The Effects of Learning Styles and Instructional Sequencing of Program Controlled and Learner Controlled Interactive Video Programs on Student Achievement and Task Completion Rates

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Industrial Arts Education

(ABSTRACT)

The purpose of this study was to determine if achievement test scores and task completion rates were affected by learning styles and instructional program sequencing, and to determine if there was an interaction of these two variables. The following research questions were addressed:

1. Is there a significant difference in achievement test scores between subjects using the program controlled interactive video program and subjects using the learner controlled interactive video program?

2. Is there a significant difference in achievement test scores between sensing type learners and intuitive type learners?

3. Is there a significant interaction of learning styles and interactive video programs on achievement test scores?

4. Is there a significant difference in task completion rates between subjects in the program controlled interactive video program and subjects in the learner controlled interactive video program?

5. Is there a significant difference in task completion rates between sensing type learners and intuitive type learners?

6. Is there a significant interaction of learning styles and interactive video programs on task completion rates?

The treatment consisted of viewing a preassigned interactive video program, (program controlled-Program 1 or learner controlled-Program 2), followed by an achievement test (final examination) covering the material presented in the interactive programs. The subjects recorded the elapsed time for the interactive video programs (task completion rate).

Two analyses of variance were used to test for significant differences in the means of the achievement test scores and task completion rates between the interactive video programs and the learning styles.

($p<.10$). Frequencies and percentages were computed to determine identifiable trends in the lesson unit selection sequence and the student learning paths through the lesson units.

The results of the study indicated that in all but one measurement there were no significant differences between the dependent variables of this study (achievement test scores and task completion rates). There was a significant difference in task completion rates between the two interactive video programs.

Based upon the overall purpose and nature of the instruction in this study, to whom the instruction was directed, and the results of the analysis of variance on achievement test scores and task completion rates, it is concluded that the program controlled interactive video program should be considered the more appropriate design strategy for this particular type of training.

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Chapter 1

INTRODUCTION

There has been much debate concerning the process of learning. Educational theorists, researchers, and practitioners have attempted to discover and explain the major components of the learning process. Many educators have indicated that one of the central needs of education is that of "specializing" or "personalizing" the process of learning (Campanizzi, 1978; Fredericks, 1976; Fry, 1972; Laurillard, 1984; Wilcox, 1979).

The concept of individualizing instruction is not a new idea; it may be traced as far back as the dialogues of Socrates. The "Socratic Method" was a process that purported inductive logic as a method of releasing knowledge that was already present in the mind. As Socrates would ask questions of a student or colleague, he would do so in a way that would allow the individual to come to an understanding of the given concept based upon his own reasoning and the guidance of the question (McInerny, 1963). This form of education could be classified as individualized instruction.

Individualized instruction continued throughout history, most notably in the form of apprenticeship programs. Individualized instruction in modern times finds its roots in the psychology of B. F. Skinner's behaviorism. Behaviorism theory is based on the concept of stimulus and response (Skinner, 1968). The basic tenet of behaviorism, as it applies to education, is that learning occurs when specific responses are elicited from given stimuli. The stimuli are designed to move the learner, in small steps, toward a given objective (Percival and Ellington, 1984). Although this instructional strategy was linear in nature, it still provided for individual responses. Skinner proposed the use of "teaching machines" for the specific purpose of individualizing the instruction of learners (Skinner, 1968). Although most educators agree that individualizing the learning process is academically valuable, they often disagree regarding how it may best be accomplished.

In a review of instructional design models, Andrews and Goodson (1980) reported that of the 40 models they studied, the major component of each was some form of target audience analysis. This analysis was related to general characteristics such as age, sex, and ability level. With characteristics such as these, the ability of an instructional designer to develop a strategy for training that is based on criteria that could apply to individual learners was non-existent or simply a restatement of the characteristic (e.g., instruction for a specific sex). In the absence of data on individual learning characteristics relating to instructional design, the educational researcher or practitioner is forced to use trial and error methods to respond to individual differences in learning or to ignore the problem altogether (Carrier, 1984).

Interactive video is a computer controlled system of delivering various forms of training and information. It combines various aspects of video (television, graphics, animation, films, etc.) with the computing/processing abilities of a microcomputer. Interactive video may allow for individual differences in learning (e.g., pacing, number of examples, or sequencing of instructional events), thereby providing control for the optimal teaching/learning environment. Interactive video offers both the designer and the learner a variety of instructional stimuli. Grabowski and Aggen (1984, p. 27,28) report several very promising features of interactive video:

(1) IV systems can be "image rich" allowing the learner to access a wide variety of still and motion visual segments (54,000 frames).

(2) Audio enhancement can support the visual images and an independent audio track can be used in conjunction with text or graphics.

(3) Keyboards and keypads can allow the learner to respond to questions ranging from true/false and multiple choice to keyword answer judging.

(4) Touch sensitive screens can offer the learner an alternative to keyboard input where spatial recognition is to be determined.

(5) Function keys can provide the designer and learner with special remediation, assistance, summation, review and other services.

(6) Self-paced programs can make the IV system the tireless, patient tutor. Students may work and learn at their own pace.

(7) The branching capabilities can enhance the self-paced learner with options for remediation, advancement, and various instructional loops of related material.

One promising possibility of interactive video is that the instruction may be designed in a fashion that provides for a wide variety of teaching/learning options, thereby meeting the needs of the individual learner.

Problem Statement

The problem of this study was to determine if achievement test scores and task completion rates were affected by learning styles and instructional program sequencing or the interaction of these two variables.

A secondary problem of this study was to identify the identifiable trends in the sequence of lesson unit selections and the use of various instructional options within the lesson units of the learner controlled interactive video program (Program 2).

Need for the Study

In past years, the major developments in education have taken several forms. The public educational systems of the early 1900's began to expand their role beyond the rudimentary "3 R's", and by the 1930's the "Essentialist's" movement solidified the curriculum of general education within the public schools. The 1940's and 1950's brought about a rapid growth in both the public school facility and the curricula. The expanded curricula moved away from the "basics" to a wide mixture of general education courses supporting a "liberal arts" curriculum. This concept of public education expanded during the 1960's and early to mid-1970's. A counter movement within education is once again stressing the importance of the "basics" and the need for more structure and discipline in the public schools (Gutek, 1981). A common thread throughout these major trends in education is the need to provide quality education to every student. Gagne and Briggs (1974) summed up this need for individualizing education by stating "the purpose of designed instruction is to activate and support the learning of the individual student." (p. 4)

A number of studies have investigated several variables associated with individualizing instruction and its effect on learning (Blitz & Smith, 1973; Carrier, 1984; Hoffman, 1982; Jacobson, 1975; Lahey & Coady, 1978; Sasscer & Moore, 1984; and Wilcox, 1979). The results of these studies vary in their findings and conclusions. This issue has taken on greater dimensions with the advent of new and improved forms of educational technology. With the introduction of interactive video into educational settings, expanded possibilities for individualizing instruction have developed.

One of these possibilities is increased control by the learner over such variables as lesson sequence and pace. Students may be given the option of selecting their own instructional paths or relying on a predetermined sequence of instruction. This capability of control over the instructional sequence may have a significant impact on the way instructional design is implemented in the future (Laurillard, 1984).

Wilcox (1979) stated that two categories of variables which influence student learning were "learner and presentation characteristics." Learner characteristics are those qualities of a learner that distinguish him/her from other learners (i.e., cognitive style, personality, etc.). Presentation characteristics are those qualities of instruction which distinguish one form of instruction from another (i.e., rate, difficulty level, mode, form, and sequence). Wilcox surmised, "How to appropriately match learner and presentation characteristics should be an important concern of teachers and instructional developers." (p. 4)

The need for further research in the area of control over both instructional sequence and design strategy with regard to learner characteristics is essential for the development of interactive video technology. This study was designed to address such research issues by evaluating the effects of two types of instructional sequencing methods, presented via interactive video technology, and two types of student learning styles were evaluated to determine if there were learning and time benefits based on the achievement test scores and task completion rates of student participants.

Research Variables

The dependent variables were:

(1) individual student achievement test scores

(2) the amount of time an individual student takes to complete the assigned interactive video program

The independent variables were:

(1) The methods of instructional sequence

- (a) Program controlled interactive video program
- (b) Learner controlled interactive video program

(2) Learning styles of sample participants:

- (a) Sensing (S)
- (b) Intuitive (N)

Primary Research Questions

1. Was there a significant difference in achievement test scores between the subjects using the program controlled interactive video program versus subjects using the learner controlled interactive video program?
2. Was there a significant difference in achievement test scores between the sensing type learners and the intuitive type learners?
3. Was there significant interaction of learning styles and interactive video programs on achievement test scores?
4. Was there a significant difference in task completion rates between the subjects in the program controlled interactive video program versus the subjects in the learner controlled interactive video program?
5. Was there a significant difference in task completion rates between the sensing type learners and the intuitive type learners?
6. Was there significant interaction of learning styles and interactive video programs on task completion rates?

Secondary Research Question

1. Were there identifiable trends in the sequence of lesson unit selections and in the use of instructional options within the lesson units as indicated by student choices in the learner controlled interactive video program (Program 2)?

Definition of Terms

Instructional Design: A systematic approach which provides a logical and knowledgable basis for developing educational material to activate and support the learning of the individual student (Gagne & Briggs, 1974).

Interactive Video: A video medium in which the sequence and selection of messages are determined by the user's response to the material being presented (Floyd, Floyd, Hon, McEntee, O'Bryan, Schwarz, 1982).

Computer Aided Instruction: An educational delivery system in which a computer presents information, training, etc. The student learns by interacting with the computer rather than another person.

<u>Level of Interactivity</u>: The potential for interaction prescribed by the capabilities of the videodisc/videotape hardware (Howe, 1985).

<u>Learner Control</u>: The sequencing of instructional material over which an individual learner has control of the order and depth of training.

<u>Program Control</u>: The sequencing of instructional material in which the instructional designer controls the order and depth of training via a computer program.

<u>Lesson Units</u>: The specific subsections of instruction that collectively comprised the overall scope of training in this study.

<u>Student Responses to Instructional Options</u>: The specific learning decisions made by individual students as they progressed through the learner controlled interactive video program (Program 2).

Limitations of the Study

1. The generalizability of this study is limited because the sampling of subjects was based on a convenience sample rather than a probability sample.

2. The singular dimension use of the <u>Myers-Briggs Type Indicator</u> did not provide for all variations of learning styles. Because of the nature of the instructional content and design (i.e., highly technical and informational) the dimension of the Myers-Briggs Type Indicator known as "Sensing - Intuitive" was used to determine learning style. This dimension of the instrument evaluates how an individual prefers to acquire information.
3. The content of the instruction and the achievement test may have been biased because of the nature of the topic and the purpose of the instruction.
4. Literature suggests that the technical content of the instruction and the low level of prior knowledge of the topic may account for low variability in lesson sequence choices for participants in interactive video Program 2.

Assumptions of the Study

1. It was assumed that participants truthfully and concientiously reviewed the interactive video programs and responded to the questions on the achievement test.
2. It was assumed that the variability of the

laboratory environment (i.e., activity levels within the laboratory) was randomly distributed for all participants.

3. It was assumed that the variability of the naivete regarding the mechanism of interactive video was randomly distributed for all participants.

Chapter 2

REVIEW OF THE LITERATURE

This chapter is a review of literature related to instructional sequencing, learning styles, and interactive video as contributing factors to the learning process. One objective of the review was to develop the context of instructional sequencing and its relevance to interactive video instruction. Another objective of the review was to identify factors related to learning style in association with instructional sequencing.

Instructional Sequencing

Judd, Daubek, and O'Neil (1975, p. 2) found the topic of learner control (as it related to instructional sequencing) to be both "interesting" and "confusing". Frederick (1976, p. 2) perceived the reasons for their confusion to be:

(1) A lack of consensus on the definition of learner control;

(2) No general agreement of the factors to be varied under learner control; and

(3) Rarely any effect on learning from manipulated learner control variables, probably because of confounding by other variables.

With these criteria, it is not surprising to find wide and varied conclusions on this topic within the literature on instructional sequencing.

Theoretical Framework of Learner Control

An individual's ability to control the path, scope, and pace of instruction is the basis of the learner control strategy. Previous studies concerned with this topic have emphasized the control of sequencing, content, pacing, feedback, and presentation media as the major attributes of learner control (Fredericks, 1976). It was summarized that students who are given the opportunity to be actively involved in their learning process (i.e., with an opportunity to make judgments on the path and depth of instruction) can and will make realistic estimates of the appropriate path, sequence, pacing, etc. of that instruction. (Dean, 1969; Slough, Ellis, and Lahey, 1972)

Fredericks (1976) reported significant savings of instructional time when students were allowed to control the amount of practice lessons within a computer aided instructional lesson when compared to a program controlled by the computer. The students were engaged in a lesson that gave them needed information to enable them to have a working knowledge of the content base before using the CAI programs. Would there have been a significant time savings if the advance training had not been present and all the learners addressed the CAI training with no prior instructions? The question of prior knowledge must be considered when evaluating the merits of learner controlled instruction.

In arguing for the use of a high level of learner control, Laurillard (1984) proposed that the more active role a student takes in an instructional activity, the more meaningful that instruction should be for the student. As a final result the learner controlled instruction should yield a greater depth and breadth of learning. This is what Wilson (1983) termed the "teachable/learnable" moment.

Campanizzi (1978) studied the effects of instructional sequencing on learner performance using CAI instructional methodology. She concluded that students within the "learner control" groups showed significant achievement gains (p<.05) over those students in the "program controlled" groups, thereby indicating a positive effect of learner controlled instruction.

Fry (1972) studied the effects of specific student characteristics and learner control in regards to student achievement. He hypothesized that whenever a match between the type of instructional control and student learning style occurred, superior learning and satisfaction would result, and the opposite effect would occur when instructional control and student learning style were mismatched. The results of this study indicated that student control was the preferred means of instruction by the participants but did not produce the best student performance of the two instructional programs.

Wilcox (1979) reviewed fourteen studies to determine the effects of instructional sequencing on student performance and presentation characteristics. Seven studies dealt with the interaction of learner control of presentation characteristics and student achievement. Five of the studies showed that when a greater degree of learner control was present, the performance of the students decreased significantly. Two studies found opposite results, and the author's conclusions were that either learner control may be situationally dependent or other extraneous variables may affect the results.

In a study involving interactive video, Laurillard (1984) hypothesized that learner control would be "more educationally effective" than other instructional methods. Although no statistical analysis was conducted to determine significant differences in student performance, the author concluded that students in the study "liked" the learner controlled interactive video. The author also concluded that:

> If interactive video were to become highly controlled and directive (in instructional sequencing), it would be a gross misuse of the medium, partly because it diminishes the potential variations in the use of stored data, and partly because it undermines the students' own responsibility for their learning. Giving the balance of control to the students not only has the benefit of being more democratic, it is probably also more educationally effective. (p. 14)

This study suggested some of the major premises for the advocation of learner controlled sequencing in the overall strategy of instructional designing.

Theoretical Framework of Program Control

The antithesis of learner controlled instruction is the program controlled approach to instructional sequencing. This approach places the control of the instructional sequence in the hands of the instructional designer. When this form of instruction is administered, control of the instructional sequencing is taken away from the student (in varying degrees) and given to the designer of the instruction.

Judd, Bunderson, and Bessent (1970) evaluated the effects of instructional control on student performance and attitudes within a CAI mathematics course. Students were given tutorial help in the areas of exponentiation, logarithms, and dimensional analysis, along with drill & practice in a number of basic mathematical skills. The learners were randomly assigned to one of five groups, each with differing levels of learner control. The results of this study indicated that there were no significant differences in student performance and attitudes among the five groups. The authors stated:

> Allowing students to determine which instructional topics to investigate and the order in which these topics are taken appears to have had little beneficial effect as compared to the predetermined

> (program controlled) sequence. An author defined sequence may well be more important for those areas of instruction in which the student is least competent. (p. 66)

The authors' anticipation that learner control would result in improved student attitudes and performance was not substantiated in this study.

In a very complex study, Oliver (1971) undertook an investigation of task analysis as it related to learner controlled/program controlled instructional sequencing. He randomly assigned learners into five groups to study an artificial (imaginary) science learning task. The groups consisted of: (1) a self-selected (ss) group, in which learners controlled the instructional sequencing; (2) a yoked (Y) group, in which learners were randomly matched to (ss) members to follow the exact instructional sequence of their (ss) partners; but without knowing the behavioral objectives of the instruction and without a general flow chart of the learning task; (3) a forced without representation (FR) group, a program controlled group in which learners were without knowledge of the behavioral objectives of the instruction and without the flow chart; (4) a forced with representation (FR) group, a program controlled group in which learners had knowledge of the behavioral objectives and flow chart; and (5) a control (C) group, in which learners had no instruction except in the use of a computer terminal to allow the learners to take the post test. The reported results of this study indicated that the (ss) group performance was the poorest of all five groups. Oliver concluded that self-selection of the instructional sequence led to lower performance than a hierarchical predetermined (program controlled) instructional sequence.

The implications of Oliver's findings are in sharp contrast to other reports, (Campanizzi, 1978; Fredericks, 1976; Fry, 1972; Lahey et al., 1976; Laurillard, 1984), of improved learning when students were allowed to choose their own path of instruction. Oliver (1971) stated a possible solution to the differences in programming approaches:

> Self selection of sequence may be found to be a beneficial technique when used for selecting and sequencing missing units as in review, or when the task is not hierarchical, or when the steps to be sequenced are large steps composed of smaller pre-sequenced materials, or when used over a longer time span, or any combination of the above. The

> technique of learner-generated sequence was unsuccessful when the task was a relatively short, abstract, mathematical-scientific system taught as small steps and of which the students had no prior experience. (p. 16)

Beard, Lorton, Searle, and Atkinson (1973) randomly assigned sixty college students to three different levels of instructional sequencing to determine if there was a significant improvement in student performance and attitudes. The learners were divided among: (1) student selection of lessons (learner controlled); (2) program selection based upon the individual student's past academic performance; and (3) forced selection of lessons independent of the student's academic performance (program controlled). No significant differences were found among the three groups on any of the performance or attitude measures.

In another CAI instructional sequencing study, Fisher, Blackwell, Garcia, and Greene (1974) sought to determine whether 4th and 5th graders allowed to choose the difficulty levels of their arithmetic problems would show greater engagement in learning than children who were not given a choice. The study included an analysis to determine patterns among the learners in their choices of curriculum difficulty levels. Their conclusions were: (1) the learners who were allowed to choose the difficulty levels of their instruction were significantly more engaged in their learning tasks than those who were not given a choice; (2) both groups' engagement level decreased significantly over a 15 day period; (3) distinctive choice patterns did occur with the difficulty levels chosen being below the students' aptitude levels.

In a study conducted by Lahey and Coady (1978), data were collected to determine whether learner control of a given lesson strategy was superior to program control in a CBI framework, and if so, whether learner control was more effective when a form of instructional guidance was provided to the student. In the study, 164 subjects were randomly assigned to four groups: (1) unguided learner controlled; (2) guided learner controlled; (3) program controlled; and (4) the control group (no CBI). Of these groups, it was determined that the learner control of the instructional sequence, with or without the instructional guidance, did not significantly improve learning over the program controlled approach.

Similarly, Lahey (1978) investigated the effects of learner control and program control on the performance of students and their attitudes toward the different treatments. The author divided the students of the San Diego Naval Training Center, Basic Electricity/ Electronic School into three groups: (1) learner control; (2) learner control with guidance; and (3) program control. The results of this analysis found no significant differences in student performance and student attitudes between either form of the learner controlled instruction and the program controlled instruction.

The foregoing reviews indicate a dichotomy in conclusions and implications as they apply to instructional sequencing. In most cases, the effects of the differing levels of control were measured on student performance, student attitudes concerning the instructional sequence, and time to complete the instruction.

The fourteen studies reviewed by Wilcox (1979) indicate the perplexity of this concept of instructional sequencing. He referred to an important aspect of instructional design and its implcations to instructional sequencing by stating:

> Perhaps it would be more fruitful to view

> learner control of presentation characteristics not only as a method of indivualizing instruction, but also as a factor which itself interacts with learner characteristics. Although some kinds of learners may benefit by being able to control presentation characteristics, other kinds of learners may benefit by having presentation characteristics determined for them. (p. 2,3)

The individual student's learning style is one example of the "other" characteristics that interact with the level of instructional sequencing.

Learning Style

"The purpose of designed instruction is to activate and support the learning of the individual student" (Gagne and Briggs, 1974, p. 4). Personalizing the process of learning has taken many different avenues. One such application is placing the control of the instruction in the hands of the individual learner. As previously noted, this theory of individualizing instruction by maximizing the learner's control of instruction has yielded mixed results. Many instructional designers have recognized the need to take into account the individual learning style of the student and to pattern instruction around the learners rather than the content of the instruction. (Blitz & Smith, 1973; Carrier, 1984; Grabowski & Aggen, 1984; Hoffman & Waters, 1982; Lawrence, 1979; McCaulley & Natter, 1980) Matching the overall instructional design with the learning style of the individual student is an area of research that may have relevent applications to the process of education and learning.

The well known Swiss psychologist, C. G. Jung, developed one of the most comprehensive theories describing the human personality. According to Jung, the human personality was made up of four major types that provided for the expression for all human perceiving (gathering of information/data) and judging (decisions concerning the data collected) (Campbell, 1971).

Jung termed the two perception processes as "sensing and intuition". He believed that the everyday events of the physical world which affect an individual are perceived either through the five senses or through an intuition about the particular events. To make sense of these perceptions, the individual must then make some type of judgment about the event (Lawrence, 1979). It is this theoretical framework of the human personality upon which several educational theorists have based their views of learning style (Keirsey & Bates, 1978; Lawrence, 1979; McCaulley & Natter, 1980; Myers, 1980).

Lawrence (1979, p. 38) placed learning style into the "sensing - intuitive" category of the Jungian typology. He defined the two classifications of learning style follows:

> Sensing students attend most often to the literal meaning they find in concrete experiences. They learn best by moving step-by-step through a new experience, with their senses as engaged as possible. Intuitive students' attention is drawn most often to things which stimulate imagination, to possibilites not found in sensory experience. Their minds work by skips and jumps, looking for patterns wherever the inspiration leads.

This analysis of learning style may have broad applications for the instructional designer. With this as a framework for curricula planning, the educator could take specific actions to accomodate different approaches to learning that individual students may have.

Lawrence contends that learning style can be identified through the administration of the Myers-Briggs Type Indicator (MBTI) developed by Isabel Briggs Myers and Katherine Briggs. The MBTI, published in 1962 by the

Educational Testing Service, represents 20 years of research and validation work. The indicator was developed as a research instrument to apply the personality theory of C. G. Jung in a practical manner. This instrument has achieved widespread circulation in the U.S. and is used in various applications (i.e., career counseling, job placement, personal counseling, educational placement and counseling).

One of the most consistent findings of researchers using the MBTI is that "intuitive" type learners score consistently higher on aptitude measures than "sensing" types (McCaulley & Natter, 1980). These authors believe that the reason for this result is that "intuitive" learners have an advantage over the "sensing" learners because most aptitude measures used in educational applications are based on the learner quickly deriving meaning quickly from words, usually describing concepts or ideas. The intuitive type learner is able to derive meaning from these concepts and ideas, and connect the relationship between the concept and idea in solving written problems. McCaulley & Natter (1980) reported findings that compare grade averages and standardized test scores for sensing and intuitive students at the Florida State University Developmental Research School.

They described comparisons of aptitude covering the reading, social studies, mathematics, science, general aptitude, and vocational subject areas. The results indicated a significant difference in aptitude levels between the two learning style types, with intuitive learners consistently outscoring sensing type learners (McCaulley & Natter, 1980).

In 1974, a learning activities questionaire was developed at the University of Florida under the direction of Isabel Briggs Myers. The 187 item instrument was designed to identify the preferred learning activities of students. The reported results of the questionaire indicated a significant difference in the learning styles of students (Chi Square probability value at .05). A summary of the preferred learning activities is as follows:

Preferred Learning Activities of Sensing Types

> Sensing types become uncomfortable when required to deal with materials which are highly complex, abstract, theoretical, or imaginative. They are comfortable with, and interested in, situations where each part of the whole can be grasped. Sensing types learn best when given a principle, or rule, followed by many examples of

variations in applying it. They tend to enjoy practice and drill (McCaulley & Natter, 1980, p. 154-155).

Preferred Learning Activities of Intuitive Types

Intuitive types value flashes of insight and quickness of perception. They get bored with the obvious, and with drill or repetition after they have seen what they consider the main point. They learn best when given a problem with the task of discovering the solution (McCaulley & Natter, 1980, p. 156-157).

Carrier (1984) reported the findings of several studies on learner choice of instructional events. She concluded that the majority of individual learners are not themselves the best determiners of which instructional strategy to follow. Carrier stated that the one factor which may predict a learner's performance under different instructional conditions was the "cognitive style" (learning style) of the individual learner.

In 1974, a study was conducted by Judd, Daubek, and O'Neil to investigate the impact of learner control on student performance in a CAI task relative to individual differences. They reported that there was no significant advantage of learner control over the other treatments and that the learner's ability to use learner control effectively appeared to be a function of personality traits as well as cognitive skills. It was the authors' hope that a more specific measure of personality could be developed to effectively analyze students' learning styles.

Hoffman & Waters (1982) studied the relationships between personality types and student performance in a self-paced CAI instructional program. The purpose of their research was to: (1) determine if specific personality types completed the CAI program faster than others; and (2) examine the relationship of personality type and attrition rate within the CAI program. A total of 155 students at the Naval Training Center in Pensacola, Florida participated in this experiment. The Myers-Briggs Type Indicator was used to evaluate personality types and indicated that "sensing" type learners completed the learning task significantly sooner than "intuitive" type learners ($p < .01$). The authors concluded that "learning by means of a computer assisted instruction program would seem to favor those who have the ability to quietly concentrate, are able to pay attention to details, and can stay with a single task until completion" (p. 21). Because of the nature of the CAI course content (learning and transcription of Morse code) there was a strong bias of instructional techniques that favored the sensing type learners.

Blitz & Smith (1973) conducted a study with CAI and programmed text as the experimental treatments to determine if personality characteristics have a bearing on an individual's success. Three separate analyses were conducted to measure several values of Aptitude-Treatment Interactions (ATI). The results expressed conflicting conclusions concerning ATI relationships for which it was suggested that the ATI effects were clearly a function of personality characteristics and not intelligence. The authors stated that "the critical factor in determining how well a student learned was based on the extent to which each mode of instruction aided his learning style by fulfilling his personality needs" (p. 36).

The authors of the preceding studies have given evidence for the need of an understanding of learning styles in designing an instructional system. Suggestions were given on how instructional designs may accomodate the learning styles of the individual student. The use of one instructional strategy or another may be offered to students, depending on their specific style of learning. Although this may be beyond the capability of an individual educator, it could be feasible with interactive video technology. The possiblity of offering the best instructional content with the most appropriate style of teaching may be a viable application of interactive video.

Interactive Video

Interactive video is a computer controlled system of delivering various forms of training and information. It combines various aspects of video (television, graphics, animation, films, etc.) with the computing/processing abilities of a microprocessor. This linkage of video (via videotape or videodisc) with a microcomputer, enables messages from the videodisc and microcomputer to be controlled by the user. When this system is organized and structured properly, it provides information to a learner, who, in turn, may respond via the computer. This interaction between the video/microcomputer system and the learner is known as interactive video.

Although interactive video systems vary, they all include three (3) basic pieces of hardware: (1) a video player (either tape or disc); (2) an interfacing device (normally, an interface card provides the electronic link by which the computer and the video player communicate); and (3) a video display monitor. A fourth component is included on more advanced interactive systems, (level III interactivity); a microcomputer with a disk drive. One additional component is the authoring program or software, which enables one to give the computer commands to program the specific training or information lessons (Floyd, 1982).

Interactive video hardware is being produced at three levels of complexity and interactivity. Level one (1) interactive hardware consists of a videotape recorder (or videodisc) and a video monitor. There is no built in microprocessing unit which controls the program. Interaction at this level is accomplished by human intervention of the program (fast forward or reverse, scan, step frame, etc.) to specific, prearranged positions on the tape or disc. Level two (2) hardware also consists of a video player,(disc or tape) with a built in microprocessing unit and a video monitor. With this capability, the instructor can have preprogrammed segments of an instructional unit available at the touch of a button on a control panel.

Also, this capability enables the instructor to retain the spontaneity of the lesson while presenting additional information to his/her students. Level three (3) interactive hardware combines the video system (tape or disc) and video monitor with an external computer. By a special linkage of the computer with the video system (via an interface board), the interactive program can be adapted to present sophisticated predesigned instruction. Level three (3) also provides for learner input which may be adapted to present a complete unit of instruction via the interactive video system without intervention from a human instructor. Level three (3) is capable of analyzing student input and control of the operation of the video system (Howe, 1985).

A level three (3) interactive video system may be used to facilitate the natural process of learning - a process in which a learner has an experience and then extracts meaning from that experience. This is, according to Wilson (1983), the "teachable/learnable moment." Combined with the intrinsic activities that a learner experiences in an interactive video program, there is an added potential of having the pace of instruction controlled by the individual learner. This is an important aspect of any learning and greatly enhances the interactive video technology.

The applications and benefits of interactive video may have wide reaching effects within education. Young and Schlieve (1984, p. 42) developed a list of evaluative questions that may aid instructional designers in their selection of media techniques. Those which pertain to instructional sequencing and learning style include:

1. Is remedial or review capability important?
2. Is immediate feedback to the learner critical?
3. Are a range of different presentation strategies required?
4. Is learner accessability important?
5. Is individualization/self-pacing important?
6. Is active learner participation important?

This list is not exhaustive, but it does provide several of the possibilities for application in level three (3) interactive video systems.

Several reports have purported the benefits of interactive video as an instructional technology (Glenn & Kehberg, 1981; Pawley, 1983; Floyd, 1980; Boen, 1983). Those which pertain to instructional sequencing and learning style include:

1. Students are "actively" involved in learning.

2. Instruction can be tailored more to individual learners.
3. Interactive video provides for a more independent learning environment.
4. Better aids for abstraction are provided.

Perhaps the greatest criticism of interactive video is that it has been presented as a panacea for all instructional problems in education. Interactive video has been credited with providing instruction, training, and information that is better, cheaper, faster, and more up-to-date than any other method of instructional delivery. The combination of the silicon chip and video tape/disk have produced a unique medium that must be given serious consideration when designing instruction. However, interactive video cannot be expected to have intrinsic assurances of effective applications in education. It may just as easily be used in trivial or ineffective ways (Bosco, 1984).

Although many interactive video programs have been developed, only a small amount of statistical data has been collected to scientifically compare the results of this instructional technology. Of the studies reviewed, only a few involved statistical methods of research.

Ebner, Manning, Brooks, Mahoney, Lippert, and

Balson (1984) reported research to determine if interactive video could improve: (1) student performance; (2) task completion rates; and (3) student attitudes within a military health-related training course. The content of the interactive video lesson was how to do intramuscular injections. The study compared the traditional method of instruction (ie. instructor lecture, demonstration, and tutorial) to interactive video training. The results of the experiment indicated a 43% time savings (task completion rate) with the interactive video system. The results of the analysis on student performance indicated that the interactive video success rate was 83% compared to a 76% success rate using the traditional method. On a retest of participants, a significant difference was determined: interactive video training produced a 75% success rate compared to 59% with the traditional method. In the comparison of the attitude instrument, Ebner, et al. (1984) found a significant difference, with students preferring interactive video instruction over the traditional method of training. The results of significant time savings, test-retest performance improvements and positive attitude results indicate that interactive video technology was quite successful in this particular type of training.

Dalton (1986) compared the results of achievement test scores and attitude measures on three instructional techniques. The study analyzed 134 junior high industrial arts students on their ability to learn twenty-seven (27) General Shop Safety Rules and their attitudes toward each of the instructional methods. Three levels of treatment, video only, computer assisted instruction, and interactive video were compared across three levels of prior knowledge, (high, average, and low) based on standardized test scores. The results indicated that all treatment levels were significantly different at the .05 level. Computer assisted instruction resulted in the best performance and interactive video was significantly higher on the attitude scale. There was also a significant treatment by achievement interaction with low level achievers scoring lower with computer assisted instruction and higher with interactive video. Students using computer assisted instruction performed the best, but low level learners performed better with interactive video.

DeBloois, Maki, and Hall (1984) stated reports of interactive videodisc use were characterized as "eighty-five percent fluff and fifteen percent substance." (p.

22) Relatively few controlled valid studies have been done to describe research results of interactive videodisc use for instructional purposes. The reported results of the scientific studies completed indicated "the use of inadequate research models, too few subjects to generate statistics of any power, non-randomized approaches, inadequate controls, and validity and reliability problems of data reported." (p. 52) Nevertheless, DeBloois et al., (1984) reported that early research indicated learners using interactive video systems were scoring significantly higher on achievement tests, were completing their instructional training in less time, and generally enjoyed and preferred interactive video instruction to the traditional approach to instruction.

Design of interactive video instruction is divided into two (2) major approaches. One approach is the "systematic" design of interactive video instruction (Nugent and Stone, (1980); Schlieve and Young, (1983); Floyd, (1980); Daynes, (1982); Cohen, (1984); and Floyd, (1980).

Floyd (1980, p. 75) indicated that the systematic design process could be accomplished by following seven (7) major steps:

1. Front end analysis - define the problem
2. Instructional strategy - define the terminal and enabling objectives (task analysis - breaking down into small groups)
3. Flow Chart - diagram of the instructional strategy
4. Visualizing and Scripting - writing script for program
5. Production - filming of video scenes, graphics, etc.
6. Programming - writing and inputting code for the program
7. Debugging - testing the program to remove all possible errors. (Floyd, 1980 p.75)

The second approach is "eclectic". Jonassen (1985) considers interactive lesson designs in two dimensions, (1) the interactive dimension and (2) the adaptive dimension. The interactive dimension indicates the way in which learners interact with an instructional program. Interaction was described in terms of the task, level of processing required to complete that task, and the context in which the instructional program was used. (p. 15) The adaptive dimension describes the way in which the instructional programs conform to meet the needs of the learner or to the content it is presenting. (p. 16) The interactive program could be designed to "adapt" to the particular learning style of the individual learner or to the instructional content.

Rhodes and Azbell (1985) proposed a unique approach to designing interactive video programs. The authors consider interactivity to have three levels: (1) Reactive, (2) Coactive and (3) Proactive. In reactive interaction, the learner has limited control of program content and structure. Users simply must "react" to subject matter in predetermined ways based on the designer's program. Coactive interaction allows users extended control of either the content or the sequence, but not both. Decision points within the program are shared by both the learner and the program designer. Proactive interaction provides maximum control over both the program content and the structure of the program. Proactive learners determine "what" will be presented (content of program) and "how" it will be presented (sequencing of program). Rhodes and Azbell (1985, p. 32) classify these interactive qualities into respective applications for education:

1. Reactive - remediation, clarification, and additional information;

2. Coactive - provides for individualized instruction, users determine what they are to do; and
3. Proactive - provides for both what will be learned and how it will be learned; personalized, because each learner is treated differently.

This unique approach to interactive video instructional designing may provide clarity for specific needs and content.

Other "eclectic" approaches for interactive video instructional design may be found in reports by Gayeski, (1981); Cambre, (1984); Kearsley and Frost, (1985).

Summary

The technology of interactive video provides a unique mixture of instructional media that may significantly improve the way in which instruction is delivered. Initially, the design of interactive video programs followed established design strategies (Cambre, 1984) of programmed test and computer aided instruction. Current design strategies have proven inadequate to address the capabilities of interactive video technology.

Laurillard (1984) stated that the issue of balance of control in instructional design for interactive video is of paramount importance.

> "The balance of control over both sequence and strategy is an issue that must be addressed by interactive video designers, and needs further investigation to find out how to determine the optimal balance". (p. 7)

The issue of program sequencing has been studied in various experiments using computer aided instruction (Fredricks, 1976; Campanizzi, 1978; Fry, 1972; Wilcox, 1979; Judd et al., 1970; Oliver, 1971; Lahey et al., 1976; Beard et al., 1973; Fisher, 1974; Lahey, 1978).

The theory of instructional sequencing falls within two major frameworks of thought. The first is "learner" controlled sequencing, where the individual learner controls the sequence of instruction by choosing "what" and "how much" to study. This type of control is compared with "program" controlled sequencing in which the sequencing of the instructional content has been predetermined by the designers of the instructional program. The findings of these studies have revealed mixed results. Some have indicated improvements with "learner control" sequencing, (Fredricks, 1976;

Campanizzi, 1978; Fry, 1972; Wilcox, 1979; and Laurillard, 1984) while others have found no significant difference between learner and program control sequencing (Wilcox, 1979; Judd et al., 1970; Lahey and Coady, 1978; Beard, et al., 1973). However, other experiments have determined that "program controlled" sequencing has provided significant advantages in learning (Oliver, 1971; Fisher, et al., 1974; Wilcox, 1979).

An underlying characteristic of several of these studies has been that the individual learning styles of the participants interact with the type of control or design of the instruction (Oliver, 1971; Wilcox, 1979; Laurillard, 1984). Many instructional designers have recognized the need to take into account the individual learning style of the student and to pattern instruction around the learner, rather than the content of the instruction (Blitz and Smith, 1973; Carrier, 1984; Grabowski and Aggen, 1984; Hoffman and Waters, 1982).

Lawrence, (1979); McCaulley and Natter, (1980); Myers, (1980) have researched the theory of learning style and its implications to instructional design. Lawrence (1979) contends that learning style can be identified through the administration of the Myers-

Briggs Type Indicator, a personality indicator developed by Isabel Briggs Myers and Katherine Briggs. The application of learning style theory with interactive video technology may offer an improvement in learner productivity.

In the review of related literature, there were no indications which were definitive regarding the use of interactive video technology and instructional sequencing in relationship to learning style theory. This study is an attempt to add empirical evidence to the effectiveness of designed instructional material with regard to specific learning styles of students.

Chapter 3

RESEARCH METHODOLOGY

Introduction to Research Methodology

The purpose of this study was to determine if there is a significant difference in achievement test scores and task completion rates in relation to student learning styles and the method of instructional program control within this particular context of interactive video instruction.

Interactive Video Programs

The interactive video programs were developed to instruct beginning students in the basic concepts of offset lithography and the parts of an offset lithographic press. Two interactive video programs were developed with identical video segments. The difference between the two interactive programs was how the sequence of instructional segments was controlled.

In Treatment 1 (Program 1) (see flowchart in Appendix A), the design of the instruction was developed and presented based upon the knowledge, experience, and logic of the instructor and instructional designer.

Within this system, the instruction followed a linear path, controlled by the computer, through a basic introduction of the concept of offset lithography, followed by a general overview of the offset press, to more specific training on each unit of the offset press, and finally to a general review of the processes (see Appendix D). This approach to instruction followed the more traditional method of instructional sequencing.

Each student began this program by following the procedure sequence (see Appendix E) for activating the interactive work station. Upon activation of the interactive computer system, the student was required to input his name and student number via the keyboard of the computer. Following this initial personal data input, the interactive video computer system would compute a series of self-tests and load several files to bring the system into operating order. Once these tests were completed, a sequence of introductory remarks regarding the instruction that was to follow was presented to the viewer. Immediately following the introductory remarks, the viewer was instructed to record his name, date of viewing, program viewed (#1 or #2), and starting time on a form attached to the interactive work station. Upon completion of this activity the viewer was informed to proceed with the instruction by pressing the space bar.

The standard instructional procedure of program 1 was to: (1) view a video instructional segment on the concept or unit of the offset lithography/offset press; (2) take a quiz covering the video instructional segment; and (3) receive remedial information. When a correct answer to a quiz question was selected, the program would continue with the next question in the quiz until all questions had been answered. Upon completing the quiz, the viewer was positively reinforced and informed as to what portion of instruction was to follow. If an incorrect answer was selected, the program remediated the viewer either by explaining why his answer was incorrect or by providing specific video segments addressing the question under consideration or a combination of both informational text and video segment. Upon completion of the remediation, the program presented the initial question again and the viewers were required to select an answer.

Following the final review of the offset press the program instructed the viewer to record his ending time on the form attached to the interactive work station and then to ask the instructor for the final exam forms.

The student was then taken to an examination station and given the "Final Examination" form (see Appendix C). Instruction regarding this instrument was given and the student was left to complete the instrument. The student then returned the completed form to the instructor. See Appendix F for a detailed example of a lesson unit.

Treatment 2 (Program 2) was learner controlled (see flowchart in Appendix B). Although the material presented during the video instructional segments was identical to Program 1, the approach of the instructional design was distinctly different. This program was developed to allow the individual learner to control the path and sequence of the instruction. The program forced the learner to make decisions concerning which of the seven sub-topics to study, and whether to review various aspects of the sub-topics or to omit the review. The student made a decision to take a quiz or study additional information, omit questions in a quiz, review questions in a quiz, choose another lesson in the program, or quit and take the final examination covering the entire offset lithography lesson. At virtually every available point in the program, the learner was given several options from which to choose. This allowed the learner to determine which lesson to study, how much instruction to receive on the topic, and when to start, stop, or change directions in the instruction.

Initially, each student in program 2 activated the interactive video computer system in the same manner as students in program 1. Initial personal data was input followed by computerized self-tests. Introductory statements, although somewhat different in the information (e.g., informing the student of his option to choose any order of lesson sequence) was presented followed by instructions to record his name, date of viewing, program viewed (#1 or #2) and starting time. Upon completion of this data entry, the student was informed to proceed with the instruction, and a main menu screen appeared, requiring the student to select a specific lesson from which to receive instruction (See Appendix G).

The main menu screen provided eight (8) choices for each student. Upon selection of one of these eight choices, the interactive computer system would access the appropriate lesson and present a primary video instructional segment. After completing the video segment, the viewer was given the following choices: (1) review optional information on the designated lesson; (2) take a quiz on the designated lesson; (3)

choose another lesson; and (4) quit and take the final exam. Choices of options 1, 3, and 4 are self explanatory. If option 2 was chosen, the viewers were presented with a quiz on the designated lesson. If a correct answer to a quiz item was selected, the standard correct choice options were: (1) continue with the quiz; (2) review optional information on the designated lesson; (3) choose another lesson; and (4) quit and take the final exam. If an incorrect answer to a quiz item was selected, the standard incorrect choice options were: (1) review optional information on this topic; (2) re-try the question; (3) continue with the next question; (4) choose another lesson; and (5) quit and take the final exam. Upon completion of a lesson the viewers were informed and given options to: (1) review optional information on the lesson; (2) choose another lesson; and (3) quit and take the final exam. Options 1 and 3 are self explanatory; option 2 would return the viewer to the main menu.

Upon selection of option eight (8), "Final Examination" each viewer was informed of the implications of this choice and was then given the opportunity to review another lesson or continue with the final examination. If he decided to select the final examination, the viewer would be asked to record his ending time on the form attached to the interactive work station. The remaining activities would be identical to those presented to program 1 subjects. See Appendix F for a detailed example of a lesson unit.

Design of Achievement Test

The development of the achievement test was based upon content analysis of the instruction. Each section of the interactive video program was timed to determine the amount of elapsed instructional time (see Appendix D). Based upon this evaluation, an achievement test was developed to provide a balanced ratio of test items to the instructional time given to a specific topic in the interactive video program.

Formative evaluation procedures were conducted from March 3, 1986 to March 21, 1986 at Virginia Polytechnic Institute and State University to evaluate the achievement test instrument and the interactive video program content. A three phase approach was implemented (Dick and Carey, 1984). Phase one was a review of the currency and accuracy of the instruction by a subject matter specialist. Phase two sought direct student input by a "one-to-one" interaction between the program designer and three student participants. Student participants were selected according to their academic achievement level (high, medium, and low) in a Graphic Arts I class at Virginia Polytechnic Institute and State University. Phase three sought input from a sample of ten students randomly selected from a Graphic Arts I class. They were used to determine the effectiveness of changes made after the "one-to-one" evaluation, to determine if learners could use the instruction without direct interaction with the instructor, and to validate the achievement test.

Following the completion of the interactive video programs, the student participants were given an achievement test which tested their knowledge of the concepts presented in the interactive video programs. The same 41 item instrument was given to all student participants in this study.

Achievement Test Revision

Following the formative evaluation, the achievement test was analyzed to determine its reliability. Statistical measures were used to examine the instrument (Kuder-Richardson #20 reliability estimate) indicating a low reliability of .57. Based upon these findings the achievement test underwent major revisions to improve its reliability. Revisions were as follows:

1. Eleven (11) test items were reworded to facilitate a clearer understanding of the questions;
2. Fourteen (14) test items were removed to alleviate redundancy;
3. Four (4) test items were added; and
4. The format was changed from alphabetical to numerical coding to conform with test answer forms. (See Appendix C)

Upon completion of the achievement test revisions, another small group administration of the test was done to determine the reliability. Fifteen (15) participants viewed the interactive video program (Program 1) and were then administered the revised achievement test. Application of the Kuder-Richardson #20 reliability estimate yielded a coefficient of .83. The test was then believed to be acceptable.

Learning Style Measurement

The learning styles of the student participants were determined by their scores on the "Myers-Briggs Type Indicator". This instrument was selected for its substantive theoretical and empirical base (as related to learning style preferences), its availability, and its ease of administration and scoring. Students were classified according to the learning style category of the test based on the theory of Myers (1962); Lawrence (1982); and McCaulley and Natter (1981).

The form used (Form G) consisted of 126 items which classified individuals along four independent dimensions of personality. Each dimension has two dichotomous positions, with only one position from each dimension assigned to any one individual. Of the four dimensions the classification that applies to the concept of learning style is the "Sensing - Intuitive" dimension. On this dimension, data are collected to determine how individuals prefer to collect information in their environments (Willis, 1984).

Sensing refers to the method of information collection based on the empirical use of the five senses and therefore tends to rely upon a direct, detailed, step-by-step approach to learning. On the opposite end of the learning style category is the intuitive learner. The intuitive learner gathers information regarding the events and aspects of his/her environment in a distinctively different way. The intuitive learner will perceive things on a more global scale and derive insights and possibilities from the data collected (Lawrence,1982).

To be classified as a sensing type learner, a respondent must score higher on the sensing scale than on the intuitive scale. The opposite result (classification of the intuitive type), would occur when the respondent scored higher on the intuitive scale than on the sensing scale. The sensing scale ranges from 1 to 57 while the intuitive scale ranges from 1 to 49. The indicator was designed so that a zero (0) score is not possible. The "Sensing -Intuitive" index of the "Myers-Briggs Type Indicator" has a total of 40 items: 24 pertain to sensing type activities, while 16 items pertain to intuitive activities. Reliability coefficients on this portion of the indicator range between .75 and .87 (Myers, 1962; Stricker and Ross, 1963). Not all classifications recorded on the MBTI indicate a definitive preference of a personality trait. Briggs (1962) indicated that those individuals who score below nine on the report form of the MBTI may not have a clear distinction of preference within that particular dimension of their personality. The majority of participants in this study indicated a strong preference in their learning style. Of the 30 participants classified as sensing type learners, 27 (90%) were definitive in their preferences while 3 (10%) were not. Of the 30 participants classified as intuitive type learners 22 (73%) were definitive in their preferences while 8 (27%) were not. Although only the sensing - intuitive portion of the indicator was analyzed in this study, the complete "Myers-Briggs Type Indicator" was administered, scored and explained to benefit the participants in understanding their personality types. Participants reviewed the analysis of their classifications on the MBTI and were asked to report any differences they perceived from their own perceptions of their personality and the classifications made by the MBTI.

Task Completion Rates

The task completion rates for the two interactive programs were timed to judge differences in the amounts of time it took students to finish them. At the beginning of the instructional session the student participants were instructed by the program to log their "beginning" time on a reporting form attached to the learning station. As the individual learners concluded their training, they were again instructed to log their "ending" time on the reporting form. A digital clock was attached to the computer monitor for a standardized form of time measurement. Total elapsed time was computed for each subject.

Experimental Work Station

Prior to the treatment, an interactive video learning station was constructed in the graphic arts laboratory at Virginia Polytechnic Institute and State University. The interactive video learning station consisted of:

1. Apple II Plus 64k Microcomputer
2. 1 Apple 5 1/4 inch Disk Drive
3. Amdek Color Monitor
4. Sony SLO-325 Beta I videotape recorder
5. Headphones
6. BCD Interface Card

The procedures for activating the interactive video system were posted on an elevated viewing stand at the learning station (See Appendix E). Students were assigned one of two offset press programs to use during the experiment (Program 1 or Program 2). The two programs (5 1/4 inch computer diskettes) were clearly displayed and marked at the learning station. The video cassette used in the experiment (Offset Press Video) was clearly marked and attached to the video tape recorder. Students were assigned specific times to view the instruction and given introductory remarks on the location of the various pieces of equipment and materials at the learning station.

Upon activation of the learning station the student participants followed the instructions of the program. There was no instructor involvement unless the computer system malfunctioned. At the conclusion of each interactive program the learners were instructed to ask for the final examination forms.

Experimental Design

Two 2 X 2 factorial analyses of variance were utilized to test the 6 hypotheses:

A 2 X 2 factorial analysis was conducted on the hypotheses relating to achievement test scores.

Ho 1: There is no significant difference between the achievement test scores of subjects in the program controlled interactive video program versus subjects in the learner controlled interactive video program.

Ho 2: There is no significant difference between the achievement test scores of "Sensing" type learners versus "Intuitive" type learners.

Ho 3: There is no significant interaction of learning styles and interactive video program type on achievement test scores.

A 2 X 2 factorial analysis was conducted on the hypotheses relating to task completion rates.

Ho 4: There is no significant difference between the task completion rates of subjects in the program controlled interactive video program versus subjects in the learner controlled interactive program.

Ho 5: There is no significant difference between the task completion rates of "Sensing" type learners versus "Intuitive" type learners.

Ho 6: There is no significant interaction of learning styles and interacive video program type on task completion rates.

In the event of an interaction, four additional hypotheses would be examined to determine the simple effects on achievement test scores:

Ho 7: There is no significant difference in achievement test scores in the program controlled interactive video program between "Sensing" and "Intuitive" learning styles.

Ho 8: There is no significant difference in achievement test scores in the learner controlled interactive video program between "Sensing" and "Intuitive" learning styles.

Ho 9: There is no significant difference in achievement test scores between the program controlled interactive video program and the learner controlled interactive video program among the "Sensing" type learners.

Ho 10: There is no significant difference in achievement test scores between the program controlled interactive video program and the learner controlled interactive video program among the "Intuitive" type learners.

In the event of an interaction, four additional hypotheses would be examined to determine the simple effects on task completion rates:

Ho 11: There is no significant difference in task completion rates in the program controlled interactive video program between "Sensing" and "Intuitive" learning styles.

Ho 12: There is no significant difference in task completion rates in the program controlled interactive video program between "Sensing" and "Intuitive" learning styles.

Ho 13: There is no significant difference in task completion rates in the program controlled interactive video program and the learner controlled interactive video program among the "Sensing" type learners.

Ho 14: There is no significant difference in task completion rates in the program controlled interactive video program and the learner controlled interactive video program among the "Intuitive" type learners.

The dependent variables were achievement test scores and task completion rates. The independent variables were methods of instructional sequencing: program controlled (Program 1) and learner controlled (Program 2) and learning styles (Sensing and Intuitive). Figure 1 illustrates the design of the study. The .10 significance level was set to reject or retain as tenable each of the hypotheses.

Figure 1

Achievement Test Scores

Learning Styles		Interactive Video Programs: Program 1	Interactive Video Programs: Program 2
Learning Styles	Sensing Type		
	Intuitive Type		

Task Completion Rates

Learning Styles		Interactive Video Programs: Program 1	Interactive Video Programs: Program 2
Learning Styles	Sensing Type		
	Intuitive Type		

Population of the Study

The population of this study consisted of sixty (60) students. The subjects were students in the Graphic Arts I classes (46 students) at Virginia Polytechnic Institute and State University scheduled during the spring quarter of 1986 and selected volunteers from two sections of the Marketing classes ("Channels of Distributing") (14 students) at Radford University during the same time period. Graphic Arts I classes were selected because of the content base of the course and the low level of exposure these students had to the concepts of offset lithography. Marketing classes were selected because of their availability for this study and their low level of exposure to the concepts of offset lithography. Only those students in the Marketing classes that met the MBTI criteria (i.e., 12 "Sensing" types and 2 "Intuitive" type learners) were selected in order to balance the learning style groups.

Administration of the Treatment

The sixty (60) students were administered the "Myers-Briggs Type Indicator" and classified according to their learning styles. Students who were categorized as Sensing type learners were designated as S, (N=30);

students who were categorized as Intuitive type learners were designated as N, (N=30). Those subjects classified as sensing type learners were randomly assigned to the two (2) treatment groups (Program 1 or Program 2), as were the the intuitive type learners, thus obtaining a balanced treatment to learning style ratio. One group of fifteen (15) Sensing learners and fifteen (15) Intuitive learners received Program 1 - program controlled interactive video. One group of fifteen (15) Sensing and fifteen (15) Intuitive learners received Program 2 - learner controlled interactive video. Treatment viewing times for all subjects were randomly assigned. Following the treatment, a final examination was administered to all subjects. The test consisted of thirty (30) multiple choice items. The score for the achievement test was the number of correct responses (0-30).

Lesson Unit Sequence and Student Response Path

The thirty (30) students who were assigned to the learner controlled interactive video program (Program 2) were tracked by the computer as they progressed through the instruction. As each student made decisions concerning the path and sequence of the instruction (see flowchart in Appendix B), the interactive video authoring software program, "The Instructor", recorded their decisions. Decisions of sequence of lesson unit selection and the use of the various options within the instruction of the lesson units were stored in a data file for retrieval at a later date. At the completion of each treatment session these data were recalled from the authoring software program and printed out as individual student records of the path and sequence through the instruction.

Two programs were used to compute a table of frequency counts and percentages representing the decisions made by the students in the learner controlled interactive video program (Program 2). The first program was used to determine the selection sequence of lesson units chosen by the participants (see Appendix G). The second program was used to determine the choices of the instructional options that participants utilized while engaged in the interactive program.

Summary

This chapter presented the research methodology and procedures used to examine the relationship of learning styles ("Sensing vs. Intuitive"), with instructional sequencing, (program controlled interactive video and learner controlled interactive video).

The learning styles of sixty (60) students were determined through the administration of the "Myers-Briggs Type Indicator". Thirty (30) "Sensing" and 30 "Intuitive" students were paired and randomly assigned to the two (2) treatment groups. One group of 15 "Sensing" learners and 15 "Intuitive" learners received Program 1 - program controlled interactive video. The other group of 15 "Sensing" and 15 "Intuitive" learners received Program 2 - learner controlled interactive video.

Subjects were required to view the prescribed interactive video programs (program 1 or program 2) during randomly assigned times in the graphic arts laboratory at Virginia Polytechnic Institute and State University.

The 2 x 2 factorial analysis of variance was selected to analyze the data for the achievement test scores and the task completion rates. Frequencies were computed to analyze data regarding the sequence of lesson unit selections and the learning paths utilized by students in the learner controlled interactive video program (Program 2). The results and findings are presented in Chapter 4.

Chapter 4

DATA ANALYSIS

The purpose of this chapter is to present the results of the analysis of the data as outlined in Chapter 3. The .10 significance level was adopted for testing the hypotheses.

The dependent variables in this study were the number of correct responses on an achievement test (see Appendix C) and the total elapsed time for the completion of the instructional task. The independent variables were learning style (sensing versus intuitive) and interactive video program (program control versus learner control). The mean scores for each of the treatment combinations are reported in Table 1 and Table 2. They represent the scores on the achievement test (0-30) and the elapsed time for the instructional task (in minutes).

Primary Analysis

Summary tables of the factorial analysis of variance based on the means shown in Table 1 are presented in Table 3 and Table 4. The results of the

Table 1

Means and Standard Deviations for Achievement Test Scores by Interactive Video Programs and Learning Styles

Learning Styles	Interactive Video Programs: Program Control	Learner Control	Total
Sensing			
M	20.47	20.47	20.47
SD	5.24	4.93	4.99
Intuitive			
M	20.53	22.37	21.43
SD	3.04	2.61	2.93
Total			
M	20.50	21.40	20.95
SD	4.21	3.99	4.09

n=15 per cell

Table 2

Means and Standard Deviations for Task Completion Rates by Interactive Video Programs and Learning Styles

Learning Styles	Interactive Video Programs: Program Control	Learner Control	Total
Sensing			
M	40.07	40.60	40.33
SD	4.59	6.50	5.54
Intuitive			
M	40.33	45.47	42.90
SD	3.52	8.25	6.76
Total			
M	40.20	43.03	41.62
SD	4.02	7.71	6.26

n=15 per cell

Table 3

Summary Table for Analysis of Variance

Achievement Test Scores by Interactive Video Program and Learning Style

Source of Variance	Sum of Squares	DF	Mean Square	F
Interactive Video Program (Program and Learner)	12.150	1	12.150	0.717
Learning Style (Sensing and Intuitive)	14.017	1	14.017	0.828
Interactive Program and Learning Style Interaction	12.150	1	12.150	0.717
Within	948.533	56	16.938	
Total	986.850	59		

Table 4

Summary Table for Analysis of Variance

Task Completion Rates by Interactive
Video Program and Learning Style

Source of Variance	Sum of Squares	DF	Mean Square	F
Interactive Video Program (Program and Learner)	120.417	1	120.417	3.349 *
Learning Style (Sensing and Intuitive)	98.817	1	98.817	2.748
Interactive Program and Learning Style Interaction	79.350	1	79.350	2.207
Within	2013.600	56	35.957	
Total	2312.183	59		

* $p < .10$

analysis of variance indicated there was no significant difference in achievement test scores between the program controlled interactive video program and the learner controlled interactive video program. Also, there was no significant difference in achievement test scores between the sensing type learners and the intuitive type learners, nor was there a significant interaction between the interactive video programs and the learning styles of the students. Reliability of the achievement test within the experiment was .75 as determined by the Kuder-Richardson #20 Reliability estimate.

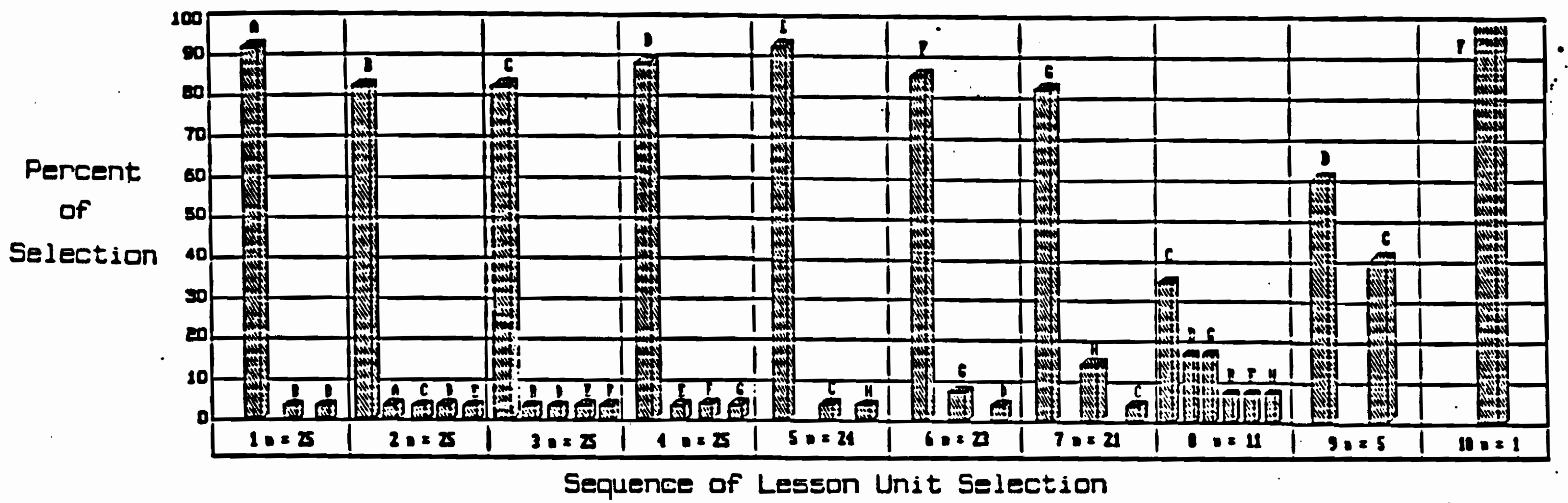
There was a significant difference ($p < .10$) in task completion rates between the program controlled interactive video program and the learner controlled interactive video program (see Table 4). The program controlled interactive video program required significantly less time to complete the instructional task than the learner controlled interactive video program. There was no significant difference in task completion rates between sensing type learners and intuitive type learners, nor was there a significant interaction between the interactive video programs in which the learners were engaged and in their learning styles.

Secondary Analysis

The sequence of lesson unit selection and the selection of the various options (paths) within the learner controlled interactive video program (Program 2) were evaluated using frequency distributions. These findings are reported in the following sections.

Lesson Unit Selection At various points during the interactive video program, students were given options to select from among eight lesson units (see Appendix G). The order of their selection is presented in summarized form in Figure 2. The sequence of lesson units (i.e., sequential versus random) which students selected during their viewing of the learner controlled interactive video program (Program 2) indicated that the vast majority of subjects (86.8%) chose the lesson units in the order they were presented on the main menu (see Appendix G).

There were a total of ten selections chosen by the subjects of this experiment, although only the first seven selections were chosen by the majority of the subjects (see Figure 2). Data were collected on 25 subjects, data from the five remaining subjects are missing due to incorrect exiting from the learner controlled interactive video program.



Lesson Unit Key

A = Introduction to Offset Lithography
B = Overview off Press Operations
C = Inking Unit
D = Dampening Unit
E = Printing Unit
F = Infeed & Delivery Unit
G = Review
H = Final Examination

Decision Point Key

1 = First Selection
2 = Second Selection
3 = Third Selection
4 = Forth Selection
5 = Fifth Selection
6 = Sixth Selection
7 = Seventh Selection
8 = Eighth Selction
9 = Ninth Selection
10 = Tenth Selection
n = number of students selecting

Figure 2

Sequence of Lesson Unit Selection
for the
Learner Controlled (Program 2)
Interactive Video Program

All 25 subjects participated in the first selection of the lesson units from the main menu with 23 (92%) of the subjects choosing the first lesson unit, "Introduction to Offset Lithography" (see Figure 2). One subject (4%) chose the "Overview of the Offset Press" lesson unit and one subject (4%) chose the "Dampening Unit" as their first selections.

In the second selection of lesson units, 21 of the subjects (84%) chose "Overview of the Offset Press" (see Figure 2). One subject (4%) chose the "Introduction to Offset Lithography", one subject (4%) chose the "Inking Unit", one subject (4%) chose the "Dampening Unit" and one subject (4%) chose the "Infeed and Delivery Unit" as their second selections.

In the third selection of lesson units, 21 subjects (84%) selected the "Inking Unit" which was the third option of the main menu (see Appendix G). The choices of the remaining subjects were distributed among "Overview of the Offset Press", "Dampening Unit", "Printing Unit", and the "Infeed and Delivery Unit" with one subject (4%) selecting each of the segments (see Figure 2).

In the fourth selection of lesson units from the main menu, 22 subjects (88%) chose the "Dampening Unit" (see Figure 2). One (4%) of the remaining subjects chose the "Printing Unit", one subject (4%) chose the "Infeed and Delivery Unit", and one subject (4%) chose the "Review".

Twenty-four (96%) of the original 25 students reached the fifth lesson unit selection level. Of these, 22 subjects (92%) selected the "Printing Unit", one subject (4%) chose the "Inking Unit", and one subject (4%) chose the "Final Examination" (see Figure 2).

Twenty-three 92% of the original 25 subjects made decisions at the sixth lesson unit level. Twenty (20) subjects (87%) chose the "Infeed and Delivery Unit" lesson unit. The "Dampening Unit" was chosen by one subject (4%) and the "Review" was chosen by two subjects (9%).

Twenty-one (84%) of the original 25 subjects made decisions at the seventh selection level. Seventeen (81%) of these subjects chose the "Review" (see Appendix G). The "Dampening Unit" was selected by one of the participants (5%) and three subjects (14%) chose the "Final Examination".

At selection levels eight, nine, and ten: eleven (44%) of the original 25 subjects made decisions at the eighth selection level, five (20%) of the subjects chose in the ninth selection level, and only one (4%) subject reached the tenth selection level (see Figure 2).

Student Reponses To Lesson Options In the learner controlled interactive video program (Program 2) students were consistent in their selections of the available options (e.g., "take the quiz on the ...", "request additional instruction", "re-try the question", continue with the quiz", etc.). Following the primary instructional video segment of each lesson unit, a mean of 72.7% of the viewers chose to take the quiz on the lesson, while 15.7% of the viewers chose additional instructional review, and 11.5% of the viewers selected another lesson unit from the main menu. No viewers chose to take the final examination following the primary instructional video segment. Table 5 presents the summary of these data.

At the conclusion of each lesson unit, a mean of 79.2% of the viewers chose to select another lesson from the main menu, while 18.1% chose to receive additional instruction. The final examination was chosen by 2.6%. Summary data regarding these selections are reported in Table 6.

Viewers who selected incorrect answers on quiz

Table 5

Summary Table for Frequency

of

Primary Selection of Program Options

Following Primary Lesson Unit Video

Lesson Unit		Quiz	Additional Instruct.	Another Lesson	Final Exam
Intro. to Offset Lith.	n=25	76.0	8.0	16.0	0
Overview Offset Press	n=24	70.8	16.7	12.5	0
Inking Unit	n=24	54.2	37.5	8.3	0
Dampening Unit	n=25	65.4	23.1	11.5	0
Printing Unit	n=23	82.6	8.7	8.7	0
Infeed & Delivery Unit	n=24	87.5	0.0	12.5	0
Mean Percentage		**72.7**	**15.7**	**11.5**	**0**

n = number of subjects making this decision

Table 6

Summary Table for Frequency

of

Selection of Program Options

Following Conclusion of Lesson Unit

Lesson Unit		Another Lesson	Additional Instruct.	Final Exam
Intro. to Offset Lith.	n = 14	100.0	0.0	0.0
Overview Offset Press	n = 15	66.7	33.3	0.0
Inking Unit	n = 19	73.7	26.3	0.0
Dampening Unit	n = 19	65.0	35.0	0.0
Printing Unit	n = 20	85.7	14.3	0.0
Infeed & Delivery Unit	n = 19	84.2	0.0	15.8
Mean Percentage		**79.2**	**18.1**	**2.6**

n = number of subjects making this decision items chose the option "retry the question" 52.5%, while 26.2% of the viewers chose the option "receive additional instruction" on the topic. Viewers chose to omit the incorrect question and move on to the next question in the quiz 8.5%, and 12.6% of the viewers chose the option of another lesson from the main menu. No viewers chose the final examination following an incorrect answer on a quiz. Summary data regarding incorrect quiz responses are reported in Table 7.

Of the viewers selecting correct answers on quiz items, 82.4% chose to select the next question on the quiz, 3.9% of the viewers chose to receive optional instruction on a specific segment of the lesson, and 13.5% of the viewers chose to select another lesson from the main menu. No viewers selected the final examination following a correct quiz reponse. Summary data regarding correct responses to quiz questions are reported in Table 8.

Summary

This chapter has presented the results from the data analysis of the relationship between interactive video programs (program control versus learner control) and the learning styles of students (sensing versus intuitive) in

Table 7

Summary Table for Frequency of

Incorrect Quiz Responses

Incorrect Quiz Resp.	Additional Instruct.	Re-try Quest.	Continue Quiz	Another Lesson	Final Exam
1 n = 5	20.0	60.0	0.0	20.0	0.0
2 n = 1	100.0	0.0	0.0	0.0	0.0
3 n = 2	50.0	50.0	0.0	0.0	0.0
4 n = 2	50.0	0.0	0.0	50.0	0.0
5 n = 2	0.0	50.0	0.0	50.0	0.0
6 n = 13	0.0	38.5	53.8	7.7	0.0
7 n = 1	0.0	100.0	0.0	0.0	0.0
8 n = 2	0.0	50.0	50.0	0.0	0.0
9 n = 13	23.1	53.8	15.4	7.7	0.0
10 n = 2	50.0	50.0	0.0	0.0	0.0
11 n = 12	8.3	66.7	0.0	25.0	0.0
12 n = 6	16.7	66.7	0.0	16.7	0.0
13 n = 8	25.0	75.0	0.0	0.0	0.0
14 n = 4	25.0	75.0	0.0	0.0	0.0
Mean Percentage	**26.2**	**52.5**	**8.5**	**12.6**	**0.0**

n = number of subjects making this decision
* Note: One incorrect quiz item was not involved in any of the students responses and therefore was not reported in this table.

Table 8

Summary Table for Frequency of Correct Quiz Responses

Correct Quiz Resp.	Continue Quiz	Additional Instruct.	Another Lesson	Final Exam
1 n = 18	77.8	0.0	22.2	0.0
2 n = 21	95.2	4.8	0.0	0.0
3 n = 19	78.9	0.0	21.1	0.0
4 n = 12	91.7	0.0	8.3	0.0
5 n = 21	95.2	0.0	4.8	0.0
6 n = 20	0.0	35.0	65.0	0.0
7 n = 21	90.5	0.0	9.5	0.0
8 n = 20	95.0	0.0	5.0	0.0
9 n = 19	100.0	0.0	0.0	0.0
10 n = 20	100.0	0.0	0.0	0.0
Mean Percentage	**82.4**	**3.9**	**13.5**	**0.0**

n = number of subjects making this decision
* Note: Five responses following correct quiz answers came as a result of the completion of the lesson unit and are reported in Table 5, therfore they are not reported in this table.

relation to achievement test scores and task completion rates. The results indicated that:

1. There was no significant difference in the scores on the achievement test by students in the program controlled interactive video program and students in the learner controlled interactive video program.
2. There was a significant difference in task completion rates made by students in the program controlled interactive video program and students in the learner controlled interactive video program.
3. There was no significant difference in the scores on the achievement test made by the students of both sensing and intuitive learning styles.
4. There was no significant difference in the task completion rates of students with sensing and intuitive learning styles.
5. There was no significant interaction in the achievement test scores of the interactive video programs and the learning styles of the students.
6. There was no significant interaction in the task completion rates of the interactive video programs and the learning styles of the students.

7. Most students in the learner controlled interactive video program (Program 2) chose to select lesson units in the sequence as listed in the main menu (see Appendix G).
8. Most students in the learner controlled interactive video program (Program 2) chose to select the "quiz" option following the primary video segment of each lesson unit.
9. Most students in the learner controlled interactive video program (Program 2) chose to select the "another lesson" option following the conclusion of each lesson unit.
10. Most students in the learner controlled interactive video program (Program 2) chose to select the "retry the question" option following an incorrect response during a lesson unit quiz.
11. Most students in the learner controlled interactive video program (Program 2) chose to select the "continue with the quiz" option following a correct response during a lesson unit quiz.

Chapter 5 will present the summary, conclusions, and recommendations for further research.

Chapter 5

SUMMARY, CONCLUSIONS,

and

RECOMMENDATIONS FOR FURTHER RESEARCH

SUMMARY

Purpose of the Study

The purpose of this study was to determine if achievement test scores and task completion rates were affected by learning styles and instructional program sequencing, and to determine if there was an interaction between these two variables. The following research questions were addressed:

1. Was there a significant difference in achievement test scores between subjects using the program controlled interactive video program and subjects using the learner controlled interactive video program?

2. Was there a significant difference in achievement test scores between sensing type learners and intuitive type learners?

3. Was there a significant interaction of learning

styles and interactive video programs on achievement test scores?

4. Was there a significant difference in task completion rates between subjects in the program controlled interactive video program and subjects in the learner controlled interactive video program?

5. Was there a significant difference in task completion rates between sensing type learners and intuitive type learners?

6. Was there a significant interaction of learning styles and interactive video programs on task completion rates?

Procedure

Two interactive video programs were developed to reflect two distinctive types of instructional designs. The first interactive video program (Program 1) was a program controlled version in which the instructional strategies were predetermined from beginning to end by the instructional designer (see flowchart in Appendix A). In this program, the student proceeded through the instruction following the preset design.

The second interactive video program (Program 2) was the learner controlled version in which the sequence of the lesson units was determined by the students viewing the instruction (see flowchart in Appendix B). In this program, the students selected various lesson units (see Appendix G) from a main menu and then proceeded through the lesson unit in as much detail and/or review as desired. The sequence of the lesson unit selections and the depth of lesson unit instruction was determined solely by the individual learner.

Although the instructional stategies for the two interactive video programs were different, the content of the instruction was identical.

Subjects in this study included students enrolled in Graphic Arts I taught at Virginia Polytechnic Institute and State University during the spring quarter of 1986 (46 students) and selected volunteers enrolled in Marketing ("Channels of Distributing") taught at Radford University during the spring semester of 1986 (14 students).

The Myers-Briggs Type Indicator was administered to the subjects to determine their learning styles. Two types of learning styles are revealed from the type indicator, (1) sensing type learners (30 subjects) and (2) intuitive type learners (30 subjects). Following the learning style classifications, subjects were randomly assigned to the two interactive video programs (Program 1 and Program 2).

The treatment consisted of viewing a preassigned interactive video program, followed by an achievement test (final examination) covering the material presented in the programs. The subjects recorded the elapsed time for the interactive video programs (task completion rate).

An analysis of variance was used to test for significant differences between the means of the interactive video programs and the learning styles on both achievement test scores and task completion rates. Frequencies and percentages were computed to determine major trends in the lesson unit selection sequence and the student learning paths through the lesson units.

Results

The following results were obtained upon completion of statistical analysis of the data:

1. There was no significant difference on achievement test scores between the learners engaged in the interactive video programs.

2. There was no significant difference on achievement test scores between learners in the two

learning style groups.

3. There was no significant interaction on achievement test scores between the interactive video programs and the learning styles of the subjects.

4. There was a significant difference in the task completion rates between the interactive video programs.

5. There was no significant difference in the task completion rates between the learning styles of the students.

6. There was no significant interaction in task completion rates between the interactive video programs and the learning styles of the subjects.

7. Most subjects in the learner controlled interactive video program (Program 2) chose to select lesson units in the sequence as presented in the main menu.

8. Most subjects in the learner controlled interactive video program (Program 2) chose to select the "quiz" option following the primary video segment of each lesson unit.

9. Most subjects in the learner controlled interactive video program (Program 2) chose to select the "another lesson" option following the conclusion of each lesson unit.

10. Most subjects in the learner controlled interactive video program (Program 2) chose to select the "retry the question" option following an incorrect response on a quiz item of a lesson unit quiz.

11. Most subjects in the learner controlled interactive video program (Program 2) chose to select the "continue with the quiz" option following a correct response on a quiz item of a lesson unit quiz.

CONCLUSIONS

Gagne and Briggs (1974) stated that the presentation of factual information is necessary to establish a base for learning. Although the presentation of factual information is not considered a high order instructional aim, it is often a requirement when students are introduced to new material. The overall purpose of the instruction in this study was to provide information regarding the nomenclature of the various parts and units of an offset printing press to students who had no prior training in this topic.

The analysis of variance on the achievement test scores regarding this instruction indicated that there was parity in student performance between the program controlled and the learner controlled interactive video programs. Similar results regarding program controlled versus learner controlled CAI were reported by Judd et al. (1970); Oliver (1971); Beard et al. (1973); Fisher et al. (1974); and Lahey and Coady (1978). Oliver's (1971) summary of inappropriate applications of learner controlled training is pertinent. He indicated that the technique of learner generated sequencing would not be successful when the the learning task was a "relatively short, abstract, mathematical-scientific (technical) system taught as small steps and of which the students had no prior experience." The instructional task of this study met most of these criteria to some extent, especially the aspect of students having no prior experience with the instructional task.

Another aspect of this study was that the instructional task lent itself to a hierarchial presentation due to the physical operation of an offset press. The offset press will operate correctly only if it is "set up" in the proper sequence (i.e., ink must be applied to the inking unit rollers before the fountain solution is added to the dampening unit rollers). Although the presentation of the factual information was not limited to a hierarchial presentation, a sequential description of the various units of an offset press could prove to be helpful when students actually operate the press. Oliver (1971) reported that when hierarchial presentation of instruction is required, a preselected instructional sequence (program controlled design) is the most appropriate design strategy.

Analysis of lesson unit selection sequence and student reponses to program options indicated that the majority of subjects in the learner controlled group followed essentially the same instructional path (i.e., sequential order) as subjects in the program controlled group. There are a variety of plausible explanations for this result. First, the lesson units were presented to the learner controlled viewers in a sequential order (i.e., 1, 2, 3, 4...) which would imply a preferred order to the instruction. Furthermore, the students' lack of prior knowledge of this topic may have left them unprepared to take full advantage of the capabilities of the learner controlled interactive version. This may explain why only slight differences in instructional sequencing took place.

It is concluded therefore, that when the aim of instruction is to present factual information to develop a knowledge base that did not previously exist within a student and when the learning may require a hierarchial understanding of the instruction, a preselected instructional sequence (program controlled design) may be the most appropriate design strategy for interactive video. Learner controlled interactive video may be more appropriate when a higher level of learning is required, (i.e., cognitive strategies in problem solving or application of intellectual skills to gain deeper understanding of concepts). In order to develop cognitive strategies in problem solving and intellectual skills, a student must have a knowledge base from which to work (prior knowledge and experience) and the freedom to attempt various means of solving problems. The learner controlled design strategy may provide the capability to allow for unique solutions to problems as well as the intellectual freedom to pursue learning in an individual manner.

The results of the analysis of variance on task completion rates indicated a significant savings of instructional time, with the program controlled interactive video version using less instructional time than the learner controlled version. The strength of effect was calculated (sum of squares of the significantly different dependent variables divided by the total sum of squares) and found that only .05 of the variance was attributable to real differences in the interactive video programs.

One possible explanation for the significant time savings in the program controlled interactive video lesson may be that the additional information the learner controlled program provided caused the participants to read, assimilate the information, and respond appropriately before making a decision, thus, requiring more time. This was not the case in the program controlled interactive video program, which automatically moved the viewers through the program, thereby removing many of the decisions that had to be made (in comparison to the learner controlled version).

Another plausible reason for this result is that the major difference in completion rates was the effect of the intuitive learners within the learner controlled interactive video program (see Table 2). The intuitive type learners used almost five more minutes in viewing the instruction than the sensing type learners (mean times of 45.47 minutes versus 40.60 minutes). This difference approached significance ($p=.103$), and is therefore noteworthy.

The average instructional time savings between the two interactive video programs was less than three minutes (program controlled = 40.20 minutes versus learner controlled = 43.03 minutes). Within the context of the graphic arts course for which this training was intended, the savings of three instructional minutes per student is insignificant and should not be viewed as a major negative detractor when designing interactive video programs for this type of training.

Therefore, it is concluded that although there was a significant difference in instructional completion rates, this factor must be understood within the total purpose and use of the particular training for which it is intended before stating which type of instructional design would be most appropriate. Within this particular training the difference in completion rates should not be viewed as _the_ decisive factor in selecting instructional designs.

The results of the analysis of variance on student learning styles (sensing versus intuitive) indicated no significant difference in achievement test scores as well as no significant difference in task completion rates. Also, the sequence of lesson unit selection and student utilization of the instructional options within the learner controlled interactive video program indicated that when the students of this program were given the option to choose their own instructional path, they chose paths very similar to the preset program controlled version.

The similarities of lesson unit selections may have been caused by the way in which the lesson choices were presented. Students viewing the learner controlled program (both sensing and intuitive type learners) viewed a main menu which presented the lesson units in a sequential fashion (i.e., 1, 2, 3, 4...). Twenty-five students made selections within the learner controlled interactive program. Of the sensing type learners, 11 followed the identical lesson unit selection sequence as that in the program controlled interactive video version and three sensing type learners chose a more random approach. Nine intuitive type learners chose the identical lesson unit selection sequence as the program controlled interactive video version and two intuitive learners chose a random approach to the selection of lesson units. It is reasonable to assume that the students of this study perceived this presentation of lesson units as the appropriate sequence to follow, thus explaining the sequential path followed by the majority of viewers.

A second explanation for these results may be that the instruction within this study did not adequately allow for differences in learning styles. The topic of instruction, "Introduction to Offset Lithography", was informational in nature, with students having had no prior training on the topic. With these criteria of the instruction, it is reasonable to assume that the students, regardless of learning style, progressed through the instruction (within the learner controlled interactive program - Program 2) in a sequential manner due to their lack of a knowledge base which may have deterred them from using the full capabilities of the learner controlled program. Therefore, the intuitive type learners apparently restrained their preferred style of learning and followed a sequential order through the instruction.

The results of this analysis of variance on achievement test scores and task completion rates in regard to learning style seem to stand in contrast to the findings of McCaulley and Natter (1980), in which they describe the preferred learning activities of the sensing type learner and the intuitive type learner. According to McCaulley and Natter (1980) the intuitive type learner would have approached the instruction in this study in a more in-depth manner, experimenting with various applications to the learning task, thus expending more time during the instruction and achieving higher scores on the achievement test. Although there was no significant difference between the learning styles in achievement test scores and task completion rates, there was a perceivable difference in the achievement scores and completion times of the intuitive type learners in the learner controlled interactive program (see Tables 1 & 2). This difference, though insignificant, when compared with the other mean scores indicates a subtle trend in learning style preferences within instructional designs.

Although the concepts of learning styles are interesting and useful within the educational process, their effects within this study did not account for significant differences in performance or completion rates. It is concluded therefore, that when informational (factual) material is to be presented to students who have no prior knowledge base or training in a specific topic, the instructional design of an interactive video program may not need to provide for differences in learning styles.

RECOMMENDATIONS FOR FURTHER RESEARCH

Based on the findings of this study, the following recommendations are made:

1. Additional investigations of the relationship between instructional sequencing and learning style should be conducted, utilizing larger, more representative, samples in order to generalize the results of the study to a broader population.

2. Instruments that measure learning style in greater detail should be utilized in order to determine specific differences in the learning styles of students.

3. Instructional topics which are unbiased to specific learning styles should be selected for further investigation.

4. Additional variables such as student attitude should be investigated in relation to the dependent variables used in this study.

5. Additional items should be included on the achievement test to improve the reliability. While the reliability estimate during the formative evaluation was .83, the reliability estimate of the experiment was .75.

6. Investigations of this type should be conducted in various other disciplines to establish a data base of

conditions which may be used by instuctional designers of interactive video programs.

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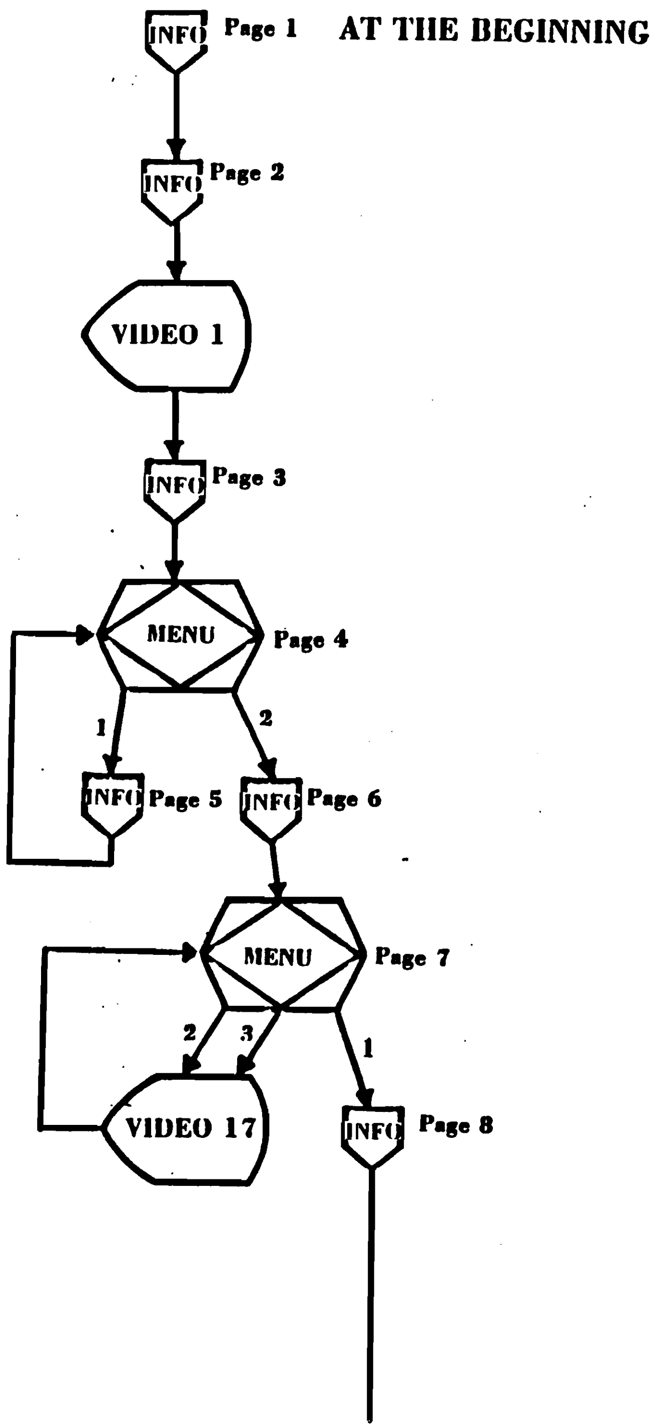
APPENDICIES

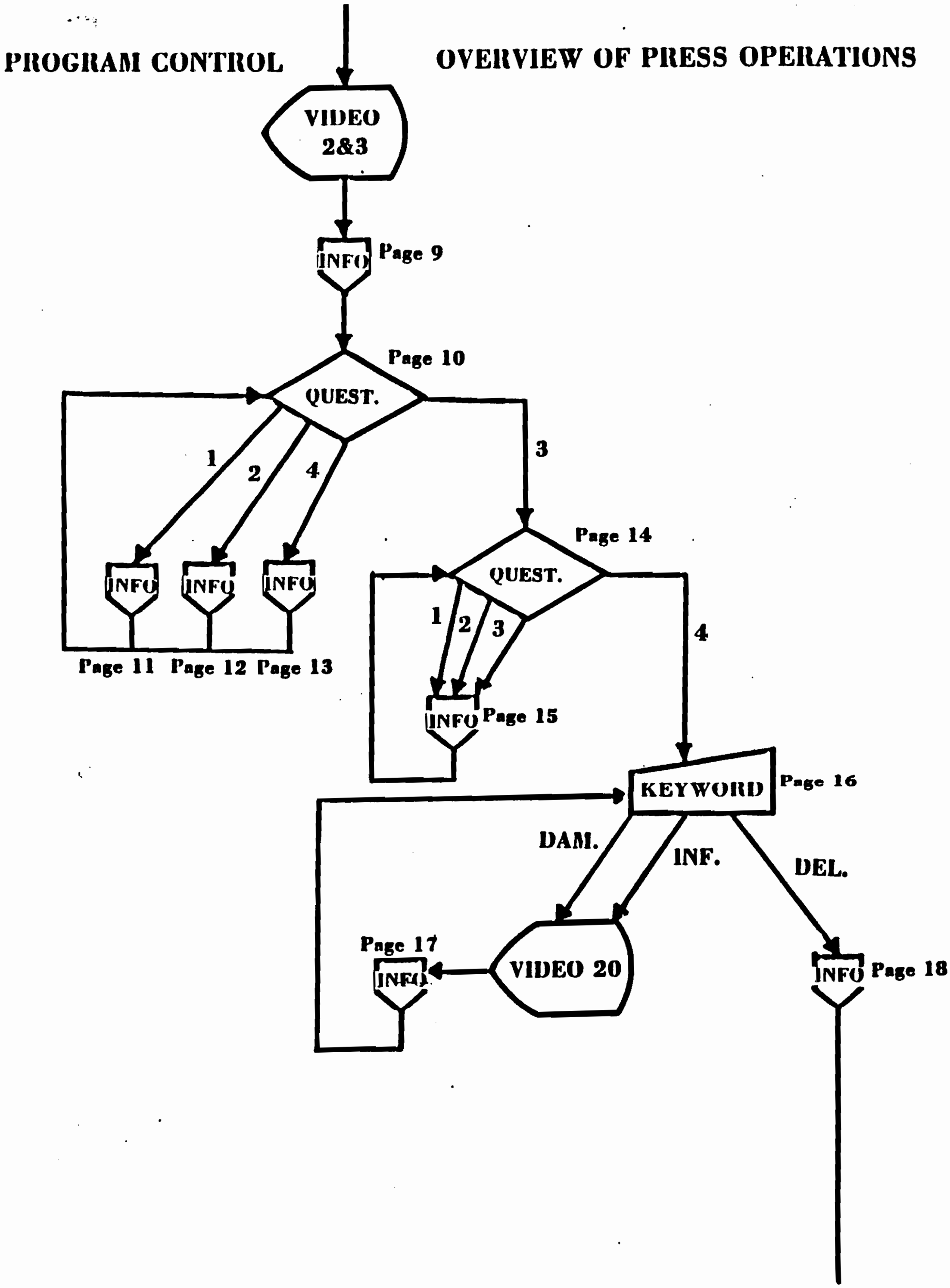
Appendix A

Program Control
Interactive Video Flowchart



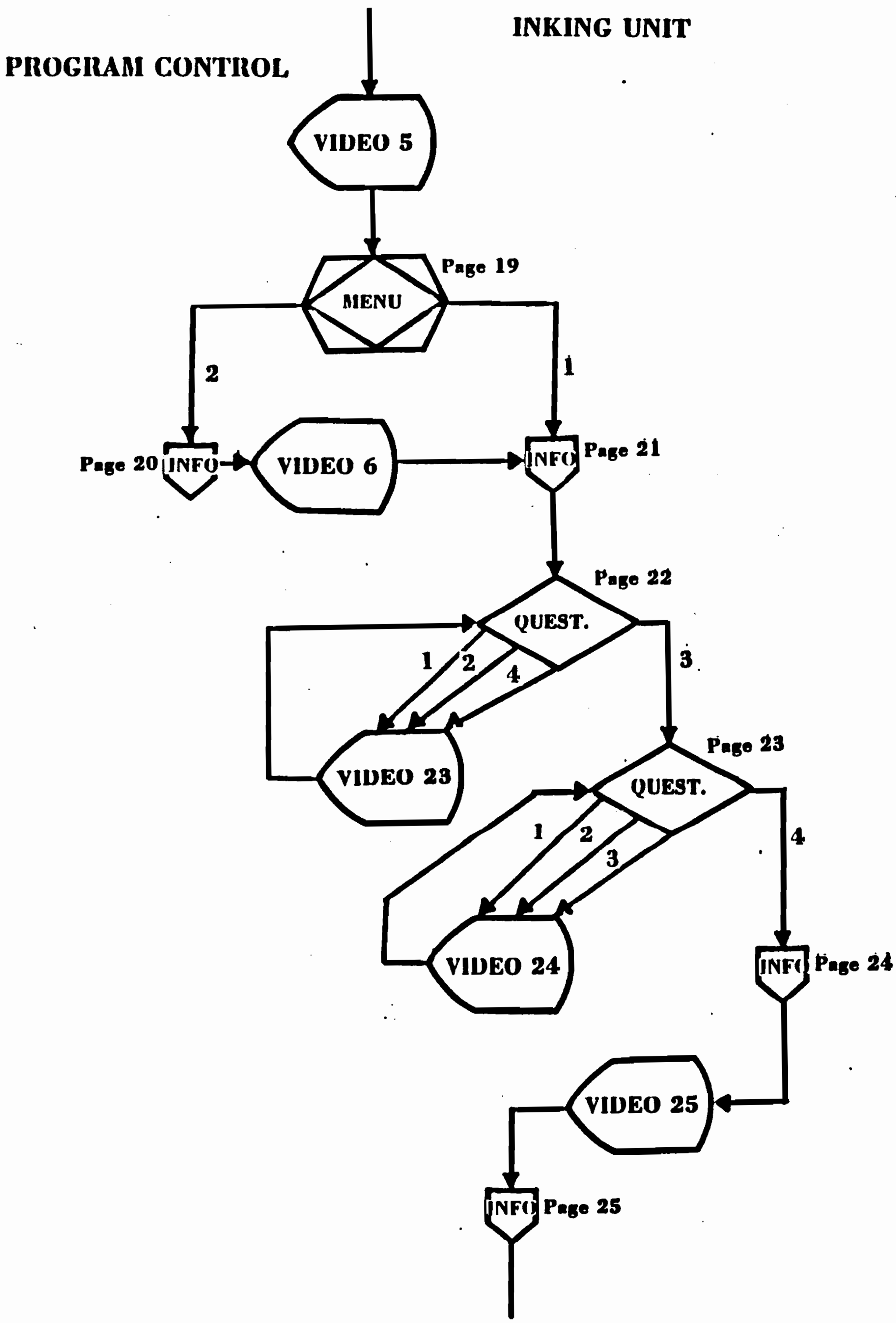
Appendix A

Program Control
Interactive Video Flowchart



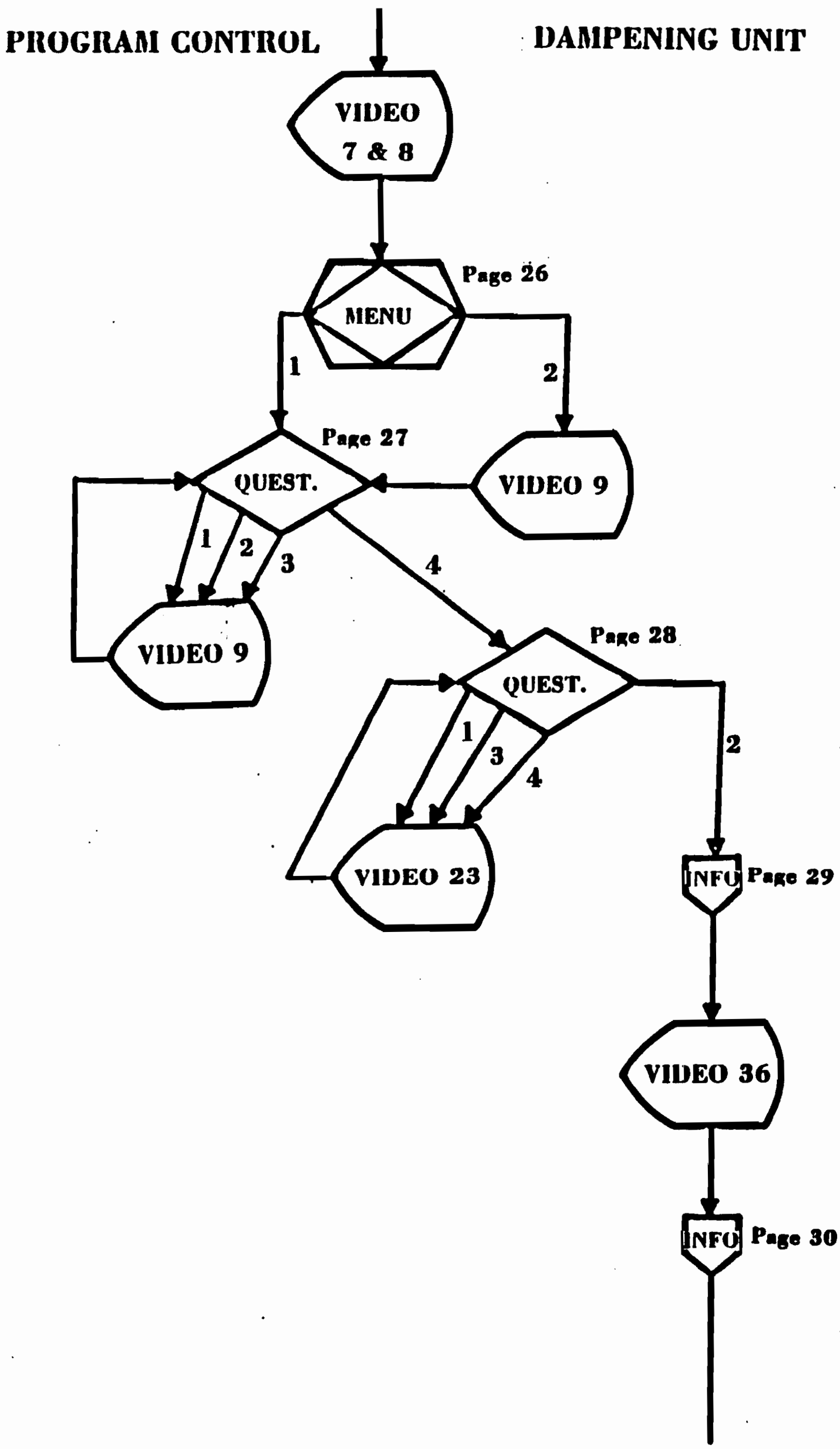
Appendix A

Program Control
Interactive Video Flowchart



Appendix A

Program Control
Interactive Video Flowchart



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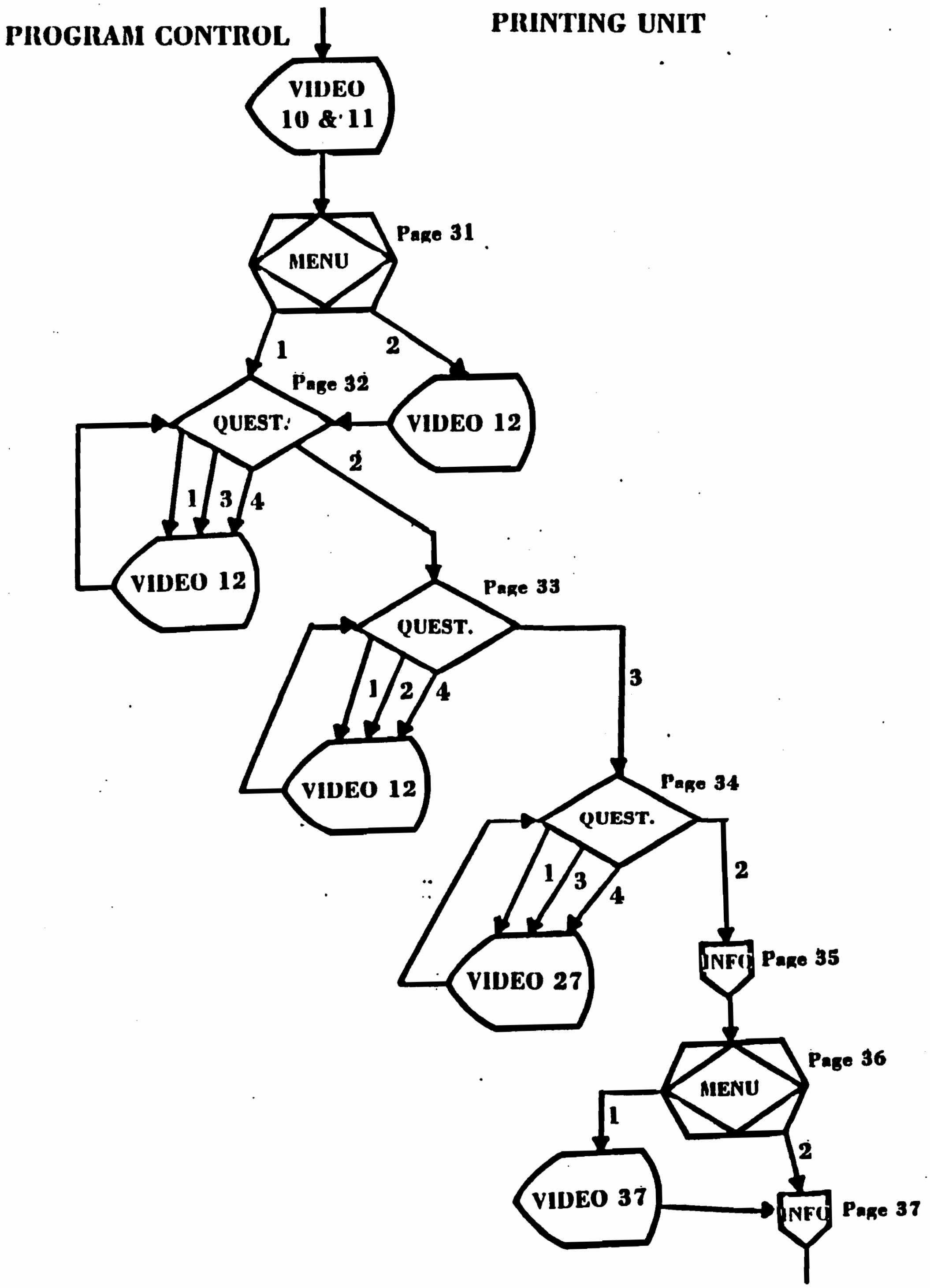
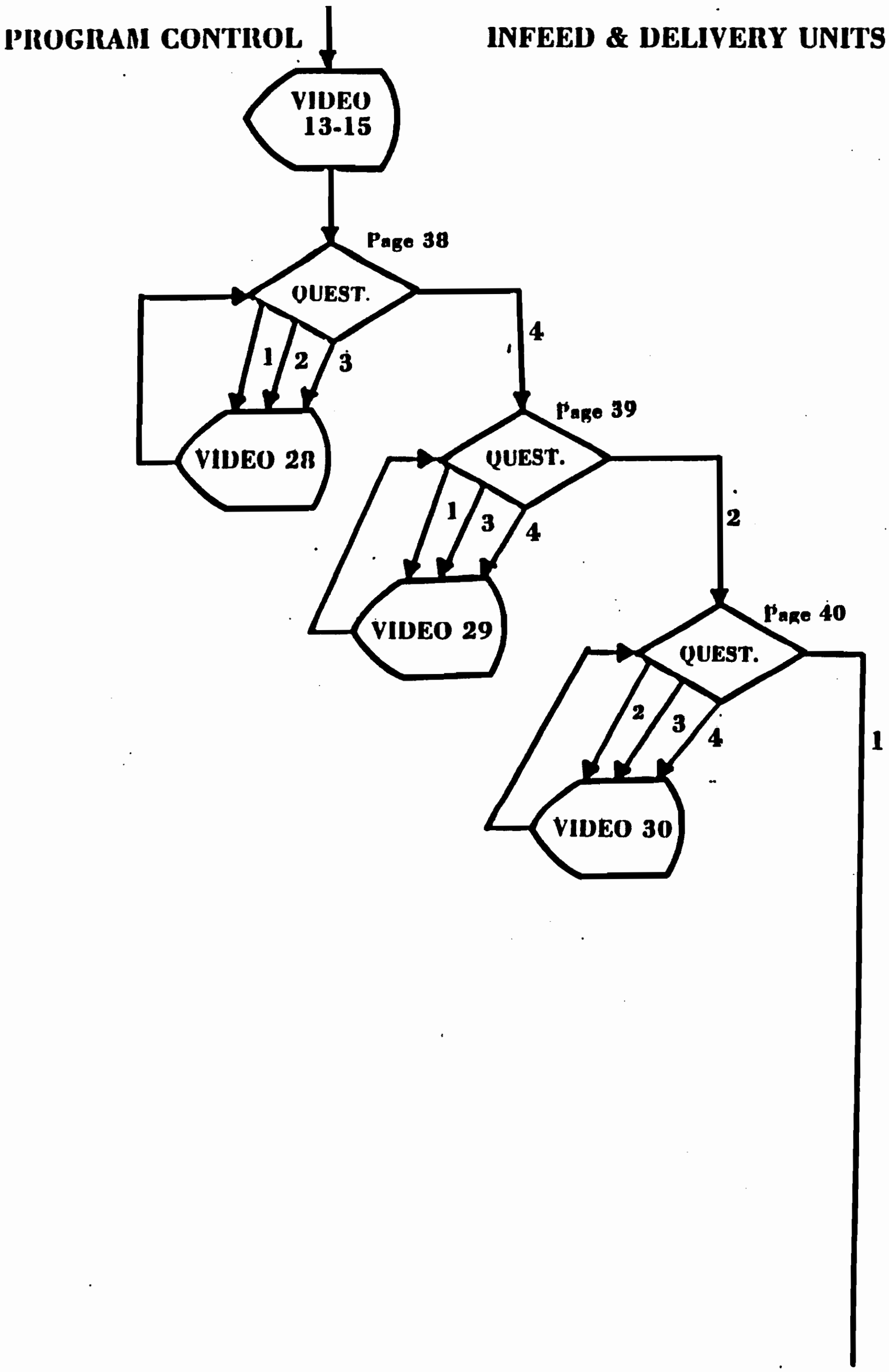
Program Control
Interactive Video Flowchart



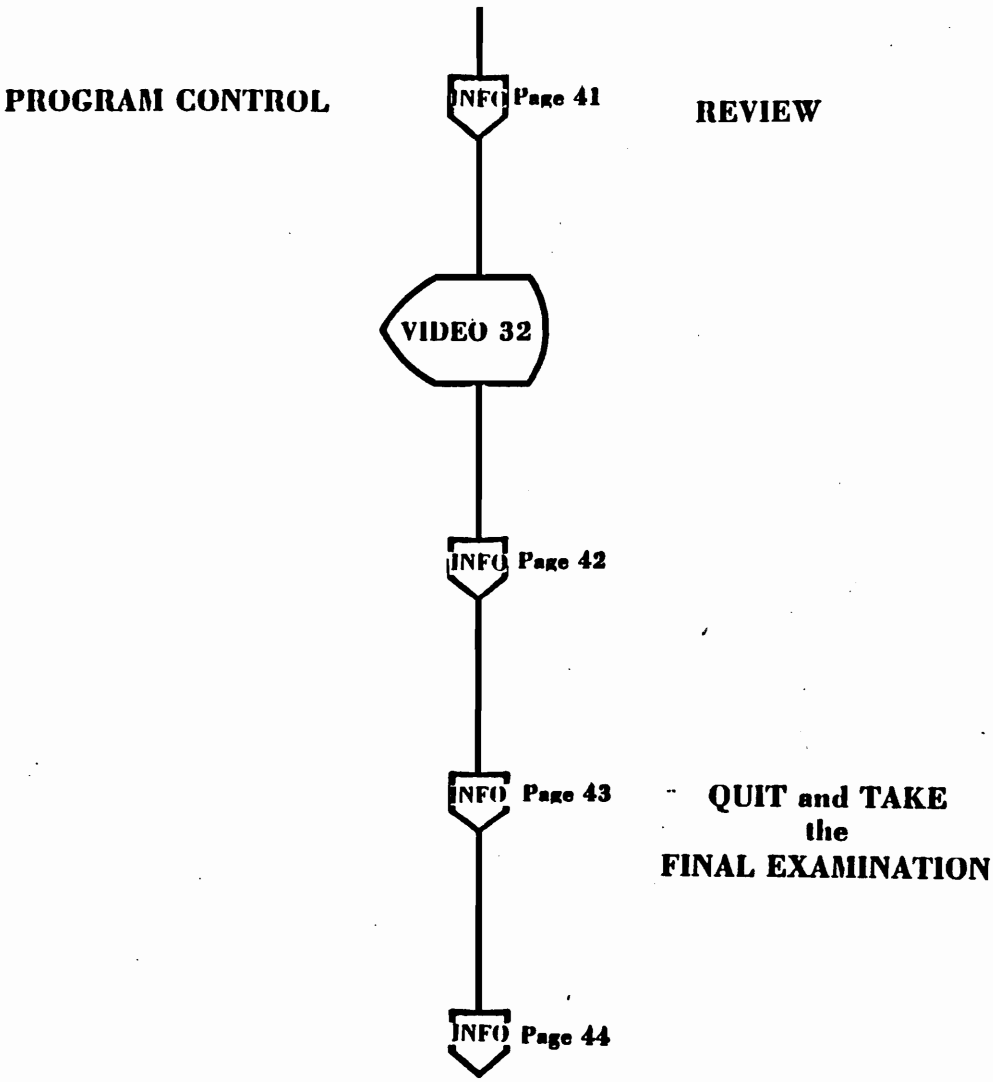
Appendix A

Program Control
Interactive Video Flowchart



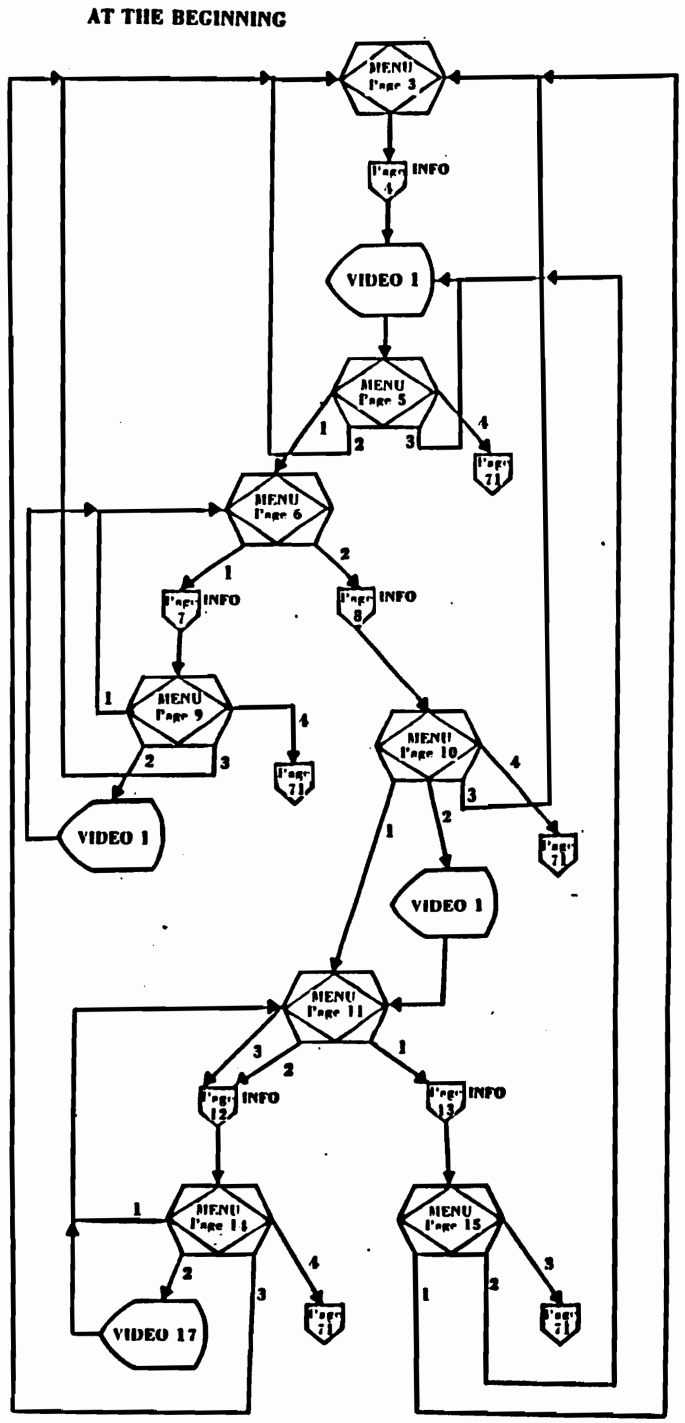
Appendix A

Program Control
Interactive Video Flowchart



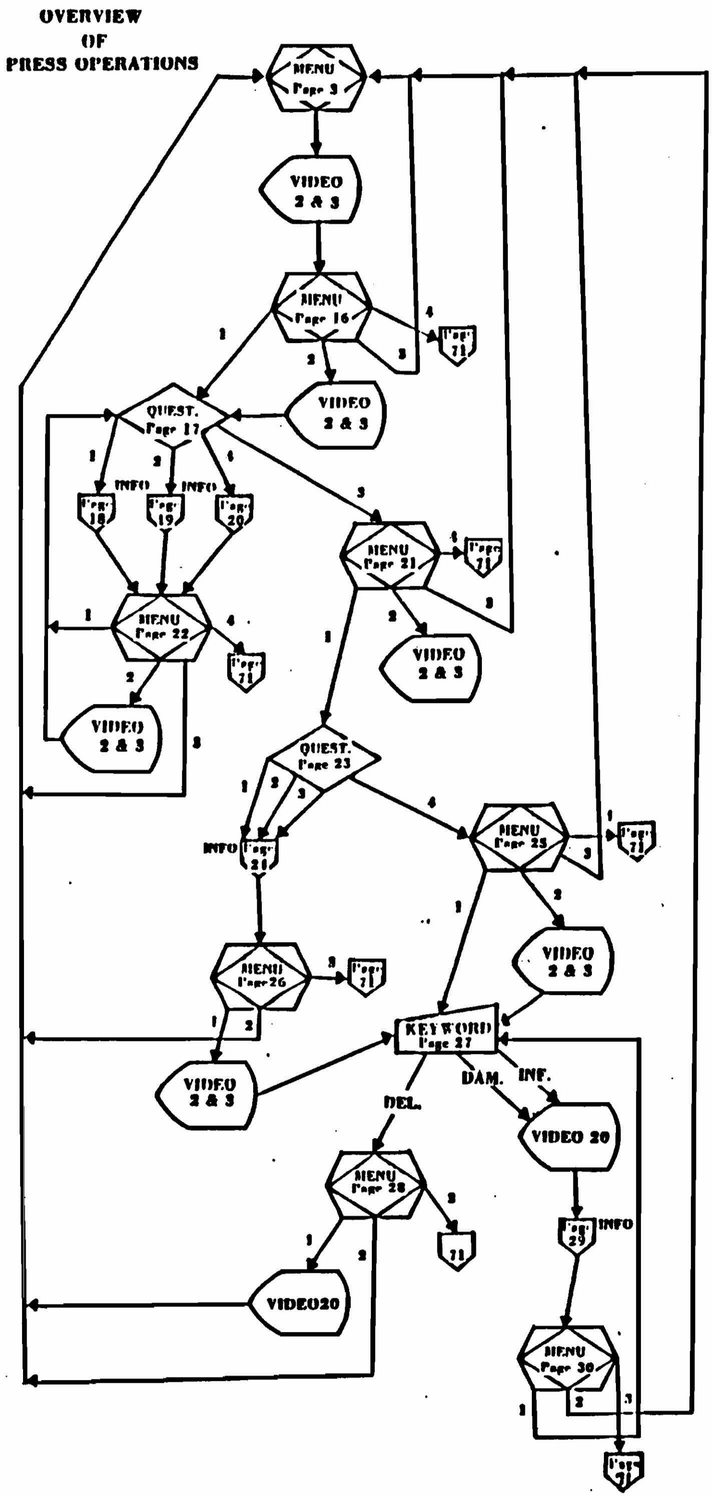
Appendix B

Learner Control
Interactive Video Flowchart



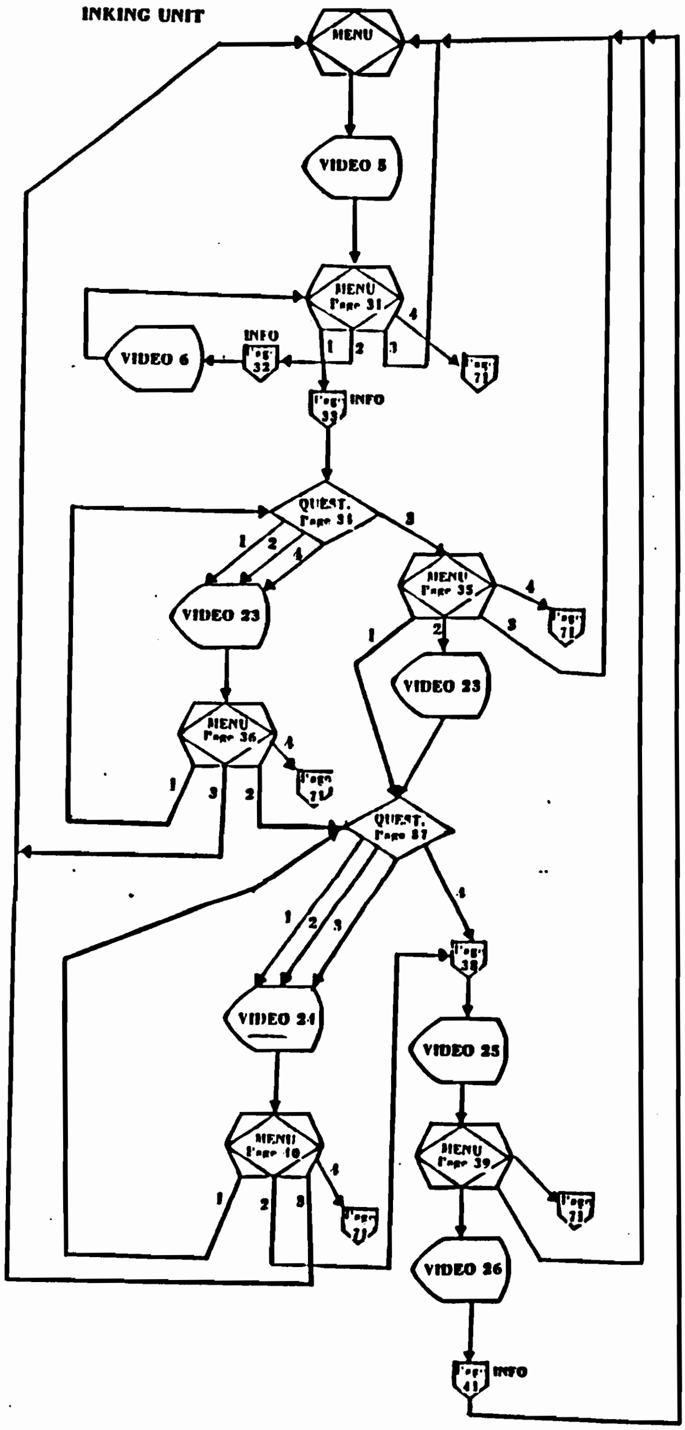
Appendix B

Learner Control
Interactive Video Flowchart



Appendix B

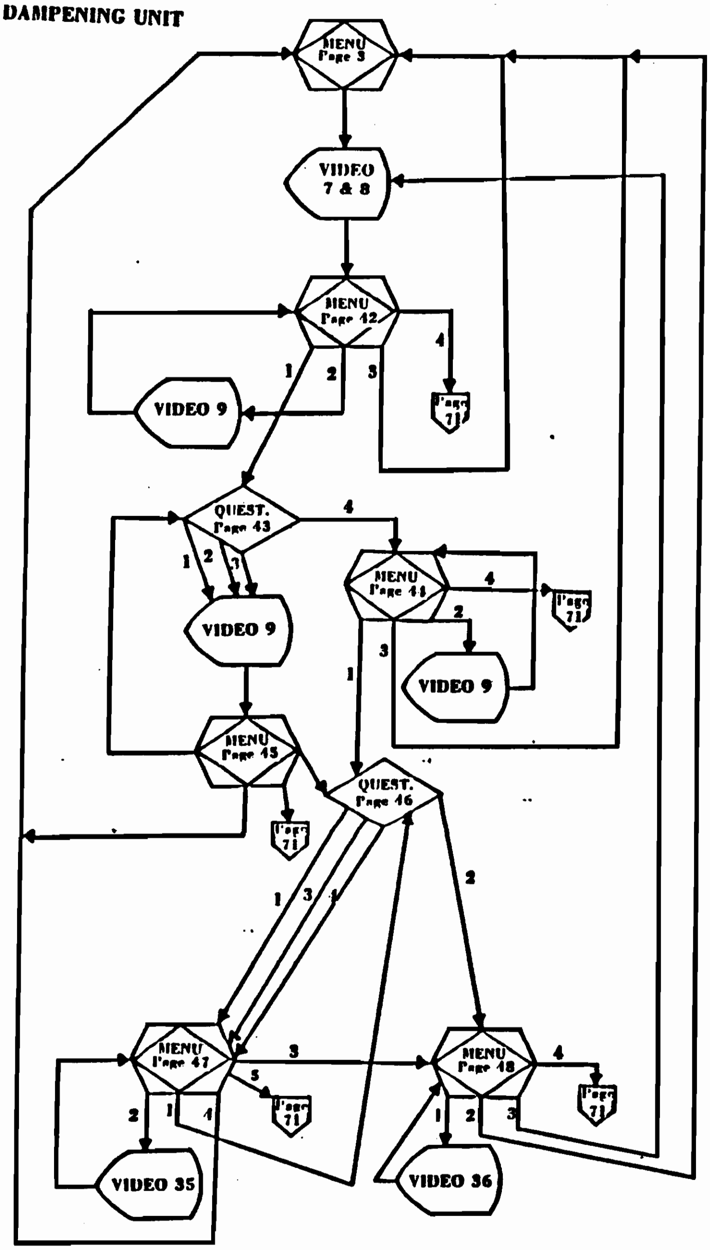
Learner Control Interactive Video Flowchart



Appendix B

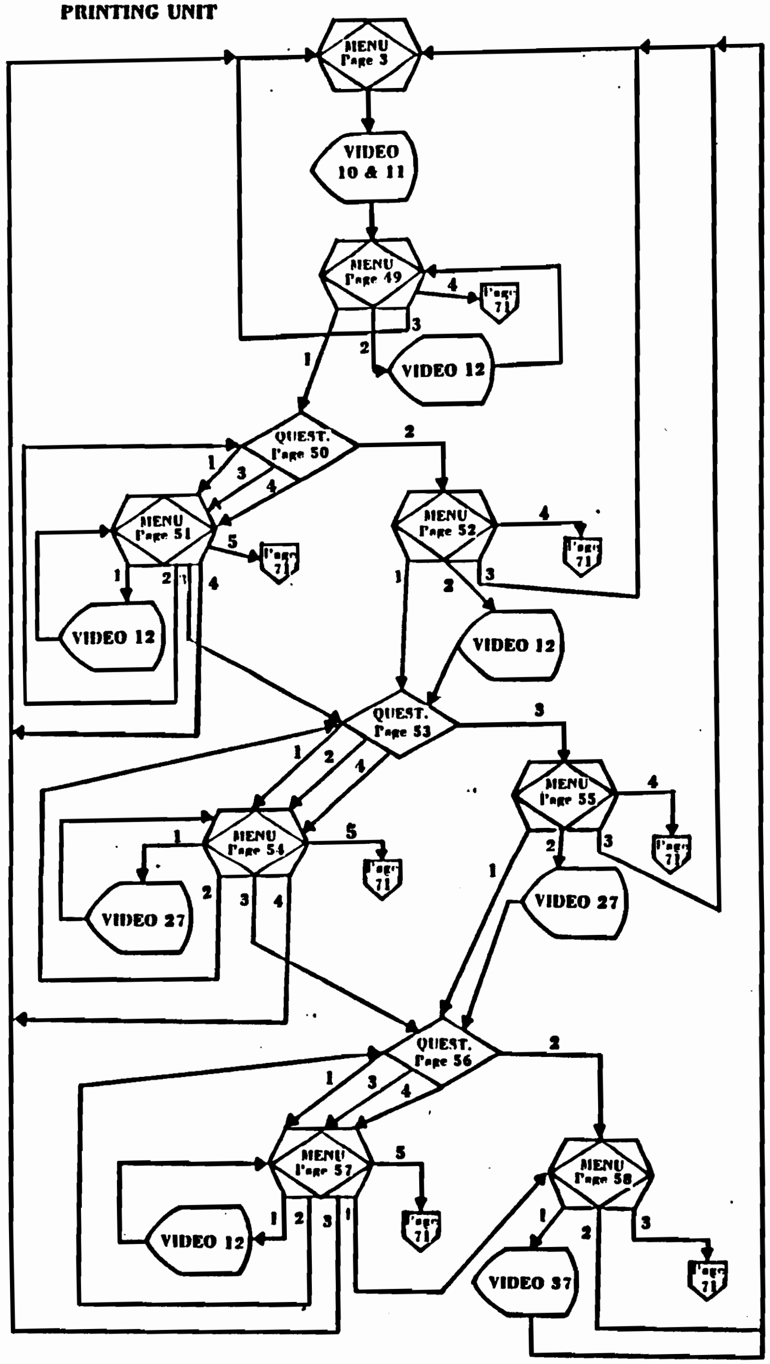
Learner Control
Interactive Video Flowchart

DAMPENING UNIT



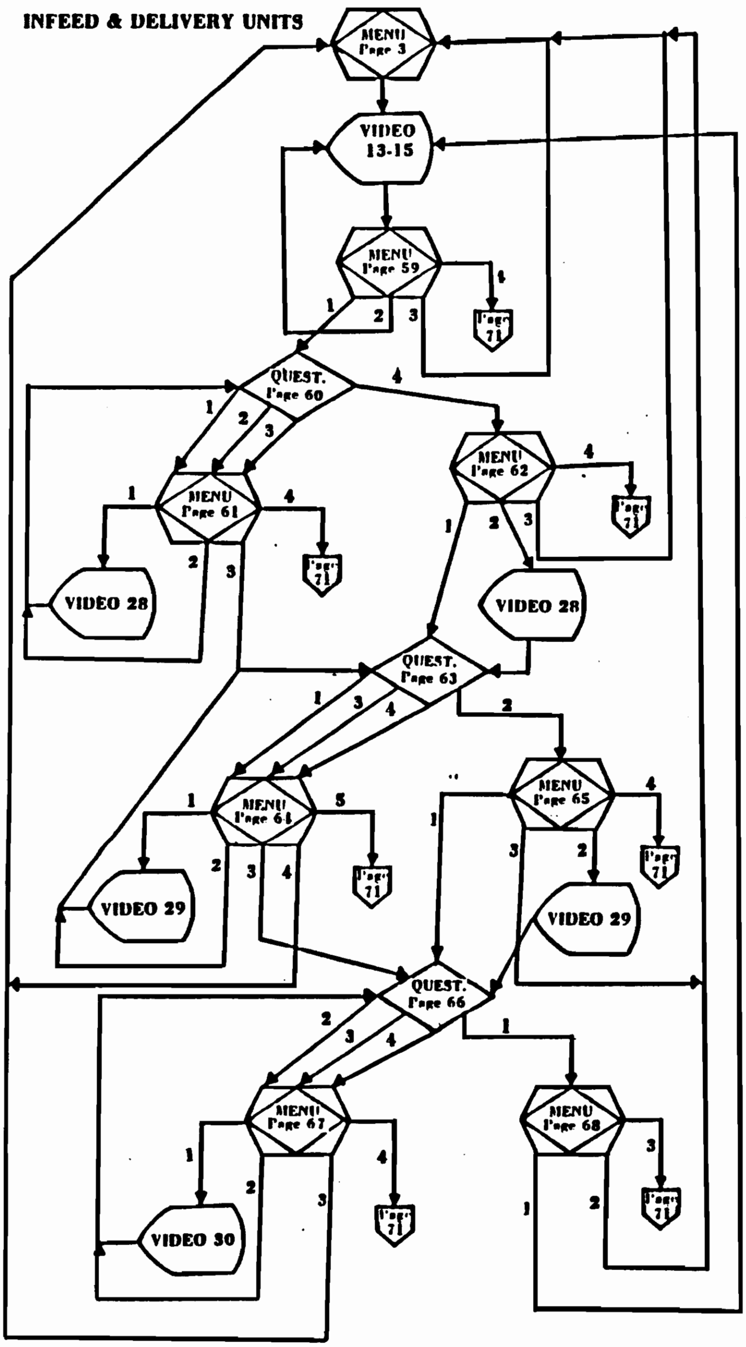
Appendix B

Learner Control Interactive Video Flowchart



Appendix B

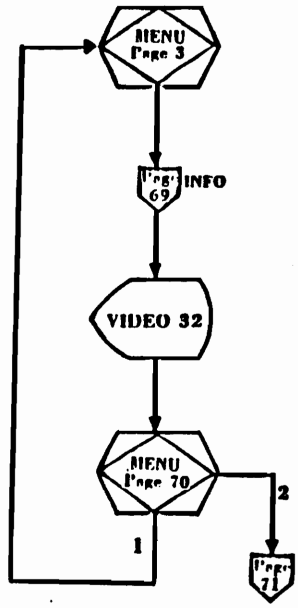
Learner Control
Interactive Video Flowchart



Appendix B

Learner Control
Interactive Video Flowchart

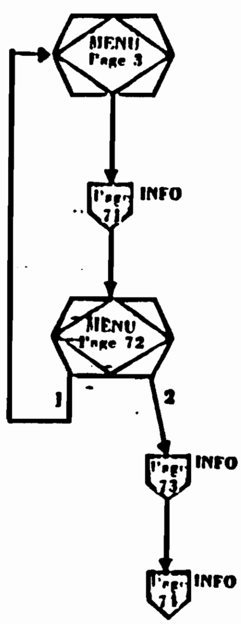
REVIEW



QUIT and TAKE the FINAL EXAMINATION

OPTION 8

Appendix B
LEARNER CONTROL



Appendix C

Achievement Test/Final Examination

INSTRUCTIONS

Read all choices carefully and thoroughly before answering each question.
Mark all answers on the answer sheet provided, with a #2 pencil.
Mark the best answer, there is only one correct answer.

1. The concept upon which lithographic printing is based is:
   1. a rough surface retaining moisture
   2. acid etching the surface
   3. pressing paper on an inked surface
   4. grease adhering to an inked surface
   5. moisture and ink repelling each other

2. Why is ink repelled from the "non-image" area on the printing plate?
   1. because the non-image area is treated with a special chemical to repel the ink
   2. because the non-image area does not have the proper surface to attract ink
   3. because the non-image area will not accept any "images" in this area
   4. because the non-image area is coated with water to repel the ink

3. Offset printing is printing from a ____________________ surface.
   1. wet
   2. textured
   3. recessed, lowered
   4. smooth, flat

4. What is the term for the image carrier on the offset press?
   1. plate cylinder
   2. blanket cylinder
   3. offset plate
   4. litho-carrier

5. What is the "non-image area" on the offset lithographic plate?
   1. area that attracts ink and eventually will print on the paper
   2. area that attracts water and eventually will print on the paper
   3. area that repels ink and water
   4. area that attracts water and repels ink

6. Why does the image area on the plate attract ink?
   1. because it is flat
   2. because ink is placed on the plate only in the image area
   3. because the image area has been treated chemically
   4. because ink cannot adhere to the silver area of the plate

7. All of the following are basic units of an offset press except:
   1. infeed
   2. paper
   3. printing
   4. inking

8. What is the function of the delivery unit on an offset printing press?
   1. to hold a sheet in position each time an impression is made
   2. to deliver a sheet of paper to be printed
   3. to remove a printed sheet after it has been printed
   4. to put a sheet of paper into the press
   5. to guide a sheet of paper through the press

9. The term "offset" refers to what concept in offset lithography?
   1. The process of changing the image from "right side up" to "up side down" back to "right side up"
   2. the process of changing the image from "right reading" to "wrong reading" back to "right reading"
   3. the process of moving the image from one side of the press sheet to the other
   4. the process of changing ink from a thick substance to a thin substance by the transferring of ink with several rollers

10. Oscillating rollers:
    1. flop back and forth to control the quantity of ink on the press
    2. flop back and forth to even out the ink film on the press
    3. rotate and move from side to side to control the quantity of ink on the press
    4. rotate and move side to side to even out the ink film across the rollers

11. The rollers that actually ink the image carrier are called ________________ rollers.
    1. form
    2. ductor
    3. distribution
    4. oscillating

12. What is the purpose of the ink fountain keys?
    1. control the pressure on the fountain roller
    2. control the rotational speed of the fountain roller
    3. control the quantity of ink on the ink fountain roller
    4. control the rate at which the fountain roller flops back and forth

13. What determines the initial feeding of ink onto the inking unit rollers?
    1. the amount of ink placed in the ink fountain
    2. the speed at which the offset press runs
    3. the rate at which the ink ductor roller turns
    4. the settings of the ink fountain keys and the speed at which the ink fountain roller is turning

14. Which roller carriers ink out of the ink fountain and onto the offset press?
    1. ductor roller
    2. distribution roller
    3. ink fountain roller
    4. form roller

15. _________________ rollers are press rollers found in both ink and water systems. They "flop" back and forth, first touching one roller and distributing its contents to another.
    1. dampening
    2. ductor
    3. oscillating
    4. form

16. The rollers that place water on the plate are called:
    1. distribution rollers
    2. ductor rollers
    3. oscillating rollers
    4. form rollers

17. The ______________ roller transfers water out of the fountain.
    1. ductor
    2. oscillating
    3. form
    4. fountain

18. What is the purpose of the ink film on the water fountain roller?
    1. to provide ink to the distribution rollers
    2. to provide ink to the form rollers
    3. to transfer ink to the fountain solution
    4. to provide the surface tension needed to "carry" the fountain solution

19. What is the purpose of the fountain solution in the process of offset lithography?
    1. to wet the paper so the ink won't be printed in the image areas
    2. to wet the image areas of the plate so as to repel the ink
    3. to thin out the ink into the proper viscosity for the printing process
    4. to place a film of fountain solution on the image carrier to prevent improper inking

20. In which order does ink transfer during the offset printing process?
    1. plate/rollers/blanket/paper
    2. rollers/blanket/plate/paper
    3. rollers/plate/paper
    4. rollers/plate/blanket/paper

21. What is the purpose of the impression cylinder?
    1. to place the image being printed on the press sheet
    2. to impress the image onto the blanket cylinder
    3. to change the image from "right reading" to "wrong reading"
    4. to place pressure on the press sheets as they travel through the press

22. The image is "wrong reading" on the ________________ cylinder.
    1. plate
    2. paper
    3. blanket
    4. impression

23. The function of the blanket cylinder is:
    1. to hold the image carrier
    2. to apply pressure to press sheet
    3. to receive an image and apply it to the press sheet
    4. to receive an image an apply it to the impression cylinder and then the press sheet

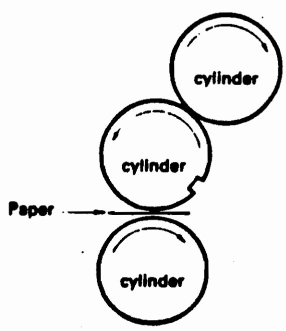
24. What is the main purpose of the infeed unit?
    1. to feed water into the water fountain
    2. to place paper onto the press
    3. to insert paper into the printing unit of the press
    4. to feed paper into the outfeed table

25. What do the paper pile guides do?
    1. they enable the press sheets to be stacked neatly after they have been printed
    2. they keep the press sheets in a specific placement to insure proper registration during printing
    3. they are used to straighten the paper stack prior to placing the paper in the press
    4. they guide the pile of paper to the outfeed table of the press

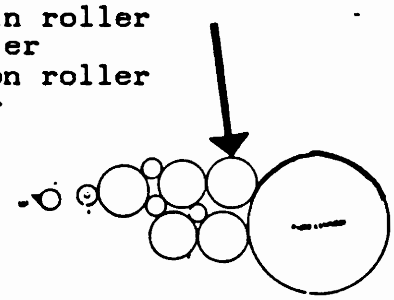
26. Which sequence is in the proper order (from start to finish) during the infeed and delivery processes?
    1. grippers on impression cylinder/suction feet/grippers on chain
    2. grippers on chain/suction feet/grippers on impression cylinder
    3. suction feet/grippers on impression cylinder/grippers on chain
    4. suction feet/grippers on chain/grippers on impression cylinder

27. What is the purpose of the delivery unit?
    1. to pull the press sheets through the printing unit and arrange them in a neat stack after printing
    2. to pick up the press sheets after printing and arrange them in a neat stack
    3. to deliver each sheet into the press at specific intervals to proper registration
    4. to deliver quantities of ink and fountain solution into the press

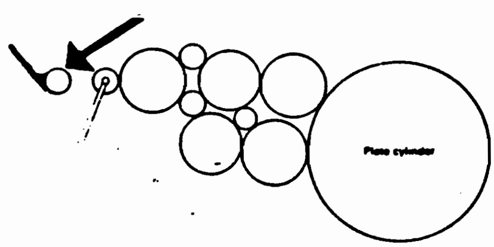
28. From the top down these three offset cylinders are:
    1. impression/blanket/and plate
    2. impression/plate/and blanket
    3. plate/impression/and blanket
    4. plate/blanket/and impression



29. The arrow is pointing at an:
    1. ink fountain roller
    2. ductor roller
    3. distribution roller
    4. form roller



30. The arrow is pointing at an:
    1. ink fountain roller
    2. ductor roller
    3. distribution roller
    4. form roller



Appendix D

Content Analysis of Interactive Video Instruction.

Instructional Topic	Time	Prop. Time	# Items on Test	Prop. Test
Introduction of Offset Lithography	3 min. 45 sec.	24%	7	23%
General Overview of the Offset Press	2 min. 07 sec.	14%	4	14%
Inking System	2 min. 35 sec.	16%	5	16%
Dampening System	2 min. 05 sec.	14%	5	16%
Printing System	2 min. 10 sec.	15%	5	16%
Infeed System and Delivery System	2 min. 15 sec.	15%	4	14%
Review of the Offset Press	0 min. 25 sec.	2%	0	0%
Totals	14 min. 42 sec.	100%	30	100%

Appendix E

Operating Procedures for the Offset Press Interactive Video Program

Please follow the operating procedures (in order of sequence) to activate the system.

1. Turn on the monitor (TV) by pulling out the "on-off", "volume" knob. Knob is located on the right side of the monitor screen.

2. Turn on the video tape recorder by pushing in the "on-off" button. Button is located on the lower left of the video tape recorder.

3. After the video tape recorder is turned-on the cassette compartment will "pop-up" on the top of the video tape recorder. Place the video cassette marked "Offset Press" into the cassette compartment with the printing (Offset Press) visible to you.

4. Push the cassette compartment (with the cassette) "down" until it is locked in place. You will hear a "click" when this occurs.

5. Place the "Offset Press" computer disk into the disk drive (located on top of the computer).
   * IMPORTANT NOTE: Make sure you are using the Offset Program to which you are assigned (Program 1 or Program 2).
   Make sure the disk is right-side-up (labelled side).
   Hold the disk on the label while inserting the disk into the disk drive.
   Close the door on the disk drive.

6. Turn on the computer by activating the "on-off" switch in the back left of the computer. NOTE: The switch is small and you will not be able to see it, you must activate the switch by "feeling" for it with your hand.

7. Place the headphones over your ears.

8. While the program is "booting up" take an "INTERACTIVE VIDEO WORKBOOK" from the file folder, (located on the right of the computer), and read the first page.

9. "That's All" the program should be up and running, just follow the instructions in the program. If the system is malfunctioning or if you have a question on any of the procedures contact your instructor.

Appendix F

Description of an Interactive Video Program Lesson Unit - "Printing Unit"

I. Program Controlled Interactive Video Program - "Printing Unit" Lesson.

Following the conclusion of the "Dampening Unit," the viewers were presented a video scene that described the parts and function of the "Printing Unit" (video scenes 10 and 11). After the conclusion of the primary video scene (scenes 10 & 11), the viewer was provided a choice: (1) begin the quiz on the printing unit or (2) review optional instruction on the printing unit. If the viewer selected option two, he/she was provided additional video instruction (scene 12) followed by the first question in the printing unit quiz. If the viewer selected option one, he/she was shown the first question in the printing unit quiz (see Example 1). The quiz question was multiple choice with four items from which to choose. If the viewer chose items one, three, or four he/she was automatically remediated to a video scene which described the process again (video scene 12). The viewer was then brought back to the first quiz question to make another selection. If the viewer chose item two from the available options in the quiz question, he/she was then presented with the second question in the quiz. Similar procedures were applied in the remaining quiz questions.

Example 1

Quiz Question

All of the following are part of the printing unit except...

1. Plate Cylinder
2. Paper Cylinder
3. Blanket Cylinder
4. Impression Cylinder

Following the successful completion of the third quiz question, the viewer was presented with information regarding the conclusion of the "Printing Unit" (see Example 2). The viewer was then automatically shown the primary video scene of the "Infeed and Delivery Units" and a similar process began again.

Example 2
Conclusion of Lesson Information
You have come to the end of the "Printing Unit"
Next are the "Infeed and Delivery Units"

II. Learner Controlled Interactive Video - "Printing Unit" Lesson

Selection of the "Printing Unit" lesson required the viewer to select option five from the main menu (see Main Menu).

Main Menu
Where would you like to begin?
1. Introduction to Offset Lithography
2. Overview of Press Operations
3. Inking Unit
4. Dampening Unit
5. Printing Unit
6. Infeed and Delivery Unit
7. Review
8. Quit and take the Final Exam

Once this selection was made, the viewer was shown the primary video instruction regarding the printing unit (video scenes 10 & 11). Following the primary instruction, the viewer was given a choice of various options from which to select (see Example 3). The viewer could choose to: (1) begin the quiz on the printing unit, (2) review additional instruction, (3) select another lesson unit, or (4) quit and take the final examination.

Example 3

Initial Lesson Options

Do you have all that straight?

1. Yes... Begin the quiz
2. Not yet... Show me a bit more
3. I know this stuff. Another lesson
4. Quit and take the final exam

If the viewer chose to begin the quiz on the printing unit, he/she was shown the first question in the quiz. The quiz questions were identical to the quiz questions in the program controlled interactive version. The typical multiple choice question had one correct answer; if an incorrect response was made, the viewer was directed to select from five options before proceeding (see Example 4). The options were: (1) review additional instruction, (2) retry the question, (3) go on to the next question in the quiz, (4) select another lesson unit, or (5) quit and take the final examination. These options were standard choices following an incorrect response to a quiz question.

Example 4

Incorrect Quiz Response Options

Sorry... You are incorrect. Choose...

1. Review the process again
2. Try the question again
3. Move on to the next question
4. Choose another lesson unit
5. Quit and take the final exam

When a correct response was given by the viewer this set of options was presented: (1) go on to the next question in the quiz, (2) review additional instruction and then go to the next question in the quiz, (3) select another lesson unit, or (4) quit and take the final examination. These options were standard choices following the correct response to quiz questions (see Example 5).

Example 5

Correct Quiz Response Options

That's a good answer.

1. Next question in the quiz
2. Review the process and continue quiz
3. Choose another lesson
4. Quit and take the final exam

Following the conclusion of the printing unit quiz, the viewer was given still another set of options (see Example 6). The options were: (1) review additional instruction on this topic and then select another lesson unit, (2) select another lesson unit (less any additional instruction), or (3) quit and take the final examination. Once any of these options were selected, the viewer exited the printing unit lesson and, based on his/her selection, was presented with either the main menu (the eight options of lesson unit and final examination) or information regarding the final examination.

Example 6

Conclusion of Lesson Options

That concludes the "Printing Unit"....

1. Video to label Fig. 5 in workbook
2. Select another lesson
3. Quit and take the final exam

III. Summary

Although each lesson unit presented unique information regarding the specific content of offset lithography and the offset press, the presentation of the instruction (video scenes) and the remediation (video scenes) was the same in each of the interactive video instructional designs. The program controlled interactive version followed a preset path of instruction and remediation while the learner controlled interactive version allowed greater freedom in instructional sequencing.

Each lesson unit incorporated a quiz, (usually three questions per quiz), of a multiple choice nature. The final examination was comprised of 30 multiple choice questions, similar in nature, but not identical to the quiz questions.

Appendix G

Main Menu

1. Introduction to Offset Lithography
2. Overview of the Offset Press
3. Inking Unit
4. Dampening Unit
5. Printing Unit
6. Infeed and Delivery Unit
7. Review
8. Final Examination

VITA

Robert Carl Wicklein was born in Litchfield, Illinois, on October 27, 1951. He attended the public schools in Mt. Olive, Illinois, and was graduated from Mt. Olive Community High School in 1969. He attended Western Kentucky University, from 1973 to 1977. From 1978 to 1980 he served as Industrial Arts teacher at Mountain Brook Junior High School, Mountain Brook, Alabama. He also attended the University of Alabama in Birmingham, Alabama and received a Master of Arts in Education in 1979. He served as Industrial Arts teacher at Schutz American School, Alexandria, Egypt, from 1980 to 1981. From 1981 to 1983 he served as Industrial Arts teacher at John Rolfe Middle School, Henrico County, Virginia.

In September, 1983 the author entered graduate school at Virginia Polytechnic Institute and State University, Blacksburg, Virginia. While in graduate school he was appointed graduate teaching assistant in the Industrial Arts Graphics Laboratory for two years.

Mr. Wicklein is the husband of Betsy Wicklein and the father of two daughters, Katherine and Laura Wicklein.

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