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Implications for the design of a 2-way video distance learning facility

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Implications for the design of a 2-way video distance learning facility

Abstract

The decade of the 80's has witnessed the virtual birth and proliferation of interactive distance learning systems. The rapid multiplication of these instructional delivery systems has not been preceded nor followed by appropriate research. Distance learning applications pose entirely new questions for the educational researcher. Among the many questions raised, are those which specifically address the layout of a distance learning terminal facility. In the effort to achieve maximum educational efficiency and effectiveness in a 2-way video system, this paper examines some specific questions regarding distance learning classroom design. Until more focused research is forthcoming, this study proposes to investigate the research findings from related fields, such as instructional television, instructional design, and learning theory. By appropriately applying those findings to the unique challenges of the distance learning classroom, conclusions are formulated.

IMPLICATIONS FOR THE DESIGN
OF A
2-WAY VIDEO
DISTANCE LEARNING FACILITY

A Research Paper
Submitted
In Partial Fulfillment
of the Requirements for the Degree
Master of Arts in
Communication and Training Technology

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July 1988

ABSTRACT

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Distance learning applications pose entirely new questions for the educational researcher. Among the many questions raised, are those which specifically address the layout of a distance learning terminal facility.

In the effort to achieve maximum educational efficiency and effectiveness in a 2-way video system, this paper examines some specific questions regarding distance learning classroom design.

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CHAPTER I

Introduction

Background to the Problem

Although the concept and practice of distance learning has been around for decades, the last few years have seen major advances in the application of new delivery technologies. Originally, distance education was delivered via the postal service in print form (Benson, 1988). Later, audiotape, radio, and television were employed to carry instruction to the remote learner. These methods are still used with a good degree of success and in various combinations (Stahmer, 1987, Harris, 1987).

There are two interesting factors which have emerged recently to change significantly the picture of distance education. First, the proliferation of delivery systems such as cable, microwave, satellite, ITFS, and fiber optic systems have all made the transmission of wide bandwidth signals an accessible commodity for many potential users. Wide bandwidth capabilities permit the transmission of full motion video signals. Before these systems became available, interactive distance learning concepts were largely restricted to telephone lines (narrowband) permitting audio and data transfer only.

A second factor changing the scene, is a growing interest among educators in the concept of interactivity. Educational television, print, audiotape, and radio, historically have been the backbone of providing instruction to distant learners. All these systems are essentially one-way systems in which students receive but cannot respond or interact with their instructor. The newer technologies, however, permit the installation of fully interactive systems allowing instant interchange between learner and teacher.

Operational Definitions

Distance learning: "Instruction that occurs at a point distant from the learner with an interactive audio and/or visual component" (Benson, 1987, p.63).

Interactive: This describes all learning situations in which students are to respond to certain prompts presented by the source of instruction, and such responses are the basis for determining the content of the next instruction (Hodgson, 1987).

Reactive: This describes a learning situation in which students are required to react to programmed mediated instruction in a manner predetermined by the courseware designer (Hodgson, 1987).

Proactive: A proactive design permits learners to exercise extensive control of the sequence, structure, content, and direction of instruction (Hodgson, 1987).

. Coactive: This term defines a mediated situation in which both proactive and reactive elements are integrated into the presentation. Virtually all distance learning systems are coactive in nature (Hodgson, 1987).

Transactive: This describes a mediated learning situation in which the student is able to access a wide variety of learning resources from a single point. Such resources might include: on line data bases, library collections, computerized image collections, live class lectures, feedback from experts, feedback from peers, computer mediated instructional programs, encyclopedias, and many other possible resources (Hodgson, 1987).

CRT: A CRT is a cathode ray tube capable of displaying an electronically generated image (Zettl, 1984).

Video: Technically, this term describes an electronic signal of relative low frequency which is capable of generating an image on a CRT. This signal

can be stored, transmitted, or displayed (Zettl, 1984).

A television: A CRT with a tuning component capable of tuning in to a broadcast frequency at any of many channels. The input ports on a television are designed to take only broadcast frequency signals. Televisions cannot read video (low frequency) signals (Zettl, 1984).

A video monitor: A video monitor is CRT capable of reading and displaying a video signal. Monitors cannot read broadcast frequency signals and have no input connectors for an antenna (Zettl, 1984).

Interactive video: This term describes all learning situations in which instruction and learning occurs via the medium of the CRT and students are required to respond to prompts in the instruction with such responses being the basis for determining the content of subsequent instruction (Hodgson, 1987).

Interactive television: This term describes a learning situation identical to that of interactive video except that the word "television" indicates that a broadcast component is included somewhere in the signal path (Feasley, 1983).

Facsimile: A facsimile machine is a device capable of scanning an image (print or picture) by

means of the xerographic process. This scanned image is then converted to electronic data which can be transmitted to a distant site via the telephone. Another facsimile at the distant site would then reconvert the electronic data back into the original image (Johansen, 1984).

Asynchronous: This is a term which describes the attribute of written interactive communication whereby responses to a message need not occur immediately. The length of delay time is determined by each individual situation (Manock, 1986).

Statement of the Problem

For many, the idea of selecting a particular classroom and equipping it to serve as their terminus for a distance education system, has proven to be a logical necessity. A common procedure is for the institution to call on their media personnel or technicians to install monitors, cameras, speakers, and microphones. Generally those entrusted with the responsibility of designing the layout of the specialized classroom have few resources to assist them. Even with the best of effort, each school ends up with their own custom designed facility (Kirkwood 1987, MSET, 1987, Hagon, 1986, Johansen, 1984).

Because of the suddenness with which distance education techniques have appeared, there are few reliable consultants, and virtually no research findings to address the specific questions raised in designing a classroom facility.

The Scope of this Review

The intent of this review is to consider some specific questions regarding the arrangement of media in a 2-way video distance learning classroom. It will not be the purpose of this treatment to determine which are the most effective pedagogical techniques, but rather this paper will rely on the works of Gagne (1979) to determine which activities are important to the processes of instruction and learning. The purpose of this investigation is to provide recommendations for a classroom design style which will best support those activities suggested by Gagne.

Because the number of hardware technologies, and combinations thereof, are so numerous, this report is limited to address only those systems employing 2-way coactive video. All statements made in this paper must be understood to be in the context of teacher and learner seeing and hearing each other.

It should also be noted that this examination will not address many very important issues related to

distance learning such as costs, cost benefit, and cost benefit comparisons with other systems. These questions are worthy of far greater attention than could be supplied in this paper. However, with this review of literature, an effort toward answering some questions of room design is begun.

The Approach to the Problem

The processes that occur in the human brain when the act of learning is taking place, is the topic of investigation for learning theorists. Contemporary learning theory has identified some important ways in which the brain stores and retrieves information. Based on these findings, Gagne (1979) has developed a multistage theory of human learning in which he has identified nine activities. He calls them the events of instruction. According to Gagne, the nine events of instruction are important steps necessary for students to achieve a high level of learning.

This paper proposes to utilize Gagne's instructional model to provide the primary basis for design recommendations. The findings of other scholars will also be referenced as they relate to the questions being addressed.

Of special interest to this investigation are the extensive research reports on instructional

television. Instructional television is perhaps the closest "cousin" of distance learning in this context. Instructional television and distance learning both deliver instruction to a distant site via the television monitor. However, instructional television (ITV) differs from distance learning in two distinct ways. In ITV, the instructor cannot observe the student, nor the student's responses, to questions. Second, the learner cannot ask a question of the teacher. Perhaps it could be argued that questions could be submitted via telephone or mail. Such techniques are used but at the expense of all spontaneous interaction (Meier, 1987, Murphy, 1966). From these observations, it can be concluded that 2-way video is a more capable instrument than ITV and caution should be exercised when applying the findings of ITV research to distance learning situations.

This report approaches classroom design questions as they relate to three visually oriented instructional devices; the videocamera, the video monitor, and the facsimile. These three terms will be defined for use in this paper as they are addressed individually later in this review.

How the Results will be Applied

System designers are often unaware of how critical their decisions are in terms of the educational effectiveness with which their systems operate. Perhaps the conclusions reached in this paper will serve to raise the level of importance generally ascribed to questions of this nature. It is also hoped that the results of this review of literature will serve to assist those who are responsible for creating a distance learning facility by providing a resource which will stimulate additional thinking and new ideas.

CHAPTER II

Review of Literature

Measure of Instructional Effectiveness

The first order of business in planning a design strategy is to establish a clear goal. For the purposes of this investigation, the goal of classroom design is to secure an arrangement capable of providing maximum instructional efficiency and effectiveness. The criterion by which goal attainment will be measured, is the instructional model provided by Gagne (1979) entitled Events of Instruction (Table 1).

Table 1

Events of Instruction

-
1. Gaining attention
 2. Informing the learner of the objective
 3. Stimulating recall of prerequisite learning
 4. Presenting the stimulus material
 5. Providing learning guidance
 6. Eliciting the performance
 7. Providing feedback about performance correctness
 8. Assessing the performance
 9. Enhancing retention and transfer
-

This treatment will judge room design to be effective and efficient to the degree that it is able to support these nine activities. Gagne deals extensively with each of these suggested events, explaining their meaning and application. However, our approach will be to explain these events only as they are applied to specific situations within this report.

Although the specialized classroom is a complex arrangement of many interrelated components, this treatment will examine only three elements within the 2-way video system. The three visually oriented components: the videocamera, the video monitor, and the facsimile will be evaluated against this nine event model.

Implications for the Videocamera

As the system builders begin to plan their strategy for the design of the specially equipped classroom, the question of whether to employ the services of a camera operator must be addressed. The alternative is to rely on one or more fixed cameras mounted in strategic positions in the classroom.

In situations utilizing the fixed camera concept, the instructor receives a wide-angle view of

the students at the distant site(s). Although the purpose of the wide-angle setting is to take in the whole class, it reduces the relative size of each student on the teacher's monitor. Even the instructor is seen by students in a less than closeup view.

Instructional event number seven is listed as "Providing Feedback". Gagne expands on event seven by saying, "When the teacher is observing the learner's performance, the feedback communication may be delivered in many different ways- a nod, a smile, or a spoken word" (Gagne, 1979, p.163). This provides "important information to the learner about the correctness of their performance" (p.163).

Johnston (1987) has noted in his studies of mediated instruction, that teacher judgements often rely on non verbal subtle cues in learners. The furled brow or a puzzled look tell the teacher that further explanation is needed. Because of the low definition inherent in the medium of video, the instructor cannot easily observe subtle expressions, and often fails to note body language that are so much a part of the complex process of human interaction.

In those systems employing a camera operator, there is the capability of zooming in on any student who begins to interact with the instructor. In such

cases it is not uncommon for the teacher to observe students' faces magnified larger than reality. Under this arrangement, the medium is being used to enhance communication rather than restrict it (Zetttl, 1984, Feasley, 1983). From the twinkle in the eye to a look of boredom, the teacher is informed larger than life.

The benefit is mutual when operators are serving at both sites. Although the concept of "the talking face" has been justly lamented by the critics, Schwarzwaldner (Murphy, 1966) has offered an interesting observation, "the mobile, intelligent, infinitely flexible human face is the best audio visual or production device ever invented" (p.48).

Referring to Table 1, instructional event number four, the reader will note that it is listed as, "presenting the stimulus material". Regarding this event, Gagne explains, "stimulus presentation often emphasizes features that determine selective perception. Thus information presented in a text may contain italics, bold print, underlining, or other kinds of physical arrangements designed to facilitate perception of essential features" (Gagne, 1979, p.160). The use of the zoom feature on the videocamera is ideally suited to the purpose of calling attention to specific features. However, a

mounted camera is capable of transmitting only a fixed view.

In research conducted by Salomon (1979) it was found that the use of the television zoom had additional applications as a means of providing support for certain cognitive processes. In experiments conducted with 80 eighth grade students, he demonstrated that by zooming in to focus on details in a complex visual field, a model for certain mental operations was provided. Such modeling helped students to internalize the focusing capability. Pavio (1980) found that this enhanced capability to zero in on details was demonstrable in subsequent testing. In this vein Kozma (1986) concludes that camera maneuvers such as pans, and depth-of-field focusing may provide important models for corresponding cognitive functions. These findings suggest that the role of the camera operator is integral to that of the instructor, and that a professional assistant relationship would contribute largely to the educational efficiency of the system. They further suggest a training program to prepare operators and instructors for their joint task.

Instruction that occurs in discussion groups is an important feature of event number five which is

recorded as "providing learning guidance". Three kinds of objectives are often considered appropriate for instruction via group discussion: subject-matter mastery, attitude formation, and problem solving" (Gagne, 1979, p.251).

In many 2-way video systems the instructor addresses students at several sites including students at his/her own site. Often there are times when the instructor wants to employ discussion techniques involving students from different locations. Under the camera operator design, such activity is accomplished instantly and smoothly. Fixed camera arrangements, however, make such an attempt so awkward, that students are seldom inclined to try. However, the ability of learners to exchange ideas with other learners is of sufficient value to those designing the New York Telecommunications Network that they have included that objective in their comprehensive plan (Benson, 1988). Based on these observations, it can be concluded that the ability to focus in on selected students as they engage peers in discussion, supports the achievement of event five, providing learning guidance.

The town of Blair, Wisconsin is one of eleven sites sharing a 2-way video system. In the initial

stages of their classroom design, they chose to utilize a camera operator. However, after a period of time they decided to replace the camera operator with multiple fixed cameras connected to a switcher. They felt that sea sickness was the frequent result of watching the video output of a student operated videocamera (Hagon, 1986). It should be noted that poorly built tripod heads permit jerky, rapid maneuvers, while well built fluid tripod heads control camera movements to produce slow, steady, professional styled movements (Zettl, 1984).

One of the critical decisions that must be made in fashioning instruction is determining what medium to use as a vehicle for the presentation of the stimulation. Although event number four, "presenting the stimulus material", is perhaps most often carried out verbally or in printed form, there are many occasions in which the lesson objectives can best be met with the use of additional media. Teachers often work hard to locate the exact software package that will ideally accomplish their lesson objectives. If their selection happens to be a 16mm film, a slide presentation, or a filmstrip program, the fixed camera system requires a technically skilled person to refocus the camera for the presentation and then when

the presentation is finished the technician must again reset the camera to its original position.

Because of the hassles involved, and the advance arrangements necessary to make use of these media, instructors are inclined to forego the trouble by omitting these mediated presentations in favor of a less effective but more convenient method of delivery. However, in a system employing the camera operator concept, no special advance arrangements are necessary. All forms of media presentations are quickly and easily accommodated by the camera operator.

The director of the Center for Learning Technologies at the New York State Education Department has worked closely with coactive distance learning operations for years and offers his philosophical advice. "The requirements of learning systems should not be the determining factors of the programs they offer, rather, the programs- and therefore the systems themselves- should have the capacity to adjust to students' identified needs" (Benson, 1988, p.1).

Implications for the Video Monitor

For the purposes of this review, the term "video monitor" will refer to a CRT (cathode ray tube)

capable of displaying the output of a videocamera or a computer. The interest at this point is on what visual information is provided to the receive site in a distance learning classroom.

. Since the scope of this review addresses only 2-way video systems, it can be understood that the video monitor is capable of displaying the output of the camera at the opposite site. This picture will be referred to as "program video" in this paper.

As can be noted from Table 1, Gagne (1979) has suggested that the initial event of instruction is that of "gaining attention". Although this appears to be a rudimentary notion, it is a common point of breakdown in the instruction/learning process. In an experiment conducted by Ford (1947), high school students were tested in an effort to determine the effectiveness of taking notes during the presentation of a motion picture. Ford found that the group who was encouraged to refrain from taking notes during the movie, scored higher on subsequent tests than the group who was advised to take notes. He concluded that the pace of the film was of sufficient speed that an attempt to write notes served only to distract attention from the instructional material in the film.

This conclusion was later confirmed by an experiment conducted by Ash and Carlson (1951).

In 2-way video systems, it is not uncommon for the instructor to use the chalkboard or overhead transparency to display written information for students at the distant site(s). As students view the information on their monitor they usually begin to transcribe the information into their notebooks. When the instructor proceeds verbally, the camera operator has two options: (a) he can hold the shot on the written materials in which case the instructor is unseen. (b) he can return the shot to the instructor in which case the written information is not visible. In either case, it is likely there will be students who's learning pace will not be accommodated. The attempt to take notes while the teacher is speaking, gesturing, or pointing out, resembles the experiments of Ford, and Ash and Carlson. When attention is distracted, Gagne's first instructional activity is aborted.

A solution to this distance learning difficulty is suggested by Manock (1986). He suggests using a computer conferencing system to carry the graphic information, citing its asynchronus attribute. An asynchronus capability would permit the instructor to

post information on the video screen and continue his/her lecture. The recipient of that information would not be required to read it at the exact same time at which it was posted, but could attend to it at a later time, presumably more convenient to the reader. In this context the asynchronous attribute would be limited but nevertheless valuable. Under this arrangement, the instructor could post written information on one video display and retain the program video on a second monitor. This plan allows notes to be copied during verbal pauses and at timing intervals selected by the student. This would increase the flexibility of the system to accommodate a broader range of learning and writing paces.

The concept of dual display monitors would seem to find support from the studies and conclusions of Kozma (1986). His research examines the effects of television pacing on learning. Regarding educational television, Kozma observes, "Quick cuts from scene to scene are not likely to provide enough time for the learner to extract that which is needed for learning and bring it into working memory. In addition, as the amount of information increases with the increase in pace, short-term memory limitations are soon reached and information is lost. The fact that the broadcast

medium presents information linearly and does not permit the child to return and view contents, puts the onus on the educational producer to maintain scenes for longer periods...to repeat important information" (Kozma, 1986, p.14).

Any restricted ability to review written information increases the likelihood that Gagne's ninth event, enhancing retention and transfer, will fail to be achieved. "Enhancing retention and transfer", includes "making provision for systematic reviews" (Gagne, 1979, p.164). From these observations, therefore, it can be concluded that a dual monitor system is one way to provide a means for a quick review of written information at least for a longer period of time than would otherwise be available.

A common difficulty arising from the attempt to transmit written information is that of aspect ratio. Instructors who write on a chalkboard or use an overhead transparency, seldom grasp the significance (or the concept) of maintaining correct aspect ratio. "If the television teacher writes on the blackboard in his or her usual way starting on the left side and moving across to the right side, you will not be able to fit the whole sentence into the shot unless you

take a long shot of the entire board and reduce the legibility of the information" (Zettl, 1984, p.403). Reducing legibility can thwart the achievement of event four "presenting the stimulus material". If students cannot read the words, they have been denied the "stimulus material". These findings lead us to conclude that a 2-way video system supplemented by a computer conferencing system can completely eliminate aspect ratio problems by providing highly legible graphics to assist in "presenting the stimulus material".

There are many time when the lesson objectives can best be met by presenting information on the page of a book. Whether this is a picture, a chart, or simply written information, the ability to magnify such information so that students can easily see it, is critical to event four "presenting the stimulus material". A common method of achieving this is for the instructor to hold the material in such a way that the videocamera operator can zoom in on the selected visual. However, in a tightly framed shot, the ability to hold the visual sufficiently steady becomes a difficult challenge (Zettl, 1984). If the teacher tries to point out various features of the visual, it becomes even more difficult to hold it steady.

A common solution to this dilemma, is to install a ceiling mounted videocamera which is prefocused on a specified target area of the instructor's desk (Hagon, 1986, MSET, 1987, Johansen, 1984). The teacher can then place the selected book, picture, chart, or 3-D object on the target area and the picture is instantly available for all students. If the target area is white and lighted properly, instructors can use this arrangement to show overhead transparencies. Special features can be pointed out and problems worked live on the monitors. These activities support event five "providing learning guidance" by walking the students through the steps of problem solution.

The overhead camera arrangement precludes the necessity of making advance preparations of materials. Elimination of the need to make advance preparation of materials, would likely increase the frequency with which teachers are inclined to use appropriate visual media. The increased use of appropriate visual media will provide increased support for activity four "presenting the stimulus material" in which Gagne suggests that appropriate use of media can increase learning (Gagne, 1979).

Videocamera technology is not well suited to handle extremely wide contrast ranges (Zettl, 1984).

Such a situation is presented by the overhead projector image in the classroom. The brilliant light reflected from the screen and the dark figures inscribed on it result in low definition images on the video monitor. The ceiling mounted camera completely eliminates the need to use the overhead projector and provides sharper images because the lighting can be controlled to optimum levels.

In order to provide for the multiple features that have been suggested, a dual monitor system would be imperative. In order to accommodate the recommendations advanced thus far, such a system would have four possible sources: program video transmit, program video receive, overhead camera video, and computer graphics video. A switcher would permit the selection of any two of the four to be displayed at any given time. The trained camera operator could provide the service of source selection as part of his educational support responsibilities.

Implications for the Use of a Facsimile

A facsimile machine is a device capable of scanning print material through the xerographic process and converting the information to electronic data. This data can be sent via telephone lines to a

distant facsimile and reconverted into hardcopy print form.

Salomon (1983) conducted some research to compare the perception of the television medium with that of the print medium. In a series of studies he found that television is typically perceived to be mentally less demanding than print materials covering the same content. Students report that they typically invest less mental effort when viewing television than when they read print materials. He conceives of this phenomenon in terms of "Amount of Invested Mental Effort" (AIME) (Johnston, 1987), and found that he was able to manipulate the amount of effort students chose to invest in processing television content by telling them the purpose of their viewing.

The important finding here is that TV teachers need to make a special effort to inform their students of the lesson purpose. By informing them in hardcopy printed form, they will instinctively approach it with greater mental effort.

This phenomenon is explained by some as being the result of cultural beliefs. Television is associated with entertainment, and computers are associated with games (Johnston, 1987). The installation of facsimile machines at each site, would

permit the instructor to provide the objectives in print form to students at all sites. This would support Gagne's second event "informing the learner of the objectives" in a manner supporting greater "Amount of Invested Mental Effort" (AIME) than video or computer graphic would stimulate.

It may be argued that courier service or the post office would be sufficient for delivery of print materials to distant sites. Such means are commonly used, however, these methods require advance arrangements if the materials are to arrive on time. The sheer convenience of the facsimile will increase the likelihood that print materials will be sent, thus increasing the likelihood that instructional event number two "informing the learner of the objective," will occur in print.

A study published by Lazarsfeld (1940) supports the findings of Salomon in reporting that newspapers (print) have a greater influence on people than radio. Klapper (1960) surmised that the priority ascribed to print media over broadcast media may be due to four factors. Print allows the reader to control the occasion, the pace, the direction of his exposure, and permits him the opportunity for easy review. The facsimile machine with its capability to produce

hardcopy print at a distant site, brings to the distance learning classroom various unique contributions which, when combined with those capabilities which are exclusively provided by the video, provide a greater range of tools with which the instructor can achieve his/her objectives.

The ability to review the material in printed form directly supports Gagne's instructional event number nine "enhancing retention and transfer". Comparing written information displayed on the video monitor with written information in hardcopy form, it can be concluded that the hard copy print is lasting and allows for subsequent review. It is approached with a greater "Amount of Invested Mental Effort" (AIME) and permits the learner to assimilate information at his own pace. The video display is temporary and allows only a limited time for review.

With these conclusions in mind it is interesting to compare the findings of Seiler (1971) in his research on the level of credibility which speakers are able to achieve with their audiences. He noted that the use of visual aids in a speaker's presentation had the effect of increasing the credibility of a speaker. The term "credibility" in this context implies trustworthiness and expertness

(Appelbaum, 1974). He also reported that retention levels increased when visual aids were used to supplement a presentation (Seiler, 1971).

Applying this information to a classroom situation, it could be argued that instructors provide handouts, syllabi, outlines, or other materials which serve as "visual aids". Such visual aids, then, would increase the level of expertness and trustworthiness of the instructor in the eyes of the student.

Activity number five "providing learning guidance" describes the event whereby the instructor guides the learner to discover the target information. It can be implied that the level of expertness and trustworthiness of the instructor in the eyes of the student is proportional to his ability to lead the student toward the instructional objective. Based on these observations we conclude that the utilization of a facsimile machine in the classroom will contribute toward the achievement of Gagne's instructional activities.

CHAPTER III

Conclusion

Method of Drawing Conclusions

This paper has examined the fledgling concept of instructors and learners interacting over distance and through media. The specific focus has been on the questions of classroom design. The approach has been to select three components of the 2-way video distance learning facility, for close examination. The role of the videocamera, the video monitor, and the facsimile have been the target of this investigation. The goal of this effort has been to determine the effectiveness and the efficiency of each of these components as they relate to questions of classroom design and operational strategy.

Evaluating the role of these instruments is possible only when a standard has been established against which their performance can be measured. For the purposes of this inquiry, the works of Robert Gagne have been selected to serve as a guide for evaluating the instructional effectiveness and efficiency of each of these three components. His instructional model entitled, "Events of Instruction" (Gagne, 1979), was established as the criterion by

which judgements are made as to the instructional effectiveness of classroom design.

The Videocamera

This report examined the classroom arrangements in which the videocamera was mounted in a fixed position. By comparing this arrangement with a system in which the services of a camera operator were employed it was found that the camera operator plan provided greater support for Gagne's "Instructional Events".

The videocamera operator plan provided the ability to zoom in close for communicating nonverbal feedback. The closeup of the talking face was found to be an interest stimulating audiovisual aid. An ability to zoom in on featured points of instruction and the ability to support certain cognitive functions were found to be advantageous. The potential for enhancing instruction that occurs in discussion groups was found to be an important property of the live operator arrangement. The fact that it easily accomodates additional forms of mediated instruction were also proven to be important features offered by the camera operator design that were not available under the fixed camera design.

It is therefore concluded that the camera operator plan is instructionally more effective and efficient. The fixed camera plan was found to be deficient in supporting Gagne's events of instruction.

The Video Monitor

This report examined classroom arrangements in which a single video monitor was employed to provide program video. This plan was compared to a system design which provides for a dual monitor arrangement. Under this scheme a switcher would select any two sources from among four sources available. The four sources available would include: program video transmit, program video receive, computer graphics, and overhead camera video.

The dual monitor system was found to be superior to the single monitor system because it provides better notetaking opportunities for students by exploiting the asynchronus attribute of computer graphic display. This arrangement accomodates a broader range of learning and writing paces by allowing slower writers to continue copying notes during later verbal pauses.

The extended viewing time also permits students to review the information. This review allows time

for the information to be brought from short term memory into long term memory.

Aspect ratio problems were totally eliminated while at the same time greater legibility was provided by the computer graphics monitor. The ability to display graphic information simultaneously with the program video appears to be a superior arrangement than a system which provides a single monitor for viewing.

It is therefore concluded that the 2 monitor/4 source design appears to provide more support for the "Events of Instruction" than does the single monitor approach. By providing the learner with supplemental visual information, which the research indicates that students are fully capable of benefitting from, it appears that additional communication channels are being employed. The literature would appear to support that a 2 monitor/4 source system is instructionally more effective and efficient than the single monitor arrangement.

The Facsimile

This report examined classroom arrangements in which no facsimile was employed and compared this to a classroom network in which facsimiles were installed at all sites. Those systems employing a facsimile

machine were judged to be superior because of the research which indicates that hardcopy print commands a greater "Amount of Invested Mental Effort" (AIME).

Supplementing video based instruction with print was found to help overcome the TV entertainment and the video games syndrome associated with video display terminals. Printed hardcopy was found to permit learners to control the occasion, the pace, and the direction of learning. The fact that hardcopy provides opportunity for later review of the material indicates an important advantage that the medium has over video displayed information.

Other research showed that visual aids, such as hardcopy handouts, serve to permote the level of expertness with which students view their instructor. These factors all combine to show that systems employing facsimiles appear to be superior to those systems which do not employ facsimiles.

It was found that terminal facilities employing the use of facsimiles rendered greater support to the "Instructional Events" of the Gagne model. Literature provides evidence to support a position that the use of facsimile machines in a distance learning network are instructionally more effective and efficient than systems which do not use facsimiles.

Recommendations

Each of the three components addressed in this review of literature (videocamera, video monitor, and facsimile) bring to the distance learning facility a unique set of attributes. Many of their properties provide a truly remarkable means of delivering instruction.

It is also accurate to admit that each of these components is characterized by certain limitations and weaknesses. The contention submitted here is that the shortcomings of one medium are often the precise areas of strength for another medium. Therefore it is imperative that all three instruments be combined to form a single tool whose parts complement and supplement each other. This is a genuine case in which the value of the whole is greater than the sum of its parts.

The acquisition and proper installation of cameras, monitors, and facsimiles according to the design plans tendered in this document, will not be sufficient to insure a quality operation. Integral to a superior system is the operational strategy. A sophisticated instrument in the hands of a novice seldom yields high class results. The instrument

simply provides the potential for excellent performance.

As noted earlier, the findings from research suggest that if the camera operator and instructor can develop a teamwork approach to instruction, there is a greater possibility for exploiting the system to its maximum potential. Distance learning instructors and camera operators must become proficient in capitalizing on the distinct attributes of their particular system design. A well designed system in the hands of a skilled instructional team, will be a powerful tool with which to carry on the business of teaching and learning over distance.

Today's educational effort is confronted with a host of difficulties that are somewhat unique. Declining enrollments, demand for higher pay, increased academic requirements, and an increasing emphasis on providing equal access to learning resources, are all constraining many administrators to seriously consider the opportunities offered by distance learning applications. Many have concluded that instruction delivered via a technical system, suffers degradation to some degree. However, given the option of either accepting a flawed course or not

even offering the course, many have chosen to provide the needed course in spite of its degraded quality.

Some have felt that the ideal classroom environment is that in which the instructor is present in the same room with the student. If this is unachievable, then the next best plan is to try to build a distance learning system most like a conventional classroom. The equipment and the technology should be installed in a manner which keeps the lowest profile. The strategy would be to design a system capable of supporting all the traditional activities in a classroom. Some have coined the word "transparent" indicating a system in which the technology is unseen, and is able to support all the activities of the conventional classroom as closely as possible.

A final recommendation proposed by this paper is that such a goal is too restrictive and beneath the potential of today's technology. The assumption that the traditional classroom represents an environment in which there are no technical restrictions on communications, is questionable. The findings of Gagne (1979) have shown that various media can be used to enhance the instruction/learning process.

Rather than viewing distance delivery systems as restrictive, or as providing necessary but second class instruction, this approach recommends that distance learning systems be recognized as assets to the events of instruction. In the classroom of the future, distance learning facilities could be the preferred method of receiving instruction in much the same way that many prefer to watch the ball game on TV as opposed to going to the game. Its nice to see the close-ups, the replays, and see the graphs displaying the statistics and scores.

It took the need for distance learning systems, to create the environment in which educators could justify the investment of school resources into building such systems. More than ever there is the need and opportunity to carefully examine the research and apply all that is known to the design and construction of facilities that will support every kind of instructional activity.

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