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Compressed Digital Video Instructional Delivery: A Study of Student Achievement, Student Attitude, and Instructor Attitude

Eddyth Niceler Worley
Old Dominion University

COMPRESSED DIGITAL VIDEO INSTRUCTIONAL DELIVERY: A STUDY OF STUDENT ACHIEVEMENT, STUDENT ATTITUDE, AND INSTRUCTOR ATTITUDE

by

Eddyth Niceler Worley

B.S. May 1968, North Texas State University
M.S. May 1990, Old Dominion University

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Approved By:

Dwight W. Allen, Dissertation Chair

Member

Concentration Area Director

Member

Dean of College of Education

ABSTRACT

The purpose of this study was to investigate compressed digital video as an instructional delivery system for distance learning. The independent variable was delivery mode. Two levels of this variable were considered. Level 1 was one-way video/two-way audio. Level 2 was two-way video/two-way audio. Student achievement, student attitude, and instructor attitude were measured as dependent variables.

A quasi-experimental study comparing the two delivery modes was conducted. Two treatment groups were established. Both groups received instruction simultaneously from the same instructors. Instructors used both treatment modes (delivery systems) during instruction.

Instructor and student subjects were naval, civilian and military personnel involved in the Communications Security Material System (CMS) compressed digital video teletraining course presented by Fleet Combat Training Center, Atlantic (FCTCLANT), Dam Neck Naval Station, Virginia.

Student achievement and student attitude data were collected for each treatment group. Instructor attitude data were collected for each instructor after experience with both treatment modes. Pre/posttests and CMS course final examination were used to measure student achievement. Student attitude was measured using a student attitude survey. Instructor attitude was measured through individual instructor interviews.

Findings revealed that compressed digital video was a highly effective instructional delivery mode based on pre/posttest comparison and final examination scores of both treatment groups. Instructors preferred two-way video/two-way audio significantly more than one-way video/two-way audio. No significant difference was revealed in student attitude between treatment groups. After experiencing compressed digital video instructional delivery, both groups rated course instruction, course content, and course delivery medium highly. Additionally, both groups rated time and distance as important factors in choosing to attend future courses via instructional television.

Findings suggest compressed digital video can be considered an effective distance learning delivery mode. Further investigation of compressed digital video technology in the instructional domain should be undertaken in the K-12 and higher education environments. Additionally, as compressed digital video technology continues to improve, investigative emphasis should focus on identifying instructional strategies and delivery systems that best support student success.

DEDICATION

With deepest love and appreciation, I dedicate this work to five people:

My parents, who through their efforts and sacrifices quite literally helped their blind child see. Without their concern for my vision, this document could never have been written.

Edward Niceler

Memories of my Father, from whom I inherited my curiosity of electronic gadgets, are with me always. There is no doubt in my heart that he was beside me throughout this project.

Lucille Ahrendt Niceler

My Mother, through her own life work, has proven to me that you can succeed at anything you set your mind, heart and energies toward.

My family, who on a daily basis remind me what the joy of life is really all about.

Robert Earl (Tim) Worley

My husband and friend, who has supported me emotionally, physically and financially throughout this project and all of my endeavors.

Eddyth Maurleen Worley

Roberta Anne Worley

My daughters, who by far, are the best works I have ever produced.

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PURPOSE OF STUDY

Relevance to Urban Education

Limited educational funding and increased demand for educational services are requiring urban educators to explore methods for consolidating and sharing resources if all urban students are to be guaranteed excellence, effectiveness, efficiency and equity of educational opportunity. Problems facing urban educational decision makers include promoting academic achievement, social and cultural awareness and understanding, staff recruitment and placement, and serving the needs of parents and community as life-long learners.

Often, urban students are denied access to advanced academic areas and disciplines simply because classes are not available. Enough students may not need or be interested in an area or discipline to justify costs associated with delivery. Other times, it is a matter of being unable to recruit and place appropriate staff. Adequate facilities and resources for delivery, demonstrations and experimentation may also be restrictive factors.

In conjunction with denied access to specialized and advanced academic areas and disciplines, urban students are often limited in access to extensive cultural and social awareness and

interaction. Many urban students lack a window to the world outside their own existence. Only a limited prospective of potential career and lifestyle opportunities is available.

Yet another problem for urban education, not unlike those faced by rural education, is the ability to attract and retain adequate professional staff to meet student needs. Teachers and administrators often prefer the perceived less tense or less isolated environment of suburban education. High demand for specialized curriculum teachers and resource personnel by all educational communities lessens urban education's competitive appeal.

Additionally, now more than ever, there is an awareness of and movement toward providing educational opportunities to the urban community at large. Parental involvement in education requires parental training. Promoting the importance and continence of education requires serving citizens as life-long learners. It has fallen to urban education to be educator of the urban community as a whole if educational change and improvement is to be effectuated.

While each area presented is a realistic inhibitor in the urban setting, no one is insurmountable. When addressing these issues individually and collectively, one possible solution is distance learning. Long adopted by rural communities as an educational life-line for bridging the isolation of rural education, distance learning applications offer multiple advantages to urban and suburban educators as well. Hard copy

correspondence, although still a viable distance learning application, has been enhanced by and progressively replaced with technologies supporting radio, telephone, computer, and television delivery. Hardware and software advancements have allowed delivery systems to be combined and enhanced in ways that better support televised educational delivery in a more time, cost and space efficient manner.

Technological Advancements in Telecommunications for Distance Learning

Technological advancements in telecommunications are offering educators more opportunities to support student success through televised instructional delivery than ever before. Learners at different locations locally, nationally and internationally can be brought together electronically to create quality learning environments and generate successful classes. Staff resources at one location can be shared with other locations. Models, demonstrations, experiments and guest experts can be shared electronically across vast distances. Cooperative learning and interaction can be fostered among culturally and socially diverse groups of students and teachers. Effective role models can be shared. Teachers can team with each other to share resources and knowledge, as well as participate in professional growth through staff development delivered to the workplace. Additionally, each of these advantages can be extended beyond the

traditional school day to offer parents and other members of the community opportunities for life-long learning programs and activities. The power of distance learning facilitates moving knowledge instead of moving students. Learners of all ages and levels are given an opportunity to experience learning that may otherwise not be available.

While each issue discussed is possible through distance learning delivery using full motion analog video, the cost of delivery has been cost restrictive in most educational environments. Technical and fiscal requirements associated with full motion analog video has limited its use primarily to one-way video/two-way audio delivery. Although one-way video/two-way audio has proven to be as effective as the traditional classroom in investigated applications (Chute, Bruning, Hulech, 1984), there remains a desire among some educators to replicate face-to-face interaction. According to D. R. Garrison, "While most distance educators argue for the necessity of providing two-way communication, the reality is that not enough is being done to actually facilitate it." (Garrison, 1989, p. 18).

A study of two-way interactive television instruction was conducted by the University of Utah. Analog video delivered via microwave was compared to traditional classroom instruction. No significant differences in instructional effectiveness between the two comparison groups was revealed. Also reported in the study was a need to consider the cost effectiveness of two-way (analog) interactive television. M. Winston Egan, I. McCleary,

J. Sebastian, and H. Lacy report, "The use of such sophisticated technologies is costly. Comparisons need to be made regarding the cost of using various technologies versus other delivery systems for serving distance learners... Will the use of the technology price the course out of the market?" (Egan, McCleary, Sebastian, Lacy, p. 30, 33).

Compressed Digital Video Development

Advancements in video technology have provided an alternative to analog delivery, supportive of two-way video/two-way audio delivery, that appears economically feasible for educational implementation. That alternative is compressed digital video.

Compressed digital video technology is moving into the forefront of educational exploration for distance learning application. Compressed digital video is also receiving an explosion of interest from satellite broadcasters, pay-for-view distributors, cable television operators, regional networks, high definition television developers and electronics manufactors. According to Jerry Farrell, Senior Vice President, Hughes Communication Inc., "The technology is here, and it has been demonstrated. Lower distribution costs will more than offset the price of compression hardware to make video telecommunications much more attractive." (Uplink, Fall 1991, p. 5). Commercial-grade compressed digital video decoder units costing close to

$75,000 a few years ago are just a few thousand dollars today. Industry experts speculate decoders suitable for at-home use will cost as little as $500 by 1994. (Uplink, Fall 1991). As costs associated with video compression technology continue to lower, usage will become increasingly more attractive to educators as an instructional delivery possibility.

Compressed Digital Video/Analog Video Comparison

Compressed digital video and full motion analog video do look different to the viewer. Full motion analog video is conventional television signaling transmitted at thirty (30) frames per second. Compressed digital video, on the other hand, is a video signal from which redundant information has been removed and at present runs at approximately twelve (12) to fifteen (15) frames per second depending on the compression algorithm incorporated. Compression algorithms, the mathematical method used to eliminate redundant information, are being constantly refined with delivery frame rates increasing with each refinement.

Two forms of redundancy are found in video signals; redundancy within a video frame and redundancy between video frames. The information within a frame, for example areas of one color, is encoded an transmitted only once by intraframe compression. Likewise, in most video frames, only small amounts of the picture actually change from one frame to the next.

Therefore, only data that actually changes is transmitted by interframe compression. Analog video typically requires a 100 megabits per second data rate for delivery. Compression techniques being developed will support 3-10 megabits per second data rate. Compression techniques in use today only require a fraction of the information bandwidth for transmission. Data rates currently used for teleconferencing and educational delivery range from 112-768 kilobits per second. What is basic to compression technology is the acknowledgement that over 90 percent of the information in a television signal is redundant and does not necessarily need to be transmitted individually from frame to frame.

Even though compressed digital video delivery is a slower frame rate, it is not to be confused with or compared to slow scan video which appears to be more a slide show than video. In compressed digital video, conventional analog audio and video signals are coded (digitized and compressed) by a CODEC (COder/DECoder), transmitted and converted back to analog audio and video which is viewed on standard television monitors. Delivery is at a slower rate causing the picture to seem somewhat slow in movement.

More cost efficient delivery is needed for educational delivery. Compression technology can be transmitted via all modes available to analog technology. Compression technology allows multiple, simultaneous deliveries over the same channel that is required for only one analog delivery. The advantage of

compression technology is that it can also be delivered over telephone lines allowing compressed digital delivery worldwide over established lines. Through this means, cost effective global access is available for educational delivery.

Compressed digital video does "look" different than analog video. Effects of this difference have not been established in the educational environment. Instructional television research, to date, has been based on analog delivery. Results of previous instructional television research should not be generalized to compressed digital delivery.

Compressed Digital Video Instructional Delivery Issues

As video compression technology becomes a cost effective instructional delivery system offering opportunities for one-way video/two-way audio and "face-to-face" two-way video/two-way audio delivery, educational decision makers must have knowledge of not only the potential of compressed digital video, but also it's effectiveness. Although compressed digital video is moving toward matching analog video delivery of thirty (30) frames per second, compressed digital video is different to the viewers eye. Is compressed digital video, either one-way video/two-way audio or two-way video/two-way audio, effective in supporting student achievement? Is there a difference in effectiveness between the two delivery levels? Is two-way video interaction desirable to either student or teacher or does one-way video/two-way audio

adequately meet the needs and expectations of both?

Although students seemingly have not been as reluctant to adapt to televised instruction as teachers, it is imperative that the attitudes of both be considered. Students needing or desiring a course that is available only via televised instruction seem willing to seize the opportunity. On the other hand, many teachers seem reluctant to engage in televised teaching due to the lack of visual contact with students. How will two-way video/two-way audio affect the attitudes of either group? Before educational decision makers can make prudent decisions regarding the implementation of compressed digital video as a distance learning delivery system, these questions must be addressed. No doubt compressed digital video technology offers much to urban, suburban and rural education, but effectiveness in the educational environment must be studied before moving toward further implementation.

Study Design and Environment

This study was designed to gain information concerning compressed digital video instructional delivery upon which educational decision makers in urban, suburban, and rural environments could rely when planning for, or proposing restructuring of instructional delivery via distance learning. Compressed digital video delivery was investigated at two treatment levels: one-way video/two-way audio and two-way

video/two-way audio. Three factors were measured; student achievement, student attitude, and instructor attitude.

A quasi-experimental comparison group design was adopted for this study. Two treatment groups were formed. Group 1 received instruction via one-way video/two-way audio. Group 2 received instruction via two-way video/two-way audio. Both groups received instruction simultaneously from the same instructors. Both groups were blind to the rationale of the study.

This study was conducted with the cooperation of the United States Navy (USN). The office of Video Teletraining (VTT), Fleet Combat Training Center, Atlantic (FCTCLANT), Dam Neck Naval Station, Virginia Beach, Virginia, operates a fully activated multi-point compressed digital instructional delivery system. Video Teletraining (VTT) coordinated the use of COMTRALANT (Commander, Training Command, U.S. Atlantic Fleet) Electronic Schoolhouse Network (CESN) of compressed digital video facilities throughout the study. Instructor and course selection were made with the assistance of VTT personnel. The use of naval resources allowed the study to be conducted in an operational educational environment that consisted of four remote classroom sites and the teaching site. All sites were capable of full two-way video/two-way audio delivery. Additionally, the system allows for full graphics and computer data transfer between sites. The system was manipulated for this study to facilitate treatment at both one-way video/two-way audio and two-way video/two-way audio levels.

Similar remote teaching and receive sites could be established in the urban educational setting.[1] Sites could have access to linking with other systems as well. Advantages of a compressed video instructional system could easily be implemented in the urban education environment. Small groups of students requiring special classes in the same district could share instructional resources from remote sites. Regular classes of students from different disciplines on the same campus or different campuses could "meet" for "across the curriculum" interaction. Classes from different districts, urban, suburban and/or rural, could be brought together to share instructors, resources, or work as cooperative learning groups promoting cross-cultural and social awareness and cooperation. Experts not otherwise available to education on a permanent basis could be brought into the classroom or network of classrooms. Through electronic field trips, students could be taken to places limited to them by time or distance. Likewise international components could be added in support of global education. Whether in support of shared resources, advanced classes, curriculum interfacing, or promotion of cultural, social and global awareness, a network of compressed video instructional delivery similar to the one used in this study is possible for urban education implementation.

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[1] For a diagram of instructor site and receive site see Appendices E and F.

CHAPTER II

LITERATURE REVIEW

Compressed digital video is a technology gaining the attention of distance educators. Compressed digital video provides possibilities for increased interactivity between instructor and student while remaining a cost effective delivery system. Only recently has compressed digital video been introduced into the educational environment for instructional delivery. Consequently, little has been written concerning compressed digital video for educational application other than to herald its coming and speculate on its potential. For the purpose of this study, a literature review was conducted to examine documented applications and research pertaining to the use and effectiveness of compressed digital video for instructional delivery. Although the focus of this review is compressed digital video as a distance learning delivery system, it is reasonable to first establish the validity of contemporary distance learning in a larger context and that of instructional television in particular.

Effectiveness of Distance Learning

In 1990, Michael Moore, et al., published The Effects of Distance Learning: A Summary of Literature. This work was

completed following a review of distance learning literature commissioned by the Congressional Office of Technical Assessment of the United States Congress for the special report, Linking for Learning: A new Course for Education. After reviewing the research of the 1980s on the issues of teaching, learning, educational planning, organization and policy making with regard to communications technology in contemporary distance education, Moore concluded:

> The weight of evidence that can be gathered from the literature points overwhelmingly to the conclusion that teaching and studying at a distance, especially that which uses interactive electronic telecommunications media is effective, when effectiveness is measured by the achievement of learning, by the attitudes of students and teachers, and by cost effectiveness. (p. 34)

There is little disagreement that distance learning incorporating technological advancements is effective. Student success coupled with on-going time, distance, and cost constraints have promoted steady growth in the adoption and expansion of distance learning programs. There is an abundance of individual program descriptions based on personal experience and educated opinion but few research based evaluations. In "Researching the Research, A Critique of Distance Education

Literature," a paper presented at the Second Distance Education Research Symposium, May 1991, Michael Beaudoin states:

> Despite noticeable gaps, the literature on distance education grows at an encouraging pace....Still, our imagination in researching and evaluating distance education has not kept pace with our innovation in applying distance education principles. Hopefully, we are not too far away from having identified and articulated acceptable principles of good practice in distance education that are derived from reliable research in the profession. (p. 1)

Effectiveness of Instructional Television

Before exploring compressed digital video televised delivery, it is important to address the effectiveness of televised instruction in general. Analog television in both receive-only and interactive modes has a rich history of distance learning support. Chu and Schramm conclude in Learning from Television: What the Research Says that there is no reason to doubt whether instructional television is an effective learning tool. By examining research from all over the world at different age levels and across a variety of subject matter they determined that the evidence is overwhelming that television, under the

right circumstances, can be effective. Chu and Schramm's report was first published in 1968. The latest edition is dated 1979, before the advent of compressed digital technology.

Effectiveness of Interactive Instructional Television

More recent research into interactive instructional delivery via television reports positive findings. Studies based on analog delivery have found positive effects when learning outcomes and perceptions were investigated. Both one-way and two-way instruction have been compared to traditional classroom instruction and determined to be as effective. (Ellis & Mathis, 1985; Roth, 1980; Sharpe, 1980; Whittington, 1987; Egan & Sebastian, 1987).

As new technologies are introduced into the educational environment, research must be planned and executed. Compressed digital video was not represented in either the Moore or Beaudoin literature reviews.

Compressed Digital Video Literature

Compressed digital video's exclusion is not surprising given the newness of the technology in educational delivery. A search of GEAC on-line catalog by Library of Congress subject heading produced no books or journals specifically addressing compressed digital video. An ERIC search of literature, 1966 to September

1991, produced only one article associated with compressed digital video. A 1988, article by Phillip English, "Back-to-School with Distance Learning" published in the Community, Technical and Junior College Journal, highlighted new developments for distance learning application. Compressed digital was noted as a possibility.

Conference proceedings, industry publications and technology publications were also examined. One paper addressing compressed digital video was found in the International Teleconferencing Association (ITCA) Teleconferencing Yearbook, 1991. "Compressed Digital Video Technologies for Business Television Applications" by Bishop, Leddick, and Black compares applications and characteristics of compressed digital video systems. Of special note to underscore the newness and recognized importance of compressed digital video, "Compressed Digital Video Technologies for Business Television Applications" was awarded the first, "A Very Outstanding Paper" recognition by Communication News magazine. Intended as a descriptive paper prepared for the business community with no research cited, Bishop, Leddick and Black conclude:

> This advancement in technology will cause significant changes in the telecommunications industry and in the handling of video signals over the next decade.... (p. 6)". What is certain is that CD-Video will begin to significantly impact business and educational

> television users this year. CD-Video will offer exciting new benefits and capabilities along with new challenges to effectively implement the new technology. (p. 11)

Another communications industry publication, Uplink, Fall 1991, presents "Compression: Who will be first?" as the cover story. In an article directed at the communications industry, Eddy Hartenstein, Senior Vice President at Hughes Communications, (a subsidiary of Hughes Aircraft Company) speculates:

> A sea of change is underway in the telecommunications industry, spurred by innovations in signal compression methods....Its promise: lower distribution costs and a hugh leap in available capacity...No one expects a revolution overnight. But industry experts say digital compression technology is now poised to spark a profound change in who provides what programming to whom...It will touch every form of video communications. (p. 5)

Additionally, in a commentary about the cover story on digital compression technology, Stephen J. Petrucci, President and Chief Executive Officer of Hughes Communications states:

> At Hughes we are confident that digital compression will be part of our industry. It's good technology.. ..In short, its a win-win innovation. And that's the best kind of technology of all...But there are many questions to be answered about compression technology." (Uplink, Fall 1991)

Networking Management, December 1990, presents teleconferencing as the cover feature. In his article, "Unified Systems Integrate Voice, Data and Images," Elliot Gold describes compressed digital video applications for video teleconferencing in detail. The article, while presenting alternatives of compressed digital video technology support for teleconferencing, cites no research addressing effectiveness. Again in Networking Management, September 1991, Gold writes of compressed digital video applications in "Making the Right Connection." The article describes videoconferencing rooms supported by compressed digital video, but again no research citations. In the most recent volume, Networking Management, November 1991, Gold writes of the success of videoconferencing with compressed digital technology. "Industry-Wide Video Networks Thrive." Emphasis is on the acceptance of videoconferencing using compressed digital video as well as analog video as a valuable delivery system for business, industry and government organizations. Although once again no research is cited, the importance of these three articles to this

review is the attention to, and implementation of, compressed digital video technology in the business arena. Historically, business and industry have relied more on their satisfaction with, and the cost saving of, a communications technology than with systematic research. Business may be more interested in using the technology than researching the technology. Will education be able to break this trend?

Two papers addressing educational applications of compressed digital video were found in Innovations in Distance Learning, a collection of papers edited by John LeBaron from the Northeast Distance Learning Conferences. Both papers highlight the Vermont Interactive Television system of Vermont State Colleges. "A Primer on Compressed Video" presented by Darrell Thompson describes the implementation of the Vermont system using compressed digital video. Along with a description of compressed digital video technology, a summary of compressed digital video delivery costs are presented. Thompson concludes with the statement:

> For a variety of reasons much consideration has been given to switching from compressed to full motion video. However, in view of the fact that transmission costs would more than double under the existing tariffs, and in view of the fact that the quality of the current system is more than acceptable, Vermont Interactive Television plans to continue using a

compressed video system for the foreseeable future. (p. 42)

The second paper concerning Vermont Interactive Television, "Vermont Interactive Television: Compressed Video Connecting Multiple Sites" also presented by Darrell Thompson, discusses the implementation of the Vermont system. Equipment cost, delivery cost and agreement contracts are presented. Although valuable descriptive information concerning compressed digital video technology and costs associated with system implementation is provided, and satisfaction with the system is implied, no evidence of learning effectiveness is included.

Further review of unpublished documents provided by VideoTelecom, Austin, Texas, produced examples of higher education applications of compressed digital video instructional and administrative delivery. No evidence of past or on-going research investigating effectiveness was included in the following user profiles:

1. Oklahoma State University and University of Oklahoma

   Both universities are sharing professors to provide day and evening bachelor and graduate classes that might not have been offered independently. The network is also used to provide student advisement.

2. University of Tennessee-Memphis

Students in Jackson, Tennessee are linked with the University of Tennessee-Memphis College of Nursing for courses in the master's degree in nursing program.

3. Nebraska Education Telecommunications Commission

Several programs are being supported by this commission. The University of Nebraska at Omaha and the University of Nebraska at Lincoln link with University Medical Center in Omaha and West Nebraska General Hospital in Scottsbluff to offer nursing classes. The University of Nebraska's Panhandle Education Center offers engineering classes taught from other universities. Chadron State College links with other universities to deliver Masters of Business Administration classes. Central Community College in Grand Island, Central Community College in Columbus, and Northeast Technical Community College are linked to offered course to students at all sites that would not normally be accessible to all campuses.

4. Northern Virginia Community College

Professors are instructing seven courses at five campuses in Annandale, Alexandria, Sterling, Manassas and Woodbridge. Faculty members also use the system for college committee meetings. Plans are to use the system for faculty and staff development workshops.

5. Murray State University and Paducah Community College, Kentucky

Both colleges use the system to ensure students have access to course sequence from a four year university. Three regional high schools and an additional community college will join the network during the year.

Two additional implementations of compressed digital instructional delivery were found. First, a pilot program in Palm Beach County School District in Florida is being undertaken. Using compressed digital video three schools (Barton Elementary, Lake Worth High School, and Lake Worth Middle School) will implement two-way interactive voice and video communications between schools. Barton Elementary will use the system within the school, as well. The pilot project is just beginning and time must be given for project implementation before evaluations can be expected.

Second, is the United States Naval Fleet Combat Training Center at Dam Neck Naval Base, Virginia. "VTT in the Navy: Training now and into the Future," reported in The Technological Horizons in Education Journal, (19, p. 65-7), a study comparing VTT (Video Teletraining) instruction to traditional classroom instruction, revealed final course grades between the two groups to be remarkably similar. (Griffin and Hodgins, 1991)

Conclusions

What has become evident is that distance learning in general can be considered effective instruction. Instructional television, both receive-only and interactive can effectively support instructional delivery based on analog delivery findings. Compressed digital video has been identified as an alternative to analog television delivery. Clearly, business, industry, government and educational institutions are beginning to implement compressed digital video for educational delivery. Cost comparisons of analog and compressed digital video delivery suggest compressed digital video is substantially less expensive. What is missing is evidence that compressed digital video can support instructional delivery effectively. Can students really learn from video delivery that "looks" different than conventional analog television?[2] With the power of compressed digital video to cost effectively deliver two-way video instead of one-way video, the question of how much interaction is needed to be instructionally effective can be asked. Finally, how do students and instructors feel about using compressed digital video either one-way or two-way? Student and teacher preference information would be of immense benefit to program design and implementation. This study seeks to provide information necessary for successful interactive television instructional

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[2] For a description of the differences between compressed digital video and analog video see Chapter I, page 6.

design and implementation using compressed digital video.

CHAPTER III

METHODOLOGY

Research Question

Is compressed digital video an effective distance learning delivery mode when student achievement, student attitude and instructor attitude are measured?

Independent and Dependent Variables

The independent variable in this study was delivery mode. Two levels of this variable were considered. Level 1 was one-way video with two-way audio. Level 2 was two-way video with two-way audio.

Three dependent variables were measured:

1. Student Achievement,
2. Student Attitude,
3. Instructor Attitude.

Experimental Environment

This study was conducted with the cooperation of the United States Navy (USN). The office of Video Teletraining (VTT), Fleet Combat Training Center, Atlantic (FCTCLANT) Dam Neck Naval

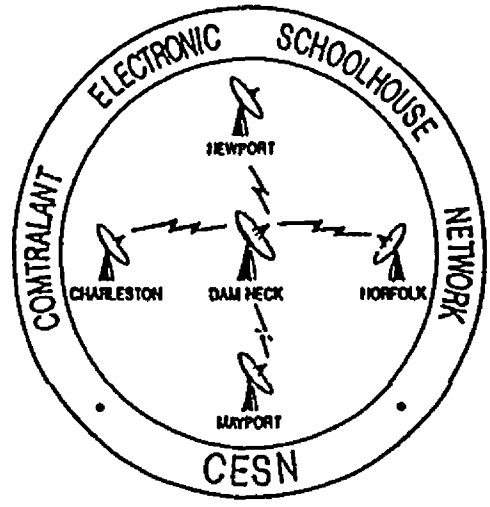
Station, Virginia Beach, Virginia, coordinated the use of Commander, Training Command, U.S. Atlantic Fleet (COMTRALANT) Electronic Schoolhouse Network (CESN) of compressed digital video facilities throughout the study. Instructor and course selection were made with the assistance of VTT personnel. The use of naval resources allowed the study to be conducted in an operational educational environment. The operational environment presented advantages and restrictions. Both influenced the design of the study.

Advantages

1. Use of an existing compressed digital video network for this study.

This study could not have been executed without the support of an existing compressed digital video network. COMTRALANT (Figure 1) Electronic Schoolhouse Network (CESN) is a compressed digital video multi-point, interactive system.

Figure 1



The system began operations March, 1989. There have been 115 course convenings serving 3,766 students. Sixteen (16) are presently been delivered. CESN services seven classrooms (Figure 2) in five cities within four states with expandable national and world-wide (Figure 3) capabilities. Both satellite and terrestrial (T1) carrier modes are used for distribution. Master control functions are operated by VTT, Dam Neck through a computer supported Digital Video Branch Exchange (DVBX) (Figure 4).

Figure 2

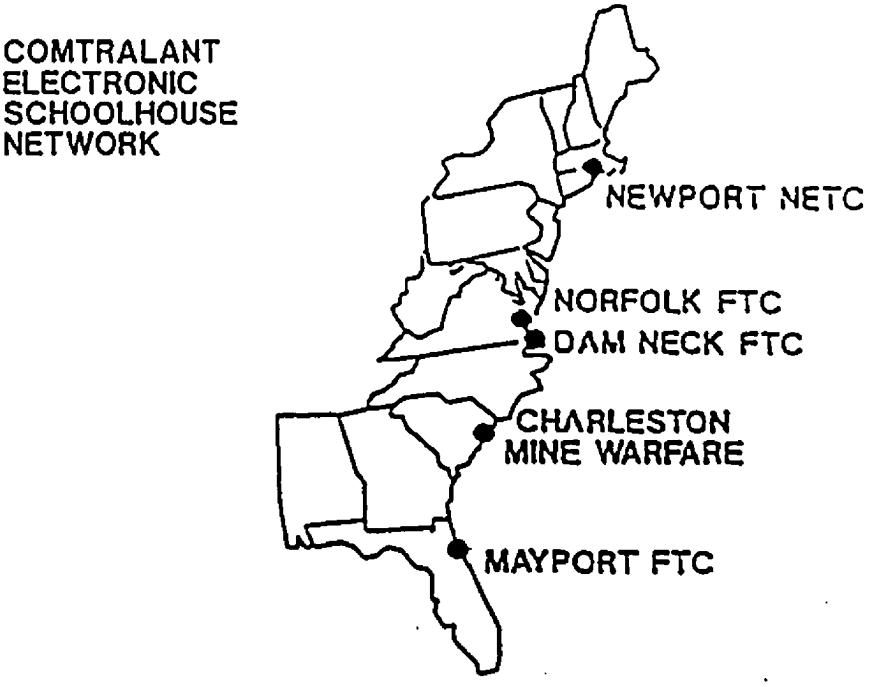


Figure 3

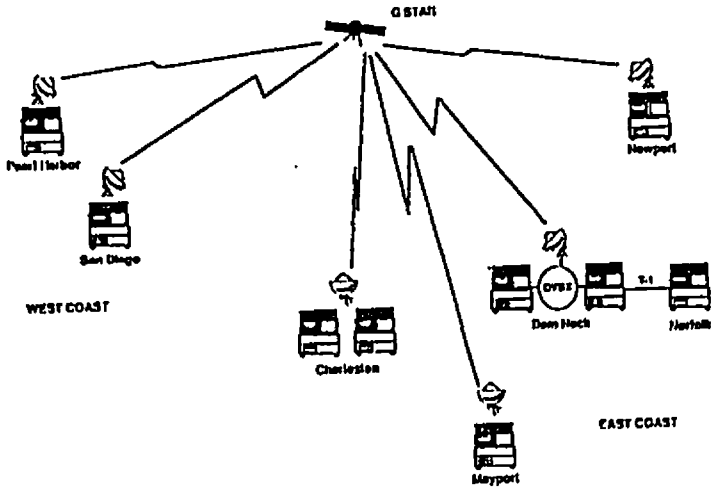
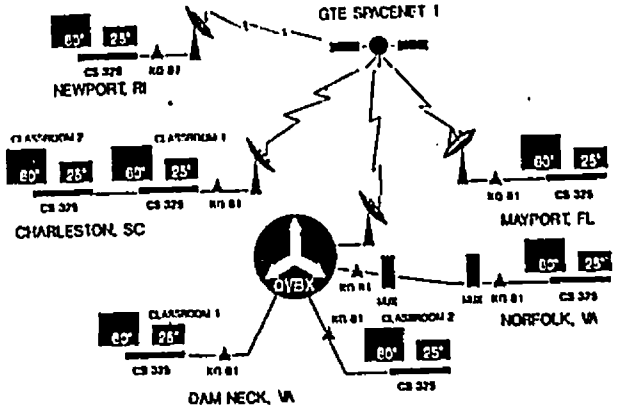


Figure 4



FIGURES PROVIDED BY OFFICE OF VIDEO TELETRAINING
DAM NECK NAVAL STATION, VIRGINIA BEACH, VIRGINIA

All classrooms are two-way video/two-way audio capable using digitized video at 512 kilobits compressed delivery rate.[3] Voice activated video and audio switching occurs in less than one second. CESN is used by the Navy at full two-way video/two-way audio capacity for course delivery. Down-grading capability allows the system to be manipulated to any lesser function. Important to this study was the capability to simultaneously deliver one-way video/two-way audio and two-way video/two-way audio.

2. Investigation of existing course.

VTT presently supports sixteen courses delivered via CESN. Communications Security Material System (CMS) is a five day course with high demand and high throughput requirements. CMS was selected for study based on course length, number of times previously delivered over CESN, combination of experienced and new instructors, and scheduling within time frame allowable for study.

3. Available student population.

CMS as a high demand, high throughput course, was able to provide the necessary student population for this study.

4. Available instructor population.

CMS instructors were experienced, highly rated traditional classroom instructors before transitioning to the Video Teletraining environment. Both experienced and inexperienced instructors were involved in this study. Two

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[3] For a list of equipment used in this study see Appendix G.

had previous VTT experience, one did not.

Restrictions

Study design was subject to operational and training needs of the Navy.

1. One week of system manipulation was allowed for the study. A second week was made available to increase student population size.
2. Random assignment of subjects to groups was not possible, mandating the need for a quasi-experimental design.
3. The four hour application level final examination evaluating CMS student achievement could not be used as a pretest instrument.

This study was designed within the parameters of the described advantages and restrictions. To that end, the conclusions drawn from the quasi-experimental design were addressed with caution.

Study Design

A quasi-experimental comparison group design was adopted for this study. Two treatment groups were formed. Group 1 received instruction via one-way video/two-way audio. Group 2 received instruction via two-way video/two-way audio. Both groups received instruction simultaneously from the same instructors.

Both groups were blind to the rationale of the study.

The study was designed for one week duration. Four receive sites were established. Sites 2 and 4 received instruction via Treatment 1 (one-way video/two-way audio. Sites 1 and 3 received instruction via Treatment 2 (two-way video/two-way audio. At the conclusion of Week 1, a second week of investigation was approved allowing an increase in student subject population. During Week 2 of the study, Sites 1 and 3 received instruction via Treatment 1 (one-way video/two-way audio) and Sites 2 and 4 received instruction via Treatment 2 (two-way video/two-way audio). All sites received instruction via both treatment methods.

Table 3.1

TREATMENT/SITE MATRIX
WEEK 1

	Treatment 1 (one-way video/two-way audio)	Treatment 2 (two-way video/two-way audio)
Site 1		X
Site 2	X	
Site 3		X
Site 4	X	

Table 3.2

TREATMENT/SITE MATRIX

WEEK 2

	Treatment 1 (one-way video/two-way audio)	Treatment 2 (two-way video/two-way audio)
Site 1	X	
Site 2		X
Site 3	X	
Site 4		X

Instructors used both treatment modes during the course of instruction. System configuration allowed instruction via two-way video/two-way audio for half of each instructional activity, by type (direct instruction, checking for understanding, monitoring of practice and assessment), and one-way video/two-way audio for the remaining instructional. Students remained unaware of changing treatment modes being experienced by instructors.

Study Populations

Student Subjects

Students involved in this study were naval military and civilian personnel assigned to the CMS course by their commands. One hundred twenty-seven (127) student subjects participated in this study. Demographics of student subject population were as follows:

Table 3.3

STUDENT SUBJECT POPULATION N = 127		
	RANK	
76 Enlisted	49 Officers	2 Civilian
	GENDER	
119 Male		8 Female

Secondly, student subject treatment matrix was as follows:

Table 3.4

STUDENT POPULATION/TREATMENT MATRIX

	Enlisted	Officer	Civilian	Male	Female
One-Way Video	37	26	1	60	4
Two-Way Video	49	23	1	59	4

Instructor Subjects

Instructors involved in this study were naval personnel assigned to teach the CMS class as regular active duty. Three (3) instructors were involved. Demographics of instructor subject population were as follows:

Table 3.5

INSTRUCTOR SUBJECT POPULATION	
RANK	GENDER
3 Male	3 Enlisted
VTT EXPERIENCE	
2 experienced	1 inexperienced

Measurement Instruments[4]

Student Achievement

Two instruments were used to measure student achievement:

1. Pretest/Posttest

A pre/posttest instrument was developed for this study by the Navy. Pre/posttest face validity was established using Navy procedures with a population of forty (40) reviewers.

[4] To review measurement instruments, see Appendices A, B, C and D.

2. Final Examination

The final examination required for CMS course completion was administered at the end of instruction. The exam was developed by naval training, validated through naval procedures, and is used for both traditional classroom and Video Teletraining CMS courses.

Student Attitude

Student attitude was assessed using the University of Maine Student Questionnaire developed and validated for instructional television courses on the University of Maine instructional television system. The instrument measures attitudes of telecourse students on presentation of course materials, instructor contact, opportunities to ask questions, instructor effectiveness, VTT effectiveness, importance of content and delivery medium effectiveness.

Instructor Attitude

An interview protocol was used to rate instructor attitude. Individual instructor interviews were conducted separately at the end of the study. Items were scored on a Likert-type scale.

Validity Controls

Instruction

Both groups received the same instruction simultaneously

via the system. There were no instructional differences between groups. There were no differences between instruction for Week 1 and Week 2. Navy training is scripted for consistency of delivery. Instructors were isolated from students with contact restricted to the instructional system.

Student Interaction

Students were geographically separated at remote receive sites.

Technical Interruption

All technical interfaces were centrally controlled.

Facilitator Treatment/Interaction

Administrative and technical facilitators were present at each remote receive site. Facilitators were aware a study was being conducted and that they were not the target of investigation. Facilitator training, held prior to commencement of this study, focused on need for consistency throughout the study, general duties, requirements, restrictions, document handling and reporting procedures. All student questions or concerns regarding content were referred to the instructors. Facilitators reported any problems observed during the course of the study.

Testing Interaction

The pretest was administered Monday morning prior to the beginning of instruction. The posttest was administered Thursday at the conclusion of four days of instruction. Pre/posttest did not duplicate knowledge assessed on the final examination.

Statistical Analysis

Student achievement, student attitude and instructor attitude data were analyzed using t-tests and Chi-square. A two x two analysis of variance was used to examine any interaction between delivery mode and remote receive site.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

Introduction

The purpose of this study was to investigate compressed digital video as an instructional delivery system for distance learning when student achievement, student attitude, and instructor attitude were measured.

The independent variable in this study was delivery mode. Two levels of this variable were considered. Level 1 was one-way video/two-way audio. Level 2 was two-way video/two-way audio.

Three dependent variables were measured:

1. Student Achievement,
2. Student Attitude,
3. Instructor Attitude.

A quasi-experimental study comparing the two delivery methods was conducted. Treatment Group 1 received instruction via one-way video/two-way audio. Treatment Group 2 received instruction via two-way video/two-way audio. Both groups received instruction simultaneously from the same instructors. Instructors used both treatment modes (delivery systems) during instruction. System configuration allowed instruction via each mode for half of each instructional activity (direct instruction, checking for understanding, monitoring of practice and

assessment) during course delivery.

The study was designed for one week duration. Four receive sites were established. Sites 2 and 4 received instruction via Treatment 1 (one-way video/two-way audio. Sites 1 and 3 received instruction via Treatment 2 (two-way video/two-way audio. At the conclusion of Week 1, an additional week of investigation was approved facilitating an increase in student subject population. During Week 2 of the study, Sites 1 and 3 received instruction via Treatment 1 (one-way video/two-way audio) and Sites 2 and 4 received instruction via Treatment 2 (two-way video/two-way audio). During the two week study, all sites received instruction via both treatment methods. Student population data were analyzed by treatment groups and treatment group/receive site.

Instructor and student subjects were naval, civilian and military personnel involved in the Communications Security Material System (CMS) compressed digital video teletraining course presented by Fleet Combat Training Center, Atlantic (FCTCLANT), Dam Neck Naval Station, Virginia.

Three categories of data were collected. Student achievement and student attitude data were collected for each treatment group. Instructor attitude data were collected for each instructor after experience with both treatment modes. Data categories and measurement instruments used were:

1. Student Achievement
    a. Pre/Posttest
    b. Final Examination
2. Student Attitude
    Student Attitude Survey
3. Instructor Attitude
    Individual Instructor Interviews

Significance was reported at .000, .01 and .05 levels. If significance was not established at these levels, significance level was calculated and reported. Significance levels were calculated and reported to a maximum of three (3) digits.

Student Achievement

Two instruments were used to measure student achievement. A pre/posttest instrument was used to measure student achievement prior to the beginning of instruction, to establish homogeneity of student population, and to determine learning differential. The CMS course final examination was used as a second measure of student achievement.

Pretest

Pretest data were analyzed using t-test and analysis of variance. Data were analyzed by treatment groups, treatment group and receive site, and for treatment group/receive site interaction.

Table 4.1

PRETEST SCORES BY NUMBER AND PERCENTAGE OF CORRECT ANSWERS FOR TREATMENT GROUPS

t-test

GROUP 1 One-Way Video/Two-Way Audio

GROUP 2 Two-Way video/Two-Way Audio

	n	$\bar{x}$	SD	t-value	Sig.
GROUP 1	64	16.69 (42.00%)	7.21 (18.03%)		
				-1.51 (-1.50)	.134 (.136)
Group 2	63	18.60 (46.76)	7.12 (17.78)		

Table 4.1 presents pretest scores by treatment group based on a forty (40) item pretest. A t-test analysis revealed no significant difference between treatment groups at .01 or .05 levels. Significant difference would be established at .134 level.

Table 4.2

PRETEST SCORES FOR TREATMENT GROUPS BY RECEIVE SITE

t-test

GROUP 1 One-Way Video/Two-Way Audio

GROUP 2 Two-Way Video/Two-Way Audio

Site 1		Site 2	
Group 1	Group 2	Group 1	Group 2
n = 15	n = 8	n = 16	n = 16
$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
19.73	18.75	20.56	20.06
49.60%	47.13%	51.81%	50.44%

Site 3		Site 4	
Group 1	Group 2	Group 1	Group 2
n = 18	n = 21	n = 15	n = 18
$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
10.22	14.05	17.27	22.56 **
25.72%	35.38%	43.47%	56.61%

** $p < .01$

Table 4.2 presents pretest data by treatment group and receive site. Each site received instruction one week via one-way video/two-way audio and one week via two-way video/two-way audio. A t-test analysis revealed a significant difference (.01)

only for Site 4. Since enrollments were collapsed into treatment groups by delivery mode for this study, this difference was noted but not considered significant to the results of the study.

Table 4.3

PRETEST SCORES BY TREATMENT GROUP AND RECEIVE SITE

Analysis of Variance

Source	SS	df	MS	F
Treatment Group	163.137	1	163.137	4.289*
Site	1673.473	3	557.824	14.664**
Group by Site	214.607	3	71.536	1.881
Within	4526.750	119	38.040	

* $p < .05$ ** $p < .01$

Table 4.3 presents pretest data with an analysis of variance to determine any interaction between treatment group and receive site. No significant interaction was found to exist between treatment group and receive site based on pretest scores.

From pretest data presented in Tables 4.1 - 4.3, it was determined that treatment groups could be considered homogeneous for the purpose of this study. Treatment group/receive site interaction did not confound pretest results.

Posttest

Posttest data were analyzed using t-test and analysis of variance to determine student achievement by treatment groups, treatment group and receive site, treatment group/receive site interaction, and in comparison with pretest data.

Table 4.4

POSTTEST SCORES BY NUMBER AND PERCENTAGE OF CORRECT ANSWERS FOR TREATMENT GROUPS

t-test

GROUP 1 One-Way Video/Two-Way Audio

GROUP 2 Two-Way Video/Two-Way Audio

	n	$\bar{x}$	SD	t-value	Sig.
Group 1	64	28.77 (72.19%)	5.42 (13.61)		
				-.78 (-.76)	.438 (.451)
Group 2	63	29.48 (73.92%)	4.86 (12.16)		

Table 4.4 presents posttest data by number and percentage of correct answers for treatment groups based on a forty (40) item pre/posttest. A t-test analysis revealed no significant differences at .01 or .05 levels between posttest scores for treatment groups. Significance would be established at .438.

Table 4.5

POSTTEST SCORES FOR TREATMENT GROUPS BY RECEIVE SITE

t-test

GROUP 1 One-Way Video/Two-Way Audio
GROUP 2 Two-Way Video/Two-Way Audio

Site 1		Site 2	
Group 1	Group 2	Group 1	Group 2
n = 15	n = 8	n = 16	n = 16
$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
31.07	28.63	30.75	29.81
77.93%	71.75%	77.19%	74.81%

Site 3		Site 4	
Group 1	Group 2	Group 1	Group 2
n = 18	n = 21	n = 15	n = 18
$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
25.33	27.76	28.47	31.56
63.56%	69.62%	71.47%	79.11%

Table 4.5 presents posttest data by treatment group and receive site. Each site received instruction one week via one-way video/two-way audio and one week via two-way video/two-way audio. A t-test analysis revealed no significant differences at .01 or .05 levels between treatment groups at any receive site.

Table 4.6

POSTTEST SCORES BY TREATMENT GROUP AND RECEIVE SITE

Analysis of Variance

Source	SS	df	MS	F
Treatment Group	26.257	1	26.257	1.109
Site	355.857	3	118.619	5.009**
Group by Site	147.109	3	49.036	.108
Within	2818.233	119	23.683	

** $p < .01$

Table 4.6 presents posttest data with an analysis of variance to determine interaction between treatment group and receive site. No significant interaction was found to exist between treatment group and receive site based on posttest results.

From posttest data presented in Tables 4 - 7, it was determined that treatment groups learned from both delivery modes and that no significant differences were found between achievement levels of treatment groups. It was also determined that no significant interaction existed between treatment group and receive site based on posttest scores.

Table 4.7

PRETEST/POSTTEST SCORES

BY TREATMENT GROUP

t-test

GROUP 1 One-Way Video/Two-Way Audio

GROUP 2 Two-Way Video/Two-Way Audio

	GROUP 1		GROUP 2	
	$\bar{x}$	SD	$\bar{x}$	SD
Pretest	16.69	7.21	18.60	7.12
Posttest	28.77	5.42	29.48	4.86
t-value	-19.15 *		-15.23 *	

* $p < .000$

Table 4.7 presents pretest/posttest data by treatment group. A t-test analysis revealed a significant difference (.000) between pre and posttest scores for both groups. From this analysis, it was determined that both treatment modes (delivery systems) provided effective instruction as defined by student learning and reflected in pre/posttest differentials.

Final Examination

Scores from the CMS (Communications Security Material System) final examination were analyzed to determine any significant difference in achievement between treatment groups.

Table 4.8

FINAL EXAMINATION SCORES BY TREATMENT GROUP

t-test

GROUP 1 One-Way Video/Two-Way Audio

GROUP 2 Two-Way Video/Two-Way Audio

	n	$\bar{x}$	SD	t-value	sig.
GROUP 1	64	94.48	8.07		
				-.35	.727
GROUP 2	63	94.94	6.41		

Table 4.8 presents final examination data for treatment groups. Final examination scores were based on 100 points. A t-test analysis revealed no significant difference at .01 or .05 levels between treatment groups.

Table 4.9

FINAL EXAMINATION SCORES FOR TREATMENT GROUPS BY RECEIVE SITE

t-test

GROUP 1 One-Way Video/Two-Way Audio

GROUP 2 Two-Way Video/Two-Way Audio

Site 1		Site 2	
Group 1	Group 2	Group 1	Group 2
n = 15	n = 8	n = 16	n = 16
$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
96.60	94.38	95.56	93.75

Site 3		Site 4	
Group 1	Group 2	Group 1	Group 2
n = 18	n = 21	n = 15	n = 18
$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$
94.83	95.00	90.80	96.17

Table 4.9 presents final examination data by treatment group and receive site. Each site received instruction one week via one-way video/two-way audio and one week via two-way video/two-way audio. A t-test analysis revealed no significant differences at .01 or .05 levels between treatment groups at any receive site.

Table 4.10

FINAL EXAMINATION SCORES BY TREATMENT GROUPS AND RECEIVE SITE

Analysis of Variance

Source	SS	df	MS	F
Treatment Group	12.125	1	12.125	.229
Site	68.017	3	22.672	.428
Group by Site	275.901	3	91.967	1.736
Within	6303.812	119	52.973	

Table 4.10 presents final examination data analyzed using an analysis of variance to determine any interaction between treatment group and receive site. No significant interaction was found to exist between treatment group and receive site.

From final examination data presented in Tables 4.8 - 4.10, it was determined that both treatment groups demonstrated a high degree of achievement and that no significant differences were found between achievement levels of treatment groups. Based on final examination scores no significant interaction existed between treatment group and receive site.

Student Attitude

Student attitude was measured using the University of Maine Student Questionnaire developed and validated for instructional television courses on the University of Maine instructional television system. For the purpose of this study, twenty-three (23) items on the questionnaire were assessed and analyzed. Significance was reported at .000, .01 and .05 levels. Levels above .05 were calculated and reported to more fully explore attitude differentials. Significance levels were calculated and reported to a maximum of three (3) digits. During Week 1 of the study, the facilitator at Site 3 reported a disruption. Site 3 was designated as a two-way video/two-way audio receive site for Week 1. A Navy instructor was present in the class as a student. Continually throughout the first day, the student made derogatory remarks about the instructors, course content, and video teletraining as an instructional delivery system. At the end of the first day, in a private conversation, the facilitator requested the student refrain from disrupting the class, be courteous to naval instructors and students at his receive site, and keep his personal opinions to himself. The disruptions, nonetheless, continued sporadically throughout the week. It is felt this student's attitude affected the attitude of other students at Site 3 in a negative manner and is reflected in the analysis of student attitude data by receive site.

Table 4.11

STUDENT ATTITUDE SURVEY ITEMS 1 TO 6 BY TREATMENT GROUP

t-test

GROUP 1 One-Way Video/Two-Way Audio

GROUP 2 Two-Way Video/Two-Way Audio

Scale = 1-6

	Item	Group 1 n = 64 $\bar{x}$	SD	Group 2 n = 63 $\bar{x}$	SD	t-value	Sig.
1.	Presentation of course materials	4.95	1.13	4.87	1.35	.36	.721
2.	Satisfied with instructor contact	4.31	1.38	4.36	1.22	-.23	.820
3.	Opportunity to ask questions	5.11	1.10	5.16	.79	-.29	.771
4.	Returned Assignments	5.08	1.16	5.30	.69	-1.28	.204
5.	Instructional aids helpful	5.06	1.11	4.90	1.24	.75	.452
6.	Video Teletraining effectiveness	4.27	1.45	4.24	1.57	.10	.919

Table 4.11 presents data for survey Items 1 - 5 by treatment group. A t-test revealed no significant difference at the .01 or .05 levels. Significance would be established at the level designated in the column identified as Sig..

Table 4.12

STUDENT ATTITUDE SURVEY ITEMS 1 TO 6 FOR TREATMENT GROUP BY RECEIVE SITE

t-test

GROUP 1 One-Way Video/Two-Way Audio
GROUP 2 Two-Way Video/Two-Way Audio

Scale = 1-6 $\bar{x}$ (SD)

Item	Site 1 Gp 1	Site 1 Gp 2	Site 2 Gp 1	Site 2 Gp 2	Site 3 Gp 1	Site 3 Gp 2	Site 4 Gp 1	Site 4 Gp 2
1. Presentation of course	5.60 (.51)	5.25 (.71)	5.00 (.63)	5.44* (.51)	4.94* (1.21)	3.76 (1.73)	4.21 (1.53)	5.50** (.62)
2. Satisfied with contact	4.33 (1.40)	4.75 (1.04)	4.56 (1.15)	4.75 (1.24)	4.61* (1.29)	3.62 (1.24)	3.67 (1.59)	4.72* (.90)
3. Opportunity to ask questions	5.27 (.70)	5.50 (.76)	5.19 (.66)	5.38 (.62)	5.33* (1.24)	4.62 (.67)	4.60 (1.50)	5.44 (.78)
4. Assignments returned	5.33 (.99)	5.50 (.76)	5.31 (.60)	5.25 (.86)	5.17 (1.20)	5.29 (.56)	4.53 (1.55)	5.28 (.67)
5. Instructional aids/materials helpful	5.47 (.64)	5.00 (1.41)	4.81 (1.22)	5.50 (.52)	5.17* (1.20)	4.19 (1.47)	4.80 (1.21)	5.17 (.99)
6. Video/teletrng Effectiveness	4.73 (1.28)	4.75 (.89)	4.69 (.87)	5.06 (1.06)	4.22* (1.44)	2.95 (1.60)	3.40 (1.81)	4.78* (1.26)

* $p < .05$ ** $p < .01$

Table 4.12 presents data for Items 1 - 6 by treatment group and receive site. A t-test revealed no significant difference between treatment group at Site 1 on any of the six (6) items. At Site 2, Group 2 (two-way video/two-way audio) rated Item 1 significantly higher (.05) than Group 1 (one-way video/two-way audio). Site 3, Group 1 (one-way video/two-way audio) rated Items 1, 2, 3, 5 and 6 significantly higher (.05) than Group 2 (two-way video/two-way audio). As previously stated, Site 3 experienced a disruption during Week 1 (two-way video/two-way audio) that may account for these differences. Site 4, Group 2 (two-way video/two-way audio) rated Item 1 significantly higher (.01) and Items 2 and 6 (.05) than Group 1 (one-way video/two-way audio). No other differences were found to be significant at .01 or .05 levels.

Table 4.13

STUDENT ATTITUDE SURVEY ITEMS 7 AND 8 BY TREATMENT GROUP

t-test

GROUP 1 One-Way Video/Two-Way Audio

GROUP 2 Two-Way Video/Two-Way Audio

Scale 1-5

Item	Group 1 n = 64 $\bar{x}$	SD	Group 2 n = 63 $\bar{x}$	SD	t-value	Sig.
7. Instructor rating	4.61	.79	4.60	.61	.05	.961
8. Course rating	3.93	1.00	3.84	1.04	.54	.590

Table 4.13 presents data for Items 7 and 8 by treatment group. A t-test revealed no significant difference at the .01 or .05 levels. Significant difference would be established at the level designated in the column identified as Sig..

Table 4.14

SURVEY ITEMS 7 AND 8 FOR TREATMENT GROUPS BY RECEIVE SITE

t-test

GROUP 1 One-Way Video/Two-Way Audio

GROUP 2 Two-Way Video/Two-Way Audio

Scale = 1-5

		Site 1		Site 2		Site 3		Site 4	
Item	$\bar{x}$ (SD)	Gp 1	Gp 2	Gp 1	Gp 2	Gp 1	Gp 2	Gp 1	Gp 2
7. Instructor rating		5.00 (.00)	4.75 (.89)	4.75 (.58)	4.75 (.58)	4.39 (1.09)	4.24 (.70)	4.33 (.82)	4.83* (.38)
8. Course rating		4.33 (.72)	4.38 (.74)	4.13 (.81)	4.19 (.54)	3.78 (1.00)	3.10 (1.21)	3.53 (1.30)	4.11 (.90)

* $p < .05$

Table 4.14 presents data for Items 7 and 8 by treatment group and receive site. A t-test revealed no significant difference at .01 or .05 levels at Site 1, Site 2, or Site 3. Site 4, Group 2 (two-way video/two-way audio) rated Item 7 significantly higher (.05) than did Group 1 (one-way video/two-way audio).

Table 4.15

STUDENT ATTITUDE SURVEY ITEMS 9, 11, 12 AND 17
BY TOTAL STUDENT POPULATION

Chi-square

N = 127

Item	n	Chi-square	df	Sig.
9. Instructional TV	34			
or		25.99	1	.000
Traditional Class	91			
11. Instructional TV Near Home	89			
or		20.48	1	.000
Traditional Class Away From Home	38			
12. Instructional TV Convenient Time	101			
or		44.29	1	.000
Traditional Class Inconvenient Time	26			
17. Take another ITV Course				
Yes	98			
or		40.33	1	.000
No	27			

Table 4.15 presents data for Items 9, 11, 12, and 17 by total population of the study. A Chi-square analysis revealed a significant difference (.000) for all items. A significant number of students would choose a traditional live course over an instructional televised course when no other factors were considered. A significant number of students would prefer an instructional television course closer to their homes than a traditional live course away from home. A significant number of students would prefer an instructional television course at a convenient time than a traditional live course at an inconvenient time. A significant number of students would take another instructional television course.

Table 4.16

STUDENT ATTITUDE SURVEY ITEMS 9, 11, 12 AND 17 FOR TREATMENT GROUP 1

ONE-WAY VIDEO/TWO-WAY AUDIO

Chi-square

n = 64

Item	n	Chi-square	df	Sig.
9. Instructional TV	16			
or		16.00	1	.000
Traditional Class	48			
11. Instructional TV Near Home	47			
or		14.06	1	.000
Traditional Class Away From Home	17			
12. Instructional TV Convenient Time	53			
or		27.56	1	.000
Traditional Class Inconvenient Time	11			
17. Take another ITV Course Yes	51			
or		24.14	1	.000
No	12			

Table 4.16 presents data for Items 9, 11, 12, and 17 for Group 1 (one-way video/two-way audio) of this study. A Chi-square analysis revealed a significant difference (.000) for all items. A significant number of students in Group 1 would choose a traditional live course over an instructional televised course when no other factors were considered. A significant number of students in Group 1 would prefer an instructional television course closer to their homes than a traditional live course away from home. A significant number of students in Group 1 would prefer an instructional television course at a convenient time than a traditional live course at an inconvenient time. A significant number of students in Group 1 would take another instructional television course.

Table 4.17

STUDENT ATTITUDE SURVEY ITEMS 9, 11, 12 AND 17 FOR TREATMENT GROUP 2

TWO-WAY VIDEO/TWO-WAY AUDIO

Chi-square

n = 63

Item	n	Chi-square	df	Sig.
9. Instructional TV	18			
or		10.25	1	.001
Traditional Class	43			
11. Instructional TV Near Home	42			
or		7.00	1	.008
Traditional Class Away From Home	21			
12. Instructional TV Convenient Time	48			
or		17.29	1	.000
Traditional Class Inconvenient Time	15			
17. Take another ITV Course Yes	47			
or		16.52	1	.000
No	15			

Table 4.17 presents data for Items 9, 11, 12, and 17 for Treatment Group 2 (two-way video/two-way audio) of this study. A Chi-square analysis revealed a significant difference for Item 9 (.001), Item 11 (.008) Items 12 and 17 (.001). A significant number of students in Group 2 would choose a traditional live course over an instructional televised course when no other factors were considered. A significant number of students in Group 2 would prefer an instructional television course closer to their homes than a traditional live course away from home. A significant number of students in Group 2 would prefer an instructional television course at a convenient time than a traditional live course at an inconvenient time. A significant number of students in Group 2 would take another instructional television course.

Table 4.18

SURVEY ITEM 13 BY TREATMENT GROUP

t-test

GROUP 1 One-Way Video/Two-Way Audio

GROUP 2 Two-Way Video/Two-Way Audio

Scale = 1-10

	Group 1 n = 64		Group 2 n = 63			
Item	$\bar{x}$	SD	$\bar{x}$	SD	t-value	Sig.
13. Overall Rating	7.19	2.22	6.68	2.49	1.21	.227

Table 4.18 presents data for Item 13 by treatment group. A t-test revealed no significant difference at the .01 or .05 levels. Significant difference would be established at the level designated in the column identified as Sig..

Table 4.19

SURVEY ITEM 13 BY TREATMENT GROUP AND RECEIVE SITE

t-test

GROUP 1 One-Way Video/Two-Way Audio
Group 2 Two-Way Video/Two-Way Audio

Scale = 1 - 10

13. Overall Course Rating

	Group 1			Group 2		
	n	$\bar{x}$	SD	n	$\bar{x}$	SD
Site 1	15	8.20	1.37	8	7.25	2.12
Site 2	16	7.56	1.41	16	7.38	2.06
Site 3	18	7.11*	2.30	21	4.90	2.79
Site 4	15	5.79	2.97	18	7.78*	1.56

* $p < .05$

Table 4.19 presents data for Item 13 by treatment group and receive site. A t-test analysis revealed no significant differences between treatment groups at Site 1 and Site 2. Site 3, Group 1 (one-way video/two-way audio) rated Item 10 significantly higher (.05) than Group 2 (two-way video/two-way audio). As previously stated, Site 3 experienced a disruption during Week 1 (two-way video/two-way audio) that may account for this difference. Site 4, Group 2 (two-way video/two-way audio) rated Item 10 significantly higher than Group 1 (one-way video/two-way audio).

Table 4.20

STUDENT ATTITUDE SURVEY ITEMS 18-22 COURSE CONTENT RATING BY TREATMENT GROUP

t-test

GROUP 1 One-Way Video/Two-Way Audio

GROUP 2 Two-Way Video/Two-Way Audio

Scale = 1 - 7

	Group 1		Group 2			
Item	$\bar{x}$	SD	$\bar{x}$	SD	t-value	Sig.
18.Interesting	4.90	1.51	4.73	1.61	.60	.548
19.Important	6.80	.54	6.70	.65	.84	.400
20.Powerful	5.22	1.28	5.23	1.19	-.03	.974
21.Valuable	6.53	.91	6.38	1.23	.80	.428
22.Good	6.29	1.14	6.21	1.08	.36	.717

Table 4.20 presents data for Items 18 - 22 rating course content by treatment group. A t-test revealed no significant difference at the .01 or .05 levels. Significant difference would be established at the level designated in the column identified as Sig.. When individual item scores are ranked per item highest to lowest, both groups rated items in identical order with "Important" highest to "Interesting" lowest.

Table 4.21

SURVEY ITEMS 18-22 CONTENT RATING FOR TREATMENT GROUP BY SITE

t-test

GROUP 1 One-Way Video/Two-Way Audio
GROUP 2 Two-Way Video/Two-Way Audio

Scale = 1-7

Item	Site 1		Site 2		Site 3		Site 4	
	Gp 1 $\bar{x}$ (SD)	Gp 2	Gp 1 $\bar{x}$ (SD)	Gp 2	Gp 1 $\bar{x}$ (SD)	Gp 2	Gp 1 $\bar{x}$ (SD)	Gp 2
18.Interesting	4.93 (1.53)	5.38 (1.77)	4.94 (1.61)	5.25 (1.39)	5.00 (1.61)	4.25 (1.52)	4.73 (1.39)	4.53 (1.74)
19.Important	6.73 (.80)	6.88 (.35)	6.88 (.34)	6.94 (.25)	6.78 (.55)	6.60 (.94)	6.80 (.41)	6.53 (.62)
20.Powerful	4.71 (1.20)	5.38 (1.77)	5.63 (.72)	5.44 (1.09)	5.61 (1.34)	4.90 (1.17)	4.80 (1.52)	5.35 (1.00)
21.Valuable	6.53 (.74)	6.75 (.46)	6.63 (1.26)	6.44 (.96	6.56 (.71)	6.05 (1.76)	6.40 (.91)	6.53 (.87)
22.Good	6.21 (1.31)	6.50 (.76)	6.56 (.63)	6.38 (.81)	6.39 (.92)	6.00 (1.38)	5.93 (1.58)	6.18 (1.07)

Table 4.21 presents data for Items 18 - 22 rating course content by treatment group per site. A t-test analysis revealed no significant difference at the .01 or .05 levels. When individual item scores are ranked per item highest to lowest, treatment groups at each site rated items in identical rank order. Sites 2, 3, and 4 rated all items in identical order with "Important" highest and "Interesting" lowest. Site 1 rated "Important" highest, "Interesting" next to lowest and "Powerful" lowest.

Table 4.22

STUDENT ATTITUDE SURVEY ITEMS 23 ~ 27
COURSE DELIVERY MEDIUM RATING BY TREATMENT GROUP

t-test

GROUP 1 One-Way Video/Two-Way Audio

GROUP 2 Two-Way Video/Two-Way Audio

Scale = 1 - 7

	Group 1		Group 2			
Item	$\bar{x}$	SD	$\bar{x}$	SD	t-value	Sig.
23.Good	5.14	1.84	5.02	1.66	.40	.692
24.Powerful	4.76	1.61	4.76	1.56	.00	.998
25.Pleasing	4.42	1.72	4.25	1.52	.59	.557
26.Successful	5.58	1.41	5.38	1.72	.71	.478
27.Positive	5.42	1.52	5.07	1.75	1.21	.228

Table 4.22 presents data for Items 23 -27 rating course delivery medium by treatment group. A t-test revealed no significant difference at the .01 or .05 levels. Significant difference would be established at the level designated in the column identified as Sig.. When individual item scores are ranked per item highest to lowest, both groups rated items in identical order with "Successful" highest to "Pleasing" lowest.

Table 4.23

STUDENT ATTITUDE SURVEY ITEMS 23 - 27 COURSE DELIVERY MEDIUM RATING BY TREATMENT GROUP

t-test

GROUP 1 One-Way Video/Two-Way Audio

GROUP 2 Two-Way Video/Two-Way Audio

Scale = 1 - 7

	Site 1		Site 2		Site 3		Site 4	
	Gp 1	Gp 2	Gp 1	Gp 2	Gp 1	Gp 2	Gp 1	Gp 2
Item	$\bar{x}$ (SD)		$\bar{x}$ (SD)		$\bar{x}$ (SD)		$\bar{x}$ (SD)	
24.Good	5.53 (1.55)	5.75 (1.17)	5.56 (1.37)	5.44 (1.21)	5.11 (1.91)	3.95 (1.91)	4.33 (2.32)	5.53 (1.38)
25.Powerful	5.13 (1.13)	5.50 (1.07)	4.75 (1.24)	5.33 (1.11)	4.88 (1.80)	3.65* (1.50)	4.27 (2.12)	5.25 (1.53)
26.Successful	5.73 (1.28)	6.13 (.84)	6.13 (.81)	5.69 (1.45)	5.33 (1.57)	4.20 (2.14)	5.13 (1.73)	6.12 (.86)
27.Positive	5.53 (1.55)	5.25 (1.04)	5.69 (1.01)	5.63 (1.26)	5.28 (1.60)	4.15 (2.35)	5.20 (1.90)	5.53 (1.18)

* P < .05 ** P < .01

Table 4.23 presents data for Items 23-27 rating course delivery medium by treatment group per site. A t-test analysis revealed a significant difference (.05) at Site 3 for Item 24, "Powerful". Group 1 (one-way video/two-way audio) rated Item 24, "Powerful", significantly higher than Group 2 (two-way video/two-way audio). Site 3, Group 2 (two-way video/two-way audio) rated all items markedly lower than all other sites. As previously stated, Site 3 experienced a disruption during Week 1 (two-way video/two-way audio) that may account for this difference. When individual item scores are ranked per item highest to lowest, both groups at all sites rated "Successful" highest. Both treatment groups at Sites 1, 2, and 3 and Group 2 (two-way video/two-way audio), Site 4 rated "Pleasing" lowest. Site 4, Group 1 (one-way video/two-way audio) rated "Powerful" lowest. Both treatment groups at Sites 2 and 3 rated all items in identical rank order.

From student attitude data presented in Tables 4.11 - 4.23, it was determined that both treatment groups displayed similar positive attitudes toward course instruction, course content and course delivery medium. Both treatment groups preferred an instructional television course close to home over a traditional live course away from home and an instructional television course at a convenient time over a traditional live course at an inconvenient time. With no other intervening factors to consider, both groups preferred a traditional live course to an instructional television course. A significant number (.000) of

students in both treatment groups would take another instructional television course.

Instructor Attitude

An interview protocol was used to rate instructor attitude. Individual instructor interviews were conducted at the end of the study. Fourteen items were discussed. Discussion items were based on a pre-study group discussion with instructors to determine what they felt were important aspects of teaching their course. Items include ability to: judge student understanding and student reaction, individualized instruction, pace lesson, establish and judge class rapport, maintain interactivity, monitor students during guided and independent practice, and feel personal and professional pride in their work.

Table 4.24

INSTRUCTOR ATTITUDE INTERVIEWS
Items 1-14

t-test

Scale = 1 - 5

TREATMENT 1 One-Way Video/Two-Way Audio

TREATMENT 2 Two-Way Video/Two-Way Audio

	Interview Item	Treatment 1	Treatment 2	t-value
1.	Ability to judge student understanding on an on-going basis.	1.333	4.333	- 5.20*
2.	Ability to judge individual student reaction during instruction or when addressing individual student questions/ comments	1.000	4.667	- 11.00**
3.	Ability to judge class (global) reaction during instruction or when addressing student questions/comments.	1.000	5.000	_____
4.	Ability to individualize instruction.	1.000	5.000	_____

Continued

Table 4.24 (Con't)

INSTRUCTOR ATTITUDE INTERVIEWS

	Interview Item	Treatment 1	Treatment 2	t-value
5.	Facilitates feeling of teaching unified class.	1.000	5.000	_____
6.	Ability to pace the lesson according to student needs.	1.000	5.000	_____
7.	Ability to judge class rapport and a feeling of being part of the class.	1.667	5.000	- 10.00**
8.	Ease of establishing class rapport.	1.667	5.000	- 10.00**
9.	Level of concentration needed to anticipate next instructional technique to maintain interactivity.	5.000	1.000	_____
10.	Personal perception of teaching.	1.667	5.000	- 5.00*

Continued

Table 4.24 (Con't)

INSTRUCTOR ATTITUDE INTERVIEWS

	Interview Item	Treatment 1	Treatment 2	t-value
11.	Absence of tension or hesitancy toward teaching.	2.000	4.333	- 7.00*
12.	Feeling of establishing rapport with students that might lead to on-going contact after class is completed.	1.333	3.333	- 3.46
13.	Ability to monitor students during guided/independent practice.	1.000	5.000	———
14.	Satisfaction with teaching using this system.	2.667	5.000	- 7.00*

* p < .05 ** p < .01

Key: 1 = lowest rating
5 = highest rating

Items 3, 4, 5, 6 and 9:
All respondents rated both one-way and two-way the same.
No t-test conducted.

Table 4.24 presents data on instructor attitude interviews. Items 3, 4, 5, 6, 9, and 13 were rated identical by all instructors with Treatment 1 (one-way video/two-way audio) rated the lowest possible score and Treatment 2 (two-way video/two-way audio receiving the highest possible score. A t-test was not conducted for these items. A t-test revealed a significant difference for Items 2, 7, and 8 at the .01 level. A significant difference was established for Items 1, 10, 11, and 14 at the .05 level. Instructors rated Treatment 2 (two-way video/two-way audio) significantly higher than Treatment 1 (one-way video/two-way audio). Analysis of Item 12 revealed no significant difference.

From data presented in Table 4.24, it is determined that course instructors preferred Treatment 2 (two-way video/two-way audio) over Treatment 1 (one-way video/two-way audio) as a course delivery mode. Additionally, during the interview process all instructors made voluntary comments that they preferred Treatment 2 (two-way video/two-way audio) over the traditional live classroom for a course they felt prepared to teach. Reasons given for this attitude were they reached more students, were forced to be more organized, felt they taught better, and were more professional. Two of the three instructors had originally resisted the move to the electronic classroom. The third instructor had the advantage of seeing the first two succeed before moving to televised instruction. Each commented that if they returned to the traditional classroom, they would take

techniques they had learned in the electronic classroom that would make their teaching more effective, but would miss the electronic teaching aides. Additionally, all three instructors commented they would advise any instructor resisting a transition to an electronic classroom to reconsider, especially if it were an electronic classroom equipped for Treatment 2 (two-way video/two-way audio).

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Introduction

The purpose of this study was to investigate compressed digital video as an instructional delivery system for distance learning when student achievement, student attitude, and instructor attitude were measured.

The independent variable in this study was delivery mode. Two levels of this variable were considered. Level 1 was one-way video/two-way audio. Level 2 was two-way video/two-way audio.

Three dependent variables were measured:

1. Student Achievement,
2. Student Attitude,
3. Instructor Attitude.

The following conclusions and recommendations are based on data presented and analyzed in Chapter IV. Conclusions are discussed in order of significant findings.

Instructor Attitude

An interview protocol was used to rate instructor attitude. Individual instructor interviews were conducted at the end of the study. Fourteen items were discussed. Discussion items were

based on a pre-study group discussion with instructors to determine what they felt were important aspects of teaching their course.

Significant differences were revealed when instructor attitude data were analyzed. Instructors preferred Treatment 2 (two-way video/two-way audio) significantly more than Treatment 1 (one-way video/two-way audio) on thirteen (13) items assessed.

On six (6) items, all instructors rated Treatment 1 (one-way video/two-way audio) the lowest possible score and Treatment 2 (two-way video/two-way audio) the highest possible score. Significance was established without conducting a t-test. Items are as follows:

Item 3. Ability to judge class (global) reaction during instruction or when addressing student questions/comments.

Item 4. Ability to individualize instruction.

Item 5. Facilitates feeling of teaching unified class.

Item 6. Ability to pace the lesson according to student needs.

Item 9. Level of concentration needed to anticipate next instructional technique to maintain interactivity.

Item 13. Ability to monitor students during guided and independent practice.

From these items, it is concluded that:

1. Instructors felt they could effectively judge class reaction, individualize instruction, appropriately pace the lesson, and monitor students during guided and independent practice using Treatment 2 (two-way video/two-way audio) significantly more than using Treatment 1 (one-way video/two-way audio).

2. Treatment 2 (two-way video/two-way audio) facilitated a feeling of teaching a unified class significantly more than Treatment 1 (one-way video/two-way audio).

3. Treatment 1 (one-way video/two-way audio) required a significantly higher level of concentration to anticipate the next instructional activity needed to maintain interactivity than Treatment 2 (two-way video/two-way audio).

A t-test revealed a significant difference at .01 for Items 2, 7, and 8. Items are as follows:

Item 2. Ability to judge individual student reaction during instruction or when addressing individual student questions/comments.

Item 7. Ability to judge class rapport and feeling of being accepted as part of the class.

Item 8. Ease of establishing class rapport.

From these items, it is concluded that:

1. Instructors felt Treatment 2 (two-way video/two-way audio) provided significantly (.01) more ability to judge individual student reaction during instruction or when addressing student questions/comments than Treatment 1 (one-way video/two-way audio).

2. Instructors felt Treatment 2 (two-way video/two-way audio) gave them significantly more ability to establish and judge class rapport with a feeling of being part of the class instead of separated from the class than Treatment 1 (one-way video/two-way audio).

A t-test revealed a significant difference at the .05 level for Items 1, 10, 11, and 14. Items are as follows:

Item 1. Ability to judge student understanding on an on-going basis.

Item 10. Personal perception of teaching.

Item 11. Absence of tension or hesitancy toward teaching.

Item 14. Satisfaction with teaching using this system.

From these items, it is concluded that:

1. Instructors felt Treatment 2 (two-way video/two-way audio) provided significantly more ability to judge student understanding on an ongoing basis than Treatment 1 (one-way video/two-way audio).

2. Instructors felt significantly (.05) better about their teaching using Treatment 2 (two-way video/two-way audio) than Treatment 1 (one-way video/two-way audio).

3. Treatment 2 (two-way video/two-way audio) produced significantly (.05) less tension or hesitancy toward teaching than Treatment 1 (one-way video/two-way audio).

4. Instructors were significantly (.05) more satisfied with teaching using Treatment 2 (two-way video/two-way audio) than Treatment 1 (one-way video/two-way audio) although Treatment 1 did give them a level of satisfaction and was rated higher than any other item for Treatment 1.

Instructor Attitude Summary

In interview discussion, all instructors related they felt both delivery systems were effective and viable for instructional delivery but that Treatment 2 (two-way video/two-way audio)

offered student and instructor significantly more advantages. Additionally, during the interview process all instructors stated they preferred, in order, Treatment 2 (two-way video/two-way audio) and Treatment 1 (one-way video/two-way audio) over the traditional live classroom for a course they felt prepared to teach. Reasons given were; they reached more students, were forced to be more organized, felt they taught better, and were more professional. Each mentioned their professional egos had been enhanced by instructional television. Two of the three instructors had originally resisted the move to the electronic classroom. The third instructor had the advantage of seeing the first two succeed before moving to televised instruction. Each commented that if they returned to the traditional classroom they would take techniques they had learned in the electronic classroom that would make their teaching more effective but would miss the electronic teaching aids. All three instructors commented they would advise any instructor resisting a transition to the electronic classroom to reconsider, especially if moving to an electronic classroom equipped for Treatment 2 (two-way video/two-way audio).

Student Attitude

Student attitude was measured using the University of Maine Student Questionnaire developed and validated for instructional television courses on the University of Maine instructional

television system. For the purpose of this study, twenty-three (23) items on the questionnaire were assessed and analyzed. Significance was reported at .000, .01 and .05 levels. If significance was not established at one of these levels, significance above .05 level was calculated and reported.

Analysis of data revealed no significant difference in student attitude between treatment groups for nineteen (19) of the twenty-three (23) items. When all receive sites were grouped together, four (4) items revealed significant differences (.000 - .008) when analyzed.

Attitude data were further analyzed by receive site. Significant differences were revealed by this process. Most differences were found at Site 3. During Week 1 of the study, the facilitator at Site 3 reported a disruption. Site 3 was designated as a two-way video/two-way audio receive site for Week 1. A Navy instructor was present in the class as a student. Continually throughout the first day, the student made derogatory remarks about the instructors, course content, and video teletraining as an instructional delivery system. At the end of the first day, in a private conversation, the facilitator requested the student refrain from disrupting the class, be courteous to naval instructors and students at his receive site, and keep his personal opinions to himself. The disruptions, nonetheless, continued sporadically throughout the week.

Items 1-6 revealed no significant differences in attitude

between treatment groups when analyzed by t-test.

Item 1. Presentation of course materials

Item 2. Satisfied with instructor contact

Item 3. Opportunity to ask questions

Item 4. Returned assignments

Item 5. Instructional aids/materials helpful

Item 6. Video teletraining effectiveness

When Items 1-6 were analyzed by treatment group and receive site, Site 2, Group 2 (two-way video/two-way audio) rated Item 1 significantly higher than Group 1 (one-way video/two-way audio). Site 3, Group 1 (one-way video/two-way audio) rated Items 1, 2, 3, 5 and 6 significantly higher (.05) than Group 2 (two-way video/two-way audio). As previously stated, Site 3 experienced a disruption during Week 1 (two-way video/two-way audio) that may account for these differences. Site 4, Group 2 (two-way video/two-way audio) rated Item 1 significantly higher (.01) and Items 2 and 6 (.05) than Group 1 (one-way video/two-way audio). No other differences were found to be significant at .01 or .05 levels. Items 1 - 6 were rated on a scale of 1 - 6, 6 being highest. Treatment group mean scores ranged from 4.24 to 5.30. Individual item mean scores suggest both treatment groups were highly satisfied with experiences assessed by Items 1 - 6.

No significant differences were revealed for Items 7 and 8 by treatment group.

Item 7. Instructor rating

Item 8. Course rating

When Items 7 and 8 were analyzed by treatment group and receive site, no significant differences were revealed at Sites 1, 2, or 3. Site 4, Group 2 (two-way video/two-way audio) rated Item 7 significantly higher than Group 1 (one-way video/two-way audio). Items 7 and 8 were rated on a scale of 1 - 5, 5 being highest. Mean scores for Item 7 were 4.61 and 4.60. Mean scores for Item 8 were 3.93 and 3.84. There were no significant differences between attitudes of treatment groups on Items 7 and 8. Both treatment groups rated instructor and course highly as reflected by individual item mean scores.

Items 9, 11, 12, and 17 presented choices concerning taking future courses. A Chi-square analysis revealed significant differences for both treatment groups.

Item 9. Instructional TV or Traditional Class

Item 11. Instructional TV near home or
Traditional Class away from home

Item 12. Instructional TV at a convenient time or
Traditional Class at an inconvenient time

Item 17. Take another ITV course: Yes or No

Both treatment groups preferred a traditional class when no other factors were considered. Both treatment groups preferred an instructional television class near home over a traditional class away from home. Both treatment groups preferred an instructional television class at a convenient time over a traditional class at an inconvenient time. Both treatment groups would take another instructional television class. Factors of time and distance emerged as important to both treatment groups. Students preferred a traditional class significantly more than an instructional television class only when no other factor were considered.

Item 13 assessed students' overall course rating on a scale 1 - 10, 10 being highest. There was no significant difference between mean scores of treatment groups. Mean score for Group 1 (one-way video/two-way audio) was 7.19 and 6.68 for Group 2 (two-way video/two-way audio). When scores were analyzed by treatment group and receive site, two significant differences were found. Site 3 rated Group 2 (two-way video/two-way audio significantly lower than Group 1 (one-way video/two-way audio). The mean score for Group 2 (4.90) was 2.55 points lower than any other receive site. As previously stated, Site 3 experienced a disruption during Week 1 (two-way video/two-way audio) that may account for this difference. Site 4, Group 2 (two-way video/two-way audio)

rated Item 13 significantly higher than Group 1 (one-way video/two-way audio). Both treatment groups were satisfied with the overall course as reflected by individual mean scores and there was no significant difference between mean scores of treatment groups.

Items 18 - 22 assessed student attitude concerning course content. A t-test analysis revealed no significant differences between treatment groups.

Item 18. Interesting
Item 19. Important
Item 20. Powerful
Item 21. Valuable
Item 22. Good

A rating scale of 1 - 7, 7 being highest was used for Items 18 22. Mean scores by treatment group ranged from 4.73 to 6.80. When individual item scores are ranked per item highest to lowest, both treatment groups rated items in identical order with "Important" highest and "Interesting" lowest.

When Items 18 - 22 were analyzed by treatment group and receive site, there were no significant differences at .01 or .05 levels. Mean scores for treatment group and receive site ranged from 4.25 to 6.94. When individual survey item scores are ranked per item highest to lowest, treatment groups at each site rated

items in identical rank order. Sites 2, 3, and 4 rated all items in identical order with "Important" highest and "Interesting" lowest. Site 1 rated "Important" highest, "Interesting" next to lowest and "Powerful" lowest. Both treatment groups felt the overall course was of merit. There was no significant differences between treatment groups. Both treatment groups considered the course more "Important" than "Interesting".

Items 23 - 27 assessed course delivery medium. No significant differences were revealed at .01 or, 05 between treatment groups.

Item 23. Good
Item 24. Powerful
Item 25. Pleasing
Item 26. Successful
Item 27. Positive

A rating scale of 1 - 7, 7 being highest was used. Mean scores by treatment group ranged from 4.25 to 5.58. When individual item mean score are ranked highest to lowest, both groups rated items in identical order with "Successful" highest to "Pleasing" lowest.

When Items 23 - 27 were analyzed by treatment group and receive site, a significant difference was revealed (.05) at Site 3 for Item 24, "Powerful". Group 1 (one-way video/two-way audio)

rated Item 24, "Powerful", significantly higher than Group 2 (two-way video/two-way audio). Site 3, Group 2 (two-way video/two-way audio rated all items markedly lower than all other sites. As previously stated, Site 3 experienced a disruption during Week 1 (two-way video/two-way audio) that may account for this difference. When individual item mean scores are ranked highest to lowest by treatment group and receive site, both groups at all sites rated "Successful" highest. Both treatment groups at Sites 1, 2, and 3 and Group 2, Site 4 rated "Pleasing" lowest. Site 4, Group 1 rated "Powerful" lowest. Both treatment groups at Sites 2 and 3 rated all items in identical rank order. Mean scores by treatment group and site for Items 23 - 27 ranged from 3.42 to 6.13 on a scale of 1 - 7, 7 being highest. Lowest means were Site 3, Group 2 discussed previously. Both treatment groups felt the instructional delivery system they experienced was of merit. Both treatment groups rated the delivery system more "Successful" than "Pleasing".

Student Attitude Summary

Students in this study reflected a positive attitude toward the instructional television experience. There were no significance differences revealed (.01 or .05) between treatment groups. There were significant differences (.000 - .008) revealed for both treatment groups concerning student choices for future instructional television courses. Students preferred

instructional television classes more than traditional classes when time and distance were factors. When evaluating content, "Important" received a higher mean score than "Interesting" from both treatment groups. When evaluating the delivery system, "Successful" received a higher mean score than "Pleasing". All items on the survey received high ratings from both treatment groups. Students in both treatment groups displayed an appreciation of conveniences associated with time and distance when selecting courses. Both treatment groups rated the delivery system "Pleasing", although "Pleasing" received a lower mean score than "Successful" which received the highest mean score for items assessing the delivery system. Scores suggest that both treatment groups felt successful with compressed digital video instructional delivery whether one-way video/two-way audio or two-way video/two-way audio.

Student Achievement

Two instruments were used to measure student achievement. A pre/posttest instrument was used to measure student achievement and to establish homogeneity of the student population. The CMS (Communication Security Material System) course final examination was used as a second measure of student achievement.

Analysis of pretest scores revealed no significant difference in achievement levels between treatment groups prior to the beginning of instruction. Analysis of posttest scores

revealed no significant difference in achievement levels between treatment groups. When pre/posttest scores were compared for level of achievement, a t-test analysis revealed a significant level (.000) of achievement for both treatment groups.

Based on pre/posttest scores, it is concluded treatment groups could be considered homogeneous for the purpose of this study. Pre/posttest scores also revealed that both treatments presented in this study were effective instructional delivery modes.

Analysis of final examination data revealed no significant difference in achievement levels between treatment groups. Mean scores for both groups exceeded 94% on the final examination. Although data was not presented for analysis, course instructors reported that final examination scores achieved by both treatment groups were comparable to scores achieved by CMS students they had taught in the traditional classroom environment. Final examination data underscores instruction via both compressed digital video instructional delivery treatment modes as highly effective.

Achievement scores were further analyzed by receive site to determine any significant differences. There were no significant differences revealed for posttest and final examination scores between treatment groups by receive site. One significant difference was revealed for pretest scores by receive site. Pretest analysis revealed a significant difference (.01) only at Site 4. The difference noted at Site 4 for pretest scores were

not repeated in posttest or final examination score analysis. Since enrollments were collapsed into treatment groups by delivery mode treatment for this study, it is concluded that the pretest difference at Site 4 was not significant to the results of this study.

An analysis of variance was conducted to determine achievement score/receive site interaction. No significant interaction was revealed for pretest, posttest or final examination achievement and receive site.

Student Achievement Summary

Analysis of student achievement data revealed that both groups achieved at a significantly high (.000) level. There were no significant differences between achievement levels of treatment groups. Student population was determined to be homogenous for the purpose of this study, and no significant interaction between treatment group and receive site was revealed.

Summary of Conclusions

Data presented and analyzed in this study suggests that both one-way video/two-way audio and two-way video/two-way audio via compressed digital delivery are effective instructional delivery modes. Analysis of student achievement data revealed students

learned significantly via both treatments.

A significant difference in instructor preference of delivery mode was revealed. Instructors felt Treatment 2 (two-way video/two-way audio) provided more ability to perform instructional tasks they had identified as important teaching techniques than Treatment 1 (one-way video-two-way audio). Instructors felt Treatment 2 (two-way video/two-way audio) provided more ability to establish and judge class rapport. Additionally, instructors felt better about their teaching using Treatment 2 (two-way video/two-way audio) than Treatment 1 (one-way video/two-way audio). Instructors had reduced tension and hesitancy towards teaching using Treatment 2 (two-way video/two-way audio) and significant satisfaction using compressed digital video instructional teletraining as a delivery system.

Although instructors preferred Treatment 2 (two-way video/two-way audio) significantly more than Treatment 1 (one-way video/two-way audio), they felt Treatment 1 was a viable instructional mode and would prefer to use Treatment 1 over returning to the traditional classroom environment if they felt comfortable with the subject they were to teach.

Analysis of student attitude revealed no significant differences between treatment groups. Data suggest both groups were satisfied with their learning experience. Both treatment groups rated course content highly. Since both groups were blind to the study, neither knew of the instructional features, nor lack of features, experienced by the other treatment group. Both

treatment groups would choose an instructional television class over a traditional class when time and distance are intervening factors. Both groups would take another instructional television course. Both groups rated course content and delivery medium highly. Both groups gave high instructor and overall course ratings. Additionally, both treatment groups rated the instructional delivery system (compressed digital video) highly successful.

Students population was determined to be homogenous for the purpose of this study. No significant interaction between treatment group and receive site was revealed.

Importance of the Study

This study was conducted to gain information concerning compressed digital video instructional delivery upon which educational decision makers in urban, suburban, and rural environments can rely when planning for, or proposing restructuring of, instructional delivery via distance learning.

1. Compressed digital video instructional delivery is effective.

Analysis of student achievement data revealed that not only did students in both treatment groups (one-way video/two-way audio and two-way video/two-way audio) achieve, they achieved at a highly significant (.000) level. Pre/posttest score

differentials underscore the presence of a strong learning effect. Final examination scores, based on a lengthy, application level assessment duplicate this finding. Additionally, based on instructor reports, final examination scores produced in this study are comparable to scores achieved by students taught by the same instructors in the traditional classroom setting.

2. More students can be served simultaneously via compressed digital video instructional delivery than can be accommodated in a single traditional classroom environment requiring similar instructional staff and material resources.

Instructors noted they are teaching approximately four to five times as many students per session than possible in the traditional classroom setting with comparable achievement results.

3. Instructors enjoy teaching via compressed digital video instructional delivery and feel a renewed professionalism.

Instructor interviews revealed a strong professional satisfaction using compressed digital video delivery. All three instructors felt renewed and motivated by their experiences with the system. The one instructor new to the system and the two experienced video teletraining instructors expressed the same attitude. All three reported they had learned new teaching techniques using the system that could be taken to the

traditional classroom setting.

4. Instructors prefer two-way video/two-way audio instructional delivery significantly more than one-way video/two-way audio instructional delivery.

All three instructors significantly chose Treatment 2 (two-way video/two-way audio) over Treatment 1 (one-way video/two-way audio). Although all instructors felt Treatment 1 could be an effective delivery system, Treatment 2 (two-way video/two-way audio) offered substantially more options for promoting interactivity. This finding is important when considering the historical reluctancy of teachers to participate in televised teaching. Seemingly, teachers are the most concerned with the lack of "feel" for student contact experienced through one-way video/two-way audio delivery. Face-to-face interaction available through two-way video/two-way audio seems to create the potential for a reversal of teacher hesitancy. Because two of the instructors participating in this study were negative concerning their initial assignment to the electronic classroom, results revealed in this study underscore the power of the technology in changing instructor attitudes.

5. There is a need for instructor training and professional development time before beginning televised instruction.

Although instructors rated Treatment 2 significantly higher than Treatment 1, all three instructors would prefer Treatment 1

(one-way video/two-way audio) over returning to the traditional classroom setting if they felt comfortable with the curriculum to be taught. This may imply that instructors, given adequate time to develop curriculum and instructional techniques will be more accepting of distance learning instruction and transition to the electronic classroom with greater ease. Expecting instructors to adapt successfully to televised teaching without professional development and training opportunities would be an unreasonable expectation of instructors and the delivery system.

6. Students feel compressed digital video is a successful delivery mode.

Student attitude survey data revealed students in both treatment groups felt the delivery medium was successful. A majority of both treatment groups would choose another instructional television course following this initial experience.

7. Students appreciate the potential of compressed digital video televised instruction to overcome limitations of time and distance in educational delivery.

Both treatment groups would choose an instructional television class over a traditional class when time and distance were intervening factors. In reality, time and distance are intervening factors in all educational environments and educational decisions being made by both administrators and

students. Student attitudes suggest compressed digital video instructional delivery can improve attendance by eliminating problems of distance and time effecting students. More students may well attend classes that can be offered at a time or place not in conflict with other real life demands. Traditional class scheduling does not afford students the flexibility to integrate school, work and family obligations. As urban students face problems of teenage parenthood, single parent families, unemployment, drugs, violence and a necessity to supplement family incomes, compressed digital video instructional delivery can meet student needs where the student is located at a time convenient for learning.

Recommendations

This study was conducted as an investigation of compressed digital video instructional delivery via one-way video/two-way audio and two-way video/two-way audio. Because this study strongly validates compressed digital video as an effective instructional delivery system for distance learning, it is recommended that variables in this study, as well as related and derivative variables, continue to be investigated as compressed digital video instructional strategies and delivery applications mature.

Further investigation of student attitude in this instructional setting is also needed. This study was conducted

with a student population inexperienced with either treatment mode. When a cadre of students experienced with two-way video/two-way audio can be identified and assessed, it is recommended that a similar study be conducted. Students sufficiently experienced with two-way video/two-way audio instructional delivery would be able to more effectively judge differences in delivery modes. Students in any future investigation should be blind to the study as their capability for unbiased comparative insight is crucial.

As compressed digital instructional delivery becomes more common, instructors and students will become more skilled in its usage. Interactive advantages available via both delivery modes must be explored further to identify which aspects and/or strategies best support student achievement. Likewise, as instructors and students more proficiently incorporate the technical advantages of two-way video/two-way audio, there may be a significant increase in student achievement in comparison to one-way video/two-way audio instructional delivery.

When a cadre of instructors well experienced with a variety of compressed digital video delivery techniques can be identified and studied, advantages and disadvantages of various delivery techniques should be studied to a greater extent. Attention should be focused on what aspects of the delivery system most influence instructional strategies and increase student achievement. Likewise, factors which influence instructor and student comfort and/or attitude should be isolated and

identified. It is believed that instructor attitude will continue to significantly favor two-way video/two-way audio because of the possibility for face-to-face interaction.

As instructors become more knowledgeable and experienced with compressed digital video delivery, incorporating more interactive strategies, it is believed that student attitude will favor two-way vide/two-way audio delivery significantly over the more limited one-way video/two-way audio. Since this study was conducted using United States Navy personnel and facilities, it is recommended that future studies focus on additional education populations. When appropriate facilities are available within the K-12 and higher education environments, similar investigations should be undertaken.

Compressed digital video technology will continue to improve. Likewise other technologies will be developed that will impact instructional delivery. Continued investigations should be conducted to identify technologies, instructional strategies, and delivery systems that best support student success.

APPENDICES

APPENDIX A

PRE/POSTTEST INSTRUMENT

PRE/POSTTEST INSTRUMENT

CMS Course Survey

INSTRUCTIONS

1. You will have 45 minutes to complete this survey.
2. Read all questions carefully and indicate your choice.
3. This survey has no bearing on determination of successful course completion. It is not a test. However, you are encouraged to do your best and to select the best possible choice.
4. The survey will be graded according to the number of correct selections. No penalty will be assessed for incorrect answers.
5. Upon completion of the survey, follow instructions as provided by the proctor.

1. CMS stands for:

   a. Crypto Management System
   b. Communication Security Material System
   c. Classified Material System
   d. Communication Management System

2. _____ has overall responsibility for COMSEC policy within the Navy.

   a. COMNAVSECGRU
   b. DCMS
   c. CNO
   d. DIRNSA

Match the following publications to the description that best describes its use.

3.	CMS 4 _____	a.	Basic authority for physical security requirements for crypto material.
4.	CSP 1 _____	b.	Crypt equipment information and guidelines.
5.	OPNAVINST 5510.1 _____	c.	General security regulations and guidance.
6.	CMS 5 _____	d.	COMSEC procedures manual and administrative guidance.

---

7. The executive officer is directly and personally responsible for the management of the command's CMS account.

   a. True
   b. False

8. In the event the CMS Custodian is away from the command (TAD, leave, etc...) for a period exceeding ___ days, the primary alternate custodian must formally relieve the CMS Custodian.

a. 30
b. 45
c. 60
d. None of the above

9. The CSPM 3 reflects _____ months of status that includes the preceding month, current month, and _____ months ROB.

a. 8, 6
b. 7, 5
c. 6, 4
d. 5, 3

10. COMSEC Material Transaction Reports are more commonly referred to as _____.

a. DCS 1
b. DCS 32
c. SF 153
d. SF 700

Match accountability legend code to best description.

11. AL 1	_____	a.	CCI equipment
12. AL 2	_____	b.	Locally accountable by serial number upon receipt by CMS Custodian.
13. AL 3	_____	c.	Centrally accountable by quantity only
14. AL 4	_____	d.	Locally accountable by quantity upon receipt by CMS Custodian
15. AL 5	_____	e.	Centrally accountable by serial number

16. Electronic Receipt Reports must be submitted within 72 hours of material receipt.

a. True
b. False

17. Electronic Receipt are required for all COMSEC material receipts.

a. True
b. False

18. Return receipt tracer action for overdue receipts must be initiated within _____ days of transaction.

a. 30
b. 45
c. 60
d. 90

19. How many copies of COMSEC transfer reports are needed for an account to account transfer?

a. Original and 1 copy
b. Original and 2 copies
c. Original and 3 copies
d. Only original required for account to account transfer

20. Excess publication amendments should be:

a. Properly destroyed and documented
b. Issued to publication custodian for entry verification
c. Returned to stock-point
d. Mailed to DCMS ASAP

21. All CMS users must be designated in writing by the CMS Custodian.

a. True
b. False

22. AL1 and AL2 material that must be destroyed, and was not listed on the CMS 2-1A, may be added to the bottom of the last page of the CMS 2-1A.

a. True
b. False

23. Records of destruction for CONFIDENTIAL AL3 and AL4 material shall be retained for at least _____.

a. 30 days
b. 45 days
c. 90 days
d. 1 year

24. Formal SF-153 destruction reports must be signed by the:

a. CO
b. Custodian and witness
c. Persons destroying material
d. Both a and b above

Match the following situations with the appropriate destruction time requirements.

25. Unissued CMS keying material

26. Emergency superseded keying

27. Amendment residue

a. ASAP after supersession but always marked crypto within 5 days

b. ASAP after supersession but always within 30 days

c. ASAP after supersession but always within 72 hours

d. Wait until directed by DCMS

28. Keying material marked Crypto is the most sensitive element of communications security.

a. True
b. False

29. SF-153 inventory reports shall never be submitted to DCMS.

a. True
b. False

30. CMS 16-1 semi-annual inventory reports must be returned within _____ days of preparation at DCMS.

a. 45
b. 60
c. 75
d. 90

31. AL1 and AL2 items not included on the CMS 16-1A must be added to the CMS 16-1B.

a. True
b. False

32. The CMS 16-1C must always be annotated prior to return to DCMS.

a. True
b. False

33. Transaction numbers will be affixed to the CMS 16-1 package.

a. True
b. False

34. Which special inventory situation always requires a full CMS inventory?

a. Change of command
b. Change of CMS custodian
c. Both a and b
d. Special inventories are never mandatory

35. The CMS Inventory (CMS 16-1) Chronological File copy is retained for _____.

a. 1 year
b. 2 years
c. Until verification of next inventory is received
d. None of the above

36. A CMS "Advice and Assistance Visit" must be conducted _____.

a. every 18 months
b. In conjunction with change of command or CMS Custodian
c. Prior to command CMS inspection
d. As desired

37. CMS inspection results shall be forwarded to DCMS.

a. True
b. False

38. Who is authorized to receive and verify contents of a COMSEC shipment?

a. CMS Custodian and TOP SECRET Control Officer
b. CMS Custodian and an alternate custodian
c. CMS Custodian and a designated CMS user
d. Any two persons with a TOP SECRET clearance

39. A CMS-25 destruction form is required to report destruction of segmented keying material.

a. True
b. False

40. The Seed Key is effective for one year after loading into the STU-III.

a. True
b. False

APPENDIX B

FINAL EXAMINATION

F I N A L E X A M I N A T I O N

The Final Examination used in this study is currently administered by the United States Navy Communications Security Material System course and is required for course completion and certification. As such, publication of the Final Examination instrument is restricted. The following sample event items are supplied. The examination is document intensive and requires application level performance.

UNCLASSIFIED

Terence R. Inman
Signature

Communications Security Material System

SAMPLE EVENTS

Sample Event 1

Identify and correctly handle any items that have been superseded in the middle of the month of June. In the event that the destruction of AL3/4 material is to be performed, a local destruction report is REQUIRED for this examination. Use the form(s) provided in Enclosure (7). The date is not 17 June 1991.

1. Identify the file in which a copy of the above destruction report (2 POINT) will be placed and the retention period of this report.

_____

_____

2. Keying material marked CRYPTO is the most sensitive element of (1 POINT) communications security; therefore, the immediate, complete, and proper destruction of superseded keying material is of the utmost importance.

True / False (circle one)

Sample Event 2

On 28 June, you receive your Communications Security Material System 2-1 disposition report. Included is CSPM (TC) 3S. Fill out an SF-153 & ETR report on 28 June. On 29 June prepare your LMAD for 01 July material. (Enclosure (4)).

1. The CSPM-3 is the primary source of status information for U.S. (1 POINT) Navy COMSEC material.

True / False (circle one)

2. A Local Holder has completed an SF-153 Local Destruction Report. (1 POINT)
The material destroyed was AL-1. What should the Local Holder do with this Destruction Report?

a. Forward it to DCMS.
b. Retain it for two (2) years.
c. Forward it to the CMS account custodian.
d. Retain it for one (1) year.

APPENDIX C

STUDENT ATTITUDE SURVEY

APPENDIX D

INSTRUCTOR ATTITUDE INTERVIEW PROTOCOL

INSTRUCTOR ATTITUDE INTERVIEW PROTOCOL

TREATMENT 1 One-Way Video/Two-Way Audio
TREATMENT 2 Two-Way Video/Two-Way Audio

Individual interviews must be conducted. Comments and/or scenarios used for clarification must be consistent for all interviews.

USING A RATING SCALE 1 - 5 (5 being highest), RATE EACH OF THE FOLLOWING CONDITIONS FOR BOTH TREATMENT 1 (one-way video/two-way audio) and TREATMENT 2 (two-way video/two-way audio).

1. Ability to judge student understanding (comprehension) on an on-going basis.

Treatment 1 _____ Treatment 2 _____

2. Ability to judge individual student reaction during instruction or when addressing individual student questions and/or comments.

Treatment 1 _____ Treatment 2 _____

3. Ability to judge class (global) reaction during instruction or when addressing student questions and/or comments.

Treatment 1 _____ Treatment 2 _____

4. Ability to individualize instruction.

Treatment 1 _____ Treatment 2 _____

5. Facilitates feeling of teaching a unified class.

Treatment 1 _____ Treatment 2 _____

6. Ability to pace the lesson according to student needs.

Treatment 1 _____ Treatment 2 _____

7. Ability to judge class rapport and a feeling of being part of the class.

Treatment 1 _____ Treatment 2 _____

8. Ease of establishing class rapport.

Treatment 1 _____ Treatment 2 _____

9. Level of concentration needed to anticipate next instructional technique needed to maintain interactivity.

Treatment 1 _____ Treatment 2 _____

10. Personal perception of teaching.

Treatment 1 _____ Treatment 2 _____

11. Absence of tension or hesitancy toward teaching.

Treatment 1 _____ Treatment 2 _____

12. Feeling of establishing rapport with students that might lead to on-going professional contact after class is completed.

Treatment 1 _____ Treatment 2 _____

13. Ability to monitor students during guided and/or independent practice.

Treatment 1 _____ Treatment 2 _____

14. Satisfaction with teaching using this system.

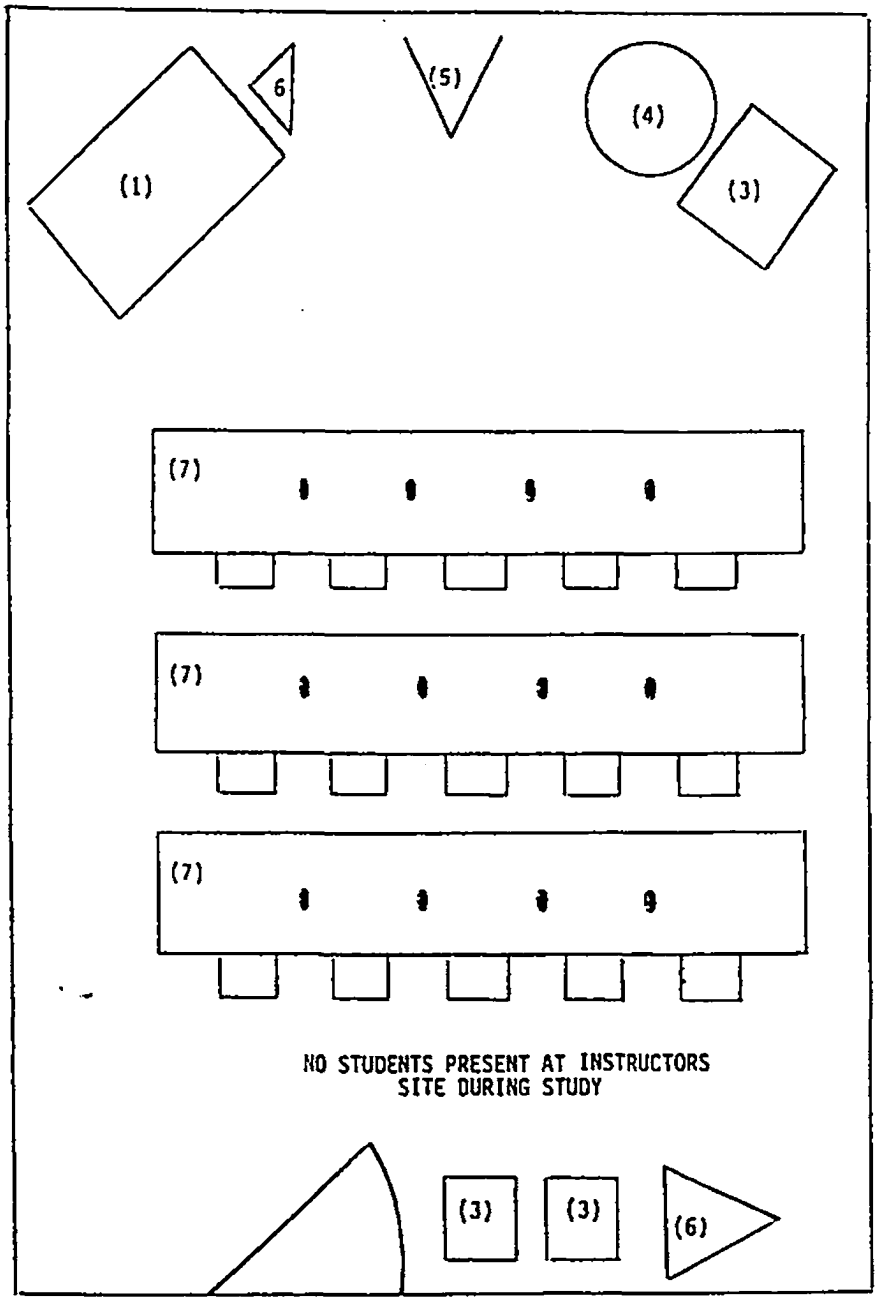
Treatment 1 _____ Treatment 2 _____

APPENDIX E

INSTRUCTOR SITE DIAGRAM

INSTRUCTOR SITE

(1) 60" MONITOR
(2) 35" MONITOR
(3) 25" MONITOR
(4) CS-300 SYSTEM (KURTA DIGI-PAD MIXER)
(5) ELMO VISUAL PRESENTER
(6) CAMERA
(7) STUDENT SEATING
● MICROPHONE

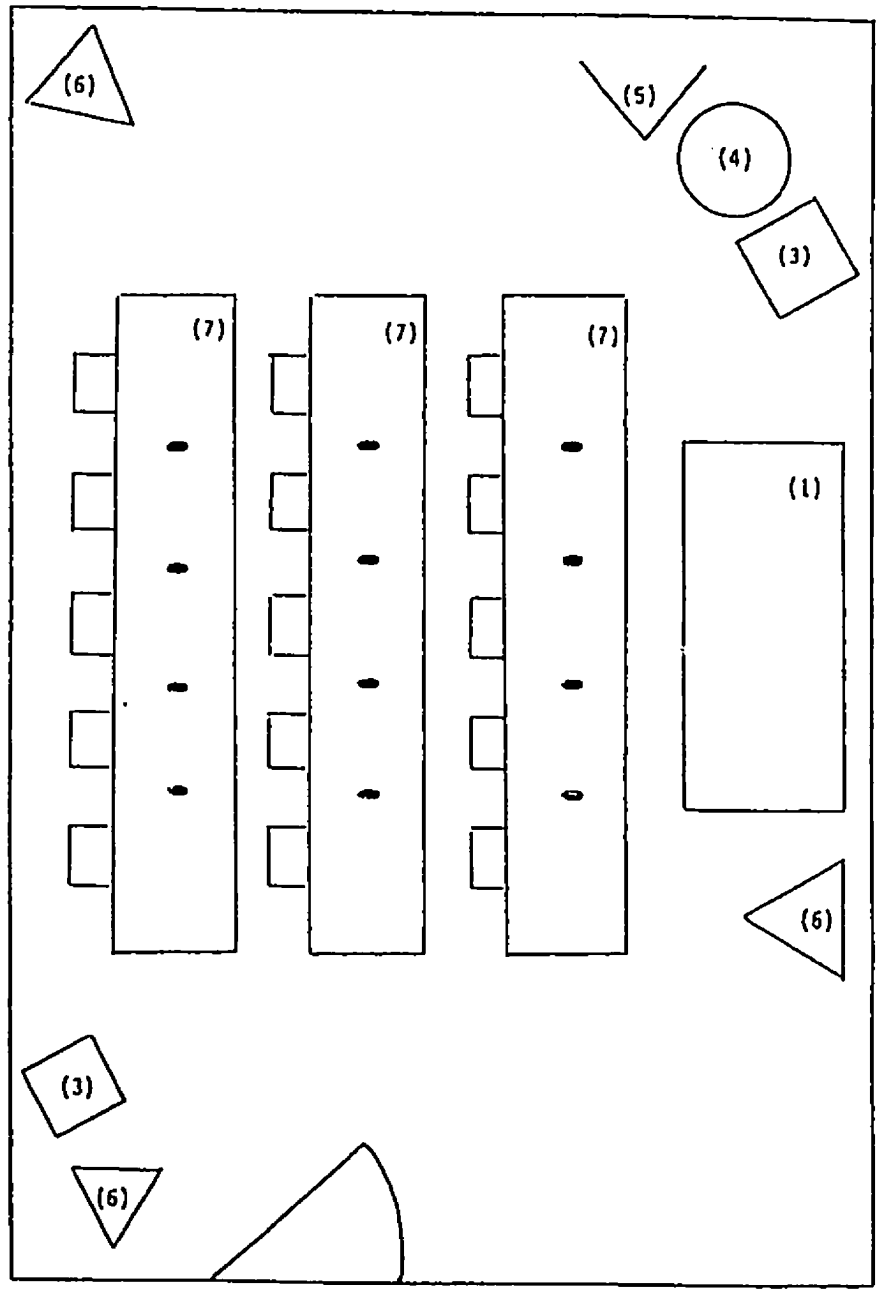


APPENDIX F

STUDENT REMOTE RECEIVE SITE DIAGRAM

STUDENT REMOTE RECEIVE SITE

(1) 60" MONITOR
(2) 35" MONITOR
(3) 25" MONITOR
(4) CS-300 SYSTEM (KURTA DIGI-PAD MIXER)
(5) ELMO VISUAL PRESENTER
(6) CAMERA
(7) STUDENT SEATING
● MICROPHONE



APPENDIX G

EQUIPMENT LIST

EQUIPMENT LIST

Item Description	Model #
VideoTelecom Digital Branch Exchange	DVBX-14
VideoTelecom coder/decoder	CS-300
Conoga Perkins Fiber Optic Modem	2290
COMSTREAM Digital Multirate Modem	CM-401
COMSTREAM Digital Multirate Modem	CM-421
RAMKO Research Remote Control	RCR-2
RAMKO Research Primus Audio and Data Routing System	RS-1616/LC
Avanti ONC-10 Modem	NCI-D-02-49
Mitsubishi Large Screen Television	VS-685R
Mitsubishi Receiver	CS-3505R
Sony Color Trinitron Monitor	PVM-2530
Bioamp Advantage One Mixer	N/A
Bioamp Advantage AGII Priority Gate	B119043
Bioamp 8 Port Mixer	B116874
Shure Unidirectional Condenser Microphone	SM91
Shure Unidirectional Condenser Microphone	819
Shure Lapel Microphone	570S
Video Telecom Zoom Box Controller	ZBC
Chinon Color Video Camera	V12.5-75M-4
Pulnix Camera	TMC-574
JVC Color Video Camera	GX-N8U
Elmo Visual Presenter	EV-308
Elmo Base Light Panel	BI-100

EQUIPMENT LIST (Con't)

Item Description	Model #
Kurta Digi Pad	8.5 x 11
Panasonic Video Cassette Recorder	AG-1730
NAVITAR Videomate slide to video system	G2000D
Sony Still Video Recorder	MVR-5500A
Program Editing Controller	RM-E5500
Realistic FM Wireless Microphone system	32-1221A

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