30	1.23	.501
Communications			
Internet	30	3.80	.381
Fiber-optic interconnect	30	3.70	.535
Local-area network (LAN)	30	3.70	.463
Wide-area network (WAN)	30	3.70	.535
Modem	30	3.56	.630
T1 voice/data/video transmission	30	3.50	.572
Telephone (wired)	30	3.43	.504
Facsimile (fax)	30	3.40	.621
Television	30	3.40	.621
Cable television	30	3.36	.556
Quick-time digital video conferencing	30	3.30	.534
Satellite television receive only (TVRO)	30	3.30	.722
Microwave audio/visual	30	3.10	.712
Pager	30	2.20	.925
Electromechanical			
Adaptive devices for special needs population	30	3.80	.407
Printer	30	3.66	.473

Scanner	30	3.26	.453
Probeware	28	3.25	.737
Copier machine	30	3.10	.711
Robotics	30	3.03	.623
Autocad	29	2.83	.603
Key response pad	30	2.80	.737
Information Systems/Devices			
Desktop/laptop computers	30	3.90	.403
Email	30	3.83	.647
Multimedia interactive	30	3.80	.407
CD-ROM interactive	30	3.56	.673
Hypermedia/hypertext	30	3.50	.371
Word processor	30	3.50	.609
Calculator	30	3.46	.563
Voice mail	30	3.36	.615
Video on demand	30	3.23	.677
Whiteboard	30	3.06	.624
Virtual reality	30	3.00	.766
Personal digital assistant (PDA)	30	2.90	.672
Emerging Technologies	<u>N</u>	<u>M</u>	<u>SD</u>
Audiovisual			
Large-screen projector	30	3.63	.493
Digital video editing/storage	30	3.36	.556
Digital camera (still motion)	30	3.30	.535
Video editing	30	3.10	.712
Videodisc player	30	2.76	.777
Videocassette player/recorder (VCR)	30	2.66	.847
Communications			
Telephone access to all classrooms	30	3.86	.435
World-wide web (WWW)	30	3.86	.346
Local-area network (LAN)	30	3.83	.381
Wide-area network (WAN)	30	3.80	.407
Building-wide data network	30	3.76	.433
Fiber-optic LAN/WAN	30	3.76	.507
Global communications/telecomputing	30	3.76	.433
Internet	30	3.72	.523
Wireless connectivity	30	3.63	.559
Modem	30	3.60	.505
Video compression	30	3.60	.563
Broadband network	30	3.53	.569
Video conferencing	30	3.50	.572
Ethernet	30	3.43	.661
Voice mail	30	3.43	.564
Cable television	30	3.40	.545

Desktop computer video conferencing	30	3.40	.847
Facsimile (fax)	30	3.40	.557
Interactive television	30	3.36	.719
Multicast television (Internet M-Bone)	30	3.36	.615
Satellite television receive only (TVRO)	30	3.36	.669
Desktop video/audio conferencing	30	3.30	.877
Quick-time digital video conferencing	30	3.26	.741
Cellular telephone	30	3.13	.689
Very small aperture terminal (VSAT)	28	2.92	1.01
Electromechanical			
Non-keyboard input devices	30	3.36	.669
Voice-to-text transcription	30	3.33	.548
Scanner	30	3.23	.549
Copier	30	2.96	.672
Autocad	29	2.89	.544
Transparent multifunctional video via infrared with point & click and voice actuated (VOX) commands	29	2.86	.860
Covert/overt video surveillance	30	2.83	.747
Knowbots	25	2.72	.815
Thumbprint/voiceprint/retinal scanner	30	2.40	.894
Identification chip in tooth or other body part	30	1.93	.944
Information Systems/Devices			
Teacher work stations	30	3.86	.346
Email	30	3.80	.407
Student work stations	30	3.80	.407
Multimedia computer system	30	3.76	.524
Administrative management system	30	3.73	.446
Centralized retrieval system (home/ school/office)	29	3.72	.457
Laptop computers	30	3.70	.535
Full-motion video on computer	30	3.66	.484
Optical disc (combines CD-ROM and laser disc)	30	3.66	.590
Hypermedia/hypertext	30	3.60	.498
Electronic bulletin board	30	3.53	.507
Data-access systems	29	3.51	.507
CD-ROM play/record	30	3.50	.630
Electronic publishing	30	3.46	.506
Compact disc (interactive)	30	3.43	.724
Desktop computer video conferencing	30	3.40	.855
Power-enhanced computer/modem	28	3.39	.572

Personal digital assistant (PDA)	30	3.33	.662
Improved graphics	30	3.30	.535
Electronic university	30	3.26	.585
Single-box laser/scanner/copier/fax	30	3.26	.693
Virtual reality	30	3.10	.845
Whiteboard	30	3.10	.607
Videotext	30	3.00	.525
Simple-text sound	29	2.79	.555

CHAPTER 5

SUMMARY, CONCLUSION, DISCUSSION, AND RECOMMENDATIONS

This study is a look into the very near future of electronic educational technology and its use in the K-12 public schools. An expert panel of individuals working with technology in various ways was assembled to participate in a Delphi study to offer their opinions on what technology would be used in the schools in the year 2000. The data was collected from winter 1994 to fall 1995.

Summary of Results

The types and configurations of electronic technologies currently available or emerging from development for use in the classrooms of schools in the near future is of vital concern to teachers, administrators, technologists, manufacturers, and developers who deal with the dissemination and use of such technologies. The purpose of this study was to assemble an expert panel in order to estimate from mean scores what present and emerging technologies one might find important to the K-12 schools of the year 2000.

Those in the business of developing or manufacturing such technologies might also have an interest in these estimates. Because of the lead time needed to secure

technical designs and materials, an estimate of what might actually be used in the schools would perhaps allow for perhaps more accurate planning and implementation on the part of these businesses. Peripheral agencies such as operators of information networks and educational broadcasting operations would also have possible uses for such predicted information as this information would allow these entities to tailor their operations to interact with these technologies.

The research methodology used to arrive at these estimates was a three-round Delphi study. This study began with an expert panel of 57 teachers, school technologists, administrators, consultants, and persons employed in the manufacturing of electronic technologies used for educational purposes.

Round one of the study identified 116 existing and emerging electronic technologies that might be important to the K-12 schools of the year 2000. These technologies were then grouped into four main categories: (1) Audiovisual, (2) Communications, (3) Electromechanical, and (4) Information Storage/Retrieval. Following round one, the panel was reduced from 57 to 36 members due to fewer panelists electing to participate in the second round and the

logistical difficulties involved in using email to send large amounts of data to the five international participants.

The panel for round two was given the task of rating each named technology on a scale from one to four (1=very unimportant, 2=unimportant, 3=important, 4=very important). This allowed the researcher to compute a group mean for each named technology and rank the technology according to score as well as category. The major categories remained (1) Audiovisual, (2) Communications, (3) Electromechanical, and (4) Information Storage/Retrieval.

In the ratings presented by the expert panel in the second round, 40 of the 50 present technologies and 58 of the 66 emerging technologies achieved a mean score of 3.00 or better.

The expert panel was further reduced to 30 members for the third round due to fewer panelists electing to participate. Each member was given a list of the 116 technologies from round two. Next to each listed technology was the individual panelist's rating for round two and the mean score from round two. Each panelist was instructed to rate each electronic technology on a scale of one to four as to the importance of that technology to the K-12 schools of

the year 2000.

According to the returns, 39 of the 50 present technologies and 55 of the 66 emerging technologies were predicted as likely or very likely to be important to the K-12 schools of the year 2000.

Conclusions

What has emerged from round three of this study are two definite concepts: networking and multifunctionality. They are interrelated in that networking capacity is often a major function of multifunctionality and vice-versa.

In the rankings of the top ten items under the banner of present technology, networking accounts for five of the criteria named. Email, which is accomplished through a network of computers, is second only to computers themselves in the rankings. The Internet, that vast and rapidly growing computer network, ranks fourth. Fiber optic interconnects, the advanced in-ground networking technology, ranks sixth. Local-area networks (LANs) and wide-area networks (WAN's) hold seventh and eighth places.

Third-round predictions for emerging technology demonstrate the evolution of networking to be even stronger. Telephone access to all classrooms, a simple networking scheme but one with vast possibilities, is ranked second to

teacher workstations (which would in all probability be networked to classrooms and other school sites).

The computer network known as the World-Wide Web ranks third, with local area-networks (LANs) fourth, email fifth, student work stations (obviously networked to various sources) sixth, wide-area networks (WANs) seventh, building-wide data networks eighth, fiber-optic LANs/WANs ninth, and global communications/telecomputing-- the ultimate in networking-- in tenth place. In sum, all ten of the top-ranked emerging technologies deal with networking. The inference drawn from these findings is that interconnectability--the evolution of connections to form networks--will play a major role in educational technology in the near future.

Next to networking comes multifunctionality. In the rankings of present technologies, multimedia (interactive) ranked fifth, adaptive devices with implied multifunctional capabilities ranked third, and CD-ROM (interactive) ranked tenth. In the emerging technology predictions, networking functions using multifunctionality (teacher work stations and student work stations) ranked in the top ten; and multifunctional computer systems held eleventh place, followed by another multifunctional technology,

administrative management systems, in twelfth place.

Fehr-Snyder (1995) points out that more than 60,000 different computer networks are now interwoven into the system known as the Internet. This system is global in reach and is expected to expand to more than 1.5 million interconnected networks within the next decade.

The personal computer, which drew the highest ranking in round three of this study, is the principal connective and multifunctional device. According to Debenham and Smith (1994), predictions call for 80% of all families in the U.S. to own computers by the year 2000. This figure does not include those computers already accessible to students, teachers, and administrators in schools.

Because the research instrument used in this study asked panelists to rate the importance of educational technologies, it must not be assumed that technologies with lower rankings will disappear from use in the schools. The sheer number of phonographs, slide projectors, and other older technologies is argument enough for their continued use, albeit in a declining situation as these technologies are replaced by newer technologies.

The inference to be drawn from these findings is that devices used in educational applications are evolving

from single-purpose uses to multiple uses. Stand-alone, single-use items such as calculators or camcorders will still be in use in the near future, but emerging devices will likely be capable of several tasks. As noted earlier, these devices will likely be interconnectible as well.

Discussion

The Delphi technique was useful in identifying a broad range of present and emerging technologies to bring before the expert panel. The response time was slightly greater than anticipated, partly due to conducting a large size of the questionnaire and partly due to conducting a portion of the research over what is traditionally a summer break for educators. Responses to the questionnaire took up to six weeks, and the responses were received by postal mail due to the size of the questionnaire.

The time span notwithstanding, the Delphi method allowed a response that covered a broad geographic and occupational range. Such an expert panel would have been impossible to assemble in one place due to insurmountable difficulties with scheduling and with the sheer expense that would have been involved.

The diversity of the Delphi panel was one of the strengths of this study. Panel members held positions that

enabled them to view electronic technology from a variety of vantage points, ranging from manufacturing and marketing to administrative and classroom applications.

Limitations of the study include the omission of those technological advances that have been happening too rapidly even for a predictive study of close proximity to the year 2000. Also, variable levels of expectation on the part of the panelists might affect the results (e.g., a researcher might not take into account that the manufacturing cost of a breakthrough could be beyond a typical school division's financial resources).

While the higher importance scores were generally given to the latest developments in technology, a few oddities surfaced during the study. One was that copiers were listed by the panelists as an emerging technology. This might possibly be explained by the evolution of copier technology in the past few years (i.e. affordable color copying, transmission of copied data to other media). Also, the weak showing of overhead projectors, still seemingly a staple of classrooms, was a bit surprising as well as was the weak showing of pagers, a technology both ubiquitous and affordable. Again, the lower rating of overhead projectors might indicate a belief that this traditional method is

being replaced by the conversion of transparency material to electronic imagery; and the lower ranking of pagers may be accounted for by the stigma of illegal usage often associated with them.

Among the surprises were the very strong showings of administrative management systems and teacher work stations. These systems are costly and do not seem to be found very often in today's schools. The strong showing of this phase of technology might have significant monetary and space considerations for school districts.

Another surprising showing came with T1 voice/data/video transmissions, a very expensive technology requiring a major installation of new telephone line capacity for a school or school division. Coordinating with suppliers and allocating the necessary funds for acquiring this technology is necessary for a school to access this service.

From the tabulated ranked results of the third Delphi round, one can see certain patterns beginning to emerge. The two principal patterns are capacity of technology for multitasking and the ability of the technology to interconnect with other multiple users and other locations.

Other patterns demonstrate a physical reduction in the

size of technologies and the movement away from technologies that still use paper or celluloid products (copy machines, overhead projectors, film projectors) to equipment that uses liquid crystal or digitally projected displays (liquid crystal display projectors, personal digital assistants, virtual reality devices). These patterns could be of considerable importance to the educator planning operations, purchasing, or curriculum development in the school of the year 2000.

These trends could also have relevance for the industries involved in creating electronic technology that will be important in the very near future, incorporating the desirability of making technology multifunctional and interconnectible rather than single functional and unconnectible. Such knowledge might tend to slow obsolescence in such technology.

Evans (1979), predicting technological change that would take place by the year 2000, supposed that more changes would take place in the years 1980-2000 than in the century and a half preceding those two decades. Feigenbaum and McCorduck (1983) warned that predictions about reasoning machines were almost laughable in that predictions are extrapolated from known constants and that the evolution and

change of these reasoning machines constitute unknown territory, thus defying reasonable predictability.

It would appear as though a short-term prediction would be more accurate, and the expert panelists in this study have listed individual types of technology that can be grouped into patterns, meaning the combination of singular technologies into multifunctional systems. Ehrenkrantz and Eckstut (1995) noted that this country enters a new technological phase every four years. They pointed out that the 1990 wonders such as video games and facsimile machines have quickly given way to more advanced technological innovations. They emphasized the need for flexibility, diversity, and the capability for expansion in the schools of the future. In light of the data in this study, the developing patterns in electronic technology (multifunctionality, interconnectivity, digitization) would appear to be in synchronization with the need for such flexibility, diversity, and expansion.

A caveat must be added. It cannot be assumed that the increasing sophistication of electronic technology, the increased accessibility of such technology, or even the lowering of prices in certain areas of technology will assure any equity in the distribution and use of such

technology. In a report on educational disparities prepared by the Virginia Education Association (1996), one can see a broad range of capital outlays in the 1994-1995 period. The disbursements for instruction, which included media, ranged from \$6.764 for Arlington to \$4.371 for Roanoke County to \$3,261 for Appomattox. The availability of funds and the decisions to use available funds will continue to cause disparity in the implementation of present and emerging electronic technologies.

Recommendations

Based on the review of literature and the three-round Delphi study undertaken by this researcher, certain patterns in the evolution and implementation of electronic technologies in education have been identified and discussed. In light of the findings, several recommendations are offered for consideration

First, an expansion of the international component of this line of study would enhance the applicability of the findings to schools on an international basis. Due to technical restrictions on being able to send large questionnaires in an easily handled manner to email users, foreign participation in this study was limited. Improvement in scanner technology may make the use of large

questionnaires more practical to handle via networked computers.

Second, because schools use traditional planning cycles that are updated each year, follow-up studies or monitoring based on this study would generate ongoing precise predictability. For example, the United States Department of Education or education departments in state governments could monitor developments and conduct periodic scans of technology development.

Third, close scrutiny of all electronic technologies and the possible applications of any technologies to educational needs is also recommended. To convolute George Santayana's famous saying about those ignorant of history being doomed to repeat it, this study suggests that those ignorant of the evolution of educational technology are doomed to have to catch up with those changes.

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Appendix A.

Members of the Delphi Panel

Members of the Delphi Panel

Numerals following names indicate participation in Delphi rounds one, two, or three.

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Appendix B.

Letter of Solicitation to Prospective Panelists

.



Nov. 29, 1994

Dear

Educational technology is evolving rapidly. Educators have great difficulty keeping pace with this evolution. The lag from development to school application may be several years. Staff development for teachers and administrators is needed to reduce this lag. Anticipation of technological innovations would permit staff development specialists and school plant designers to make preparations to move these technological innovations into the schools more quickly.

To help these specialists reduce the lag from technological innovation to application, we are conducting a Delphi study to determine the electronic technologies that are anticipated to be in use in K-12 schools and classrooms by the year 2000.

Because of your position and expertise, your opinions and judgements are important to us. We invite you to serve on a Delphi panel to help identify these technologies.

The Delphi study will have three rounds. In round one you will be asked to identify electronic technologies you believe will be in use in schools and classrooms by the year 2000. In rounds two and three you will be asked to make judgements about the technologies identified in round one. Each round will take about 30 minutes of your time. All three rounds should be completed by the end of March 1995.

Your participation in the study will be very much appreciated. Please indicate your decision by returning the enclosed response form.

The information provided by you will be confidential. Your name will appear only in a list of participants.

Thank you for your consideration. If you have questions, please call Raymond Jones at (804)489-9476 or (804) 436-5642, or use e-mail to rjones@whro-pbs.org.

Sincerely Yours,

Raymond Jones
Doctoral Candidate

David Parks
Professor

Nov. 29, 1994

Dear

Educational technology is evolving rapidly. Educators have great difficulty keeping pace with this evolution. The lag from development to school application may be several years. Staff development for teachers and administrators is needed to reduce this lag. Anticipation of technological innovations would permit staff development specialists and school plant designers to make preparations to move these technological innovations into the schools more quickly.

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Your participation in the study will be very much appreciated. Please indicate your decision by returning the enclosed response form.

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Thank you for your consideration. If you have questions, please call Raymond Jones at (804)489-9476 or (804) 436-5642, or use e-mail to rjones@whro-pbs.org.

Sincerely Yours,

Raymond Jones
Doctoral Candidate

David Parks
Professor

Appendix C.

Panelist Response Form

Panelist Response Form

YES I would like to be a member of the Delphi panel to identify educational technologies used in the public schools of the year 2000.

NO I am not able to be a member of the Delphi panel.

(Please check the appropriate response. If you wish to serve, please fill in all pertinent data. If you do not wish to serve, please return this form, with your name, in the enclosed stamped envelope or by e-mail so that we may confirm panel membership.)

Panelist Information

NAME:

ADDRESS:

PHONE NUMBER: (_____) _____ ext _____

FAX NUMBER: (_____) _____ ext _____

ELECTRONIC
MAIL ADDRESS:

POSITION:

COMMENTS:

RETURN TO: Raymond T. Jones/David J. Parks
401 East Eggleston
College of Education
Virginia Tech
Blacksburg, VA 24061-0302
rjones@whro-pbs.org

Appendix D.

Electronic Technology Awareness Survey

Electronic Technology Awareness Survey

In order to briefly assess your awareness of various electronic technologies, please check off those types of technologies with which you are familiar. Please enclose this survey with your participation response.

Video Technology

- Satellite television
- Microwave television
- Cable television
- Videocassettes
- Laserdiscs

Computers

- Personal computers (PCs)
- Personal digital assistants (PDAs)
- CD-ROM
- Modems
- Local area networks (LANs)
- Internet

Audio Technology

- Audio cassettes
- Compact discs
- Digital recording devices

Telephone Technology

- Cellular telephones
- Facsimile (fax)
- Voice mail

Appendix E.

International Email Message Samples

Mime-Version: 1.0
 Content-Type: text/plain; charset="us-ascii"
 To: rjones@whro-pbs.org
 From: caroline@ic.uva.nl
 Subject: Delphi-study
 Status: RO

Hallo mr. Jones,

I'd like to participate in the Delphi-study concerning the use of electronic technology in the classroom. I work at the IT-department of the University of Amsterdam and graduated 6 years ago in child education and psychology.

There are 32 lines left (40%). Press <space> for more, or 'i' to return.
 ALT-F10 HELP * VT-100 * FDX * 2400 N81 * LOG CLOSED * PRT OFF * CR * CR

Name: Caroline van Amerongen
 Adress: caroline@ic.uva.nl
 Positon: Marketing and PR
 Additional comments:

I'm very interested to eventually recieve the result of this study.
 Is it your intention to have members from European countries in this panel?

Familiar with:

- * satellite and cable television
- * videocassettes
- * PC/MAC
- * CD-ROM
- * modems
- * LAN's
- * Internet
- * audio cassettes
- * CD
- * telephone
- * fax

 There are 10 lines left (81%). Press <space> for more, or 'i' to return.
 ALT-F10 HELP * VT-100 * FDX * 2400 N81 * LOG CLOSED * PRT OFF * CR * CR

<http://www.informatik.tu-muenchen.de/~stumpf/>

Command ('i' to return to index):

ALT-F10 HELP * VT-100 * FDX * 2400 N81 * LOG CLOSED * PRT OFF * CR * CR

From Germany.EU.net!Joerg.Heitkoetter Tue Feb 7 08:13:06 1995
Return-Path: <Joerg.Heitkoetter@Germany.EU.net>
Received: by whro-pbs.org (/=\=/\ Smail3.1.28.1 #28.10)
id <mOrbpj3-0002YGC@whro-pbs.org>; Tue, 7 Feb 95 08:13 EST
Received: by mail.Germany.EU.net with ESMTTP (8.6.5:29/EUnetD-2.5.1.c) via EUnet
id OAA21931; Tue, 7 Feb 1995 14:12:11 +0100
Message-Id: <199502071311.OAA28500@jazz.Germany.EU.net>
Received: from localhost.Germany.EU.net
by jazz.Germany.EU.net with SMTP (8.6.4/EUnetDlan-1.13-1.1.7)
via EUnet for [mail.germany.eu.net]
id OAA28500; Tue, 7 Feb 1995 14:11:08 +0100
To: rjones@whro-pbs.org
Subject: Re: Become a Delphi Study Panel Member
In-reply-to: Your message of "Mon, 06 Feb 1995 14:36:00 EST."
<mOrbZEN-0001gtC@whro-pbs.org>
Date: Tue, 07 Feb 1995 14:11:02 +0100
From: Joerg Heitkoetter <Joerg.Heitkoetter@Germany.EU.net>
Status: RO

Appendix F.

Round-One Delphi Questionnaire



March 13, 1995

Dear -----:

Thank you for your willingness to serve as one of the experts on the international Delphi panel to predict educational technology that will be used in the K-12 schools of the year 2000.

Enclosed are instructions and questions for round one of the study. The questionnaire has a label with your name on it. Your responses will be held in strict confidence. The label for those queried by mail is for data processing only. A prompt response will help facilitate completion of this study. The results of the research will be made available to you at the conclusion of this study.

Should you have any questions, please call Raymond Jones at (804) 489-9476 or (804) 436-5642. You may also e-mail inquiries to rjones@whro-pbs.org. Thank you very much for your participation.

Sincerely,

Raymond T. Jones
Doctoral Candidate

David J. Parks
Professor

INSTRUCTIONS

1. Please answer both questions in the form of a list, using either a single word, short phrase, or a complete sentence.
2. When answering both questions, please do so from the perspective of your experience, your current position, and looking forward to the year 2000. This study defines educational technology as electronic equipment or systems now in existence or likely to emerge in the years leading up to 2000, such as computers, and excludes non-electronic devices such as printed matter, slate blackboards, and chalk or ink-based writing implements. The study will identify existing and emerging technologies which will be used by students, teachers, or administrators in the K-12 schools of the year 2000.
3. Please complete both questions and return the information in the enclosed, addressed envelope (international panelists please respond by e-mail). Your prompt response will be of great benefit to the study. Should your envelope become separated from the instrument, please send the instrument to--

Raymond Jones/David Parks
401 East Eggleston
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Virginia Tech
Blacksburg, VA 24061-0302
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Thank you for your participation. Your involvement in this study is very much appreciated.

Question # 1

1. Please list below those existing educational technologies you believe will be used by students, teachers, or administrators in the K-12 schools of the year 2000. For the purposes of this study, educational technology is defined as electronic equipment or systems used by students, teachers, or administrators, such as computers, and excludes non-electronic devices such as printed matter, slate blackboards, and chalk or ink-based writing implements.

Question # 2

2. Please list below those emerging educational technologies you believe will be used by teachers, students, or administrators in the K-12 schools of the year 2000? For the purposes of this study, educational technology is defined as electronic equipment or systems used by students, teachers, or administrators, such as computers, and excludes non-electronic devices such as printed matter, slate blackboards, and chalk or ink-based writing implements.

Appendix G.

Round-Two Delphi Questionnaire



6/12/95

Dear Panel Member:

Thank you for your participation in Round One of our international Delphi panel predicting educational technology that will be used in the K-12 schools of the year 2000.

Below are two lists generated by Round One of this study. List one identifies those present technologies identified as potentially being used in the K-12 schools of the year 2000. List two identifies those emerging technologies listed as potentially being used in the K-12 schools of the year 2000.

For the purposes of this study, educational technology is defined as electronic equipment or systems used by students, teachers, or administrators, such as computers, and excludes non-electronic devices such as printed matter, slate blackboards, and chalk or ink-based writing implements.

Beside each listed technology in both categories is a numerical scale from one to four. For the purposes of predicting technology usage, please score each technology listed in both categories on a scale of: (1) Very Unimportant, (2) Unimportant, (3) Important, (4) Very Important. Circle the numerical value which best applies to the technology's usage in the K-12 schools of the year 2000.

As with Round One, a pre-addressed, stamped envelope is included for your convenience. Your response will be held in strict confidence. A prompt response will help facilitate this study. The results of the research will be sent to you at the end of the study.

Should you have any questions, please call Raymond Jones at (804) 489-9476 or (804) 436-5642). You may also e-mail inquiries or responses to rjones@whro-pbs.org. Thank you very much for your continued participation.

Raymond T. Jones
Doctoral Candidate

David J. Parks
Professor

Round Two

1. **Existing** technologies you believe will be used by students, teachers, or administrators in the K-12 schools of the year 2000. Please circle the numerical ranking you feel best applies to each technology. The scale values are: (1) Very Unimportant, (2) Unimportant, (3) Important, (4) Very Important.

* Adaptive devices for special needs population	1	2	3	4
* Audiotape recorder/player	1	2	3	4
* Autocad	1	2	3	4
* Cable television	1	2	3	4
* Calculator (electronic)	1	2	3	4
* Camcorder	1	2	3	4
* Compact-disc player	1	2	3	4
* Compact-disc recorder	1	2	3	4
* Compact-disc ROM/interactive	1	2	3	4
* Copier machine	1	2	3	4
* Desktop/laptop computer (PC)	1	2	3	4
* Digital camera (still motion)	1	2	3	4
* Email	1	2	3	4
* Facsimile (fax)	1	2	3	4
* Fiber optic interconnect	1	2	3	4
* Film projector	1	2	3	4
* Flex cam (video conferencing)	1	2	3	4
* Hypermedia/hypertext	1	2	3	4

* Internet	1	2	3	4
* Key response pad (hand held)	1	2	3	4
* Laserdisc player	1	2	3	4
* Liquid crystal display (LCD) projector	1	2	3	4
* Local-area network (LAN)	1	2	3	4
* Microwave (audio/video)	1	2	3	4
* Modem	1	2	3	4
* Multimedia (interactive)	1	2	3	4
* Overhead projector	1	2	3	4
* Pager	1	2	3	4
* Personal digital assistant (PDA)	1	2	3	4
* Phonograph	1	2	3	4
* Printer (dot/ink/laser)	1	2	3	4
* Probeware	1	2	3	4
* Quick time digital video	1	2	3	4
* Robotics	1	2	3	4
* Satellite receiver (TVRO)	1	2	3	4
* Scan converter	1	2	3	4
* Scanner (print)	1	2	3	4
* Slide projector	1	2	3	4
* T-1 voice/data/video transmission	1	2	3	4
* Telephone (wired)	1	2	3	4
* Television	1	2	3	4

* Television production facilities	1	2	3	4
* Video on demand	1	2	3	4
* Video projector	1	2	3	4
* Videotape player/recorder (VCR)	1	2	3	4
* Virtual reality	1	2	3	4
* Voice mail	1	2	3	4
* White board (electronic)	1	2	3	4
* Wide-area network (WAN)	1	2	3	4
* Word processor	1	2	3	4

2. **Emerging** technologies you believe will be used by students, teachers, or administrators in the K-12 schools of the year 2000. Please circle the numerical ranking you feel best applies to each technology. The scale values are: (1) Very Unimportant, (2) Unimportant, (3) Important, (4) Very Important.

* Administrative management systems	1	2	3	4
* Autocad	1	2	3	4
* Broadband network	1	2	3	4
* Building-wide data network	1	2	3	4
* Cable television	1	2	3	4
* Cellular telephone	1	2	3	4
* Centralized retrieval system-- home/school/business	1	2	3	4
* Compact-disc interactive	1	2	3	4
* Compact-disc ROM (play/record)	1	2	3	4
* Copier machine	1	2	3	4

* Covert/overt video surveillance	1	2	3	4
* Data access systems	1	2	3	4
* Desktop computer video conferencing	1	2	3	4
* Desktop video/audio conferencing	1	2	3	4
* Digital camera	1	2	3	4
* Digital video editing/storage/ playback	1	2	3	4
* Electronic bulletin board	1	2	3	4
* Electronic publishing	1	2	3	4
* Electronic universities	1	2	3	4
* Email	1	2	3	4
* Ethernet	1	2	3	4
* Facsimile (fax)	1	2	3	4
* Fiber optic LANs/WANs	1	2	3	4
* Full motion on computer/CD ROM	1	2	3	4
* Global communication/telecomputing	1	2	3	4
* Hypermedia/hypertext	1	2	3	4
* Identification chip in teeth or other body part	1	2	3	4
* Improved graphics	1	2	3	4
* Interactive television	1	2	3	4
* Internet	1	2	3	4
* Knowbots	1	2	3	4
* Laptop computers	1	2	3	4

* Large screen projection (computer, television, other video)	1	2	3	4
* Local-area networks (LAN)	1	2	3	4
* Modem	1	2	3	4
* Multicast television (internet M-bone)	1	2	3	4
* Multimedia computer systems	1	2	3	4
* Non-keyboard input devices (voice recognition)	1	2	3	4
* Optical disc (combines CD-ROM and laser disc)	1	2	3	4
* Personal digital assistant (PDA)	1	2	3	4
* Power-enhanced computer/printer/modem	1	2	3	4
* Quick-time digitized video/video conferencing	1	2	3	4
* Satellite downlinks	1	2	3	4
* Scanner (print)	1	2	3	4
* Simple text sound	1	2	3	4
* Single box laser printer/scanner/copier/fax	1	2	3	4
* Student work stations (multimedia)	1	2	3	4
* Teacher work stations with delivery to classrooms	1	2	3	4
* Telephone access to all classrooms	1	2	3	4
* Thumbprint/voiceprint/retinal reader	1	2	3	4

* Transparent multifunctional video via infrared with point & click and vox	1	2	3	4
* Very small aperture terminal (VSAT)	1	2	3	4
* Video editing	1	2	3	4
* Video conferencing	1	2	3	4
* Videotape player/recorder	1	2	3	4
* Videodisc player	1	2	3	4
* Video on demand	1	2	3	4
* Videotext	1	2	3	4
* Video compression	1	2	3	4
* Virtual reality	1	2	3	4
* Voice mail	1	2	3	4
* Voice to text transcription	1	2	3	4
* Whiteboard/panaboard (stores/plays/sends electronically)	1	2	3	4
* Wide-area network (WAN)	1	2	3	4
* Wireless connectivity (modems/LANS)	1	2	3	4
* World-wide web (WWW)	1	2	3	4

Appendix H.

Round-Three Delphi Questionnaire



Sept. 5, 1995

Dear Panel Member:

Thank you for participation in Round Two of our international Delphi panel predicting educational technology that will be used in the K-12 schools of the year 2000. Your questionnaires from Round Two were tabulated over the summer when many panel members were on vacation. We hope you had a pleasant summer.

Below are two lists generated by Round Two of this study. List **one** identifies those **present** technologies identified as potentially being used in the K-12 schools of the year 2000. List **two** identifies those **emerging** technologies listed as potentially being used in the K-12 schools of the year 2000.

For the purposes of this study, educational technology is defined as electronic equipment or systems used by students, teachers, or administrators, such as computers, and excludes non-electronic devices such as printed matter, slate blackboards, and chalk or ink-based writing implements.

For your reference, beside each listed technology in both categories is your Round-Two score (**YS**) on a scale of one to four (one being very unimportant; four being very important) plus the Round-Two group mean score (**GMS**) given to each item. Also following each item is a numerical scale from one to four. As in Round Two, for the purposes of predicting technology usage, please score each technology listed in both categories on a scale of: (1) Very Unimportant, (2) Unimportant, (3) Important, (4) Very Important. Circle the numerical value which best applies to the technology's usage in the K-12 schools of the year 2000. This is the third and final round of prediction.

As with the previous rounds, a pre-addressed, stamped envelope is included for your convenience. Your response will be held in strict confidence. A prompt response will help facilitate this study. The results of the research will be sent to you at the end of this study.

Should you have any questions, please call Raymond Jones at (804) 489-9476 or (804) 436-5642, or e-mail inquiries to rjones@whro-pbs.org. Thank you for your continued participation.

Raymond Jones
Doctoral Candidate

David J. Parks
Professor

Round Three

1. **Existing** technologies you believe will be used by students, teachers, or administrators in the K-12 schools of the year 2000. Your score from Round Two and the Group Mean Score are indicated. For the final round, please circle the numerical ranking you feel best applies to each technology. The scale values are: (1) Very Unimportant, (2) Unimportant, (3) Important, (4) Very Important.

* Adaptive devices for special needs population

YS: GMS: 3.72 1 2 3 4

* Audiotape recorder/player

YS: GMS: 2.30 1 2 3 4

* Autocad

YS: GMS: 2.90 1 2 3 4

* Cable television

YS: GMS: 3.47 1 2 3 4

* Calculator (electronic)

YS: GMS: 3.44 1 2 3 4

* Camcorder

YS: GMS: 3.38 1 2 3 4

* Compact-disc player

YS: GMS: 3.41 1 2 3 4

* Compact-disc recorder

YS: GMS: 3.14 1 2 3 4

* Compact-disc ROM/interactive

YS:	GMS: 3.66	1	2	3	4
* Copier machine					
YS:	GMS: 3.08	1	2	3	4
* Desktop/laptop computer (PC)					
YS:	GMS: 3.91	1	2	3	4
* Digital camera (still motion)					
YS:	GMS: 3.31	1	2	3	4
* Email					
YS:	GMS: 3.85	1	2	3	4
* Facsimile (fax)					
YS:	GMS: 3.30	1	2	3	4
* Fiber-optic interconnect					
YS:	GMS: 3.61	1	2	3	4
* Film projector					
YS:	GMS: 1.55	1	2	3	4
* Flex cam (video conferencing)					
YS:	GMS: 3.19	1	2	3	4
* Hypermedia/hypertext					
YS:	GMS: 3.51	1	2	3	4
* Internet					
YS:	GMS: 3.72	1	2	3	4
* Key-response pad					
YS:	GMS: 2.91	1	2	3	4

* Laserdisc player					
YS:	GMS: 2.72	1	2	3	4
* Liquid crystal display (LCD) projector					
YS:	GMS: 2.97	1	2	3	4
* Local area network (LAN)					
YS:	GMS: 3.74	1	2	3	4
* Microwave audio/video					
YS:	GMS: 3.14	1	2	3	4
* Modem					
YS:	GMS: 3.58	1	2	3	4
* Multimedia interactive					
YS:	GMS: 3.80	1	2	3	4
* Overhead projector					
YS:	GMS: 2.97	1	2	3	4
* Pager					
YS:	GMS: 2.42	1	2	3	4
* Personal digital assistant (PDA)					
YS:	GMS: 3.00	1	2	3	4
* Phonograph					
YS:	GMS: 1.36	1	2	3	4
* Printer (dot/ink/laser)					
YS:	GMS: 3.66	1	2	3	4

* Probeware					
YS:	GMS: 3.36	1	2	3	4
* Quick-time digital video					
YS:	GMS: 3.34	1	2	3	4
* Robotics					
YS:	GMS: 3.11	1	2	3	4
* Satellite receiver (TVRO)					
YS:	GMS: 3.44	1	2	3	4
* Scan converter					
YS:	GMS: 3.37	1	2	3	4
* Scanner (print)					
YS:	GMS: 3.25	1	2	3	4
* Slide projector					
YS:	GMS: 1.77	1	2	3	4
* T1 voice/data/video transmission					
YS:	GMS: 3.40	1	2	3	4
* Telephone (wired)					
YS:	GMS: 3.41	1	2	3	4
* Television					
YS:	GMS: 3.41	1	2	3	4
* Television production facilities					
YS:	GMS: 3.14	1	2	3	4
* Video on demand					

YS:	GMS: 3.20	1	2	3	4
* Video projector					
YS:	GMS: 3.16	1	2	3	4
* Video player/recorder (VCR)					
YS:	GMS: 3.08	1	2	3	4
* Virtual reality					
YS:	GMS: 3.05	1	2	3	4
* Voice mail					
YS:	GMS: 3.36	1	2	3	4
* White board (electronic)					
YS:	GMS: 3.11	1	2	3	4
* Wide-area network (WAN)					
YS:	GMS: 3.74	1	2	3	4
* Word processor					
YS:	GMS: 3.44	1	2	3	4

2. **Emerging** technologies you believe will be used by students, teachers, or administrators in the K-12 schools of the year 2000. Your score from Round Two and the Group Mean Score are indicated. For the final round, please circle the numerical ranking you feel best applies to each technology. The scale values are: (1) Very Unimportant, (2) Unimportant, (3) Important, (4) Very Important.

* Administrative management systems

YS:	GMS: 3.61	1	2	3	4
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* Autocad

YS:	GMS: 3.12	1	2	3	4
* Broadband network					
YS:	GMS: 3.53	1	2	3	4
* Building-wide data network					
YS:	GMS: 3.80	1	2	3	4
* Cable television					
YS:	GMS: 3.44	1	2	3	4
* Cellular telephone					
YS:	GMS: 3.22	1	2	3	4
* Centralized retrieval system-- home/school/business					
YS:	GMS: 3.78	1	2	3	4
* Compact-disc (interactive)					
YS:	GMS: 3.44	1	2	3	4
* Compact-disc ROM (play/record)					
YS:	GMS: 3.50	1	2	3	4
* Copier machine					
YS:	GMS: 3.00	1	2	3	4
* Covert/overt video surveillance					
YS:	GMS: 2.79	1	2	3	4
* Data-access systems					
YS:	GMS: 3.46	1	2	3	4
* Desktop computer video conferencing					

YS:	GMS: 3.23	1	2	3	4
* Desktop video/audio conferencing					
YS:	GMS: 3.14	1	2	3	4
* Digital camera					
YS:	GMS: 3.26	1	2	3	4
* Digital video editing/storage/ playback					
YS:	GMS: 3.44	1	2	3	4
* Electronic bulletin board					
YS:	GMS: 3.48	1	2	3	4
* Electronic publishing					
YS:	GMS: 3.22	1	2	3	4
* Electronic universities					
YS:	GMS: 3.26	1	2	3	4
* Email					
YS:	GMS: 3.75	1	2	3	4
* Ethernet					
YS:	GMS: 3.37	1	2	3	4
* Facsimile (fax)					
YS:	GMS: 3.27	1	2	3	4
* Fiber-optic LANs/WANs					
YS:	GMS: 3.70	1	2	3	4
* Full-motion video on computer/ CD ROM					

YS:	GMS: 3.72	1	2	3	4
* Global communication/telecomputing					
YS:	GMS: 3.66	1	2	3	4
* Hypermedia/hypertext					
YS:	GMS: 3.60	1	2	3	4
* Identification chip in teeth or other body part					
YS:	GMS: 1.90	1	2	3	4
* Improved graphics					
YS:	GMS: 3.30	1	2	3	4
* Interactive television					
YS:	GMS: 3.38	1	2	3	4
* Internet					
YS:	GMS: 3.75	1	2	3	4
* Knowbots					
YS:	GMS: 2.88	1	2	3	4
* Laptop computers					
YS:	GMS: 3.72	1	2	3	4
* Large-screen projection (computer, television, other video)					
YS:	GMS: 3.62	1	2	3	4
* Local-area networks (LANs)					
YS:	GMS: 3.76	1	2	3	4
* Modem					

YS:	GMS: 3.52	1	2	3	4
* Multicast television (internet M-bone)					
YS:	GMS: 3.36	1	2	3	4
* Multimedia computer systems					
YS:	GMS: 3.77	1	2	3	4
* Non-keyboard input devices (voice recognition)					
YS:	GMS: 3.34	1	2	3	4
* Optical disc (combines CD-ROM and laser disc)					
YS:	GMS: 3.52	1	2	3	4
* Personal digital assistant (PDA)					
YS:	GMS: 3.29	1	2	3	4
* Power-enhanced computer/printer/modem					
YS:	GMS: 3.39	1	2	3	4
* Quick-time digitized video/video conferencing					
YS:	GMS: 3.26	1	2	3	4
* Satellite television receive only (TVRO)					
YS:	GMS: 3.51	1	2	3	4
* Scanner (print)					
YS:	GMS: 3.20	1	2	3	4
* Simple-text sound					

YS:	GMS: 2.90	1	2	3	4
* Single-box laser/scanner/ copier/fax					
YS:	GMS: 3.31	1	2	3	4
* Student work stations (multimedia)					
YS:	GMS: 3.65	1	2	3	4
* Teacher work stations with delivery to classrooms					
YS:	GMS: 3.74	1	2	3	4
* Telephone access to all classrooms					
YS:	GMS: 3.82	1	2	3	4
* Thumbprint/voiceprint/retinal readers					
YS:	GMS: 2.44	1	2	3	4
* Transparent multifunctional video via infrared with point & click and VOX					
YS:	GMS: 3.06	1	2	3	4
* Very small aperture terminal (VSAT)					
YS:	GMS: 3.03	1	2	3	4
* Video editing					
YS:	GMS: 3.25	1	2	3	4
* Video conferencing					
YS:	GMS: 3.54	1	2	3	4
* Videotape player/recorder					

YS:	GMS: 2.82	1	2	3	4
* Videodisc player					
YS:	GMS: 2.86	1	2	3	4
* Video on demand					
YS:	GMS: 3.25	1	2	3	4
* Videotext					
YS:	GMS: 2.97	1	2	3	4
* Video compression					
YS:	GMS: 3.55	1	2	3	4
* Virtual reality					
YS:	GMS: 3.19	1	2	3	4
* Voice mail					
YS:	GMS: 3.30	1	2	3	4
* Voice-to-text transcriptions					
YS:	GMS: 3.20	1	2	3	4
* Whiteboard/panaboard (stores/ plays/sends electronically)					
YS:	GMS: 3.05	1	2	3	4
* Wide-area networks (LANs)					
YS:	GMS: 3.63	1	2	3	4
* Wireless connectivity (modem/LAN)					
YS:	GMS: 3.58	1	2	3	4
* World-wide web (WWW)					
YS:	GMS: 3.77	1	2	3	4

GLOSSARY OF ELECTRONIC TECHNOLOGIES

Adaptive devices for special needs population. Devices configured to be used by those incapable of operating normally configured devices.

Administrative management systems. Computer based program designed to manage multiple tasks for school administrators.

Audiotape recorder/player. Device capable of recording and reproducing audio on magnetic tape.

Autocad. Computer system used for the design of mechanical, architectural, or industrial products.

Broadband network. A system for transmitting information over communications links capable of handling a greater range of frequencies than a regular voice-grade line.

Building-wide data network. A system for distributing a variety of data packages throughout an entire building.

Cable television. Television programming disseminated to multiple users via coaxial or fiber-optic cable.

Calculator (electronic). Electronic device capable of processing various mathematical functions.

Camcorder. A combination of camera and video recorder in a single unit.

Cellular telephone. A telephone using wireless transmitting and receiving capacity to interface with cell relay stations.

Centralized retrieval system for home/school/business. A networked system for extracting the same data base information at home, at school, or from a business location.

Compact-disc player. Device capable of reproducing audio from a standard 4.75" digital disc read by laser.

Compact-disc recorder. Device capable of recording audio onto a standard 4.75" digital disc by laser.

Compact-disc ROM/interactive. Digital disc containing Read Only Memory in excess of 600,000,000 bytes of information

with the added capacity for the user to actively manipulate selected portions of the disc.

Compact-disc ROM (play/record). A device which allows the user to record information to a CD-ROM as well as play and interact with the CD-ROM.

Copier machine. A machine capable of electronically scanning and reproducing on paper a copy of the material scanned.

Covert/overt video surveillance. Hidden or visible video devices used to achieve electronic surveillance of a given area.

Data-access systems. One or more software systems capable of handling the organization, storage, retrieval, and integrity of information stored in a database.

Desktop/laptop computer (PC). A personal computer (PC) small enough to fit on a desk top or a person's lap.

Desktop computer video conferencing. A system combining desktop personal computers with video cameras and using slowscan video to effect a two-way video conference.

Desktop video conferencing. Person to person video communications using cameras connected to telephones, computers, transmitters, microwave links or satellite links to effect a two-way video conference.

Digital camera (still motion). A device capable of electronically recording a still visual image which can then be transferred to electronic storage or displayed immediately on a video monitor or computer screen.

Digital video editing/storage/playback. The conversion of original analog video material into digital (numerical) form which can be manipulated, saved, and reproduced back into analog form.

Electronic bulletin board. Computer network messaging screen.

Electronic publishing. A paperless form of publishing using computer generated texts.

Electronic universities. Collected courses of study using computer networks to produce virtual classrooms.

Email. Electronic mail sent via a computer interconnect or network.

Ethernet. Baseband local-area network configuration using coaxial cable and with a capacity for transferring data at up to ten megabytes per second.

Facsimile (fax). The electronic scanning and transmission of documents via wired or wireless telephony.

Fiber-optic interconnect. The connection of two or more sites via optical fiber cable.

Fiber-optic LANS/WANS. Local-area networks and wide-area networks interconnected through fiber-optic cable.

Film projector. A device capable of displaying continuous running film on a surface.

Flex cam (video conferencing). Camera that can be manipulated to include a variety of shots (as opposed to a fixed camera) for videoconferencing.

Full motion video on computer/CD ROM. Video moving in real time (as opposed to slow scan) on computers through computer programs or played back on computers via CD-ROMs.

Global communication/telecomputing. The ability to interconnect on a global scale using computer technology.

Hypermedia/hypertext. A technique for connecting information in a free-form manner (hypertext), often enhanced by a combination of text, graphics, video, and audio (hypermedia).

Identification chip (in teeth or other body parts). An electronically encoded chip containing information obtainable by electronic scanning.

Improved graphics. High resolution video graphics.

Interactive television. Enhanced television service allowing the viewer to be an active rather than a passive participant in telecasts.

Internet. An aggregate of interconnected services available through global interconnected computer networks.

Key response pad. A keynote keyboard.

Knowbots. Robots with a capacity for learning.

Laptop computers. Portable internally powered computers.

Large-screen projection (computer/television/other video). Electronic projectors capable of taking a variety of video input sources and enlarging the video image for projection on a reflective surface.

Laserdisc player. Device capable of reproducing video and audio from a digital laser disc up to 12" in diameter.

Liquid-crystal display (LCD) projector. A device which displays video through a liquid crystal medium as opposed to the older video cathode tube display.

Local-area network (LAN). Two or more computers interconnected in order to share data but not extending across a public right of way (e.g., a public telephone system).

Microwave audio/video. Delivery of audio or video signals via high frequency wireless microwave signal.

Modem. A peripheral device which modulates a digital signal in analog fashion along a telephone transmission path and then demodulates the signal from analog to digital at the receiving point. The term "modem" is a contraction of modulate/demodulate.

Multicast television (Internet M-bone). Computer transmission of two or more video signals through broadband telephone lines.

Multimedia computer systems. Computers equipped with the necessary hardware for multiple tasks such as CD-ROM,

slowscan or real-time video, modem, audio processing, video or audio editing, voice commands, CD recording, floppy-disc storage or optical-disc storage.

Multimedia interactive. A multitude of capabilities (information storage, video, audio, scanning, transmission) that can be manipulated by the user in a variety of ways.

Non-keyboard input devices (voice recognition). An advanced command protocol bypassing keyboard-generated commands to allow commands by voice.

Optical disc. Mass storage device using light beams to store and retrieve information from a light-sensitive disc.

Overhead projector. A visual projector using light and a magnifying lens to enlarge and project an image.

Pager. Wireless receiver capable of storing data and alerting the user by vibration or audio of the reception of data.

Personal digital assistant (PDA). Small electronic device which can, depending on configuration, offer some services of computing, paging, facsimile transmission, and data transfer.

Phonograph. A device capable of reproducing audio by electromechanical means from a grooved disc.

Power-enhanced computer/printer/modem. Computer system using added peripheral devices to increase the range and diversity of operation.

Printer. A peripheral device that converts computer output to paper.

Proeware. An electronic measuring device that gathers measurements through physical contact.

Quick time digital video. Video that is not in smooth realtime but which does provide motion, albeit it with barely noticeable breaks in the transmission of the video material.

Robotics. Electronically controlled machinery capable of simulating human tasks.

Satellite receiver (TVRO). Television receive-only (TVRO) system consisting of a satellite dish and satellite receiver capable of C-band and KU-band reception.

Scan converter. A device capable of converting any foreign or domestic television scanning medium: NTSC (National Television Systems Committee), PAL (phase alternation line), and SECAM (Sequential Couleur a Memoire), into another medium, e.g., National Television Systems Committee to phase alternation line. NTSC (National Television System Committee) scan is the television standard for the United States.

Scanner (print). A computer input device which takes paper input and converts the images on the paper to an electronic copy of the images.

Simple-text sound The addition of audio to alphanumeric text on a computer.

Single-box laser/scanner/copier/fax. A single device capable of storing, scanning, copying, and faxing visual/textual material.

Slide projector. A device which uses a high intensity light beamed through a photographic slide to project that slide onto a reflective surface, usually with the capacity to enlarge the original image.

Student work stations (multimedia). A workstation in a school using a combination of audiovisual technologies such as multimedia computers, satellite reception, local-area networks, wide-area networks, and portable data storage.

T1 voice/data/video transmission. A long-haul transmission medium which transmits voice, data, or video information at a rate of 1.544 megabits per second.

Teacher work stations with delivery to classrooms.

Electronic work stations which allow teachers to access multimedia technology to prepare lessons and transmit those lessons to classrooms as well as store and retrieve records,

prepare audiovisual materials, and communicate with peers, administrators, and with various sources of information.

Telephone (wired). An instrument that transmits audio by wire or fiber-optic cable to remote locations by modulating audio carrier waves and reconvertng the carrier waves to audible signals at the receiving point.

Telephone access to all classrooms. A school which has a telephone interconnection with every classroom.

Television. The transmission of stationary or moving video images via electromagnetic waves with the reconversion of the waves into visual images at the reception point.

Television production facilities. A facility for recording and editing video images.

Thumbprint/voiceprint/retinal readers. Scanning devices which allow precise identification of individuals through electronic scans of thumbprints, voice, or eyes.

Transparent multifunctional video via infrared with point & click and VOX (voice actuated commands). Multimedia video capacity (split screen/picture within picture, text/graphics over video) accessible by infrared signals transmitted by a hand-operated "point & click" device or by voice commands.

Very small aperture terminal (VSAT). Narrow beam receptor of video transmissions aimed at a limited number of fixed sites.

Video conferencing. Face-to-face communication from distant points by use of video.

Video editing. The flexible electronic manipulation of video images.

Video on demand. Video material which can be immediately and precisely accessed.

Video projector. A device used to project video images on a reflective surface, usually with the capacity to enlarge the original image.

Video player/recorder (VCR). A device which uses magnetic tape to record and reproduce video images.

Videotext. Text conveyed by a video-based medium.

Video compression. Digital technique squeezing a video signal into a smaller bandwidth, thereby allowing more video signals per pathway.

Virtual reality. An electronic simulation of things seen, heard, and felt. The process uses electronic goggles, earphone devices, and tactile manipulators or sensory mechanisms to generate a simulacrum of reality.

Voice mail. An electronic system for sorting, directing, and recording spoken messages received by telephone.

Voice-to-text transcriptions An electronic method for transforming spoken words into paper or electronic texts.

Whiteboard (electronic) A device similar to the traditional "blackboard" but which, in addition to being written on, can electronically store that writing plus be used to call up audio/visual materials. The device can be interfaced with a multimedia computer for further manipulation of the material such as transmission to distant points.

Wide-area network (WAN) A network using computers and other devices separated by wide distances.

Wireless connectivity (modem/LAN) Interfacing with a network or modem without using a hardwired connection (i.e. wireless).

Word processor Application software that allows electronic entry, formatting, manipulation, and printing of text.

World-wide Web (WWW) A global network of interconnected computers.

VITA

The author was born September 9, 1948, in Norfolk, Virginia. He received his public school education through the Chesapeake Public Schools. He received a Bachelor of Science Degree in Elementary Education with emphasis on library science from Old Dominion University in 1973, a Master of Science Degree in Educational Media from Virginia State University in 1978, and a Certificate of Advanced Graduate Studies from Old Dominion University in 1983.

The author was a media specialist with the Virginia Beach Public Schools in 1974 and then became a media specialist with the Chesapeake Public Schools from 1974-1979. He taught gifted and talented children in 1979 and 1980 and then communications from 1980 to 1983.

He became a school administrator in 1983, working as communications and public relations supervisor for the Chesapeake Public Schools. He was also a staff assistant to the superintendent of schools.

The author taught music appreciation courses for Christopher Newport University and delivered guest lectures at Old Dominion University, Norfolk State University, and Virginia Wesleyan College.

While pursuing an educational career, the author has

also been active in broadcasting and has worked for a number of radio stations in the Hampton Roads area. In 1993, he became Vice-President for Radio Services at WHRO, the public broadcasting telecommunications center in Norfolk.

The author has also been a regular newspaper columnist for the Newport News Daily Press since 1977 and the Chesapeake Post since 1988. He is a member of the Virginia Writers Club and has been published in numerous periodicals.

He is married to Joan W. Jones, an educator and certified flight instructor, and resides in Chesapeake, Virginia. His goal following doctoral work is to acquire an aircraft pilot's license and to resume deep sea wreck diving.

A handwritten signature in black ink that reads "Raymond Jones". The signature is written in a cursive style with a long horizontal line extending to the right from the end of the name.