INTERACTIVE VIDEODISC TECHNOLOGY IN PUBLIC SCHOOL SETTINGS: AN ANALYTIC REVIEW AND DELPHI STUDY

by

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(ABSTRACT)

This study examined the nature and potential of interactive videodisc technology in public schools through an analytic review of the current literature and a modified Delphi study. The analytic review synthesized some of the writings related to classroom applications, technology policy in education, cognition and learning, and dissemination and diffusion of innovation in schools. The Delphi component of the study managed an interaction among 32 national videodisc and education leaders. It consisted of an in-depth interview and two subsequent rounds of questioning of a panel chosen from the fields of education, government, private industry, and the military. The initial interviews asked panelists to respond to four questions: (a) the potential of interactive videodisc technology for education, (b) the measures/policies needed to achieve visions of potential, (c) the barriers inhibiting the potential, and (d) future scenarios.

Analysis of the interview data informed the design of two subsequent research instruments that were limited to visions of potential and measures needed to achieve those visions. The questionnaires, by providing anonymous feedback of group judgment and

individual comments, enabled panelists to reassess their original positions and beliefs.

A review of the findings revealed nine domains of issues panelists considered important to understanding the relationship of interactive videodisc technology and schooling. They are: (1) technological capabilities; (2) legitimate descriptors; (3) potential benefits; (4) goals and rationale for use; (5) production and design issues; (6) marketing issues; (7) research issues; (8) funding and responsibility issues; and (9) applications in different locations.

A systematic search for commonality within those domains disclosed four recurring themes: (1) the complexity and interrelatedness of issues; (2) the importance of the context to technology applications; (3) the discrepancy between potential and reality; and (4) historical parallels between public school applications of interactive videodiscs and other media technology.

The concluding chapter presents a discussion of those themes and their implications, along with recommendations for further research and for ways that the various stakeholders of technology in education might promote thoughtful applications of interactive videodisc technology.

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Dedicated to

the memory of my father,

and to

my dear friends

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CHAPTER 1

INTRODUCTION

Recent developments in communications technology have captured the imagination of some American leaders in industry, the military and education. Heralding the era of technology, many of these leaders assert that the decreasing costs and increasing accessibility of the microcomputer in combination with the videodisc offer increasing instructional opportunities for every element of the population (Molnar, 1975). Claims regarding the role of the interactive videodisc, the technology that combines capabilities of television and computer, abound. Described as an "ideal teaching medium" (Copeland, 1983, p.74); capable of becoming the panacea and "problem-solver" of some of the nation's pressing educational problems (Bejar, 1982; Gach, 1982), particularly those problems related to science education (Bailey, 1981; Bunderson, Olsen & Baillio, 1981), interactive videodisc technology has been hailed as a ". . . breakthrough in instructional technology of revolutionary import to educators" (Levin, 1983, p.11).

Analysis reveals, however, that there is a great discrepancy between claims of potential benefit and the reality in education. Current use of interactive videodisc technology (hereafter referred to as IVD) has barely begun, and data regarding the education market remains scarce. Estimates published in the spring of 1983 revealed the number of videodisc players utilized in public school classrooms in the United States to be in the range of 150-1,200 (Educational Turnkey Systems, 1983). Since then, there has been growing awareness, increased

experimentation around the country, and expansion in sales. While currently there are no available published figures, industry estimates suggest there are at least 20,000 videodisc players in the schools (J. Mecklenberger, personal correspondence, June 27, 1988). Nevertheless, the nationwide videodisc market in education is still characterized as undeveloped.

The consequence of an undeveloped educational market is that little is known about IVD technology and its effects on cognition and learning, and even less about its introduction and implementation in the formal institution of schooling. Policy makers at all levels of education are faced with decisions regarding allocation of limited resources as they consider plans to purchase technology and to train staff. However, many lack the information necessary to make informed decisions about IVD technology.

In the Spring of 1984, a review of the videodisc literature in combination with informal interviews and telephone surveys of people involved with research and development of IVD revealed: (a) a lack of awareness of videodisc activity around the country; (b) a desire for a written synthesis of information related to IVD technology; and (c) a wish for clear articulation of issues related to successful videodisc applications in public schools (Bosco, 1984; C. Char, personal communication, February 1984; R. France, personal communication, May, 1983; J. Kleinmann, personal communication, November, 1983; A. Molnar, personal communication, December 1983; G. Salomon, personal communication, January 1984).

To address those expressed needs, a Delphi study examining the relationship of IVD technology and public schooling was initiated in late Spring, 1984. Through a carefully-managed interaction, the beliefs of a panel of education and videodisc leaders were explored. The Delphi procedure allowed 32 panelists, who were geographically dispersed around the country, first to identify issues relevant to successful applications of IVD to public school instruction and then to reassess the relative importance of those issues. Four questions were used as a comprehensive and logical framework for eliciting beliefs and developing a gestalt. They focused on:

1. the potential of IVD technology as it relates to education and public schooling;

2. the inventive measures or policies needed to achieve the potential of IVD for education;

3. barriers inhibiting the realization of potential; and

4. a five and ten year forecast of IVD activities in schools.

Analysis of the interview data led to the design of the subsequent rounds of a questionnaire.

Significance of the Study

Major objectives of the dissertation included synthesizing some of the interesting developments in the field of IVD technology in addition to providing ready access to some specialized expertise as it related to public schooling. It was anticipated that the product as well as the process of the inquiry would contribute to education.

The product of the Delphi procedure contains pooled judgments that offer both practical and theoretical insights to consumers of an emerging technology. This particular Delphi has identified nine domains of issues considered important to understanding the relationship of IVD and public schools. It also has revealed four themes. Together, the issues and themes furnish a framework within which IVD policies can be analyzed. Furthermore, implications are presented for those interested in designing and producing interactive systems, marketing them, researching them, and/or implementing them in schools, along with a broad range of recommendations for promoting thoughtful school applications.

The actual process used with the Delphi procedure has also contributed to education. By increasing communication among the diverse and major stakeholders of technology in education, awareness has been broadened and understandings have been enhanced.

Finally, while this investigation was initiated several years ago, the need for formalized study of IVD technology and public school applications remains current. This is evident in the variety of national activities and recent publications related to IVD and education.

Assumptions

The study is based on the following assumptions:

1. Throughout this study, interactive videodisc technology

(IVD) refers to any of the hardware/software configurations that integrate the powers of video and computers.

There are five components of the videodisc system: a videodisc player, a computer, a television monitor, an interface device, and videodisc and computer software.

A twelve inch laser disc offers 54,000 grooves or spaces for information storage. Visual, textual and audio cues recorded on its optical-magnetic memory are read by a laser light beam and decoded by the videodisc player. The design of the program enables the actions of the user to determine the flow of the computer or video program.

2. Technology in general, and IVD specifically, will be important to society and to schools.

3. Thoughtfully examining visions of the present and future relationships of IVD and schooling is important for leaders who wish to take a proactive stance in education.

4. The relationship of IVD and schools is a complex one. IVD, itself, is both a sophisticated and "dynamic" media, whose developments in both hardware and software are occurring at an astonishing rate. Consequently, policy-makers and practitioners alike have difficulty assimilating scattered information related to classroom applications of IVD. Introduction of IVD into schools represents major innovation or attempts to change people and organizational structures in the complex social institution that has been inherently resistant to change (Berman & McLaughlin, 1975; Fullan, 1982; Goodlad, 1975).

Limitations of the Study

There is an inherent limitation to any Delphi research because it is a communication process concerned with beliefs of a selected panel. The views expressed reflect individual subjective realities shared under a particular set of conditions. How the passage of time and the changing conditions in society affect panelists' belief systems is unknown. In this study, panelists were involved in questioning three times over a period of one and one-half years. They shared their beliefs with a researcher whom they knew to be a public school teacher. Their perception of the researcher may have biased their views. The bias may have been compounded by the researcher's biases both in selection of panelists and in analysis of data.

Other limitations are related to the design of the research instruments. Because the initial interviews generated a large amount of data, the planned design of the subsequent rounds of questionnaires was altered in several ways: (a) The focus was limited to the first two questions dealing with visions and measures; (b) the structure was limited to statements of assertion; and (c) the responses to the statements were limited to the dimensions of agreement and of issue significance. The questionnaires did not explore the ranking, feasibility, and probability of issues, nor did they probe in-depth the conflicts and rationales underlying discrepant views. Furthermore, despite efforts to achieve clarity, there remained ambiguity in some questionnaire statements, particularly those that included "ideal" or "ideally." Lastly, the data reduction process itself may have distorted some views and inhibited the development of a gestalt.

CHAPTER 2

REVIEW OF RELATED LITERATURE

Literature pertinent to the relationship of IVD technology and education crosses several fields of interest, including technology design, production, and marketing; research on media, cognition and learning; educational policy; and classroom instruction. A broad review of those fields was undertaken in 1984 to discover what was known about IVD and what research studies had been conducted that would have relevance for public schooling. It was found that: (a) the published literature was scarce; (b) little was known about IVD; (c) most articles, written from a stance of advocacy, were more descriptive than analytical in detailing potential instructional benefits; (d) little was written that examined the future developments of interactive videodiscs and their consequences; and (e) while a few articles dealt with public school applications, none were found that comprehensively examined the relationship of the technology to public schooling.

The findings of the 1984 literature review suggested a need for a holistic and disciplined inquiry to identify and critically analyze important issues related to IVD applications in public schooling. Based on the literature review of 1984, the Delphi methodology was chosen as the approach most compatible with the research goals. However, the analyses and conclusions of the Delphi study have been informed by an on-going literature review.

For the purposes of this study, this chapter will review selections of relevant literature published prior and subsequent to the actual investigation. It will be organized in three sections. The first section will discuss IVD as an instructional technology; the second section will discuss IVD applications in public schools; and the third section will discuss literature related to the methodology used in this study.

Section 1: IVD as Instructional Media.

According to the educational futurist Harold Shane (1987), the rapidity of innovations has thrust society past what Toffler labeled "future shock" into a state of hyperturbulence where institutions and resources are inadequate to deal with the acceleration of change (p. 5). This appears to be the case in education and industry, when decision-makers seek to understand and plan for successful applications of an emerging, complex instructional tool called interactive videodisc. Analysis of the literature pertaining to IVD reveals three problems decision-makers face:

(1) understanding the nature of interactive videodisc media;

(2) finding reliable and appropriate sources of information;

(3) finding literature with an analytic focus.

Understanding the Nature of IVD

The first problem decision-makers face is understanding the nature of the sophisticated and complex IVD technology. In researching the

origin of the term, "videodisc technology," four discussions dealing with videodisc history were unearthed (Daynes, 1984; DeBloois, Maki, & Hall, 1984; Jarvis & Booth, 1982; Kenney, 1985). While the articles present some discrepancy regarding who deserves credit for early developments, their importance lies in illuminating the reality that the videodisc is far from a new technology; rather, it is a technological concept that has evolved and will continue to evolve.

It appears that the earliest time reference to the term can be found in Paul Lupkow's 1881 application for a videodisc patent in Germany (Daynes, 1984). Videodisc historians (DeBloois et at., 1984; Jarvis & Booth, 1982; Kenney, 1985) seem to agree that Lupkow's work inspired Scotsman John Baird, whom they credit with inventing the 1927 videodisc, "Phonevision," for the London market. It is at this point in the development story that uncertainty emerges. This historical uncertainty parallels the confusion in the definition of the term. Note the three variations of definitions presented by Jarvis and Booth (1982):

> . . . if an optical videodisc means a motion video copy on a broadcast bandwidth playback device then the originator was either an employee of Philips during the 1969-1972 era or an employee of the competing MCA-DiscoVision during the 1968-1973 era . . .
>
> . . . On the other hand, if a videodisc is considered to be a master recording, then we must recognize Philip Rice for his 3M-sponsored work.

. . . If an optical disc is defined as containing information that can be used to display text or make a picture, one has to note the IBM disc demonstrated at the 1964 World's Fair (p. 14).

History aside, the more current written descriptions of videodiscs are still wrought with ambiguities. Some depict IVD in terms of hardware capability (Floyd & Floyd, 1982; others define IVD in terms of software function (Bejar, 1982; Levin, 1983); one writer defines IVD as both program material and a philosophy of video production designed to take maximum advantage of various technical capabilities (Gach, 1982). Authors seem to disagree about whether IVD should be considered an extension of the computer or, as Hosie (1987) asserts, "a hybrid new medium," (p. 5) that needs its own nomenclature.

What seems to be commonly accepted is that IVD represents a fusion of the computational power of the microprocessor with the massive optical storage capacity of the videodisc. Also widely accepted throughout the industry is the classification system that was proposed by the Nebraska Videodisc Design and Production Group in 1979. In that system, videodisc system capabilities are categorized and distinctions are drawn according to the location of the controlling program; Levels of Interactivity 0-4 designate increasing levels of sophistication in programming design (software) and functional capabilities of the player (hardware).

As the technical developments and applications of IVD have grown, so have the number of related terms and articles describing the technology. The publication, Videodisc and Related Technologies: A

Glossary of Terms (Miller & Sayers, 1986) contains definitions for over 500 terms. Articles by Daynes (1984) and Char and Newman (1986) provide clarification of the technical capacities of the various levels of videodisc systems.

Lowenstein (1986) suggests that mere description of hardware and software components of IVD technology fails to express its totality. While educators (Callison, 1983; Gayeski & Williams, 1983; Jernstedt, 1982), designers (Bork, 1985; Hon, 1982) and media theoreticians (G. Salomon, personal correspondence March, 1984) acknowledge interactivity as the most significant aspect of IVD, interactivity itself is a very vague concept. Furthermore, design of IVD appears to be at an experimental stage (Bork, 1987b). As McKenzie (1986) notes, interactivity when applied to instruction involves multiple components or strategies whose relationship to learning are little understood.

Understanding of IVD appears to be confounded by descriptions that refer to it as if it were a single entity, thus minimizing the complexity of its nature. As a complex instructional medium that is continuing to evolve, IVD may vary in its contents, symbol systems, transmission technologies, and social situations of use. Bosco (1986) suggests that it is more useful to think about IVD not a a single approach to instruction, but rather as "a category designation for a wide array of approaches" (p. 15).

Finding Reliable and Appropriate Information Sources

Decision leaders face a second problem related to accelerated changes in society: that of locating reliable and appropriate sources of information. Bosco (1986), in discussing the difficulty in accessing evaluation reports of IVD, cites three contributing factors: (a) There are many unpublished, proprietary reports; (b) often, reports are presented at conferences and not recorded in ERIC; and (c) those that are published may be less conspicuous because the variety of applications is reported in journals having diverse readership.

Strategies for seeking information on interactive video were the focus in McLean's dissertation (1985). While her sample was confined to corporate training developers considering the adoption and implementation of IVD, three of her findings appear equally relevant for educators: (a) Information on IVD is difficult to find; (b) traditional information sources are often inadequate to meet the needs of decision-makers; (c) information requirements and perceptions about sources and strategies may change either with the growth of the technology or with the phase in the decision-making process.

Compounding the difficulty educators face in seeking IVD information appropriate to public schools are issues related to the transfer of technology from one setting to another. Most of the videodisc development work has occurred in military and corporate settings with in-house research studies. The few studies that are accessible cite successes of training applications in one setting that may be irrelevant for the vastly different setting of public schools.

As Hosie (1987) points out, there is a grey area between educational and training applications. Further, there has been recognition that the dimensions of environment and the school culture often act as barriers to successful transfer of computer-based technology innovations from the military and industry to public schools (Seidel, cited in Miller, 1984; Seidel, Hunter, Kastner, & Rubin, 1974).

As the need for information about IVD has increased, so have organized efforts to promote and disseminate IVD knowledge. This is reflected in the emergence of organizations, publications, conferences and seminars with those goals. Those have included:

- 1985 The Institute for the Transfer of Technology to Education (ITTE), a subdivision of the National School Board Association in Alexandria, Virginia.

- 1986 The Interactive Videodisc Consortium (IVC), supported by the Corporation for Public Broadcasting.

- 1987 The National Videodisc Demonstration Laboratory at the Smithsonian Institute in Washington, D.C.

- 1986, 1987 Annual National Videodisc Symposiums for Education, co-sponsored by the University of Nebraska and the National Videodisc Design Group.

- 1986-1988 Federal-Private Sector Task Force Meetings on Technology-Based Learning, co-sponsored by The Learning Technology Institute and the U.S. Department of Commerce, Office of Productivity, Technology and Innovation.

- 1986 The International Interactive Communication Society (IICS) Journal published by the IICS.

- 1985 The Videodisc Monitor, published monthly by Future Systems, Incorporated.

- 1986 (August) Journal of Computer Based Instruction: Issue Devoted to Interactive Videodisc Technology.

Lack of Analytic Focus in IVD Literature

A third major problem faced by those seeking information related to interactive video is that much published work has been written from a stance of advocacy. In such articles, IVD is often depicted as having almost unlimited potential to revolutionize education (Van Horn, 1987), and as having instructional effectiveness that is assumed to be a foregone conclusion (Malenke, 1986). The need to consider carefully issues beyond the claims of advocates was the basis for this dissertation study; since the inception of the study, this need for reasoned analysis has been articulated by others (Bosco, 1984; Hannafin, 1986; Hosie, 1987).

The lack of analytic focus in much of the IVD literature has been noted in three articles (DeBloois, Maki, & Hall, 1984; Hannafin, 1986; Hosie, 1987). After engaging in an exhaustive search, DeBloois et al. (1984) characterized the literature as an "unruly body of information . . . 85 percent fluff and 15 percent substance" (p. 22). Two years later, Hannafin (1986) expressed similar criticism, noting that the "occasional research studies and critical analyses that can be found

"usually possess little scholarly focus" (p. 5). Further, Hannafin (1986) and Hosie (1987) submitted that claims of IVD effectiveness are often unsubstantiated and speculative. An accompanying concern independently expressed by both authors was the lack of well-defined empirical or theoretical foundations for the design and application of IVD technology.

Given the infancy of IVD and the somewhat atheoretical nature of the field of media technology, the lack of analytic focus is understandable. Research related to IVD suffers from the same methodological constraints as other instructional research. While policy-makers clamor for empirical evidence to prove the comparative worth of the expensive IVD, researchers debate the appropriate paradigms. For example, Clark and Salomon (1986) argued that comparisons of effectiveness of different delivery systems are fruitless. They asserted that the instructional design components of the lesson are more salient than the individual technology. Reeves (1986) concurred that the experimental and quasiexperimental comparative research paradigms are ineffective in assessing instructional technology; he urged that they be abandoned in research and evaluation of IVD. In their place, he suggested development of new approaches that rely on causal models of the influence of the critical dimensions of IVD on learning outcomes.

Despite some acknowledged limitation of the videodisc research and literature, there are descriptive case studies that illuminate the potential and nature of IVD (Bransford, 1987; Harless, 1986; Williams,

1987). There are also several reported efforts to incorporate theory and/or former research findings in developing principles of interactive videodisc software design, application and evaluation (Allen, 1986; Kearsley & Frost, 1985; Merrill, in press; Park & Seidel, 1987).

Section 2: IVD Applications in Public Schools

Literature Review Through 1984

Although the 1984 literature review portrayed IVD as promising media for increasing the effectiveness and efficiency of instruction (DeBloois et al., 1984), references to public school applications were rare. The educational market was undeveloped. As a result, the majority of those concerned with harnessing the potential of IVD for primary and secondary education could only envision the future (Bailey, 1981; Glenn & Kehrberg, 1981; Levin, 1983). Their goals of use varied. One research scientist dreamed of using videodisc technology to enrich educational experiences and to contribute to the goal of equal educational opportunity (Bejar, 1982). Some educational analysts hoped local education systems would adopt videodiscs for their special education population (Educational Turnkey Systems, 1983; Thorkildsen & Hofmeister, 1984). Other visionaries in the National Education Association anticipated enhancing curricula nationwide by producing interactive, magazine-formatted discs that could be updated yearly. Their ambitious NEA-ABC Schooldisc Project was suspended in 1984 because of market realities.

At that time, there were only a few published reports that delineated actual classroom applications. One detailed the design and use of an interactive economics course for secondary schools (Kehrberg & Pollak, 1982). Another report, emanating from Simon Fraser University in Canada, specified the design, production and field testing of an interactive video program on blood circulation for elementary children (Kirchner, 1982). Because this article was published in the now-defunct magazine, "Videodisc/Videotex," it had limited circulation.

The scarcity of publications in 1984 belies the amount of videodisc experimentation that seems to have occurred in public schools. Through informal networking at conferences, the researcher became aware of two videodisc projects at the state level of education and one at the national level. The State Departments of Education in Florida and in Virginia promoted videodisc awareness through sponsoring workshops that were created and directed by Dr. and Mrs. Paul Becht and Mr. Mark Delp, respectively. About the same time, the United States Department of Education's Division of Educational Technology launched a national effort, "Videodisc Interactive Microcomputer (VIM) Project." Forty-five elementary schools across the country were provided with experimental videodiscs, an interface between the videodisc and computer, an electronic mail system and authoring system, and access to videodisc consultants (Withrow & Roberts, 1984). A formal, unpublished evaluation of the national VIM project cited three problem areas: (a) hardware integration, maintenance and management; (b) insufficient software; and

(c) inadequate teacher training (Withrow, personal correspondence, July, 1984).

The problem areas experienced in the VIM project had been anticipated as potential barriers to IVD innovation in previous publications. Some articles implied that the technical capabilities of the hardware would be the key to integrating technology in schools. Others claimed that software issues would determine the impact of IVD on education (Bejar, 1982; Levin, 1983). Still others insisted that the way in which the school and teacher implemented the technology would determine its effects (Dede, 1981; Jernstedt, 1982). In an earlier review of literature dealing with barriers to widespread use of computer-based innovations, it was suggested that diverse obstacles vary in their importance according to both the stage of innovation and the individual setting (Seidel et al., 1974).

Contributing to the difficulty of harnessing technology in the public schools is the organizational structure of schools (Berman & McLaughlin, 1975). Decisions to introduce costly technology are made at district and administrative levels, while application takes place at the instructional, classroom level. Because technology use impinges on the actions within and among the various levels of bureaucracy in public schools, the conception of IVD extends beyond that of a mere teacher resource to representing major innovation in schooling organization and practices (Heinich, 1984; Lowenstein, 1986).

The dual conception of IVD as a media technology and as major innovation implies the relevance of literature on educational change and

innovation to this dissertation study. A comprehensive, scholarly analysis of prior studies on educational change has been provided by M. Fullan (1982) in The Meaning of Educational Change. Throughout his book, Fullan supports a focus on the culture of the public schools as a means of clarifying the process of innovation.

Literature Review After 1984: Three Trends

IVD literature published subsequent to the 1984 review reflects increasing interest in the relationship of IVD to children and to their learning. Three trends can be discerned. They are (a) increased experimentation dealing with IVD, cognition and learning; (b) increased availability of videodisc software for public school curricula; and (c) increased discussion of the importance of context for innovation.

Trend 1: Increase in Experimental Efforts

Research efforts exploring the relationship of IVD to cognition and learning have been conducted by individuals, by groups affiliated with academic centers, and by private companies. One individual researcher working out of Harvard Graduate Center, C. Chomsky (1987), has reported working on an experimental software project that uses IVD to simulate reading aloud to children. Her books-on-disc project is based on theories related to the value of hearing books read aloud and the value of listening while reading. While the project remains in the development stage, (C. Chomsky, personal correspondence, August 17, 1988), the

intent of the work, its current design, and potential applications in schools and libraries are described in Chomsky (in press).

Another research effort concerned with storytelling was conducted by Char (1986) on behalf of the Bank Street's Center for Children and Technology. In three studies, Char investigated how children interacted with a variety of interactive visual materials, including two software animation packages and a videodisc-based filmaking/editing system. She concluded that the materials fostered creativity and imagination in the storytelling of children, ages 8-12 years.

Many other studies exploring the potential of interactive videodisc with children have been conducted at Bank Street. One (Tally & Char, 1987) investigated children's use of a Level One videodisc, focusing on their manipulation of the following features: two independent sound tracks, freeze frame capability, variable play speed, variable direction of play, and frame accurate searching. They found that elementary aged children not only are able to exploit the flexibility and control of the videodisc for game and for learning goals, but they also invent games that are not explicitly part of the design.

Two research and development projects at Bank Street involved creating and researching videodisc prototypes, "The Voyage of the Mimi" and "Palenque." Both have been developed to study how technology-based environments can support children in transformational, intention-developing exploration (Wilson, Hawkins, Bruner, Chaiklin, Ghitman, Moeller, & Tally, 1987). "The Voyage of the Mimi" prototype uses the science themes and film footage from the television series of the same

name. While it was intended to be used in schools, its design offers students opportunities for self-guided exploration and information-gathering (Wilson, 1987c). Less traditional in design is "Palenque" (Wilson, 1987a), the interactive, multimedia optical disc database environment created for use in homes by children, 8-14 years of age, and by their families. Based on themes, characters and locations from the "Second Voyage of the Mimi" T.V. show, the "Palenque" prototype provides users with a simulated visit to Palenque, an archaeological dig of the ancient Maya, along with opportunity to peruse the Palenque Museum database. The visually-rich database environment is intended to promote "browsing" and "engagement in the exploration and discovery process itself, rather than ...." the learning of a specific content (p. 7).

A second academic center researching the potential effects of videodiscs on cognition and learning is Vanderbilt's Learning Technology Center (LTC). Its commitment to videodisc research is based on a perception of random access videodiscs as a milestone in communication. The center proposes that the world is in the midst of a video revolution; and that with modern videodisc technology, the potential to create, preserve and review information in the form of language, gesture, intonations, and non-linguistic context represents a major landmark in human history (Bransford, Sherwood, & Hasselbring, 1988).

A major goal of the LTC is to develop IVD, with its rich visual contexts that are similar to life, in order to create idealized learning environments (called havens). In so doing, the researchers hope both to increase the speed and ease of learning in the formal settings of school

and to promote transfer of thinking and problem-solving skills (Bransford, 1987).

To accomplish these goals, the LTC has used portions of commercial videodiscs, like "The Raiders of the Lost Ark" and "Swiss Family Robinson," as research tools in experiments with college youth in laboratory settings and with children in public schools (Sherwood, Kinzer, Hasselbring, & Bransford 1987). The results of the various experiments have provided evidence that the use of videodiscs can provide students with relevant contexts that "anchor instruction" and promote improved learning in math problem-solving, science content, and reading comprehension (Bransford, Sherwood, Hasselbring, 1988; Bransford, Sherwood, Hasselbring, Kinzer, & Williams, in press; Sherwood, Kinzer, Hasselbring, & Bransford, 1987).

LTC also developed and experimented with three videodisc prototypes; "The Producer," "The Empiricist," and "The Thinker" (J. Bransford, personal correspondence, March, 1986). The first prototype, "The Producer," is an easy to use authoring system that fosters a generative approach to learning. It enables users of all ages to play with the multiple symbol systems of videotape, graphics, and text to create interactive stories and to produce professional-looking video and text that can be used by others as instruction or as entertainment (Bransford, Sherwood, Hasselbring, Kinzer, & Williams, in press). The second prototype, "The Empiricist," provides high school or college students with the opportunity to manipulate a rich set of life-like experiences along with measurement problems in order to learn statistics

and experimental design. As yet, there are only descriptive data and no published results of studies (R. Sherwood, personal correspondence, September 12, 1988). The third prototype, "The Thinker," is still in the development phase. LITC is using it to facilitate research on the idea of synergistic design, where the videodisc program helps integrate instruction in the different content areas of science, mathematics and problem-solving (Bransford, Sherwood, Hasselbring, 1988). LITC hopes to conduct future studies that compare the value of integrating disciplines to the more traditional, non-integrated approaches of instruction (Bransford, Sherwood, & Hasselbring, 1988; Sherwood, Kinzer, Bransford, & Franks, 1987).

Trend 2: Variety of Videodisc Software Growing

The second trend in the literature is a noticeable increase in videodisc software intended for public school use. One reflection of the growth of commercially prepared courseware can be found in the Catalog of Interactive Videodiscs for Education, published by Ztec Company of Lexington, Kentucky. The premiere edition in 1986 presented an annotated listing of over 130 discs; the more recent edition, published a year later, lists over 230 discs.

An increase in noncommercial efforts to design and promote interactive videodisc software also has been exhibited by individuals and by states. There have been two dissertation studies investigating the feasibility of creating interactive videodiscs for effective high school instruction. Kwan (1985) developed an interactive videodisc

sewing course; it was completed with 1,172 man hours and with an additional cost of $2,100 for materials. His research conclusion was that quality courseware could be created in any educational institution that has available resources and that uses a systematic approach to design and development procedures. Substantiating his claim is Miller's 1988 dissertation study which explored the feasibility of videodisc instruction in instrumental music education. After developing and evaluating the effectiveness of an oboe instructional disc teaching reedmaking, Miller recommended that efforts should be made to implement technology-based programs in music education and that development of IVD could be made less expensive and less intimidating through teacher involvement in retrofitting existing media.

Teacher involvement in repurposing videodisc software is a major component of New Hampshire's Interactive Videodisc Teacher Training Program. The state has allocated close to $5 million for this large scale grass-roots effort of change and innovation. Under the direction of G. Pacquin, over thirty districts have been introduced to videodisc curricula. Over the next three years, a selected group of teachers from more than forty schools will be provided with the opportunity to use a new authoring system, "MacMentor," and design their own discs on such subjects as astronomy, chemistry, language arts, and fine arts. Their software will then be disseminated statewide (G. Pacquin, personal correspondence, February 12, 1988).

A challenge to the premise that teachers, in general, have the knowledge, time and energy to be effective designers of videodiscs is

found in the research findings of Char and Tally (1986). In four classroom case studies of videodisc use in elementary schools, they observed that teachers could be valuable contributors to videodisc design process, but lacked the time necessary to reprogram videodiscs. They suggested that teachers be involved in the design process as consultants so they could identify content, suggest organization of programmed learning activity and improve on the accompanying documentation and print materials.

Trend 3: Context of Change

The third trend noted in the IVD literature is a recognition of the importance of context to change and innovation. Sybouts (1986) stressed the importance of systematic planning for IVD innovation, and urged planners to consider the setting in which an innovation effort occurs as the important and often overlooked starting point.

Recognizing the sociocultural complexity of the public school context, Lowenstein (1986) suggested that promoters of IVD shift their thinking. Rather than maintain the traditional, linear, cause-effect model of change and innovation, she recommended that they examine context and engage in a more holistic, interrelational way of thinking. Support for this paradigmatic shift in thinking is found in Goodlad's book, The Ecology of School Renewal (1987). Defining schools as ecological communities that are composed of policies, organizational structures, curricular arrangements, instructional practices, and a

broad array of actors, Goodlad perceives change and improvement in terms of healthy interrelationships and sound functioning of units.

Reflecting this holistic approach is a case study examining the deliberations and decision-making processes involved in a school developing interactive videodisc curriculum (Williams, 1987). The focus was on the processes of implementation rather than on the outcomes of student learning. The research findings confirm both the variety of factors impinging on the success of the project and the importance of social interactions within the school district.

Another study that demonstrates the importance of the broader contexts of technology use in school districts was conducted by the research staff at Bank Street College Mathematics, Science and Technology Teacher Education Project (Martin, 1986). The adoption process of technology was investigated through a case study of sixteen teachers in four New York districts during and subsequent to their training in using the multimedia elementary science and math program, "The Voyage of the Mimi." It was observed that individual teacher experimentation had different impact depending on the context of the wider system in which it occurred. A major conclusion was that the way districts define goals, support teachers and provide feedback affects the adoption and diffusion of the technological innovation.

Confirmation of the importance of district support to teacher's use of IVD in classrooms has been provided by other studies. In one, Cannings (1986) directly elicited the opinions of practitioners who had learned to use the technology in their Masters of Science in Educational

Computing program at Pepperdine University. The sample population of 130 Los Angeles teachers cited ten reasons for videodisc nonuse, ranking lack of district support as the second most important.

Insight into the reasons district support is so necessary is provided in the reserach of Char and Tally (1986) and Honey, Martin, and Robinson (1987). While the two research projects had different goals and conditions, their findings were consistent. Both studies highlighted the importance of teachers establishing a climate appropriate for student-guided discovery learning, and the difficulty many teachers experience as they adopt materials innovative in both content and form. The observations indicated that even teachers with enthusiastic intention to innovate have trouble changing their usual expository pedagogical style to one compatible with discovery-learning.

Section 3: Delphi Methodology

The Delphi is a research approach that has evolved in its technique and applications as a spin off from Air Force defense research conducted by the Rand Corporation in the 1950s. The goal of the initial study, "Project Delphi," was to obtain consensus of opinion from a group of experts through a series of questionnaires interspersed with controlled opinion feedback. Because of the sensitive nature of the study, knowledge of the technique failed to spread beyond the defense community until Rand published Gordon and Helmer's study in technology forecasting in 1964 (Linstone & Turoff, 1975). From that point, interest in and use

of the research approach began to spread throughout the United States and abroad into industry, government and academia.

While many think of the Delphi merely as a forecasting technique used to obtain a consensus, the concept has been interpreted more broadly:

- As defined by Linstone and Turoff (1975) ". . . Delphi is 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).

- Scheele (1975) shares that communication process view and suggests that the results of the collective consideration be seen as "the product of a carefully designed and managed interaction" and not merely answers to a set of questions (p. 38).

- Sutherland (1975) conceives of the Delphi as part of a "normative system design" of policy setting that contributes soft data for future decision-making, increases communication among the diverse stakeholders who are separated by distance, and provides written synthesis of perceptions of current activities and beliefs.

- Turoff (1975) proposes that the Delphi be considered a tool for analysis, rather than a mechanism for making a decision. He defines Delphi as: "an organized method for correlating views and information pertaining to a policy area and for allowing respondents the opportunity to react and assess differing viewpoints" (p. 87).

- Helmer (1975) highlights the value of Delphi to supply "soft" data in the social sciences and to provide decision makers with ready access to specialized expertise (p. xx).

The conceptions of Delphi vary, as do the actual application techniques. As Linstone and Turoff (1975) note, the Delphi in its design and use "is more of an art than a science" (p. 3). Yet, various applications share some characteristics, including: a degree of anonymity of individual responses, some feedback of individual contribution, some assessment of the group judgment, and some opportunity for individuals to revise their views.

Delphi studies have been used a lot in education for administrative planning, particularly in higher education. However, there also have been Delphi applications dealing with public schooling. One example is Coombs' (1985) study of future trends in America's secondary schools. Another Delphi application that is germane to this dissertation in content as well as methodology was a forecast study related to computer-based technology in education. Sponsored in 1975 by The National Science Foundation Office of Technological Innovation in Education, this Delphi was conducted as a three day invitational conference, entitled "Ten Year Forecast for Computers and Communications: Implications for Education 1985." A detailed report is presented in Computers and Communications (Seidel & Rubin, 1977).

Another study forecasting the future of technology trends in American classrooms was announced in the July 1987 issue of "Technological Horizons in Education" (T.H.E.). Co-sponsored by The

Association for Childhood Education, International and The Society for Visual Education, Inc., this study, entitled "Instructional Tools of the 90s," asks media specialists, state education officers, teachers and curriculum directors from around the country which skills and subjects will be most important to children in grades K-9 and how teachers will use technology as a teaching tool in the decade ahead. Results are as yet unpublished.

Chapter Summary

The literature discussed in this chapter has encompassed three areas: IVD as an instructional medium; IVD applications in public schooling; and the Delphi research methodology. The review has established that: (A) Despite increased attention to applications of IVD for education, there are no studies that systematically or comprehensively examine the relationship of interactive videodisc technology to public schools; (b) there is a need for a disciplined and holistic inquiry to identify and critically analyze issues related to IVD applications in public schools; and (c) the Delphi methodology is well suited to the study of an emerging technology, like IVD, and education. That approach is detailed in the following chapter.

CHAPTER 3

METHODOLOGY

("IVD" REFERS TO INTERACTIVE VIDEODISC)

The purpose of this chapter is to describe the methodology and procedures used in this study. It will be structured in two subsections, one describing the rationale, one describing the five stages of the Delphi.

Rationale

Delphi is an organized research methodology for correlating views and information pertaining to a policy area and for allowing respondents representing such views an opportunity to react to and assess differing viewpoints. By its structure, it allows individuals who are geographically dispersed to deal with complex problems and derive a group judgment. Through intensive interviews and subsequent rounds of questioning, it identifies issues, fosters examination of statements of belief, and obtains positions of accord and significance. In addition, it provides a degree of anonymity for the individual responses, some feedback of individual contributions, some evaluation of the group judgment and some opportunity for individuals to revise their views. The intent is that the results of the inquiry are not mere answers to a set of survey questions, but rather a product of a carefully managed interaction (Scheele, 1975, p. 38, p. 68). This product, while not necessarily a consensus, consists of "pooled judgments that have

'validity' believed to be greater than that of any individual" (Scheele, 1975, p. 57). The Delphi technique was selected for use in this study as a framework for analysis and predictions. Analysis of issues and predictions were believed to be needed to help inform decision-makers of the potential of the media.

Stages of the Delphi

Five stages were planned in this Delphi Study: 1. creation of a Delphi panel; 2. individual interviews with panelists,; 3. Round One Questionnaire,; 4. Round Two Questionnaire; and 5. concluding report. Descriptions of each stage follow.

Stage One: Creation of a Delphi Panel

A number of factors guided the selection of the Delphi panel. Among them were the researcher's: (a) concern for representing national, state and local educational interests; (b) desire to include both practical and theoretical considerations relating to the research, development, and implementation of IVD in schooling; and (c) respect for the advice of the doctoral committee and research methodologists, such as Fortune, Seidel and Scheele, regarding the composition of a successful panel.

After consulting the professional literature and seeking expert advice, a preliminary list of panelists was created. Initially, they were arranged according to the three categories of experts recommended by Scheele (1975): (a) stakeholders who are or will be directly

affected; (b) experts who have applicable specialties or relevant experience; and (c) facilitators who have skills in clarifying, organizing, synthesizing, stimulating or supplying alternative global views of culture and society (p. 68).

To elicit participation of potential panelists, the researcher conducted telephone interviews. Research goals of this study and potential responsibilities of the panelists were outlined:

- There would be an initial phone interview of 30-45 minutes.

- Prior to the interview the panelists would be provided with four open-ended questions. In that way they would have the option of preparing answers or responding more spontaneously.

- Additionally, there would be three successive rounds of questionnaires that would evolve from the information collected and analyzed from the preceding round. It was expected that the response to each round of the Delphi questionnaire would necessitate a time commitment of approximately one hour.

- Lastly, it was expected that the entire study would be complete within six months from its inception (March, 1984 - September, 1984).

Thirty-two potential panelists agreed to participate. It is difficult to be definitive in describing them in terms of the three non-discrete categories of stakeholder, expert and facilitator. Many of the panelists have interests and positions that overlap categories; furthermore, several switched career positions during the time the research was being conducted. Nevertheless, by using the original and overlapping categorizations, the composition of the 32 member panel can

be characterized as 11 stakeholders (at 27 percent), 23 experts (at 56 percent), and seven facilitators (at 17 percent). Within the panel, several were involved in education at a national level; three had careers with state level involvement; one was an administrator at the local level. There were two publishers, one from an education journal, and one from a videodisc industry journal. There were also eight producers of hardware and software, two educators involved with change and the future, eight researchers of computer-related media, cognition and learning, and one military technologist (See Appendix A for the list of chosen Delphi panelists, their career positions at that time, and their category designations).

Stage Two: Interviewing Individual Panelists

Creating the Interview Instrument

The researcher's interview questions were explored with three professional educators and technology-enthusiasts[1] during the late winter, 1983. Actual pilot interviews using the interview questions[2] were conducted in late February, 1984, in order to refine the interview technique and clarify conceptual issues.

From an analysis of the results of the pilot interviews, the researcher was able to refine several questions and prepare some probes

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[1]Responses were given by Dr. D. Roper, a physics professor at Virginia Tech; Dr. R. Fuller, physics professor and videodisc pioneer at the University of Nebraska; and Dr. P. Butler, a technology project officer at the United States National Institute of Education.

[2]Pilot interviews were conducted with Dean L. Simutis and Dr. R. Braden of Virginia Tech.

or cues at the end of the structured interview. It was hoped that the probes would encourage panelists to respond to predetermined issues and provide data that could be more easily categorized and analyzed than data from purely open-ended questions. However, the potential limitation of using the probes was also recognized; probes could lead or bias the panelists.

Following are the structured, open-ended interview questions, their rationale, and the probes used at the end of interviews when time permitted:

Questions.

1. Please discuss your views regarding the potential of IVD technology as it relates to education and public schooling. (The purpose was to have respondents contemplate, envision and describe the "ideal" with regard to situations, conditions and relationships.)
2. What are the inventive measures/policies needed to achieve those visions? (The goal was to have respondents still think creatively, but more concretely and more action-oriented.)
3. What do you conceive of as the barriers to reaching the potential? (Here, panelists were asked to be more realistic and to apply their practical knowledge and experience.)
4. In reality, what do you think will happen with IVD and the public schools in the next five years? Ten years? (Predictions of the future were elicited.)

Probes.

1. Do you have anything to add about the nature of IVD and its potential presently or in the near-term future?
2. Do you have anything to add about the relationship of IVD with cognition and learning presently or in the future?
3. Do you have anything to add about the relationship of IVD and the formal institution of schooling presently or in the future?

Conducting the Interviews

Between March and June, 1984, all 32 interviews were conducted and documented both by written notes and by audio tape recordings.

Analysis of Interview Data/Round One Instrument Construction

In the original design of this study, it was anticipated that the analysis of the interview data would be quickly conducted and lead to the creation of a Round One Questionnaire. Round One Questionnaire would present the researcher's summary of the interviews in order to provide a scope of the issues to panelists, probe their positions of accord, and elicit their reactions to a need for clarification.

Because of the amount of rich, dense information collected during initial interviews, analysis and the subsequent design of the instrument for Round One proved to be much more time-consuming than originally anticipated. Panelists were apprised of the delay through two communications (See Appendix B for copies of the communiques).

Analysis of the interview data was conducted using ethnographic techniques suggested by Spradley (1980). The verbatim principle guided the selective transcription of the interviews. With that approach, the respondents' terms and original syntax were recorded.

The data then were searched for domains and themes. The goal was to group ideas according to similarity in order to maximize an economy of words while minimizing a loss of individuality within answers. Ten major categories were found throughout the data collected from 32 interviews and across the four interview questions. One category, "caveats," related to the Delphi technique; the other nine categories related to IVD. They were: legitimate descriptors; technological capabilities; production and design; marketing; research; instructional benefits; applications in different locations; goals and rationale for use; funding and responsibility issues.

Next, all the information was coded and rearranged according to both those nine categories and the original four interview questions. The researcher then reorganized all ideas into assertions, all the while applying the verbatim principle. The length of the resulting instrument suggested the need for data reduction.

Different decision rules to eliminate information were explored. One criterion attempted, for example, was to eliminate all responses unrelated to classroom instruction across the four interview questions. While that rule appeared to narrow the focus appropriately, it also arbitrarily restricted the range of responses being sought.

Three decision rules for data reduction that appeared least distorting were finally determined. The first rule was to limit the Delphi rounds to the first two interview questions while offering to provide panelists with the original data from questions three and four upon request. A second decision was to eliminate two of the ten categories, these being "caveats to answers" and "descriptors of IVD." The third rule was to collapse and organize data statements from the remaining categories into three sections entitled: (A) Instructional Benefits, (B) Uses of IVD in Public Schools, and (C) Uses of IVD in Learning Environments Other Than Public Schools. Those statements relating to visions and measures that were eliminated in the process of collapsing can be found in Appendix C and Appendix D, entitled "An Addendum of Visions" and "An Addendum of Measures," respectively.

Using the above described decision rules, Round One Questionnaire was redrafted. It was administered to three educators[3] to acquire feedback in March, 1985. Their comments helped to improve the clarity of the instrument.

Stage Three: Round One Questionnaire

A revised Round One Questionnaire accompanied by a cover letter and instructions was mailed to the 32 panelists on May 10, 1985 (See Appendix E). The instrument had been reduced to eleven pages. It was

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[3]They were: L. Britt, a doctoral student in Educational Research at Virginia Tech; C. Heine, a technology consultant and National Training Director for the United States Legal Services; J. Mecklenberger, National School Boards Association Executive.

structured into two sections. Section One, entitled "Visions of the Potential of IVD for Learning," dealt with responses to question one. Section Two, entitled "Actions and Policy Measures Needed to Achieve Visions," dealt with the responses to question two. In both sections, data statements relating to the remaining eight categories (technological capabilities; production and design; marketing; research; instructional benefits; applications in different locations; goals and rationale for use; funding and responsibility) were collapsed and organized under one of three categories: (A) Instructional Benefits, (B) Uses Within Public Schools, and (C) Uses Within Learning Environments Other Than Public Schools.

In all, there were 141 items. For each item, panelists were asked to check one of three boxes to denote whether they agreed with it, disagreed with it or believed that further comment or clarification was needed. A comment sheet was provided. A fourth column was offered for panelists to denote significance of the item through either a check or a zero. Respondents were provided with a postage-paid, return envelope and were requested to return the questionnaire within three weeks.

Analysis of Round One/Round Two Instrument Construction

In the Delphi design, analysis of Round One Questionnaire data leads to the formation of a Round Two Questionnaire. This second round continues to probe the individual and group view of issues. It permits respondents to examine the results of Round One along with the written comments of their peers in order to reassess their own beliefs.

When the Round One Questionnaires from 27 panelists were returned in June 1985, responses were tabulated and comments were summarized (See Appendix E and F). There was so much information that once again a process of data reduction was needed to create a managable Round Two Questionnaire. The following decision rule was applied: Retain all items that thirteen or more panelists found to be significant issues. Since there were 27 respondents, the number 13 would be approximately half. Application of this rule permitted the elimination of 66 items from the 141 original ones. The 75 items retained for use on the second round questionnaire were considered important issues by at least half or more of the respondents (See Appendix F for the Round Two Questionnaire).

Stage Four: Round Two Questionnaire

The second and final questionnaire, the Round Two Questionnaire, was mailed to all 32 original panelists in early July, 1985. Its intent was to enable panelists to reassess their original views by providing anonymous feedback from individual panelists and by revealing the group judgment.

The structure of the Round Two Questionnaire was similar to Round One, only reduced in size. It contained: the statements describing panelists' visions of the potential of IVD for learning and the measures needed to achieve them; the preliminary results of agreement among respondents; and the clarifying comments made by respondents. Panelists were asked to review the information and rerate each item; they needed

to check the appropriate box to indicate agreement or disagreement, and to use a check or zero to denote whether each item was a significant issue. As with the first round, an optional comment sheet was provided along with an envelope already addressed to the researcher.

By September, 1985, 28 Round Two Questionnaires had been completed and returned to the researcher. (See Appendix G for a list of panelists who responded and Appendix H for the results of Round Two Questionnaire.)

Stage Five: Concluding Report

A final report of findings was sent to all the original 32 panelists in March, 1988. The report consisted of both a discussion of The Round Two Questionnaire that is found in Chapter Four (Findings) of this dissertation and discussions of Interview Findings to questions three and four that are found in Appendices I, J, and K.

CHAPTER FOUR

FINDINGS

The preceding chapter described the methodology of this investigation into the nature and potential of interactive videodisc (IVD) technology in education. Using a modified Delphi technique, four areas of inquiry were introduced in the interviews: visions of use of IVD in education, measures needed to achieve those visions, barriers inhibiting the realization of vision, and predictions of future developments. In response to a need for data reduction, the subsequent rounds of the Delphi questionnaire were limited to the first two categories, visions and measures.

The summaries and discussions of the findings from the Round Two Questionnaire are presented in this chapter in two parts: Part One deals with the Round Two Responses to Question One and Part Two deals with the Round Two Responses to Question Two. A discussion of the data from Interview Questions Three and Four, along with a discussion of Unanticipated Findings can be found in Appendices I, J, and K.

Part One: ROUND TWO Responses to Question One

"What are your views regarding the potential of IVD as it relates to education and public schooling?"

Responses to the first interview question were used to create Section One in the Delphi questionnaire that was entitled, "Visions of the Potential of IVD." After data reduction, the second and final

questionnaire contained 34 statements. They were organized under three headings: (a) Visions of Instructional Benefits, (b) IVD Use Within Public Schools, and (c) IVD Use in Learning Centers Other Than Public Schools.

Following are three tables that present the content summary along with Round One (RD1) and Round Two (RD2) rating responses of agreement and of issue significance. The response tallies are given in percentage form in order to facilitate comparisons between the two Delphi rounds, which involved 27 and 28 participants, respectively. The tables are succeeded by a brief discussion of highlights of the findings.

TABLE 1

Round One (RD1) and Round Two (RD2) Percentage Ratings of Agreement and of Issue Significance for Section One (A) Visions of Instructional Benefits

	Agreed		Significant	
	RD2	RD1	RD2	RD1
CURRICULA-RELATED VISIONS				
- expand curricula/teaching of important and abstract concepts	100	81	86	70
- motivate by providing impractical, dangerous or expensive experiences ...	100	96	75	85
- provide resource options to teachers .	89	93	71	78
- eliminate lock-step curriculum	54	74	43	48
IMPROVING STUDENT UNDERSTANDING AND ACHIEVEMENT				
- provide remediation - mastery learning	96	93	71	78
- provide dynamic assessment and feedback	82	78	64	56
- increase engagement and interaction ..	86	78	50	56
- provide visual models of behavior	79	74	46	59
- increase learner control over environment and over pacing of instruction	71	81	32	63
ALTERING ORGANIZATIONAL STRUCTURE				
- deliver instruction to remote sites ..	93	89	64	67
- deliver instruction to the home	61	78	54	63

TABLE 2

Round One (RD1) and Round Two (RD2) Percentage Ratings of Agreement and of Issue Significance for Section One (B) Visions of IVD Uses in Public Schools

	Agreed		Significant	
	RD2	RD1	RD2	RD1
GOALS AND RATIONALE FOR USE				
- optimize IVD usage	82	81	46	56
- respond to problems in society	54	71	43	48
PRODUCTION AND DESIGN ISSUES				
- use principles effective instruction .	86	81	61	48
- design by practioners	71	56	32	56
- design by multidisciplinary teams	75	81	43	52
- cooperation of researchers, educators and hardware/ software producers	25	56	25	48
FUNDING AND RESPONSIBILITY ISSUES				
- local schools long-range budgets	54	67	46	48
- state commitment to pilot projects ...	61	74	46	59
- state commitment				
- priority math/science	54	67	43	48
- priority remediation	36	67	32	63
LOCAL SCHOOL IMPLEMENTATION				
- systems approach to implementation ...	86	78	79	59
- apply results of research	43	67	39	52
- research on innovation and change	46	70	32	52
- funds for staff training equivalent to that spent on IVD system	61	56	61	63

TABLE 3

Round One (RD1) and Round Two (RD2) Percentage Ratings of Agreement and of Significance for Section One (C) Visions of IVD Uses in Learning Environments Outside Public Schools

	Agreed		Significant	
	RD2	RD1	RD2	RD1
IN THE HOME				
- promote an electronic cottage-flexible work, leisure study schedule	39	67	29	59
- provide skills training for industry .	71	56	39	56
IN NEW LEARNING CENTERS				
GOALS AND RATIONALE				
- provide quantity and quality of software for individual learning style needs	75	78	57	52
- promote training focus to improve problem solving/information handling .	86	70	54	56
- provide 'training' and support of 'education'	57	56	36	52
ALTER CURRICULUM AND/OR ORGANIZATIONAL STRUCTURE				
- encourage structure to evolve from needs of learning, not teaching	86	81	46	52
- simulate work environment for learners of all ages	87	85	57	63
- eliminate time as a prime measure of curricula sequencing	61	59	46	52
- redefine the locus of learning and the role of students	86	70	50	56
- redefine teachers' role as facilitators of multiple learning environments	86	85	57	67

Discussion of Table 1:

(A) Visions of Instructional Benefits

Panelists were presented with 11 statements that dealt with three categories: curriculum, students' understanding and achievement, and organizational structure of schools. Responses to most of these statements indicated a high level of agreement and belief in the significance of the issues. This suggests that the category of potential instructional benefits is a vital area of exploration for consumers of IVD.

(1) Comparing Table 1 ratings of issue significance discloses that the Delphi panelists consider the category of curricular benefits to be more important than the category of student performance benefits.

(2) Of the four potential benefits of IVD considered most significant, three deal with curriculum and one with student performance. The statements claim that IVD has the potential to:

- expand curriculum by teaching important, abstract concepts that have been difficult to teach;

- provide motivating experiences not usually found in classes because they are impractical, expensive or dangerous;

- provide resource options to teachers that enable them to flexibly manage and personalize instruction;

- improve student understanding and achievement by providing tutorials that review, remediate and extend learning until students achieve mastery.

(3) The first two curricular benefits are the only two statements on the entire questionnaire to have elicited unanimous agreement from the Delphi panelists.

Discussion of Table 2:

(B) Visions of IVD Uses in Public Schools

Panelists were presented with 13 statements of belief that addressed four issues related to use of IVD within public schools: goals and rationale for use, production and design issues, funding and responsibility issues, and the process of local school implementation. Unlike responses to "Visions of Instructional Benefits," the responses to "Visions of IVD Uses in Public Schools" demonstrate a general lack of accord and modest ratings of issue significance.

(1) In Round Two, only three statements elicited ratings of issue significance above 46 percent: Of these, two dealt with the process of implementation and one dealt with a design issue.

(2) The implementation statement receiving the highest rating of issue significance (79 percent) claimed that: "Within public schools, IVD will ideally be used in ways that require a systems approach for implementation; one that considers teacher preparation, instructional materials , administrative support, community support, facilities and equipment."

Its rating of issue significance ranks it as the second most important issue among the 72 issues in the Delphi.

(3) The two other issues in "Visions of Uses of IVD in Public Schools" that were considered significant received ratings of 61 percent. The implementation statement asserted that: "IVD will be used in ways that require financial allocations for staff training equivalent to those spent for hardware and software."

As the written comments of panelists highlighted: (a) using the medium effectively demands staff training; (b) cost of IVD projects is dependent on the level of implementation in a system and on the nature of the interactive materials developed; and (c) while heavy investment in teacher training is important, it is unlikely.

These findings suggest that the financial allocations for staff training necessary for successful introduction and implementation of IVD projects in public schools are in conflict with public school traditions of finance and traditions of staff development.

(4) The third statement considered significant stated: "IVD designers should apply the characteristics of effective instruction to the design of courseware."

While this issue also garnered a relatively high rating of accord (86 percent), several comments provided by panelists suggested a lack of acceptance and/or lack of awareness of the specifics of "effectiveness research."

(5) Many comments imply a clash between visions of the ideal and the current realities in education.

Regarding the issue of goals: In response to the statement

suggesting use of IVD to respond to problems in society and education, a panelist wrote, 'How I wish!'

Regarding the issue of design: In response to the statement encouraging software design by practitioners who understand the classroom, panelists cautioned that in reality, teachers have neither the time nor expertise to design quality courseware.

Similarly, while the panel endorsed the concept of multidisciplinary design teams in their rating or accord, it was qualified with the comment that the expense made it an unlikely change.

Regarding issues of responsibility and funding: Conflicting perspectives were offered in response to the claim of statewide commitment to IVD pilot projects. One panelist suggested that a grassroots approach would be appropriate; another argued that commitment from professional organizations would be equally important or more important than state involvement. A few panelists even dismissed the role of individual states entirely; two agreed with the strongly worded argument that: "In reality, no one state has adequate resources. ONLY at the national level is it possible to integrate IVD pilot projects to demonstrate cost-effectiveness."

In response to the assertion that IVD requires long-range budgets, a panelist noted that: "It's unlikely that IVD will change traditional patterns of finance."

Regarding issues of implementation: In response to the statement that implementation of IVD should be supported through application of research results, several comments focused attention on

current classroom realities: "Curricular and resource decisions in education at the local level are rarely based on scientific research; [rather,] use of IVD is often determined by what appears to work for the classroom teacher."

Discussion of Table 3:

(C) Visions of IVD Uses in Learning Environments Other Than Public Schools

Panelists were presented with ten statements of belief; two referred to home learning and eight referred to private learning centers. The moderate ratings of accord and low ratings of issue significance for these concepts are understandable--Both private learning centers and home learning are alternatives to public schooling and are inherently out of mainstream thought.

(1) Delphi ratings and comments accentuate the relationship between values and philosophies of learning and the goals of use for IVD.

(2) Many panelists referred to IVD as a tool that could accomplish various reforms to help education become what it "ought to be."

They defined the following goals of use for IVD in private learning centers: (a) providing for students' individual learning styles; (b) training students to handle the information created by the knowledge explosion; (c) redefining the locus of learning for students and teachers; and (d) reforming curriculum and educational structure.

They defined the goals of use of IVD in the home as strengthening the skills of the work force by providing competency-based skills training for industry and as promoting the development of an electronic cottage to permit flexibility of work, study, and leisure.

(3) One concern expressed by many was that fascination with technological capabilities would overwhelm thoughtful consideration of goal setting. Many agreed that: "What is technologically feasible is not necessarily worthwhile."

Part Two: Round Two Responses to Question Two

"What are the inventive measures or policies needed to achieve the potential of interactive video disc technology for education?"

Responses to the second interview question were used to create Section Two in the questionnaires from both Delphi rounds. The structure in both questionnaires was the same: Section Two, entitled Measures Needed to Realize the Potential of IVD, presented statements under one of three headings - (A) Instructional Benefits; (B) IVD Use within Public Schools; and (C) IVD Use in Learning Centers Other Than Public Schools. As a consequence of data reduction, Section Two (Measures) in The Round Two Questionnaire retained 38 out of the original 80 statements.

A content summary of the Delphi beliefs related to Section Two, along with Round One and Round Two rating responses of agreement and of significance, is presented in Table 4, Table 5 and Table 6. Following the tables is a brief review of highlights of the findings.

TABLE 4

Round One (RD1) and Round Two (RD2) Percentage Ratings of Agreement and of Issue Significance for Section Two: (A) Measures Needed to Achieve Instructional Benefits

	Agreed		Significant	
	RD2	RD1	RD2	RD1
RESEARCH RELATED MEASURES				
- research impact of IVD on learning under different conditions	29	67	29	52
- develop methods to measure benefits of teaching abstract, intangible concepts	61	70	39	56
- develop methods to measure IVD impact on student and teacher attitudes	71	70	39	52
- develop measures for cost-effectiveness	68	74	46	63
- synthesize IVD research to determine the implications for educational practices	61	70	36	48
PRODUCTION AND DESIGN MEASURES				
- infuse massive resources to develop exemplary courseware	75	93	75	81
- infuse massive resources to create critical mass of quality, pertinent courseware	75	89	64	85
- develop model courseware to demonstrate effective instruction of important concepts	96	85	79	63
- develop model courseware to demonstrate significantly improved learning outcomes	96	93	75	78
- develop model courseware to demonstrate comparative cost-effectiveness	71	70	61	56
- design interchangeable databases	68	67	43	56
MARKET-RELATED MEASURES				
- infuse massive resources to support packaged deals of software/hardware/ training	29	56	25	48
- standardize IVD equipment	36	63	43	56
- lower the cost of IVD systems	86	74	54	63
MEASURES RELATED TO RESPONSIBILITY ISSUES				
SOLICIT FUNDS FOR IVD PROJECTS FROM -				
- consortia traditional funding agencies	43	63	32	52
- business-school collaboratives	75	74	61	63

(Table continued)

	Agreed		Significant	
	RD2	RD1	RD2	RD1
- R & D Limited Partnership, syndicate of U.S. Department of Commerce, industry and education	46	67	32	56
- educational publishers	75	70	61	52
- federal government through NSF & DOE .	68	63	46	59
- the state governments	39	41	29	52
CREATE A NATIONAL CENTER FOR IVD TO -				
- involve educators with IVD potential .	29	67	21	48
- demonstrate successful applications ..	36	81	25	63
- increase communication among technology and education stakeholders	61	67	32	48
CREATE "NATIONAL DEFENSE TECHNOLOGY ACT"				
- to reflect priority to finance R & D .	71	78	43	56
- to offer national directions for equity and excellence in education ...	43	54	39	48

TABLE 5

Round One (RD1) and Round Two (RD2) Percentage Ratings of Agreement and of Significance for Section Two (B) Measures Related to IVD Uses within Public Schools

	Agreed		Significant	
	RD2	RD1	RD2	RD1
PLAN TO INTRODUCE AND ADOPT INNOVATIONS				
- persuade decision makers of IVD value	96	93	68	67
- plan formative/summative evaluations .	86	89	50	74
- create climate conducive to innovation	89	93	68	67
- provide hands-on training experience .	86	85	50	63
- plan short/long-term support for staff	86	85	61	70

TABLE 6

Round One (RD1) and Round Two (RD2) Percentage Ratings of Agreement and of Significance for Section Two (C) Measures Related to IVD Uses in Learning Environments Other Than Public Schools

	Agreed		Significant	
	RD2	RD1	RD2	RD1
CONCERN FOR COMMUNITY AND LIFE-LONG LEARNING				
- develop new structures that facilitate community access to IVD resources	71	81	43	52
- create year-round Community Center that demonstrates uses of state of the art technologies for training staff	61	63	32	52
CONCERN FOR PATTERNS OF FINANCING EDUCATION				
- create and support local learning centers by community/industry collaboration ..	82	81	43	56
- alter patterns of finance to provide large up front investments in technology for long-term benefits	64	74	36	67
CONCERN FOR A REDEFINITION OF GOALS AND CURRICULUM				
- create electronic-based learning centers to express redefined goals and curriculum of educators and the private sector ..	50	74	36	56
- create learning centers that use IVD for management of instruction	57	67	36	48
- use IVD in centers to help students redefine responsibility for learning .	82	85	50	63
- use IVD to accommodate learning styles	68	81	43	63

Discussion of Table 4:

(A) Measures to Achieve Instructional Benefits

Panelists were presented with 25 statements related to four categories: research, production and design, marketing, and funding and responsibility. The range of response ratings of agreement and of issue significance varied widely. This suggested that there is little consensus regarding what measures are necessary to achieve instructional benefits of IVD.

(1) The only category of measures with consistently high ratings of issue importance is production and design. Two of the statements in this category also elicited very high levels of accord (96 percent): both statements asserted a need for developing model IVD courseware, one for the purpose of demonstrating significantly improved learning outcomes and the other for the purpose of demonstrating effective instruction of important concepts.

(2) While the category of research measures garnered low ratings of issue importance, research activities are implied in statements dealing with the development process of IVD courseware.

Discussion of Table 5:

(B) Measures Related to IVD Uses in Public Schools

Panelists were presented with five statements specifying what is necessary to successfully introduce and implement IVD projects within a school. Response ratings indicated a high level of accord and a moderate level of issue importance.

(1) The measures advocated are non-specific to IVD; they are relevant for introduction of any innovation to public schools. Taken together, the five issues offer a systematic plan for innovation: (a) create awareness and persuade decision makers of IVD value; (b) create a climate conducive to innovation; (c) plan short- and long-term support for teachers; (d) plan formative and summative research evaluation; and (e) provide hands-on experience in training.

Discussion of Table 6:

(C) Measures Related to IVD Uses in Learning Environments Other Than Public Schools

Panelists were presented with eight statements conveying concern for three issues: community and life-long learning, a redefinition of educational goals and curriculum, and patterns of financing education. While all of the issues elicited a moderately high level of agreement, none were considered significant by more than 50 percent of the respondents.

(1) The findings seem to indicate an interest in life-long learning and a concern for increasing local community involvement in the education process.

(2) Analysis of the findings also suggests a perceived incompatibility between current structures and patterns of public schools and the changing needs of society.

Chapter Summary

Round Two Questionnaire contained 75 statements that previously had been judged significant issues by approximately half the Round One Delphi respondends. The relevance and value of the findings for consumers of technology may vary, depending on their needs and philosophies. For some, examining the range of issues rather than the ratings may be of benefit. For others, noting the outlier views that received relatively low ratings in the first or second round survey may be of interest since they reflect divergence from traditions and current realities.

As in the first questionnaire, Round Two Questionnaire statements were organized in two sections: Section One related to visions of IVD in education and Section Two related to measures needed to achieve those visions. Each section contained three categories of statements, one dealing with instructional benefits, the second dealing with uses of IVD in public schools, and the third dealing with uses of IVD outside public schools.

Within the category of "Visions of Instructional Benefit," panelists enumerated three uses of IVD: to expand curricular opportunities, to improve student achievement and understanding, and to deliver instruction to remote sites or to homes. The 25 statements of "Measures Needed to Achieve Visions of Instructional Benefits" covered issues of marketing, production and design, research, responsibility and funding.

The 14 statements in the section "Visions of IVD Use in Public Schools" also conveyed concern for production and design of courseware appropriate to schools and for issues of funding and responsibility. In addition, they suggested the need for public schools to clarify goals and rationale for IVD use and to employ a systems approach to its implementation. While only five statements were provided in "Measures Related to IVD Use in Public Schools," they inadvertently offered a comprehensive plan to introduce and adopt innovation.

The ten statements in "Visions of IVD Uses in Learning Environments Other Than Public Schools" reflected interest in alternative models of education as a response to a rapidly changing society. IVD was presented as a tool of reform of curriculum and/or organizational structures. The eight statements of "Measures Related to IVD Uses in Learning Environments Outside Public Schools" substantiated interest in the use of IVD to facilitate reform, whether in community centers or private learning centers. Two of the statements addressed a need for altering traditional patterns of financing education if technology is to be used.

The rating responses to the 75 statements indicated varying degrees of consensus. The level of rating of agreement and of significance for a particular issue rarely paralleled. All but two statements demonstrated higher ratings of agreement than of significance.

The highest ratings of agreement and of issue significance in this study were given to two curricula-related visions: Statements that IVD should be used (1) to expand curricula by teaching important and

abstract concepts and (2) to motivate by providing impractical, dangerous and/or expensive experiences elicited 100 percent rating accord and 86 percent and 75 percent rating of issue importance, respectively.

The only other two statements that elicited high ratings of agreement and of issue significance related to production and design measures needed to achieve instructional benefits. The first stated that model courseware was needed to demonstrate effective instruction of important concepts; the second stated that model courseware was needed to demonstrate significantly improved learning outcomes.

The next chapter will conclude this report by discussing issues and themes that emerged from the findings, the implications, and recommendations for research and for ways to actualize the potential of videodisc technology in public schools.

CHAPTER 5

CONCLUSIONS

("IVD" REFERS TO INTERACTIVE VIDEODISC)

Interactive videodisc technology is a sophisticated, complex and costly media technology unto itself. Education as a field is complex, as is the institution of public schooling with its loosely coupled, nested sub-systems. Hence, an attempt to understand potential applications of IVD within the culture of public schools necessitates an examination of perspectives from multiple disciplines involved.

This study was designed to elicit beliefs of experts from those disciplines. Its scope was intentionally broad, addressing issues relevant to multiple audiences concerned with public school use of interactive media technology. A major goal of the study was to elicit views related to:

(1) the potential of IVD technology for education and the public schools.

(2) measures/policies needed to achieve visions of potential.

(3) barriers inhibiting the potential.

(4) the reality scenario in five and in ten years.

The 32 Delphi respondents provided expertise from the fields of education, government, private industry, and the military. Chosen as stakeholders, facilitators or experts, the panelists represented different levels of concern related to use of IVD in schools. Their views reflected their specialties in instructional design, production

and marketing, research and evaluation, educational policy, staff development, and classroom instruction. Through the two rounds of written questionnaires that had been developed from earlier responses to an in-depth interview, panelists had opportunity to interact anonymously with each other's views.

The results are difficult to summarize because the interview and questionnaire responses are so diverse, wide in scope, and even sometimes contradictory. Nevertheless, a review of the findings reveals nine issues and four themes common across the questions. Hence, this concluding chapter will discuss those issues and themes, along with some current literature, then will present some implications and recommendations.

Issues and Themes

Nine domains or categories of issues important to understanding the relationship of IVD and schooling emerged from analysis of the Delphi findings. They include:

(1) technological capabilities

(2) legitimate descriptors of IVD

(3) potential benefits of IVD

(4) goals and rationale for use

(5) production and design issues

(6) marketing issues

(7) research issues

(8) funding and responsibility issues

(9) applications in different locations.

A systematic search for commonality within those domains disclosed four recurring themes:

(1) the complexity and interrelatedness of issues

(2) the importance of the context to technology applications

(3) the discrepancy between potential and reality

(4) historical parallels between public school applications of IVD and other media technology.

Theme One: Interrelatedness of Issues

The complexity of individual issues and their interdependence has been cited in Chapter Four (Findings) and in Appendix I: Findings to Question Three. Nine issues were identified as significant to IVD innovation in public schools. It was noted in interview responses (see Appendix I) that there are dynamic interactions among those issues that often act as barriers to widescale use of IVD. The reality of multiple interactions is compatible with a non-linear approach to planning technology change in public schools (Lowenstein, 1986; Shane, 1987). Support for such a holistic perspective is provided by Goodlad (1987). In his book, The Ecology of School Renewal, he contends that the loosely-coupled nature of public schools defeats traditional linear input/output strategies of improvement; he suggests applying the metaphor of ecology to schools and examining efforts of change within that framework. The interrelatedness of issues suggests the wisdom of using a social-interaction framework to examine IVD applications in schools. This approach directs attention to the context of environment.

Theme Two: Importance of Context

What emerges from the professional literature and this investigation is a dual concern: concern for understanding the relationship of IVD to individuals, their cognition and learning, and concern for understanding the relationship of IVD to the institution within which it operates. Both orientations, to the sociology of learning and to the culture of schooling, focus attention on context.

At the classroom level, educational traditions and research have long acknowledged the impact of structure and climate on student performance. The Delphi comments stress how interactive technologies provide opportunity for altering traditional classroom structures and for creating reactive environments. Within the more reactive environments, the instructional design of videodiscs can either maintain the traditional pattern of behavior-managed objectives, or it can facilitate inquiry-based, self-guided, discovery models of learning (Bork, 1987a; Deschler & Gay, 1986; Wilson, 1987b).

Delphi findings also emphasize the relationship between introduction and implementation of IVD and school level operation. This investigation (see Appendix I) noted that the actual infrastructure of schools and attitudes of staff were seen as major barriers to the successful application of IVD technology. It highlighted the irony that, while policy decisions are made at administrative levels, success of innovation is ultimately dependent on the quality of implementation at the classroom level. This is consistent with prior analyses of school policy in general (Fenstermacher & Amarel, 1983) as well as with

recent discussions of policies related to computers in public schools (Crumb, in press).

It appears that the culture of the schools, that is, how schools define policies and goals and how they structurally organize and provide for staff development, impacts the success of innovations. The implication for those planning IVD projects is to consider the context.

Many of the panelists discussed issues outside the school district that affect the success of IVD applications within schools. Some linked their views to broad issues in society and to their perceptions of the purposes and nature of the public school within that society. Several panelists envisioned and predicted IVD applications as a response to the following conditions: the knowledge explosion; the impermanence of information; the rapidity of change, particularly technological change; and the lack of a national policy in education.

The perspective of an expanded context of societal conditions reminds us that IVD is a mere tool available to the many institutions involved in education. Its availability can stimulate reflection regarding the broad and important questions of goals, curriculum, and structures of public schooling.

Theme Three: Discrepancy Between Potential and Reality

The discrepancy between claims of potential of IVD and the reality in schools was a motivating force for initiating this doctoral investigation in 1984. At that time, many of the quotations taken from the literature portrayed videodisc as "the ideal, ultimate" teaching

medium, a revolutionary tool and even a "panacea" for some of the nation's educational problems (See Chapter One). Yet, the actual level of penetration in the public schools was meager.

In more recent descriptions by IVD enthusiasts, claims are qualified. For example, in an article in the educational journal, Phi Delta KAPPAN, Van Horn (1987) contends that laser videodiscs could revolutionize education and alter conventional instructional methods, but he notes that the response of educators has been shortsighted.

Collectively, the investigation findings support the conclusion that IVD instruction has the capacity to contribute significantly to the improvement or reformation of education. However, the findings also present a complex reality of multiple, interrelated barriers that inhibit the full actualization of IVD potential in public school.

There remains a discrepancy between the specific potential defined by the panelists and the conditions which currently exist. Round Two results indicated that there were nine visions of potential that over 60 percent of the respondents regarded as significant issues. Six of the visions referred to goals of use. They included: expanding curriculum of important and abstract concepts; motivating by providing impractical, dangerous or expensive experiences; providing resource options to teachers; providing remediation and opportunity for mastery learning; providing dynamic assessment and feedback; and delivering instruction to remote sites. The seventh vision clarified an important design consideration, that of incorporating principles of effective instruction. The eighth and ninth visions specified recommendations for

local school implementation that included application of a systems approach in planning and appropriation of funds for staff training equivalent to that spent on software and hardware.

In order to contrast those visions with current conditions, both an updated literature review and informal telephone survey of videodisc experts[4] were conducted. The following understandings emerged:

Understandings Related to Goals of Use

While the number of available videodiscs appropriate to public schools is growing, and the goals of expanding curricular and teaching options appear to be addressed, experts remain unaware of IVD software projects designed to deliver instruction to remote sites, or of projects focused on mastery learning.

Understandings Related to Design

Academic interest in interactive design has grown. While interest in incorporating characteristics of effective instruction has been demonstrated in isolated projects, it has not as yet become a design standard.

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[4]Experts contacted include: J. Mecklenberger, Director of The Institute of Technology Transfer to Education; R. Miller, editor of the Videodisc Monitor; R. Fox, Director of Society for Applied Learning Technology; J. Clark, President of Videodiscovery; J. Tully of Pioneer Corporation; R. Palmich and J. Townsend of IBM.

Understandings Related to Implementation in Public Schools

While there appears to be a growing awareness of the need for holistic thinking and planning for technology use in education, a systems approach to IVD implementation is rare. Few schools have the financial resources to allocate the necessary funds for staff training urged by the Delphi panel.

Most comments describing current conditions of IVD applications included some reference to the undeveloped educational market. The comments varied along a continuum of pessimism to optimism. Expressing pessimism was Dustin Heuston, who has pioneered educational applications of IVD at Wicat, " . . . while there will be a lot of frantic wiggles, feints, shoulder movements and pretense, the videodisc is not going to make it in [public] education for quite a while" (cited in Emerson, 1987, p. 22). More positive, yet cautious was Jim Mecklenberger, Director of the Institute for Technology Transfer to Education. He noted that while there are as yet trivial numbers of videodisc players in the schools nationwide, there are increasing numbers of hardware-software vendors. The greatest optimism was expressed by software developers. Their enthusiasm seems to be based on three factors: (a) a substantial increase in yearly sales of software to education; (b) an increasing number of large-scale state projects, such as those in Florida, New Hampshire, Texas, California, and Minnesota; and (c) an increase in the number of schools interested in IVD.

Theme Four: Parallels Between Public School Use of IVD and Other Media Technology

While some IVD proponents argue that IVD is a unique media and not just a computer peripheral, both its interactive nature and its functional role in public schooling invite comparisons with other school attempts at technology innovation. Parallels between IVD and other media technology can be found in descriptions of technology, goals of use, research issues, growth of markets, barriers to school use, and visions of potential.

Descriptions of Technology

Within the Delphi, many panelists characterized IVD as an instructional tool or information storage medium. However, a minority perspective portrayed IVD as more than a delivery system and "more significant than a new tool." A conception emerges of IVD as a powerful device that enables users to "tinker with the world." This is reminiscent of the position that the computer is more than an information delivery system; it is a new intellectual resource with the power to shape and represent thoughts (Luehrmann, cited in Hunter, Kastner, Rubin, & Seidel, 1975; Papert, 1980).

Goals of Use

The Delphi findings advance three major goals of use for IVD. These include (a) enhancement of curricular opportunities;

(b) improvement of student learning and performance; and (c) promotion of educational reform in organizational structure and in practice. These three goals are among those specified as goals of computer usage (Hunter et al., 1975; Seidel, 1980).

The importance of considering the goals of use and the specific context of use when selecting design options was highlighted in this study dealing with IVD; it also has been mentioned in prior writings dealing with computer usage (Bork, 1981; Hunter et al., 1975).

Research Issues

The findings of the Delphi panel raise a number of research issues associated with IVD that correspond to those found in computer literature. There appear to be analogous needs and methodological considerations for research dealing with IVD and computers.

For both computer and videodisc research, there are pragmatic needs. The Delphi revealed needs for IVD research to: (a) inform and validate the design process of courseware; (b) determine how the technology is best applied in public school settings; and (c) acquire data needed by policy-makers to provide evidence of teacher and student satisfaction, cost effectiveness, and student learning and performance benefits. Becker's (1987) review of computer research revealed the very same needs; he maintained that because of the changes in technological capabilities of the microcomputers, much of the prior research on CAI is outdated.

For both the computer and IVD fields, there are also theoretical concerns in research that impinge on practical considerations. Comments in both this study and in computer literature (Becker, 1987; Hunter et al., 1975; Seidel, 1980) (a) bemoan the lack of theory guiding technology research; (b) recognize the inadequacy of currently available research instruments to measure cognitive processes or to measure long-range educational outcomes; (c) urge the design of courseware and evaluation instruments that are consistent with the philosophical values and intended objectives of the educational institution; and (d) advocate collaborative and comprehensive research projects.

Growth of Markets

The Delphi findings indicated that the market issues for both IVD and computers are quite similar. For example, both markets are dependent on the availability of quality software that has been appropriately designed to meet instructional needs in public schools. A second similarity is that the cost of design demands a large front-end investment. A third striking parallel between computers and IVD is the "chicken-egg phenomena" of their market growth. However, a distinction between them is that the consumer market for computers is booming while it has failed to materialize for IVD. This may be because the design and development cycle for IVD is so much more complex, time-consuming and costly.

Barriers to School Use

The Delphi findings concerning barriers to school use of IVD indicated a more complex reality than is usually delineated. Economic considerations of design and production often are forwarded as the major barriers to an educational market. While Delphi findings confirmed the importance of economic considerations, they also suggested that the attitudes and infrastructure of schooling act as equally important barriers. The influence of attitude and infrastructure on adoption and implementation of computer-related materials has been dealt with in prior research (Becker, 1983; Hunter et al., 1975).

The Delphi findings also indicated a dynamic interdependence of factors inhibiting the realization of IVD potential. This interrelatedness of issues has a counterpart in computer literature; Hunter et al. (1975) refer to the "circular interrelationship among obstacles" (p. 7) inhibiting the development, adoption, and dissemination of computer-based learning materials in public schools. They further observe that many of the intertwined obstacles are not technology-specific; rather, the obstacles relate to the problems of innovation in American education. This perception was also expressed by several Delphi panelists.

Furthermore, the findings from this study support the belief expressed in prior computer literature (Hunter et al., 1975; Lipson, 1981; Weingarten, 1981) that the removal of barriers to widescale technology usage demands comprehensive and coherent strategies at all three levels of education, local, state, and federal.

Visions of Potential

Varied perceptions and visions of IVD potential within the Delphi were seen to reflect diverse values and beliefs relating to society and to the role of technology and public schooling within it. The interdependence of values, technology, and social relations was similarly noted in discussions of computer use (Hunter et al., 1975; Seidel, 1980).

Furthermore, several social-issue concerns raised within the Delphi interviews have previously been cited in relation to computer use. Specifically, there have been fears regarding equitable distribution and use, anxiety over a diminished role for the humanities, and worry over the effect of machine use on interpersonal relations (Becker, 1983; Shane, 1987).

The Delphi theme of the discrepancy between technological potential and reality in public school education has a strong historical precedent. As Tyack and Hansot (1985) pointed out, while radio, television, language labs, programmed instruction, and computers have all been heralded as panaceas to educational problems, they all have failed to achieve the potential claimed. The distance between the visions of potential of the computer and the limiting conditions within public schools was also explored by Becker (1983) in a booklet entitled, Microcomputers in the Classroom: Dreams and Realities. What Becker asserted about computers parallels the IVD reality as depicted in this study: Despite increasing usage, there remains an insufficient quantity of videodiscs in public schools to alter instruction on a wide scale.

The historical parallels found between IVD and the computer suggest that Tyack and Hansot's (1985) cautionary comment regarding computers may be equally relevant to videodisc technology: "Those who see pedagogical salvation in computers ignore the fate of earlier technological panaceas" (p. 40).

It is difficult not to share the excitement of IVD advocates when contemplating the potential of IVD to improve teaching and learning. Yet the dissertation findings support the Delphi comment that, "The potential of IVD technology is not necessarily what is desirable, nor what is probable." Policy-makers who are contemplating applications of IVD in public school settings may wish to use the four recurring themes in the Delphi -- (1) the complex interrelatedness of issues; (2) the importance of context; (3) the discrepancy between potential and reality; (4) historical parallels to other technology -- to sensitize them to the challenging realities.

Implications

Major results of this study have implications for those interested in designing and producing interactive systems, marketing them, researching them, training personnel, and/or implementing and evaluating their use in public schools. The dissertation findings suggest that:

(a) The various stakeholders of technology and education have a need for knowledge about the nature and potential of IVD to improve teaching and learning. Assorted software and hardware configurations

provide a variety of capabilities that are compatible with different philosophies of teaching and learning.

(b) Some people believe that IVD can be used to enhance curricular opportunities, improve student learning and performance, and/or promote educational reform in practice and/or in organizational structure. Some of the resistence to IVD may be attributed to a mismatch between goals of use and perceived benefits.

(c) IVD can best be understood within its context of use. Introduction of IVD into public schools is difficult; it represents major changes and innovations related both to individuals and to organizational structures.

(d) Successful implementation of IVD in public schools demands a dual concern -- concern for the relationship of IVD to individuals and concern for the culture of the institution it will serve.

(e) The ability of public schools to assimilate IVD is a far greater problem than than of technological development; the current structures and traditional attitudes within public schools appear to be incompatible with widescale use of IVD.

(f) Advocates of IVD in public schools must recognize that they are in competition for limited financial resources with other constituencies seeking curricular reform.

(g) There is a need for holistic thinking that considers the multiple, interrelated issues of IVD applications within the broader context of a rapidly changing society. Policy-makers may wish to use

the nine categories of issues and four themes that emerged within this study to sensitize them in their decision making.

(h) Comprehensive, coherent planning at all levels of education is needed to promote widescale usage of IVD.

Recommendations

Dissertation findings in combination with professional literature suggest that school structure and attitudes, as well as economic factors act as barriers to widescale use of technology in public schools. It appears that, if the potential of IVD is to be actualized, comprehensive and coherent strategies are needed at all levels of education. The following recommendations are offered as possible ways to promote thoughtful and wise use of IVD and to eliminate the barriers to widescale usage in public schools.

Organizations at the Federal Level, Such as the Department of Education and the National Science Foundation, Could --

1.1 Create a task force with broad representation that: (a) examines basic issues related to educational goals, the future, and the potential of interactive technologies to meet those goals; (b) establishes coherent and comprehensive strategies related to public school use of interactive technologies, such as IVD; and (c) encourages respect for the local autonomy of public schools while ensuring equity of access and opportunity on a national level.

1.2 Fund long-range research and development efforts to increase knowledge about IVD.

1.3 Establish formal mechanisms to create awareness and promote information exchange related to IVD and public schools. Possible plans might involve conferences, mass media, demonstration sites, written publications, and the creation of both an information and materials clearinghouse.

1.4 Encourage large scale curriculum development to provide a critical mass of software for use in public schools.

Public Schools Could --

2.1 Redefine goals and rethink organizational and curricular strategies to provide flexibility for student and teacher use of technology.

2.2 Rethink budget patterns that inhibit use of costly technology; for example, they might explore partnerships with community organizations and industry to provide the large up-front investments necessary for implementation.

2.3 Apply a systems approach to implementation of technology innovations: (a) clarify goals and rationale for use; (b) choose technology whose design and benefits are compatible with goals; (c) create a climate conducive to innovation; (d) plan formative and summative evaluations that are aligned with the goals of the project; (e) provide for on-going staff development activities that offer hands-on training; and (f) educate the community regarding the innovative practices.

2.4 Recognize that use of interactive technologies often involves shedding of traditional teaching-learning paradigms and that the shift of responsibility from the teacher toward the learner is difficult even for instructors who desire it.

2.5 Increase funds for annual staff development and reform staff development practices to provide long-term, on-going support for teachers' adoption of new resources and new strategies. One possibility would be to adapt the structure of the National Writing Projects and create Media Technology Summer Institutes that help interested practitioners develop the skills and expertise to become change agents in their schools.

Colleges of Education Could —

3.1 Ensure that future educators learn about emerging technologies, such as IVD, as well as develop facility with hands-on use of them.

3.2 Promote understanding of the history of public schools as a basis for developing a future orientation that examines the relationship of technology to public schools in the 21st Century.

Designers and Producers of IVD Products Could —

4.1 Increase communication with users to determine the problems of teaching and learning and then allow users to influence the design process.

4.2 Consider the sociology of learning and culture of schools; engage multidisciplinary design teams that utilize the first-hand knowledge of practitioners.

4.3 Develop model courseware that demonstrates effective instruction of important concepts that are difficult to teach.

Future Research

The investigation into the relationship of IVD and public schooling generated a considerable amount of data that suggest areas for further research. Some possibilities are presented below in one of three categories: Delphi Research Examining IVD Applications in Public Schools; Policy Studies Exploring Local, State, and Federal Activities Related to IVD; and Investigations Into the Relationship of IVD, Cognition, and Learning.

Delphi Research Examining IVD Applications in Public Schools

1. Replicate aspects of this Delphi study with a new panel to determine reliability of results and changes over time.
2. Examine any of the issues, but extend the Delphi investigation beyond identification of accord and issue importance to determine dimensions of priority, probability, and feasibility.
3. Explore the correlations between participants' profiles of experience and training and their beliefs. For example, to what extent do users of technology at the public school level share visions of the

ideal with producers of software or federal government representatives? The findings would have implications for future collaborative efforts among diverse stakeholders who possess differing perspectives and various levels of concern.

4. Examine the correlation between panelists' visions of ideal and their forecasts of future realities.

Policy Studies Exploring Local, State, and Federal Activities Related to IVD Applications in Public Schools

1. Use a case study approach to explore IVD innovation and staff development practices at either the state or the local level, paying attention to the dynamic interactions among levels of bureaucracy.

2. Explore the beliefs of local, state and national educational leaders concerning the issues of responsibility for promoting the use of IVD and for insuring equity.

3. Engage in historical research of technology policies that impact public schools at the state and/or national level.

4. Investigate the practices and policies of schools of education relative to their use of IVD.

Investigations Into the Relationship of IVD, Cognition and Learning

1. Design, develop and validate models of courseware appropriate to particular philosophies and goals in the public schools.

2. Evaluate IVD courseware on the basis of performance outcomes, teacher and student attitudes, and cost-effectiveness.

3. Develop and research IVD projects without concern for market realities; engage in case studies to describe children's use of IVD.

4. Research the ways in which different instructional design approaches affect the cognition and learning of users in different settings. For example, how does the traditional tutorial design differ in effect from an inquiry-based simulation? Or, within a tutorial, how do different types of orienting activities, different types and numbers of embedded practice, or different access times influence the amount and type of learning?

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APPENDIX A:

1984 CAREER POSITIONS OF PANELISTS AND THEIR CATEGORY DESIGNATION AS STAKEHOLDER (S), FACILITATOR (F), OR EXPERT (E)

Panelist	Career Position	Category
Dr. P. Becht	Professor College of Education University of Florida	S,E
Dr. A. Bork	Director Ed Technology Center University of CA, Irvine	E
Mr. J. Cecil	Director Public School Education Public Broadcasting System	F
Dr. C. Char	Research Associate Bank Street College	E
Dr. D. Crandall	Executive Director The Network	F
Dr. C. Dede	Futurist Professor of Ed University of Houston	E,F
Mr. M. Delp	Supervisor, Media Technology VA Department of Education	S,E
Dr. J. Exline	Associate Director of Science VA Department of Education	S
Mr. R. France	Executive Producer MD Center for Public Broadcasting	E
Dr. T. Gates	Director, Media Services Fairfax County Public Schools	S
Dr. S. Gibbon, Jr.	Director, Science and Math Education Bank Street College	E
Ms. C. Hargan	Senior Staff Scientist HumRRo	E
Mr. M. Heyer	President, Heyer Associates	E
Dr. A. Hofmeister	Vice President for Research Utah State University	E

Panelist	Career Position	Category
Dr. G. Jackson	Co-Director, Education Tech Center Harvard University	F
Dr. J. Kleinmann	Director, National Foundation for Improvement of Education (NEA)	S
Dr. J. Licklider	Computer Science Professor M.I.T.	E
Mr. D. Lippert and Dr. H. Lenke	Vice Presidents for Ed Services Digital Equipment Corporation	E
Mr. R. Lippincott	Director Videodisc Projects WGBH Educational Foundation	E
Dr. J. Lipson	Group Director Wicat Educational Systems	E
Dr. J. Mecklenberger	Assistant Executive Director National School Boards Association	S,E
Mr. R. Miller	Editor, The Videodisc Monitor	E
Dr. A. Molnar	Director, Science and Engineering National Science Foundation	S,E
Dr. S. Newman	Manager of Communications WNET's The Learning Lab	S
Mr. R. Nugent	Director Nebraska Videodisc Design Group	E
Dr. S. Rockman	Director of Technology Far West Regional Laboratories	E
Dr. L. Rose	Executive Secretary Phi Delta Kappa	F
Dr. G. Salomon	Guest Professor Harvard University	F,E
Dr. R. Selden	Associate at National Commission on Excellence in Education	F,S
Dr. S. Stevens	Professor of Education George Mason University	E

Panelist	Career Position	Category
Dr. H. Wagner	Assistant Laboratory Director U.S. Army Research Institute	E,S
Dr. F. Withrow	Director of Technology U.S. Office of Education	S,E

APPENDIX B:

POSTCARD AND LETTER SENT TO PANELISTS REGARDING DELAYS IN ANALYSIS OF INTERVIEWS

Postcard sent September, 1984

RESEARCH UPDATE

TO: DELPHI PANELISTS

FROM: Ronnie B. Lowenstein

Hooray! Initial interviews have been completed.

Due to both an increase in panel size, from 20 to 32 members, and a richness in data provided by you all, my original schedule is inoperable.

Please be patient while I analyze. I hope to send Round One Questionnaires within three weeks.

Letter sent December 13, 1984

Dear _____;

The winter season presents an opportunity for me to wish you holiday cheer along with patience for delays in my graduate research.

While personal obligations have substantially and unavoidably slowed my analysis, my enthusiasm and commitment to this project remain high.

If all goes as planned, ROUND ONE Questionnaire will be sent out in the early part of the New Year.

Until then, warm regards . . .

Sincerely,

Ronnie B. Lowenstein

APPENDIX C: AN ADDENDUM OF VISIONS

Below are listed the statements collected through interviews that were not expressed in the questionnaires. They are presented according to the categories of technological capabilities, market issues, production and design issues, research issues, uses of IVD within public school and uses of IVD in learning environments other than public schools.

Addendum of Visions Related to Technological Capabilities

(1) Digital optical discs will develop and replace the current analog video discs that store digital information.

(2) Only when there is "Read After Write" capability (where users can actually record and prepare discs locally), will IVD become affordable.

- RAW will allow increased local production and use of public domain materials.

(3) Libraries of optical digital discs would be set up in a jukebox arrangement that allowed frequent updating.

(4) IVD will be the forerunner of 3-D (3 dimensional) television.

(5) Assignments and teacher-prepared material will be sent on line and transported through digitized systems via satellite or cable. They will be received by converters attached to the home TV. This will contribute to the realization of an electronic cottage in the home that uses telecommunications networks.

Addendum of Visions Related to Market Issues

(1) Markets for IVD will grow as a response to forces from the home and industry for performance and skills rather than for accreditation and degrees.

(2) A home market in a developing self-servicing economy will drive the educational process; there will be large markets for IVD that train people to assess, maintain and self-repair products.

(3) As the knowledge explosion continues, IVD will supply the networking interconnections needed between schools, within schools, and between schools and communities.

(4) Public broadcasters will develop a symbiotic relationship with video disc programs; by investing in the conversion of video disc programs and developing IVD systems for the home, a lucrative market will develop that generates revenue.

(5) As IVD encourages a democratization of knowledge, and reduces the need for print literacy, a broader market desiring IVD will emerge seeking to experimentally access and acquire information.

(6) Many well-financed projects of IVD curriculum software will be developed for a large market to prevent homogenizing of the curriculum.

Addendum of Visions Related to Production and Design Issues

(1) Designing quality IVD systems necessitates concurrent dealing with technological capabilities, software content, and the cultural context within which they will be used.

Addendum of Visions Related to Research Issues

(1) IVD will be used as a tool for research, providing an alternative way of thinking about and learning from media. Researchers can explore how learners -

- might increase their repertoire of visual information about the world and in so doing, make their internalized models of reality more reliable.

- might learn about their own perceptions.

- might use visual data to supplant time-consuming mental transformations and learn more rapidly.

- attain higher level thinking skills.

(2) There will be many pilot projects to research how IVD can best be used within the social institution of schooling.

(3) Research will abound that -

- explores the relationship of processing of images, text and learning.

- explores how to communicate about images when they become a principal medium of learning.

- evaluates the claims of value of IVD use by developing a pilot project of highly-interactive IVD courseware in a specific discipline.

- evaluates the claims of value by researching courseware that is a total curriculum unto itself, rather than a supplement to the curriculum.

- makes projections regarding IVD cost effectiveness.

(4) There will be an experimental project that uses IVD to educate people in disbelief, helping them to develop critical thinking as they enrich their repertoire of visual information about the world.

Addendum of Visions Related to Uses of IVD Within Public Schools

(1) IVD will be used to teach difficult concepts earlier and more quickly than traditionally assumed possible, with the potential of accelerating students through the educational system.

(2) IVD will increase human processing speed of information conveyed in pictures.

(3) IVD will facilitate understanding of processes by providing user control of time and space to review or explore.

(4) There will be a massive education/public relations campaign about IVD technology initiated in order to elicit general public and political support for its use in schools. Elements will include -

- hands-on experiences to promote understanding of IVD.

- persuading decision-makers of the need for allocating money to develop and implement IVD systems.

- providing print and video media for policy-makers to use to talk responsibly with their home communities.

(5) An installed base of hardware will become sufficiently large and a critical mass of IVD software will be reached in order for IVD to become an inexpensive and cost-effective medium.

(6) Curriculum will be permitted to lead the application of IVD.

(7) IVD will be used to establish the following clear goals -

- to foster critical thinking.

- to increase capabilities of students to sift and filter the glut of multimedia information bombarding them.

- to support equity in education.

- to economically accelerate the rapidly expanding flow of information to teachers in both pre-service and in-service training, as well as to others who may need it.

- to merely supplement current curriculum.

- to complement the way we presently teach, acting as a flexible tool box, allowing the teacher to provide a variety of strategies.

(8) IVD will be used to enhance characteristics of effective instruction by considering the important variables of -

- level of student engagement.

- level of participation and response.

- level of student success.

- level of academic learning time.

(9) Public schools will be redesigned and equipped so classrooms will resemble corporate conference rooms with IVD support, a teacher control unit and a large size projection screen to display resources found in a centralized library.

(10) The teachers' role will shift to more of a guidance role of tutor and peer in problem solving, helping learners deal with metaknowledge rather than knowledge alone.

(11) Following the implications of child development needs, with student autonomy and interaction being relatively constrained, the primary grade levels will use IVD more as a supplement.

(12) IVD will be used to provide high resolution models significant to user understanding in the following areas -

- ethical behavior and decision making.
- complex skilled performance and/or procedural knowledge as in medical surgery, or in mechanical and vocational arts.
- language development to extend the ways users can integrate ideas and express themselves.
- aesthetic and intuitive domains.
- social interpersonal communication and understanding.
- simulations of experiments and situations too dangerous, expensive or impossible to witness within current physical or time dimensions in schools.
- motivational use when identification with lifelike situations or people is important.

Addendum of Visions Related to Uses of IVD in Learning Environments Other Than Public Schools

(1) Thoughtful considerations of the problems in society and in education will be followed by deliberations over how IVD technology will support goals. There will be -

- major curricular reform on a large scale with highly interactive, individualized computer technologies as the primary information- delivery system for the basic cognitive material now presented in the classrooms.

- a response to the knowledge explosion with use of IVD to compress knowledge and make it accessible at many levels, across disciplines and across sense systems.

- creation of new structures/learning centers that build a closer relationship between the community and its citizens.

- cooperation between local industries and communities in designing and supporting new learning centers.

- new learning centers that use IVD networks, housed in commercial dwellings, museums, libraries and other cultural outreach sites to train lifelong learners.

APPENDIX D: AN ADDENDUM OF POLICY MEASURES

Presented below are statements of policy measures that were collected from panel interviews, but which were not expressed in the rounds of questionnaires. They are presented according to categories of technological capabilities, market issues, production and design issues, research issues, and uses of IVD within public schools.

Addendum of Measures Related to Technological Capabilities

(1) Large amounts of money are needed to break the chicken-egg cycle -- without IVD hardware or software in the schools, there will be no research to verify claims of potential of IVD application. Demonstration research is critical to deal with the practical and political problems of promoting IVD in public schools. Once research can offer proof of the educational value of IVD capabilities, educational decision-makers can be persuaded to allocate the large sums of money to buy hardware, to support production of appropriate software and to implement innovative IVD applications.

(2) Publishers or private industry must invest in creating a critical mass of software for a target audience in public schools in order to break the chicken-egg phenomenon.

(3) The federal government needs to break the relative lack of educational applications and to stimulate the development of the technologies through labs that explore IVD capabilities.

(4) Read after write capability must be developed; applications in schools will occur only when IVD is affordable, software is plentiful, and teachers have a sense of control over it.

The technological breakthrough of RAW will occur without an educational thrust; things will develop from a technology push and not from an educational pull.

(5) Policies need to be created that will sort out when IVD is the best delivery medium relative to other possible information technologies.

Addendum of Measures Related to Market Issues

(1) Public/private industry must collaborate to produce the critical mass of high quality IVD software appropriate to schools.

(2) National direction and stimulation of markets is needed even though local control of schools must be maintained; isolated resources working independently fail to meet national needs.

(3) There is a need for all three levels of government to be involved: the Federal role is to fund research, make information available, support the development of applications, sponsor markets, and, recognizing the barriers of introducing technological innovation, work in stages -- sponsor wide-scale distribution of VD equipment capable of interactivity with distribution of the more linear software.

(4) Encouragement of home markets is necessary to increase public awareness of the potential of IVD for education.

(5) Using tax incentives for industry to provide hardware or software is a questionable strategy because it fails to provide the support for the school and classroom teacher; it puts technology ahead of the need.

Addendum of Measures Related to Production and Design Issues:

(1) Heavy teacher involvement in production and design of IVD must be promoted if IVD usage is to be successful.

(2) Massive training of local teachers to create and adapt IVD is necessary if it is to be accepted for classroom use.

(3) Involve teachers with technologists in the design process; but, recognize that the complexity of design is too heavy a burden for most teachers.

(4) IVD programs are needed that will train IVD authors for the educational system. This is an alternative solution to the idea of having multidisciplinary teams of experts producing discs. The latter method is prohibitively expensive and constrains the fluent creation of instructional materials.

(5) Federal funds and local grants are necessary to promote experimental designs of discs without concern for commercial markets. It is vital to create designers who go beyond the technical knowledge and possess pedagogical understanding.

(6) Design of courseware needs to apply what has been learned about effective instruction.

(7) Government needs to deal with policies and laws that address the economic realities and legal concerns of IVD use and public schooling, including copyright laws, first sale doctrine, fair use in schools.

(8) New reward systems and incentives must be created for the academicians interested in developing IVD courseware.

(9) Priorities regarding what courses should be developed include:

(a) courses difficult to teach by conventional methods,

(b) courses often taught poorly, and

(c) existing courses whose curriculum can be improved and updated.

Addendum of Measures Related to Research Issues

(1) Funding is needed to develop sophisticated software to be used for basic and applied research questions, such as how do we communicate about images? Or, what is the relationship between the sensorially concrete images of IVD and cognition and learning? Or, between user interaction and learning?

(2) Research is needed to help people in education make the transition from a "dump mode of learning" to "an adaptive mode of learning."

(3) Research is also needed to track the impact of large amounts of IVD use on the psychological, academic and social growth of learners. What is the impact, for example, of a stand-alone, individualized work station with self-motivating curricula on the values, beliefs and

performance of a student? How does IVD technology affect the school climate and sociology of the schools?

(4) Military activity may drive the research concerned with educational uses of IVD; a mandate is needed to promote research on a large enough scale and in a coherent enough way so results can demonstrate efficiency and effectiveness of IVD.

Addendum of Measures Related to Uses of IVD Within Public Schools

(1) Alter attitudes in education; stop the pendulum approach of short-range planning in curriculum and get more capital intensive for long-range planning.

While research is important, the issues related to technology are far more political than they are data-based; public relations is needed to alter attitudes regarding resource allocations.

Altering attitudes may necessitate a massive public relations effort to persuade the public that there is a need to invest in educational curricular revision that harnesses IVD and other technologies. Popularizing "IVD and schools" though the mass media of best sellers and television talk shows may be helpful.

(2) In retraining educators, we must focus on helping college instructors of future teachers use IVD successfully and, in so doing, model effective use of IVD for the prospective teachers.

(3) Create awareness and inform people by having professional organizations

(a) support publications that inform and stimulate reflection.

(b) serve as a clearinghouse for groups evaluating software.

(c) sponsor workshops with local organizations.

(4) Create a national network of educational decision-makers to lobby government and industry regarding technology and education.

(5) Professional organizations can promote training of educators by collaborating with private industry in opening up regional demonstration centers that will help technology-producers and users work more closely together.

(6) A three-way partnership of local school systems, industry and federal government needs to be promoted to provide funding to train teachers to design quality software which then is marketed and creates a cash flow returning to the schools.

(7) Lots of experimentation and observation of IVD use in schools is needed since there is a conflict and paradox related to the introduction of this technology in schools; not until schools restructure themselves to accommodate IVD can IVD really flex a muscle, yet, to restructure schools without more knowledge about the consequences of IVD use is to risk making irreversible mistakes.

(8) We need Congress to support the development of entirely new curricula that use interactive technologies for schooling, grades 1-16. Anticipating three alternative courses for each subject area, monies needed would be at one billion/year for seven years. This is less than one percent of the total educational budget.

APPENDIX E: COVER LETTER AND REVISED ROUND ONE QUESTIONNAIRE WITH TABULATED RESULTS

RONNIE B. LOWENSTEIN
2998 BORGE STREET
OAKTON, VIRGINIA 22124
MAY 10, 1985

Dear Dr.

It has been sometime since I communicated with you about my doctoral dissertation, The Potential of Interactive Videodisc Technology (IAVD). Since our last contact, I've handled a large number of time-consuming responsibilities and health emergencies. Nevertheless, I've finally been able to complete the task of collating data received from over 65 hours of interviews.

To refresh your memory, I've printed a summary of the entire Delphi procedure on the reverse of this letter.

I am now asking you to respond to the enclosed Round One Questionnaire. I have limited its focus while attempting to maintain the integrity of the Delphi design. This questionnaire evolved from a more complete, though rough draft of 32 pages. If you wish to receive a copy of the latter, please request it on your comment sheet.

The enclosed instrument is structured in two sections, one dealing with VISIONS OF THE POTENTIAL OF IAVD FOR LEARNING and the other dealing with ACTIONS AND POLICY MEASURES NEEDED TO ACHIEVE THOSE VISIONS. In both

sections, statements are organized under one of three, non-discrete categories: (a) Instructional Benefits; (B) Uses Within Public Schools; (C) Uses Within Learning Environments Other Than Public Schools.

After reading each statement, you need only to check one of three boxes to denote whether you agree with it, disagree with it or believe that further comment or clarification is needed. (A comment sheet is provided.) A fourth column denoting significance of the item requires either a check or a zero.

For your convenience, I have enclosed a self-addressed envelope within which you can return the questionnaire. Please send it back by May 28, 1985.

Your cooperation is greatly appreciated.

Sincerely,

Ronnie B. Lowenstein

SYNOPSIS OF THE DELPHI PROCEDURE - A MANAGED INTERACTION

STAGE ONE: Respondents, chosen because of their expertise in education or videodisc technology, agreed to participate on a Delphi Panel. They were asked the following questions:

1. What are your visions regarding the potential of IAVD learning?

2. What are the measures/policies needed to achieve these visions?

3. What do you conceive of as the barriers to achieving these visions?

4. In reality, what do you think will happen in 5 years? in 10 years?

STAGE TWO: Researcher used interview data to develop Round One Questionnaire to be sent to panelists.

Round One Questionnaire Enclosed

Please note that:

(1) The focus of the questionnaire has been limited to the first two interview questions.

(2) The questionnaire provides a summary of interview responses to present a scope of issues, to probe positions of accord, to elicit reactions regarding significance of each items, and reactions to whether there is a need for clarification.

STAGE THREE: Panelists complete Round One Questionnaire and return it to the researcher within two weeks. Researcher will analyze responses and communicate with you shortly afterwards.

POTENTIAL OF IAVD FOR LEARNING

SECTION ONE: VISIONS

INSTRUCTIONS

Please review each of the following statements identified in the personal interviews as visions of the potential of IAVD learning.

Check the appropriate space to indicate whether you agree or disagree with each statement and whether you wish to add comments or clarification on the comment sheet provided.

Finally, please note whether you consider each statement a significant consideration by either placing a check to denote significance or a zero to denote little or no significance.

(A) VISIONS OF INSTRUCTIONAL BENEFITS: Upon analyzing the data related to visions of instructional benefits, two major categories emerged: one concerned with improving processes of learning and one concerned with enhancing curriculum and the context for learning. (A = Agree; D = Disagree; S = Significant.)

"IAVD WILL BE USED TO . . .	A	D	S
(1).. expand curriculum by teaching important, abstract concepts that have previously been difficult to teach.	22	5	19
(2).. provide resource options to teachers that enable them to flexibly manage and personalize instruction.	25	2	21
(3).. release education from a lock-step curriculum by:			
a) providing programs that flexibly organize information across disciplines and levels.	20	7	13
b) updating and transporting emerging knowledge to the educational community.	21	5	12
(4).. release education from rigid time and space structure of schooling through:			
a) delivery of instruction and expertise to the home.	21	6	17
b) delivery of instruction to remote sites.	24	2	18
c) supplying sufficient networking interconnections between and within schools and communities.	13	10	9
(5).. enrich opportunities for motivation and learning with experiences not usually found in classes because they are impractical, expensive or dangerous.	26	1	13

SECTION ONE: VISIONS continued..

	A	D	S
(6).. research the processes of teaching, thinking and learning with videodisc.	21	5	12
(7).. improve student understanding and achievement by:			
a) providing tutorials that review, remediate, and extend learning until students achieve mastery.	25	2	21
b) dynamically assessing student learning needs and providing appropriate and immediate auditory.	21	5	15
c) increasing the control of learners over their environment and pacing their own learning.	22	5	17
d) facilitating joyous education through increased learner engagement and interaction with materials.	21	5	15
e) reducing the need for print literacy, thereby allowing a broader audience to experientially access specialized information.	8	11	6
f) providing clear, visual models of behavior for instruction.	20	6	16

(B) <u>VISIONS OF IAVD USE WITHIN PUBLIC SCHOOLS</u>: In the data on uses, concern was evidenced for development and management of IAVD at all levels - classroom, district, state and national level.

"WITHIN PUBLIC SCHOOLS, IAVD WILL IDEALLY BE USED IN WAYS THAT . . .	A	D	S
(1).. optimize rather than maximize IAVD usage.	22	1	15
(2).. are determined by:			
a) results of research.	18	8	14
b) clearly defined instructional goals.	19	6	12
c) thoughtful considerations of how IAVD can respond to problems in society and education.	17	9	13
(3).. aggressively alter traditional models of planning and financing education.	7	16	11
(4).. require long-range rather than yearly budgets.	18	9	13
(5).. require a systems approach to implement IAVD that considers: teacher preparation; instructional materials; administrative support; community support; facilities and equipment.	21	5	16

SECTION ONE: VISIONS continued..

	A	D	S
(6).. require large initial investments to achieve cost effective delivery of instruction.	21	5	16
(7).. require financial allocations for staff training equivalent to that spent for hardware and software.	16	9	12
(8).. apply research on innovation and change to its introduction and implementation.	15	9	17
(9).. promote unprecedented cooperation among educational researchers, software/hardware producers and educators.	19	7	14
(10).. encourage IAVD designers to apply characteristics of effective instruction to design of courseware.	22	3	13
(11).. encourage software design by:			
a) multidisciplinary teams that have expertise in both the intuitive and analytic domain.	22	4	14
b) practioners who understand the classroom.	20	6	15
c) using IAVD modules that train designers.	12	12	7
(12).. alter current administrative and teaching structures by:			
a) using IAVD in classrooms as the prime source of instruction for individual or for small groups.	7	19	12
b) offering traditional subjects in the A.M. and individualized IAVD opportunities in the P.M.	8	16	6
(13).. adequately supply schools with resources, including:			
a) a centrally located player shared by a few classrooms.	5	20	7
b) a player located in every classroom.	12	13	12
c) a player for every 203 students in a laboratory.	13	10	12
d) equipment for designing classrooms to resemble corporate conference rooms with a teacher control unit and large projection screen.	5	12	7
(14).. promote a statewide commitment to integrating IAVD schools through:			
a) pilot projects that demonstrate IAVD to be a cost-effective tool for achieving educational goals.	20	5	16
b) a media campaign that seeks to educate the public and education decision-makers of the value of IAVD.	15	9	12

SECTION ONE: VISIONS continued..

	A	D	S
c) establishing a priority focus on IAVD programs for			
1) special needs students	16	8	12
2) the gifted	16	6	12
3) remediation	18	6	13
4) handicapped	13	10	9
5) math and science	18	7	17
6) achieving quality media that exists	13	11	8
7) new courses	13	11	9
8) improvement of existing courses	14	11	11

(C) VISIONS OF USE IN LEARNING ENVIRONMENTS OTHER THAN PUBLIC SCHOOLS: From the data, two categories emerged: one using IAVD in the home and one using IAVD in new learning centers.

"IN THE HOME, IAVD SHOULD IDEALLY BE USED IN WAYS THAT . . .			
(1).. promote the realization of an electronic cottage (home) that provides sufficiently complete curricula to permit flexibility and choice in scheduling work, leisure and study.	18	8	16
(2).. provide competency-based skills training for industry.	15	8	15
(3).. train people to assess, maintain and self-repair consumer products.	14	9	6
"IN NEW LEARNING CENTERS, IAVD SHOULD IDEALLY BE USED IN WAYS THAT . . .			
(1).. reject the prescriptive mode of learning found in most public schools and replace it with an adaptive mode of learning that emphasizes discovery and autonomy.	16	8	10
(2).. develop intellect, allowing schools to focus on goals of socialization.	8	17	11
(3).. encourage organizational structure to evolve from needs of efficient learning rather than from the needs of efficient teaching.	22	3	14
(4).. simulate work environments to train learners of all ages to adapt to a changing world.	23	2	17
(5).. eliminate time as a prime measure of curricular sequencing.	16	6	14
(6).. provide sufficient quantity and quality of software to meet individual learning styles and needs.	21	3	14
(7).. abolish the artificial structures of class and grade, yet maintain appropriate book and social activities.	10	15	11

SECTION ONE: VISIONS continued..

	A	D	S
(8).. place equal emphasis on cognitive, rational learning and art, myth, creativity, the bodily arts, interpersonal relations, and community service.	10	15	11
(9).. redefine the locus of learning, the role of the student and his responsibility for learning.	19	5	15
(10).. promote a training focus to help students problem-solve, handle reams of information, formulate questions, seek and evaluate answers.	19	5	15
(11).. enable teachers to shift roles from primary dispensers of information to facilitators of multiple learning environments.	23	2	18
(12).. provide training with stand-alone systems and support education by supplementary human instruction.	15	8	14

POTENTIAL OF IAVD FOR LEARNING

SECTION TWO: ACTIONS OR POLICY MEASURES

In this section, you are asked to review statements of actions and policy measures that panelists believe are necessary to achieve the potential of IAVD for learning. Items have been organized under three subheadings with the following structure:

(A) VISIONS OF INSTRUCTIONAL BENEFITS
"To realize visions of instructional benefits, the following actions or policy measures are necessary..."

(B) IAVD USE WITHIN PUBLIC SCHOOLS
"To realize visions of IAVD use within public schools, the following actions or policy measures are necessary..."

(C) IAVD USE IN LEARNING CENTERS OTHER THAN PUBLIC SCHOOLS
"To realize visions of IAVD use in learning environments other than public schools, the following actions or policy measures are necessary..."

POTENTIAL OF IAVD FOR LEARNING

SECTION TWO: ACTIONS OR POLICY MEASURES

INSTRUCTIONS

Please review each of the following statements identified in the personal interviews as actions or policy measures needed to achieve the potential of IAVD learning.

Check the appropriate space to indicate whether you agree or disagree with each statement and whether you wish to add comments or clarification on the comment sheet provided.

Finally, please note whether you consider each statement a significant consideration by either placing a check to denote significance or a zero to denote little or no significance.

(A) VISIONS OF INSTRUCTIONAL BENEFIT: Data analysis revealed that actions or policy measures deemed necessary to realize visions of instructional benefits related to diverse issues of technological development, design and production, marketing, and research and demonstrations.

"TO REALIZE VISIONS OF INSTRUCTIONAL BENEFITS, THE FOLLOWING ACTIONS OR POLICY MEASURES ARE NECESSARY . . .	A	D	S
(1).. infusing massive financial resources to:			
a) research production and use of IAVD in learning under different conditions.	18	8	14
b) promote information exchange between and among producers and educators through conferences, seminars, publications, and teleconferences.	17	5	11
c) develop exemplary courseware and applications.	25	1	22
d) create a critical mass of quality and pertinent courseware.	24	2	23
e) support enough curricular projects to prevent homogenizing of curriculum.	14	10	11
f) create a national curriculum.	3	22	9
g) support the use of packaged deals for software/hardware/training to encourage markets.	15	11	13
h) nationally distribute vd equipment to "technologize" public schools.	5	18	5
i) release local teachers for training in IAVD design, help them market their designs, allowing cash flow to return to the schools.	8	17	10

SECTION TWO: ACTIONS OR POLICY MEASURES continued..

	A	D	S
j) sponsor IAVD training of those willing to work in public schools.	12	12	10
k) develop public awareness with a media campaign.	11	12	8
l) create non-profit, independent development and production centers where direction is initiated by outside consortia, but profit from sale and distribution of materials benefit both.	19	7	12
(2).. funding for educational vd projects in education from:			
a) long-term, low interest loans from information technology corporations.	10	12	10
b) consortia of traditional funding agencies.	17	7	14
c) consortia of regional agencies.	17	6	12
d) business, industry and education collaborations.	20	4	17
e) educational publishers.	19	4	14
f) a federal line item "information technology tax.	5	17	8
g) federal government through the NSF and DOE.	17	9	16
h) state government.	11	13	14
i) local government.	8	17	11
j) Department of Defense.	10	15	10
k) a Research and Development Limited Partnership (a syndicate representing industry, education and the U.S. Department of Commerce).	18	7	15
(3).. creating a National Center for IAVD, necessary to			
a) respond to the economy of scale of IAVD.	10	14	11
b) provide access to the limited number of IAVD experts.	12	12	10
c) involve educators with the creative potential of IAVD.	18	7	13
d) act as a national clearinghouse for information.	18	8	11
e) demonstrate successful projects and applications.	22	4	17
f) integrate research and training efforts in all levels of government across the country.	10	14	9
g) serve as advisors, consultants to the developers, distributors and users of IAVD.	15	9	10
h) act as a catalyst for increasing communications between the stakeholders of technology and educations.	18	6	13

SECTION TWO: ACTIONS OR POLICY MEASURES continued..

	A	D	S
(4).. legislating a "National Defense Education Technology Act" that would:			
a) plan long-term actions on a national scale with respect for local autonomy.	12	12	11
b) reflect a federal priority to finance R & D functions that neither individual schools nor individual states can afford.	21	4	15
c) provide national directions and vision in education with concern for equity and excellence.	16	9	13
d) promote major curriculum reform involving technologies.	14	11	12
e) support Technology Transfer efforts of the military.	15	11	10
(5).. creating public awareness of IAVD as a tool for accomplishing needed reforms in education through:			
a) innovative marketing techniques designed by professional public relations specialists.	12	13	11
b) workshops, print media and seminars sponsored by professional educational organizations.	18	8	12
c) an international Sputnik-like event.	5	17	2
(6).. developing research methods that permit measurement and evaluation of IAVD benefits related to:			
a) teaching intangible understandings, abstract concepts and processes.	19	5	15
b) increasing teacher and student satisfaction.	19	4	14
c) increasing cost-effectiveness as compared to competitive deliver systems.	20	4	17
(7).. developing model IAVD programs and courses that demonstrate:			
a) effective instruction of important concepts.	23	0	17
b) significantly improved student learning outcomes.	25	0	21
c) efficiency and cost effectiveness in instruction, as compared to competitive delivery systems.	19	3	15
(8).. synthesizing research that spans the psychological, social, behavioral and spectrum in order to determine implications of IAVD for educational practice.	19	4	13

SECTION TWO: ACTIONS OR POLICY MEASURES continued..

	A	D	S
(9).. creating regional IAVD demonstration centers that would:			
a) be funded by state and national legislation.	15	7	10
b) promote understanding among providers and users.	15	6	5
c) advise school systems in selecting hardware and software appropriate to local needs.	15	7	8
(10).. developing direct read after write (DRAW) capability.	15	5	12
(11).. industrial standardizing of IAVD equipment.	17	6	15
(12).. designing interchangeable data bases/software.	18	5	15
(13).. lowering of the cost of IAVD systems.	20	4	17
(14).. changing current Federal government regulations of royalties from courseware developed in government vd-projects in order to eliminate disincentives.	15	7	8

(B) IAVD USE IN PUBLIC SCHOOLS: Data analysis revealed concern for administrative decisions across the nested subsystems of education.

"TO REALIZE VISIONS OF IAVD USE WITHIN SCHOOLS, THE FOLLOWING ACTIONS OR POLICY MEASURES ARE NECESSARY . . .	A	D	S
(1).. Federal support for a major, large scale curriculum reform effort and teacher training on IAVD-based systems.	9	16	10
(2).. technology transfer of IAVD developments from the military to public school through:			
a) state educational agencies.	11	13	7
b) vocational schools where training for civilian occupations have parallels to the military.	14	9	9
c) junior ROTC.	3	20	1
(3).. creating mechanisms that increase communication and information exchange among various levels within an educational system.	20	3	11
(4).. massive retraining of all those who control the educational infrastructure; including, state and local educational agencies, teachers and professional associations, colleges and universities responsible for training teachers.	8	15	11
(5).. educating and persuading decision makers of the value of the IAVD system.	25	2	18
(6).. developing a set of clear, realistic expectations derived by involving the instructional staff.	20	4	12

SECTION TWO: ACTIONS OR POLICY MEASURES continued..

	A	D	S
(7).. tightly defining criteria to acquire IAVD systems compatible with instructional goals and existing technology.	15	8	11
(8).. creating a climate that fosters teacher awareness, understanding and adoption of innovations.	25	1	18
(9).. careful planning for the short and long range technical as well as intellectual support services for the classroom teacher.	23	1	19
(10).. planning formative and summative evaluation of projects from their inception.	24	2	20
(11).. providing hands-on experimentation in training to encourage staff to develop their own visions of productive use.	23	3	17

(C) IAVD USE IN LEARNING ENVIRONMENTS OTHER THAN PUBLIC SCHOOLS

"TO REALIZE VISIONS OF IAVD USE IN LEARNING ENVIRONMENTS OTHER THAN PUBLIC SCHOOLS, THE FOLLOWING ACTIONS OR POLICY MEASURES ARE NECESSARY . . .

	A	D	S
(1).. establishing profit-oriented training centers that compete with public schooling by private industry or multinational companies.	11	16	10
(2).. the private sector and educators collaborating to redefine goals of education and curriculum and then subsidizing creation of learning centers compatible structures and electronic-based environment.	20	5	15
(3).. community and industry collaborating to crate and support local learning centers.	22	3	15
(4).. developing new structures in learning centers that:			
a) alter traditional patterns of resource allocation and provide large amounts of investment capital upfront for long-term benefits.	20	6	18
b) use IAVD as a major tool for management of instruction for the teachers/facilitators.	18	8	13
c) use IAVD to help students take greater responsibility for their own learning.	23	3	17
d) provide the entire community with easy access to IAVD systems and resources.	22	4	14
e) provide alternative paths of learning to accommodate different learning styles, while maintaining academic rigor.	22	4	17

SECTION TWO: ACTIONS OR POLICY MEASURES continued..

	A	D	S
(5).. devising vanguard projects that experiment with IAVD technology and different structures in education to meet national needs. Examples of vanguard projects are:			
a) Paperts micro world.	11	5	8
b) establishing national systems of data retrieval that allow us to tap into current knowledge at every level of education as we need it.	14	9	10
c) establishing electronics-based networks that link experts from government, the private sector and education in order to aid instruction.	14	8	11
d) elevating the role of the IAVD teacher through leadership activities, awards and benefits similar to those enjoyed by other professionals.	12	9	9
e) creating a Demonstration-Community Center that offers learning services to the entire community on a year round basis, utilizes the latest technologies and provides strong support for a differentiated staff and their training.	17	6	14

APPENDIX F: COVER LETTER AND ROUND TWO QUESTIONNAIRE

RONNIE B. LOWENSTEIN
2998 BORGE STREET
OAKTON, VIRGINIA 22124

Dear Dr._____;

I have greatly appreciated all the time and thoughtful consideration you have already given as a panelist in my doctoral research. Your responses support my belief that an investigation of the potential of IAVD technology for learning is important and timely. The product of my Delphi research, while not a consensus, will offer pooled judgements that are believed to have validity greater than any individual. To obtain that product, you are asked to respond to a second and FINAL questionnaire.

Please note that while this Round Two Questionnaire is similar in structure to the first, it is greatly reduced in size. From the original 141 items, 75 were retained because they were rated significant by 13 or more of the 27 respondents.

The enclosed questionnaire contains:

(a) 75 statements of visions of the potential of IAVD for learning and the measures needed to achieve them.

(b) preliminary results of agreement among respondents.

(c) clarifying comments made by respondents.

Your task is to review the information and rerate each item:

(1) Check the appropriate box to indicate agreement or disagreement.

(2) Note whether you consider each statement a significant consideration by placing a check to denote significance or a zero to denote little or no significance.

If you wish to clarify or react to any issue, feel free to use the comment sheet.

For your convenience, I have enclosed a self-addressed envelope within which you can return the questionnaire. Please send it back by August 5.

Thanks again for your cooperation.

Sincerely,

Ronnie B. Lowenstein

POTENTIAL OF IAVD FOR LEARNING

SECTION ONE: VISIONS

INSTRUCTIONS

Round 1 results are presented in order to help you reassess your own beliefs.

Please review: (a) the following statements identified in Round One as being considered significant by at lease 13 of the 27 respondents, (b) Round 1 results of degree of agreement among respondents and (c) the clarifying comments included on some of the issues.

Then, rerate each issue by (1) checking the appropriate space to indicate agreement or disagreement and by (2) placing a check or zero in the third space to indicate whether you consider the statement a significant issue.

(A) VISIONS OF INSTRUCTIONAL BENEFITS:

"IAVD WILL BE USED TO . . .

(1).. expand curriculum by teaching important, abstract concepts that have previously been difficult to teach.
Round 1....22 Agreed - 5 Disagreed
Comments:..

(2).. provide resource options to teachers that enable them to flexibly manage and personalize instruction.
Round 1....25 Agreed - 2 Disagreed
Comments:.. Teachers will still have the planning and management tasks to contend with..

(3).. release education from a lock-step curriculum by providing flexibly organized information across discipline and levels.:
Round 1....20 Agreed - 7 Disagreed
Comments:.. Disciplines and levels are useful ways of organizing and accessing information. Interdisciplinary applications have separate problems.

ROUND 1 RESULTS...SECTION ONE: VISIONS continued

(4).. release education from rigid time and space structure of schooling through delivery of instruction and expertise to the home.
Round 1....21 Agreed - 6 Disagreed
Comments:.. - Home education is complex issue, with many factors unrelated to education.
- Fear that extensive home education will impoverish public schools; they could become dreary warehouses for disadvantaged youngsters.

(5).. release education from rigid time and space structure through delivery of instructions to remote sites.
Round 1....24 Agreed - 2 Disagreed
Comments:..

(6).. enrich opportunities for motivation and learning with experiences not usually found in classes because they are impractical, expensive or dangerous.
Round 1....26 Agreed - 1 Disagreed
Comments:.. Dislike "enrich"; for many students, learning procedural skills through IAVD instruction will become an important part of curriculum.

(7).. improve student understanding and achievement by providing tutorials that review, remediate, and extend learning until students achieve mastery.
Round 1....25 Agreed - 2 Disagreed
Comments:.. Goals equally apply to computer instruction.

(8).. improve student understanding and achievement by dynamically assessing student learning needs and providing appropriate and immediate visual/auditory feedback.
Round 1....21 Agreed - 5 Disagreed
Comments:.. Assessing needs and providing feedback are two different design factors.

(9).. improve student understanding and achievement by increasing learner control over environment and pace of learning.
Round 1....22 Agreed - 5 Disagreed
Comments... - More research is needed; D. Morrill's extensive research on learner control failed to find improvement in achievement.
- Autonomy and discovery objectives are not necessarily ideal; they necessitate an extra information processing step that fails to replace organized, systematic learning.
- Schools will still control learning by selecting resource materials used.

ROUND 1 RESULTS...SECTION ONE: VISIONS continued

(10).. improve student understanding and achievement by facilitating joyous education though increased learner engagement and interaction with materials.
Round 1....21 Agreed - 5 Disagreed
Comments:.. - This presumes high quality IAVD courseware.
- "Joyous" is disturbing; substitute "motivated attitude" or "satisfying education."

(11).. improve student understanding and achievement by providing clear visual models of behavior for instruction.
Round 1....20 Agreed - 6 Disagreed
Comments:.. - This goal of ITV was never well-received.
- Extremely important to provide visual models of skilled performance.
- We lack adequate theories of learning and teaching. They may not exist for 1000 years.
- Massive amounts of unclear junk will appear.

(B) VISIONS OF IAVD USE WITHIN PUBLIC SCHOOLS:

"WITHIN PUBLIC SCHOOLS, IAVD WILL IDEALLY BE USED IN WAYS THAT . . .

(1).. optimize rather than maximize IAVD usage.
Round 1....22 Agreed - 1 Disagreed
Comments:.. - We'll see both.
- It is LEARNING I want to optimize or maximize.

(2).. are determined by results of research.
Round 1....18 Agreed - 8 Disagreed
Comments:.. Yes! When cognitive science research is focus.

(3).. are determined by thoughtful considerations of how IAVD can respond to problems in society and education.
Round 1....17 Agreed - 9 Disagreed
Comments:.. How I wish!

(4).. require long-range rather than yearly budgets.
Round 1....18 Agreed - 9 Disagreed
Comments:.. - It is unlikely that IAVD will be a major force in changing this.
- Yearly project reviews are necessary to respond to dynamic developments in technology.

ROUND 1 RESULTS...SECTION ONE: VISIONS continued

(5).. require a systems approach for implementation; one that considers teacher preparation, instructional materials, administrative support, community support, facilities and equipment.
Round 1....21 Agreed - 5 Disagreed
Comments:.. - While this is indeed required in Education, it is unlikely and won't happen willingly; it is like asking Amtrack to plan for airplanes.

(6).. require financial allocations for staff training equivalent to that spent for hardware and software.
Round 1....15 Agreed - 9 Disagreed
Comments:.. - This depends heavily on the nature of the materials developed.
- Always! Lack of teacher training undercuts use.

(7).. apply research on innovation and change to its introduction and implementation.
Round 1....19 Agreed - 7 Disagreed
Comments:.. Dream on!
- This is too vague to disagree with.
- I see little use in this research.

(8).. promote unprecedented cooperation among educational researchers, software/hardware producers and practitioners.
Round 1....15 Agreed - 11 Disagreed
Comments:.. Who has time? Specialization will be required.

(9).. encourage IAVD designers to apply the characteristics of effective instruction to design of courseware.
Round 1....22 Agreed - 3 Disagreed
Comments:.. What ARE these characteristics? I do not believe we know.
- IAVD is too new for rigid formulation.

(10).. encourage software design by multidisciplinary teams that have expertise in both the intuitive and analytic domain.
Round 1....22 Agreed - 4 Disagreed
Comments:.. Don't see this as a likely change. (Expensive)

(11).. encourage software design by practitioners who understand the classroom.
Round 1....20 Agreed - 6 Disagreed
Comments:.. - Unlikely; they lack the time and expertise.
- Designers need knowledge of media, the subject and the learning process.

ROUND 1 RESULTS...SECTION ONE: VISIONS continued

(12).. promote a statewide commitment to integrating IAVD schools through pilot projects that demonstrate IAVD to be a cost-effective tool for achieving educational goals.
Round 1....20 Agreed - 5 Disagreed
Comments:.. - Important in some states but, in others, statewide is of little significance.
- ONLY at the national level is all of this possible. No one state has adequate resources.
- Pilot projects have only a tangential relationship to subsequent action. What WOULD be good, though hardly IAVD-specific, is a SYSTEM which includes pilot projects as a necessary precondition to widespread adoption practices.

(13).. promote a statewide commitment to integrating IAVD in schools through establishing a priority focus on IAVD programs for remediation and/or math and science.
Round 1.... 18 Agreed - 6 Disagreed for remediation
18 Agreed - 7 Disagreed for math and science.
Comments:.. - The IAVD medium can respond to all areas; priorities become a political decision.
- To be successfully integrated into schools, IAVD must be successfully integrated into regular classrooms first, thus avoiding typecasting as a tool for the dumb, smart or handicapped.
- The means to achieving the ideal may necessitate inclusion of less than the ideal.

PROGRAMS IN MATH/SCIENCE
PROGRAMS FOR REMEDIATION

(C) VISIONS OF USE IN LEARNING ENVIRONMENTS OTHER THAN PUBLIC SCHOOLS:

"IN THE HOME, IAVD SHOULD IDEALLY BE USED IN WAYS THAT . . .

(1).. promote the realization of an electronic cottage that provides sufficiently complete curricula to permit flexibility and choice in scheduling work, leisure and study.
Round 1....18 Agreed - 8 Disagreed
Comments:.. - I am affirmative about this only because the medium required considering investment in hardware, and that requires grander justification such as "electronic cottage."
- Home learning in the "electronic cottage" is an important and exciting development.

ROUND 1 RESULTS...SECTION ONE: VISIONS continued

- Electronic cottage seems to be a silly term. Curricula refers only to study, not work or leisure.
- Overexpecting has often been a mistake with the technology.

(2).. provide competency-based skills training for industry.
Round 1....15 Agreed - 8 Disagreed
Comments:.. - This is very specialized to particular industries.
- While the technology makes these ideas feasible, they are not necessarily worthy.

"IN NEW LEARNING CENTERS, IAVD SHOULD IDEALLY BE USED IN WAYS THAT..

(1).. encourage organizational structure to evolve from needs of efficient learning rather than from needs of efficient teaching.
Round 1....22 Agreed - 3 Disagreed
Comments:.. - This isn't important in and of itself, but as a powerful rationale needed to motivate people.
- Don't efficient teaching and learning relate?

(2).. simulate work environments to train learners of all ages to adapt to a changing world.
Round 1....23 Agreed - 2 Disagreed
Comments:.. - By adapting, we mean acquiring new skills?

(3).. eliminate time as a prime measure of curricular sequencing.
Round 1....16 Agreed - 6 Disagreed
Comments:.. - IAVD enables us to use time effectively.

(4).. provide sufficient quantity and quality of software to meet individual learning styles and needs.
Round 1....21 Agreed - 3 Disagreed
Comments:.. - Very expensive!

(5).. redefine the locus of learning, the role of the student and his responsibility for learning.
Round 1....19 Agreed - 5 Disagreed
Comments:.. - This is the most important element needed in schooling.
- This can already be found in most non-school learning centers.
- Today educators have a clear focus on how, and why students learn; however, they continue to face the concerns over student motivation.

ROUND 1 RESULTS...SECTION ONE: VISIONS continued

(6).. promote a training focus to help students problem solve, handle reams of information, formulate questions and seek and evaluate answers.
Round 1....19 Agreed - 5 Disagreed
Comments:..

(7).. enable teachers to shift roles form dispensers of information to facilitators of multiple learning environments.
Round 1....23 Agreed - 2 Disagreed
Comments:.. - Why use 'teacher' for center personnel?
- Teachers will always be models for knowledgeable behavior; as we learn more about learning, the shift will occur naturally.

(8).. provide training with stand-alone systems and support education by supplementary human instruction.
Round 1....15 Agreed - 8 Disagreed
Comments:.. - Expand on this distinction to make it clear; Curriculum is split into both (a) training in subjects that have a limited range of answers and (b) education with its broad range of multiple answers.

POTENTIAL OF IAVD FOR LEARNING

SECTION TWO: ACTIONS OR POLICY MEASURES

INSTRUCTIONS

Round 1 results are presented in order to help you reassess your own beliefs.

Please review: (a) the following statements identified in Round One as being considered significant by at least 13 of the 27 respondents, (b) Round 1 results of degree of agreement amount respondents and (c) the clarifying comments included on some of the issues.

Then, rerate each issue by (1) checking the appropriate space to indicate agreement or disagreement and by (2) placing a check or zero in the third space to indicate whether you consider the statement a significant issue.

(A) VISIONS OF INSTRUCTIONAL BENEFITS

"TO REALIZE VISIONS OF INSTRUCTIONAL BENEFITS, THE FOLLOWING ACTIONS OR POLICY MEASURES ARE NECESSARY..."

(1).. infusing massive financial resources to research production and use of IAVD in learning under different conditions.
Round 1....18 Agreed - 8 Disagreed
Comments:.. - Massive funds for research are not as critical as massive funds for development.
- 'Massive' financial resources are not needed, large sums maybe. Lack of money is not deterring development.
- Why ignore the value of research on the computer along versus interactive video?

(2).. infusing massive resources to develop exemplary courseware and applications.
Round 1....25 Agreed - 1 Disagreed
Comments:..

(3).. infusing massive resources to create a critical mass of quality and pertinent courseware.
Round 1....24 Agreed - 2 Disagreed
Comments:.. - This and No. 2 go together; both are critical needs.

SECTION TWO: ACTIONS OR POLICY MEASURES continued

(4).. infusing massive financial resources to support the use of packaged deals of software/hardware/training to encourage markets.
Round 1....15 Agreed - 11 Disagreed
Comments:.. - Each component should be developed separately, and schools should integrate them.

(5).. funding for videodisc projects in education from consortia of traditional funding agencies.
Round 1....17 Agreed - 7 Disagreed
Comments:.. - Source of funding matters little.
- I am concerned that the D.O.D. and the business community lack a true commitment to education and procedures compatible with education.

(6).. funding for educational videodisc projects from business, industry and education collaborations.
Round 1....20 Agreed - 4 Disagreed
Comments:..

(7).. funding for educational videodisc projects from educational publishers.
Round 1....19 Agreed - 1 Disagreed
Comments:.. - Only if they develop some expertise and creative thinking about IAVD.
- Unlikely!
- Great idea since they already know schools and have the commercial organization to do it.

(8).. funding for education videodisc projects from the federal government through the NSF and DOE.
Round 1....17 Agreed - 9 Disagreed
Comments:.. - Will not the DOE soon be extinct?
- Prefer a new organization structure, but a Federal government role is essential.

(9).. funding for education videodisc projects from the state governments
Round 1....11 Agreed - 13 Disagreed
Comments:..

(10).. funding for education videodisc projects from a Research and Development Limited Partnership (a syndicate representing industry, education and the U.S. Department of Commerce.
Round 1....18 Agreed - 7 Disagreed
Comments:..

SECTION TWO: ACTIONS OR POLICY MEASURES continued

(11).. creating a National Center for IAVD necessary to involve educator with the creative potential of IAVD.
Round 1....18 Agreed - 7 Disagreed
Comments:.. - Unsure I entirely agree with the premise of a national center. Concept is a bit vague.
- Regional centers would be more effective.
- ONE center? The Carnegie study recommends 7.
- Surely, there will be several centers; government intervention is a poor idea.

(12).. creating a National Center for IAVD necessary to demonstrate successful projects and applications.
Round 1.....22 Agreed - 4 Disagreed
Comments:.. - Lack confidence in demonstration centers; I prefer regional development centers.

(13).. creating a National Center for IAVD necessary to act as a catalyst for increasing communications between the stakeholders of technology and educations.
Round 1.....18 Agreed - 6 Disagreed
Comments:.. - Matchmakers are sometimes helpful.

(14).. legislating a "National Defense Education Technology Act" that would reflect a federal priority to finance R and D functions that neither individual schools nor individual states can afford.
Round 1....21 Agreed - 4 Disagreed
Comments:.. - Very important.
- Why "Defense?"
- Eliminate "Defense" and the contamination of the defense emphasis on educational development.

(15).. legislating a "National Defense Education Technology Act" that would provide national directions and vision in education with concern for equity and excellence.
Round 1....16 Agreed - 9 Disagreed
Comments:..

(16).. developing research methods that permit measurement and evaluation of IAVD benefits related to teaching intangible understandings, abstract concepts and processes.
Round 1....19 Agreed - 5 Disagreed
Comments:.. - Politics and conflict of interests contaminate this as a policy issue..avoid it!

SECTION TWO: ACTIONS OR POLICY MEASURES continued

(17).. developing research methods that permit measurement and evaluation of IAVD benefits related to increasing teacher and student satisfaction.
Round 1....19 Agreed - 4 Disagreed
Comments:..

(18).. developing research methods that permit measurement and evaluation of IAVD benefits related to comparing cost-effectiveness of IAVD to other competitive delivery systems.
Round 1....19 Agreed - 3 Disagreed
Comments:.. - Neither computer nor videotape appear to be competitive with IAVD; please delineate what systems are considered competitive. (Original respondent referred to ITV, ITFS, Cable, Satellite delivery systems.)

(19).. developing model IAVD programs and courses that demonstrate effective instruction of important concepts.
Round 1....23 Agreed - 1 Disagreed
Comments:..

(20).. developing model IAVD programs and courses that demonstrate significantly improved student learning outcomes.
Round 1....25 Agreed - 0 Disagreed
Comments:..

(21).. developing model IAVD programs and courses that demonstrate efficiency and cost effectiveness, as compared to competitive delivery systems.
Round 1....19 Agreed - 3 Disagreed
Comments:..

(22).. synthesizing research that spans the psychological, social, behavioral spectrum in order to determine implications of IAVD for educational practice.
Round 1....19 Agreed - 4 Disagreed
Comments:.. - Most existing education research is useless.
- This appears to be vague and unachievable.

(23).. industrial standardizing of IAVD equipment.
Round 1....17 Agreed - 6 Disagreed
Comments:.. - While there are advantages and disadvantages in standardization, at this point, I prefer to let the market place determine standards; the consequence is a delay in school involvement.

SECTION TWO: ACTIONS OR POLICY MEASURES continued

(24).. designing interchangeable data bases/software.
Round 1....18 Agreed - 5 Disagreed
Comments:..

(25).. lowering of the cost of IAVD systems.
Round 1....20 Agreed - 1 Disagreed
Comments:.. - Economics of scale dictating high capitalization will be negated by 1990; this will ensure IAVD as a cost effective tool for education.

(B) IAVD USE WITHIN PUBLIC SCHOOLS

"TO REALIZE VISIONS OF IAVD USE WITHIN SCHOOLS, THE FOLLOWING ACTIONS OR POLICY MEASURES ARE NECESSARY . . .

(1).. educating and persuading decision makers of the value of the IAVD system.
Round 1....25 Agreed - 2 Disagreed
Comments:..

(2).. creating a climate that fosters teacher awareness, understanding and adoption of innovations.
Round 1....25 Agreed - 1 Disagreed
Comments:.. - But, how?

(3).. careful planning for the short and long range technical as well as intellectual support services for the classroom teacher.
Round 1....24 Agreed - 2 Disagreed
Comments:.. - Careful is such a value-laden word.

(4).. planning formative and summative evaluation of projects from their inception.
Round 1....24 Agreed - 2 Disagreed
Comments:.. - Summative evaluation usually too expensive.
- This is occasionally valuable.
- A poor policy issue, since we don't know how to do this.

(5).. providing hands-on experimentation in training to encourage staff to develop their own visions of productive use.
Round 1....23 Agreed - 1 Disagreed
Comments:.. - Hands on experience ALONE is insufficient, though necessary in staff development.

(C) IAVD USE IN LEARNING ENVIRONMENTS OTHER THAN PUBLIC SCHOOLS

"TO REALIZE VISIONS OF IAVD USE IN LEARNING ENVIRONMENTS OTHER THAN PUBLIC SCHOOLS, THE FOLLOWING ACTIONS OR POLICY MEASURES ARE NECESSARY..."

(1).. the private sector and educators collaborating to redefine goals of education and curriculum and then subsidize creation of learning centers compatible structures compatible with an electronic-based environment.
Round 1....20 Agreed - 5 Disagreed
Comments:.. - Defining goals is a questionable activity, unless it is done by highly imaginative individuals. The usual behavioral approach is deadly.

(2).. community and industry collaborating to create and support local learning centers.
Round 1....22 Agreed - 3 Disagreed
Comments:..

(3).. developing new structures in learning centers that alter traditional patterns of resource allocations and provide large amounts of investment capital upfront for long-term benefits.
Round 1....20 Agreed - 6 Disagreed
Comments:.. - All this should happen in public schools, too.
- Takes money to make money.

(4).. developing new structures in learning centers that use IAVD as a major tool for management of instruction for the teachers/facilitators.
Round 1....18 Agreed - 8 Disagreed
Comments:..

(5).. developing new structures in learning centers that use IAVD to help students take greater responsibility for their own learning.
Round 1....23 Agreed - 3 Disagreed
Comments:..

(6).. developing new structures in learning centers that provide the entire community with easy access to IAVD systems and resources.
Round 1....22 Agreed - 4 Disagreed
Comments:.. - This is a 'Messiah Complex.'
- Why can't we turn schools into community learning centers?

SECTION TWO: ACTIONS OR POLICY MEASURES continued

(7).. developing new structures in learning centers that provide alternative paths of learning to accommodate different learning styles, while maintaining academic rigor.
Round 1....22 Agreed - 4 Disagreed
Comments:.. - This would be nice, but not necessary.

(8).. devising vanguard projects that creates a Demonstration-Community Center that offers learning services to the entire community on a year round basis, utilizes the latest technologies and provides strong support for a differentiated staff and their training.
Round 1....17 Agreed - 6 Disagreed
Comments:.. - Good project, but not a national model.
- Why a demonstration center?

Some Round One General Comments...For Your Information

1. One panelist noted that each of the topics under visions of instructional benefits could be the subject of a dissertation.

2. A couple of panelists mentioned that they are always uncomfortable with the Delphi approach. (Though the researcher's attempt to capture the essence of respondent's views and retain their syntax and word choice was recognized and appreciated.)

3. Several panelists remarked how provocative the questionnaire was; the ideas probed a large scope of issues.

4. Several panelists found it difficult to respond to statements of vision without a stated time frame or more specific context of conditions.

5. One panelist found it impossible to denote significance on a two-point scale.

6. One respondent felt the choice of language found in Section One, (A) Visions of Instructional Benefits, made "those things sound more vivid and important in the scheme of things than they are or will be." Another reaction of this panelist to the questionnaire was in inference that many respondents appeared not to care very much about IAVD, per se,

but, rather had strong educational reform beliefs and they see IAVD as a key to achieving desirable ends.

7. Several noted that it is hard to differentiate between IAVD and other interactive technologies; much that can be said about IAVD can be said about any computer-based (interactive) instruction...

8. One panelist noted that: Despite the potential of videodisc technology along with other electronic media to radicalize education as we know it, technology alone will not drive the changes; rather, massive shifts in public policy at the local, state and federal level are needed to alter educational decisions.

Furthermore, the most compelling argument for change in education is economic and military competitiveness in the global economy.

APPENDIX G: PANELISTS WHO RESPONDED TO QUESTIONNAIRE

NAME	ROUND ONE	ROUND TWO
Dr. P. Becht	+	+
Dr. A. Bork	+	+
Mr. J. Cecil	+	+
Dr. C. Char	+	+
Dr. D. Crandall	+	+
Dr. C. Dede	+	+
Mr. M. Delp	+	+
Dr. J. Exline	+	+
Mr. R. France	+	+
Dr. T. Gates	+	+
Dr. S. Gibbon, Jr.	-	-
Ms. C. Hargan	+	+
Mr. M. Heyer	+	+
Dr. A. Hofmeister	+	+
Dr. G. Jackson	+	+
Dr. J. Kleinmann	+	+
Dr. J. Licklider	-	+
Mr. D. Lippert*		
Dr. H. Lenke	+	+
Mr. R. Lippincott	+	+
Dr. J. Lipson	+	+
Dr. J. Mecklenberger	+	+
Mr. R. Miller	+	+
Dr. A. Molnar	+	+
Dr. S. Newman	-	-
Mr. R. Nugent	+	+
Dr. S. Rockman	+	+
Dr. L. Rose	+	+
Dr. G. Salomon	-	-
Dr. R. Selden	+	+
Dr. S. Stevens	+	+
Dr. H. Wagner	+	+
Dr. F. Withrow	+	+
TOTAL	27/32	28/32

**Because of impending job transfer, Mr. D. Lippert requested that his associate and videodisc project manager at DEC, Dr. H. Lenke, be substituted as panelist. After considering their close collaboration with videodisc technology, the researcher decided to honor the request.

APPENDIX H: RESULTS OF ROUND TWO

POTENTIAL OF IAVD FOR LEARNING

DATA FROM ROUND 2 SECTION ONE: VISIONS

(A) VISIONS OF INSTRUCTIONAL BENEFITS:

"IAVD WILL BE USED TO . . .

(1).. expand curriculum by teaching important, abstract concepts that have previously been difficult to teach.
Round 2....22 Agreed - 5 Disagreed - 24 Significant
Comments:.. - What about important concrete concepts.
- Although IAVD has the potential to expand curriculum, it may not use important, abstract concepts. Few current applications do.

(2).. provide resource options to teachers that enable them to flexibly manage and personalize instruction.
Round 2....25 Agreed - 2 Disagreed - 20 Significant
Comments:.. - We must change the focus of instruction to a focus on learning.
- Has potential; most will not use the potential.

(3).. release education from a lock-step curriculum by providing flexibly organized information across discipline and levels.:
Round 2....15 Agreed - 12 Disagreed - 12 Significant
Comments:.. - Maybe, in limited circumstances.
- Increase in knowledge, blurring of boundaries between and among disciplines and the rapid change in information will combine to lead to accelerating learning tracks and more multidisciplinary courses.

(4).. release education from rigid time and space structure of schooling through delivery of instruction and expertise to the home.
Round 2....17 Agreed - 10 Disagreed - 15 Significant
Comments:.. - This is possible, but whether it will happen is up for grabs.
- This won't happen when IAVD is alone; possible when laser, broadcast, CD ROM and audio are all in one box.
- IAVD will have the greatest impact on continuing education in the home and/or in the factory; the baby boon has reached the age for competitiveness on jobs.

SECTION ONE: VISIONS continued

(5).. release education from rigid time and space structure through delivery of instructions to remote sites.
Round 2....26 Agreed - 1 Disagreed - 18 Significant
Comments:.. - What is the meaning of 'remote sites.'

(6).. enrich opportunities for motivation and learning with experiences not usually found in classes because they are impractical, expensive or dangerous.
Round 2....28 Agreed - 1 Disagreed - 21 Significant
Comments:.. - One of the most critical opportunities for technology to become integral part of curriculum.
- Potential to enrich motivation; although those using it will already be motivated.
- I agree with the comment 'Dislike enrich;' for many students IAVD instruction will become an important part of curriculum.

(7).. improve student understanding and achievement by providing tutorials that review, remediate, and extend learning until students achieve mastery.
Round 2....27 Agreed - 1 Disagreed - 20 Significant
Comments:.. - Where skill training is important, this is true.
- Hear! Hear! to the comment that such goals apply equally to computer instruction.

(8).. improve student understanding and achievement by dynamically assessing student learning needs and providing appropriate and immediate visual/auditory feedback.
Round 2....23 Agreed - 4 Disagreed - 18 Significant
Comments:.. - Certainly true in the ideal but the incremental expense to achieve true personalized assessment will far outstrip the incremental value.
- This is a complex issue that needs more study.
- Emphasize the value of providing 'interactive feedback.'

(9).. improve student understanding and achievement by increasing learner control over environment and pace of learning.
Round 2....20 Agreed - 8 Disagreed - 9 Significant
Comments:.. - Extensive, well controlled research by Dr. Merrill of U. of Southern California showed that learner control produced little or no advantage in learning. He concludes that the bright learn better with learner control, but unless taught they don't use learner control to improve achievement.

SECTION ONE: VISIONS continued

- Check Merrill's study - the comment that his research 'failed to find improvement in achievement' is not totally accurate.
- The comment 'schools will till control learning by selecting resource materials' is possible but unlikely.

(10).. improve student understanding and achievement by facilitating joyous education though increased learner engagement and interaction with materials.
Round 2....24 Agreed - 4 Disagreed - 14 Significant
Comments:.. - You sound like George Leonard.. Hurray!
- Eliminate "joyous education."
- Joyous learning is not the ONLY way to learn or even the most effective.

(11).. improve student understanding and achievement by providing clear visual models of behavior for instruction.
Round 2....22 Agreed - 6 Disagreed - 13 Significant
Comments:.. - Yes when models of behavior is a subject; no, when it is model of human behavior.
- I agree with the comment that much junk will appear.

(B) VISIONS OF IAVD USE WITHIN PUBLIC SCHOOLS:

"WITHIN PUBLIC SCHOOLS, IAVD WILL IDEALLY BE USED IN WAYS THAT . . .

(1).. optimize rather than maximize IAVD usage.
Round 2....23 Agreed - 3 Disagreed - 13 Significant
Comments:.. - Yes! Yes! to the comment that it is LEARNING that needs to be optimized or maximized.

(2).. are determined by results of research.
Round 2....12 Agreed - 15 Disagreed - 11 Significant
Comments:.. - Change the "are determined by" to "apply."
- More likely to be determined by what appears to work for the teacher.
- Curricula and resource decisions in education at the local level are rarely based on scientific research results.
- Ideally IAVD will be determined by creative production and curriculum design. Research is sometimes incomplete.

(3).. are determined by thoughtful considerations of how IAVD can respond to problems in society and education.
Round 2....13 Agreed - 13 Disagreed - 14 Significant

SECTION ONE: VISIONS continued

Comments:.. - Change "are determined by" to "apply."
- Sometimes.
- If this is attempted, the result will be a further tilt toward humanism in the schools as producers seek to avoid church/state conflict and therefore seek alternative answers to moral questions regardless of their validity. It is impossible to be committed to presenting "truth" while simultaneously ruling out religion as a possible source of that truth.
- Depends on how one interprets ideally!

(4).. require long-range rather than yearly budgets.
Round 2....15 Agreed - 12 Disagreed - 13 Significant
Comments:.. - Occasionally.

(5).. require a systems approach for implementation; one that considers teacher preparation, instructional materials, administrative support, community support, facilities and equipment.
Round 2....24 Agreed - 8 Disagreed - 22 Significant
Comments:.. - This is critical.

(6).. require financial allocations for staff training equivalent to that spent for hardware and software.
Round 2....17 Agreed - 10 Disagreed - 17 Significant
Comments:.. - If widely implemented, the percentage of money spent on staff training will not have to be that high.
- Important, but not likely.
- This medium is very demanding if used effectively; it is not video or CAI; it requires significant training.
- I agree with the comment that cost is related to the nature of the materials developed.

(7).. apply research on innovation and change to its introduction and implementation.
Round 2....7 Agreed - 20 Disagreed - 7 Significant
Comments:.. - forget research and just apply good management.
- Research on innovation and implementation is only helpful when it is tied to specific problems.
- Both comments: 'This is too vague to disagree with;' and 'I see little use in this research are good comments.

SECTION ONE: VISIONS continued

(8).. promote unprecedented cooperation among educational researchers, software/hardware producers and practitioners.
Round 2....7 Agreed - 20 Disagreed - 7 Significant
Comments:.. - A nice goal - hard to be against. Just don't lock me up with educators too long.

(9).. encourage IAVD designers to apply the characteristics of effective instruction to design of courseware.
Round 2....24 Agreed - 4 Disagreed - 17 Significant
Comments:.. - Are we supposed to opt for ineffective stuff? IAVD use requires a conceptualization of what constitutes effective instruction.
- People will try.
- I agree with the comment that we do not know the characteristics of effective instruction.

(10).. encourage software design by multidisciplinary teams that have expertise in both the intuitive and analytic domain.
Round 2....21 Agreed - 10 Disagreed - 12 Significant
Comments:.. - This will happen for all software design and not IAVD design per se.
- Large committees bog down.

(11).. encourage software design by practitioners who understand the classroom.
Round 2....11 Agreed - 15 Disagreed - 9 Significant
Comments:.. - Understand yes, but not necessarily current teachers. Hopefully, that understanding will not lead to a perseverance of status quo.
- Encourage input into design by teachers but not expect them to become the major designers.
- Practitioners must have a role, but as facilitators rather than designers.
- Specialists in the schools will primarily deal with IAVD in schools; classroom is not likely locale for use.

(12).. promote a statewide commitment to integrating IAVD schools through pilot projects that demonstrate IAVD to be a cost-effective tool for achieving educational goals.
Round 2....17 Agreed - 10 Disagreed - 13 Significant
Comments:.. - I'm just skeptical about "integrating."
- Commitment from other professional organizations is equally or more important. Pilot programs must have predefined expansion programs.
- Grassroots approach will be or telling.

SECTION ONE: VISIONS continued

- Innovations are rarely systematic in introduction and implementation.
- I agree with the comment, 'ONLY at the national level is all of this possible; no one state has adequate resources.'

(13).. promote a statewide commitment to integrating IAVD schools through establishing a priority focus on IAVD programs for remediation and/or math science.
Round 2....15 Agreed - 11 Disagreed - 12 Significant
10 Agreed - 14 Disagreed math and science
- 9 Significant
Comments:.. While not an ideal, these foci are likely politically.
- These areas are politically viable budget line items. For that reason, IAVD may be funded for those areas first. But, these are critically political questions, not technical nor instructional ones.

(C) VISIONS OF USE IN LEARNING ENVIRONMENTS OTHER THAN PUBLIC SCHOOLS:

"IN THE HOME, IAVD SHOULD IDEALLY BE USED IN WAYS THAT . . .

(1).. promote the realization of an electronic cottage that provides sufficiently complete curricula to permit flexibility and choice in scheduling work, leisure and study.
Round 2....11 Agreed - 15 Disagreed - 8 Significant
Comments:.. - Recent trends suggest that the technology has a long way to go before the concept of a universal cottage is realized.
- I agree with the comment that overexpecting has often been a mistake with the technology.
- While there will be some home use, the main uses will be institutional..in schools, libraries, game parlors, tutorial centers.
- Home use and homework will only be a small part of its use.

(2).. provide competency-based skills training for industry.
Round 2....20 Agreed - 6 Disagreed - 11 Significant
Comments:.. - Unclear about your meaning...correspondence courses in the home? Homework?
- It depends on the industry and the particular jobs.

SECTION ONE: VISIONS continued

"IN NEW LEARNING CENTERS, IAVD SHOULD IDEALLY BE USED IN WAYS THAT..

(1).. encourage organizational structure to evolve from needs of efficient learning rather than from needs of efficient teaching.
Round 2....24 Agreed - 3 Disagreed - 13 Significant
Comments:.. - A little too loose to get a handle on; some structure is needed to guide study.

(2).. simulate work environments to train learners of all ages to adapt to a changing world.
Round 2....25 Agreed - 3 Disagreed - 16 Significant
Comments:.. - Pie in the sky.

(3).. eliminate time as a prime measure of curricular sequencing.
Round 2....17 Agreed - 8 Disagreed - 13 Significant
Comments:.. - Don't understand this.

(4).. provide sufficient quantity and quality of software to meet individual learning styles and needs.
Round 2....21 Agreed - 5 Disagreed - 16 Significant
Comments:.. - MAYBE..maybe 2-3 styles of learning; but not so many as to fall prey to the 80-20 rule that dictates 80 percent of cost to get the last 20 percent of effectiveness.
- Justifiable only if learning centers replace schools or some parts of schools.

(5).. redefine the locus of learning, the role of the student and his responsibility for learning.
Round 2....24 Agreed - 3 Disagreed - 14 Significant
Comments:.. - Redefining is a bit grand for a poor little disc.
- The focus of learning is a philosophical issue and should not be determined by hardware.
- I agree with the RD1 comments that most non-school learning centers already have redefined the locus of learning, etc.; yet, we continue to face concerns over motivation. That is why new centers for learning may replace public schools.

(6).. promote a training focus to help students problem solve, handle reams of information, formulate questions and seek and evaluate answers.
Round 2....24 Agreed - 3 Disagreed - 15 Significant
Comments:.. - Critical in the information explosion is the ability to edit.

SECTION ONE: VISIONS continued

- Important goals regardless of learning technology.

(7).. enable teachers to shift roles form dispensers of information to facilitators of multiple learning environments.
Round 2....24 Agreed - 5 Disagreed - 16 Significant
Comments:.. - This is also true in schools.
- At least seven studies show that teachers...won't voluntarily be supplanted by technology.

(8).. provide training with stand-alone systems and support education by supplementary human instruction.
Round 2....16 Agreed - 9 Disagreed - 10 Significant
Comments:.. - Possible, not likely.
- Learning centers should always strive to use whatever medium is appropriate to the task.

POTENTIAL OF IAVD FOR LEARNING

SECTION TWO: ACTIONS OR POLICY MEASURES

INSTRUCTIONS

Round 1 results are presented in order to help you reassess your own beliefs.

Please review: (a) the following statements identified in Round One as being considered significant by at least 13 of the 27 respondents, (b) Round 1 results of degree of agreement amount respondents and (c) the clarifying comments included on some of the issues.

Then, rerate each issue by (1) checking the appropriate space to indicate agreement or disagreement and by (2) placing a check or zero in the third space to indicate whether you consider the statement a significant issue.

(A) VISIONS OF INSTRUCTIONAL BENEFITS

"TO REALIZE VISIONS OF INSTRUCTIONAL BENEFITS, THE FOLLOWING ACTIONS OR POLICY MEASURES ARE NECESSARY..."

(1).. infusing massive financial resources to research production and use of IAVD in learning under different conditions.
Round 2....8 Agreed - 19 Disagreed - 8 Significant
Comments:.. - The term 'massive' is relative; I agree that large sums of money are needed for statements 1-4.
- 'Massive' is meaningless unless it is defined.
- I concur with the comment that lack of money is not deterring development.
- As a developer of computer related materials, I can attest to the fact that lack of money is deterring development.
- Development is most important.
- Several panelists feel strongly that development is more important than research.

(2).. infusing massive resources to develop exemplary courseware and applications.
Round 2....22 Agreed - 7 Disagreed - 21 Significant

SECTION TWO: ACTIONS OR POLICY MEASURES continued

Comments:.. - This is a critical factor.
- Even though everyone seems to disagree, I still feel there is currently enough momentum to carry development. The alternative is a project on the scale of Apollo or Manhattan. Unfortunately, I do not believe this country will ever make that level of commitment to producing instructional materials. This is why I must believe something else will get the job done.
- This is a long-low yield approach.

(3).. infusing massive resources to create a critical mass of quality and pertinent courseware.
Round 2....21 Agreed - 8 Disagreed - 18 Significant
Comments:.. - This is also a critical factor.
- Concur with comment that No. 2 and No. 3 are critical.

(4).. infusing massive financial resources to support the use of packaged deals of software/hardware/training to encourage markets.
Round 2.... 8 Agreed - 18 Disagreed - 7 Significant
Comments:.. - Meaning of 'packaged deals'?

(5).. funding for videodisc projects in education from consortia of traditional funding agencies.
Round 2....12 Agreed - 14 Disagreed - 9 Significant
Comments:.. - "Traditional funding agencies" is restrictive; new technology may mean new sources.
- Consortia appears to be difficult to form.
- Nice but not necessary.

(6).. funding for educational videodisc projects from business, industry and education collaborations.
Round 2....21 Agreed - 12 Disagreed - 17 Significant
Comments:.. - Government most important.
- This force will eventually change schools.
- Ideas are more vital than sources of funding/

(7).. funding for educational videodisc projects from educational publishers.
Round 2....21 Agreed - 4 Disagreed - 17 Significant
Comments:.. - First, the publishers must be convinced.
- I agree with the comment that it is unlikely; in fact, it is growing more so.

SECTION TWO: ACTIONS OR POLICY MEASURES continued

(8).. funding for education videodisc projects from the federal government through the NSF and DOE.
Round 2....18 Agreed - 7 Disagreed - 13 Significant
Comments:.. - The bulk of education dollars are presently at state levels and must be tapped for all phases of development and implementation; but, development dollars should be aggregated to fund nationally developed materials, not state developed.
- Three panelists expressed strong agreement with the comment that stated preference for a new organizational structure and recognized how essential a Federal role is.
- Feds should support small number of "lighthouse" projects to show what can be done with IAVD.
- This has already happened; more is likely, particularly through NSF.

(9).. funding for education videodisc projects from the state governments
Round 2....11 Agreed - 13 Disagreed - 8 Significant
Comments:.. - Desirable, but not "necessary."

(10).. funding for education videodisc projects from a Research and Development Limited Partnership (a syndicate representing industry, education and the U.S. Department of Commerce.
Round 2....13 Agreed - 11 Disagreed - 9 Significant
Comments:.. - Too vague.
- This is merely a financial arrangement to make No. 6 or No. 7 happen.

(11).. creating a National Center for IAVD necessary to involve educator with the creative potential of IAVD.
Round 2....8 Agreed - 16 Disagreed - 6 Significant
Comments:.. - Just one center?
- Surely there will be several centers.!?
- Lost my faith in the federal government "showing the way syndrome" reflected in statements 11-15.
- Bureaucracy may sink it all.
- Center, historically, have had little impact.

(12).. creating a National Center for IAVD necessary to demonstrate successful projects and applications.
Round 2....10 Agreed - 14 Disagreed - 7 Significant

SECTION TWO: ACTIONS OR POLICY MEASURES continued

Comments:.. - First we need some successful projects.
- Many centers are necessary; if IAVD remains that scarce, it will never succeed as an educational force.
- Nice, but not necessary.

(13).. creating a National Center for IAVD necessary to act as a catalyst for increasing communications between the stakeholders of technology and educations.
Round 2....17 Agreed - 6 Disagreed - 9 Significant
Comments:.. - What about a special interest group?
- Depends on the nature of such a center.
- Could work, but need the right populations.

(14).. legislating a "National Defense Education Technology Act" that would reflect a federal priority to finance R and D functions that neither individual schools nor individual states can afford.
Round 2....19 Agreed - 7 Disagreed - 12 Significant
Comments:.. - Point of information - 70 percent of all Federal R and D is military.
- Two commenters concur with the comment to 'Eliminate defense and the contamination of the defense emphasis on educational development.
- Good idea for many technologies, not just IAVD.

(15).. legislating a "National Defense Education Technology Act" that would provide national directions and vision in education with concern for equity and excellence.
Round 2....12 Agreed - 15 Disagreed - 11 Significant
Comments:.. - 'Defense' in the sense that sound education is an effective defense situation.

(16).. developing research methods that permit measurement and evaluation of IAVD benefits related to teaching intangible understandings, abstract concepts and processes.
Round 2....17 Agreed - 8 Disagreed - 11 Significant
Comments:.. - We already have knowledge and expertise to develop effective and efficient products. LET'S PUT THE MONEY TO THAT TASK!
- Research methodologies are in existence now.
- This is where CAI has never done its homework.
- The comment that politics and conflict of interests contaminate this as a policy issue is a good point.

SECTION TWO: ACTIONS OR POLICY MEASURES continued

(17).. developing research methods that permit measurement and evaluation of IAVD benefits related to increasing teacher and student satisfaction.
Round 2....19 Agreed - 6 Disagreed - 11 Significant
Comments:.. - Is concern with satisfaction related to marketing or effectiveness?
- Change 'benefits' to 'effects.'

(18).. developing research methods that permit measurement and evaluation of IAVD benefits related to comparing cost-effectiveness of IAVD to other competitive delivery systems.
Round 2....18 Agreed - 7 Disagreed - 13 Significant
Comments:.. - Substitute 'alternative' for competitive.

(19).. developing model IAVD programs and courses that demonstrate effective instruction of important concepts.
Round 2....26 Agreed - 0 Disagreed - 22 Significant
Comments:.. Also computer programs and courses.
- This is paramount!

(20).. developing model IAVD programs and courses that demonstrate significantly improved student learning outcomes.
Round 2....26 Agreed - 0 Disagreed - 21 Significant
Comments:.. - But, this will not affect political decisions.
- Necessary, but not sufficient condition.

(21).. developing model IAVD programs and courses that demonstrate efficiency and cost effectiveness, as compared to competitive delivery systems.
Round 2....20 Agreed - 6 Disagreed - 15 Significant
Comments:.. - Cost effectiveness isn't nearly as important as effective instruction that significantly affects student learning outcomes.
- Difficult.

(22).. synthesizing research that spans the psychological, social, behavioral spectrum in order to determine implications of IAVD for educational practice.
Round 2....17 Agreed - 9 Disagreed - 13 Significant
Comments:.. - Nice goal.
- Two panelists agree with the comment that most existing educational research is useless.
- Ineluctable part of academic legitimacy.
- Most research fails to be helpful.

SECTION TWO: ACTIONS OR POLICY MEASURES continued

(23).. industrial standardizing of IAVD equipment.
Round 2....10 Agreed - 15 Disagreed - 15 Significant
Comments:.. - Unlikely and unnecessary.
- Nice, but not necessary; it won't happen for years.

(24).. designing interchangeable data bases/software.
Round 2....19 Agreed - 7 Disagreed - 17 Significant
Comments:.. - Very important.

(25).. lowering of the cost of IAVD systems.
Round 2....24 Agreed - 1 Disagreed - 17 Significant
Comments:.. - Several commented that this lowering happens naturally; one comment stated that it therefore is not a policy measure or action.
- Cost of all technology will decrease, for equivalent power. But, people will push for more power.
- Cost is relative to value. Today, reasons for using IAVD are not clear to the public. If No. 19 - 21 occur, lowering cost will be unnecessary.

(B) IAVD USE WITHIN PUBLIC SCHOOLS

"TO REALIZE VISIONS OF IAVD USE WITHIN SCHOOLS, THE FOLLOWING ACTIONS OR POLICY MEASURES ARE NECESSARY . . .

(1).. educating and persuading decision makers of the value of the IAVD system.
Round 2....26 Agreed - 0 Disagreed - 19 Significant
Comments:..

(2).. creating a climate that fosters teacher awareness, understanding and adoption of innovations.
Round 2....25 Agreed - 0 Disagreed - 19 Significant
Comments:.. But, how?
- Vague.

(3).. careful planning for the short and long range technical as well as intellectual support services for the classroom teacher.
Round 2....24 Agreed - 2 Disagreed - 17 Significant
Comments:.. How about "haphazard planning?!"

(4).. planning formative and summative evaluation of projects from their inception.
Round 2....23 Agreed - 3 Disagreed - 14 Significant

SECTION TWO: ACTIONS OR POLICY MEASURES continued

Comments:.. Evaluation is great, but how and against what.
I'd hate to spend as much on evaluating Project A as it would cost to do project B.
- Part of research burden.

(5).. providing hands-on experimentation in training to encourage staff to develop their own visions of productive use.
Round 2....24 Agreed - 0 Disagreed - 14 Significant
Comments:.. Substitute 'schools' for 'staff.'

(C) IAVD USE IN LEARNING ENVIRONMENTS OTHER THAN PUBLIC SCHOOLS

"TO REALIZE VISIONS OF IAVD USE IN LEARNING ENVIRONMENTS OTHER THAN PUBLIC SCHOOLS, THE FOLLOWING ACTIONS OR POLICY MEASURES ARE NECESSARY..."

(1).. the private sector and educators collaborating to redefine goals of education and curriculum and then subsidize creation of learning centers compatible structures compatible with an electronic-based environment.
Round 2....14 Agreed - 11 Disagreed - 10 Significant
Comments:.. Success will be more dependent on entrepreneurial skill and marketing than collaborative development.
- The implied process is flawed.

(2).. community and industry collaborating to create and support local learning centers.
Round 2....23 Agreed - 6 Disagreed - 12 Significant
Comments:..

(3).. developing new structures in learning centers that alter traditional patterns of resource allocations and provide large amounts of investment capital upfront for long-term benefits.
Round 2....18 Agreed - 7 Disagreed - 10 Significant
Comments:.. Nice, but, not necessary.

(4).. developing new structures in learning centers that use IAVD as a major tool for management of instruction.
Round 2....16 Agreed - 9 Disagreed - 10 Significant
Comments:..

(5).. developing new structures in learning centers that use IAVD to help students take greater responsibility for their own learning.
Round 2....23 Agreed - 3 Disagreed - 14 Significant
Comments:.. Traditions must be established.

SECTION TWO: ACTIONS OR POLICY MEASURES continued

(6).. developing new structures in learning centers that provide the entire community with easy access to IAVD systems and resources.
Round 2....20 Agreed - 4 Disagreed - 12 Significant
Comments:.. Hear! Hear! Power to peephole.
- Good comment. ('Why can't we turn schools into community learning centers?')
- Nice but, not necessary.
- Libraries currently offer voluntary access.

(7).. developing new structures in learning centers that provide alternative paths of learning to accommodate different learning styles, while maintaining academic rigor.
Round 2....19 Agreed - 5 Disagreed - 12 Significant
Comments:.. - Skip the rigor.
- Nice, but not necessary.

(8).. devising vanguard projects that creates a Demonstration-Community Center that offers learning services to the entire community on a year round basis, utilizes the latest technologies and provides strong support for a differentiated staff and their training.
Round 2....17 Agreed - 8 Disagreed - 9 Significant
Comments:.. Go for it!
- Someone has to see a business opportunity.

GENERAL COMMENTS RELATED TO THE ROUND TWO QUESTIONNAIRE:

I have real problems in sorting out responses on visions within public schools that are based on ideal situations when practical reality will result in different responses.

I had trouble with the statements because of the word, "Ideally" and the wording. None seemed clear enough to support answers.

I have tried to be a little more critical this round. Even though all topics addressed have c=some validity, we need to initially address ourselves to the "critical issues." I think we need to narrow the field...Words like ideally continue to give me problems with a delineation of scope.

Still had some trouble reacting to exact words of statements. I often had to ignore some aspects of a statement because I agreed with what I judged to be the main thrust of the statement.

The more I thought about it, the less I liked learning centers as a general community facility. They are needed in some places, but generally schools, libraries, home and worksites do and should do the job.

A number of the statements give an impression that IVD is more than a tool. It is important to emphasize that it is a means to an end, and not an end in itself.

IVD is not the issue. It is only one little pipsqueak in the landscape of schools/learners/technology. Some of the questions seem to suggest that IVD is to be the tail that wags the dog of Education. Because I respect the concerns your questions reflect, I'd hate to have them trivialized by being reduced to an issue of IVD technology.

APPENDIX I: FINDINGS OF INTERVIEW QUESTION THREE

"What do you conceive of as the barriers to reaching the potential of IVD?"

As part of the data reduction process, responses to the third interview question had been eliminated from the Delphi Questionnaire. Consequently, panelists never had the opportunity to review each other's beliefs nor reassess their own. The following discussion highlights selected comments from the interview data. It is organized according to categories of barriers related to: school market issues; production and design issues; research issues; uses in school; and technological capabilities.

Discussion of Barriers Related to School Market Issues

(1) Respondents appeared to agree that market-cost issues were the most important category of barriers preventing the realization of IVD potential. The descriptive phrase used most often was the "chicken-egg phenomenon." How can a school market develop without a sufficient quantity of appropriate and well-designed software and hardware? Similarly, without a developed market, how will the production of appropriate software and hardware be funded?

(2) Other barriers noted include:

(a) a low level of awareness in all stakeholders;

(b) a lack of centralized mechanisms to promote information exchange within and among school systems;

(c) a lack of startling prototypes with commercial sex appeal;

(d) a need for a critical mass of courseware;

(e) copyright laws that inhibit usage of software;

(f) a lack of centralized mechanisms to promote successful innovation processes in schools;

(g) a need for massive pre-and in-service training of educators; and

(h) the public school traditions of short range planning which is incompatible with the economy of scale of IVD.

(3) Taken together, the comments on barriers reveal a more complex reality of interdependent factors than costs alone. The findings suggest that conducive economic conditions are necessary but not sufficient to encourage application of IVD in public schools. The human factors and the sociology of institutions appear to be as significant as economic factors in influencing individual markets.

(4) In addition to the interdependent factors affecting growth of individual markets, there appears to be an interrelationship among markets. While this issue was never specifically addressed in a discussion of barriers, it emerged in responses to other questions.

Discussion of Barriers Related to Production and Design Issues

(1) Panelists presented a list of ten barriers related to production and design. Examined individually, each of the ideas appears to have some validity; yet, none conveys a totality of view.

(2) Taken together, the Delphi responses convey a picture of relationships between three stakeholders -- software developers, school users and funders -- that intimate what is needed to remove barriers.

(3) The following paragraph is an integration of individual comments taken directly from the research study:

There is a lack of massive front-end investments needed to support long-range commitments for educational software targeted to the needs of an identified audience. Multidisciplinary production/design teams must be formed that combine sophisticated skills and understanding. The expertise must include that of educators who understand the culture and needs of the school, content experts, computer programmers, and video production specialists. Formal mechanisms should be created that promote increased communication between the developers and the users. In that way, software can be more coherently designed and integrated with school needs. Even well-designed courseware, modestly priced and appropriate to the school curriculum, may not be purchased unless there is a critical mass available and an adequate supply of hardware in the school. Publishers, who are the current major supplier of media to the public schools, need to alter their attitude and traditional funding and organizational patterns. They need to make

massive front-end investments, value author and computer programming time, and develop new marketing techniques to reach the school.

Discussion of Barriers Related to Research Issues

While not all panelists mentioned the term "research" in discussing barriers to realizing the potential of IVD, all were concerned with issues that related directly or indirectly to the process and products of research. Three categories of research barriers were noted:

(1) The first research barrier noted was lack of knowledge about IVD. Pilot studies were suggested to remedy: (a) ignorance regarding the unique attributes of IVD; (b) ignorance regarding IVD simulation to teach higher level thinking skills; (c) lack of concrete evidence that use of IVD under varying conditions results in increased learning; and (d) lack of systematic evaluation that demonstrates cost-effectiveness of IVD.

(2) The second category of research barriers was lack of dissemination of information and of resources. Some panelists desired the creation of a research and evaluation clearinghouse; others suggested a materials resource clearinghouse.

(3) The third category of research barriers dealt with methodological considerations. Some panelists bemoaned: (a) the high cost of experimentation with prototypes,combined with low demand; (b) the inadequacy of research techniques for measuring intangible goals and media use; and (c) inattention in research design to the sociology of learning and the role of technology in schools.

Discussion of Barriers Related to Uses in the Public School

(1) In discussing the barriers to use of IVD in public schools, a majority of panelists spoke in terms of "change and innovation."

(2) Within the framework of change, panelists enumerated four categories of barriers: societal conditions, attitudes of the public, attitudes of public school personnel, and infrastructure of the public schools.

Societal Conditions

While not many panelists discussed external conditions as barriers affecting the uses of IVD in public schools, those that did enumerated: (a) the rapid technological changes, (b) the knowledge explosion with the resultant impermanence of information, and (c) the lack of national policy in education.

Attitudes of the Public

(a) Several panelists characterized public support of education, in general, and public support of technology in education as "meager." They decried the attitudes that gave lip service to the importance of intellect and creativity but financially failed to support programs and strategies to develop them.

(b) Many commented on the low level of public awareness and understanding of the relationship of technology and education; they specified the lack of knowledge about and experience with IVD as obvious barriers to the realization of its potential.

(c) Less obvious was the perception offered that the public's traditional reticence with school experimentation obstructed change.

(d) A few panelists observed a public backlash against technology, either because of some unfulfilled and unrealistic expectations, or because of mistaken beliefs that the history of technology has been unsuccessful.

Attitudes of Educators

(a) The panelists who cited traditional attitudes among educators as barriers tended to characterize educators as a conservative group, "resistant to change," and ignoring the needs of a rapidly changing environment.

(b) A few pointed out that throughout the history of education there has been reliance on labor-intensive efforts, short-range planning and quick "band-aid solutions" to problems.

(c) They offered a variety of reasons to explain the pervasive resistance to change: a traditional focus on print and print literacy that tended to devalue visual media; a comfort with the status quo; average age of teaching staff; philosophic belief in tradition; political disagreement over whose responsibility it is to develop and promote IVD; lack of educational visionaries who can lead change efforts; lack of communications among practitioners, researchers, and developers of IVD technology; and fear of a shift in the teaching/learning paradigm.

Infrastructure of Education

(a) A number of panelists described the actual infrastructure of education as the most powerful barrier to the realization of IVD potential.

(b) Reference was made by one respondent to the "rational" and "loosely coupled" nature of education that "emasculated innovations and large scale curriculum reform."

(c) A few other panelists, while less passionate in their descriptions, seemed equally convinced that the local autonomy, decentralized control, traditional short-range planning, and financial models of support found in public schooling are all in conflict with the economy of scale of IVD technology.

(d) Another area of incompatibility frequently cited was the state of pre- and in-service training. Not only was the lack of technology-trained personnel noted, but also the lack of support mechanisms necessary to promote annual staff development and local school leadership of change.

(e) The traditional attitudes and modes of operation defined by the infrastructure of schools emerged as the major adversaries of change.

Discussion of Barriers Related to Technological Capabilities

(1) Eight specific barriers related to technological capabilities were mentioned: (a) machine durability and reliability; (b) lack of voice activation; (c) speed of access; (d) difficulty in

using; (e) the limited application of artificial intelligence embedded in the computer; (f) lack of standardized technology; (g) the rapidity with which the technology is changing; and (h) the inability of IVD to "read and write."

(2) Of the eight barriers, only the latter three were mentioned by more than two panelists. The lack of frequency and the comments suggest that the category of technological capabilities was not perceived as a major barrier to public school use of IVD.

APPENDIX J: FINDINGS OF INTERVIEW QUESTION FOUR

"In reality, what do you think will happen with IVD technology and the public schools in the next five years? Ten Years?

In the interviews conducted between March and June, 1984, the thirty-two Delphi panelists responded to the request for predictions in question four. As part of a data reduction process, the responses were eliminated from the subsequent rounds of the Delphi questionnaire. Following some general observations, highlights of findings are discussed according to the categories of: marketing issues; production and design issues; research issues; uses in public schools; uses in the military; uses in other learning environments; and technological capabilities.

General Observations

(1) "Crystal-ball gazing," as one panelist described it, appeared to cause discomfort for some respondents. One panelist flatly refused comment to question four.

(2) While all other thirty-one respondents provided some five-year predictions, at least seven added qualifications. Each one of the seven linked an attitude of "optimism" or "pessimism" with the varying scenarios he/she thought possible. This may reflect panelists' uncertainty about the future and/or awareness of the fragility of prediction.

(3) When Delphi panelists were asked to project ten years into the future, three refused comment. One explained the difficulty of forecasting in terms of the rapid changes in society. Another protested that he didn't have "models (mental models) for interactive technologies." Instead of a forecast, he offered an old Hebrew saying, "That since the prophets, prophecy was given to the gods."

(4) Most panelists limited their forecasting to a few categories, most frequently to "uses in public schools" and "marketing issues."

(5) There appeared variability among views; for each category, there appeared a continuum of possibilities, sometimes including contradictory views.

(6) A final observation is that some of the panelists predicted a future reality that closely resembled their vision of the ideal they had presented in response to question one.

Discussion of Five-Year Market Predictions

The five year market predictions comprised a description of the conditions of the education market and its relationship to other markets and to software design.

(1) Several panelists concurred that by 1989 there would only be a small installed base in schools, despite the lowering of costs from a large installed base in industry. Sadness was conveyed that the size of the 1989 education market would be too small to encourage large-scale development of quality courseware.

(2) On the other hand, several panelists imagined an intense consumer market developed by 1989, comparable to the 1984 computer market.

(3) It is unclear if panelists meant the same thing by "consumer market." One respondent described it as providing informal IVD instruction for the home. He was so convinced of its commercial success that he forecast what he knew was contrary to prevailing assumptions: The home market would impel the industrial and military markets.

Discussion of Ten-Year Market Predictions

Ten year forecasts dealing with marketing considerations tended to be offered with greater conviction than five year forecasts. The remarks, while displaying concern for issues addressed in the five year forecast, also described some impacts of the IVD market.

(1) Regarding conditions anticipated in 1994, a few panelists envisioned an installed base of IVD in public schools that approached the size of the installed base of microcomputers in schools of 1984, at 1-2 in every school. Several foresaw the emergence of a substantial educational market that relied on home use of IVD. One panelist imagined the creation of commercially successful Videodisc Publishing companies that would combine the modus operandi of Time-Life Publishing and Video Clubs and spur the educational market.

(2) Regarding software, there were several panelists who expressed firm conviction that, by 1994, there would finally be a

critical mass of quality educational software capable for demonstrating IVD effectiveness.

(3) There were variant views regarding the distribution paths for IVD software in 1994: Mention was made of technology transfer between private industry and public schools and far greater networking, "vis a vis cooperative university consortia."

(4) Three predictions dealt with the consequences of a large and successful educational market: (a) one anticipated the end of the conflict between national marketing of courseware and local school autonomy; (b) another forecast a renewed interest in education as a profession; and (c) the third forecast that new companies that found an educational market would become relatively big industries.

Discussion of Five-Year Production and Design Predictions

Despite the acknowledged importance of production and design, only a few panelists volunteered predictions.

(1) Regarding design approach, there was concurrence that there would be wide-spread recognition of the need for interdisciplinary teams for interactive software. Two panelists were more optimistic and specific in their predictions; they both prophesied increased funding for collaboration among media designs, educational psychologists,and educational users.

(2) Regarding costs, five panelists concurred that there would be a continual lowering of costs in designing and producing IVD systems in the next five years. But there was a wide discrepancy in price

forecasts. One ventured that the cost of hardware systems would be reduced 15 percent each year; others speculated specific costs of systems to be at $500, at $1,000-2,000, or $3,000-5,000.

(3) Regarding public perception, a few panelists expressed optimism that the public would recognize IVD as a cost-effective and efficient medium of instruction; perhaps IVD would be acclaimed the ultimate tutor.

Discussion of Ten-Year Production and Design Predictions

(1) There was only one ten year forecast; a prophesy that a level of artificial intelligence in design would allow IVD to be a "seductive conversational companion."

Discussion of Five-Year Research Predictions

(1) Many respondents appeared to concur that within five years there would be few and isolated research efforts.

(2) They also seemed to agree about the kinds of projects that would dominate: (a) those concerned with special needs students; (b) those researching teaching of conventional, manipulative skills; and (c) those single-disc projects designed as curricular adjuncts.

(3) A few panelists speculated that exemplary demonstration projects would not be taken seriously by the public nor by the educational community.

(4) Viewpoints seemed to diverge into two categories with different perspectives, one theoretical and one more pragmatic. Those with a theoretical concern seemed dismayed that on-going fragmentation of experimental projects inhibits progress toward understanding the relationship of IVD to mental processing and learning. Those more pragmatically inclined were concerned about the effect the predicted research conditions would have on policy decisions to use IVD in educational settings. A number of them expressed sadness that experiments would involve only fragments of curriculum and hence, affect only minor curricular revision.

(5) Several panelists contrasted the present and short term lack of IVD credibility in education with the acceptance and innovative uses of IVD in private industry. They predicted many private industry experimental projects. One specified a demonstration project that would be protected from publicity at its proprietary learning center. Another foresaw major private companies experimenting with transportable, accessible and compact curricula that would compete with public schools.

Discussion of Ten-Year Research Predictions

The ten year scenarios offered by the more pragmatic panelists encompassed both optimistic and pessimistic projections.

(1) One panelist was convinced that there would still be a need to demonstrate IVD as an effective medium for achieving instructional goals. However, other panelists expected that there would be a critical mass of software appropriate to educational settings to demonstrate

effectiveness. Most optimistic was the prophecy that, by 1994, there would be a national commitment to sponsor curriculum revision of our entire educational system, spawning multiple experimental design projects.

(2) Two of those panelists concerned with theory expressed some optimism: they anticipated projects which would reflect a synthesis of research and translation of theory into practice.

Discussion of Five-Year Public School Uses Predictions

Panelists expressed concern with the general societal conditions that affect education; with factors that specifically affect use of IVD within schools; and with the impact of IVD on schools and society.

(1) They forecast conditions that would inhibit use of IVD in schools: (a) a continuing push for basics; (b) tight educational budgets; and (c) a quest by educators and politicians for quick, band-aid solutions rather than systematic, long-term approaches.

(2) Many panelists seemed to agree that, despite barriers minimizing public school use of IVD systems, by 1989 there would be general societal awareness of IVD and much use of IVD in community colleges, the military, vocational schools, the commercial sector, medical profession, engineering profession, private institutions, and business schools.

(3) There appeared to be consensus that there would be an initially slow infiltration into public schools; although panelists offered different reasons for this, including: lack of quality software

appropriate to curricula; lack of seed money available from government to product software; and lack of trained designers.

(4) Views diverged over whether there would be a "critical mass" of software by 1989. A few respondents claimed that even with a critical mass of software, IVD promoters would have failed to convince most educators of the worth of IVD.

(5) One panelists ventured that implementation will have begun in only five to ten percent of the 16,000 public school systems. Another was more optimistic, and forecast that implementation will have begun all over.

(6) There were a variety of goals of use envisioned for the initial uses of IVD within public schools: (a) some envisioned its use as a tool for implementing mastery learning; (b) others depicted it as the tool for implementing individualized learning; however, there was divergency over whether it would be a mainstay of instruction or a sophisticated audio visual support; (c) several panelists predicted that IVD would first be a cost-effective archival tool of film in libraries; and (d) one specified archival use initially for the hard sciences, vocational training and mathematics. The rationale given was: those are the three areas of national concern that offer economic justification to offset the cost of IVD. Also, objectives for those areas are more easily defined and measured than those in the humanities.

(7) Nine different consequences of IVD use in public schools were noted by panelists: (a) two dealt with the influence of IVD on students with the respondents claiming that students would assume more

autonomy and responsibility for learning; (b) seven remarks forecast attitudinal changes among educational staff with one claim that educational staff would increasingly ignore the arts and humanities; (c) another negative prediction was inattention to connections between subjects; (d) more positive were the predictions of an erosion of the traditional model of teacher-led instruction; (e) a reassessment and redefinition of basic skills; (f) a restructuring of schools eager to try a more open-school environment; and (g) an evolving concept of a teacher-technology partnership in which IVD is viewed as a cost-effective, efficient tool to complement and/or supplement human instruction.

Discussion of Ten-Year Predictions of Public School Uses of IVD

Most of the scenarios of ten year predictions presented ideas within the context of societal conditions.

(1) Only two panelists claimed that there would be little or no integration of IVD in schools by 1994.

(2) Most other respondents envisioned increasing acceptance of IVD by school boards and administrators to increase the efficiency of learning and/or to provide a cost-effective means of solving problems of education.

(3) Some of the predictions related to wide-scale use of IVD included: (a) masses of students having opportunity to speed through the educational process; (b) a restructuring of work and schools; (c) a decline of public school enrollments since chunks of educational

mandates would be usurped by private learning centers using IVD; (d) a loss of local autonomy of schools; and (e) an increase in home instruction or in private learning centers that then increases inequity of access.

Discussion of Five-Year Military Predictions

Only three panelists out of 32 referred to the military. In their brief comments, all three panelists conveyed interest in the planned activities of the military and their relationship to the educational community.

(1) They concurred that while there would be continued development, demonstration, and evaluation of IVD applications in the military, only a few state school systems would display interest in them.

Discussion of Ten-Year Military Predictions

(1) Widespread use and distribution of IVD throughout the military was forecast, contingent on an accumulation of research evidence demonstrating effectiveness and on developed markets that ensure affordability of IVD.

(2) All three respondents anticipated increased efforts between private industry, the military, and the education community to promote technology transfer.

Discussion of Five-Year Learning Center Predictions

(1) Three panelists forecast a visible but not enormous increase of private schools that would use IVD systems extensively by 1989. Their views regarding the student population were split. In one scenario, private schools competed for public school students; in another scenario, industry-sponsored training schools used IVD with adult-workers.

Discussion of Ten-Year Learning Center Predictions

(1) For the ten year forecast, several more panelists envisioned a large number of technology- oriented learning environments outside of public schools.

(2) There appeared to be a variety of discrepant views regarding the impact of technology environments on public schools. Some panelists felt there would be a negative impact on public schools, while several others predicted a positive enhancement. Concern was expressed over an increase in inequity of educational access and speculation was made regarding home market competition hastening the demise of public schools. In contrast were two optimistic scenarios envisioning public school growth. In one, public schools grew stronger by narrowing their focus to those "education" tasks that can only be facilitated by human beings and by relegating the "training-skill" tasks to interactive technologies in learning centers. In another scenario, community-school partnerships increased to help public schools become community sites

serving a diverse student population pursuing lifelong learning and relying on IVD instruction.

Discussion of Five-Year Predictions Related to Technological Capabilities

Only a few panelists proposed forecasts that related to technological capabilities of IVD.

(1) Their predictions ranged from an assertion that IVD would disappear to a listing of six areas of development: (a) expansion of menu-driven touch panels; (b) increasing compatibility of software; (c) newer programming and authoring languages; (d) greater applications of artificial intelligence; (e) miniaturized systems; and (f) development of erasable read and write discs.

Discussion of Ten-Year Predictions Related to Technological Capabilities

The technological capabilities forecast for the ten year scenario represented contradictory perspectives.

(1) One panelist insisted that there would only be a few changes in the parameters of IVD, the main difference being in the power of the computer. In contrast was the claim that there would be many rapid technical advancements, including: (a) 3-d television; (b) holographic projections; (c) interactive holograms; (d) hook-up to cable and satellite receivers in schools; and (e) common use of bar codes and light pens.

APPENDIX K: UNANTICIPATED INTERVIEW RESPONSES

Two unanticipated categories of response emerged during the initial interviews of Delphi panelists. These were caveats to responding to the Delphi questions and legitimate descriptors of interactive videodisc technology.

Caveats

Many panelists expressed hesitancy and offered caveats in response to the first interview query requesting their visions of IVD potential for education.

(1) Several panelists linked their reluctance to define ideal uses of IVD in public schools to the concept of innovation. They expressed frustration with the slowness of change and the discouraging feelings often experienced by change agents.

(2) Other panelists emphasized the nature of IVD as a technological tool whose ideal uses and applications are determined by the nature and goals of the institutions employing it. They insisted that the benefits of IVD must be examined within the philosophic framework of the system using it. One panelist summed it up: "What is technologically possible will be differentially desired in different settings."

Legitimate Descriptors

Some of the reluctance of panelists in the initial interviews may have been related to the ambiguity and vagueness of the term, "interactive videodiscs." A majority of the 32 respondents requested researcher clarification of the term. The researcher, following the ethnographic tradition of refraining from imposing her own conceptions, refused to define IVD. Instead, she acknowledged the ambiguity of the term as a function of the dynamism of the field and elicited the panelists' notions.

While there was no consensus concerning an appropriate definition within the findings, the panelists' descriptions of interactive videodisc technology did appear to fall loosely into three categories:

(1) those that depict IVD as an extension of the computer; such as,

. . . an information storage device . . . possessing the potential to be controlled by computer;

. . . a mere computer peripheral, which greatly increases the storage capabilities and makes high resolution images rapidly accessible;

(2) those that define IVD in terms of its visual, multimedia symbols; such as,

. . . a media heaven;

. . . the first non-linear dynamic art form;

. . . a multifaceted instructional tool that is a symbol system and

manipulator in one device, . . . allowing maximum interactions with multiple symbol systems;

. . . a powerful, sometime magical, convenient, flexible technology that allows maximum interactions with a multimedia data base;

. . . a device that by increasing sensorially concrete experiences of the users, increases their ability to tinker with the world; and

(3) definitions that describe IVD in functional terms; such as,

. . . an innovation for schools;

. . . a tool box for teaching that permits instructional designers to think flexibly, and gives users the ability to sift and filter multimedia information;

. . . more significant than a new tool, IVD, by expanding the curriculum, is a target of opportunity of learning and the schools.

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