AN ABSTRACT OF THE THESIS OF

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The major purpose of this study was to assess the effectiveness of interactive video in the teaching/learning process. More specifically, a comparison was made of the relative effectiveness of interactive video and linear video as delivery modes in the acquisition of basic photography skills in an independent learning environment at a college level.

This study employed the largest sample size of any research project to date published on the instructional effectiveness of interactive video (N=128). An experimental pretest to posttest design was used. Students in educational media classes were randomly assigned to interactive video (IV; N=64) and linear video groups (LV; N=64). Analysis of covariance was used to compare achievement of the experimental group with that of the control group.

Participants also completed an attitude survey. This form offered insights into students' perceptions concerning the instruction. The written reaction form was measured on a five-point Likert scale, and related to such items as rate of instruction, frustration level, technical problems, and motivation. Significance of between group differences on individual items was tested using the Mann--Whitney U test, and ordinal consensus was measured using a Leik scale.

Results indicated that the IV group recorded significantly and consistently larger achievement gains than did the LV group. There was a difference in means between pretest and posttest scores of 29.70 (from 49.80 to 79.50) points for the linear group as compared to 35.81 (48.94 to 84.75) for the IV group. The average difference of 6.11 points in favor of the IV group, is significant at the .001 level (F=10.48).

Sixteen of 28 items on the attitude survey had significant differences in group means ($p. < .05$). Twenty-one means favored the IV group. Key attitude differences concerned level of learner control, level of interaction, and preference over traditional methods of instruction. Both groups exhibited a substantial degree of agreement (high consensus level) on most items.

Time efficiency was not increased with interactive video. The LV group all took 30 minutes to watch the tape, the LV group's time ranged from 34 minutes to 70 minutes with an average of 49 minutes.

All instructional materials were produced expressly for the study by the investigator. This provided the opportunity to document the process involved in planning and producing interactive video materials and permitted an exploration of the instructional design considerations involved. In this study both programs were designed to be nearly identical in content, with differences relating to the attributes of the media rather than the instructor or the approach.

Interactive video instruction, if carefully designed and implemented, can be a very powerful and effective method of instruction from the viewpoints of both achievement and attitude.

EFFECTIVENESS OF INTERACTIVE VIDEO IN TEACHING BASIC PHOTOGRAPHY SKILLS

by

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TABLE OF CONTENTS

LIST OF TABLES

EFFECTIVENESS OF INTERACTIVE VIDEO IN TEACHING BASIC PHOTOGRAPHY SKILLS

CHAPTER I

INTRODUCTION AND PURPOSE OF THE STUDY

Introduction

The introduction of a new instructional technology has historically been followed by immoderate claims about the impact and effectiveness of that technology. When movable type facilitated the general populace access to books, critics reasoned that this would eliminate the need for memorization and thus cause an end to thinking.

Electric and electronic media have continued this tradition of exaggerated claims. As early as 1913 Thomas Edison predicted that:

> Books will soon be obsolete in the schools. Scholars will soon be instructed through the eye. It is possible to teach every branch of human knowledge with the motion picture. Our school systems will be completely changed in ten years. (New York Dramatic Mirror, July 9, 1913, quoted in Wood and Wylie, p. 21)

Society heralded the advent of television with mixed reactions. Supporters of television professed that it "would bring the latest in cultural achievement to the remotest corners of the country, befriend the lonely and distract the anxious, it would also play the role of the Great Educator" (Broderick, 1982, p.46). McLuhan envisioned the advent of a "global village" (McLuhan, 1962). Critics of television were equally adamant in their condemnation of the new medium, predicting that television viewing would only result in "illiteracy, eyestrain, deficit spending, and tooth decay" (Pipes, 1981, p. 8).

Educators greeted computer-assisted instruction (CAI) with bold prognostications about its impact and effectiveness. However, many researchers argue that neither instructional television nor CAI has lived up to its potential (Broderick, 1982; Cohen, 1984; Levin, 1983; Pipes, 1981; Price and Marsh, 1983; Withrow and Roberts, 1983).

The latest extravagant claims are for interactive video; a medium that combines the processing power of a microcomputer with the visual and auditory strength of videotape or videodisc clearly has enormous potential (Grabowski, 1984; Leveridge, 1979; Meyer, 1984; Waldrop, 1983). A typical attitude is reflected by Steven Floyd who states that interactive video will have "the most long ranging impacts of any of the new delivery systems" (1980, p. 73). Levin calls it "a breakthrough in instructional technology of potentially revolutionary importance" (1983, p. 11). Rist (1984) makes an even bolder assertion:

> No doubt about it interactive videodisc is a breakthrough in educational technology. It has the potential to offer individualized instruction that is exciting and fun and that actively involves the learner. Interactive videodisc visionaries predict it'll leave educational television and computer-assisted instruction in the dust. (p. 28)

Some of the claims are so audacious as to cause suspicion. Wollman (1983) notes that interactive video has been hailed as the most important teaching tool since the book--a "lifesaver of humanity" (p. 39). "The most potentially powerful communication device in the history of instructional communication" (Jonassen, 1984, p.21). "Once the television viewer experiences the euphoric surge of power over the screen action, there's no turning back to passive, glazed-eyed popcorn munching. Once the CAI student is greeted by stereo music, superstar screen personalities ... plus sensational full-color motion picture action, there's no more putting up with greenish alpha-numerics" (Levin, 1983, p. 12).

Pipes advocates a cautionary approach to promoting innovations in video technology. "The job of the educational technologists in this pioneer era is to lay out the possibilities without overselling--to avoid making claims so extravagant that the new video must surely disappoint" (Pipes, 1981, p.11).

Statement of the Problem

Interactive video (also termed "intelligent videodisc") as an instructional delivery system has been introduced only very recently. Because of the complexity and cost of the hardware and software, interactive video has only been in use since about 1979 (Manning et al., 1983). As with other media, the early years of implementation are filled with extreme claims, inappropriate applications, and enormous promise.

Bold predictions about interactive video have been made, but few studies have actually been conducted to validate or refute these claims. This study addresses the need for systematic research to measure the effectiveness of interactive video as an instructional tool. A preponderance of the literature is based on anecdotal accounts. Willard Thomas, who participated in the Videodisc-Microcomputer Project, a two-year project funded by the U.S. Department of Education, reflects on the current use of interactive video; "We played with the videodisc to explore its potential, but have we used it on a systematic basis? Heavens, no" (Rist, 1984, p. 28).

Rod Daynes, project director for the Nebraska Videodisc Design/Production Group, also points to the need for more research in interactive video:

> The videodisc is still so new that no one as yet really understands its implications, its potential, or how best to design and produce materials to take full advantage of certain unique disc attributes. (Daynes, 1982, p. 24)

The lack of research has also been noted in an article entitled "Interactive Videodiscs: A Review of the Field"; "Because videodiscs are relatively new, there are not many studies dealing with the effectiveness, acceptability, or possible uses" (Manning, et al., 1983, p. 33). Furthurmore, James J. Bosco (1984) cautions that many of the articles and reports on interactive video are written from a stance of advocacy.

> In order for the technology to be used effectively, we need to get beyond the statements of the first generation of advocates to more careful considerations. If interactive video is to become a useful tool in education, and not a mere toy or plaything, we need reasoned analysis as much as enthusiasm. (p. 13)

Background to the Problem

The concept of combining a videotape recorder or videodisc player with a microcomputer has had great appeal for instructional designers, trainers, and educators. However due to the substantial costs for hardware, the enormous effort involved in software authoring, and the potential technical complexities in delivering the instruction, one should not embrace interactive video without careful consideration (Manning et al., 1983; Nugent, 1979; Zakiriya, 1984).

The need for methodological research on the instructional effectiveness of interactive video is especially important for three reasons: expense, potential, and what has been called the "gee whiz" factor.

The implementation of interactive video instruction involves a substantial investment in hardware, but even more important is the planning and effort that goes into designing interactive video software. This process is described in detail in Chapter IV of this study. The development of the 30-minute interactive videotape used in this study took more than 400 work hours. With this high ratio of development time to instructional time, it is especially important to demonstrate that the medium can produce measurable results.

When a technology has the potential of interactive video, extravagant claims will be made. The more claims made, the greater the need for research to support or refute them. This type of unsupported enthusiasm has been demonstrated in claims made about instructional television and computer-assisted instruction. The panacean claims made about these media caused a reactionary response which prevented their true potential to be realized (Floyd, 1980; Pipes, 1981; Rist, 1984; Wollman, 1980).

The "gee whiz" factor refers to the electronic appeal of the hardware causing an overzealousness in its attraction (Bear, 1983). There is a common attitude that the more buttons a machine has, the greater its benefit. Interactive video has become a buzzword for instructional designers. Often, persons involved with a technology during the early stages of its development are caught up with the technology as a thing unto itself. Again, controlled research is needed to separate the medium's appeal from its effectiveness.

Purpose of the Study

The major purpose of this study is to assess the effectiveness of interactive video in the teaching/learning process. More specifically, a comparision is made of the relative effectiveness of interactive video and linear video as delivery modes in the acquisition of basic photography skills in an independent learning environment at a college level.

A second impetus for the study stems from the wide diversity of photography skills and experience typically possessed by the students in the population. For many students who have no prior photographic experience, traditional group instruction proceeds too rapidly; for others with considerable experience, the instruction will often be repetitive. This diversity suggests the need for an alternative mode of delivery. The investigator postulated that a self-instructional, self-paced approach would be beneficial for both novices and experienced photographers.

Research Procedures

In this study, students enrolled in a teacher education program received instruction in basic photography skills in one of two methods. The control group received instruction in an independent learning environment via a linear videotape. Linear videotape refers to the traditional format of videotape. The viewer watches from beginning to end in real-time without any branching of the program. The experimental group also received instruction in an independent learning environment but via interactive video. Interactive video is computer controlled video which allows branching of the program for remediation or enrichment (Floyd,1980; Levenson, 1983; Troutner, 1983). With interactive video, viewers have some degree of control over sequence and selection of material. Content of both tapes was nearly identical (see Chapter IV for specific differences in the tapes). The tapes were produced by the investigator and are based on a slide-illustrated lecture covering the same material.

The subjects for this study were drawn from 320 college students enrolled in the teacher education program at Southern Oregon State College. During any given quarter 50 to 60 of these students are enrolled in required educational media classes. During winter and spring quarters of 1985 all students in these classes were involved in the study. Additionally, 30 students were volunteers from other required Education classes. From this group of 128 subjects, students were randomly assigned to experimental and control groups utilizing a random number table (Borg and Gall, 1983). Participants then completed a 25-item written multiple-choice test (pretest) covering key concepts incorporated in the videotapes. Subjects waited five to seven weeks before watching the appropriate videotape. Students were given an alternative form of the same test (posttest) immediately following the treatment. Analysis of covariance was used to compare achievement of the control group with that of the experimental group. Students were informed that their scores on the tests would only be used in conjunction with this study, although the information contained in the instruction would be included in exams for the class.

Participants also completed an attitude survey. This Personal Reaction Form offered insights into students' perceptions relating to the instruction. The written reaction form was measured on a five point Likert scale, and related to such items as rate of instruction, frustration level, technical problems, and motivation. Significance testing for between group differences in responses on individual items was conducted using the Mann--Whitney U test. Within and between group agreement levels were calculated using the Leik Scale of Ordinal Consensus (Leik, 1966). Demographic data and time spent on instruction were also recorded.

Scope of the Research

It is not claimed that the results of this study can be generalized to all learners or all content areas. However, this study does provide data on one content area and hopefully will promote investigation of interactive video's instructional effectiveness in other content areas.

Photography was chosen as the content area for several reasons. As stated previously, students involved in learning photography often have a wide diversity in experience level (Nikon, 1979). It was postulated that the self-paced capabilities of the interactive videotape would be effective in teaching this subject. Additionally, photography is a subject that requires a visual approach (Langford, 1977); the visual strength of videotape is valuable here for such purposes as magnification and illustrating examples of photography. A third factor in the selection of teaching basic photography skills was the fact that these skills are not perceived as trivial. As our society becomes more visual in learning, there is a growing need to be able to communicate visually (Fransecky and Debes, 1972). This study explores the characteristics that interactive video and linear video possess and explores some implications for other content areas. The review of related research examines studies in other content areas and examines factors such as motivation, attitudes, and cost effectiveness. This study measures only short term achievement and student attitude in the area of instruction in basic photography skills.

This study does not compare interactive video or linear video to live instruction. The effectiveness of linear video in comparison with live instruction and other modes of delivery has already been studied in great detail. In a review of hundreds of comparative effectiveness studies, in general, no significant differences were found when instructional linear television was compared with face-to-face instruction. Chapter II briefly refers to some of these studies and outlines attributes of instructional television.

Perhaps a more relevant issue is whether to study method or medium. William Winn, in the article "Why Media" (1984), postulates that research should be conducted not on which delivery system is most effective, but on what characteristics a medium of instruction has that makes it effective or ineffective. Winn notes that computer-assisted instruction is not significant for how it works but for the fact that it allows self-paced instruction, individualized instruction, and branching ability. He reasons that written text could also provide these characteristics. Therefore, we should be examining the effects of self-paced instruction, individualized instruction, and branching ability, not of computer-assisted instruction. Winn disagrees with McLuhan and contends that the method not the medium is the message.

In the last ten years, research in instructional media has increasingly measured attributes of specific media rather than comparing formats of media (Fowler, 1980). However, certain media have inherent characteristics; they are "better" at certain methods than other modes of instruction. Certainly, video or slides are more effective in communicating visual concepts than an unillustrated lecture. These characteristics are, therefore, almost inherent to the medium. We can make some generalizations that interactive video is "better" at doing certain things than other modes of delivery. In this study assumptions are made about characteristics that interactive video facilitate as compared to linear video. Interactive video would appear to facilitate visual learning, self-paced instruction, branching, and other methods of instruction. These "facilitated characteristics" are detailed in Chapter II.

Statement of Hypotheses

The results of the study will determine retention or rejection of the following null hypotheses:

1. There is no significant difference ($p < .05$) in achievement test score means between those receiving instruction via interactive video (experimental group) and those receiving instruction via linear video (control group).

2. There are no significant differences in attitude measure means ($p <$ .05) between those receiving instruction via interactive video (experimental group) and those receiving instruction via linear video (control group).

$$M_E = M_C$$

Research Objectives

The primary objectives of this study are :

1. To determine if there is a significant difference in achievement between students who receive instruction using an interactive video mode and those using a linear video mode.
2. To determine if there are significant differences in attitudes about the instruction between students using an interactive video mode and those using a linear video mode.
3. To analyze the factors which contribute to the difference in achievement between the groups (assuming there is a difference).
4. To analyze factors contributing to the difference in attitude between the groups (assuming there is a difference).

The following questions will be posed:

1. Will students who learn using the interactive video mode, rather than the linear video mode, score higher on a written examination at the end of an instructional session?
2. Will students prefer receiving instruction via the interactive mode or the linear mode?

3. What factors contribute to the difference in achievement between the two groups (assuming there is a difference)?
4. What factors contribute to the difference in attitudes between the two groups (assuming there is a difference)?
5. Will the technical complexities of the interactive video hinder learning?

Definition of Terms

Achievement: Difference between pretest and posttest scores on the written test measure.

Basic photography skills: Fundamental operation of a camera, knowledge of types of cameras and films, and how to take pictures.

Delivery System: Hardware and software configurations employed to present instruction.

Independent learning environment: Students working outside of a full class situation. Students work one-on-one without the instructor's guidance. However, an instructor or aide is available if technical assistance is needed.

Instructional Effectiveness: The number of correct responses students obtain on the achievement test. The test is designed to measure cognitive recall, synthesis, and immediate transfer.

Instructional Mode: Used interchangeably with delivery system.

Interactive video: A videotape controlled and accessed by a microcomputer. Viewers have some degree of control over sequence and selection of material. In the literature, interactive video is used interchangably with intelligent videodisc or interactive videodisc.

Linear video: A videotape viewed from beginning to end without any branching of the tape forward or backward. The program is viewed in "real-time".

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

A computer search of the Educational Resources Information Center data base (ERIC), from 1966 to February, 1985, identified 64 citations with the phrase "interactive video" somewhere in the title or abstract (of these 15 had "interactive video" in the title). Additionally, 25 other citations containing the descriptors "intelligent videodisc", "interactive videodisc", or "interactive videotape" were identified. Interestingly, ERIC searches conducted in October 1983, utilizing the same descriptors, resulted in a total retrieval of only 20 citations. A search of Dissertations Abstracts identified 8 dissertations relating to interactive video. A search of Books in Print identified only two books devoted to interactive video.

Most of the citations focused on defining interactive video, hardware aspects, sample programs, or on the promise of the medium. This is supported by the dissertation of Fishman (1983), who reports that only nine citations out of 155 located were educational research studies and that only two were of definite value to her study. Similarly, Cambre (1984) reviewed 25 articles in technology journals and trade publications related to interactive video and found only one reported empirical study designed to address questions concerning the nature or effects of interactivity, instructional design, learning strategies, or other pedagogical issues. She noted that fully one-half of the articles described the functions and capabilities of the hardware. Cambre cautions that "the extent to which we begin looking at substantive issues relating to interactive video technologies might very well determine the future of these technologies in education" (p. 24).

The review of literature impinging on this study is divided into five main sections: defining interactive video, characteristics of interactive video, effectiveness of related media, effectiveness of interactive video, and finally the role of the medium.

The first section offers several author's definitions of interactive video and explores relative advantages of videodisc compared to videotape. To gain a further understanding of interactive video the instructional characteristics that the medium can facilitate are discussed in detail. This is especially important in light of William Winn's argument that it is the method, not the medium, which needs examination.

Before investigating research on the effectiveness of interactive video it may be beneficial to review the literature on the comparative effectiveness of other delivery systems. Interactive video has been called the "omnibus medium" (Nugent, 1979); that is, it encompasses the attributes of most other media. Therefore, it is appropriate to examine media which are associated with interactive video. This chapter includes a brief synopsis of the research on the effectiveness of traditional instructional television, computer-assisted instruction, and other instructional media.

The next section investigates the effectivness of interactive video by citing studies and applications in several areas: business, the military, and medicine, as well as education. Numerous interactive video programs are described and discussed. In addition to examining research on achievement outcomes, several other factors are discussed, including attitudinal effects, time efficiency, and cost effectiveness.

The final section looks to the future. In this section, projections are made as to what role interactive video might play in the teaching/learning process in the future and how that role may affect educational institutions. Stumbling blocks that stand in the way of interactive video reaching its instructional potential are also discussed. The review of related literature concludes with a summary of the major findings and topics discussed in the chapter.

Defining Interactive Video

Interactive Video is a powerful new training and information retrieval device which combines the branching and interactive ability of the microcomputer with the visual and auditory strength of videotape (Thomas, 1981). Streibel (1982) and others use the term, "intelligent videodisc", synonymously with "interactive video". Streibel concluded that the power of the medium is that all of the video and audio information can be randomly accessed by a microcomputer which is in turn driven by the diagnostic and prescriptive procedures built into the microcomputer program. Steve Floyd (1980) characterizes interactive video as having the "flexibility of accessibility of a book, with the impact of motion and immediacy of video, as well as the feedback and documentation that we generally associate with live instruction" (p. 73). He indicates that well-designed lessons can increase the feedback, flexibility and impact of a lesson, while reducing the delivery cost. He loosely defines interactive video as any program in which "the sequence and selection of material is determined by a viewer's response." Thomas (1981) provides a more technical definition: "a combination of microprocessor control, electronic recording, and visual display" (p. 18).

Interactive video may involve either videotape or videodisc. Andriessan and Kroon (1980) propose that the videodisc will become a powerful instrument in education. They state that videodiscs can be produced easily in large quantities and at low cost. Videodisc provides greater image quality than videotape for still pictures and slow motion. The disc allows rapid random access, programmed stops, and unlimited pause time.

However, Floyd argues that the cost and production constraints for mastering a videodisc makes it prohibitive for most small-scale users at this time. Kehrberg and Pollock (1981) propose that videotape-based systems can be used to reduce the cost of using an interactive video system. In fact, tape-based systems are usually used in the development stage. The University of Utah VCIS project used videotape because the videodiscs were expensive to master and changes could not be made without remastering (Bejar, 1982).

Before videodisc will be cost-effective on a limited copy basis there will need to be recordable videodiscs. However, progress on recordable discs has been slow. Tim Onosko (1982) in "Visions of the Future" reported that every manufacturer of video hardware has a disc recorder in development. Nearly three years later there still is not one commercially available.

Characteristics of Interactive Video

Research in instructional media has increasingly examined attributes of specific media rather than comparing formats of media (Fowler, 1980). However, it is apparent that media have certain inherent characteristics; that is they are "better" at certain methods than other modes of delivery. One can make some generalizations that interactive video is "better" at doing certain things than other modes of instruction. In this study some assumptions are made about characteristics that interactive video facilitate as compared to linear video. These "facilitated characteristics" are detailed in this section.

Visual Strength: The videodisc has been described as the "omnibus" medium (Nugent, 1979), allowing all types of visuals to be displayed: photographs, text, diagrams, charts, and video (live action). In this study, since both the interactive video and the linear video use the same format of videotape, the visual impact between modes is similar. However, the interactive video mode incorporates computer generated text. Videodisc would have the added advantage of still imagery. Videodisc offers a sharp image in the still mode even for extended periods, while videotape can only be paused for short periods and suffers from a drop in clarity. The ability for the videodisc to display large passages of text is still questionable. Because of the limited resolution of the standard television set (525 lines), videodisc does not carry large amounts of print well (Nugent, 1979). Considering the problems of reading from a television screen, it may be more advantageous to present large amounts of text in manuals, texts, or workbooks.

New experimental intelligent videodisc systems have the capability of allowing audio while in the still mode (Levenson, 1983). Interactive videotape or videodisc also has the capability of allowing computer generated imagery to be overlayed with real video. This is a feature which has great promise for modeling and simulations (Allen, 1984; Kadesch, 1981).

Information Storage: Videotape, and especially videodisc, can serve as a visual database. Many more images can be stored and offered via video then in a slide program or illustrated lecture. The videodisc can contain 54,000 images per side which can be individually recalled (Backer, 1982). Striebel (1982) asserts that a key asset of the medium is the fact that all of the video and audio information can be randomly accessed by the microprocessor. Numerous videodisc projects have used the disk as a visual storage, retrieval, and display device. These include such applications as art collections, biology slides, and even merchandise catalogs. This visual database feature is so important that the State of Alaska's Department of Education found the most positive endorsement of videodisc technology to be in the replacement of film and slides (Bosco, 1984).

Audio: Video offers the advantage of allowing lip-sync and direct synchronization with the visuals. This is an inherent advantage over slide-tape media. For this study, the audio capabilities are equal for both the interactive video and the linear video modes. Intelligent videodisc can offer two separate soundtracks which could be used for alternate soundtracks, e.g. two different languages, two different levels, a track for remediation or one with a musical background and one without.

Interactivity: Interactive video offers the learner a participatory experience. Grabowski and Aggen (1984) and Striebel (1982) stress that the interactive features of interactive video are the real strength of the medium. With interactive video, learners are given some control in the learning experience. Learners control which sequences they want to view and in which order to see them (Jonassen, 1984).

The level of interactivity needs to be examined very carefully. Hoekema (1983) comments that a surprising number of sophisticated videodisc training programs provide users with a low level of control over program pace and sequence. Many intelligent videodisc systems utilize only a numeric keypad for input, thus often limiting the learner's level of interaction to only entering the position for the program to branch to (Holzman, 1981). Bork (1982) asserts that the quality of interaction can be assessed by noting the type of input required of the learner during the interaction, the method of analyzing this response, and the action taken in the program after the input. Bork points out that the quality of interaction designed into the program will ultimately determine the instructional quality of that program.

Many educators have addressed the need for participatory experiences in learning (Cohen, 1984; Dewey, 1916; Heinich, Molenda, & Russell, 1982; Kemp, 1977; Kadesch, 1981). Dale, in his classic media study, directly correlated participatory experience with effectiveness of learning. Cohen (1984) states that "making a student become actively involved with the learning situation increases the likelihood that the student will learn" (p.18).

Individualized Instruction: Interactive video allows branching and pacing to the learner's own interest and experience level (Ignatz and Ignatz, 1982). The microprocessor qualities of interactive video allow for self-paced instruction. The same qualities can also offer prescriptive and diagnostic information to the learner and the instructor. Advanced students may skip over some of the material, while other students may branch to supplemental material for remediation. One student may spend three times as much time with the program as another. In the traditional lecture, film, or slide-tape program all learners would work at the same pace. Kadesch (1981) found that four factors contribute to enhanced learning:

* the requirement of a high level of mastery;
* a relatively large number of unit quizzes;
* immediate feedback on student performance;
* review units or review questions.

Surprisingly, he found that self-pacing, as opposed to pacing constraints imposed by the instructor, is not of particular benefit to students. Cohen (1984) also advocates caution in allowing extensive learner control of pacing and content. Hartley and Lovell (1978) suggest that a free-learning approach may interfere with achievement of less competent, less confident students. Learners with such control may not make effective decisions concerning their own learning sequence. Cohen argues for adaptive rules in which students are given more control as they become more competent and confident. Furthermore, she concludes that a certain amount of learner control is "highly suggested and desired" in interactive programs. Hiscox (1981) summarizes the need for individualized instruction:

> The success of the videodisc in instruction will depend largely on how well they maintain student's motivation by providing attainable goals, frequent feedback, appropriate difficulty and minimized failure, and whether they allow for such individual differences as attributes and interests, time required for learning, student's knowledge base, and generalized ability. (quoted in Ehrlich, 1984, p. 3)

Management of Instruction: Interactive video can incorporate computer-managed instruction, thus providing a record of the learner's performance. Test scores and a record of learner progress can be provided as a by-product of the instruction. The program can be designed to require a criterion level of success before the learner can proceed with the instruction (Bosco, 1984). In this study, the software keeps a record of each response for every question attempted by each student, and reports a total score and class average. The relative merits of using scores from a test completed at the computer is a concept that needs further analysis. Because of this, and because the investigator did not wish to penalize learners for experimenting with different answers and learning strategies, the scores from the questions that students completed at the computer were not used in this study.

Simulations: The branching ability of the microprocessor allows for visual simulations. The picture taking simulation in this study, making picture-taking decisions and then seeing a simulation of the resulting photograph, could not be easily done with linear videotape or any other medium. This simulation is perhaps the primary difference between the tapes in this study. Kadesch (1981) did interactive video simulations in physics and found that these lessons allowed students to explore the effects of systematically changing the values of parameters for a system.

Summary of Attributes: Hoekema (1983), continuing in the tradition of extravagant claims for interactive video, asserts that the medium combines the strengths of all other media of communication. But he also cautions that because of these considerations, interactive video takes a longer time to develop than any other medium. Ehrlich (1984) adds that sound instructional design considerations will ultimately determine the success of the medium:

> The integration of the media capabilities of a computer/videodisc training system are determined by appropriate instructional design strategies and visual design and message design techniques. Within the limitations imposed by the hardware and software capabilities of a particular delivery system, the instructional message should be dictated by sound instructional design considerations. (p. 2)

Nugent (1979) advocates that designers of interactive video programs must take into consideration the unique attributes of the medium. She asserts that interactive video is not a television nor a computer; it is a technology of its own, requiring unique design strategies and rendering many current design assumptions obsolete. She feels that this approach will demand a multi-dimensional instructional design that exploits the medium's capabilities in meeting learner needs. Kadesch (1981) advises that before we really know the attributes of interactive video more research is needed.

> It now seems possible to discern the desirable attributes of an instructional delivery system together with ... (the) desirable properties of the instruction itself. Much more in the way of materials in the video computer format need to be developed and extensive evaluations of these materials need to be made. (p. 301)

Effectiveness of Related Media

Linear Television

Since the 1950's a great deal of research has examined the effectiveness of television as an instructional method. A preponderance of this research has been concerned with whether television teaches as effectively as face-to-face classroom instruction. Among the first of the studies comparing television to other forms of instruction were those performed by Erickson and Chausow in the 1950's (Erickson and Chausow, 1960). Their studies examined the relative effectiveness of offering college courses via open circuit television. They concluded that no significant differences were found when instructional television was compared to face-to-face live instruction. Since that time major reviews of literally hundreds of comparative effectiveness studies have reached the same general conclusion (Allen,1971; Campeau, 1966; Chu and Schramm, 1967; Dubin, Hedley, Schmidbauer, Goldman, & Traveggia, 1969).

Chu and Schramm reviewed 207 studies involving 421 comparisons between instructional television and live instruction. From this analysis they reported that in 65 per cent of the cases there was no significant difference; in 21 per cent, students learned significantly more via television; and in 14 per cent, they learned significantly less via television.

The apparent tendency of television to be less effective with older students than younger learners was markedly confirmed in results from college groups. Schramm (1962) noted that in reviewing studies involving college students; only three per cent of the studies found television to be more effective than live instruction; 13 per cent found television less effective; and 84 per cent found no significant difference. Schramm summarized that television's improved effectiveness over live instruction appeared most frequently in the primary groups, less frequently in the high school groups, and least frequently in college and adult groups.

Further analysis by Chu and Schramm provides additional information concerning television's effectiveness. In the studies using adult participants, there appeared to be no conclusive or consistent evidence to suggest that the following variations would improve learning from television: physical variations such as size of screen, use of color, camera angle, variations in viewing conditions pertaining to viewing angle and distance, home or school viewing, homogeneity or heterogenity of viewing groups, permissive versus required viewing; pedagogical variations such as use of humor and animation, dramatic versus expository presentation, use of inserted questions; variations in student response mode; and variations in student-teacher contact, such as two-way talkback.

Corcoran (1969), in reviewing the literature on advantages and disadvantages of instructional television, concluded that ITV is most effective to impart knowledge of small, distant, or unusual objects, and past or live events. He also noted that a major limitation of television was that students and teachers viewed television as an impersonal, one-way communication device.

Abel and Creswell (1983) in a research project involving 3,932 students in 12 telecourses found that between 50 and 75 per cent of the students felt the need to ask questions during the instruction to clarify course content. Furthermore, as noted by Schramm (1962), television as an instructional medium; does not stop to ask questions, it does not readily permit classroom discussion, it is an inefficient medium for conducting drill, it does not adjust well to individual differences, and it tends to encourage a passive form of learning. The lack of two-way communication in ITV is repeatedly cited as the most significant disadvantage of linear television (Abel and Creswell; Campeau, 1974; Corcoran; Schramm, 1962).

Several researchers suggest that to properly evaluate the effectiveness of televised instruction, new and appropriate criterion instruments need to be employed. McKeachie (1967) cites his own and other research in support of the conclusion that television is less effective than live instruction for college students. He states that although the differences are not statistically significant by themselves, their consistency is statistically significant. However, he cautions that achievement tests do not measure the proficiency with which students can evaluate visual properties of the instructional content. These properties might be better taught via televised instruction. Attitudinal measures may also prove to be a possible indicator of significant differences.

One confounding influence in this discussion is the relative quality of the television programs involved in the research. Does the software in the studies exploit or neglect the strengths of the medium. A major problem with instructional television programs has been the use of "talking heads" instead of utilizing a highly visual approach (Campeau, 1974).

Computer-Assisted Instruction

Since interactive video could be considered as the combination of instructional television and computer-assisted instruction (CAI), it may be beneficial to briefly review the research on the effectiveness of computer-assisted instruction as well as that on instructional television. With the current interest in computers in education there has been a wealth of research analyzing the last 20 years of CAI research. Each review arrives at conclusions that are fairly consistent with other reviews.

Dence (1980) reviewed 17 major CAI studies published between 1969 and 1978. He found that, in a review of studies using CAI under a variety of conditions and comparing its use to traditional methods of instruction, there was an abundance of no-significant difference findings between the two methods. However, Dence did find that the results of each study helped to define which variables could be of importance for future research. Among those factors are: subject matter, type of CAI, branching, student attitudes, feedback, individualization, time, retention, and student variables.

Fischer (1983) examined the conditions necessary for effective CAI. His conclusion:

> CAI is an effective use of computers-- for certain students, in some subject areas, as a supplementary activity. Besides increasing student achievement, it also changes student attitudes and behaviors, apparently in positive ways. Used wisely, it can be a powerful and effective tool to help students gain control of their own education, both in achievement and attitude. (p. 84)

Fischer specifies that CAI appears to be most effective when it's integrated with regular science or foreign language instruction and used with either low or high achieving students.

Perhaps the most positive findings are those reviewed by Bracey (1982). In a review of several large scale research projects he stated that:

> In general, students learn more, retain more, or learn the same amount faster using computers. Unfortunately, no studies have been completed that tell us why that may be. (p. 52)

The most specific and most often quoted of any of the reviews of research is an article by Kulick, Bangert, and Williams (1983). These researchers integrated findings from 51 separate evaluations of CAI in grades 6-12. The analysis showed that students raised their scores on final examinations .32 standard deviations by using computer-based instruction. Additionally, these students developed very positive attitudes towards courses they were taking. Finally, the computer substantially reduced the amount of time that the students needed for learning. Orlansky (1983), in reviewing studies of military training found that computer-based instruction was not significantly better at increasing achievement, but was significantly better in saving students time in attaining the required minimum levels of knowledge and skills without a loss of student achievement.

As in the review of research on film and television, there is no overwhelming research evidence of the superior effectiveness of computer-assisted instruction. There are indications that computers can be effective for certain instructional tasks (such as tutorials, drill and practice, problem solving, simulations, inquiry, and dialogs); in certain subject fields (science, mathematics, foreign language); and with certain types of learners (usually high and low achievers but less frequently with average achievers). There is sufficient evidence to suggest a strong motivational element in computer use by students. Continued use of computers lessens the initial motivation and tends to reduce retention. The heightened effectiveness of CAI with elementary and secondary students is substantially reduced at the higher education level. Most of the research concludes by stating that more research on CAI needs to be done.

Research Based on Other Media

Because of the paucity of research comparing interactive video to more traditional media it is useful to examine comparative delivery strategy studies based on other media.

A research study (Canelos, et al., 1980) examined the type of instructional strategy that would most effectively facilitate the learning of music intervals for beginning music majors. The three delivery systems were linear programmed text, computer-assisted instruction and self practice using textbook study. Results indicated that CAI was a significantly better instructional strategy for learning music intervals than programmed printed instruction or textbook study. An attitude measure indicated that the learners preferred the instructional information to be well organized.

Hayes and Brinbaum at the University of Maine asked young children questions about information that had been presented only visually, only aurally, or both ways. The number of correct answers given by the children was significantly greater when the questions were based on visual material rather than on information presented both ways or only aurally (Arnold, 1982).

Contradicting this is the classic work of Edger Dale (1946). He found learning which involved both seeing and listening to be more concrete than either mode alone. Jerrold Kemp (1977), in another classic media study, found participation and self pacing to be important factors in the effectiveness of instructional systems.

Motion pictures and television have been considered to be quite similar presentation devices. Chu and Schramm (1967) concluded that there appeared to be little difference between learning from television and learning from film if the two media were used in the same way. This may provide some explanation as to why Reid and MacLennan (1967) found that instructional film research exhibited the same general no-significant-difference pattern as that found for most comparative effectiveness research.

McKeachie (1967) reviewed film research and found that participation increased learning. He suggested participation be planned in the production of a film or television presentation. Further, students having prior experience with instruction via film learned more than students without such experience.

Several researchers have examined the relative effectiveness of still and motion pictures. Chu and Schramm (1967) found no consistent evidence that motion pictures enhanced learning more than still visual images. However, in two other studies some superiority for moving over still images was noted for tasks in which continuity of the filmed action played an essential part in learning to perform the task (Campeau, 1974).

Because of the complexity of determining the effectiveness of multimedia instruction, few studies into this question have been conducted. Campeau calls for more research in which learner, media, task, and situational variables are specified for use in multivariate designs. The combining of media to produce the maximum impact on learning remains an area open for further investigation.

Jamison, Suppes, and Wells (1974) summarize that, at the college level, it is broadly correct to conclude that most media of instruction are equally effective.

Summary of Comparative Effectiveness Research

An extensive review of comparative effectiveness of media research was conducted. On the basis of that review, the conclusion that any medium can be an effective method of instruction has been supported. The general consensus is towards no-significant difference findings concerning the relative effectiveness of media. Evidence suggests that how the instructional materials are designed, applied, and implemented may be of more importance than which media is used to deliver the instruction. Indeed, this again affirms Winn's contention that the researcher should be more concerned with the instructional method employed than with the medium used to deliver that information.

It is apparent from the body of literature reviewed that there has been a wealth of research conducted on the comparative instructional effectiveness of media, yet decisions on which instructional method to employ are still frequently based on other considerations. This has been summed up especially well by Campeau (1974) who cautions that:

> ...decisions as to which audiovisual devices to purchase, install, and use have been based on administrative, and organization requirements and on considerations of cost, availability, and user preference, not on evidence of instructional effectiveness. (p.31)

Effectiveness of Interactive Video

Sample Programs

Educators have done much of the basic work on interactive video. In Utah, so much work has been done by the University of Utah at Salt Lake, Utah State University and B.Y.U. that the state has been referred to as "videodisc valley" (Onosko, 1982).

In 1978 the Corporation for Public Broadcasting funded public station KUON-TV at the University of Nebraska to investigate the potential of videodisc technology for public/instructional television. As part of this multiyear grant, a variety of videodisc programs have been designed and produced on a range of topics--from fingerspelling for the hearing-impaired to gymnastics, dentistry, and flight training (Daynes, 1982).

A project which developed a retrieval system to evaluate the advantages and disadvantages of an interactive computer and video display system over traditional methods for using a slide library was used at the art school of the University of Iowa (Sustik, 1981).

The Guided Exposure to Microcomputers project at Miami-Dade Community College adapted linear videotape to interactive video. This was done to familiarize faculty with microcomputers and the potential of interactive video (Anandam and Kelley, 1981).

A setback for educational interactive video was the ABC-NEA Schooldisc. This project was intended to produce magazine-type discs with interactive capabilities on a yearly basis. The project was suspended because the cost of producing discs using teams of curriculum and production personnel became too high in relation to the small number of schools with disc players. "It is disquieting to consider that a major television company and the largest educational association in the U.S. have stumbled on a videodisc project" (Bosco, 1984, p.14).

Electronic Learning magazine (April, 1984) published a guide to educational videodiscs, which listed 33 programs, characterized by a wide variety of formats, levels of interactivity, and prices. Subject matter ranged from Astronomy to Whales and programs included the highly interactive program "The Puzzle of the Tacoma Narrows Bridge Collapse". In this program students take part in a bridge construction simulation and study the relationship between bridge collapse and harmonic motion.

Interactive videodiscs for the consumer have recently been introduced. Optical Programming Associates (OPA), a consortium of MCA, Phillips and Pioneer have produced educational discs in over a dozen subjects. The first was "How To Watch Pro Football," which was followed by the "First National Kiddisc," a collection of 22 games and activities for children (Onosko 1982). Subsequent offerings have included "Belly Dancing...You Can Do It!", "Gardening at Home", and the interactive mystery "Murder, Anyone?", in which players are challenged to solve a murder by questioning eight suspects and cracking their alibis. "Dragon's Lair" and "Foxfire" are two interactive videodiscs which have been popular in video arcades and are now being adapted for home use.

Interactive video has had applications in the industrial market for both sales and training. Sears published an experimental catalog for Summer 1981 and organized it on interactive videodisc (Onosko 1982). Cuisinarts Inc. uses interactive video systems to demonstrate its products and answer questions in retail outlets. In comparison of sales at two major department stores, one with the system and one without, Cuisinart reported sales to be 65 per cent higher at the store with interactive video. Two of the largest industrial users are General Motors and Ford. Together they have installed more than 25,000 videodisc players and have produced a number of discs for training and customer information. Some disks are programmed differently for two types of users, sales personnel and customers. One program uses gaming sequences for the quiz segments on features of new car models. Salespersons earn or lose Product Training Dollars according to their responses. Ford conducted a survey of its dealers and found that 70 per cent of the dealers felt the interactive training improved the quality of customer presentations; 70 per cent said it made it easier to promote a broader range of product options; and fully 90 per cent said it improved the overall quality of their sales training. More than 4,000 dealers have interactive video programs in use (Broderick, 1982).

The medical community has also been a leader in development of interactive video instructional materials. The American Heart Association is marketing an interactive videodisc system for teaching cardiopulmonary resuscitation. A mannequin is wired into the inteeractive system. As the learner practices compressions and ventilations, information on their effectiveness is relayed to the computer. Appropriate instructions, suggestions or demonstration footage are displayed on the television screen. Learners are given immediate feedback on their performance (Levin, 1983). Research findings from this project are discussed in the next section of this chapter.

Another program used real life medical emergencies, enacted dramatizations, and sections from existing medical films to create simulations for training Emergency Medical Technicians (Keener and Bright, 1983). A series of 60 interactive video programs on the subject of health physics is being produced for the Nuclear Energy Industry (Broderick, 1982). A pharmaceutical company used 30 interactive videodisc systems to explain the uses of new antipsychotic medications to participants of the 1984 American Psychiatric Association convention. The use of interactive video as information kiosks is an increasingly common application of the medium.

The military has been especially noticeable in embracing interactive video training. Perceptronics of Woodland Hills, California, under a U.S. Department of Defense contract, used realistic film segments, stored on videodisc, coupled with computer graphics to produce a game-like simulation for training military tank and gunnery personnel (Onosko 1982). The Army Communicative Technology Office (ACTO) is studying non-print means such as videodisc for presenting technical and instructional materials. In their tests, ACTO found virtually no difference in training results for interactive video as compared to traditional instruction, and in some instances results were better for interactive video due to its ability to allow immediate remediation (Broderick, 1982). At the University of Maryland, a videodisc program has been developed to teach functional literacy to field soldiers. The program is a time-travel simulation in which soldiers travel through historical events such as the Battle of the Bulge. The program is in a game format, and soldiers must apply functional literacy to accomplish their missions.

Perhaps the most unique and fascinating interactive video project may be the creation of "vicarious travel experiences", the work of Massachusetts Institute of Technology's Architecture Machine Group. One of the MIT travel systems is a visual tour of Aspen, Colorado. Viewing the "movie map" you can drive down a street, turn corners or enter a public building. Viewers can ask questions about the city and can even fly over Aspen via a computer graphic simulation (Onosko, 1982).

More striking than the wide diversity of interactive video programs is the lack of formative evaluation of these programs. Most of the literature is concerned with the production and promise of the medium and not with its effectiveness. The next section examines several projects that report research results.

Research Findings

Most of the research findings are based on anecdotal accounts, observations, and learner feedback with little statistical data. For example, the findings of the Art History project at the University of Iowa were that the major strengths of interactive video were speed, information retrieval, verbal and visual integration, research possibilities and "fun". The major weaknesses were poor image quality, inability to compare images simultaneously and the limited range of material. Striebel (1982) reported that, overall, the system was viewed favorably (subject to improvements and modifications).

The short (six year) history of research on interactive video is almost a case study of poorly conducted, inappropriate, and misapplied research. The studies are characterized by; small sample sizes, confounding influences, lack of control groups, invalid or unreliable testing instruments, inappropriate conclusions, and an almost total lack of replication. In all fairness, much of the research of the past two years is better, and has investigated more focused and relevant questions. This study is designed to avoid the methodological errors reported in previous research.

One of the earliest interactive video studies (Andriessan and Kroon, 1980) was conducted at Philips Research Laboratories and used an interactive videodisc to teach 12 students about the workings of the heart. The program was adapted from an existing 20-minute film. The researchers made some specific observations of the new medium. The average time the student spent with the system was 55 minutes, the shortest time was 26 minutes, the longest two hours. Most participants viewed the entire lesson while pausing several times to review or make notes. The questions on the posttest were "mostly answered correctly". The lowest score was 70 per cent. The questions showed that "the subjects had understood the material quite well. In general, the subjects expressed positive opinions of the system" (p. 24). In comparing the interactive system with slides and film, students mentioned the advantages of personal control, and branching through the material. Critical remarks mostly addressed the actual course content.

An interactive economics unit developed by the Minnesota Educational Computing Consortium found that initial reactions of students and teachers were favorable and suggested that the use of microcomputers and videodisc technology will play a significant role in the future of instruction (Kehrberg and Pollack, 1981). Research procedures involved administering a pretest and an alternative form posttest to 44 students. Mean scores went from 57 per cent correct on the pretest to 78 per cent correct on the posttest. This resulted in a t-test value of 8.02 (df=29), which indicated a statistically significant difference between the pre and posttest scores. The researchers volunteer that these scores should be interpreted cautiously. No comparison group was used and controls during the study were lacking. Furthermore, a mean posttest score of 78 does not describe how this method compared to other methods of instruction

(Glenn, Kozen, and Pollack, 1984).

Another less-than-perfect experiment involved Omar Bradley Middle School in San Antonio, Texas (EITV, 1985). Four-hundred-and-ten students were divided into three groups of classes. The first watched a linear video program about the biological control of insects. The second group of classes watched the same tape but discussed it with their teachers, and the third group saw the same program in an interactive format. Comments by Science teacher Arthur Jennings hint to some of the study's methodological problems.

> The results were predictable: Category One scored lowest, Two was next best, and the 'interactive kids' in Three scored substantially higher. Almost all of them scored 90 per cent or better while few of the others exceeded 80 per cent.
>
> It was not a fair experiment. The day was the Monday after Thanksgiving; the program was a less-than-lively lesson not covered in any of the books or curriculum... Furthermore, some of the classes were doubled in size for the occasion. It was a trial by fire, but the interactive system came through. (p. 64)

The military has also engaged in questionable research techniques. The U.S. Army examined four different methods of conducting training extension courses: film, linear video, interactive video, and baseline performance control. Results showed no significant difference between the linear and interactive video approaches, "a finding that may be attributable to the fact that the interactive functions of interactive videodisc were not properly utilized" (Ebner et al., 1984, p. 28).

Commercial interests seem to have an especially strong tendency to offer generalized conclusions and few specific findings. Bank of America conducted an evaluation on a disc they produced on bank-teller skills. The program used demonstrations, drills, reviews, and a simulation to promote learning. Without giving information on sample size or procedures, the researcher notes that 100 per cent of the students who responded to a questionnaire felt the program helped them learn. A hundred per cent felt the information was clearly presented, 83 per cent had no machine breakdowns, and 75 per cent said enough interaction was used. A more sobering way of stating this would be: 17 per cent had machine breakdowns, and one-fourth of the learners felt the need for more interaction. Nevertheless, the author, Nicholas Iuppa, (Floyd and Floyd, 1982) concludes that "people have learned to do something far better than they ever could with standard video" (p. 138); and that interactive video may become "the most important teaching medium in the world" (p. 135).

One commercial project that does offer some valuable data is Dick Handshaw's work for the First Union Bank of North Carolina. The project was not conducted as an experiment in interactive video, but as a solution to a serious business problem. The bank needed to train a large, geographically-dispersed audience in the use of a new automated banking system. They had a short amount of time and wanted to build a positive attitude toward the automation project. Through interactive video, 100 learners were trained in 12 cities in 3 weeks. Trainees went through the instruction in an average of three hours and ten minutes, whereas instruction previously took two weeks without media. More than 80 per cent of the test audience was rated "good", 17 per cent "fair", and 2 per cent "poor". In short, training took 20 per cent of the conventional time, at 25 per cent of the cost (Handshaw, 1982).

Focused research has also been conducted in the academic community. Henderson et al. (1983) conducted research on the effects of interactive video on the performance of underachieving students in mathematics. A criterion-referenced pre and posttest and a School Learning Questionnaire were administered to 58 experimental students (interactive video) and 43 control students (traditional instruction). The results showed that the interactive video modules were effective in teaching or reteaching mathematical skills to secondary students. However, the hypothesis that exposure to the modules would result in an increase in effort attributions specific to mathematics was not supported.

Lyness (1985), using the American Heart Association's program, conducted research on the effectiveness of interactive video to teach CPR theory and skills. The willingness to experiment with non-traditional instructional delivery modes was prompted by a need for standardized teaching and a shortage of qualified instructors. On both a written test and performance tests there was no significant difference between traditional face-to-face CPR instruction and instruction by interactive video. Additionally, the interactive video system taught the concept of clearing an obstructed airway passage more effectively. Several confounding factors in this study include: the disc used a different instructor than the live instructor, students in live instruction worked in small groups, while the interactive video students received individualized instruction, and the study did not include a measure of retention.

A research study that did measure retention was conducted by Ebner et al. (1984) for the U.S Army Academy of Health Sciences at Fort Sam Houston Texas. The control group consisted of 42 trainees receiving instruction concerning intramuscular injections via traditional class sessions. The experimental group (n=28), also was instructed using traditional class sessions, but used interactive video as supplements for demonstrations, exercises, and study opportunities. On initial performance testing, 83 per cent of the videodisc group passed-- a rate that was eight percentage points ahead of the historical average. The control group's success rate, at 76 per cent, was approximately equal to the traditional norm. Although initial testing results favored the videodisc subjects, the difference in pass rates was not significant. However, on delayed posttesting the difference was significant. On a second examination, administered 17 days later, 75 per cent of all videodisc trainees were successful while only 59 per cent of the control group students were successful.

Five studies are worth closer analysis due to their similarity to this experiment. These similarities include the populations studied, the instructional methods compared, and the subject matter addressed.

Grantz and Reeve (1983) studied the effectiveness of interactive video in an independent learning environment using 60 students enrolled in classes required for admission to teacher education. Students watched a program concerning classroom management strategies, and then completed a written multiple-choice test. The same test was used for both pre and posttesting. Results indicated no mean difference between the pretest and posttest and no mean difference between the treatment and no treatment groups. An analysis of covariance between adjusted means yielded no significant difference with the three covariates: age, sex, and pretesting effects.

A case study of linear versus interactive videotape training was conducted at Clark Equipment Company. This project involved teaching a safety refresher course to veteran lift truck operators (Wooldridge and Dargan, 1983). A formal evaluation of the program using statistical analysis was conducted by Western Michigan University. The control group (n=16) viewed the conventional videotape together as a group in a meeting room. For the experimental group (n=16), an interactive system was placed in the supervisor's office, right in the work environment. Operators came to the office at their scheduled time and worked through the program individually. The interactive program required learners to answer each question correctly before proceeding to the following section. Both groups took a posttest comprised of the ten questions used in the interactive video program. Twenty-four days later they took a revised form of the same test as a retention measure. An 18.75 percent improvement was found for the experimental group. However, they reasoned that since tests may reinforce learning, there was the possibility that the interactive video group did well because they had the opportunity for reinforcement. Additionally, without a pretest there was the possibility that the experimental group did better than the control group because they happened to be more experienced, capable, or knowledgeable.

Because of these confounding influences, the posttest was redesigned and the experiment was repeated. The new test provided a way to isolate the ability to understand concepts from the ability to recall information. The results of the second study showed that the interactive video group scored 26.3 per cent better than the linear video group on "recall", but only 2.3 per cent on "concepts". A combined retention measure showed an increase of 13.6 per cent.

Ability to recall information was deemed of significant difference, but concepts and retention was not significantly correlated.

The most pronounced differences between groups concerned age and experience levels. In the interactive group, there was no evidence of the effect of age or experience. However, there was a very strong effect of both these factors on all operators who viewed the conventional videotape. The group's mean scores showed that young operators did significantly better (at the .01 level) than older operators. The data also showed that for the control group, the more experience they had, the lower their scores. The researchers concluded that by providing a means for requiring continuing interaction, interactive video apparently held the attention and involvement of older subjects to a greater extent than did linear video. Other data indicated that interactive video: reduced training time by 66 per cent compared to conventional classroom training (one hour compared to three hours), cut supervisor's time for administering training to five minutes, and improved the operator's motivation to learn.

Fishman's doctoral dissertation (1983) compared interactive video, linear video and traditional lecture as methods of delivering Cancer Chemotherapy instruction to nurses. Analysis of covariance was used to determine the significance of achievement differences between pretest, posttest, and retention test score means. The study also investigated the relationships between the dependent variables and nurse's age, educational background, and professional experience. Time measures and student opinions were also recorded.

The results of the study showed that the interactive video group (n=22) obtained a significantly higher level ($p < .001$) of mastery than either the linear video group (n=22) or lecture group (n=20) on both the posttest and the retention test. At pretest, all three groups had an equivalent mastery level of learning of approximately 60 per cent. At posttest, the interactive video group achieved a higher degree of mastery (93%) than the linear video group (81%) or the lecture group (73%). Although the interactive group did significantly better than the other groups on pretest-to-retention testing, they did not do better on posttest-to-retention testing. In the latter comparison, all three groups showed a decline in mastery, with the interactive video group declining ten points and the other two groups declining approximately five points each. These differences were not statistically significant. Fishman notes that these results must be qualified since the study utilized only one lecture and one lecturer (albeit the same instructor as in the videotapes). The linear video instruction took approximately one-half the learning time of the other groups.

Results from a seven-item semantic differential opinion survey were compared. There was no significant difference between groups on the following continua: "ineffective-effective", "impersonal-personal", "boring-interesting", "inefficient-efficient", "confusing-clear", or "inappropriate-appropriate". The item "humanistic-mechanical" showed a significant difference between groups ($p<.001$). Posthoc tests (Fisher's LSD) showed that the lecture group rated their method of instruction significantly less mechanical and more humanistic than either the linear video group ($t=2.99$, $p.<01$) or the interactive video group ($t=4.83$, $p<.001$). Older more experienced nurses found the computer more intimidating than the younger less experienced nurses.

For the interactive video group, gain in achievement correlated significantly with higher level of education, but did not correlate with experience or age level. Additional opinion data indicated that the nurses felt that interactive video enabled them to learn at their own pace, repeat segments at will, obtain immediate feedback, and work independently. The main weakness cited was the inability for human interaction. Fishman concludes that when designing interactive video more attention should be given to the student's ability to ask questions during or at the conclusion of the instruction.

Barbara Fowler's doctoral research (1980) utilized a multivariate approach in analyzing the effectiveness of interactive video. The study focused on comparing two different delivery systems for teaching cognitive recall of the names of the components of a 16mm projector. One delivery system was comprised of a programmed student manual, a videotape, and slides. Since the logistics of this system were physically manipulated by the learner, this approach was referred to as the "Student Mediated" delivery system (SM). The experimental delivery system utilized an interactive videodisc which presented video and audio material equivalent to that presented through the SM system. This was referred to as the "Computer Mediated" delivery system (CM).

The study also investigated the effectiveness of two different instructional approaches presented through each delivery system. The "No Conceptual Functionality" treatment (NCF) taught the components of the projector in the order in which they would be used in operating the machine. The NCF treatment presented information serially, from beginning to end, without random access to other parts of the program.

A second treatment, Conceptual Functionality (CF), employed a considerable amount of branching based on student performance. In order to achieve equivalent student interaction between groups, the NCF treatment incorporated branching as part of its sequencing. In the CF treatment the components of the projector were grouped according to operating systems. Participants were 120 undergraduate students enrolled in Educational Psychology classes.

Results of this study indicate that the CM delivery system was significantly better than the SM system in terms of higher achievement on cognitive recall, synthesis, analysis and transfer. Additionally, the CM students completed their instructional sequences in significantly less time than those using the SM delivery system. Student attitudes were also better for those students using the computer mediated videodisc.

Two effects associated with instructional treatment emerged from the study. The NCF treatment was slightly favored on time savings, while the CF treatment was favored on achievement on an optional posttest. Fowler suggests that studies utilizing different content be conducted to ascertain if subject of instruction affected attitude and achievement.

A factor analysis of the effectiveness of interactive video in biological science was conducted by Yeany et al. (1980). Among the variables examined as likely to predict achievement were scholastic aptitude, cognitive development, and locus of control. The control group attended lecture and lab sessions; the experimental group attended the same sessions but additionally individually watched an interactive videotape and used a guided problem-solving manual (total n=99).

Results indicate that interactive video had a significant positive affect on student achievement. The experimental group had a mean of 63.8, while the control group had a mean of 60.2. A positive correlation was found between cognitive development and achievement, but there was no correlation between locus of control and cognitive development.

The Role of Interactive Video

> Current efforts to merge personal computers with video to create interactive video programs may have the most long range impact of any of the new delivery systems. (Floyd, 1980, p.73)

Some authors propose that the cost effectiveness of interactive video will permit school districts forced with declining enrollments and budgets to offer a greater variety of courses. This will allow classes taken by only a few students to continue to be offered. Small rural schools will especially benefit from this new technology (Kehrberg and Pollack, 1981; Onosko, 1982).

Interactive video can also be beneficial to present an instructional message to a number of learners in a constant manner. When instruction needs to be delivered repeatedly, consistently, and at a number of sites interactive video may prove to be a cost-effective medium (Bosco, 1984).

There is some consensus in the literature that interactive video will enhance rather than replace the teacher's role. Teachers may choose their level of involvement, from reviewing a student's work to introducing the material themselves (Kehrberg and Pollack, 1981). The implication is that this system frees the instructor from lecturing so that he or she can serve as a resource, concentrating on specific problem areas or group exercises. "Well designed lessons can actually increase the feedback, flexibility and impact of a lesson while reducing the delivery cost" (Floyd, p.73).

Bosco envisions a more profound impact of interactive video on the educational system. While mechanization in industry has been a way of reducing costs, mechanization in education has generally resulted in increased costs. This is because the mechanisms have been added to all other costs, and nothing is deleted. Bosco believes that if automated instructional systems are going to reduce costs, then entire courses need to be delivered using these systems, or modules will need to be produced which would provide a new pattern of faculty deployment. He believes that although the development of entire courses will be resisted on philosophical and economic grounds, the use of modules will be a feasible implementation. Education will need to face the issue of: "what can a machine do best; what can a human being do best; and how can the two work in concert?" (Bosco, p.18).

Stumbling Blocks

> The videodisc is still so new that no one as yet really understands its implications, its potential, or how best to design and produce materials to take full advantage of its unique attributes. (Daynes, 1982, p. 24)

The hardware exists. Several large organizations are working on interactive video. But, when and where will the potential power of this new medium be realized? Willard Thomas outlines some of the factors that will determine the answer:

* The recognition of interactive video as a new and different medium
* The integration of visual logic into programmed instruction methods
* The evolution of a visual syntax
* The development of programming languages for handling visual syntax and images
* The use of digital video signals
* The production of reliable recorders
* Economical software duplication
* A catalytic event (Thomas, 1981)

There are a few more pragmatic stumbling blocks. These involve cost and compatibility. High development costs, coupled with a lack of machine and software compatibility have resulted in the slow development of a market for educational interactive video materials. This results in a lack of software, which in turn restrains hardware purchases. Delivery costs are also high. An interactive video system ranges from around $3,000 to $10,000 (Bosco), this is several times higher than a linear video or microcomputer learning station.

Richard Clark (1982) offers a broad solution: "In order to utilize these new theories, we must go beyond a narrow concern with the medium of instruction and, in addition, concern ourselves with questions of achievement, access, motivation, satisfaction, and efficient use of limited resources" (p. 18).

Summary

In reviewing the literature relating to interactive video the focus has been on instructional effectiveness of the medium. Although there are many articles explaining how the technology works and its enormous potential, relatively few report research findings or explore issues such as interactivity or instructional design.

Interactive video is characterized as combining the branching and interactive ability of the computer with the visual and auditory strength of television. In the literature, the term "interactive video" is used interchangeably with "intelligent videodisc" or "interactive videodisc".

The instructional characteristics of interactive video were examined in detail. The lack of two-way communication was cited as a major disadvantage of linear video; while interactivity, individualized instruction, and record management were included among major strengths of interactive video.

The invesigator reviewed research on the effectiveness of instructional television, computer-assisted instruction, and other media. Those studies resulted in a preponderance of no significant differences concerning comparative instructional effectiveness of various media formats. Several authors felt that analyses of instructional methods and applications may be more instructive than comparing delivery systems.

The major part of this chapter is a survey of numerous interactive video programs and research studies. The majority of these accounts are of an anecdotal nature, often written from a stance of advocacy.

Among the projects, there is wide diversity in subject matter, applications, and level of interactivity. In education, industry, the military, and medicine, interactive video has had substantial applications for training, informing, and educating. The research on the effectiveness of interactive video has been marked by flawed methodology, small sample sizes, and inappropriate questions. Several studies found interactive video to be as effective as face-to-face instruction, and significantly more effective than linear video. Some of the more recent research has been of a multivariate design and has used factor analysis. In addition to instructional effectiveness, time efficiency, cost effectiveness, and learner attitudes were also studied. In general, interactive video was found to consume more time than linear video, but can be cost effective under proper conditions (especially in an industrial setting). Learner preference and motivation were consistently cited as advantages of interactive video.

The role of interactive video in the educational environment was explored. There was a schism in opinion on whether it will supplement or replace instructors. Several stumbling blocks for the implementation of interactive video were noted: including station costs, lack of compatibility, and lack of software. Beyond this a new conceptualization of design and application will be needed to assure effective use of the medium. The effectiveness of interactive video has had limited exploration and evaluation. It is hoped that this study will add to this body of knowledge.

CHAPTER III

METHODS AND PROCEDURES

This study determines if there is a significant difference in the results between two different delivery modes of teaching basic photography skills in an independent learning environment. Effectiveness of interactive video as compared to linear video is measured by scores from a common written examination given to both groups.

Description of the Population

The subjects for this study were drawn from 320 college students enrolled in the teacher education program at Southern Oregon State College. During any given quarter 50 to 60 of these students are enrolled in educational media classes. All students enrolled in these classes during winter and spring quarters of 1985 were involved in the study. A total sample size of 128 subjects was required for this study according to a sample size table (Cohen, 1969). Ninety-eight students were required to complete the instruction as part of the Educational Media class, and 30 students were volunteers from Introduction to Education or Human Development and Learning classes. These courses are required for all education majors. Students enter these classes with a diversity of photography skills ranging from absolute beginner to possessing extensive prior experience. An analysis was made to ascertain that there was no overlapping in populations. The mean age for students at Southern Oregon State College is 26. Students in this study ranged from 20 to 50 years of age.

Using a random number table (Borg and Gall, 1980) the subjects were randomly assigned to control and experimental groups. The group receiving instruction via linear videotape was considered the control group and the students receiving instruction via interactive video served as the experimental group. Each quarter, before scoring, the pretests were turned face down and numbered consecutively. Then, starting at an arbitrary point on the random number table, pretests were alternatly placed into control and experimental groups as their numbers occurred on the random number list. The students were assigned to appropriate groups and then the pretests were scored.

Borg and Gall report that random assignment is not a perfect method for assuring treatment group equivalence, but since it relies on chance it ensures that subjects who receive the different treatments are reasonably comparable.

Dependent Variables

There are two dependent variables in this study, one in the cognitive domain and the other in the affective. The cognitive dependent variable in this study is the score from a written examination given after the treatment. The score is considered as an interval data. One way analysis of covariance was applied to the fixed model.

The affective dependent variable is the score from an attitude survey. The attitude measure is derived from a "Personal Reaction Form" each participant completed immediately after treatment. The attitude inventory form used was originally developed by Brown (1966) to assess attitudes relative to the use of computer-assisted instruction and later adapted to include items related to interactive video by Fowler (1980). Brown's inventory has been used in numerous studies with college students (Taylor, Hansen, Brown, 1972; Gallager, 1970; and Hagardy, 1970; all cited in Fowler, 1980). Both Brown (1966) and Gallager (1970) reported a reliability estimate of .89. For this study the inventory was revised to cover items related to teaching basic photography skills via interactive video. A parallel version of this Personal Reaction Form was developed to assess attitudes of students receiving instruction via linear video. This form covers such areas as motivation, level of difficulty and technical complexity, it also provided demographic data (see Appendices H and I). Measures were on a five point Likert-type scale and measures of ordinal consensus for both within and between groups were made using a Leik scale (Leik, 1966). Because no assumptions can be made regarding the equality of the intervals between each of the five catagories, analysis techniques applicable to ordinal data were used.

The "Measure of Ordinal Consensus" was developed by Robert K. Leik at the University of Washington. Procedures involved in this analysis involved compiling the frequency distribution and relative frequency percentage of each item. Then a mean response score for each question was calculated by assigning a value of one to five to each of the response catagories and calculating the mean value of all responses.

One always represented the least favorable response and five the most favorable. Differences in attitudes between groups could be shown by subtracting the mean score of one group on a single item from the mean score of the other group on that same item. Additionally, the degree of consensus within groups was determined. Consensus is the degree to which respondents concur in their choices. Results in agreement scores have a theoretical range from -1.00 (maximum dispersion) to +1.00 (perfect consensus). The mean response score represents the average response of the group. The measure of consensus indicates whether that average was indeed representative of commomly held perceptions.

Significance testing for between group differences in responses on individual attitude items was conducted using the Mann--Whitney U test. Because the attitude scores were derived from a measure with unequal intervals, it was appropriate to utilize a nonparametric test of statistical significance. Borg and Gall (1983) report that the Mann--Whitney U test can be used to determine whether the distribution of scores of two independent samples differ significantly from each other. If the measure is statistically significant, it denotes that the majority of scores in one population is higher than the majority of scores in the other population. The two populations are represented by the two independent samples on which the U test is made. The obtained U is converted into a z score, which is compared to a normal curve tabular value in order to test the hypothesis. In this study an analysis was made to determine if any of the attitude items resulted in statistical differences in U scores.

Sampling Matrix

According to Cohen's sample size table, the minimum sample size needed for F to detect an effect size (f) of .25, a power level ($1-\beta$) of .80, significance level (α) at .05, and two levels in the independent variable, is 64 subjects per cell (Cohen, 1969). The sampling matrix for the study is shown below:

Table 1

Sampling Matrix

	Pretest	Treatment	Posttest
Experimental Group	N=64	Interactive Video	N=64
Control Group	N=64	Linear Video	N=64

Data Gathering Procedures

All students were given alternative forms of the same written test both before and after treatment (see Appendices C,D, and E). The pretest was used to measure initial knowledge of the subject and the posttest was used to measure achievement. Courtney and Sedgwick (1983) note that allowing five weeks between pretesting and posttesting will avoid a residual effect. In this study the delay ranged from five to seven weeks. Students did not see the results of the pretest until the experiment was concluded. They were not informed of the different treatments nor which group was the experimental group. It was explained to them that the scores on the pre and posttest would only be used in conjunction with this study.

The dependent variable measuring achievement consisted of a 25-item multiple-choice exam score with content validity measured by a Delphi procedure. The Delphi panel was composed of four faculty members who teach basic photography at the college level. Each panel member viewed the videotape, reviewed the exam, listed recommendations or suggestions needed for revision, and commented on any ambiguity or inconsistency in the test items. After the Delphi panel evaluated the test, suggestions and recommendations were compiled and reviewed. The test was then returned to the panel members for final approval.

Reliability was determined by the split-half technique. In this method a single administration of the instrument is made, the test split into two halves which are scored separately, and a Pearson correlation coefficient between the two scores is calculated. Then the Spearman-Brown prophecy is used to compensate for the fact that the reliability was estimated from a test one-half the length of the final form. Reliability was computed as .85 on the Pearson correlation and adjusted to .92 by employing the Spearman-Brown prophecy (Gronlund, 1985).

Hypotheses

The results of the study determine retention or rejection of the following null hypotheses:

1. There is no significant difference ($p < .05$) in achievement test score means between those receiving instruction via interactive video (experimental group) and those receiving instruction via linear video (control group).

2. There are no significant differences ($p < .05$) in attitude measure means between those receiving instruction via interactive video (experimental group) and those receiving instruction via linear video (control group).

$$M_E = M_C$$

Statistical Model

The basic statistical tool utilized for this study is one-way analysis of covariance using the F statistic. This technique combines the concepts of analysis of variance and regression to handle situations in which the researcher cannot completely control all of the variables in the study. Courtney and Sedgwick (1983) describe this as a procedure for testing the significance of differences among postmeasure mean scores, while factoring in the influence of uncontrolled effects in the experiment. The covariance analysis adjusts for initial differences in the data, using premeasure information as a base. This adjustment increases precision and reduces sampling error. The criterion of random sampling is required in the use of this tool.

One-way analysis of covariance, using the F statistic was used to determine if any significant difference exists in achievement between the experimental and control groups. From this statistic the effectiveness of the interactive video can be compared with that of the linear videotape. The pretest is designated as the co-variate and used as the reference for comparison to the posttest.

The mathematical model which is appropriate to the one-way analysis of covariance, fixed design, is shown below:

$$Y_{ij} = \mu + \alpha_i + \beta(X_{ij} - \bar{X}) + \varepsilon_{ij}$$

where, μ is a fixed constant representing the overall mean,

α represents the effect of the treatment,

$\beta(X_{ij} - \bar{X})$ is the adjustment of the postmeasure, and

ε_{ij} is a random variable (NID, $0, \sigma^2$)

Thus the components of the model allow for the testing of a single hypothesis, that being for the treatment effect.

Table 2

Analysis of Covariance - Achievement

Source of variation	Adjusted Df	Adjusted SS	Adjusted MS	Computed F	Tabular F
Between Groups	1	A	A/1	$\frac{MS_{BET}}{MS_{WTHN}}$	3.90
Within (Error)	125	B	B/125		
Total	126	C			

CHAPTER IV

DESIGN AND DEVELOPMENT OF MATERIALS

This chapter focuses on the development process involved in the materials for this study, and offers an examination of some of the issues and problems involved in producing an instructional interactive video program. It is hoped that these experiences may serve as a case study for the development of similar materials. A thorough analysis of the procedures that were involved in producing the videotapes for this study is presented. This is followed by a description of the interactive video program. To offer a better understanding of an interactive videotape a "walk through" account of the "Picture This" program is given. The next section of this chapter details the differences between the interactive and linear videotapes utilized in this study. The hardware systems and learning stations employed are also noted. Finally, and perhaps most importantly, a section is included on the instructional design decisions made in producing materials for the study. This is the "why" behind the "how" of this chapter. Included in this is a survey of other producers' design sequences. Again, in light of the argument over medium or method, this section explores many of the specific instructional approaches that the videotapes in this study encompass.

All materials used in this study were designed and developed by the investigator, with the exception of the attitude instrument, which was adapted from an existing form. Howard LaMere, a graduate student at Southern Oregon State College, assisted with production and programming of the interactive and linear videotapes. The materials were produced on campus at Southern Oregon State College from June to August of 1984.

Task Analysis

The analysis of the procedures involved in creating the materials for this study is divided into five main parts: needs analysis, design, production, implementation and evaluation, and revision. Contained within this are more than 40 specific steps. Some of these steps involve getting "up to speed" with interactive video. Because the medium is so new, many designers and producers may find it necessary to become acquainted with the technical and design aspects which are unique to interactive video.

Needs Analysis

Research on interactive video. Upon first reading about interactive video one is struck by the extreme claims made about the potential of the medium. A preponderance of the articles focus on hardware aspects or the medium's potential, however several articles do outline a design sequence and cite example programs. Very few articles report on the instructional effectiveness of interactive video programs. Thus the impetus for this study.

Viewing interactive video programs. Because interactive video is such a new medium, a first step was to investigate the current state-of-the art. Finding articles that mentioned programs was relatively easy but actually previewing the programs was more difficult. A local teacher did have several for preview and several others were seen at the yearly conference of the Association of Educational Communication and Technology. A program on photography, the Pioneer Photodisc was previewed (Holzman, 1981). For the most part the programs were disappointing: exhibiting a low level of interactivity. For example, the Pioneer Photodisc simply offers the viewer a menu of sections to watch; in effect the learner can watch the program in any chapter order. The level of interactivity is restricted to random access of frames and chapters.

Research on photography - content outline. Probably everyone who teaches photography has a different definition of what constitutes "basic photography skills". The investigator has been teaching photography as part of educational media classes for five years. From that experience a set of skills which constitutes a functional literacy was developed, including how to take better pictures, and a basic understanding of camera and film types. This definition does not include darkroom skills or the physics of photography. Instead these skills are based on the ability of the user to control the image: to exercise creative control in the picture-taking process.

Field experience. The examiner has had extensive experience in media production, instructional design, and computer use. A more limited background in computer programming was possessed. After reviewing several interactive video systems the decision was made to use the Whitney system and its authoring system Insight 1000 Plus. The promotional materials for this system, like the advertisements for many other systems, assure that the aspiring interactive video producer does not need programming skills. This was not the case. The software and the documentation contained several "bugs" which required getting into the BASIC program and recoding.

A first production involved revising a short videotape on how to use the Apple computer to include segment branching and review questions. There was no tutorial with the authoring system, but even worse than this the documentation was not only confusing but on several instances incorrect. It may be expedient to use an existing videotape for learning the mechanics of interactive video production, however, contending with video that is not designed for branching and feedback, does not address the real strengths of the medium. Furthermore, without proper pause or break points it may be difficult to segment the tape for interactive video. In fairness, the authoring system was effective in generating the procedures and questions, and an early version of the software was utilized.

Design

Development of script and flowchart. Now possessing some prior experience with interactive video the decision was made to produce a full-scale interactive video production, to be titled "Picture This- A Lesson in Basic Photography Skills". Careful consideration to interactivity and technical limitations was given in writing the script. This involved including visual feedback sections for questions, and pauses in the narration to compensate for inaccuracies of tape shuttling. The script format included text screen notation and branching notation as well as video images and narration (see Appendix A). By numbering all text screens and video shots the planning process is facilitated. It is important to think holistically and to plan for interaction and variations in learner responses. At this point the procedures of the interactive videotape were visualized as a flowchart. The process of developing algorithms for an audio-visual medium will be a challenge for designers of interactive video materials.

The script was based on lecture notes from a slide-lecture which the investigator had used for three years. Several references were checked for content accuracy and instructional approach. This version of the script was completed nearly a year before final production of the program began.

Script review and revision. Four professors who teach photography at a college level reviewed and commented on the script. Changes were made to the script based on this feedback. Some concern was noted that too much material was being presented at one time. One reviewer commented that the program contained the material for an entire ten-week course in photography. It was reasoned that having a substantial amount of content would be a credible challenge to the instructional effectiveness of the program.

Development of a prototype. A prototype of the interactive videotape was produced during March of 1984. This tape consisted of approximately the first six minutes of the script. The experiences encountered in producing the prototype greatly contributed to the success of the final tape. The lessons learned in the production of it are significant enough for the investigator to prescribe the use of a prototype production for anyone beginning in interactive video production. Specifically, the following findings were made based on experiences from production of the prototype:

* It is essential to carefully plan the program before beginning production. At this point the producer should script, storyboard, and flowchart the entire program. Note should be made of branching and decision points and video should be shot to allow for these conditions. In the case of this program, because of the inaccuracies associated with shuttling the tape backwards or forwards, pauses in the narration needed to be intentionally included to allow some leeway for the tape to branch back to the correct address.
* A team approach may be beneficial. There are so many steps involved in production of an interactive videotape that it may be most effecient to divide the work up and to utilize a production schedule. A production team at Maricopa Community College (Story, et al., 1985) utilized a Gantt chart to integrate procedures, time, processes, and assignments for the orderly development of an interactive video presentation. They identified the following positions on a development team: subject expert, computer expert, instructional designer, and video expert. To this list could be added graphic artist, narrator, and talent. The team approach also facilitates simultaneous activity which can expedite the production.
* Use organizational skills and number everything. During programming of the program careful attention has to be paid to frame addresses, text screen numbers, question numbers, and procedure numbers. Instead of notes and numbers scattered on scraps of paper, the producer will benefit from keeping careful records of these pieces of information.

The prototype was shown to several students and faculty members, suggestions were noted, revisions to the program were made, and the final production was begun.

Revisions and final script form. Based on the experiences mentioned above the final version of the script was written. It is interesting to note that from this interactive video script, a linear video script was developed. This may be the first time a linear videotape was adapted from an interactive video program. In reality this involved only minor script revision (see later in this chapter for specific differences between tapes).

Production

Production of graphics. A professional graphics studio was contracted to produce the still graphics for the program. Some of these were adaptations of illustrations from books which were modified for style consistency and to be suitable for video display. The design of the program required using numerous captions and spelling-out key points on screen (e.g. "the larger the number... the smaller the opening").

Shooting slides. In order to capture still photography effects such as depth-of-field, freezing of motion, and lens magnification, many of the visuals for the program were shot with a 35mm camera and later transferred to video using a film-chain. These included shots of a bike rider photographed at different shutter speeds, fence posts shot at different f-stops, and a landscape shot at a variety of focal lengths. The picture-taking simulation involved shooting 27 different pictures of a panorama: utilizing different focusing distances, exposures, and focal lengths.

Audio production. Narration for the program was recorded at a local radio station. The narration was used as a "voice-over" to the video. Background music and sound effects were later mixed in. The music worked to fill in short one or two second gaps in the narration, which were included to allow for branching points. The completed sound track was transferred to videotape and visual material was later edited in sync to the audio portion.

Studio video production. Video footage for the program was shot during a period of three weeks using the college's modest television studio. All taping was done using 3/4" video equipment. This was an involved process due to the complexities of setting up over 70 separate shots including many extreme close-ups.

Field video production. The opening and closing sequences involved location shots of a mountain-top panorama and a waterfall. For these sequences, both still photographs and videotape was shot simultaneously. The concept was to have the learner try to capture what they see in the video panorama in a simulated still photograph (thus the program's title "Picture This"). Additionally, the segment on film selection used some location shots of a person entering a camera store and being confronted with a profusion of film types. These location shots brought a "real-world" sense to the program and added variety from the many studio shots.

Electronic graphics. The title sequences were created using an Apple computer and graphics software, including a program called "Transitions", which allows wipes and dissolves between computer graphics. These were saved to disk and later transferred to videotape. Although the Whitney system has the ability to read images directly from the disk, this was not done since it would consume time and computer memory during the running of the program. Computer-generated graphics were used only for the opening and closing titles of the program so that interactive video viewers would not confuse computer-generated images with video-generated images.

Transfer of slides to videotape. Slides were transferred to videotape using a film-chain. An exception to this was the "Gallery of Great Pictures" segment. This was a two-projector slide show, which was videotaped by simply training a camera on a projected image. This worked nearly as well as the film chain.

The drop in resolution and change in aspect ratio from slides to video was a shortcoming noted by a few viewers of both the linear and interactive videotapes. For any subject other than photography skills it would probably not be necessary to shoot slides first.

Editing of interactive videotape. The soundtrack was laid down on the master tape and then video footage was inserted using raw footage. For the half-hour edited program more than four hours of raw footage was shot. Since all of the shots were planned from the script and storyboard there was very little creativity needed in editing. For the most part it involved just locating the best "take" of a shot. Most shots were taped three or four times to give some flexibility in editing. Short portions of "black" video signal were included between major segments to allow smoothly branching to these sections. At this point the video portion of the program was complete and activity moved to the computer.

Generating time code. In the Whitney system the computer "reads" an audible time code that is on audio track two of the videotape. These timecode locations are referred to as "addresses", with each address representing approximately one-half second of real time. To generate the timecode a cable is connected between the "cassette out" jack of the Apple computer and the "audio in" jack of the VCR. The "Timecode Writer" program is run from the authoring software, the VCR is put into "audio-dub" mode, and the VCR records the pulses generated by the computer. It is important to note that since the timecode in the Whitney system is generated on work copies of the tape, and not the 3/4" master, additional copies must come from the VHS copy or new timecode needs to be generated for each copy.

Logging branch point addresses. When the computer is programmed to show a particular segment of video material it must be instructed exactly where on the tape the segment begins and ends. Locating these points involves watching the program, pausing it at each branch point, and noting the address of that point. This can be a very time consuming process, but by noting these branch points in the script in advance, the process will be greatly expedited. The "Videotape Manager" program of Insight is a utility which allows the operations of the VCR to be controlled through the number keys of the Apple and keeps a log of all addresses selected.

Creation of text pages. A text screen represents each time there is a computer-generated text message, this includes greeting messages, instructions, menus, questions, or feedback. In the "Picture This" program 53 text screens were used. For example, just one multiple choice question might involve five text screens; one for the question and one in reply to each of the four possible answers. Some text screens can be used more than once, such as using "Not quite right, let's watch that segment again" in response to several different wrong answers.

Text screens were created using the "Applewriter" word processing program, with each screen being numbered. The text screens are kept as a separate text file on the disk, and are accessed by number by the BASIC program as needed.

Authoring of events. Insight organizes a lesson as a series of individual instructional events. An event can be one of the following:

- a multiple choice question
- a match (fill-in or short-answer) question
- a procedure section, which is a prescribed presentation of lesson material
- a conditional event, which represents a presentation of material based on certain conditions being met, such as two incorrect responses to a question.

The most effecient way to create events is to translate the program's flowchart into a series of individual events. Without utilizing a flowchart at the script writing stage, the producer may find he or she does not possess the video, audio, or text material needed to create all of the events for the program.

The author is now ready to enter specific instructions into the computer regarding what will take place in the lesson. With careful preparation and organization, this is a very straightforward procedure consisting of making choices from menus and typing single-word English language commands from lists which are displayed on the screen. These commands for creating events include:

- Seek, tells the computer to shuttle the videotape to a specified address.

- Play, instructs the computer to play videotape until a certain location is reached.
- Show, is really a combination of other commands. Show instructs the computer to Seek a specified location, Play videotape starting at that location and finishing at another specified address, and then switch back to Apple video.
- Text, causes the computer to display a page of text. When the author specifies the Text command, the computer asks for the page number of the text to be displayed, and at what speed the text is to be printed on the screen- Fast, Med, or Slow. The text will continue to be displayed until the next command is given.
- Delay, specifies that the computer waits a specified number of seconds before executing the next command.
- Getkey, instructs the computer to wait for the student to press any key before going on to the next command.
- Repeat, tells the computer to repeat the main event that has just occurred, typically to repeat a question that was answered incorrectly.
- Next, tells the computer that, having completed the particular events comprising this main event, it should go on to the next main event.
- Jump, instructs the computer to jump to another specified event in the program, typically contingent upon conditional circumstances.

The Whitney system limits the number of main events in a lesson to 30, and the number of commands within an event to 10. Because the "Picture This" program required 40 main events, the program was broken into two sub-lessons which were chained together. The events are stored as a series of commands, for example this sequence:

```
TEXT (F) PAGE 3
APPLE
GETKEY
SHOW 100 TO 200
NEXT
```

prints page 3 of the text at fast speed, then displays it until the viewer presses any key. Then a video segment from address 100 to 200 is shown, then the next event is executed.

A multiple-choice question with one correct answer and three distractors might take the following form:

```
TEXT (M) PAGE 4
APPLE
IF A
TEXT (S) PAGE 5
GETKEY
SHOW 100 TO 125
REPEAT
IF B
TEXT (S) PAGE 5
GETKEY
SHOW 100 TO 125
REPEAT
IF C
TEXT (M) PAGE 6
GETKEY
SHOW 210 TO 250
REPEAT
IF D
TEXT (M) PAGE 7
WAIT 5
NEXT
```

In this example a question is asked (text screen 4), displayed at medium speed. If the student answers A or B, text screen 5 is displayed (slow speed) which informs the student that they missed the question and instructs them to hit any key to rewatch that segment. The tape is then rewound and section 100 to 125 is shown, the tape stops and the question is repeated. If the student answers C, then text screen 6 is displayed (medium speed), which informs the student that they misunderstood the question and instructs them to press any key to proceed. At this point the VCR shuttles forward and new material is shown (210 to 250), which may explain the material in a different manner or use a different example, then the question is repeated. If the student answers D (correct answer), text screen 7 (medium speed) congratulates them on understanding the material. The screen is displayed for five sections and then the computer proceeds to the next main event. In practice, these commands would not be typed but would be selected from menus for creating a multiple-choice question.

Construction of computer program. After all of the events are created and revised as needed the "Build a Program" utility is employed. In this process the computer automatically converts the English language commands into a BASIC program. This was an intriguing process to watch, but since the program needed to be rebuilt and saved after each work session, this became a time consuming process. More importantly, after the program was built, several times it had errors in it. Detecting the errors in a program built by a computer proved to be a difficult task.

Adjustment of addresses. Upon running the program it was found that some of the addresses were inaccurate. For instance, the tape would stop too soon, cutting off the last few words of a sentence; another segment might start too early, playing the last few words of a previous segment. What is especially trying about this process is that the exact accessing of the tape is contingent upon the events of the program. For instance, rewinding the tape will cause the accessing to be different than fast-forwarding the tape. This shifting of a few frames will be different for different viewers based on their particular path through the program. This is a major disadvantage of videotape as compared to videodisc, which is consistently frame-accurate. With videotape the author may need to compromise and use addresses which are accurate in relation to the typical path through the program. Again, having slight pauses in the narration at branch points will allow the program to run more smoothly.

Debugging computer program. Upon running the program it was found to break down under certain conditions. Because of the complexity of the program determining all possible "bugs" in it was difficult. Also, several of the events contained inappropriate commands or branched to incorrect text pages. The Special Edit feature of Insight allowed the events to be edited without going into the BASIC code.

Preparation of delivery materials. Backup copies of the computer disks and linear videotape were made. Because time code cannot be effectively copied from a master, no backup copy of the interactive videotape was made. All materials were labeled and user instruction sheets were created.

Implementation and evaluation

Field testing. The prototype was shown to several students and faculty members, suggestions were noted, revisions to the program were made, and the final production was produced. In October of 1984, students in three Educational Media classes watched the program. Students in one class watched the linear videotape individually, students in another class watched the interactive videotape individually, and students in the third class watched the interactive videotape as a group. Each class orally made comments and suggestions. All students took a posttest, however no pretest or attitude measure was administered. Mean scores were: 70 for the linear video treatment group, 83 for the group interactive video treatment, and 87 for the individual interactive video treatment. In the group interactive video instruction, answers to the questions in the program were obtained from a consensus of the group. Interestingly, the group interactive video mean was only four points lower than that of the individual treatment. Given the expense and logistical complexity of delivering individualized interactive video instruction, group viewing of interactive video may be an economical alternative. This could provide the basis for an interesting future study. Of the 22 students who used the interactive videotape in an independent-learning environment only one experienced technical difficulty with the hardware or software. It was reasoned that this was due to excessive heat and a whisper fan was added to the microcomputer. This apparently alleviated the problem.

Several observations can be drawn from the field-testing of the tapes. First, it is important to schedule participants for individual instruction. Students grew quite impatient waiting for another student to finish the program so they could watch the tape. Enough time must be allotted to allow for the diversity of time it takes for different learners to work through the interactive videotape. Some students finished in as short as 35 minutes, while others required as long as 75 minutes. Second, the issue of student note taking needs to be addressed. Some students were so preoccupied in writing down the content of the instruction that they were quite distracted from watching the screen. For the final study, students were advised that they would be given a handout containing the information involved in the tape, and that note taking was not necessary.

Development of testing instrument. A search was made for a standardized test of basic photography skills. The Modern Photography Comprehension Test was identified as a possible solution, however a letter to the publisher of the instrument was returned as undeliverable with no forwarding address available. Because no testing instrument could be found an achievement test was developed. This was a 25-item multiple choice test (Appendix D contains a copy of the test). As detailed in chapter III, content validity was measured by a Delphi procedure and reliability was determined through split-half testing. Attitude measures relative to linear and interactive video instruction were identified in Barbara Fowler's dissertation (1980). For this study, the surveys were adapted to include items relevant to teaching basic photography skills (Appendices H and I contain copies of this survey).

Final Implementation.

Test and procedure revision. Suggestions for changes in the instrument were acted upon and final copies of the instruments were printed. An alternative form of the test, to be used as a pretest was also printed. Attitude measures, schedule sheets, and appointment reminders were also printed.

Set up of learning environment. A small room was set up with the linear video system. The interactive video system was set up in the college's Educational Computer Lab. Headphones were included in both systems. Because of distractions in the Computer Lab the interactive video system was moved to a small room for the second implementation of the study.

Treatment. As detailed in chapter III, instruction was delivered to 128 students during three weeks each of Winter and Spring quarters. Of the 64 interactive video subjects only 3 experienced major mechanical malfunctions of the system, and none of the 64 linear video students experienced mechanical malfunctions.

Program Description

see script in Appendix A

The videotape and disk are inserted; upon powering up the videotape is automatically rewound to the beginning and the program is loaded into the computer's random-access memory. The first text screen welcomes the viewer to the lesson and prompts them to type in their first name and press "return". The next text screen querys the student, in the form of a multiple-choice question, if this is the first time that they will be watching the program. If the student selects "A) Yes, lets start at the beginning", the tape starts at the beginning. Choosing "B" branches to a menu which allows specific program sections to be selected for reviewing.

After selecting "A", the VCR goes into play mode and the first video segment is shown. This segment begins with a point-of-view shot of walking up a mountain trail to a panorama of the view from the top. The learner is told that the program will give them the basic skills to make decisions on how to capture that scene in a photograph. The opening title and credits roll, and then approximately two minutes of material concerning focusing systems is shown.

The tape stops and a text screen displays a multiple-choice question concerning the material just seen. A wrong response is met with a text screen informing them that the answer is not correct and instructs them to press any key to continue. When this is done the tape is rewound and the segment needed to correctly answer the problem is replayed. The question is again posed. Throughout the lesson remedial segments run from about 20 to 60 seconds. If the student again answers incorrectly the process is repeated. Students cannot proceed until correctly answering the question. This mastery learning condition continues throughout the program. When the correct answer is given the next question is presented. After correctly answering a third multiple-choice question the next video segment is shown.

The second video segment runs approximately three minutes and covers aperture and the concept that f-stops are fractions. When the tape stops the student is asked if they wish to review the material just covered or continue on to review questions. If they choose to continue, two more multiple-choice questions are posed. Again, students must give a correct answer to proceed.

The next section is on shutter speed. After about two minutes of material a fill-in question is asked. A text screen lists six exposures and the student is asked to type in what they notice about them. If the word "equal" or "same" appears in their answer, a text screen reinforces their answer. An incorrect or unrecognized answer is met with a noncommital response to "notice that all the exposures are equal". After either response the tape is started again. The next segment covers freezing motion, depth of field, and metering; this runs seven minutes.

After this section a menu is given, allowing the student to choose any of the previous sections to review or to go on to review questions. Four more multiple-choice questions are posed. One of these utilizes a unique feedback mechanism. The learner is asked to choose the best shutter speed for freezing the motion at a baseball game. The reply is given with a video segment of what the correct picture would look like, accompanied by narration appropriate to the correctness of the answer.

After this series of questions, the second computer program is automatically loaded into the computer's memory and the next video segment is shown. This is a three-minute musical montage entitled "A Gallery of Great Photographs". This segment serves to illustrate examples of different types of photographs and as a musical break from the instructional content. After the next video segment on film types (three minutes), the viewer is given the option of reviewing that segment or proceeding on to more content. If they choose to proceed, video is shown concerning types of cameras, parallax, characteristics of lenses, and a few examples of the uses of photography.

The video then returns to the mountain-top panorama. The narrator informs the student that they will be given the chance to capture that scene through a picture-taking simulation. A text screen offers a choice of using a 21mm, 50mm, or 200mm lens. After selecting one of these lenses, a text screen concerning the characteristics of the selected lens is displayed. A short video segment of the panorama is seen and then the viewer is prompted to choose one of three focusing distances. After selecting, a text screen is displayed concerning the effects of focusing at the chosen distance. Then another multiple-choice question asks the viewer to select one of three different exposures. Upon selection, another screen informs the student of the consequences of using that exposure, and tells them to standby to see their "photographic masterpiece".

At this point the computer processes the conditional events of the past three questions and branches to one of the 27 possible pictures on the tape. The tape is shuttled to that address and the student sees a slide shot using the parameters selected. The narration asks the student if the picture "came out" the way they expected it to and if they would like to repeat the simulation and see what other combinations would look like. When the learner decides not to repeat they go on to "The Big Conclusion".

Video is played which briefly exhibits all 27 possible combinations and the narrator reminds the student that their is no right or wrong way to shoot a picture and that if they can capture a scene in the way they want to then they have indeed accomplished something worthwhile. The segment concludes with the closing credits and then a text screen informs the student that they may review any section of the tape or end the lesson.

If the viewer decides to review a section, a menu of the program's 13 sections is displayed and a selection is made. If they decide they've "seen enough" a text screen thanks them for "interacting", and instructs them to return the materials to the lab assistant. The disk then comes on and a record of the student's responses and score is automatically recorded on the disk in an individual file.

Differences Between Interactive and Linear Videotapes

The linear and interactive video tapes were designed to be as similar as possible while still addressing the strengths and limitations of their respective formats. Designing, script writing, and production for both tapes were done simultaneously. In fact, the linear video is a slightly differently edited version of the interactive video program. First the interactive videotape was edited, then from that master, a linear video master was created. The differences between the tapes mainly concern pauses for branching and auditory feedback to answers in the interactive video and the lack of the picture-taking simulation in the case of the linear videotape. Specifically, the linear videotape differs from the interactive videotape in the following instances (refer to script in Appendix A):

* Taking out two second pauses after shot numbers 2, 19, 27, 52, 58, and 70.
* Dropping the sentence "Before we get to controlling the light lets stop for a moment and review what we've learned so far" in shot number 10.
* Deleting shot number 29, which is a split-screen of six different exposures in reply to a computer-generated question.
* Editing out shots 55A and 55B, which are video replys to a question on how to best freeze the motion at a baseball game.
* Editing out the picture-taking simulation (shots 89, 91, and 93) and

instead just showing the split-screen shots of the 27 possible pictures that could be taken.

It should be noted that the linear videotape is not a "cut-up" version of the interactive videotape, but a carefully planned, fully formed, cohesive program. The linear video runs 29 minutes and 30 seconds and the interactive videotape without any computer interaction lasts 32 minutes.

Hardware Configuration

The linear video system was composed of a Panasonic VHS PV6600 videotape recorder, a Panasonic 13" color monitor, and Mura lightweight headphones with a volume control. The interactive video system was composed of a Panasonic NV 8200 VHS videotape recorder, a Panasonic 13" color monitor, Mura lightweight headphones, an Apple II microcomputer with 64K and a single disk drive. The computer was equipped with the Whitney interactive interface card, connecting cables, and a whisper fan.

Physical Learning Environment

Both the interactive and linear treatment groups received instruction in a very similar setting. The 64 students who received linear video instruction were seated alone in a small room with a videotape recorder, 13" color monitor, and lightweight headphones. The investigator or a lab assistant turned the equipment on and started the tape for the student. The student was given an instruction sheet requesting that they not pause or rewind the tape. At completion of instruction the student stopped the tape, went to the rear of the room, and completed a posttest and attitude measure. Students were advised that they would later be given a handout covering the information contained in the program and that note taking was not neccessary. They were also informed that the score on the pre and posttest would only be used in connection to this study.

The 64 students who received instruction via interactive videotape were seated in the Educational Computer Lab, isolated from other students and often in the room alone. Because some students reported distractions in the room, the interactive system was moved into a small room similar to the one containing the linear system. The student was seated at a microcomputer keyboard that was connected to a videotape recorder, 13" color monitor, and lightweight headphones. The investigator or a lab assistant inserted the videotape and computer disk. Turning on the power automatically activated the interactive system and loaded the computer program into the microcomputer's random-access memory. At this point the student was given an on-screen welcome to the instruction, prompted to type in their name, and to press the return key to begin the program. The student was given an instruction sheet outlining this process. Assistance was available to answer technical questions only. At the conclusion of the program, the student returned the materials and went to a table in the back of the room to complete the posttest and attitude measure.

Instructional Design Considerations

There has been little published research on basic issues of design and production of interactive video materials (Rhodes, 1985). Current design theory is an amalgam of principles from programmed instruction, computer-assisted instruction, and instructional television. With new dimensions in variability and interaction comes the need for procedures to use those features (Daynes, 1982). Floyd (1980) states it well:

> Although the costs for computer hardware and video equipment are decreasing rapidly, the cost for developing software is not. Designing effective programming for computers or video is a creative labor-intensive process. As a result the productivity and operating cost ... will be determined to a great extent by the effectiveness of the program design. (p. 73)

Fully exploiting the wide range of possibilities created by linking a computer with video will require a great diversity of creative talents. Daynes (1982) proposes that the real effort in designing and producing interactive video programs is in planning the material. But even beyond that it will take a new perception..."traditional methods for planning, filming and editing have to be updated to designing a visual database" (Daynes, 1982, p.24).

Valuable insights into the goals and objectives of the programs utilized in this study can be gained from examining the instructional design considerations which were involved in their production. Many of these decisions are based on literature in media psychology, learning theory, and communication theory, from such authors as Fleming and

Levie, F.M Dwyer, and R. Gagne. In designing both the linear and the interactive videotapes the aim was to address the characteristics and limitations of each medium as effectively as possible (see Chapter II, Characteristics). For the most part, the considerations apply equally to both formats, but in instances where differences exist they are noted below (primarily related to learner interaction and control). The background, interests and abilities of the intended learners were other design factors. The nature of the subject matter was also given attention. Listed below are some of the specific design considerations.

Visual Factors

Both television and still photography are visual media; this fact was one of the keystones of the design. The videotaped programs were highly visual, the narration primarily serving to explain and reinforce the images and captions.

Magnification. One of the characteristics of television which was exploited was the magnification of small details, such as the shutter speed dial and the focusing ring.

Motion. To avoid the static quality so prevalent in instructional television, motion was incorporated into the shots whenever possible. This capability was used in sequences such as the diaphragm of a lens opening to illustrate aperture, and an actual through-the-viewfinder shot of a microprism system coming into focus. Other visualization techniques included; progressive disclosure by using wipes, highlighting by the use of a pointing device, change of emphasis by using slip-focus, and changing perspective through camera movement.

Visual comparisons. Video capabilities were used to compare different photographic images by utilizing split-screen shots and dissolves.

Graphics and captions. There were more than 30 graphics in each program these served to illustrate concepts which could not be as effectively photographed (e.g. focusing systems), as comparison charts (e.g. three methods of controlling depth of field), and as captions. Key concepts and new terms were emphasized by the use of captions. In some instances the entire video display was composed of just a phrase written out (e.g. "the larger the number- the smaller the opening").

To keep the interactive video program from becoming an "electronic workbook" text screens were kept to ten lines of type or less. An exception to this are the three responses to decisions on the simulation. It was reasoned that in these cases the need for detailed feedback on the effect of the student's decision outweighed the need for brevity of text displays.

Interaction

As detailed in the Review of Related Literature, the level of learner interaction is a key factor in the effectiveness of educational media. The inability of students to be drilled on or to ask questions about the material covered was cited as a major weakness of linear television. Several authors express the belief that level of interactivity is the key issue in designing interactive video programs.

In "Picture This" there are several levels of interactivity. Interaction ranges from choosing review sections to answering multiple-choice and fill-in questions. The most sophisticated interaction is involved in the picture-taking simulation. Selecting one of three options for each of three exposure factors results in 27 possible video responses. There is no one right or wrong answer. Multi-variate response is a key strength of interactive video. However, dealing with that complexity poses major design challenges for the producer.

How learner feedback is handled is another important design decision. In this program feedback was immediate, individualized, and positive. If the student answered a question correctly a text screen was immediately displayed which congratulated them on their response, e.g. "That's right, you're getting to be a real shutterbug". If the student's answer was incorrect a non-threatening response would be displayed, e.g. "Not quite right let's review that section". After the student presses any key the tape is rewound, the appropriate section reshown, and the question is repeated. For most responses there was an individual response e.g. "That's not correct, but that was a tough one, let's go back and review". By varying the feedback the designer can avoid some of the mechanization that is associated with programmed learning. In some instances feedback responses were used more than once, this was done to save memory space and to provide some continuity. Another option that is technically possible is to delay giving responses to the questions until completion of the program.

"Picture This" requires mastery learning, that is the student must correctly answer the question to proceed with the program. This is purely a design decision and not a technical one. The correct answer could be given after a specified number of attempts, or the question skipped, or help sections could be offered. In this program, if an incorrect answer was given, the segment containing the information for the answer was reshown. In retrospect it may have been beneficial to provide different remediation techniques. These can include rephrasing the question, showing a different example, or explaining the concept in a different manner.

Control

Along with learner interaction, learner control has been cited as a key design decision in producing interactive video programs. Several authors note that learner control over scope and sequencing of material needs to be limited (Hartley and Lovell, 1978; Kadesch, 1981). Others feel that interactive video has the potential to revolutionize education by giving near total control of learning to the learner (Ehrlich, 1984; Hiscox,1981). A compromise between these two extremes is advocated by Cohen (1984), who asserts that control should be progressively increased as learner confidence and competence increases.

How learner control is actually affected is worthy of some discussion. In numerous instances students could go back and review sections of the program without penalty. Although technically feasible, students in this study were not allowed to skip sections or questions, or to pause the tape. Students watching the program for the first time were directed into watching the program in the order it was designed. After the first viewing learners could watch any section of the program in any order they wished to. Although students in this study did not watch the program more than once, the ability to offer subsequent reviewing of specific sections could be very beneficial for students wanting to review the material for a test. As in providing interactivity, the ability to offer random-access viewing is both a strength of the medium and a challenge to its designers.

Language Level

Both videotapes were written in a conversational style. The aim was to avoid the technical and dry writing style so often found in instructional material. Literary techniques for doing this included frequent use of the first person. For example note the use of the word "you" in this paragraph from the script:

> Picture this...you are on a short hike to a place at the top of a hill with a special view. You are with a very special friend. How will you preserve this special moment? If you decide to preserve that moment with a photograph you will have to make some very important decisions...what film to use, what lens, what angle, and what exposure. All of these decisions will effect your picture. This program will give you the basic skills to make these types of technical and creative decisions.

From this passage one can note the avoidance of polysyllabic words, sesquipedalian language, and complex sentences (in marked contrast to a scholarly dissertation).

Another aim in writing the script was to use as few numbers and technical terms as possible, while still achieving the program's objectives. An attempt to utilize humor in the script was also a design consideration. For example, after a rather lengthy discourse on what the numbers on a film box refer to, the section concludes with the statement "there is one more number on the box to remember, one that needs no explanation...the price tag".

Jerrold Kemp (1977) has noted that learners are apt to learn more from information that has meaning to them. To facilitate this the program used real-life examples, experiences that the learner might actually experience or have interest in; taking pictures of a view from a mountain top, a baseball game, or snap shots of the family. Heinich (1982) asserts that letting students be aware of the objectives of the instruction will also be beneficial. In "Picture This" the benefits of the program are communicated several times during the instruction. In the passage quoted earlier the narrator iterates that "This program will give you the basic skills to make these types of technical and creative decisions".

Content Coverage

Many authors have noted the effectiveness of repetition in aiding learning. In both videotapes key concepts were repeated several times. Additionally, the key objectives of the programs are mentioned at both the beginning and end of the program. One difference between the interactive videotape and the linear videotape that may prove to lead to a significant difference in effectiveness between formats is the fact that the interactive video forces the learner to repeat any segment that they incorrectly respond to a question about. Therefore, the difference in repetition may be an important difference between the treatments.

Certainly a half-hour program cannot be a comprehensive lesson in photography. However, a sizable amount of information is covered. One of the program's reviewers noted that the program was roughly equivalent to the ten-week photography course that he teaches. In the attitude instruments several learners expressed the opinion that too much material was being presented at one time. For purposes of this study it was reasoned that having a formidable learning assignment would be a good test of the media's effectiveness. Because of the large amount of instructional material covered, two design considerations were made. The information was broken into short segments, covering a single concept. Here again, the interactive video may prove to be more advantageous than the linear video in that it stops the tape after each segment to ask students review questions. Another device that was used to avoid intellectual overload was the inclusion of a musical break in the middle of the program. This slide show served not only to illustrate types and techniques of pictures but as an interlude from the purely cognitive material.

Working with high technology requires contending with technical considerations as well as design considerations. For example, the picture taking simulation was limited to making three choices from three factors, when in reality there are many more decisions and choices to make when taking a picture. Just a three-by-three matrix results in 27 possible combinations. These 27 possibilities take a great deal of programming time, computer memory, and videotape space. Offering the student four choices from each of four different factors would result in 64 possible combinations, and would be too complex for the system to effectively handle.

Content Organization

Making learners aware of objectives has been promoted as increasing effective learning (Heinich, 1982). In both versions of "Picture This" the goals and objectives of the program were explained early in the program, repeated, and summarized at the end. On a more quantitative level, the interactive video program contained ten content questions, five opportunities to choose to review materials, and three simulation questions. One design decision may be worthy of closer inspection. Only the first half of the interactive video program contained content questions. The second half did not question the student but simply provided them the option of reviewing sections. An analysis of correct responses on the achievement test of concepts taught in the first half versus those made in the second half determined that having review questions may have increased achievement (see discussion in chapter VI).

Design Sequences

The research shows a number of different approaches to the interactive video design process. Streibel (1982) develops what he calls an Instructional Systems Design (ISD) from a "top-down" manner. That is, he begins with the most general considerations defined first...needs, goals, constraints and users. This approach helps to factor a complex design problem into a hierarchy of simpler problems.

Daynes (1982) uses a two part process: first the interactive functions are determined and computer software written, then the visual and sound materials are planned and assembled (Daynes, 1982). Floyd (1980) expands this to seven steps: 1) front-end analysis, 2) instructional strategy, 3) instruction flow chart, 4) visualizing and script writing, 5) production, 6) programming, and 7) debugging.

Clark (1982) describes design theory as examining: 1) resources available, 2) management strategies, 3) selection of the most effective medium, 4) operational selection of procedures, and 5) a plan for formative evaluation. A variety of other designers have presented adaptations on these design sequences.

One approach to designing interactive strategies is to classify the types of screens available to the learner. The Nebraska Videodisc Group identifies seven sets of video frames: 1) orientation, brief information concerning the title, table of contents, objectives, etc.; 2) content, where the instruction takes place; 3) decision, options which require input from the student; 4) strategy or comment, help or advice to the student on how best to achieve the learning objective; 5) summary, concluding frames of the content 6) problem, questions or problems to test mastery of the objectives; and 7) help, assistance with operations of the program (Daynes, 1982). The Pioneer Corporation has attempted to classify interactive video screens into a set of standardized flowchart symbols.

All of the previously mentioned sequences use design algorithms; indeed the systematic approach itself could be considered an algorithm. Algorithms are precise tools that embody proven approaches to cognitive and psychomotor learning. However, Lindsey (1984) states that for design of affective material algorithms are "fish out of water" (p. 17). Affective learning is characterized by a lack of defined sequences of operations, for this reason precise prescriptions are not applicable. It is Lindsey's contention that interactive video will never become a pure science. Regardless of how purely cognitive or psychomotor the original instructional intent is, if television is involved, there is an affective component that must be dealt with--

either by design or default.

> Television is not just another medium as far as the learner is concerned. It carries with it a history of creative entertainment. .... Hooking a computer or any other device to it doesn't fool them either. If a television is involved, the designer just "bought into" a sizable set of expectations. (p. 18)

Lindsey feels the solution to this dilemma is to think holistically. This may involve principles from such diverse areas as advertising, drama, humor, and communication theory; using what works regardless of the source. Along with algorithms, the interactive video designer needs to employ heuristics. These are guidelines based on previous experience, which although lacking the precision of algorithms, allow room for the intuitive.

Summary

The design, production, and utilization of an interactive video program is indeed a prodigious task. One that involves skills in instructional design, video production, computer programming, educational psychology, and communication techniques. In producing materials for this study five major steps were identified: needs analysis, design, production, implementation and evaluation, and revision.

Because of the complexity of the development process, several authors recommend the use of a team approach for design and production of interactive video materials. This team should include an instructional designer, a content specialist, a scriptwriter, an engineer, a computer programer, and a TV producer/director (Daynes, 1982). At Maricopa Community College a Gantt chart is utilized to integrate procedures, time, processes, and assignments into a functional developmental display. The chart consists of design, programming, and video production processes sequenced by time considerations and personnel assignments (Story, et al., 1985).

Although there appears to be a consensus for the need for systematic design and planning of interactive video, there is no consensus on which specific method to use. Numerous design and production sequences have been developed. In general, these are more similar than dissimilar. Most of the design concepts are adaptations of traditional media design theory adapted or expanded to address the unique needs and attributes of interactive video. One researcher noted that interactive video design needs to incorporate heuristics involved in the affective domain as well as algorithms of cognitive and psychomotor learning.

Even with the voluminous size of this chapter many issues and concerns have not been addressed. Perhaps more important than understanding the processes involved in creating an interactive video program, is developing an understanding of when and how to use the medium. Clearly from the research, or rather the lack of research, we have not accomplished that goal. What we are beginning to do, and what this chapter has aimed to do, is to provide some guidance and experience in the issues, decisions, and concerns involved in creating interactive video materials. This chapter does not claim to be a model or system for the development of interactive videotapes. It can however, serve as a case study, and provide some valuable insights into the tasks, decisions, and issues that the prospective producer of interactive video materials may expect to encounter.

CHAPTER V

RESULTS AND DISCUSSION

Introduction

The data compiled from treatment of the 128 subjects in this study are presented in this chapter. Data are reported under three broad headings: demographics, achievement, and attitude. Data are derived from measures on achievement pretest and posttest and from attitude surveys. The interactive video treatment group (IV) was considered the experimental group and the linear video treatment group (LV) was considered the control group.

Achievement measures were analyzed with the use of analysis of covariance. Courtney and Sedgewick (1983) report that this method is effective for testing the significance of differences among post-measure mean scores, while factoring in the influence of uncontrolled effects in the experiment.

Attitude measures are analyzed through the use of the Mann-Whitney U test of significance and the Leik Measure of Ordinal Consensus. Since these data are more subjective in nature than the achievement data, the statistical handling takes a more descriptive form. Included in the attitude data are sample comments from subjects on the major strengths and weaknesses of the treatment they experienced. Because the attitude data is ordinal it necessitates treatment on an item-by-item basis, without being able to derive a total attitude score. Attitude responses are discussed immediately following reporting of the findings. Attitude measures reported include frequency of responses, within and between group means, within and between group levels of agreement, and significance levels.

The study was administered during winter and spring quarters of 1985. In effect this was a quasi-replication of the study. Achievement results for both quarters are presented in composite form as well as individually. Because of smaller sample size the single administration data may not be statistically exact, however, it can offer insights into the replicability and consistency of the study. In winter quarter there were 32 IV students and 30 LV students; in spring quarter the treatment was administered to 32 IV students and 34 LV students.

Demographic Data

Demographic data were derived from information requested on the attitude survey. The following information was requested from subjects: name, sex, age group, class standing, and previous experience with photography, computers, and instructional television. Time on instruction was derived from sign-in sheets filled out by students when receiving instruction.

Analysis of covariance adjusts for initial differences between groups, using pretest information as a base. Even with random assignment to groups and the use of a covariate adjustment, it is beneficial to examine the similarity or disparity between groups. This demographic data may also be useful in extrapolating the experiment to other populations.

Sex: The interactive video treatment group (IV) was composed of 22 males (34%) and 42 females (66%). The linear video treatment group (LV) was composed of 28 males (44%) and 36 (56%) females. The high proportion of females to males is consistent with the general demographics of the department's population as well as many other schools of education.

Age: Age data were broken into six groups: 18-22, 23-30, 31-40, 41-50, over 50, and No Answer. Following is the breakdown by age group.

Table 3

Breakdown by Age Group.

AGE	IV #	IV %	LV #	LV %
1) 18-22	19	30	19	30
2) 23-30	16	25	21	33
3) 31-40	23	36	15	23
4) 41-50	4	6	6	9
5) 50+	0	0	1	2
No Answer	2	3	2	3

Mean age group for the IV group was 2.19 and for the LV group it was 2.17, with 1 representing the 18-22 group and 5 the 50+ group. Replies of "No Answer" are not factored into percentages or means. The data indicate nearly identical average age groups.

Class Standing: Class standing was divided into eight groups. The results are shown below.

Table 4

Breakdown by Class Standing

CLASS STANDING	IV #	IV %	LV #	LV %
1) Freshman	2	3	3	5
2) Sophomore	12	19	11	17
3) Junior	24	38	11	17
4) Senior	16	25	23	36
5) Graduate	6	9	9	14
6) Post. Bac.	3	5	6	9
7) Non Admitted	1	2	0	0
No Answer	0	0	1	2

Mean class standing for the IV group was 3.39 and 3.66 for the LV group; indicating class standing for both groups averaged between junior and senior.

Experience: On the attitude survey three questions queried students on previous experience in photography, using computers, and instruction via videotape. Tables 5, 6, and 7 present results from these items.

Table 5

Previous Experience in Photography.

PHOTO EXPERIENCE	IV #	IV %	LV #	LV %
1) Very Little	24	37	20	32
2) Little	15	23	15	24
3) Some	23	35	23	37
4) Extensive	1	1	3	4
5) Very Exten.	1	1	2	3
No Answer	0		1	

Mean experience level for the IV group was 2.06 and for the LV group it was 2.23. This is with 1 representing "Very Little" and 5 representing "Very Extensive". Mean experience level for both groups was between "Little" and "Some". The difference between means on photography experience was .17, which represents less than two-tenths of a heading.

Table 6

Previous Experience Using Computers.

COMPUTER EXPERIENCE	IV #	IV %	LV #	LV %
1) Very Little	19	30	24	38
2) Little	13	20	15	24
3) Some	26	41	23	36
4) Extensive	6	9	1	2
5) Very Ext.	0	0	0	0
No Answer	0		1	

Mean experience level for the IV group was 2.29 and for the LV group it was 2.01. The difference between means was .28, which again is relatively low, with both groups' computer experience level being between "Little" and "Some". In effect this item is not relevant to the linear video group, but it was informative to know previous computer experience level for the interactive video users. The section on attitudes has several items dealing with student's perceptions of interacting with a computer.

Table 7

Previous Experience in Instruction via Videotape.

VIDEO INST. EXPERIENCE	IV #	IV %	LV #	LV %
1) Very Little	49	77	31	49
2) Little	13	20	16	26
3) Some	2	3	14	22
4) Extensive	0	0	2	3
5) Very Ext.	0	0	0	0
No Answer	0		1	

Mean experience level for the IV group was 1.26 and for the LV group it was 1.79. The difference between means was .53 which is considerable. Both groups' previous experience in instruction via videotape was between "Very Little" and "Little". Schramm (1962) has noted that the effectiveness of instructional television decreases as experience with that method increases. Since the IV group's mean experience was about a half-a-category less than the LV this may have had some effect. However, since both groups' experience was low, this effect should have been slight. It is interesting to note that on average the experience level with video instruction is considerably less than with computers. It may be that today's college student (or at least the subjects in this study's population) get less exposure to instructional television than to computing. This could be the basis for an interesting study. On all three experience categories means between groups were within .53 of each other, and all means were near "Very Little" or "Little".

Time on Instruction: A ledger was kept in which students wrote in their starting and finishing times with the instruction. For the linear video group since there was no stopping or branching of the tape, it took each of them the same amount of time; the duration of the tape, 30 minutes. For the interactive group, time on instruction would vary according to: how many review questions they missed, if they decided to review sections, if they decided to repeat the picture-taking simulation, and how fast they read the text screens. No record was kept of how long it took students to complete the tests. For the IV group mean time on instruction was 49.34 minutes. Shortest time was 34 minutes and the longest time used was 70 minutes. On average the LV instruction utilized 40 per cent less time than did the IV instruction. The issue of time efficacy and cost effectiveness of interactive video is addressed in the next chapter.

The pattern of time utilization for the IV instruction was consistent. Winter quarter, the mean time was 48 minutes with a range of 35 to 65 minutes, spring quarter the mean was 50 minutes, with a range of 34 to 70 minutes.

Achievement Results

Hypothesis 1 - Null hypothesis rejected.

> There is no significant difference ($p < .05$) in achievement test score means between those receiving instruction via interactive video (experimental group) and those receiving instruction via linear video (control group).

Analysis of covariance (ANCOVA) was used to determine the significance of difference between mean scores for experimental (IV) and control groups (LV) on a multiple-choice achievement test (see Appendix D).

The dependent variable was students' scores on the achievement test, the covariate was the pretest score on an alternative form of the same test (see Appendix C), and the independent variable was the instructional treatment (interactive video, linear video) to which the subjects were randomly assigned.

The pretest was used as a covariate in order to adjust for initial differences between groups, reduce sampling error, and to give a more precise estimate of post instructional performance (posttest).

Table 8 shows the pretest, posttest, and adjusted posttest mean scores on the achievement test by type of instruction.

Table 8

Pretest, Posttest, and Adjusted Posttest Means on Achievement Test by Type of Instruction

Type of Instruction	Pretest Mean	Posttest Mean	Adjusted Posttest Mean
Interactive Video	48.94 (N=64)	84.75 (N=64)	84.95
Linear Video	49.80 (N=64)	79.50 (N=64)	79.30

As can be seen from both the adjusted means and the pretest-posttest gains, the Interactive Video Group did considerably better than the Linear Video Group. The IV posttest mean was 5.25 points higher than the LV group and 5.65 points higher on adjusted posttest means. More significantly the IV group showed a gain from pretest to posttest mean of 35.81 as compared to 29.70 for the LV group, this is a difference of 6.11 points.

Table 9

Analysis of Covariance - Treatment Effect

Source of variation	Adjusted Df	Adjusted SS	Adjusted MS	Computed F	Tabular F
Between Groups	1	1017.33	1017.33	10.48	3.90
Within (Error)	125	12131.62	97.05		
Total	126	13148.95			

Significance 0.0019

The ANCOVA table (Table 9) shows a highly significant F ($p<.001$), which indicates a low probability that these differences were due to chance.

Consistency of Results: As noted above, administration of this study was begun during one academic quarter (N=62) and continued the next (N=66). A measure of the consistency and reliability of the effect of the treatment can be seen from noting the nearly identical results from both quarters. Table 10 is a comparison of mean scores, while Tables 9, 11 and 12 are ANCOVA tables which afford comparisons of F ratios and significance levels.

Table 10

Comparison of Pretest, Posttest, and Adjusted Posttest Means
Winter Quarter, Spring Quarter and Comprehensive Results

Group	Pretest Mean	Posttest Mean	Adjusted Post Mean	N	Gain	Gain Diff.
IV Winter	52.13	84.75	85.23	32	32.62	6.79
LV Winter	54.17	80.00	79.49	30	25.83	
IV Spring	45.75	84.75	84.80	32	39.00	5.88
LV Spring	45.94	79.06	79.02	34	33.12	
IV Total	48.94	84.75	84.95	64	35.81	6.11
LV Total	49.80	79.50	79.30	64	29.70	

Posttest means for both quarters were remarkably similar. In fact, the IV Group had exactly the same mean for both winter and spring quarters, and the LV Group's means were within a percentage point of each other. The gain from pretest mean to posttest mean (unadjusted) ranged from a high of 39.00 for IV spring to a low of 25.83 for LV winter. Although there was considerable divergence in achievement gains, the actual difference in gains between groups was quite consistent, being within a percentage point from one quarter (6.79) to the other (5.88).

Table 11

Analysis of Covariance - Treatment Effect
Winter Quarter

Source of variation	Adjusted Df	Adjusted SS	Adjusted MS	Computed F	Tabular F
Between Groups	1	508.08	508.08	4.74	4.00
Within (Error)	59	6327.11	107.24		
Total	60	6835.19			

Significance 0.0315

Table 12

Analysis of Covariance - Treatment Effect
Spring Quarter

Source of variation	Adjusted Df	Adjusted SS	Adjusted MS	Computed F	Tabular F
Between Groups	1	550.81	550.81	6.28	4.00
Within (Error)	63	5529.17	87.76		
Total	64	6079.98			

Significance 0.0142

The F ratio and significance levels were quite different between quarters and extremely divergent for the comprehensive results. The large increase in F ratio and level of significance for the comprehensive results is due to the effect of larger sample size reducing the element of random error and increasing the significance of differences. This has some important implications since much of the research conducted on interactive video has used small sample size.

Standard Deviation:

Table 13

Standard Deviation For Achievement Pretest and Posttest - Winter Quarter, Spring Quarter, and Comprehensive Results

Group	Pretest Std. Dev.	Posttest Std. Dev.	Difference	N
IV Winter	15.02	9.45	5.57	32
LV Winter	15.32	15.33	+.01	30
IV Spring	15.54	12.08	3.46	32
LV Spring	17.59	12.14	5.45	34
IV Total	15.50	10.76	4.74	64
LV Total	16.95	13.63	3.32	64

It may be noted that in most cases the standard deviation was markedly more reduced by the IV treatment than the LV treatment. This is probably due to the fact that the interactive video instruction required mastery learning while proceeding through the program. One LV group student's score went down from a 60 on pretest to a 56 on posttest. When questioned on this situation she replied that the instruction had come on a "bad day" for her and she simply "tuned out" the videotape. With the interactive video program, students needed to stay alert in order to answer the review questions and complete the instruction.

Attitude Results

Hypothesis 2 - Null hypothesis rejected.

> There are no significant differences ($p < .05$) in attitude measure means between those receiving instruction via interactive video (experimental group) and those receiving instruction via linear video (control group).

Explanation of data treatment: Data for students' perceptions concerning the instructional method subjected to are drawn from attitude surveys that all students completed immediately after instruction and achievement posttesting. Because these data are of an ordinal nature, it is not statistically appropriate to derive an overall attitudinal measure. Instead the survey is treated item-by-item. Robert Leik (1966) developed a scale which calculates an adjusted mean, compensating for the inaccuracies of using an ordinal Likert scale. Perhaps more importantly, the Leik scale provides the researcher with a measure of within and between group consensus for each item. This handles the situation where there is disparity in frequency but similarity in means. An agreement level of 1.0 would mean all students gave the same reply, this would be complete agreement or consensus. If half the subjects had responded at one extreme and the other half at the other extreme, this would result in a -1.0 level, or complete dissensus. If responses were evenly divided between all categories this would be an agreement level of 0.

Significance testing for between group differences in responses was conducted using the Mann--Whitney U test. This nonparametric test can be used to determine whether the distribution of scores of two independent samples differ significantly from each other. The two groups are represented by U scores, upon which a z score is derived. The z score is then compared to a tabular value (1.60 at $p < .05$) in order to test the hypothesis (Gronlund, 1985).

For each item the following data are included: the question posed to the student, raw frequency for each response, percentage of responses by category level, cumulative percentages, group mean, within group consensus, differences between group means and level of agreements, Mann--Whitney z score and level of significance. The importance and applicability of each survey item is discussed immediately following the data for that item. On all items "No Answer" responses or missing responses were not included in percentages.

The original attitude surveys (see Appendix H and I) are slightly different from the items presented here in two ways. Some questions were different for each group. Where this difference is slight (substitution of a word or two), the change is presented in parenthesis within the question. Where the difference is major, both questions are presented. Caution must be used in these questions since sometimes they are comparing quite diverse concerns. A second change in format from the original attitude surveys is that the order of preference has been transposed on several items from left to right. In this section the category on the left always represents the lowest value (1) and the category on the right is the highest value (5). The lowest value represents what was considered the least "favorable" response and vice versa. Since this was at times a subjective decision the reader is advised that a higher mean does not necessarily represent greater effectiveness or satisfaction. For example a higher mean on time that the learner could work efficiently does not necessarily equate to increased effectiveness or satisfaction. However, in general, a higher mean and a higher level of consensus will indicate a greater perception of satisfaction and achievement by students. A feeling of the overall level of satisfaction by students can be gleaned from the profile of means (Table 15). Students were asked to list three things they liked most and least about the instructional method or program they used. Typical comments from those queries are included in this section. Finally, key items and major sources of divergence are discussed in the summary to this section.

HARDWARE

1. I had difficulty operating the hardware.

	All the time	Most of the time	Some of the time	Only occasionally	Never	N/A
IV						
Freq.	1	1	0	5	56	1
%	1.6	1.6	0	7.9	88.8	
Cum. %	1.6	3.2	3.2	11.1	100	

Likert Mean 4.809 Agreement .905

	All the time	Most of the time	Some of the time	Only occasionally	Never
LV					
Freq	0	0	3	5	56
%	0	0	4.6	7.8	87.5
Cum. %	0	0	4.6	12.5	100

Likert Mean 4.828 Agreement .914

Between Group Differences

Likert Mean -.019 Agreement -.009
z score .236 Significance .404

Discussion As can be seen from above, neither group had much difficulty operating the hardware. Both means were near the "Never" category (4.809 and 4.828) and there was an extremely high level of consensus for both groups (.904 and .914). From this data it can be inferred that the interactive video hardware was no more difficult for students to operate than was the linear video equipment.

2. While going through the program I encountered mechanical malfunctions.

	All the time	Most of the time	Some of the time	Only occasionally	Never	N/A
IV						
Freq.	1	1	1	10	51	
%	1.5	1.5	1.5	15.6	79.7	
Cum. %	1.5	3.1	4.5	20.3	100	

Likert Mean 4.703 Agreement .851

	All the time	Most of the time	Some of the time	Only occasionally	Never	N/A
LV						
Freq	0	0	0	3	61	
%	0	0	0	4.6	95.3	
Cum. %	0	0	0	4.6	100	

Likert Mean 4.953 Agreement .976

Between Group Differences

Likert Mean	-.25	Agreement	-.125
z score	2.695	Significance	.003

Discussion This item is more important than Item 1 in that it involves actual occurrences of mechanical malfunctions not just the students' perceptions of hardware problems. Although both means were near the "Never" category (4.703 and 4.953) there was considerable difference between means (-.25), and considerable number of IV students had at least some mechanical malfunction. The difference in distribution of scores between groups was highly significant (.003).

It could be expressed that fully 80 per cent of the IV students experienced no mechanical failure, however, a more sobering way of expressing this statistic would be that one in five IV students experienced at least some mechanical failure (as compared to one in twenty for the LV group). From observation and comments it was found that the majority of the IV malfunctions (15%) were just one occurrence when the picture-taking simulation did not offer the student the chance to rerun the simulation. The three reports of LV malfunctions were due to the brightness of the monitor being turned down and not to videocassette recorder (VCR) malfunctions. Two IV students experienced major malfunctions in which the interactive features of the system were never accessed; these were due to a loose connection in the system. The impact of these malfunctions on achievement measures in this study is not known.

Item 2 has some major implications for interactive video instruction. Although less than five per cent of the IV students experienced what can be considered major malfunctions, even a small percentage or minor malfunctions can be significant when the learning task is critical. From this experience interactive video was found to be not as reliable as linear video.

3. I found it difficult to concentrate on the program because of the hardware.

	All the time	Most of the time	Some of the time	Only occasionally	Never	N/A
IV						
Freq.	1	1	3	11	48	
%	1.5	1.5	4.6	17.1	75	
Cum. %	1.5	3.1	7.8	25	100	

Likert Mean 4.625 Agreement .812

	All the time	Most of the time	Some of the time	Only occasionally	Never	N/A
LV						
Freq	0	0	3	12	46	3
%	0	0	4.9	19.6	75.4	
Cum. %	0	0	4.9	24.5	100	

Likert Mean 4.704 Agreement .852

Between Group Differences

Likert Mean	-.079	Agreement	-.04
z score	.357	Significance	.360

Discussion In this item, both groups' means and agreement levels were nearly identical (within .08). The technical complexities of the IV system or the LV system were not perceived by students as distracting.

4. I was intimidated using the computer.

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
IV						
Freq.	0	2	2	12	48	
%	0	3.1	3.1	18.7	75	
Cum. %	0	3.1	6.2	25	100	

Likert Mean 4.656 Agreement .828

I was intimidated using the video cassette recorder.

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
LV						
Freq	1	0	2	16	45	
%	1.5	0	3.1	25	70.3	
Cum. %	1.5	1.5	4.6	29.6	100	

Likert Mean 4.625 Agreement .812

Between Group Differences

Likert Mean .031 Agreement .016
z score .137 Significance .442

Discussion In Item 4 the questions were different for each group, since one could not ask the LV group about a computer that they did not use. The important question here was, "Was the computer intimidating to the IV students". As can be seen from the mean (4.65) students for the most part strongly disagreed to computer intimidation, in fact from the small difference between groups (.031) it may be concluded that the computer was no more intimidating than the VCR.

INSTRUCTION

5. While watching this program I felt challenged to do my best.

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	0	1	5	51	7	
%	0	1.5	7.8	79.6	10.9	
Cum. %	0	1.5	9.3	89	100	

Likert Mean 4 Agreement .89

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
LV						
Freq	2	9	11	38	4	
%	3.1	14	17.1	59.3	6.2	
Cum. %	3.1	17.1	34.3	93.7	100	

Likert Mean	3.51	Agreement	.695

Between Group Differences

Likert Mean	.49	Agreement	.195
z score	2.90	Significance	.002

Discussion The difference in between group means on this item was considerable (.49), and highly significant (.002). It would appear that students felt more challenged, more consistently (agreement difference .195) to do their best with the IV treatment. This is probably due to the IV review questions which required the students to correctly answer before completing the instruction.

PROGRAM REACTION

6. The video was effective in letting me see sharp, clear photographs.

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	1	13	7	39	4	0
%	1.5	20.3	10.9	60.9	6.2	
Cum. %	1.5	21.8	32.8	93.7	100	

Likert Mean	3.5	Agreement	.687

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
LV						
Freq	0	17	5	33	8	1
%	0	26.9	7.9	52.3	12.6	
Cum. %	0	26.9	34.9	87.3	100	

Likert Mean	3.5	Agreement	.626

Between Group Differences

Likert Mean	.007	Agreement	.061
z score	.058	Significance	.475

Discussion Means and agreement were nearly identical for this item, and the z score was the lowest obtained for any item. This is a good test to measure if the image quality of both treatments was equivalent. Based on this item that would appear to be true. This is promising because the IV system required a compromise in monitor adjustments between computer display and VCR display. It may be noted that the relatively low means (3.5) indicate that television is still not extremely effective in portraying sharp, clear images.

7. <u>The diagrams and graphics appeared clear and easy to read.</u>

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	0	3	2	45	14	
%	0	4.6	3.1	70.3	21.8	
Cum. %	0	4.6	7.8	78.1	100	

Likert Mean 4.093 Agreement .828

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
LV						
Freq	0	2	4	35	22	1
%	0	3.1	6.3	55.5	34.9	
Cum. %	0	3.1	9.5	65	100	

Likert Mean 4.222 Agreement .761

<u>Between Group Differences</u>

Likert Mean	-.129	Agreement	.067
z score	1.241	Significance	.106

<u>Discussion</u> The intent of this question was to receive feedback on the design of the graphics more than the technical limitations of the display device. As can be seen from comparing the means for this item with item 6 (4.09 and 4.22 to 3.50) there was a higher level of satisfaction with the graphics than the photographs. Whether this is due to screen resolution or graphic design is open for question.

8. The delays while the system was preparing for the next segment were distracting.

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
IV						
Freq	1	11	12	36	4	
%	1.5	17.1	18.7	56.25	6.2	
Cum. %	1.5	18.7	37.5	93.7	100	

Likert Mean 3.484 Agreement .679

I would have liked pauses in the instruction to allow me to rest between segments.

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
LV						
Freq	3	18	10	29	3	1
%	4.7	28.5	15.8	46	4.7	
Cum. %	4.7	33.3	49.2	95	100	

Likert Mean 3.174 Agreement .539

Between Group Differences

Likert Mean	.31	Agreement	.14
z score	1.53	Significance	.06

Discussion These questions were quite different and do not apply well to comparison, however important information for each group can be extrapolated from within group data. One of the key arguments for videodisc versus videotape (see Chapter II) is the shorter search time for videodisc branching. Typical branch times in this program were five to ten seconds, with one delay of over thirty seconds (the picture simulation). Apparently from the high mean (4.09) the delay was not perceived as a major distraction, in fact some students commented they enjoyed the pause. However, 18.7 per cent of respondents agreed or strongly agreed that the delays were distracting.

Linear video subjects demonstrated a mixed reaction to wanting pauses in the instruction to allow rest between segments. The mean was in the "Uncertain" category (3.17) and agreement was relatively low (.539)

9. I felt frustrated by the way the information was presented.

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
IV						
Freq	1	2	2	40	19	
%	1.5	3.1	3.1	62.5	29.6	
Cum. %	1.5	4.6	7.8	70.3	100	

Likert Mean 4.156 Agreement .781

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
LV						
Freq	0	3	7	41	12	1
%	0	4.7	11.1	65	19	
Cum. %	0	4.7	15.8	80.9	100	

Likert Mean 3.984 Agreement .801

Between Group Differences

Likert Mean	.172	Agreement	-.02
z score	.848	Significance	.203

Discussion This was an important item but was open to some interpretation by respondents. From student comments it was found that some respondents felt that this item was in reference to the organization of the instructional material, while others felt it was in reference to the delivery method. In either case, between 85 and 92 per cent of respondents either disagreed or strongly disagreed to being frustrated by the way the information was presented, with the IV mean being slightly higher than the LV (4.15 to 3.98).

10. In view of the time allowed for learning, I felt too much material was presented.

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
IV						
Freq	1	14	17	28	4	
%	1.5	21.8	26.5	43.7	6.2	
Cum. %	1.5	23.4	50	93.7	100	

Likert Mean 3.312 Agreement .593

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
LV						
Freq	4	21	14	23	1	1
%	6.3	33.3	22.2	36.5	1.5	
Cum. %	6.3	39.6	61.9	98.4	100	

Likert Mean 2.936 Agreement .571

Between Group Differences

Likert Mean	.376	Agreement	.022
z score	1.921	Significance	.025

Discussion In reviewing the script, members of the Delphi panel indicated that perhaps too much material was covered in the program. As mentioned in Chapter IV this was deemed an appropriate challenge to the effectiveness of the instructional delivery systems employed. This was reinforced by the data from the attitude survey. Nearly 40 per cent of LV students either agreed or strongly agreed that too much material was presented, while only 23 per cent of IV students responded within these categories (the IV mean was .376 higher than the LV). This item was significant at .025. Although it would appear that the IV treatment lowered cognitive overload, it must be remembered that the average time on instruction for the IV group was nearly double the LV group, while covering the same amount of material.

11. <u>The segment on a "Gallery of Great Photographs" was useful in showing me examples of good photographs.</u>

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	2	5	8	41	7	1
%	3.1	7.9	12.6	65	11.1	
Cum. %	3.1	11.1	23.8	88.8	100	

Likert Mean 3.730 Agreement .753

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
LV						
Freq	2	12	13	29	7	1
%	3.1	19	20.6	46	11.1	
Cum. %	3.1	22.2	42.8	88.8	100	

Likert Mean 3.428 Agreement .603

<u>Between Group Differences</u>

Likert Mean	.302	Agreement	.15
z score	1.782	Significance	.035

<u>Discussion</u> The "Gallery of Great Pictures" section served as a visual "breather" from the purely cognitive material in the programs, and to illustrate examples of good photography (see rationale in Chapter IV). This section was the same for both groups, since it did not involve any computer related features. Although, there was some disparity between means (.302), neither group rated it highly. There was relatively low agreement within groups (.592 and .571). Results from this item may be due to the lower resolution of television compared to slides or inappropriate selection of photographs. One student commented that it would have been beneficial to provide exposure and technical information along with the photographs.

12. <u>The simulation of taking a picture was an effective way of reviewing the skills learned in the videotape.</u>

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
<u>IV</u>						
Freq	0	5	6	27	26	
%	0	7.8	9.3	42.1	40.6	
Cum. %	0	7.8	17.1	59.3	100	

Likert Mean 4.156 Agreement .671

<u>The example of 27 different ways of taking a picture was an effective way of reviewing the skills learned in the videotape.</u>

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
<u>LV</u>						
Freq	1	25	16	20	1	1
%	1.5	39.6	25.3	31.7	1.5	
Cum. %	1.5	41.2	66.6	98.4	100	

Likert Mean 2.92 Agreement .611

<u>Between Group Differences</u>

Likert Mean	1.23	Agreement	.06
z score	6.452	Significance	.0001

<u>Discussion</u> It was postulated that the picture-taking simulation would be a key factor in the relative effectiveness of the interactive videotape, since it afforded the highest level of interactivity. This was dramatically supported by the data from this item. The mean for having the simulation versus just seeing the results of different decisions was fully 1.23 points higher for the IV group (significance .0001). Although the questions were slightly different, the disparity between group means does indicate a high level of perceived effectiveness of the simulation (4.15) versus a low level of satisfaction for the alternative of just viewing the effects of different picture-taking parameters (2.92). Eighty-two per cent of the

IV group strongly agreed or agreed that the simulation was effective, while only 33 per cent of the LV group rated the alternative in those categories.

FEEDBACK

13. I felt I had enough control over the rate and sequence of the instructional material.

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	2	7	5	39	10	1
%	3.1	11.1	7.9	61.9	15.8	
Cum. %	3.1	14.2	22.2	84.1	100	

Likert Mean 3.761 Agreement .722

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
LV						
Freq	0	33	8	22	0	1
%	0	52.3	12.6	34.9	0	
Cum. %	0	52.3	65	100	100	

Likert Mean 2.825 Agreement .587

Between Group Differences

Likert Mean	.936	Agreement	.135
z Score	5.145	Significance	.0001

Discussion Learner control is a key item in this study. As noted in chapter II, the ability of interactive video to offer increased learner control is both a strength of the medium and a challenge for designers. The discussion on instructional design considerations in chapter IV notes that limited learner control was given to IV students and effectively none to LV students. Responses indicate a much higher level of satisfaction over control of rate and sequence with the IV method (a difference of .936), although neither mean was as high as

"Agree" (3.76 to 2.82). Seventy-seven per cent of the IV responded in the top two categories, versus only 35 per cent for the LV group. There was higher agreement among the IV subjects (.722 vs. .587).

Of the six items with the highest significance levels (.0001), this was the only item with exactly the same question being posed to both groups. Learner control would appear to be a key factor in between group differences in student attitudes.

14. <u>The method by which I was told whether I had given a right or wrong answer became monotonous.</u>

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
<u>IV</u>						
Freq	0	3	4	49	8	
%	0	4.6	6.2	76.5	12.5	
Cum. %	0	4.6	10.9	87.5	100	

Likert Mean 3.968 Agreement .859

<u>I would have liked a discussion after the instruction to review my understanding of the material.</u>

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
<u>LV</u>						
Freq	7	36	6	14	0	1
%	11.1	57.1	9.5	22.2	0	
Cum. %	11.1	68.2	77.7	100	100	

Likert Mean 2.428 Agreement .674

<u>Between Group Differences</u>

Likert Mean	1.54	Agreement	.185
z Score	7.80	Significance	.0001

<u>Discussion</u> By necessity these were radically different questions for each group; so much so that the wide disparity in means should be discounted. Response to the IV question (mean 3.96, agreement .859)

signifies that students did not feel the computer feedback was monotonous. This indicates that students did not object to the interaction with the computer.

The data from the LV question indicates that those students generally felt the need for a discussion after the instruction (68% agreed or strongly agreed). As noted in Chapter II, the lack of ability for students to ask questions and interact with linear television was identified in the research as a major weakness of instructional television. This was supported by data from this item.

15. The computer questions were helpful for me in reviewing my understanding of the material.

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	1	0	2	44	17	0
%	1.5	0	3.1	68.7	26.5	
Cum. %	1.5	1.5	4.6	73.4	100	

Likert Mean 4.187 Agreement .828

Review questions during the instruction would have been helpful for me in reviewing my understanding of the material.

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
LV						
Freq	10	30	7	17	0	
%	15.6	46.8	10.9	26.5	0	
Cum. %	15.6	62.5	73.4	100	100	

Likert Mean 2.484 Agreement .601

Between Group Differences

Likert Mean	1.703	Agreement	.227
z Score	7.116	Significance	.0001

Discussion As in item 14 there was wide disparity between group means for this question. However, in item 15 the questions are much more similar to each other. The IV group indicated that they found the computer questions helpful in reviewing their understanding of the material (95% either agreed or highly agreed). The high mean (4.18) and agreement level (.828) for this item are among the most significant of the findings in this study.

The LV group had to ponder if review questions would have aided the instruction. Sixty-two per cent of these students agreed or strongly agreed, although agreement was only .601. Although students had a high perception of the effectiveness of the review questions, the actual effect would need further study.

16. I dreaded missing a review question because I had to watch the same material over again.

IV	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
Freq	6	13	12	22	5	6
%	10.3	22.4	20.6	37.9	8.6	
Cum. %	10.3	32.7	53.4	91.3	100	

Likert Mean 3.12 Agreement .508

It would be helpful to rewatch the segments of the tape that I did not fully understand.

LV	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
Freq	13	45	3	3	0	
%	20.3	70.3	4.6	4.6	0	
Cum. %	20.3	90.6	95.3	100	100	

Likert Mean 1.937 Agreement .828

Between Group Differences

Likert Mean	1.183	Agreement	-.32
z Score	5.553	Significance	.0001

Discussion Again, this item involves substantially different questions. For this reason, within group data are more instructive than between group differences. The investigator pondered if increased effectiveness of interactive video would come at the expense of increased anxiety over missing review questions. This may have some validity. Both the mean and agreement level were inconclusive for the IV group (3.12 and .508). Although five persons strongly disagreed to this item, six others strongly agreed. The high number of no-answers (six) are from persons who did not miss any questions and thus did not experience reviewing sections. The dissensus in responses for this item indicates that an effective strategy could be to offer the student an option of using or not using review questions.

The LV group reacted to the idea of rewatching portions of the tape. Fully 90 per cent of respondents agreed or strongly agreed that this would be helpful. Although this question was not posed to the IV group, the data indicate that reviewing sections of the tape is perceived as helpful.

17. <u>While receiving the instruction via interactive video (or videotape), I felt as if someone were engaged in conversation with me.</u>

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
<u>IV</u>						
Freq	1	21	8	33	1	
%	1.5	32.8	12.5	51.5	1.5	
Cum. %	1.5	34.3	46.8	98.4	100	

Likert Mean 3.187 Agreement .578

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
<u>LV</u>						
Freq	4	30	10	18	2	
%	6.2	46.8	15.6	28.1	3.1	
Cum. %	6.2	53.1	68.7	96.8	100	

Likert Mean 2.75 Agreement .562

<u>Between Group Differences</u>

Likert Mean	.437	Agreement	.016
z Score	2.436	Significance	.007

<u>Discussion</u> As noted in Chapter IV one intent of the script was to instruct in a conversational style. Apparently the IV treatment was more successful at this than was the LV (difference .437, significance .007), although neither group's mean reached "Agree" or "Strongly Agree". The higher mean for the IV may be due to the computer questions which were interactive, and used positive feedback (two concepts involved in conversation).

INTERACTIVE VIDEO - VIDEO INSTRUCTION

18. Instruction in this subject, learning basic photography skills, was more interesting presented via interactive video (or videotape) than if it were presented through other methods such as an illustrated lecture or printed text.

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	0	5	12	25	22	
%	0	7.8	18.7	39	34.3	
Cum. %	0	7.8	26.5	65.6	100	

Likert Mean 4 Agreement .656

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
LV						
Freq	0	13	17	25	9	
%	0	20.3	26.5	39	14	
Cum. %	0	20.3	46.8	85.9	100	

Likert Mean 3.46 Agreement .593

Between Group Differences

Likert Mean	.54	Agreement	.063
z Score	3.806	Significance	.0002

Discussion This is an important item because it points to the learner's overall satisfaction with the method used as compared to traditional instruction. There was considerable difference in means between groups (.54), and a high level of significance (.0002) this is in large part the basis for rejection of null hypothesis two. The IV group showed great interest in learning via that method (mean 4.0), with nearly 35 per cent strongly agreeing it was more interesting than traditional methods (as opposed to 14 per cent for the LV group).

19. I could have learned the information just as well using video without the computer-related features of the instruction (the questions and the simulation).

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
IV						
Freq	0	1	6	50	7	
%	0	1.5	9.3	78.1	10.9	
Cum. %	0	1.5	10.9	89	100	

Likert Mean 3.984 Agreement .882

I could have learned the information better with review questions or doing a simulation of taking a picture.

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
LV						
Freq	9	28	14	13	0	
%	14	43.7	21.8	20.3	0	
Cum. %	14	57.8	79.6	100	100	

Likert Mean 2.484 Agreement .617

Between Group Differences

Likert Mean	1.5	Agreement	.265
z Score	8.262	Significance	.0001

Discussion These questions required some conjecture from respondents, but strongly reflect a perception of superior strengths for interactive video features. The first question inquires how effective the IV instruction would be without the computer-related features; the second question is the opposite of that inquiry: how effective would the LV instruction be with computer-related features included. This is another key finding. The mean for the IV group was 1.5 points higher than the LV and agreement was .265 higher (significance .0001). Approximately 90 per cent of the IV students either agreed or strongly agreed that the interactive features were important, while only 20 per cent of the LV students disagreed that review questions or a simulation would have improved their learning in this program.

20. For learning about photography I would prefer interactive video (or video instruction) to traditional instruction (illustrated lecture and text).

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	1	5	16	30	12	
%	1.5	7.8	25	46.8	18.7	
Cum. %	1.5	9.3	34.3	81.2	100	
Likert Mean	3.734			Agreement	.679	
LV						
Freq	0	20	13	26	5	
%	0	31.2	20.3	40.6	7.8	
Cum. %	0	31.2	51.5	92.1	100	
Likert Mean	3.25			Agreement	.562	

Between Group Differences

Likert Mean	.484	Agreement	.117
z Score	2.507	Significance	.005

Discussion This is as close to an overall preference question as was possible for this experiment. It was not germane to have students compare interactive video with linear video since the majority of students had not experienced both methods. Instead this question compared the method they used with traditional methods for learning about photography. Here again, the mean for the IV group was considerably higher than that of the LV group (difference .484, significance .005).

21. Interactive video (or video instruction) made it possible for me to learn more quickly than I would have learned using traditional methods of instruction.

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	0	5	21	29	9	
%	0	7.8	32.8	45.3	14	
Cum. %	0	7.8	40.6	85.9	100	

Likert Mean 3.656 Agreement .687

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
LV						
Freq	0	12	17	29	6	
%	0	18.7	26.5	45.3	9.3	
Cum. %	0	18.7	45.3	90.6	100	

Likert Mean 3.453 Agreement .632

Between Group Differences

Likert Mean	.203	Agreement	.055
z Score	1.119	Significance	.114

Discussion This item examined perceived time efficacy for each method used. Means for both groups were similar, falling between "Uncertain" and "Agree" and with very similar levels of agreement (within .055 of each other). Between 55 (LV) and 65 (IV) per cent of both groups either agreed or strongly agreed that the method they used was more time efficient than conventional methods of instruction.

22. In view of the time and effort I put into it, I was satisfied with what I learned via this method.

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	0	2	6	39	17	
%	0	3.1	9.3	60.9	26.5	
Cum %	0	3.1	12.5	73.4	100	

Likert Mean	4.109		Agreement	.789	

<u>LV</u>

Freq	0	3	4	48	8
%	0	4.7	6.3	76.1	12.6
Cum. %	0	4.7	11.1	87.3	100

Likert Mean	3.968	Agreement	.857

<u>Between Group Differences</u>

Likert Mean	.141	Agreement	-.068
z Score	1.349	Significance	.086

<u>Discussion</u> Means for this item can be considered as the overall satisfaction level. Here again, the IV mean (4.109) was higher than the LV mean (3.968), though the disparity (.141) and significance level (.086) were not as large as on other items. Both mean and agreement levels were quite high, indicating a high level of satisfaction and high degree of consensus. The largest difference was in the "Strongly Agree" category, with the IV group leading 26 per cent to 12 per cent.

23. <u>This method of instruction makes learning too complicated.</u>

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A

<u>IV</u>

Freq	0	1	2	52	9
%	0	1.5	3.1	81.2	14
Cum. %	0	1.5	4.6	85.9	100

Likert Mean	4.078	Agreement	.898

<u>LV</u>

Freq	0	2	6	47	9
%	0	3.1	9.3	73.4	14
Cum. %	0	3.1	12.5	85.9	100

Likert Mean	3.984	Agreement	.851

Between Group Differences

Likert Mean	.094	Agreement	.047
z Score	.651	Significance	.261

Discussion There was some concern that the inclusion of a computer to the IV system would be perceived as making learning complicated and mechanical. As can be seen from items 23 and 24 this did not prove to be true. All means from these items were near the 4 level ("Disagree"), with the IV method surprisingly being perceived as slightly less complicated and mechanical than the LV system. This confirms the fact that the computer can be perceived as personalizing instruction via its interactive abilities. Agreement levels were also high and approximately equivalent.

24. This method of instructional makes learning too mechanical.

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
IV						
Freq	0	5	12	39	8	
%	0	7.8	18.7	60.9	12.5	
Cum. %	0	7.8	26.5	87.5	100	

Likert Mean	3.781	Agreement	.765

	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	N/A
LV						
Freq	0	12	13	30	9	
%	0	18.7	20.3	46.8	14	
Cum. %	0	18.7	39	85.9	100	

Likert Mean	3.562	Agreement	.641

Between Group Differences

Likert Mean	.219	Agreement	.124
z Score	1.351	Significance	.086

Discussion See discussion of item 23. A substantial difference between items 23 and 24 is in the "Agree" category. A much higher percentage of both groups found the method mechanical (7.8 IV, 18.7 LV) than complicated (1.5 IV, 3.1 LV).

25. If keeping my job depended upon learning basic photography skills, this method of instruction would be the best approach that could be used, aside from actually operating the camera itself.

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	1	2	20	34	7	
%	1.5	3.1	31.2	53.1	10.9	
Cum. %	1.5	4.6	35.9	89	100	

Likert Mean 3.687 Agreement .734

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
LV						
Freq	0	15	12	33	4	
%	0	23.4	18.7	51.5	6.2	
Cum. %	0	23.4	42.1	93.7	100	

Likert Mean 3.406 Agreement .641

Between Group Differences

Likert Mean	.281	Agreement	.093
z Score	1.854	Significance	.03

Discussion Although there was some disparity between group means (.281), large percentages of both groups responded "Agree" or "Strongly Agree" to this item. Within group agreement levels and significance level were also relatively high. This was an important item because it can be viewed as "bottom line" effectiveness; that is, when it really counts would this be the most effective method to use to learn this material.

26. <u>If I had to, I could figure out how to operate a camera based on what I learned from this instructional program.</u>

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	0	4	3	50	7	
%	0	6.2	4.6	78.1	10.9	
Cum. %	0	6.2	10.9	89	100	

Likert Mean 3.937 Agreement .859

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
LV						
Freq	0	3	8	49	4	
%	0	4.6	12.5	76.5	6.2	
Cum. %	0	4.6	17.1	93.7	100	

Likert Mean 3.843 Agreement .859

<u>Between Group Differences</u>

Likert Mean	.094	Agreement	.0
z Score	1.223	Significance	.109

<u>Discussion</u> Both groups had high means and agreement levels on this item. Even with some reservations, students perceived both methods as being effective in accomplishing the objectives of the lesson. Both groups' means and agreement levels were nearly identical on this item.

27. <u>I would like to learn about other subjects via interactive video (or instructional video).</u>

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	0	1	11	44	8	
%	0	1.5	17.1	68.7	12.5	
Cum. %	0	1.5	18.7	87.5	100	

Likert Mean 3.921 Agreement .835

LV

Freq	0	6	19	33	6
%	0	9.3	29.6	51.5	9.3
Cum. %	0	9.3	39	90.6	100

Likert Mean 3.609 Agreement .710

Between Group Differences

Likert Mean .312 Agreement .125
z Score 2.236 Significance .011

Discussion Both groups indicated a high motivation to learn other subjects via the method utilized; with the IV group mean somewhat higher (difference .312). Several IV students commented that they could see enormous promise for interactive video in other areas of interest (e.g. genetics). Since so few students in the study had previous exposure to instructional television it was reassuring to see considerable motivation for more use of the medium.

28. How long do you feel you could work efficiently with interactive video (or video) instruction at one sitting?

	15 minutes	Half hour	One Hour	Two hours	More	N/A
IV						
Freq	1	13	43	4	1	2
%	1.6	20.9	69.3	6.4	1.6	
Cum. %	1.6	22.5	91.9	98.3	100	

Likert Mean 2.85 Agreement .831

LV

Freq	2	43	16	2	1
%	3.1	67.1	25	3.1	1.5
Cum. %	3.1	70.3	95.3	98.4	100

Likert Mean 2.328 Agreement .804

Between Group Differences

Likert Mean .522 Agreement .027
z Score 5.225 Significance .0001

<u>Discussion</u> There was considerable disparity between group means (.522) on this item, although both groups exhibited a high level of agreement (.831 and .804). Sixty-nine per cent of the IV group felt they could efficiently work with interactive video for an hour, while 67 per cent of the lV group felt they could only use linear video efficiently for half an hour. Interestingly, this coincided closely with the actual time spent on instruction for each group.

TESTING

29. There were distractions in the room while I was watching the program.

	All the time	Most of the time	Some of the time	Only occasionally	Never	N/A
IV						
Freq	3	6	8	15	32	
%	4.6	9.3	12.5	23.4	50	
Cum. %	4.6	14	26.5	50	100	

Likert Mean 4.046 Agreement .523

	All the time	Most of the time	Some of the time	Only occasionally	Never	N/A
LV						
Freq	0	1	3	11	49	
%	0	1.5	4.6	17.1	76.5	
Cum. %	0	1.5	6.2	23.4	100	

Likert Mean 4.687 Agreement .843

Between Group Differences

Likert Mean	-.641	Agreement	-.320
z Score	3.432	Significance	.0005

<u>Discussion</u> The next seven items relate more to confounding influences in the study than to the effectiveness of the methods. The sizable difference in means for item 29 (.641) is due to the IV station being located in the department's computer lab during winter quarter. Noise from other students and from line printers in the lab were

distractions. During the second implementation of the study the IV station was moved to an isolated room. Although distractions were far less during spring quarter (spring mean 4.68, agreement .843, winter mean 3.40, agreement .484); the achievement test mean was identical to winter quarter and gain from pretest to posttest was six points higher for spring quarter. The effect of distractions on achievement is unknown. The occurrence of distractions has important implications for schools and colleges that use interactive video. Because the system requires substantial investment in hardware, including a computer, many institutions may not have the resources or space to isolate the system, and the computer lab may be the typical location for the interactive video system.

30. <u>There were distractions in the room while I was taking the post-test.</u>

	All the time	Most of the time	Some of the time	Only occasionally	Never	N/A
<u>IV</u>						
Freq	1	5	5	16	37	
%	1.5	7.8	7.8	25	57.8	
Cum. %	1.5	9.3	17.1	42.1	100	

Likert Mean 4.296 Agreement .648

	All the time	Most of the time	Some of the time	Only occasionally	Never	N/A
<u>LV</u>						
Freq	0	1	3	11	49	
%	0	1.5	4.6	17.1	76.5	
Cum. %	0	1.5	6.2	23.4	100	

Likert Mean 4.687 Agreement .843

<u>Between Group Differences</u>

Likert Mean	-.391	Agreement	-.195
z Score	2.411	Significance	.007

Discussion   The factors influencing this item are the same as item 29. The investigator inquired of respondents how they could have experienced distractions in a room that they were sitting alone in. Students indicated that there were distractions from persons in the hall talking. Certainly, the distractions experienced in this study were no greater than in most educational situations.

31. I ran short on time and had to hurry through the post-test.

	Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree	N/A
IV						
Freq	8	8	2	35	11	
%	12.5	12.5	3.1	54.6	17.1	
Cum. %	12.5	25	28.1	82.8	100	

Likert Mean   3.515   Agreement   .585

	Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree	N/A
LV						
Freq	0	4	2	31	27	
%	0	6.2	3.1	48.4	42.1	
Cum. %	0	6.2	9.3	57.8	100	

Likert Mean   4.265   Agreement   .710

Between Group Differences

Likert Mean	-.75	Agreement	-.125
z Score	3.773	Significance	.0002

Discussion   Considerably more of the IV students agreed or strongly agreed to this item than did the LV students (25 per cent to 6.2 per cent). This is most likely due to the IV requiring more time for instruction than the LV method. This finding intimates that the effect of the IV method could have been even greater than that reflected by achievement measures.

32. I grew weary by the end of the instruction.

	Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree	N/A
IV						
Freq	2	19	11	27	4	
%	3.1	30.1	17.4	42.8	6.3	
Cum. %	3.1	33.3	50.7	93.6	100	

Likert Mean 3.190 Agreement .540

	Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree	N/A
LV						
Freq	0	26	5	26	6	1
%	0	41.2	7.9	41.2	9.5	
Cum. %	0	41.2	49.2	90.4	100	

Likert Mean 3.190 Agreement .5

Between Group Differences

Likert Mean	0	Agreement	.04
z Score	.068	Significance	.471

Discussion Both groups' means and agreement levels were essentially the same for this item. This indicates some superiority for the IV method in that instruction consumed nearly twice as much time, yet students felt no higher level of fatigue.

33. The post-test was representative of what I was supposed to learn from the instructional program.

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	0	0	3	49	12	
%	0	0	4.6	76.5	18.7	
Cum. %	0	0	4.6	81.2	100	

Likert Mean 4.140 Agreement .882

LV

Freq	1	1	6	43	12	1
%	1.5	1.5	9.5	68.2	19	
Cum. %	1.5	3.1	12.6	80.9	100	

Likert Mean 4.015 Agreement .817

Between Group Differences

Likert Mean .125 Agreement .065
z Score .988 Significance .172

Discussion Both groups responded quite high to this item and exhibited high levels of agreement.

34. The pretest tipped me off to the right answers on the posttest.

	Strongly agree	Agree	Uncertain	Disagree	Strongly Disagree	N/A
IV						
Freq	2	12	9	36	5	
%	3.1	18.7	14	56.2	7.8	
Cum. %	3.1	21.8	35.9	92.1	100	

Likert Mean 3.468 Agreement .656

LV

Freq	6	8	8	31	8	3
%	9.8	13.1	13.1	50.8	13.1	
Cum. %	9.8	22.9	36	86.8	100	

Likert Mean 3.442 Agreement .591

Between Group Differences

Likert Mean .026 Agreement .065
z Score .423 Significance .337

Discussion Means and agreement levels were remarkably close for both groups. Therefore any confounding influence from this item should have affected both groups equally. It should be noted that students never saw the results of the pretest, so even if they had some exposure to the questions (at least five weeks earlier) they did not have exposure to the correct answers.

35. This experiment was well administered.

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
IV						
Freq	1	0	3	38	22	
%	1.5	0	4.6	59.3	34.3	
Cum. %	1.5	1.5	6.2	65.6	100	

Likert Mean 4.25 Agreement .781

	Strongly disagree	Disagree	Uncertain	Agree	Strongly agree	N/A
LV						
Freq	0	0	8	42	13	1
%	0	0	12.6	66.6	20.6	
Cum. %	0	0	12.6	79.3	100	

Likert Mean 4.079 Agreement .833

Between Group Differences

Likert Mean	.171	Agreement	-.052
z Score	1.748	Significance	.038

Discussion It is rewarding to the investigator that both groups generally felt that the study was well administered.

Summary of Attitude Data:

Although the attitude survey cannot accurately produce an overall measure, it is possible to get a comparative profile of students' perceptions of each method by tallying survey responses. Of 28 items on the survey concerning the perceived effectiveness, dependability, and motivation of each method, 16 were found to have significant differences in Mann-Whitney U levels ($p < .05$). Items with the largest significance levels generally also had the greatest differences in means; in fact the first nine ranks were identical for both ranking methods (Table 16). Twenty-three group means were higher for the IV group, compared to 5 for the LV. Of the seven questions concerning testing, four items exhibited significant differences. On testing items, three means were higher for IV, three for LV, and one identical.

On agreement levels, 21 levels were higher for the IV group, compared to seven for the LV. On items involving testing, three agreement levels were higher for IV and four for LV (Table 14).

Examining the levels of significance and between group differences may be informative. Of the first 28 items, 16 items were significant at the .05 level, and 11 of those items had a difference greater than .4 of a category, all except one of these means were higher for the IV group. These need to be considered with some caution. Five of those items involved questions which were substantially different for each group. Of the seven items on testing, one item had a difference above .4; that mean was higher for the LV group. These data would indicate that student perception was higher for the interactive video method than for the linear video method. However, items involving lack of testing contaminates favored the LV group (Table 14).

Of the first 28 items, between group levels of agreement showed differences above .15 on six items, five favored IV and one the LV group. Of these six items, five also had a between group disparity in means above .4. Of the seven testing related items, two were above .15 in agreement differences, and both favored LV. Of 21 items which involved students' reaction to the same question, only two had differences in agreement levels above .15 (.19 and .15). This indicates great similarity in item agreement levels between groups.

Table 14

Comparison of Group Means and Agreement Levels

Item #	Group Means			Agreement Levels		
	IV	LV	Difference	IV	LV	Difference
1	4.80	4.82	-.12	.90	.91	-.01
2	4.70	4.95	-.25	.85	.97	-.12
3	4.62	4.70	-.07	.81	.85	-.04
4	4.65	4.62	.03	.82	.81	.01
5	4.00	3.51	.49	.89	.69	.19
6	3.50	3.50	.00	.68	.62	.06
7	4.09	4.22	-.12	.82	.76	.06
8	3.48	3.17	.31	.67	.53	.14
9	4.15	3.98	.17	.78	.80	-.02
10	3.31	2.93	.37	.59	.57	.02
11	3.73	3.42	.30	.75	.60	.15
12	4.15	2.92	1.23	.67	.61	.06
13	3.76	2.82	.93	.72	.58	.13
14	3.96	2.42	1.54	.85	.67	.18
15	4.18	2.48	1.70	.82	.60	.22
16	3.12	1.93	1.18	.50	.82	-.32
17	3.18	2.75	.43	.57	.56	.01
18	4.00	3.46	.54	.65	.59	.06
19	3.98	2.48	1.50	.88	.61	.26
20	3.73	3.25	.48	.67	.56	.11
21	3.65	3.45	.20	.68	.63	.05
22	4.10	3.96	.14	.78	.85	-.06
23	4.07	3.98	.09	.89	.85	.04
24	3.78	3.56	.21	.76	.64	.12
25	3.68	3.40	.28	.73	.64	.09
26	3.93	3.84	.09	.85	.85	.00
27	3.92	3.60	.31	.83	.71	.12
28	2.85	2.32	.52	.83	.80	.02
Testing						
29	4.04	4.68	-.64	.52	.84	-.32
30	4.29	4.68	-.39	.64	.84	-.19
31	3.51	4.26	-.75	.58	.71	-.12
32	3.19	3.19	.00	.53	.50	.04
33	4.14	4.01	.12	.88	.81	.06
34	3.46	3.44	.02	.65	.59	.06
35	4.25	4.07	.17	.78	.83	-.05

Table 15

Profile of Attitude Means

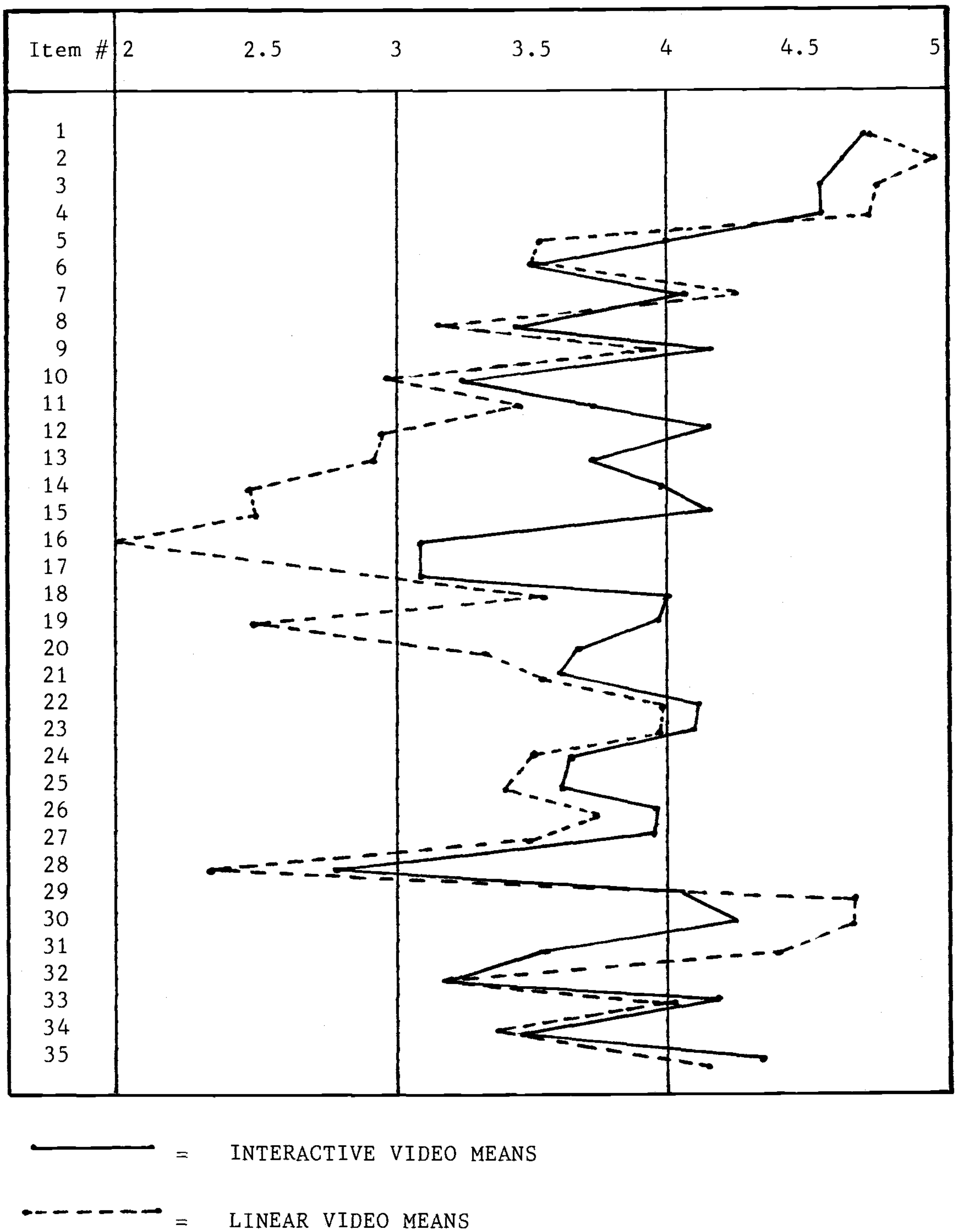

Table 16

Key Attitude Differences
Ranked by Degree of Significance

Sig.	Same Q.	Item #	Content	Diff	Diff Rank
.0001	N	15	computer questions helpful/ review questions would have been helpful	1.70	1
.0001	N	14	method of feedback monotonous/ liked a discussion after instruction	1.54	2
.0001	N	19	could have learned just as well without computer features/ would be better with review questions or simulation	1.5	3
.0001	N	12	usefulness of simulation/ examples of 27 different pictures	1.2	4
.0001	N	16	dreaded missing review question/ would be helpful to review sections	1.18	5
.0001	Y	13	enough control over rate and sequence of instruction	.93	6
.0002	Y	18	more interesting than traditional methods	.54	7
.001	Y	28	how long could work effectivly with method	.52	8
.002	Y	5	challenged to my best	.49	9
.003	Y	2	mechanical malfunctions	-.25	17
.005	Y	20	prefer method to tradtional instruction	.48	10
.007	Y	17	felt someone was engaged in conversation with me	.43	11
.01	Y	27	like to learn other subjects with method	.31	13
.02	Y	10	too much material presented	.37	12
.03	Y	11	"Gallery" sequence useful	.30	15
.03	Y	25	best approach to use for learning photo	.28	16

Additional Student Comments

On the attitude survey students were asked to comment on three things they liked most and three things they liked least about the program or method they used. Following are examples of typical comments.

List three things you liked most about the instructional method or instructional program you have just used:

IV

"I found myself very interested about a subject I previously couldn't care less about."

"The friendly manner the material was presented."

"I could review or go on as I wanted to. Enjoyed a program geared to me!"

"I controlled it, I could review."

"I enjoyed the involvement of myself."

"The questions at the end of each section helped my understanding."

"The levity introduced in the review questions."

"Feeling of success when answering questions correctly."

"Being tested at the end of each section made me pay more attention to the material so I could get a right answer and move on."

"Good pacing things didn't come too fast."

"I liked being able to create my own picture."

"The synthesis of information experienced in the picture taking exercise at the end of the tape."

"It was an innovative alternative to sitting in a lecture class, provided opportunity for me to learn at my own pace and to review the things I was unsure of. The simulation at the end was great! I'd like to come back when I have more time and play with it."

LV

"Did not get too technical - kept most information on layman's terms."

"Easy to digest; symbols, key words, and diagrams were helpful."

"It was explained clearly and concisely."

"Simplified a difficult concept."

"It was colorful and entertaining."

"It made learning easier through visualization."

"The 'Gallery of Great Photos' was nice and relaxing."

"Enjoyed the convenience of being able to watch it when I wanted to."

"Pleasant and unpressured environment."

"Enjoyed being alone and watching videotape."

"I learned in 30 minutes what I always expected would take me hours to learn in a photography class."

List three things you disliked most about the instructional method or instructional program you have just used:

IV

"Takes away personal interaction."

"Not being able to ask specific questions."

"Wished I could stop and go back sometimes sooner than the review time that was built in."

"Would have liked ability to fast forward during review sessions, or a different review as opposed to reviewing the original material."

"Too close to screen. I like very dim words on screen which made dim pictures."

"It hurt my eyes to focus so close. I had to sit back to watch the video and pull my chair forward to answer questions."

"The program just stopped when I wanted to take a second photograph."

LV

"I really wish there had been a way to interact to the machine. Perhaps with a computer this could be done."

"I would have liked immediate feedback."

"No opportunity to ask questions."

"Would have liked replaying parts."

"A little too much material for me all at once."

"Material was covered too quickly."

"Moved a bit slow for me."

"Easily distracted if not interested."

"It would have been nice to have a camera here while they showed the parts."

Summary of Student Comments:

A majority of positive comments for the LV system addressed the program, a majority of negative comments about linear video concerned the delivery system. In agreement with the research on instructional television (see Chapter II) the major weaknesses were perceived as the lack of interaction and the inability to ask questions. Some LV students felt the program went too quickly and others felt it was too slow.

For the IV group the positive comments were evenly split between the method and the material. Most commonly cited strengths were the picture-taking simulation and the review questions. There was disagreement on learner control, with some students wanting more control over pacing and sequence. As noted in Chapter IV it was technically possible to give learners more control, but this was not part of the design strategy employed.

CHAPTER VI

SUMMARY AND CONCLUSIONS

Summary of Findings

This chapter summarizes the findings of the study, and offers some insights into probable causes for those findings. Additionally, ideas for further study are offered.

This study had the largest sample size of any research project to date published on the instructional effectiveness of interactive video (N=128). The increased effectiveness of interactive video as compared to linear video for teaching basic photography skills to students enrolled in a teacher education program was demonstrated at a high level of significance ($<.001$). Both null hypotheses, concerning a lack of significant difference in achievement and attitude measures between experimental and control groups, were rejected. Four research objectives were examined:

1. To determine if there is a significant difference in achievement between students who receive instruction using an interactive video mode (IV) and those using a linear video mode (LV).

The data indicated that the IV group scored significantly and consistently larger pretest to posttest gains than the LV group. The average difference of 6.11 points in favor of the IV group was significant at the .001 level.

2. To determine if there are significant differences in attitude concerning the instruction between students using an interactive video mode and those using a linear video mode.

Sixteen of 28 attitude survey items had statistically significant differences in distribution of scores ($p. < 5$). Twenty-one of 28 means were higher for the IV group. Several of the means on testing contaminants were higher for the IV group, which may indicate the effect might have been slightly larger without these confounding influences.

3. To analyze the factors which contribute to the difference in achievement between the groups (assuming there is a difference).

4. To analyze factors contributing to the differences in attitude between the groups (assuming there are differences).

Although these factors were not statistically analyzed, student comments and attitude survey responses indicate that several factors were important to the difference in effect and attitudes between treatments (see below).

Additionally the following research question was examined:

5. Will the technical complexities of the interactive video hinder learning?

Attitude surveys responses indicate that IV students were not significantly more intimidated by using the computer-assisted method than the linear video system ($p<.44$). However technical malfunctions of the IV system were far more prevalent than for the LV system (80 per cent no malfunctions IV, versus 95 per cent for the LV).

Possible Reasons for Achievement Differences

Practice and Repetition: Many researchers have noted that practice and repetition facilitate learning. The interactive video method offered these attributes through the use of review questions, remediation of material, and options to review sections. One could argue that in large part the increased effectiveness of the IV system is due to the student getting an opportunity to first be quizzed on the material (questions in the IV program were different than those on the achievment test). Additionally, the picture-taking simulation offered synthesis of the information and an opportunity to apply the information.

Attentiveness: With linear video the viewer can "tune out" the program or become easily distracted. The interactive video program used in this study required mastery learning; if the viewer did not pay attention and kept missing review questions it would take longer to proceed through the instruction. It would appear that interactive video could help increase concentration for viewers with low motivation, however this may come at the price of increased anxiety and stress. Subjects in this study, for the most part, did not indicate that they dreaded missing a review question, in fact several students commented that they enjoyed the challenge, and the chance to review their understanding of the material before being tested. As noted in Chapter II, Kadesch (1981) found that four factors contribute to increased learning: the requirement of a high level of mastery, a relatively large number of unit quizzes, immediate feedback on student performance, and review units or review quizzes. All four of these factors are present in the interactive videotape used in this study and absent from the linear method.

<u>High Level of Interaction:</u> Again, as noted in Chapter II many researchers have noted that participatory experiences aid learning. Anandam and Kelly (1981) noted that interactive video "changes the student from passive observer to active participant" (p. 3). However, Bosco (1984) cautions that just because interactive video requires the student to utilize a keyboard, equating motor response with active participation trivialzes the notion of what is active and what is passive in learning situations. In some cases existing programs have become "interactive" by simply adding menus or review questions. In this study, the program was specifically designed to incorporate a high level of interaction, including a simulation of taking a picture.

High Quality of Software: Ultimately the effectiveness of any medium will be determined by the quality of software utilized. This has been evident in the inability of educational films, television, and possibly CAI to reach their full potential. From student responses, it is apparent that there was a high level of satisfaction with the programs used in this study. By careful design both programs were nearly identical in approach and content. However, the interactive videotape utilized the attributes of computer-related features. In comparative effectiveness research frequently a mediated lesson is compared with a live instructor or two different instructional programs are compared. It is essential in this type of research to compare instruction which is equivalent; this allows the attributes of the medium to be isolated from the method and quality of instruction. This is an important lesson for designers of interactive video software; as Bosco noted we must get beyond considerations of the hardware and focus on well-designed, well-applied software.

Possible Reasons for Attitude Difference

As indicated in Chapter V there were 16 significant attitude differences. For purposes of explanation these can be grouped into five main areas:

Level of Learner Control: Quite evidently one factor in the difference between groups was that the linear video group effectively had no control over rate or sequence of instruction, while the computer-related features of the interactive video system afforded that group some degree of learner control. Several IV subjects indicated that they would prefer greater control over program pacing, however 78 per cent of them either agreed or strongly agreed that they felt enough control. The issue of amount of control to offer the learner remains a controversial and important issue for designers and would make an excellent topic for further study.

Opportunity for Review Questions, Feedback, and Review Sections: As noted in the preceding item, the LV group had no opportunity for review, while the IV group encountered considerable opportunity for review, review questions or feedback. The LV group indicated a high desire for opportunities for review and practice. This was the most commonly cited shortcoming of the linear video method. The IV group exhibited a high level of agreement that the review questions and review sections were helpful to them, and that interaction with the IV system was positive and reinforcing.

Preference over Traditional Instruction: The difference in preference of the method used over traditional methods favored the IV group by .484 and was significant at the .005 level. Additionally, the IV group's mean was .54 higher (significance .0002) in agreeing that the method they used was more interesting than traditional instruction. This can be due to several factors. Certainly one factor is novelty; the concept of using a videotape recorder connected to a microcomputer was enticing to many learners. However, the Hawthorne effect may not be germane because data indicated that learning via videotape was also novel to most participants. Students in the population typically had more exposure to computers than instructional television. A more important factor might have been the interaction afforded by the computer. Research on CAI (see chapter II) has shown that the holding power of computers is in large part due to the interactive nature of the technology. In this study, the IV group had a higher perception that someone was involved in a conversation with them while receiving instruction than did the LV group (difference .437, significance .007). It may be interpreted that the computer-assisted video instruction was perceived as being more humanizing, individualized, and personal than did the linear system.

Challenge to do Best: The IV group felt more challenged to do their best while watching the program than did the LV group (difference .49, significance .002). It is believed that this can be directly attributed to the IV students needing to correctly answer review questions to proceed with instruction. As mentioned above, whether this is a trade off for increased anxiety is a concept worthy of further study.

Time Able to Effectively use the Method: It is interesting to note that each group felt they could work effectively with the method approximately the amount of time that it actually took to watch the program. For the LV group this was thirty minutes, and for the IV group the average time on instruction was about fifty minutes. It may be that students had the perception of being able to effectively longer work with the IV system because of being an active learner. In education it is a maxim that "involvement precedes interest", and this may have been the case in this study. It may be discovered that instruction may take longer with interactive video, but because learners are active and not passive, they can work longer effectively.

Recommendations for Further study

Retention: Achievement measures in this study measured only immediate recall of information. Testing took place immediately following treatment. A larger question would be the comparative effectiveness of methods in retention testing. This can be difficult to measure in light of confounding influences occurring between treatment and retention testing. An informal measure of achievement retention was conducted winter quarter. Using a small sample (IV=13, LV=19) a measure from posttest to retention test was made. Retention testing was conducted three to four weeks after posttesting and consisted of only ten items on a educational media final exam. Results indicated that both groups' mean scores declined approximately eight points between testings. Because of small sample size, the influence of studying for the test, and the small number of items on the retention test, these results may not be reliable.

Fishman (1983) compared pretest, posttest and retention test for IV , LV, and live lecture for instruction on chemotherapy to nurses. IV retention went down ten points (N=18), LV five points (N=12), and live instruction five points (N=13). Analysis of covariance determined that there was no statistically significant difference among the groups in the decline of mastery from posttest to retention test among the three groups ($p<.001$).

There is some evidence, however, that interactive video may improve retention. A research study at the Clark Equipment Company (see Chapter II, Wooldridge and Dargan, 1983) found that retention measures showed a 13.6 per cent increase of IV over LV for teaching a safety refresher course to lift-truck operators.

The apparently mixed effectiveness of interactive video in increasing retention is surprising in light of educational research which indicates that mastery learning and active learning increase both retention and transfer of learning (Fishman). The issue of retention is an issue in need of further exploration.

Cost-benefit, Time Effectiveness: Although this study demonstrated that interactive video can increase instructional effectiveness, it did not explore the issues of cost or time effectiveness. Interactive video is more complicated to produce than almost any other medium of instruction, and development and production costs are proportionally higher, typically as much as four times greater than CAI or linear video. However, the high development costs can be offset by repeated use of the materials and the automation of some instruction. Therefore, interactive video may be attractive to trainers who need to provide the same instruction to large number of persons at many different cites.

Increased station cost is also a drawback of interactive video. An interactive video system costs more than twice as much as a linear video system. This high station cost may make interactive video inappropriate for training or instructional situations where numerous stations are needed and funds are limited.

This study found an increase in instructional effectiveness of IV of about 17 per cent over LV. This increase may not be large enough in many situations to justify the added expense. Time on instruction was also higher for the IV group than the LV group, about 50 per cent higher. In many instances this may not be an acceptable trade off.

Fishman compared IV to LV and live instruction and found very similar findings . The LV group each took 27 minutes, the lecture 50 minutes, and the IV group averaged 54 minutes (range 44-92 minutes).

A research study on computer-assisted instruction found that in military training, CAI saves time, but doesn't raise scores significantly (Orlansky, 1983). This study found the opposite to be true for interactive video. Orlansky makes the point that in military and industrial training a saving in time is directly related to increased benefit of the instruction. However, in education the duration of the course is set, students do not receive pay, and the school system would save no money if students completed a course in less time. For most public schools time efficiency is not a priority. Further research is needed to test if interactive video can be both cost and instructionally effective.

Attitude vs Achievement: Research in computer-assisted instruction has indicated that CAI may make a larger difference in learner attitude than in achievement. This may also prove to be true for interactive video. This study did not compare the level of significance between the two different research questions. It may be that interactive video's largest benefit is not its instructional effectiveness, cost effectiveness, or time efficacy, but in its ability to motivate and involve students.

Factor Analysis: This study addressed the question of how interactive video compares to linear video in instructional effectiveness and student perceptions. A more focused question is why was interactive video more effective than linear video. This chapter has offered some insights into probable causes for differences in results between the two methods. These projections are based on: data from the attitude surveys, student comments, personal experience, and intuitive judgment. Research should be conducted to provide a formal factor analysis to assess the reasons behind the performance of interactive video. This could be accomplished by altering the design of interactive videotapes and testing single attributes of interactive video. Below are several aspects which could be varied to test for their individual effect.

Varying Learner Control: Throughout this thesis the point has been reiterated that the amount of learner control to give students is a key issue for designers of interactive video materials. It would be beneficial to determine if there is a direct relationship between level of learner control and student achievement. This would have implications far beyond just interactive video instruction. With interactive video this level could be modified by offering students varying levels of control over program pacing, sequence, and feedback. Students could be offered more control over what method of instruction to use or whether review sections would be optional or automatic.

Varying Level of Interactivity: Another interesting question would be if there is a direct relationship between level of interactivity and achievement. By comparing programs with varying levels of interactivity the effect of learner interaction on achievement could possibly be isolated. Variable factors could involve comparing the use of review questions to the use of simulations, or the use of multiple-choice questions versus inquiry questions.

Group Instruction: This study examined only individualized instruction, yet interactive video may have some important implications for group instruction also. As noted in Chapter IV, field testing the materials utilized in this study involved comparing IV individualized instruction to IV used in a class environment. In the group instruction answers to questions were derived from a consensus of the group. A short amount of time was allowed for questions and discussion with the instructor. Although adequate controls were not maintained, this experiment did find that the mean for the IV group treatment was only four points lower than that for the IV individualized method. Given the cost and complexity of delivering individualized instruction it would be beneficial to compare these two different forms of delivery.

Mechanical Dependability: In this study nearly twenty per cent of IV students experienced at least some mechanical malfunction. For many training situations this would be an unacceptably large figure. Before large scale implementation of interactive video instruction is conducted it would be beneficial to determine the mechanical reliability of different systems.

Brevity of Instruction: Barbara Fowler (1980) in her doctoral dissertation noted that due to the brevity of instruction generalizations are limited to instruction of similar length. In her case, as well as this study, instructional sequences occurred over a 30 to 50 minute time span. Further research should be conducted utilizing instruction given under other time conditions.

Replicability: Research in the social sciences has often been criticized for its lack of replication. Interactive video has been especially susceptible to this. At the time of this writing only eight other dissertations on interactive video had been written. Interactive video offers a relatively facile way to replicate a study because the same materials can be reemployed. It would also be worthy of investigation to administer the same materials to different populations.

Different Populations and Subject Matter: Interpretation and generalization of results from this study is limited to data obtained from students enrolled in a teacher education program instructed in basic photography skills. Other studies should be conducted to determine the relative effectiveness of interactive video with different populations and with different subjects of instruction. It may be discovered that a particular medium is good at teaching some concepts to some learners and not good at others. This is an area of research that CAI research is just beginning to focus on.

Applications of Interactive Video: Determining the proper application of interactive video may be as important as investigating the relative effectiveness of the medium. As the research in CAI and instructional television has shown, proper design of software and wise application of the medium can be the decisive factor in determining the effectiveness of a technology. A relevant question is "Should we be using interactive video based instruction or interactive video assisted instruction?". Research on CAI has shown that computer-assisted instruction has been more effective than computer-based instruction. Indeed in this study, in which instruction was IV based, many students indicated the desire for discussion, hands-on experience, and live question-and-answer sessions. The attribute-treatment interaction could be studied to determine what kind of student learns best from interactive video. Additionally, the level of use needs to be explored. There are at least three distinct utilization levels: class level, unit level, and lesson level. Bosco feels that ultimately interactive video will be more beneficial utilized as learning modules rather than replacing entire courses of study. The role of interactive video was examined in detail in Chapter II. It was concluded that educators will need to face the question: "What can a machine do best; what can a human being do best; and how can the two work in concert?" (Norbert Weiner, quoted in Bosco, 1984, p. 18).

Use in Conjunction with Other Media: In reality, most educators and trainers draw on a variety of methods and media. Studying an instructional technology in isolation is to some degree an academic exercise. Research should be conducted to determine the effectiveness of interactive video when used in concert with other media. Cronbach and Snow (1977) assert that a variety of presentation media are necessary for effective individualized learning environments. Fowler (1980) utilized a combination of media for comparing the effectiveness of delivery methods. One group utilized a combination of programmed student manual, linear videotape, and slides. The experimental group utilized an interactive videodisc system. Although her study did not utilize IV in conjunction with other media it does provide a good jumping off point for further study into that question. Although it is difficult to conduct multi-variate research, it is essential that it be done because actual learning and teaching will ultimately be delivered in the real world of multi-sensory environments. Only then will interactive video be able to come out of the research lab and into the real world of training and education.

Conclusion

In this study interactive video was shown to be more effective than linear video in teaching basic photography skills to students enrolled in a teacher education program. Significant improvements were measured in both achievement and attitude. This study demonstrated that interactive video can be a very powerful and effective training method, given certain considerations. These considerations are essential issues in the effective use of the medium. Interactive video materials must be designed and produced to address the unique characteristics and strengths of the medium; it must be utilized effectively, converging the capabilities of the technology with the nature of the educational task; and it must be used in conjunction with other media and methods, taking into consideration the total learning environment and learner characteristics. Ultimately, it is the instructional methods that interactive video facilitate that will be the strength of the medium. In concluding, it is worth reiterating J.J. Bosco's advice to potential designers, producers, and users of interactive video:

> In order for the technology to be used effectively, we need to get beyond the statements of the first generation of advocates to more careful considerations. If interactive video is to become a useful tool in education, and not a mere toy or plaything, we need reasoned analysis as much as enthusiasm.

Hopefully this study will serve as a pioneering effort in the reasoned analysis of interactive video, and will aid in the transformation of the medium from technological plaything to educational tool.

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APPENDICES

APPENDIX A.

Interactive Video Script

PICTURE THIS...

A Lesson In Basic Photography Skills

Arnie Abrams

(computer text 1) "Welcome to...press any key to begin"

QUESTION #1

(computer text 2)

"Is this the first time you will be watching the program?

A. Yes let's start at the beginning.

B. No let's review a specific section."

(branch)

if A then next

if B then 97 (Menu)(computer text 53)

1.(visual) p.o.v. shot, walking up a trail.

(narration)

Picture this... you are on a short hike to a place at the top of a hill with a very special view. You are with a very special friend. How will you preserve this special moment? If you decide to preserve that moment with a photograph you will have to make some important decisions...what film to use, what lens, what angle, and what exposure. All of these decisions will effect your picture. This program will give you the basic skills to make these type of technical and creative decisions.

2.(visual) graphic..."Picture This...A Lesson in Basic Photography Skills" music

3. (visual) graphic "Produced by Arnie Abrams and Howard LaMere"

music

PAUSE

4.(visual) old time camera

(narration)

Before we're ready to take our pictures lets start with a few basic concepts. There are two basic concepts to photography, controlling the image and controlling the light.

-the image is controlled through the lens system

-the light is controlled through exposure.

PAUSE

5.(visual) camera lens

(narration)

Lets look at a typical camera lens...
there will be several sets of numbers; the focusing ring, the aperature scale , and the depth of field scale.
The first one we need to look at is the focusing ring...the numbers on this ring relate to the distance of the camera to the subject, they may be in feet or in meters. Rotating this ring makes the image appear sharp or in focus.

PAUSE

6.(visual) gr:viewfinder types, supered over eye to camera

(narration)

When we look through the viewfinder we may encounter several different focusing systems. Lets look at three common types.

7.(visual) split image screen

(narration)

In a split image system the center of the image will split apart when the image is out of focus and join together as you come into focus.

8.(visual) coincidence type screen

(narration)

In a coincidence type system you will get a double image when out of focus and as the image gets in focus the image will come together or coincide.

9.(visual) microprism screen

(narration)

In a microprism system when you are out of focus the image will be blurred but as you come into focus it will sharpen and glass beads will appear.

10.(visual) combo split and micro screens

(narration)

Great pictures require precise focusing. To get razor sharp focus it is best to combine the microprism system with one of the first two systems like this.

Before we get to controlling the light lets stop for a moment and review what we've learned so far.

11. QUESTION #2

(computer text 3)

"Recall we mentioned two basic priciples of photography, these are:

A) Controlling the image and controlling light.

B) Controlling split image and controlling microprism.

C) Controlling focus and controlling the lens.

D) Controlling the camera and controlling yourself."

(branch)

if A then

(computer text 4)

"right...thats a good start lets go on"

continue to next question

if B or C then

(computer text #5)

"no thats not right lets go back and review that section."

rewind tape and play #4

if D then

(computer text #7)

"you can't be serious let's go back and review"

play #4

12 QUESTION #3

(computer text #8)

"You sharpen an image by rotating what set of numbers on the lens ?

A the depth of field scale

B the f-stop

C the meter marker

D the focus ring"

(branch)

if D then

(computer text #10)

"I think you've got it , lets go on"

goto next

if A,B,C then

(computer text #9)

"not quite right, lets review that section "

play #5-5

13. QUESTION #4

(computer text #11)

"Which is a preferred type of focus system for sharpest focus ?

A split-image

B coincidence

C combination of split-image and single-vision

D combination of micro-prism and split-image"

(branch)

if D then

(computer text #14)

"That's right , you're getting to be a real shutterbug"

goto next

if A or B then

(computer text #12)

"No, remember a combination of split-image or coincidence with a micro-prism screen will allow best results. Lets go back and watch that section again"

play 6-10

if C then

(computer text #13)

"No there is no such thing as single-vision"

play 6-10

14 (visual) camera

(narration)

So far, so good. Our only decision to this point has been on what distance to focus at. Now lets decide on the amount of light the film will be exposed to.

PAUSE

15 (visual) camera lens

(narration)

The next set of numbers on a lens is the aperature control. F-stops or aperature simply means the size of the opening of the lens.

16 (visual) open shutter

(narration)

When the hole or aperature is larger it lets in more light, when it is smaller it lets in less light. The darker a scene is, the more light will be needed to record the image , and thus we will need a larger aperature.

17 (visual) f-stops

(narration)

One of the great consistencies of photography is that in any concept involving numbers things will always be backwards...well almost always. Let's call this the "always-backwards-concept". If you're the kind of person who's always getting things backwards, photography will come naturally to you. Our first case in point is aperature.

The smaller the number of the f-stop the larger the opening will be and the more light will come through. Conversly, a larger f-stop number will be a smaller opening and will let in less light. A small f-stop has a large number and a large f-stop has a small number.This is because f-stops are fractions...
f2 means the lens is half-way open
f16 means the lens is 1/16th of the way open.

18 (visual) f-stops with halved light

(narration)

Each f-stop will double or cut in half the light of the f-stop next to it. For example moving from f5.6 to f4 will double the amount of light let in. Because of the strange nature of circles and physics the numbers are not exactly doubled but the size of the opening is.

19 (visual) person with eye to the camera

(narration)

By the way , when you go to take pictures you will usually be looking through the viewfinder and not at the lens. You can tell the focus ring from the f-stop because the focus ring will glide smoothly while the f-stop control will click at each f-stop. You can also shoot between clicks or f-stops.

20. QUESTION #5

(computer text#15)

"well thats a lot of material would you like to review aperature or keep on going?

A review

B keep on going to the review question on aperature."

(branch)

if A then play 15-19

if B then next

21 QUESTION #6

(computer text#16)

"f-stop or aperature refers to

A focus distance

B how long the lens remains open.

C the size of the opening of the lens

D the address of the photographer"

(branch)

if C then

(computer text#18)

" right !"

goto next

if A or B then

(computer text#17)

"no, remember that f-stop or aperature is the size opening of the lens"

goto

play 15-16

if C then

(computer text #7...can't be serious

play 15-16

22. QUESTION #7

(computer text #19)

"If f2 is two f-stops away from f5.6 it will let in --- as much light ?

A f2 will let in 4 times as much light.

B f2 will let in twice as much light.

C f2 will let in 1/4th as much light.

D f2 will let in 5/6th as much light."

(branch)

if A then

(computer text #20

"well done that was a tough one"

goto next

if B.C.or D then

(computer text #21)

"incorrect but that was a tough one. If f2 was ... lets review the section on f-stops"

play 15-19

PAUSE

23 (visual) house with curtains and plants

(narration)

Aperature is only half the story of controlling light, the other factor is shutter speed. Shutter speed is how long the shutter stays open, exposing the film to light. Its like the curtains in your home , aperature is how wide you open the curtains, shutter speed is how long you leave the curtains open. These basic controls will always be intertwined.

24 (visual)

(narration)

Photography is a series of compromises. And one of the primary ones is between f-stop and shutter speed.

25 (visual) shutter speed dial

(narration)

Like f-stops, shutter speeds are fractions. You put a one before the number.For example, a shutter speed of 500 means the shutter will remain open for 1/500th of a second. A shutter speed of 60 means it stays open for 1/60th of a second.Following our "always-backwards-concept", the smaller the number is the longer the shutter remains open and the more light is allowed in.

26 (visual) list of shutter speeds

(narration)

Each setting doubles or halves the amount of light of the setting adjacent to it. So a 60th would allow in twice as much light as 125th.

27 (visual) typical exposure

(narration)

Exposure is the combination of aperature and shutter speed. One setting will always affect the other.

PAUSE

28. QUESTION #8

(computer text #22)

"Study these exposures:

1/15-f16	1/125-f5.6
1/30-f11	1/250-f4
1/60-f8	1/500-f1.9

What do you notice about them? (type in your answer)"

(branch)

If the word same or equal appears then

(computer text #23)

" Right ! They are all the same- when the f stop is doubled the shutter speed is halved."

goto next

If same or equal does not appear then

(computer text #24)

" Notice that all the exposures are equal. When we double the f-stop we cut the shutter speed in half, thus they are all equal in the amount of light gathered."

goto next

PAUSE

29 (visual) split screen of pictures

(narration)

If all of these combinations give the same exposure then why does it make any difference which one we use. The answer is that each exposure will produce a different effect in your picture. The mark of a good photographer is to be able to control the image in order to capture his or her own personal expression.

30 (visual) graphic freezing motion-depth of field

(narration)

Two important considerations in the trade off between aperature and shutter speed will be the freezing of motion and depth of field. Lets look at each of these in detail.

31 (visual) split of bird pictures

(narration)

A slow shutter speed (below 1/60th) will blur movement. A fast shutter speed will freeze the action. Here are some examples.

32 (visual) bike at 1/500

(narration)

This picture taken at 1/500th of a second freezes a very short instant in time. In 1/500th of a second the bike will not travel far enough to detect any motion. Even the spokes on the wheels are visible.

33 (visual) bike at 1/60

(narration)

The same picture taken at 1/60th of a second causes the bike to blur. In that amount of time the bike has moved a visible distance. The faster the subject is moving the faster shutter speed you will need to freeze the action.

34 (visual) bike at 1/2

(narration)

The same picture at half a second leaves a rather interesting effect. Three different exposures creating three very different pictures. If you were doing an ad for a bike company the first picture would be good to show what the bike looks like while this picture would not work at all. However if you were doing an illustration for an article on bike racing this picture might be an effective illustration.

35 (visual) bike pan

(narration)

One other technique you can use to freeze action is to do a pan. With a pan you move the camera to follow the action. If the camera is panning at the same speed as the object then the object will be sharp and the background will be a blur.

36 (visual) race cars pan

(narration)

These types of pictures are often seen in pictures of race cars or horse races. These take some practice.

37 (visual) blurred picture

(narration)

Besides subject movement, camera movement will also blur your picture. If you need to use a shutter speed slower then a sixtyth of a second it is best to put your camera on a tripod.

PAUSE

38 (visual) gr:depth of field

(narration)

The second exposure consideration is depth of field. Depth of field refers to the zone or area of focus. This is the distance from the nearest point that will be in focus to the farthest point that will be in focus.

39 (visual) gr:3 methods

(narration)

There are three methods of controlling depth of field: f stop,subject to camera distance and lens size. Lets look at examples of each method.

40 (visual) fence at f2

(narration)

The larger the f stop the smaller the depth of field and vice versa. For instance in this picture taken at a very large f stop (f2) the forward and back posts are blurry while just the center few posts are in sharp focus. This is very shallow depth of field.

41 (visual) fence at f8

(narration)

The same picture taken at f8 increases the depth of field. Now the front posts and background are beginning to come into focus. (pause 2 seconds)

42 (visual) fence at f16

(narration)

With the lens at a very small, f16, the entire scene comes into focus, this is very great depth of field. The reason for this is that when light comes through a small opening the light rays are more directed and less scattered. Its much like the way we squint our eyes to see better.

43 (visual) split of flower close up and landscape

(narration)

Recall photographs you've seen.In extreme close-ups there will be very shallow depth of field, while in far away shots, like landscapes, almost everything will be in focus.

44 (visual) fence post from 2 feet

(narration)

A second factor controlling depth of field is the distance of the subject from the camera. When we take close ups we have shallow depth of field. This picture taken from two feet away from the post captures the background as just a blur.

45 (visual) fence post fron 10 feet

(narration)

The same picture taken at ten feet away now brings the background into focus.

46 (visual) putting on long lens, cut to fence post telephoto

(narration)

But let's suppose we wanted a close up of the fence post. So we put on a telephoto lens. Now once again the background becomes a blur. The larger or more powerful the lens is, the shallower the depth of field.

47 (visual) putting on wide angle cut to fence post wide angle

(narration)

With a wide angle lens we get great depth of field. Once again its a trade off, this time between magnification and depth of field. (pause 2)

48 (visual) gr 3 methods of depth of field

(narration)

Lets review the three methods of controlling depth of field. Notice that these follow our always-backwards-concept: the larger the f-stop-the smaller the depth of field...; the closer the subject is to the camera-the smaller the depth of field...; and the larger the lens is -the smaller the depth of field will be. Before you stop shooting close-ups you should consider that greater depth of field does not neccessarily mean a better picture. There are times you will want to limit depth of field to make one object stand out or for some other effect, its just another one of your creative controls. Another reason you might give up depth of field is to be able to shoot at a faster shutter speed in order to freeze motion. Remember that if you shoot at a faster shutter speed you will need to use a larger f stop, its another photographic trade off.

PAUSE

49 (visual) auto exposure camera

(narration)

We have seen a great number of ways you can take a picture. Even with an automatic exposure camera you wil find you may want to use the manual mode in order to achieve the effect you want in your photograph. Lets now look at how the camera measures light.

50 (visual)match-needle viewfinder

(narration)

Most 35mm cameras have a built in light meter. Light meters measure exposure. Some meters work by matching needles others by matching L.E.D. lights. Either way, one measurement is how much light is available and the other one shows how your camera is set. When the two match up you most likely will have a correct exposure.

51 (visual) white bird on black background

(narration)

Certain situations such as a light object against a dark background or vice-versa can fool the camera's light meter. You should bracket your exposures in these situations.

52 (visual) split of 3 exposures

(narration)

To bracket, you shoot pictures at the setting recommended by the light meter as well as.one f stop over and under. One of the three exposures should be a good one. Again, you may like the effect in an over or underexposed picture, its just one more of the creative tools you may want to use.

PAUSE

53. QUESTION #9

(computer text #25)

"We've just covered a sizable amount of information, including shutter speed, exposure , freezing motion, depth of field, and metering. Would you like to see any of these sections again?

A yes, the section on shutter speed.

B yes, the section on freezing motion.

C yes, the section on depth of field.

D yes, the section on metering.

E no lets go on to some review questions"

(branch)

if A,B,C,D play appropriate video section

if E goto next

54. QUESTION #10

(computer text #26)

"Shutter speed refers to:

A.how wide the lens is open

B how long the film will be exposed to light

C how fast the camera is moving"

(branch)

if A or C then (computer text #27)

"no lets review the section on shutter speed"

play 23-27

if B then (computer text #28)

"right on"

goto next

55 QUESTION #11

(computer text #29)

If you were taking pictures at a softball game and wanted to freeze the action which would be the best shutter speed to use?

A 500

B 60

C 15

D 1

(branch)

if B,C, or D then (VIDEO #55A)

55A (video) Slide of a baseball game

(narration) Not really- a shutter speed of 500 or 1/500th of a second will capture a briefer instant of time then either 1/60th, 1/15th, or one full second. This picture taken at 1/500th really freezes the action.

next

if A then (VIDEO #55B)

55B (video) slide of a baseball game

(narration) Good answer- a shutter speed of 500 or 1/500th of a second will capture a briefer instant of time then either 1/60th, 1/15th, or one full second. This picture taken at 1/500th really freezes the action.

next

56. QUESTION #12

(computer text #30)

"Depth of field refers to the zone or area of focus. Which of the following is not a direct method of controlling depth of field?

A panning

B subject to camera distance

C f stop

D lens size"

(branch)

if B,C,or D then

(computer text #31) "No Lets review the three methods ."

play 38-48

if A

(computer text #32)

" Very good, these must be too easy for you"

next

57. QUESTION #13

(computer text #33)

" What is meant by the term bracketing?"

A taking pictures at the metered exposure as well as above and below that setting.

B putting the camera on a tripod.

C shooting the same picture at different distances

D shooting the same picture with different lenses.

(branch)

if A

(computer text #34)

"Right. A scene with extreme contrast of light and dark will fool the meter and you should bracket your exposure.

next

if B,C or D

(computer text #35)

"Not really, a scene with extreme contrast of light and dark will often fool the meter. Bracketing refers to taking pictures at the metered exposure as well as above and below that setting. Lets review that section"

play 51-52.

58 (computer text #36)

"A gallery of great photographs"

musical break with examples of excellent photographs.

59 (visual) p.o.v. of entering camera store

(narration) Now that we know the basic operation of the camera we're ready to go out shooting...well almost ready...first we need to drop by the camera store. At the camera store we still have important some decisions to make...what film, camera type and lens to use.

60 (visual) pan camera store

(narration) Film comes in boxes with all kinds of names and numbers on them, but believe it or not, all of these strange marks actually mean something. Lets wind our way through this confusion, starting with the name of the film.

61 (visual) three rows of film boxes

(narration)

There are three main types of film; print film, slide or movie film, and instant print film. Print films produce a negative with which to make prints from, slides or movies produce a positive which is directly used in the projector. Because you're using the original it is important to take great care in handeling slides and movies. Instant print film develops by itself shortly after exposure, again there is no negative, you are handleing the original.

Print film is usually labeled with the suffix "color", for example Kodacolor, Ektacolor, Fujicolor. Slide and movie films usually end with the word "chrome", Kodachrome, Agfachrome, or Fujichrome. Black and white film is only available as print film.

62 (visual) warm film boxes and cool film boxes

(narration)

No color film will be completly nuetral in reproducing color. All film will give a slight tint to the image. Warm balanced films will give a slightly reddish tint. Cool balanced films will give a slightly blueish tint.

63 (visual) film boxes

(narration)

The number after the name of the film refers to film speed. Film speed refers to the film's sensitivity to light. This sensitivity is measured by the ISO number of the film. This number, which used to be called ASA, also follows our always-backwards-concept, the higher the number the less light the film requires for proper exposure.

High speed films, such as Ektachrome 400, can often be used indoors without a flash, They can also be used outdoors at a faster shutter speed or smaller f stop then slower films such as Kodachrome 64. But once again there's a trade off: higher speed films will be grainier or less sharp then slower films.

64 (visual) side of box with film size

(narration)

We're not done with numbers yet. On the side of the box there's another set of numbers - these refer to film size and number of exposures. For instance 135-36, means the film is 35 millimeters wide and there are 36 pictures on the roll.

65 (visual) film sizes compared

(narration)

Film size is measured in millimeters or inches, the larger the film is the sharper the image will be. This is because larger film does not need to be magnified as much to make an enlargement. Common film sizes include; 110 used in pocket cameras, 126 used in instamatics and box cameras, 135 in 35 millimeter cameras and two-and-a-quarter-inch or larger film used in studio cameras. 110 film will not make an acceptable 8 by 10 enlargement, while two-and-a-quarter-inch film can be blown up to poster size with no problem.

66 (visual) expiration date

(narration)

Another important number on the box is the expiration date. To assure good pictures you should only buy film that you will have processed before its expiration date. If you buy slightly outdated film it will probably be "o.k", but there's no assurance. There's one other number on the box, one that needs no explanation...

67 (visual) price tag

(narration)

the price tag.

68 (visual) film box

(narration)

Lets review the numbers on the box one more time...films are either prints, slides or movies, or instant prints. The suffix "color" usually signals a color print film while "chrome" usually means slides or movies. Some films are cool balanced and some warm balanced.

69 (visual) film speed

(narration)

ISO refers to the films sensitivity to light. The higher the number the less light it requires for proper exposure.

70 (visual) film size and exposure number

(narration)

Different cameras use different size film. The larger the film is the sharper the image will be. The number after the film size is the number of exposures on the roll.

PAUSE

71. QUESTION #14

(computer text #37)

" Its not really important to remember all of these names and numbers, what is important is to remember what they mean and how they will affect your creative efforts.
Would you like to go back and see the portion on film selection again

Yes...

No..."

(branch)

if yes then replay 59-70

if no then next

72 (visual) cameras

(narration)

Now that you've decided on a film you should be aware of the types of cameras available.

There are four main types of cameras - rangefinder, twin-lens-reflex, single-lens-reflex, and view camera. Lets look at each type.

73 (visual) rangefinder

(narration)

The rangefinder is perhaps the most common, and least expensive type of camera- these include most Instamatics, Polaroids, and pocket cameras. These cameras usually have fixed or automatic focus and exposure, you cannot control the settings. With a rangefinder the film is exposed through one lens and you look through a seperate viewfinder lens. This brings up the problem of parallax.

74 (visual) parallax flower

(narration)

Because the lens you look through and the one the film is being exposed are not exactly in the same place, you may be seeing something slightly different than what the camera is seeing. Usually this will not be a problem, but on close-ups you will be seeing one picture- the flower, while the film will be seeing another- the stem. You've probably seen someone's snap-shots that had the top of a person's heads cropped off, parallax was probably the problem.

75 (visual) TLR

(narration)

The second type of camera is the twin lens reflex or TLR . This also suffers from parallax, but is a step above the rangefinder. You still look through a seperate lens but now you can control the focus. As the bottom lens comes into focus you will also be looking at a focusing screen in the viewfinder lens. Twin lens reflex cameras include some of the older Brownie and other box cameras.

76 (visual) SLR

(narration)

With the single lens reflex system photography took a great step foreward. Now what you see is what you get. This system solves the parallax problem. Light comes in through the camera lens and is reflected to the eye through a series of mirrors. When you take the picture the mirror lifts up out of the way and the film is exposed to the light. When you take a picture with a SLR the click you hear is not the lens opening but the sound of the mirror lifting up and then dropping back down again. This system also lets you directly see the effects that different lenses and filters will cause. Most 35mm cameras use a single lens reflex system.

77 (visual)view camera

(narration)

The fourth type of camera most people will never use.

This is the view camera, which is usually used in the studio. View cameras use a very large format of film and thus make very sharp enlargements. These cameras are often used for publication purposes such as magazine covers. View cameras have no seperate viewfinder lens- you look directly through the camera lens from the open back of the camera. When you are ready to take a picture, you insert a sheet of film, put a black cape over the back of the camera and expose the film. These cameras are usually larger and more difficult to use than other types of cameras.

PAUSE

78 (visual) lenses

(narration)

With a single lens reflex camera you can change the lens to capture exactly what you want in the picture. Lets look at some various lenses. Lenses are measured by their magnification. The number refers to the power of the lens. Here is a 21mm wide-angle lens, a 50mm standard lens, and a 85-210 telephoto zoom lens.

79 (visual) Putting on lens cut to wide angle scene

(narration)

A wide angle lens such as this 21mm captures a lot in the picture. (pause 2) Wide angle lenses have great depth of field and are good for panoramas.

80 (visual) 50mm scene

(narration)

This picture was shot with a 50mm lens. A lens between 40 and 55 millimeters will record roughly what you see with the naked eye- that's why these lenses are referred to as standard lenses. These lenses produce the sharpest images and require the least light.

81 (visual) 85mm scene

(narration)

Telephoto lenses magnify what you see. They bring you right in on the action. But they do have two disadvantages, they require more light and have less depth of field. This scene was shot at 85mm.

82 (visual) 135mm scene

(narration)

Here's the same scene shot at 135mms. Notice how the foreground and background are beginning to blur.

83 (visual) 200mm scene

(narration)

Finally the same scene at 200mms, we've really zoomed right in on the scene. Interesting photographs require a variety of shots; wide angle, telephoto, close ups, medium and long shots.

84 (visual) split of various pictures

(narration)

To get better pictures try to capture the subject in an interesting fashion. Move in close to the subject, place the camera high or low for an unusual angle, blur the motion or freeze it, use great depth of field or very shallow, experiment with light. Be creative, use your imagination.

85 (visual) Ansel Adams photo.

(narration)

Photography has been called the only new art form of the past thousand years. Ansel Adams viewed photography as the study of light. Photographs now hang next to paintings in great art museums. Photography is a way all of us can visually express ourselves.

86 (visual) Dorothea Lang the depression

(narration)

Photography can be a historical record- capturing a moment in time- giving us a very unique view of the past.

87 (visual) embryo

(narration)

Photographs can show us other worlds- infrared and x-ray photography opens new vistas. The structure of the atom or our tiny fragile planet from outer space.

88 (visual) snap shot

(narration)

Or it can preserve a moment of our lives as no other medium can. Photography can be much more than fuzzy out-of-focus snapshots, if you take the time to learn, explore, and discover.

PAUSE

89 (visual) pan from the top of mountain

(narration)

Lets try something just for fun. Pretend we're back on top of that mountain we visited at the beginning of this program. You will need to decide how to capture that moment... what lens,exposure, and focus to use. Through the wonders of interactive video you will be able to see the finished picture and how your choices influence the results. Remember that photography is a series of compromises so one decision will affect others. First let's decide on what lens to use- this will determine what will be in the picture and will be a factor in your depth of field and exposure .

QUESTION #15

90 (computer text #38)

"Lets use:

A. a 21mm lens

B. a 50mm lens

C. a 200mm lens"

branch

if A (computer text #39)

" a 21 mm lens is a wide angle lens. It will capture a great deal of the panorama, although things will appear far away. A wide angle will give you great depth of field and you will not need to worry about camera vibration.

You're aperatures on this lens will range from f3.5 to f16. This is a good lens to capture landscapes with. Now lets decide on what distance to focus at."

goto next

if B (computer text #40)

" a 50mm lens is considered a standard lens. It will record about the same as we see with the naked eye. A 50mm lens will give you medium depth of field and you will not need to worry about camera vibration at any speed faster than 1/30th. The standard lens is the sharpest and fastest of any lens. This one has aperature settings from 1.9 to f16. This is a good general purpose lens. Now lets decide what distance to focus at."

goto next

if C (computer text #41)

" a 200mm lens is a telephoto lens. It will magnify what you see and is good for enlarging distant objects. This lens has shallow depth of field and will need to be on a tripod for shutter speeds slower than 1/125th. This lens has aperature settings from f3.5 to f16. Now lets decide what distance to focus at."

goto next

QUESTION #16

91 (visual) panorama of landscape

(narration)

The distance we focus the lens at will effect sharpness and depth of field. Depth of field will also be affected by lens size and aperature. There is a flowering bush six feet in front of us, a rock twelve feet in front of use, and the waterfall more than 100 feet away (called infinity on a lens) .

(computer text #42)

"Lets focus on:

A. the bush at six feet

B. the rock at twelve feet

C. the waterfall at infinity"

(branch)

if A then

(computer text #43)

" the closer you focus the less depth of field you will have. You may like this picture with the foreground in focus and the background out of focus. This will make the bush stand out as the center of attention. However if you want greater depth of field you should consider the other two factors for greater depth of field, a small lens and a small f stop. Now lets set our exposure"

if B then

(computer text #44)

" By focusing at twelve feet you have struck a compromise between close-up and distant focusing. This should give you medium depth of field. If you use a small f stop (f16) you should be able to get depth of field from just behind the bush to infinity. At a large f stop (f3.5) depth of field will only be from about eight feet to sixteen feet. Now lets set our exposure" if C then

(computer text #45)

" By focusing at infinity you will be sure to get anything farther than thirty feet away in focus. But lets suppose you wanted the rock twelve feet in front of you also in focus. By using a small f stop (f16) and not too long of a lens and focusing at just under infinity you will get depth of field from about eight feet away to infinity. Now lets decide on exposure"

QUESTION #17

92 (computer text #47)

"We have set our focus and chosen our lens now lets set exposure." Exposure will effect the lightness and darkness of our picture. Within that is setting the shutter speed which will effect freezing of motion. And selecting an f stop, which will effect depth of field. All of the following exposures will allow in the same amount of light, they will differ in depth of field and freezing of motion. Why don't you decide on one.

A. f3.5 - 1/250

B. f8 - 1/60

C. f16 - 1/15"

(branch)

if A. then

(computer text #47)

"1/250th will freeze the motion, letting us see the water in the waterfall, While f3.5 will give you little depth of field. If you were trying to limit depth of field this would be a good choice. But for greater depth of field f/16 - 1/15 th would increase it.

If 1/15 th of a second is too slow of a speed to shoot at you could compromise and use f8 at 1/60th of a second." Lets take a look at your photographic masterpiece."

goto appropriate tape segment

if B. then

(computer text #48)

"f8 at 1/60th of a second is a good compromise between depth of field and freezing motion. f8 will give medium depth of field and 1/60th will freeze action unless its relativly fast. Since there really is'nt much motion in this scene you could even use f/16 at 1/15th for even greater depth of field. But you might have to worry about camera motion at 1/15th, especially with a bigger lens. Lets take a look at your photographic masterpiece."

goto appropriate tape section.

if C. then

(computer text #49)

"f/16 at 1/15th will give you very great depth of field. Is that the effect you wanted? One compromise for this great depth of field will be the fact that shooting at 1/15th of a second will make it neccessary to have a very steady camera hand or to use a tripod. This would be especially critical with a telephoto lens.A good compromise between depth of field and freezing motion would be f8 at 1/60th. Now lets take a look at your photographic masterpiece."

goto appropriate tape section

PAUSE

93 (visual) appropriate photo for decisions

(narration)

Well here it is. Did it turn out the way you thought it would? Can you see how important and creative these decisions are. You should be proud of your self, you probably have come a long way in just the time it has taken to interact with this program. As you become more experienced in photography these decisions will come almost intuitivly to you.

QUESTION #18

94 (computer text #50)

Would you like to run this picture taking simulation again ?

A. Yes I'm interested in seeing what other combinations would look like.

B. No thanks. Maybe some other time. Lets get on to The Big Conclusion.

(branch)

if A. replay 89-94

if B. then next

95 (visual) split screen of 27 pictures

(narration)

Did you know that with just three different settings of exposure, focus, and lens size you could produce 27 different pictures of the same scene. Perhaps you'll never think the same of automatic cameras. We did not even decide on many other factors, film type and size, camera type, the composition of the photo, the angle, or the creative use of lighting. Photography is a life long endeavor, there is not a right way or a wrong way to shoot a picture. If you can capture a scene in the way you want, then you have indeed done something worthwhile. The best way to become a better photographer is through practice. Good luck and good shooting.

QUESTION #19

96 (computer text #51)

"At this time you may go back and review any section of this tape or end the lesson.

A. Lets end the lesson, I've seen enough.

B. Lets take another look at a previous section.

(branch)

if A. then

(computer text #52)

"Thanks for interacting. Please return these materials to the lab assistant. This has been a production of ..."

if B. then 97

goto menu of all sections.

97. QUESTION #19

(computer text #53) MENU

Let's take another look at the section on:

A. Introduction and titles(1-4)

B. Focusing (5-10)

C. Aperature (14-19)

D. Shutter speed (23-27)

E. Freezing motion (29-37)

F. Depth of field (38-48)

G. Metering (49-52)

H. Musical Break (58)

I. Types of films (59-70)

J. Types of cameras (72-77)

K. Lenses and uses of photography (78-88)

L. Photo simulation (89-94)

M. Conclusion (95)

PICTURE THIS - CONTENT OUTLINE

I- Introduction (1-3)
Creative decisionmaking, titles, 2 basic concepts

II- Focusing (4-10)
Numbers on the lens, elements, viewfinder types

-Question 1- Two basic principles (11)
2- How to focus (12)
3- Preferred focus system (13)

III- Aperature (14-19)
f-stops defined, always-backwards-concept, f-stops compared, focus glides

-Question 4- Review yes or no (20)
5- What is f-stop (21)
6- f-stop differences (22)

IV- Shutter Speed (23-27)
Shutter speed defined, numbers backwards, speeds compared

-Question 7- Exposures Compared (28)

V- Freezing Motion (29-37)
Controlling the image, speeds compared, panning, camera motion

VI- Depth of Field (38-49)
depth of field defined, 3 methods, always backwards, f-stop, distance, lens size, review

VII- Metering (50-52)
Built in meters, bracketing

-Question 8- Review yes or no (53)
9- Shutter speed is (54)
10- Freezing motion (55)
11- Depth of field (56)
12- Bracketing means (57)

VIII- Musical Break (58)

IX- Types of Film (59-70)
Prints vs slides, warm vs cool, speed, size, expiration date

-Question 13- Review yes or no (71)

X- Types of Cameras (72-77)
4 types, parallax

XI- Lenses (78-83)
Focal length defined, compared

XII- Uses of Photography (84-88)

Art-expression, history, other worlds, preserve memories

XIII- Photo Simulation (89-94)

-Question 14- Lens to use (90)
15- Focus setting (91)
16- Exposure (92)
17- Repeat simulation yes or no (94)

XIV- Conclusion (95)
Creative decisions, other factors, practice

-Question 18- Review yes or no (96)

INSTRUCTIONAL DESIGN CONSIDERATIONS

- user friendly- written in a humorous fashion, incorrect answer reponses non-threatening.

- conversational- non-technical, avoids jargon and big words

- numbers and definitions kept to a minimum

- points out which points are especially important

- frequent use of the word "you"

- relates to viewer's own experience through use of real-life examples

- teaches practical skills needed by casual photographer

- repetition of key concepts

- questions must be answered correctly to proceed

- large amount of information but does not cover all aspects of photography

- some generalizations made for simplicity

- step-by-step progression through concepts

- review questions after each major portion

- objectives laid out early, repeated and summerized

- highly visual, captioned illustrations

- graphics reinforce narration

- probably too long, musical break for a rest

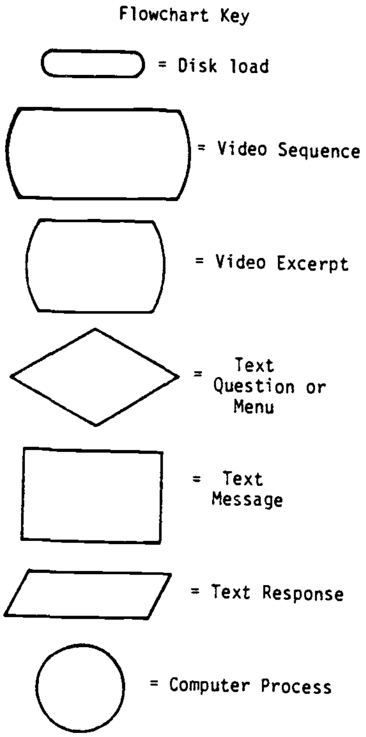
- student may pause by just hitting one button

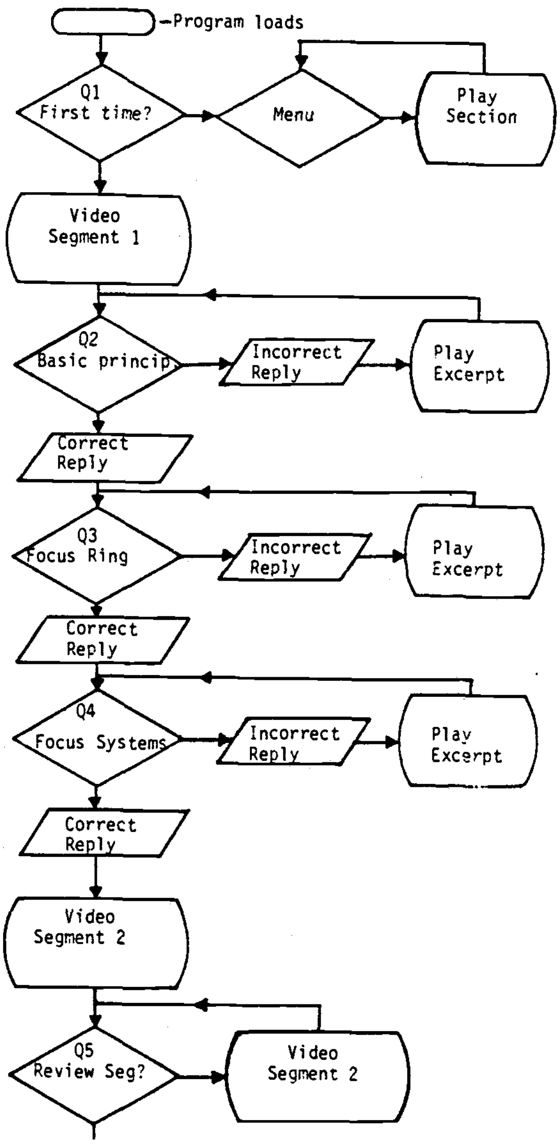
- random access to any section at beginning and ending of program, first time users directed to introduction.

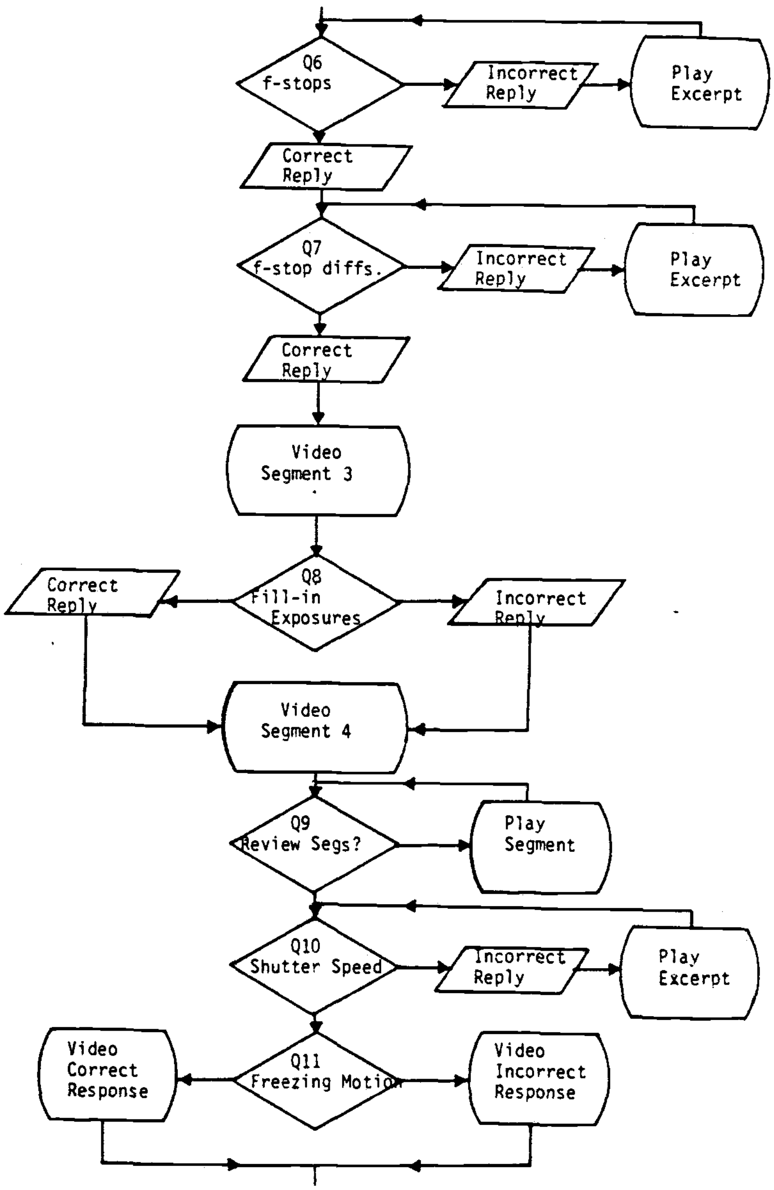
APPENDIX B.

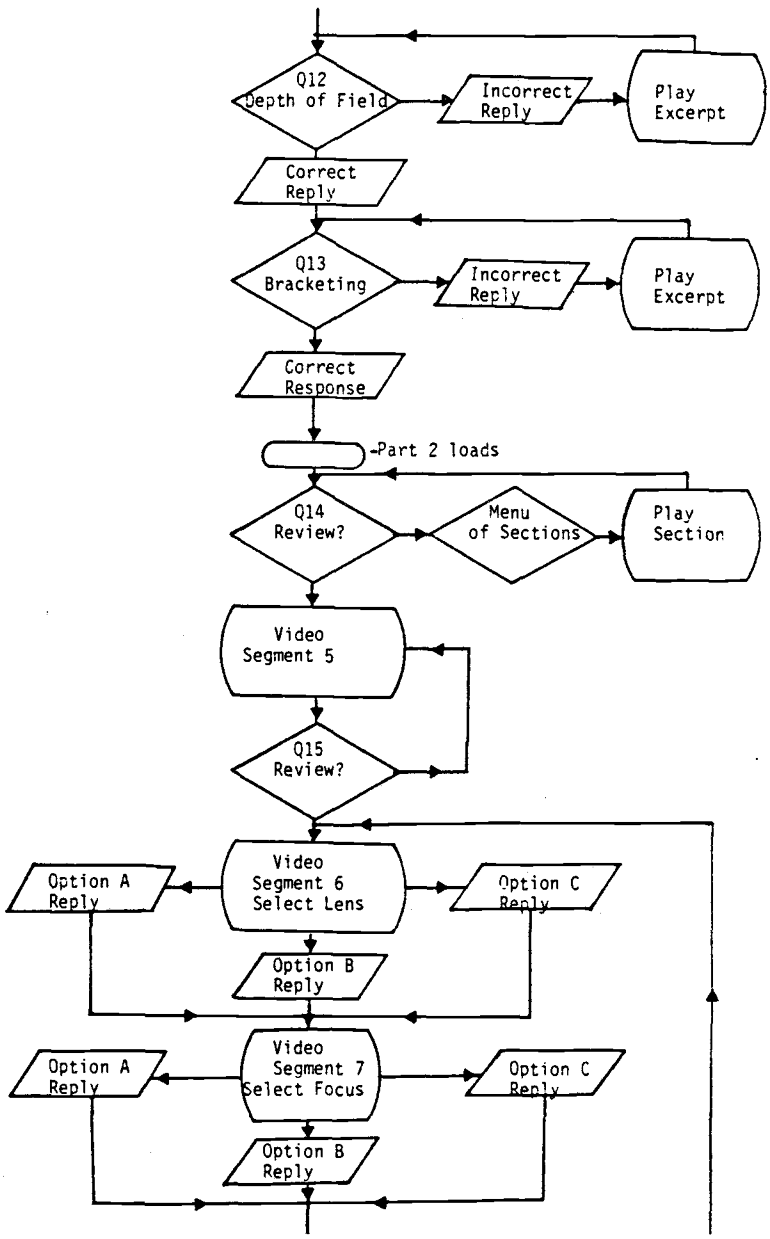
Program Flowcharts

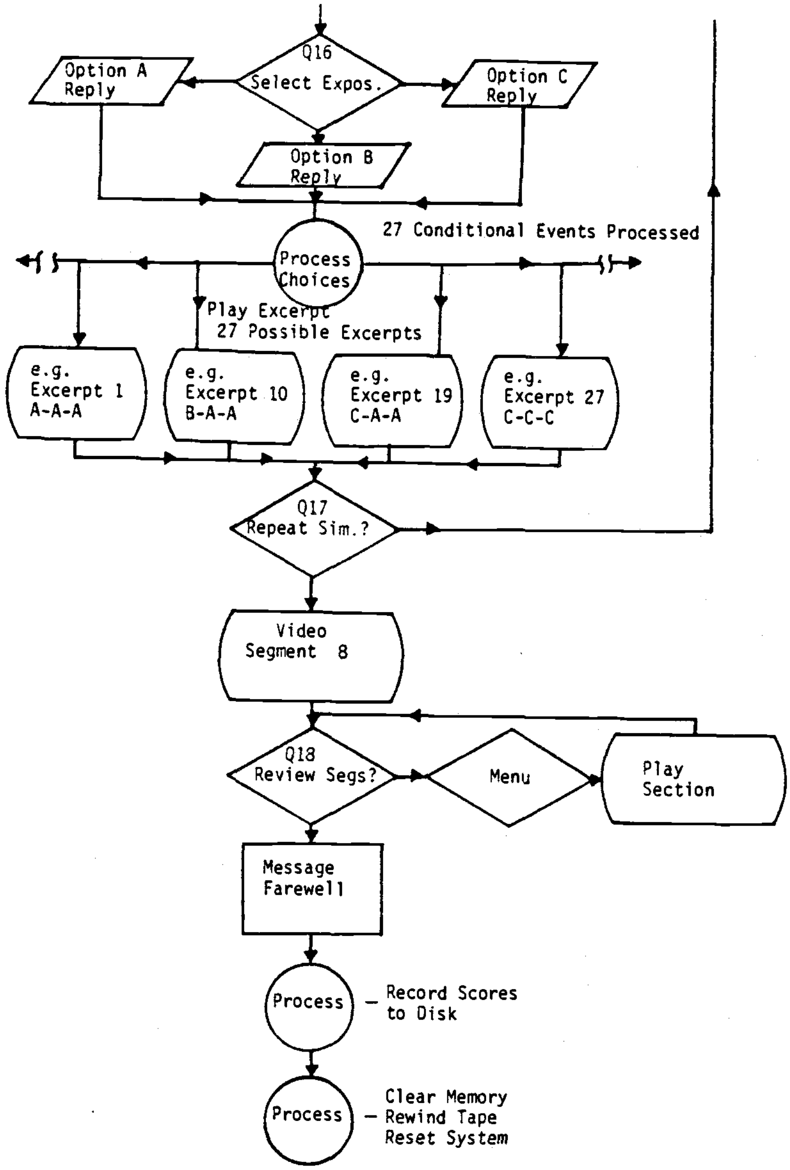
"PICTURE THIS"
INTERACTIVE VIDEO FLOWCHART





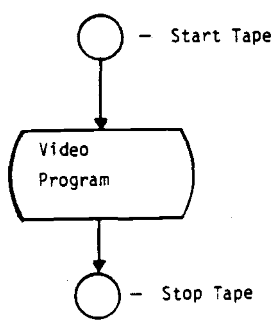

Q6
f-stops
Incorrect Reply
Play Excerpt
Correct Reply
Q7
f-stop diffs.
Incorrect Reply
Play Excerpt
Correct Reply
Video Segment 3
Correct Reply
Q8
Fill-in Exposures
Incorrect Reply
Video Segment 4
Q9
Review Segs?
Play Segment
Q10
Shutter Speed
Incorrect Reply
Play Excerpt
Video Correct Response
Q11
Freezing Motion
Video Incorrect Response


Q12
Depth of Field
Incorrect Reply
Play Excerpt
Correct Reply
Q13
Bracketing
Incorrect Reply
Play Excerpt
Correct Response
Part 2 loads
Q14
Review?
Menu of Sections
Play Section
Video Segment 5
Q15
Review?
Option A Reply
Video Segment 6 Select Lens
Option C Reply
Option B Reply
Option A Reply
Video Segment 7 Select Focus
Option C Reply
Option B Reply



"PICTURE THIS"

LINEAR VIDEO FLOWCHART



APPENDIX C.

Achievement Pretest

PICTURE THIS
PHOTO QUIZ

Ed Media SOSC 1985 Arnie Abrams

Name___________________________________

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1. Shutter speed refers to:

   a. how wide the lens is open
   b. how long the film will be exposed to light
   c. how fast the film is moving
   d. the zone or area of focus

2. f-stop or aperture refers to:

   a. how long the lens remains open.
   b. focus distance.
   c. the address of the photographer.
   d. the size of the opening of the lens.

3. Taking pictures at the metered exposure as well as above and below that setting is referred to as:

   a. panning
   b. not-taking-any-chances
   c. parallax
   d. bracketing

4. A telephoto lens compared to a wide angle lens will:

   a. require less light.
   b. result in greater depth-of-field.
   c. provide less magnification.
   d. none of the above.

5. When is it most important to use a tripod ?

   a. when using a wide angle lens in bright light
   b. when capturing fast motion
   c. when using a very slow shutter speed
   d. when using a very fast shutter speed

6. You sharpen an image by rotating what set of numbers on the lens ?

   a. the f-stop
   b. the focus ring
   c. the meter marker
   d. the depth-of-field scale

7. The two basic principles of photography are:

    a. Controlling the image and controlling light.
    b. Controlling depth-of-field and controlling light.
    c. Controlling aperture, controlling shutter speed.
    d. Controlling the camera and controlling yourself.

8. A 21mm lens would be considered a:

    a. wide angle lens
    b. standard lens
    c. telephoto lens
    d. none of the above

9. What is a disadvantage of high speed film ?

    a. you will need to use larger f-stops.
    b. it will decrease depth of field.
    c. the colors are not as good as slower speed films.
    d. they are grainier or less sharp than slower films.

10. ISO refers to:

    a. the films sensitivity to light.
    b. the size of the film.
    c. a type of camera.
    d. an international spy organization.

11. Using a small f-stop like f16 will result in :

    a. shallow depth-of-field
    b. great depth of field
    c. better color balance
    d. freezing the motion

12. Which would normally have greater depth of field a close-up of an insect or a panorama of a landscape ?

    a. The close-up of the insect.
    b. The panorama of the landscape.
    c. They would both be the same.
    d. Subject to camera distance does not affect depth-of-field.

13. How would you stop a moving object's image from blurring ?

    a. faster shutter speed
    b. smaller f-stop
    c. bigger lens
    d. none of the above

14. What is one danger in using slides, rather than print film ?

    a. slides cost more
    b. slide film is smaller
    c. you are using the original
    d. none of the above

15. When the hole or aperture is larger it:

    a. allows in more light.
    b. keeps the lens open longer.
    c. allows in less light.
    d. keeps the lens open for less time.

16. What is a disadvantage of 110mm film ?

    a. it requires more light than other types of film.
    b. it will not produce acceptable enlargements.
    c. it costs more.
    d. it is cool balanced.

17. Which exposure will allow in the most light ?

    a. 1/15 - f16
    b. 1/30 - f16
    c. 1/30 - f4
    d. 1/500 - f11

18. If f11 is two f-stops away from f5.6 it will let in:

    a. f11 will let in twice as much light.
    b. f11 will let in half as much light.
    c. f11 will let in 4 times as much light.
    d. f11 will let in 1/4th as much light.

19. If f5.6 is one f-stop away from f8 it will let in:

    a. f5.6 will let in twice as much light.
    b. f5.6 will let in half as much light.
    c. f5.6 will let in 4 times as much light.
    d. f5.6 will let in 1/4th as much light.

20. The bigger the lens you use (telephoto)...

    a. the less depth of field.
    b. the greater the depth of field.
    c. the sharper the image will be
    d. lens size does not affect depth-of-field

21. What is an advantage of high speed film ?

    a. they can often be used indoors without a flash.
    b. they can be used at slower shutter speeds.
    c. they can be used with larger f-stops.
    d. the colors are better than slower speed films.

22. Photography has been called a series of compromises; what would explain this ?

    a. Because you have to give up faster shutter speed for greater depth-of-field.
    b. Because you have to give up depth-of-field for a longer lens.
    c. Because you have to give up one asset for another.
    d. All of the above.

23. Which type of camera prevents parallax view ?

    a. T.L.R.
    b. S.L.R.
    c. Rangefinder
    d. none of the above

24. Panning refers to :

    a. giving a film a poor review
    b. moving the camera to follow the action
    c. using a slow shutter speed
    d. taking several exposures

25. Which is the preferred type of focus system for sharpest focus ?

    a. split-image
    b. coincidence
    c. combination of split-image and single-vision
    d. combination of micro-prism and split-image

APPENDIX D.

Achievement Posttest

PICTURE THIS
PHOTO QUIZ

Ed Media SOSC 1984 Arnie Abrams

Name____

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1. The two basic principles of photography are:

   a. Controlling the image and controlling light.
   b. Controlling depth-of-field and controlling light.
   c. Controlling aperture, controlling shutter speed.
   d. Controlling the camera and controlling yourself.

2. A 21mm lens would be considered a:

   a. wide angle lens
   b. standard lens
   c. telephoto lens
   d. none of the above

3. Which type of camera prevents parallax view ?

   a. T.L.R.
   b. S.L.R.
   c. Rangefinder
   d. none of the above

4. Panning refers to :

   a. giving a film a poor review
   b. moving the camera to follow the action
   c. using a slow shutter speed
   d. taking several exposures

5. f-stop or aperture refers to:

   a. how long the lens remains open.
   b. focus distance.
   c. the address of the photographer.
   d. the size of the opening of the lens.

6. When the hole or aperture is larger it:

   a. allows in more light.
   b. keeps the lens open longer.
   c. allows in less light.
   d. keeps the lens open for less time.

7. If f5.6 is one f-stop away from f8 it will let in:

   a. f5.6 will let in twice as much light.
   b. f5.6 will let in half as much light.
   c. f5.6 will let in 4 times as much light.
   d. f5.6 will let in 1/4th as much light.

8. If f11 is two f-stops away from f5.6 it will let in:

   a. f11 will let in twice as much light.
   b. f11 will let in half as much light.
   c. f11 will let in 4 times as much light.
   d. f11 will let in 1/4th as much light.

9. Shutter speed refers to:

   a. how wide the lens is open
   b. how long the film will be exposed to light
   c. how fast the film is moving
   d. the zone or area of focus

10. Which exposure will allow in the most light ?

   a. 1/15 - f16
   b. 1/30 - f16
   c. 1/30 - f4
   d. 1/500 - f11

11. When is it most important to use a tripod ?

   a. when using a wide angle lens in bright light
   b. when capturing fast motion
   c. when using a very slow shutter speed
   d. when using a very fast shutter speed

12. Using a small f-stop like f16 will result in :

   a. shallow depth-of-field
   b. great depth of field
   c. better color balance
   d. freezing the motion

13. Which would normally have greater depth of field a close-up of an insect or a panorama of a landscape ?

   a. The close-up of the insect.
   b. The panorama of the landscape.
   c. They would both be the same.
   d. Subject to camera distance does not affect depth-of-field.

14. The bigger the lens you use (telephoto)...

   a. the less depth of field.
   b. the greater the depth of field.
   c. the sharper the image will be
   d. lens size does not affect depth-of-field

15. Taking pictures at the metered exposure as well as above and below that setting is referred to as:

   a. panning
   b. not-taking-any-chances
   c. parallax
   d. bracketing

16. Which is the preferred type of focus system for sharpest focus ?

    a. split-image
    b. coincidence
    c. combination of split-image and single-vision
    d. combination of micro-prism and split-image

17. What is one danger in using slides, rather than print film ?

    a. slides cost more
    b. slide film is smaller
    c. you are using the original
    d. none of the above

18. ISO refers to:

    a. the films sensitivity to light.
    b. the size of the film.
    c. a type of camera.
    d. an international spy organization.

19. What is an advantage of high speed film ?

    a. they can often be used indoors without a flash.
    b. they can be used at slower shutter speeds.
    c. they can be used with larger f-stops.
    d. the colors are better than slower speed films.

20. What is a disadvantage of high speed film ?

    a. you will need to use larger f-stops.
    b. it will decrease depth of field.
    c. the colors are not as good as slower speed films.
    d. they are grainier or less sharp than slower films.

21. What is a disadvantage of 110mm film ?

    a. it requires more light than other types of film.
    b. it will not produce acceptable enlargements.
    c. it costs more.
    d. it is cool balanced.

22. How would you stop a moving object's image from blurring ?

    a. faster shutter speed
    b. smaller f-stop
    c. bigger lens
    d. none of the above

23. You sharpen an image by rotating what set of numbers on the lens ?

    a. the f-stop
    b. the focus ring
    c. the meter marker
    d. the depth-of-field scale

24. A telephoto lens compared to a wide angle lens will:

    a. require less light.
    b. result in greater depth-of-field.
    c. provide less magnification.
    d. none of the above.

25 Photography has been called a series of compromises; what would explain this ?

    a. Because you have to give up faster shutter speed for greater depth-of-field.
    b. Because you have to give up depth-of-field for a longer lens.
    c. Because you have to give up one asset for another.
    d. All of the above.

APPENDIX E.

Comparison of Pretest and Posttest

Question Sequence

Comparison of Pretest and Posttest Question Sequence

Pretest Question #	Posttest Question #
1	9
2	5
3	15
4	24
5	11
6	23
7	1
8	2
9	20
10	18
11	12
12	13
13	22
14	17
15	6
16	21
17	10
18	8
19	7
20	14
21	19
22	25
23	3
24	4
25	16

APPENDIX F.

Relation of Questions to Script

Relation of Posttest Questions to Script Location

Posttest Question #	Frame # in Script
1	4
2	79
3	76
4	35
5	15
6	16
7	18
8	18
9	23
10	27, 28
11	37
12	42
13	43
14	46
15	52
16	10
17	61
18	63
19	63
20	63
21	65
22	31
23	5
24	81
25	24, 27, 63

APPENDIX G.

Raw Data for Achievement Tests

Raw Data for Achievement Tests.

IV				LV			
Winter		Spring		Winter		Spring	
Pre	Post	Pre	Post	Pre	Post	Pre	Post
60	92	36	92	48	68	32	84
64	84	44	84	76	96	28	92
36	84	52	84	40	60	52	92
48	72	60	96	24	28	32	60
40	68	68	96	96	92	76	100
52	88	64	100	44	84	28	80
52	76	60	84	56	88	48	84
60	92	36	68	52	96	36	64
80	100	80	100	52	88	76	100
56	80	16	60	60	80	64	84
32	76	32	52	52	84	52	80
84	100	32	88	72	96	60	80
68	100	48	92	52	80	64	84
32	92	48	96	60	56	68	92
48	88	52	96	72	100	36	72
40	80	56	88	44	84	56	76
48	88	48	80	68	84	56	76
64	80	56	96	48	96	52	76
84	96	40	84	52	84	60	84
56	88	48	88	56	96	52	88
52	76	32	76	40	88	48	68
28	60	44	88	40	76	92	92
64	84	52	92	48	64	36	72
44	84	56	92	32	76	12	64
40	80	44	84	84	88	36	92
48	88	28	80	36	76	28	56
36	84	36	68	64	88	28	64
56	96	32	76	52	72	32	84
64	88	16	92	53	64	32	60
44	84	32	68	52	68	56	88
60	92	36	72			36	96
28	72	80	100			32	68
						28	68
						38	68
N=32		N=32		N=30		N=34	
N=64				N=64			

APPENDIX H.

Linear Attitude Survey

ATTITUDE TOWARD LINEAR VIDEO INSTRUCTION

This is not a test of knowledge; there is no one "right" answer to a question. We are interested in your opinion of each of the statements below. Your opinions will be strictly confidential. Do not hesitate to record exactly how you feel about each item. We are seeking information, not compliments; please be frank.

Name__________________________________ Date____________________

Time________________ Soc. Sec. Number_________________________

Sex: M F Age: 18-22 23-30 31-40 41-50 Over 50 No Answer

Class Standing: Freshman Sophmore Junior Senior Graduate Post Bac. Non Admitted

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CIRCLE THE RESPONSE THAT MOST NEARLY REPRESENTS YOUR REACTION TO EACH OF THE STATEMENTS BELOW.

HARDWARE

1. I had difficulty operating the hardware.

   All the time | Most of the time | Some of the time | Only occasionally | Never

2. While going through the program I encountered mechanical malfunctions.

   All the time | Most of the time | Some of the time | Only occasionally | Never

3. I found it difficult to concentrate on the program because of the hardware.

   All the time | Most of the time | Some of the time | Only occasionally | Never

4. I was intimidated using the video cassette recorder.

   Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

INSTRUCTION

5. While watching this program I felt challenged to do my best.

   Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

PROGRAM REACTION

6. The video was effective in letting me see sharp, clear photographs.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

7. The diagrams and graphics appeared clear and easy to read.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

8. I would have liked pauses in the instruction to allow me to rest between segments.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

9. I felt frustrated by the way the information was presented.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

10. In view of the time allowed for learning, I felt too much material was presented.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

11. The segment on a "Gallery of Great Photographs" was useful in showing me examples of good photographs.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

12. The example of 27 different ways of taking a picture was an effective way of reviewing the skills learned in the videotape.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

FEEDBACK

13. I felt I had enough control over the rate and sequence of the instructional material.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

14. I would have liked a discussion after the instruction to review my understanding of the material.

Strongly disagree   Disagree   Uncertain   Agree   Strongly agree

15. Review questions during the instruction would have been helpful for me in reviewing my understanding of the material.

Strongly disagree   Disagree   Uncertain   Agree   Strongly agree

16. It would be helpful to rewatch the segments of the tape that I did not fully understand.

Strongly disagree   Disagree   Uncertain   Agree   Strongly agree

17. While receiving the instruction via videotape, I felt as if someone were engaged in conversation with me.

Strongly disagree   Disagree   Uncertain   Agree   Strongly agree

VIDEO INSTRUCTION

18. Instruction in this subject, learning basic photography skills, was more interesting presented via videotape than if it were presented through other methods such as an illustrated lecture or printed text.

Strongly disagree   Disagree   Uncertain   Agree   Strongly agree

19. I could have learned the information better with review questions or doing a simulation of taking a picture.

Strongly disagree   Disagree   Uncertain   Agree   Strongly agree

20. For learning about photography I would prefer video instruction to traditional instruction (illustrated lecture and text).

Strongly disagree   Disagree   Uncertain   Agree   Strongly agree

21. Video instruction made it possible for me to learn more quickly than I would have learned using traditional methods of instruction.

Strongly disagree   Disagree   Uncertain   Agree   Strongly agree

22. In view of the time and effort I put into it, I was satisfied with what I learned via this method.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

23. This method of instruction makes learning too complicated.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

24. This method of instructional makes learning too mechanical.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

25. If keeping my job depended upon learning basic photography skills, this method of instruction would be the best approach that could be used, aside from actually operating the camera itself.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

26. If I had to, I could figure out how to operate a camera based on what I learned from this instructional program.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

27. I would like to learn about other subjects via instructional video.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

28. How long do you feel you could work efficiently with video instruction at one sitting?

15 minutes	Half hour	One Hour	Two hours	More

TESTING

29. There were distractions in the room while I was watching the program.

All the time	Most of the time	Some of the time	Only occasionally	Never

30. There were distractions in the room while I was taking the post-test.

All the time	Most of the time	Some of the time	Only occasionally	Never

31. I ran short on time and had to hurry through the post-test.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

32. I grew weary by the end of the instruction.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

33. The post-test was representative of what I was supposed to learn from the instructional program.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

34. The pre-test tipped me off to the right answers on the post-test.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

35. This experiment was well administered.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

EXPERIENCE

36. My previous experience in photography has been:

Very extensive	Extensive	Some	Little	Very little

37. My previous experience in using computers has been:

Very extensive	Extensive	Some	Little	Very little

38. My previous experience in instruction via videotape has been:

Very extensive	Extensive	Some	Little	Very little

39. List three things you liked most about the instructional method or instructional program you have just used.

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40. List three things you disliked most about the instructional method or instructional program you have just used.

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Thank you for your cooperation. Please use the space below for additional comments.

APPENDIX I.

Interactive Video Attitude Survey

ATTITUDE TOWARD INTERACTIVE VIDEO INSTRUCTION

This is not a test of knowledge; there is no one "right" answer to a question. We are interested in your opinion of each of the statements below. Your opinions will be strictly confidential. Do not hesitate to record exactly how you feel about each item. We are seeking information, not compliments; please be frank.

Name___________________________________ Date____________________

Time_________________ Soc. Sec. Number__________________________

Sex: M F Age: 18-22 23-30 31-40 41-50 Over 50 No Answer

Class Standing: Freshman Sophmore Junior Senior Graduate Post Bac. Non Admitted

CIRCLE THE RESPONSE THAT MOST NEARLY REPRESENTS YOUR REACTION TO EACH OF THE STATEMENTS BELOW.

HARDWARE

1. I had difficulty operating the hardware.

   All the time | Most of the time | Some of the time | Only occasionally | Never

2. While going through the program I encountered mechanical malfunctions.

   All the time | Most of the time | Some of the time | Only occasionally | Never

3. I found it difficult to concentrate on the program because of the hardware.

   All the time | Most of the time | Some of the time | Only occasionally | Never

4. I was intimidated using the computer.

   Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

INSTRUCTION

5. While watching this program I felt challenged to do my best.

   Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

PROGRAM REACTION

6. The video was effective in letting me see sharp, clear photographs.

   Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

7. The diagrams and graphics appeared clear and easy to read.

   Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

8. The delays while the system was preparing for the next segment were distracting.

   Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

9. I felt frustrated by the way the information was presented.

   Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

10. In view of the time allowed for learning, I felt too much material was presented.

    Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

11. The segment on a "Gallery of Great Photographs" was useful in showing me examples of good photographs.

    Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

12. The simulation of taking a picture was an effective way of reviewing the skills learned in the videotape.

    Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

FEEDBACK

13. I felt I had enough control over the rate and sequence of the instructional material.

    Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

14. The method by which I was told whether I had given a right or wrong answer became monotonous.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

15. The computer questions were helpful for me in reviewing my understanding of the material.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

16. I dreaded missing a review question because I had to watch the same material over again.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

17. While receiving the instruction via interactive video, I felt as if someone were engaged in conversation with me.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

INTERACTIVE VIDEO

18. Instruction in this subject, learning basic photography skills, was more interesting presented via interactive video than if it were presented through other methods such as lecture or printed text.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

19. I could have learned the information just as well using video without the computer-related features of the instruction (the questions and the simulation).

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

20. For learning about photography I would prefer interactive video to traditional instruction (illustrated lecture and text).

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

21. Interactive video made it possible for me to learn more quickly than I would have learned using traditional methods of instruction.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

22. In view of the time and effort I put into it, I was satisfied with what I learned via this method.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

23. This method of instruction makes learning too complicated.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

24. This method of instructional makes learning too mechanical.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

25. If keeping my job depended upon learning basic photography skills, this method of instruction would be the best approach that could be used, aside from actually operating the camera itself.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

26. If I had to, I could figure out how to operate a camera based on what I learned from this instructional program.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

27. I would like to learn about other subjects via interactive video.

Strongly disagree	Disagree	Uncertain	Agree	Strongly agree

28. How long do you feel you could work efficiently with interactive video instruction at one sitting?

15 minutes	Half hour	One Hour	Two hours	More

TESTING

29. There were distractions in the room while I was watching the program.

All the time	Most of the time	Some of the time	Only occa-sionally	Never

30. There were distractions in the room while I was taking the post-test.

All the time	Most of the time	Some of the time	Only occa-sionally	Never

31. I ran short on time and had to hurry through the post-test.

    Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

32. I grew weary by the end of the instruction.

    Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

33. The post-test was representative of what I was supposed to learn from the instructional program.

    Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

34. The pre-test tipped me off to the right answers on the post-test.

    Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

35. This experiment was well administered.

    Strongly disagree | Disagree | Uncertain | Agree | Strongly agree

EXPERIENCE

36. My previous experience in photography has been:

    Very extensive | Extensive | Some | Little | Very little

37. My previous experience in using computers has been:

    Very extensive | Extensive | Some | Little | Very little

38. My previous experience in instruction via videotape has been:

    Very extensive | Extensive | Some | Little | Very little

39. List three things you liked most about the instructional method or instructional program you have just used.

    ____
    ____
    ____
    ____
    ____
    ____

40. List three things you disliked most about the instructional method or instructional program you have just used.

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Thank you for your cooperation. Please use the space below for additional comments.