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ABSTRACT

This paper examines prior research on learner control in an effort to apply the findings to the design of interactive video systems. Early research on learner control is detailed, including descriptions of research supporting learner control or having mixed reactions to learner control. Alternatives to learner control are also discussed, including adaptive control strategies and learner control with advisement. The effects of learner characteristics on learner control are then considered, and research that specifically considers interactive video is detailed. Suggestions for the effective design of interactive video materials emphasize the importance of training, the need for individualized design, and the effect of content on learner control and retention. (31 references) (EW)

How Past Research on Learner Control Can Aid in the Design of Interactive Video Materials

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How Past Research on Learner Control Can Aid in the Design of Interactive Video Materials

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Introduction

Interactive video is the combination of a computer and a video source in a single instructional medium that provides the best characteristics of each. The computer provides intelligent branching and easily-changeable text, while the video source (tape or disc) provides true-life visuals with accompanying audio.

The following suggestions for the design of interactive video materials are synthesized from learner control studies in a number of areas. While these suggestions focus mainly on the use of learner control with interactive video, they also are generally applicable to instructional materials presented through computers without supplemental video.

Definition of Learner Control

Learner control can be described as the degree to which a learner can direct his or her own learning process. In theory, such control could include student choices at the curriculum level, the opportunity for a student to study a given unit or lesson as long as needed, or the ability of the student to select and sequence a variety of internal processing strategies (Merrill, 1980). However, this term most often describes the instructional choices made during a particular lesson. By definition, these choices can be made either by the instructional program (as originally defined by a designer) or by the learner during the presentation of the materials.

The use of learner and/or program control can also be described as the locus of instructional control, with the control of instruction being either external (program control) or internal (learner control). Hannafin (1984) used this terminology, describing external instructional control as shown in those situations where all learners follow a predetermined path established by the designer. Internal locus of instructional control is shown in lessons where

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(1) This paper is based on the dissertation research of both authors. Detailed results of this research will be presented orally at the conference. Readers are encouraged to also read Hannafin (1984) for a similar list of suggestions.

individuals control the path, pace, and/or contingencies of instruction. Steinberg (1977) adds sequencing, instructional strategy, completion time, amount of practice, and level of difficulty to the variables that may be controlled either by the student or by the computer.

The specific variables under study in learner control research, therefore, typically include content, sequence, and pacing. Each of these may be included to some extent in each learner control study. Control of content is often studied by allowing some students to choose the amount of material they wish to learn, while control of sequence is usually researched by permitting some students to choose the order of their learning. Pacing, often neglected in some learner control studies, is now being investigated in some instances (e.g., Belland, Taylor, Canelos, Dwyer, & Baker, 1985) where pacing is controlled either by the learner or by the program.

Early Research with Learner Control

One of the earliest discussions concerning the ability of some students to control their own learning indicated that some adult learners tend to be able to direct their own learning when given control of their curriculum (Mager & Clark, 1963). A similar study (Fernald, Chiseri, & Lawson, 1975) showed that student pacing enhanced students' achievement and to some degree increased students' positive evaluations of a course.

Other early research in learner control (Judd, 1972; Judd, Bunderson, & Bessent, 1970; Lahey, Hurlock, & McCann, 1973) began to examine this instructional variable in greater detail. Generally, this group of studies showed that:

1. Learner control should perhaps only be used when the students already have some expertise in a content area.
2. Learners have mixed feelings over being given control over their learning (i.e., sometimes they prefer it, sometimes they do not).
3. Learners need training in the use of learner control to be able to use it effectively.

Merrill (1979) also reported studies on the use of learner control in computer based learning situations. While none of the data showed that the use of learner choice caused a drop in student learning, there was also no clear indication that the overall use of learner control consistently increased achievement, efficiency, or attitude toward the instruction.

Merrill (1979, 1980) also discussed the importance of students controlling their own cognitive processing

of the information presented to them. In addition, Merrill stated that the challenge is not whether to use learner control at all, but how to help each student best use the learner control that is available.

Based on the above studies, some type of learner control (e.g., pacing or sequence) would appear to be appropriate for instructional materials presented through interactive video. This use may be particularly appropriate with interactive video as the instructional medium, since instructional control is needed both for computer text and video/audio material.

Training in how to use the available learner control options is also very important, especially with interactive video where the learning materials may be less structured and the system more complicated to use. Such training is particularly important with this new medium since the learner may be totally unfamiliar with this type of learning system.

Studies Supporting Learner Control

Supporting the idea that students would benefit from having a great deal of control over their own learning, Campanizzi (1978) showed achievement gains to be significantly greater under learner control than program control. In a similar manner, Newkirk (1973) showed that long-term retention (two weeks) was significantly greater and attitudes were slightly more favorable for those who were allowed to use learner control.

There also appears to be a strong, intuitive appeal for allowing students to choose the type of instruction they will receive (Carrier, 1984). In support of this intuitive appeal, Santogrossi and Roberts (1978) described how students without an externally imposed structure may be able to allocate more energy for new or difficult material and spend less time and effort on familiar content. They also stated that an instructor-selected pace, no matter what it may be, would be inappropriate or boring for a large proportion of the class.

Allowing students to skip over material they already know is also intuitively appealing in interactive video instruction, where materials are often designed to be learned in a less structured manner. While giving students this type of control may appear to be beneficial, it may in the long run reduce effectiveness by allowing other students, not familiar with the content, to also omit certain parts of the instruction.

Studies with Mixed Support for Learner Control

While the above research generally supports the use of learner control, another body of research (e.g.,

Balson, Manning, Ebner, & Brooks, 1984/85; Mayer, 1976; Reiser & Sullivan, 1977) has shown that such control is associated only with equivalent learning gains, rather than increased achievement. The results from this group of studies showed that:

1. Learner control is as effective (but not more effective) in terms of achievement scores for students using this control strategy.
2. Attitudinally, learner control is rated equal to (or better than) program control by students using these strategies.

In addition, students using learner control often chose to end an instructional sequence too soon when they were given control over the amount of information they were to see (control of content). One such study (Fisher, Blackwell, Garcia, & Greene, 1975) showed learner control to be associated with students working substantially fewer problems per day (although this group was rated higher in engagement by observers).

Fry (1972) also showed that subjects under a high degree of learner control learned the least, although they did form the most favorable attitudes toward the method of instruction. Gay (1986) showed similar results with the learner control groups overall showing lower or equal achievement scores than groups under program control.

These results somewhat reduce the justification for including some type of learner control in an instructional lesson. Based on this research, designers should limit to some degree the learner control available for students learning from interactive video materials. Such control should include only very limited control of content (choosing whether or not to study a particular lesson) and perhaps only partial control of the sequence and/or pacing.

Available learner control might specifically include the ability to choose the sequence of topics, the option to choose computer text or video materials, and the ability to control the overall pace of the presentation of the instruction. As described above, care should be taken when learners are allowed to choose whether or not to actually view certain materials (computer text or video sequences) since learner control of content may allow some students to omit important lesson modules.

Adaptive Control Strategies

One alternative to standard learner control has been the use of adaptive control strategies. Using a computer-based algorithm, this type of strategy adjusts the learning environment and prescribes instructional treatments within an individual lesson to meet indivi-

dual student needs and characteristics (Tennyson & Rothen, 1979).

Although extremely complex to design, such systems have been used quite effectively in providing an alternative to strictly learner controlled or program controlled instruction. The results of studies in this area (Tennyson, Park, & Christensen, 1985; Ross & Rakow, 1981; Tennyson, Tennyson, & Rothen, 1980) have shown that:

1. Groups using adaptive control perform better than either program control or learner control groups on both immediate and delayed tests of achievement.
2. Groups using standard learner control generally finished in less time and performed less well in final achievement tests than those using adaptive control.
3. Groups using standard learner control showed an increasing deficit from the immediate test to the delayed test as compared to adaptive learner control (Ross & Rakow, 1981).

While much of the adaptive control research has been carried out with complex, instructional systems, interactive video designers can still learn some strategies from its implementation. The most important of these is obviously the importance of adapting the instruction to the needs of the individual learner currently using the system. While the adaptation used in most interactive video systems cannot be nearly as comprehensive as that used in the research described above, it can still include appropriate pretests, embedded questions, and other attempts at understanding the needs of the learner.

Such adaptation is particularly important with interactive video where the complexity of the system may overwhelm some learners. Decisions concerning the appropriate use of computer text, branching, and video playback at appropriate times in a lesson are extremely important, especially when numerous options are available in the learning system.

Learner Control with Advisement

Another type of learner control research can be described as learner control with advisement, a situation where the learner is able to make some decisions as to content, sequence, etc., while the program makes suggestions for some of those choices. Such advisement may be necessary since typical learner control strategies may fail to provide students with the necessary cognitive information about their learning progress by which they can make meaningful decisions (Tennyson & Rothen, 1979).

Subjects using this advisement control strategy have been compared to groups having complete control or adaptive control of an instructional program in a number of different studies (Hannafin, Garhart, Rieber, & Phillips, 1985; Tennyson, 1980; Tennyson, 1981; Johansen & Tennyson, 1983). The results of these studies showed that groups receiving advisement information in general:

1. had higher post-test means,
2. had more students reach mastery,
3. had longer time on task,
4. needed less instructional time, and
5. needed fewer instructional instances.

In a similar study, Laurillard (1984) found that students do make use of instructional suggestions and like being given advice on what to do next in terms of sequence and strategy. Goetzfried and Hannafin (1985) also found that learning using a learner controlled advisement strategy was effective, reporting comparable learning results among an adaptive strategy, an advisement strategy, and a typical linear, program control strategy, although linear control was more efficient in terms of time.

The above results may also be applied to the design of effective interactive video instruction. Unlike the difficulty of applying adaptive control strategies, advisement can be easily applied to interactive video. Such advisement could include any or all of the following:

1. Suggestions for choosing a particular instructional sequence.
2. Suggestions for viewing a videotape/ videodisc passage for more information.
3. Giving extra information concerning why a particular choice should be made.

Effects of Learner Characteristics

The use of learner control has also been shown to be affected by certain student characteristics. For example, while Fry (1972) showed that learner control overall was a detriment to learning, its use actually increased learning when the students were of high aptitude and high inquiry. In a similar manner, Gay (1986) demonstrated that students using learner control were much more efficient in the use of their time when they had a prior conceptual understanding of the material.

Ross and Rakow (1981) also supported this type of interactive effect, showing that high entrance ability students performed equally well under both program and learner control conditions. In a similar way, Allen and Merrill (1985) discussed the differential effectiveness of learner control in their description of an

"expert learner," described as someone who can select and apply appropriate learning strategies without help. Studies such as these suggest that while learner control overall may not be an effective or efficient learning strategy for all students, it may be worthwhile for those learners with higher aptitude or previous knowledge of the instructional content.

This research suggests that learner control with interactive video can be used most effectively with higher ability students or with students who already have some knowledge in the content area to be taught. If instruction is being designed for learners other than these groups, there should be limits placed on the amount of available learner control.

Research with Learner Control and Interactive Video

Specific studies looking at the use of learner control with interactive video have been very small in number. While this lack of studies is probably due to the lack of overall research studies with this new medium, there have been several studies of importance in this area.

One of the first studies learner control and interactive video (Laurillard, 1984) reported a small field trial of this new technology at the Open University in England. Using interactive videotape, this study showed that:

1. Students make sequencing choices that are often different from the expected sequence.
2. Students like advice on what sequence or strategy to use at a certain point.
3. Students do make use of this advice when offered.

Laurillard also stated that student control of sequence in free learning situations is important since a student's choice of route is likely to be more meaningful than the alternate routes not chosen by the student during the program.

Hannafin, et. al. (1985) also discussed the use of learner control in interactive video instruction. While stating that it is not advisable, in general, to allow learner control unless additional prompting is provided, these authors also stated that there is evidence to suggest that an imposed lesson structure has the potential for conflict with a learner's internal schema.

Finally, Gay (1986) reported research which showed an interactive effect between prior familiarity with a topic and the use of learner control in an interactive video learning situation. While overall posttest scores were higher with subjects under program control, equivalent scores were reported between program and learner control for those students with a high prior

conceptual understanding of the material. As described above, Gay also demonstrated that students with a prior conceptual understanding of the material were much more efficient in the use of their time when using learner control. According to the author, it appeared that prior conceptual understanding may have acted as an advance organizer, making the presentation of well-structured materials (program control) considerably less important.

Findings from this research are similar to the results already described in the preceding sections. These findings include the importance of providing students with advice concerning learner control options, the possible negative effects from an imposed lesson structure, and the importance of previous knowledge when using learner control.

Conclusion

While most of the above research concerns the use of computers to present instructional materials, much can also be gained from this research concerning the effective design of interactive video materials. Suggestions for this design are summarized below:

1. Some type of learner control may be appropriate in many different interactive video learning situations.
2. Training in how to use learner control options is extremely important.
3. Learner control of content is often not appropriate since some students may skip important material or quit the lesson too soon.
4. The adaptation of interactive video materials for each learner, although potentially difficult, is very important.
5. Advising a student during instruction as to sequence, etc. should help increase retention.
6. Learner control may be most effective with higher ability learners or those with some prior knowledge of the content.

While the above suggestions certainly do not guarantee the effective design of interactive video materials that incorporate some type of learner control, they should aid the instructional designer in the incorporation of various learner control options. The appropriate use of these suggestions should also increase the effectiveness of the materials that make use of these options.

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