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AUTHOR Hannafin, Michael J.; Colamaio, Maryanne E.
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ABSTRACT

The effects of various interactive video instructional control options and practice on learning were examined in this study. The interactive video lesson was a 30-minute videotape designed to introduce cardiopulmonary resuscitation (CPR). Subjects were 48 graduate and undergraduate volunteers, none of whom had prior experience with CPR or interactive video. Students were randomly assigned to one of three instructional treatments with the following locus of instructional control versions: (1) designer imposed, following a predetermined path through the lesson dependent on responses to embedded practice questions; (2) learner selected, allowing individual control decisions at certain points; or (3) linear, with no options for control or imposed decisions for remediation or question repetition. A posttest was administered to assess the learning of facts, procedures, and problem-solving skills. Both the designer imposed and learner selected groups performed better than the linear group, and scores on practiced items were higher than non-practiced items for each type of learning. These effects were greatest for factual learning and least influential for procedural learning. Supplemental materials include 41 references, sample practice questions, and a graph showing the interaction between practice and type of learning. (MES)

THE EFFECTS OF LOCUS OF INSTRUCTIONAL CONTROL AND PRACTICE ON LEARNING FROM INTERACTIVE VIDEO

MICHAEL J. HANNAFIN

MARYANNE E. COLAMAIO

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ABSTRACT

The purpose of this study was to examine the effects of locus of instructional control and practice on the learning of facts, procedures, and problem solving skills during interactive video. Subjects were volunteers from graduate and advanced level undergraduate college classes. The instructional content was a 30 minute videotape, "Project Lifesaver," which was designed to introduce cardiopulmonary resuscitation (CPR). Students were randomly assigned to one of three instructional control groups: 1) designer imposed; 2) learner selected; or 3) linear (control). A posttest was administered to assess learning of facts, procedures, and problem-solving skills. The results indicated 1) significant differences between practiced and non-practiced information; 2) significant differences on posttest scores among locus of instructional control groups; and 3) a significant interaction between practice and type of learning.

The Effects of Locus of Instructional Control and Practice on Learning From Interactive Video

Interest in the instructional applications of interactive video has grown dramatically during the past decade (Cambre, 1984; Ebner, et ol, 1981). Interactive video instruction has been described at various levels ranging from essentially uninterrupted linear video through fully conditional lesson execution where lesson sequence is controlled through the input of information external to the video itself (Daynes & Butler, 1984). For purposes of this paper, interactive video, is defined as "...any video program in which the sequence ond selection of instructional messoges is determined by the user's response to the material" (Floyd, 1982, p. 2).

Whereas interest in the application of interactive video has grown dramoticolly, only recently have empirical data has been published to either guide or support design decisions (Hannafin, et al., 1985). In generol, findings related to the effects of interactive video instruction hove been positive (see, for example, Ho, Savenye, & Haas, 1986; Honnafin, Phillips & Tripp, 1986; Malouf, MocArthur & Rodin, 1986; Smith, Jones & Wough, 1986). However, in other coses nominal or no performcnce effects have been reported (Dalton, 1986; Meanor & Honnafin, 1986). In addition, many of the methodological problems that plagued the study of instructionol technology in the post have persisted in the study of interactive video (cf Clork, 1983; Reeves, 1986).

Some proponents have suggested thot interactive video is o unique medium unlike either the video and computer component technologies (DeBlois, 1982). If true, then virtuolly no foundation exists upon which to bose interactive video design decisions. However, the claims of unique effectiveness of any computerized instructionol system hove been challenged (Clark, 1985). A greater relationship among the evolved empiricol research in the design of computer-bosed, video, ond traditionol instruction in the design of interaction video has been proposed (Hannofin, 1985). Significont research hos been reported in a variety of areas which seems likely to generolize to the design of interactive video instruction. At the very least, accrued knowledge may represent a more logical framework for testing the tocit assumptions of interactive video than the simple acceptance of alleged uniqueness.

Consideroble reseorch in the design of computer-based instruction, for example, has focused on locus of instructional control decisions. Locus of instructional control can ronge from fully learner controlled through complete imposed lesson control. Proponents of learner control point to individualizotion, increased sense of responsibility for leorning, and the potentiol for optimal learning efficiency as support for transferring control of lesson components and/or sequence to learners (Bunderson, 1974; Laurillard, 1984; Merrill, 1975; Merrill, Schneider & Fletcher, 1980).

Recently, however, research findings have contraindicated unaided learner control of lesson activities (Steinberg, 1977) in favor of either imposed odoptive lesson control or learner control with various forms of embedded coaching or advising (See, for example, Ross & Rokow, 1981; Tennyson, 1980, 1984; Tennyson, Christensen, & Park, 1984). Factors such as the nature of the learning task, the oge of leorners, ond the desired learning outcomes of the instruction operate interactively during computer-based instruction (Hannafin, 1984).

The relationship between type of learning and type of learner interaction during computerized instruction has also been studied. Schaffer and Hannafin (1986), for example, reported increases in the magnitude of factual learning from interactive video, but corresponding decreases in the efficiency of such learning due to additional instructional time requirements. Some have suggested that interactive video is superior for higher-lever learning--especially in the health sciences field (DeChenne & Evans, 1982; Hon, 1982; Levensen, 1983; Lyons et al, 1982). Interactive video has been touted as an ideal system for the teaching of the higher-order problem solving skills required in medical emergency simulations (Harless, 1986). Others have suggested that the type, level, and location of interaction activities affects the magnitude and level of learning from interactive video. Explicit questioning during interactive video tends to improve the learning of factual knowledge but may hamper incidental, higher-level learning (Hannafin & Hughes, 1986). Precisely which types of interaction promote particular kinds of learning, however, remains unclear.

The purpose of this study was to examine the effects of varied interactive video lesson control options and of en-route lesson interactions on the learning of facts, procedures, and problem-solving skills.

METHODS

Subjects

Forty-eight subjects, consisting of graduate and advanced level undergraduate college students, participated in this study. None of participants had prior training in cardiopulmonary resuscitation (CPR) procedures, which were the focus of the instructional content of the interactive video lesson. In addition, none had prior experience in learning from interactive video.

Instructional Content

The instructional content used for the treatment phase of the study was the American Heart Association videotape, "Project Lifesaver." "Project Lifesaver" is a 30-minute videotape presentation which is designed to introduce CPR. The instructional content was selected due to the extensive use of interactive video in health sciences and the requirement for multiple types of learning required in the training of CPR (e.g., Bidwell, Collins-Nakai, Taylor & Jensen, 1985; Harless, 1986; Hon, 1982; Rosenblatt & Gaponoff, 1984)

The lesson was divided into four segments roughly equal in information density and duration: 1) "General Overview of the Heart Functions," 2) "Airway Problems and Techniques," 3) "Breathing Problems and Techniques," and 4) "Circulation Problems and Techniques." Each segment presented facts and procedural steps to be applied in problem-solving situations.

A total of 12 questions were embedded during the lesson. In order to provide en-route practice of lesson content, the questions were distributed equally among factual information, procedural steps, and problem-solving applications. One of each question type as embedded at the end of each of the four lesson segments.

Sample questions from the "Airway Problems and Techniques" segment are shown in Figure 1.

Insert Figure 1 About Here

Instructional Treatments

Three locus of instructional control versions of the lesson were developed: designer imposed, learner selected, and linear.

Designer Imposed. Students in this group followed a pre-determined path through the lesson. After answering each embedded question students were given knowledge of results of their response. At this point, they proceeded to the next segment if the answer was correct, or were branched to review only the video segment that related to the question if incorrect. After the review, the question was presented a second time. Again, knowledge of results was provided, and the lesson continued if the answer was correct. If incorrect on the second attempt, the correct response was provided before the lesson continued.

Learner Selected. Students in this group controlled their path through the lesson. At each point for which a designer imposed decision was enforced in the imposed control group, the student was permitted to make an individual control decision. In addition, students were permitted to choose the order of the video segments. Whereas students were advised as to the recommended lesson sequence, the actual selection of sequence choices was made individually. Students were given instructional control options after answering the embedded questions and given knowledge of results. If the answer was correct, the student was given the option to review only the video portion that pertained to the question or to proceed to the next part of the lesson; if incorrect, the same choice was provided. If the student chose to review the video segment, the option to repeat the question a second time was provided. If the student chose not to repeat the question, the lesson proceeded to the next part. If the question was chosen a second time and answered correctly, knowledge of results was provided and the lesson proceeded. If answered incorrectly on the second try, the correct response was provided and the lesson proceeded to the next part.

Linear (Control). Students followed a linear path through the lesson. After answering each of the embedded questions, students were given knowledge of results and proceeded to the next segment of the lesson. No options for controlling the sequence of the lesson, and no imposed decision for remediation or question repetition were provided.

CPR Posttest

The criterion test consisted of 24 randomly ordered multiple choice questions which tested for knowledge of the information and procedures, as well as problem-

solving applications of the knowledge, presented during the lesson. The 12 embedded postsegment questions, distributed equally among facts, procedural steps, and problem-solving applications, were repeated on the posttest. In addition, 12 new questions were divided equally among facts, procedures, and problem-solving. Knowledge of results was not provided after individual posttest questions. Feedback in the form of total number of correct responses was provided upon completion of the posttest. Coefficient alpha for the 24-question multiple choice test was .61.

Dependent Measures

The dependent measures were scores on each of the posttest subscales: Facts, Procedures, and Problem-Solving. Separate scores were computed for each type of learning for practiced and non-practiced items for each type of learning. Practiced items were those embedded during the lesson; non practiced items were not presented, initially, but relevant instruction was presented during the lesson.

Design and Data Analysis

The study employed a 3 x 3 x 2 factorial design. One between subjects factor, Locus of Instructional Control, included three levels (Linear (Control), Designer Imposed, and Learner Selected). There were two within subjects factors: Test Scale which consisted of three levels (Facts, Procedures, and Problem-Solving), and Practice which consisted of two levels (Practiced and Not-Practiced).

MANOVA procedures were used to analyze the CPR posttest scores. Newman-Keuls contrast procedures, where appropriate, were used to examine pairwise differences.

Procedure

The 48 participants were randomly assigned to one of the three instructional control groups. The participants were introduced to the nature of the lesson but were told of neither their particular group assignment nor how their treatment differed from others.

All participants viewed the "Project Lifesaver" interactive video lesson in accordance with treatment group assignments. Upon completion of the lesson, the CPR Posttest was administered immediately.

All treatments were administered individually in a room designated for the study. The instructional treatments were systematically rotated to ensure balance across treatments and to avoid contamination of individual treatments over time.

Results

Table 1 contains the means and standard deviations for types of learning by treatment combinations. The findings are summarized by effect.

Insert Table I About Here

Locus of Instructional Control

Significant differences were found for the overall posttest scores among the three levels of instructional control, F (2,45) = 5.02, p .01. Both the Designer Imposed (x = 20.7) and the Learner Selected (x = 20.5) groups performed better than the Linear group (x = 18.4). No significant differences were found between the Designer Imposed and Learner Selected groups.

Practice

Significant differences were found between scores on practiced and non-practiced items, F (1,45) = 44.65, p .0001. Practiced items (x = 10.8) were learned at a significantly higher rate than non-practiced items (x = 9.0).

Type of Learning x Practice

There was a significant interaction between Type of Learning and Practice, F (2,44) = 30.74, p .0001. This effect is illustrated in Figure 2. Scores on practiced items were higher than non-practiced items for each type of learning, but the effects were proportionately greatest for factual learning and least influential for procedural learning.

Insert Figure 2 About Here

Discussion

The purpose of this study was to examine the effects of locus of instructional control and practice on the learning of facts, procedures, and problem solving skills from interactive video. The results suggest that either of the interactive versions of instruction was superior to the linear design, embedded practice exerts the most powerful influence among the treatment variables studied in learning from interactive video, and that the influence of practice is greatest for factual and problem-solving learning.

The differences found for locus of instructional control were interesting. Both of the interactive lessons were superior to the linear video lesson. This finding is consistent with findings for computer-based instruction which suggest that adaptive designs, with sequence options either imposed by the designer or learner control

with coaching for making choices, yield successful learning (See, for example, Ross & Rakow, 1981; Tennyson, 1984).

Practice, as defined in this study, was important for the learning of facts and problem-solving skills, but relatively unimportant for the learning of procedures. This effect is consistent with the hypotheses of early television researchers. For procedural tasks, visual images are important aids in that they illustrate for the learner the succession of steps to be followed (Chu & Schramm, 1967). In effect, a form of vicarious rehearsal may occur during which appropriate visually-oriented procedures can be modeled and consequences observed. Video images may provide sufficiently strong instructional stimuli to illustrate visual procedures, and to encourage appropriate mental rehearsal, that physical practice in the procedures themselves is unnecessary in some cases (See also Heestand, 1978, Allen, 1957; Fitts & Posner, 1967).

Problem-solving, on the other hand, was more sensitive to the influence of formal practice during interactive video instruction. Though the required procedures may be fairly well known, the selection and application of such steps to novel situations during controlled instruction is uniquely important. These findings offer support for the growing interest in interactive video simulations (Floyd 1982, Harless, 1986; Hon, 1983; Levensen, 1983) where the practice and application of problem solving skills principal learning focus.

The impact of interaction during video lessons -- the opportunity to respond and receive feedback and appropriate remediation or clarification — also provides support for some of the promise of interactive video. The findings of this study are consistent with previous research in which progressive interaction improved learning from video in a more or less linear manner: The more interactive instruction the greater the learning of factual information (Schaffer & Hannafin, 1986). The present findings replicate, extend, and qualify this conclusion. This study replicated the effects using verbal information derived from an entirely different content and tentatively extended earlier conclusions to include problem-solving. The effects, however, were not evident for procedural learning, thereby qualifying the scope of the inference. Based on both earlier research and the present study, interactive video instruction appears useful and effective for certain types of learning, but is likely unnecessary or even ineffective for others.

A predicted interaction between practice and locus of instructional control was not found. Practice was hypothesized as most important for the learner selected group since the inherent sequence provided through imposed lesson control assured the remediation of mislearned information, the repetition of questions missed initially, and the provision of correct answers when needed. In the learner selected treatment, the implementation of these features was controlled directly by individuals permitting students to select when (or if) options would be utilized. It was presumed that appropriate practice and feedback would be most important for this group since individuals could use information derived during practice to self-regulate, modify subsequent decisions, and otherwise alter the manner in which choices were made (Salisbury, Richard & Klein, 1986). An inspection of the "path" followed by students in the learner selected treatment, however, revealed that only one of the 16 participants followed a lesson completion path other than the one "advised" initially. In effect, the operational differences between the designer and learner control groups were virtually eliminated during the study.

The findings of this study provide additional support for the effectiveness of interactive forms of video instruction. Based on the few research studies reported to date, there is reason to be encouraged with the performance of interactive video. The study of interactive video, however, remains in its infancy. Whether the context for study is to be extrapolated from related research or a new research context is to be proposed to examine the presumed unique capabilities of the technology, disciplined inquiry in the study of interactive video is imperative. The need for further study remains before the promise of the technology can be validated.

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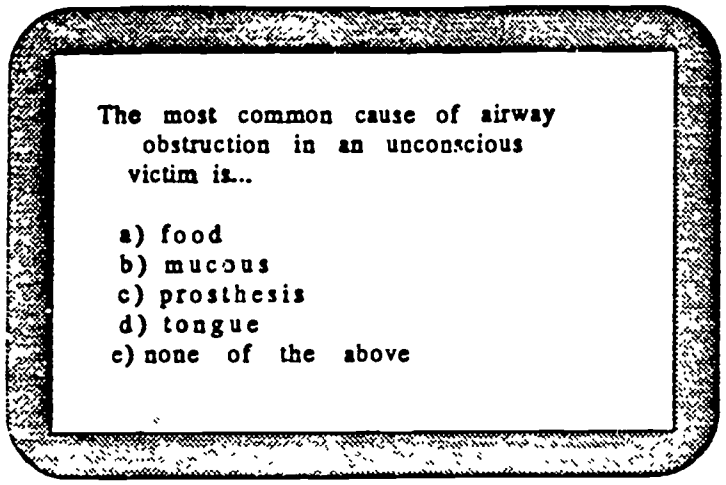
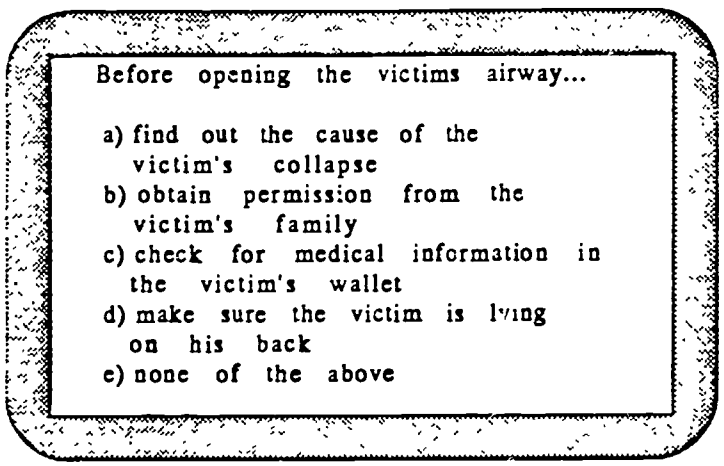
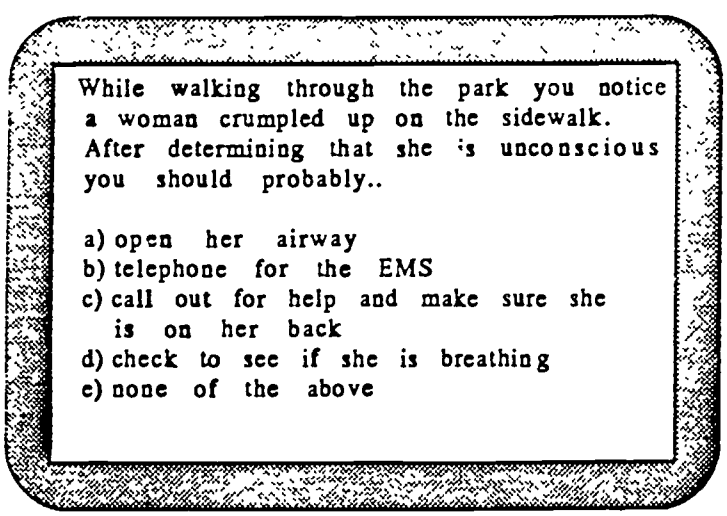


Sample Factual Question



Sample Procedural Question



Sample Problem Solving Question

Figure 1. Sample Practice Questions from CPR Lesson.

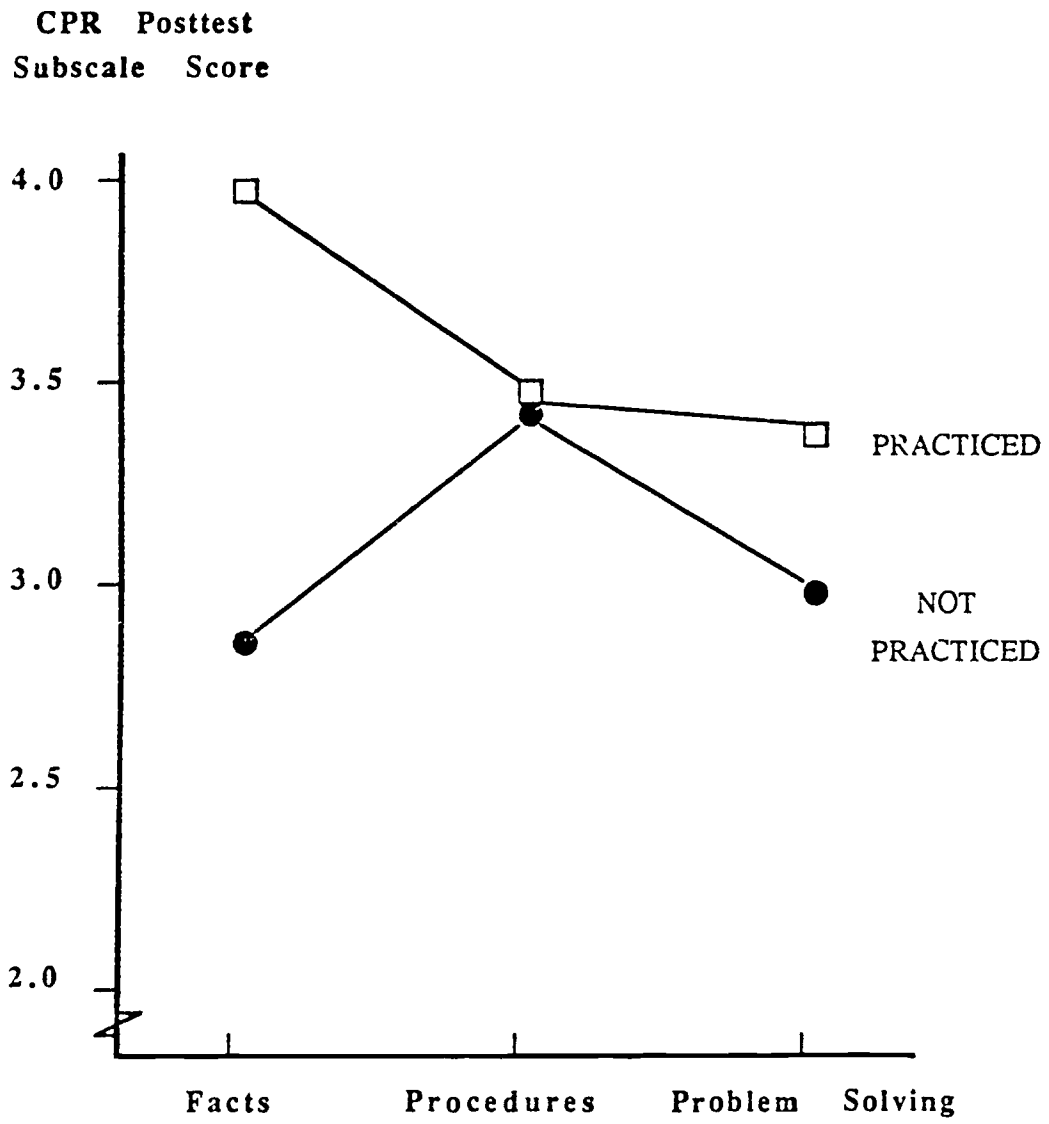


Figure 2. Interaction between Practice and Type of Learning.