DOCUMENT RESUME

ED 236 218 TM 830 738

AUTHOR Hofmeister, Alan M.
TITLE The Videodisc and Educational Research.
SPONS AGENCY Department of Education, Washington, DC.
PUB DATE Mar 82
GRANT G008101536
NOTE 18p.; Paper presented at the Annual Meeting of the American Educational Research Association (66th, New York City, NY, March 19-23, 1982).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143) -- Information Analyses (070)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; Cost Effectiveness; Educational Research; *Educational Technology; *Instructional Development; Microcomputers; *Research Needs; Simulation; Technological Advancement; *Videodisc Recordings

ABSTRACT

The future of educational research with the videodisc is discussed in relation to: (1) recent and planned hardware developments, and (2) research areas where videodisc technology may be appropriate. Examples of some of the different configurations possible among videodisc players, microcomputers, touch screens, and printers are provided. The findings of a small research study using concept analysis and the videodisc to determine appropriate instructional sequences have been included. (Author)

THE VIDEODISC AND EDUCATIONAL RESEARCH[1]

Alan M. Hofmeister

Utah State University

This research is supported by U.S. Department of Education Grant #G008101536.

[1]Paper presented at the Annual Meeting of the American Educational Research Association, New York City, March 1982.

Abstract

The future of educational research with the videodisc is discussed in relation to: (1) recent and planned hardware developments, and (2) research areas where videodisc technology may be appropriate. Examples of some of the different configurations possible among videodisc players, microcomputers, touch screens, and printers are provided. The findings of a small research study using concept analysis and the videodisc to determine appropriate instructional sequences have been included.

THE VIDEODISC AND EDUCATIONAL RESEARCH

In order to appreciate the future of educational research with the videodisc, we must first understand the capability and flexibility of future videodisc systems.

The present videodiscs have excellent capacity if we store materials that can be presented one frame at a time, e.g., a library of paintings or photographs. The high quality, single frame image and the 54,000 frame capacity[1] of the present videodisc give a considerable cost and quality advantage over videotape or computer-stored graphics. A 160K microcomputer disc will store approximately 40 frames of quality video. Even in modest amounts, such visuals are expensive to develop and store. For a videodisc with a production cost of $60,000 and a retail disc price of $20 per disc, a single visual would cost the producer 10 cents and the purchaser .04 cents. This is not to suggest that videodisc technology is inexpensive. It certainly is not (Paris, 1981). For high capacity video storage, the videodisc does compare favorably with computer graphics. The biggest storage limitation of the present videodisc is the limited audio capacity. If we use audio with a visual, we use up frames at the rate of 30 per second and have approximately 30 minutes of audio per side on a disc.

---

[1]A common misconception relating to the storage capacity of a frame is that a frame can hold a page of text. The average printed page of text requires 5.3 videodisc frames if it is to be easily read on most monitors. For more information on this, the reader is referred to the excellent article by Schipma (1981).

The educator faces another storage limitation in that the present videodisc can store only one kilobyte of computer memory. This severely limits the interactive capacity of videodiscs, and most interactive educational applications have involved the interface of disc player and microcomputer--a powerful combination which, unfortunately, increases cost and reduces reliability.

The videodisc players of the near future will overcome the present restrictions in audio storage and computer memory. We will shortly use disc players that will have a capacity of eight seconds of audio for each of the 54,000 frames. The players will also come with 64K of computer memory. With a high speed intelligent random access player with massive audio and visual capacity, the educator will have a versatile instructional aid. The educational researcher will have a research tool capable of simulations and data collection activities that previously would not have been possible because of cost factors and technical limitations.

Summary: Hardware Development Projections

The following is a summary of projections on hardware developments.[1]

---

[1]Given the volatile nature of the field, I would not like to suggest that these projections are totally reliable. The Year 1 projected developments exist, at least in some prototype form. The Year 2 projections are based on information from Xerox, which is working on the "read and write" videodisc technology. "Read after write" technology, although expensive and somewhat unreliable, already exists. "Read after write" technology deletes the present separate mastering and stamping process.

Within a Year

1. Videodiscs with eight seconds of audio per frame plus the present 30-minute dual tracks will be generally available;

2. Videodisc players with 64K of memory will be available.

3. Videodisc manufacturing costs will drop to half their present cost due to the introduction of a range of new "mastering" techniques. The studio production costs will, unfortunately, still be with us, and such costs are usually a large part of total production costs.

Within Two Years

"Read and write" videodisc technology will be available. The "omnibus medium" will be a reality in that the disc will carry both computer programs and data as well as video and audio information--all media with "read and write" potential.

A Questionable Research Direction

Before moving into possible areas of research, I would like to make an observation on an area of research that I consider of limited value. When a new media is developed, educators rush in with a host of comparative studies. These studies typically take similar curriculum content and compare the presentation with the new media against the "traditional" media.

Because of the often unique instructional interactions that occur between a media and the curriculum content, such studies have rarely yielded anything of practical significance. Also, such research may result in an unhealthy emphasis on the hardware. We end up being more concerned with the effectiveness of the hardware rather than the effectiveness of instruction. If one were to conduct research in this area, such research should be concerned with determining the characteristics of curricular material and learner populations suited to the new media.

Researching Conceptual Instruction

While videodisc technology will open up a range of research possibilities that will enhance the value of CAI, the new videodisc technology will also open up research possibilities that will have extensive implications for all modes of instruction. Such generalizability of findings becomes possible because of the quality of simulation available on the videodisc. Never before have educational reseachers had access to a tool capable of quality simulation and on-line data collection at such a low cost.

One of the deficiencies of present CAI efforts is the lack of emphasis on concept teaching. Much of the present technology effort is tied to the linear task analysis approaches left over from the early days of programmed instruction. We have failed to capitalize on the high speed random access capabilities in present computer and videodisc hardware. The early work of Markle and Tiemann (1972), and Engelmann (1969) in concept analysis takes on considerably more significance because we now have hardware resources compatible with their theoretical structures.

In the use of a concept analysis approach, the instructor identifies the critical and the irrelevant attributes of a concept. Examples and nonexamples of a concept are then selected so as to ensure that the student will learn what attributes need to be present for an example to qualify as an example of the concept classification. For example, if you are teaching the concept of a lake, the examples and nonexamples would have to be arranged and presented so that the learner realizes that attributes such as "surrounded by land" are critical, and attributes such as "the presence of fresh water" are irrelevant.

In order to teach concepts, we need to have available a rich and carefully selected variety of examples and nonexamples. If we wish to individualize the instruction so that the instructional content is based on an ongoing assessment of the pupil's learning, then the high speed random access of information becomes important.

One of the problems we face in the teaching of concepts is the lack of research on the instructional sequences. While we have a general theoretical structure, much of the information we need for instructional planning does not exist. The relationships among such variables as curriculum area, learner prerequisites, and the ratio of examples to nonexamples have yet to be treated in depth. The following findings from the formative evaluation of one of our earlier discs exemplifies the application of the videodisc to research in concept development.

Teaching Matching

One of the prerequisities for participation in most forms of instruction is an understanding of matching. Most forms of preschool assessment and instruction rely heavily on a pupil's ability to match an example with members of its respective class.

In our work with severely mentally retarded pupils, competency in matching was a prerequisite to most of our interactive videodisc programs. To teach this concept, we prepared an interactive videodisc program to teach matching. We set out to teach three levels of difficulty of matching across sizes, shapes and colors. The easier level was the task of identifying the one member of a group that matched the sample. The next level called for picking out the two members of a group that matched the sample, and the third level required the selection of the three members of a group that matched the sample.

We had a choice of two instructional strategies; in strategy one, we would take one area, e.g., color matching; teach all three levels of difficulty, and then move to the next area, e.g., shape matching, and hopefully, start at the second level, teach to the third level and then move to size matching, starting at the second or third level.

In strategy two, we would teach the first level of difficulty in color, then the first level in shape, and then the first level in size. The next steps would be to teach the second levels in color, shape and size, and then the third levels in color, shape and size.

In keeping with the principle of lean programming,[1] we chose

---

[1]Lean programming refers to the practice of field-testing with the least expensive approach. Field-test data will identify when an instructional sequence is incomplete. It is, however, very difficult to determine when a sequence contains superfluous material. To avoid developing materials that are unnecessarily expensive in terms of learner time or material, the least expensive approach is taken first, and the field-test data will indicate whether more material or time is needed.

the shorter approach, namely, the first strategy. Six severely retarded pupils were selected, and strategy one was field-tested. One of the six pupils was not able to successfully complete any of the initial instructional tasks and was dropped. The data in Figure 1 represents the pattern of pupil responses for the remaining five subjects.

The trials per lesson refers to the average number of times it was necessary to route a pupil through the criterion test at the end of the lesson. Three consecutive correct trials were necessary before the pupil could move to the next lesson. Instruction in the first sequence was terminated when the two leading pupils had reached a point of frustration.

With the aid of the instructional authoring system, the lessons were reordered into the sequence listed on the horizontal axis in Figure 2. This sequence was an adaption of the second strategy (see p. 6). There was a reduction in trials per sesson. Such a reduction was to be expected for Level I color lessons because these lessons had been completed successfully by all pupils during the first sequence. However, no pupils had previously completed Level III lessons, nor had the pupils been exposed to the Level I lessons for shape and size. One of the two leading pupils had stopped in the first sequence at Lesson 8 after 125 trials. In the second sequence, this pupil passed Lesson 8 after 14 trials. The other leading pupil had stopped in the first sequence at Lesson 9, after 74 trials. In the second sequence, this pupil successfully completed Lesson 9 after 11 trials.

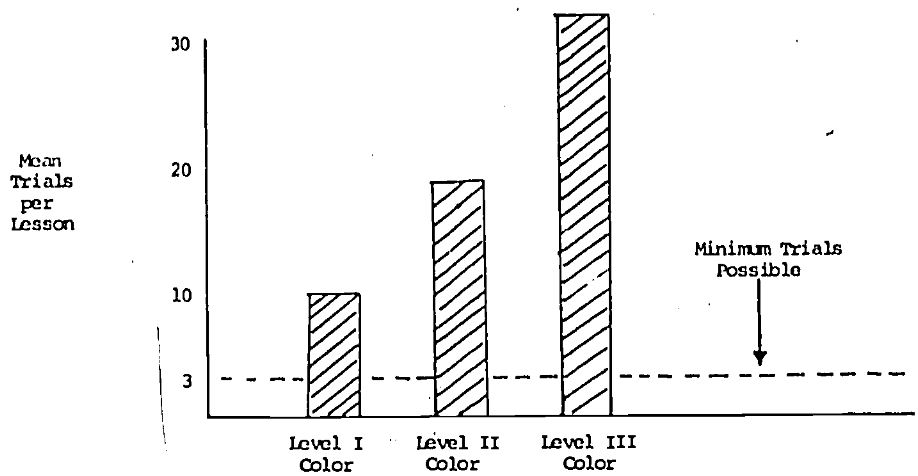

Figure 1. Trials per lesson for instructional sequence 1, Group 1

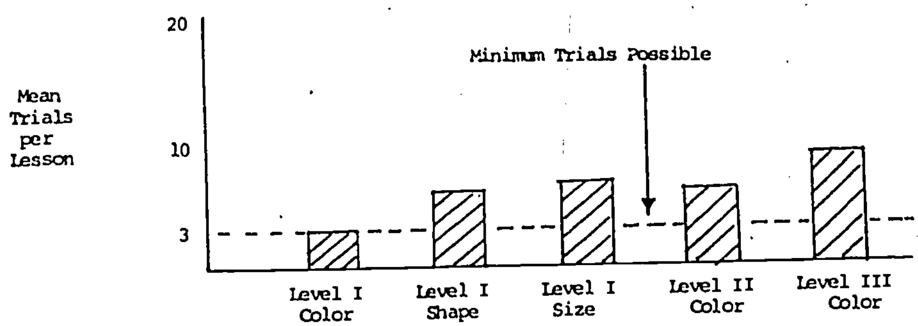

Figure 2. Trials per lesson for instructional sequence 2, Group :

Further replication of this program with the revised sequence and a second group offered additional support for the increased effectiveness of the second strategy. Figure 3 represents the results of a second group of five handicapped pupils.

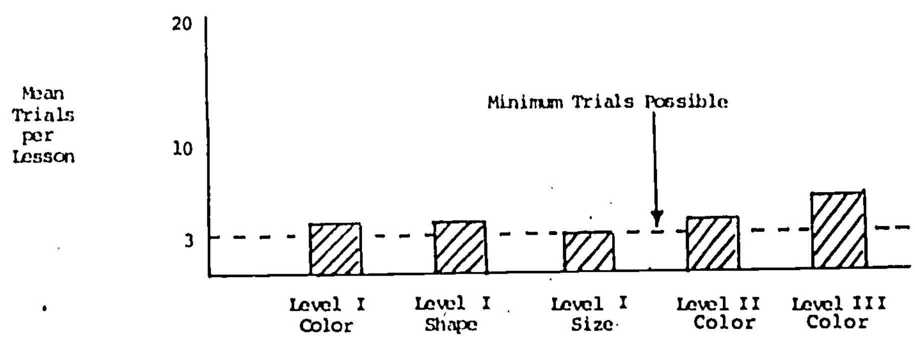

Figure 3. Trials per lesson for instructional sequence 2, Group 2

With the aid of an authoring system, we were able to quickly change instructional sequences and collect a wealth of data. This software enabled us to closely monitor the progress of the group and individuals; when a weakness in the instruction was identified, we were able to rearrange the instructional sequences.

The biggest restriction to the above listed process of formative evaluation and revision is the present "read only" feature of the videodisc. At present, we have to systematically plan to counter the present inability to add new material to a videodisc. We have not found this "read only" restriction as serious a problem as we initially thought it would be. The two major strategies we use to minimize this problem are:

1. The use of the computer to add text and a small amount of graphics to the instructional sequence, and

2. Extensive prototype testing using videotape before disc production.

We are presently finalizing an interface board that will allow us to use many of the procedures in our videodisc authoring software with random access videotape playbacks.

Future Videodisc Software

The lack of instructional material on videodiscs is a major source of frustration for educational researchers. The videodisc is an ideal media for collections of flora, fauna, paintings, diagrams of muscles, nerves, bones, and other specialized encyclopedias. Many such videodisc collections are under discussion and prototype discs have already been developed (Schipma, 1981; Sustik, 1981; Wilhelms, 1981). When quality collections with educational relevance are available, the educational researcher will have a rich resource with which to increase the quality of CAI and our understanding of a variety of instructional variables.

The Videodisc and Instructional Assessment

While criterion-referenced assessment has opened up new possibilities, it has created a variety of problems. Of major concern are the management problems associated with assessing groups of pupils on several hundred specific instructional objectives. Individual assessment is extremely expensive. Group assessment causes problems when:

1. the pencil and paper format is inappropriate for the specific skill being assessed;
2. many of the pupils are exposed to test questions well above their abilities;
3. the teachers have to analyze and prepare prescriptions from extensive data bases.

The videodisc offers considerable promise as an assessment tool. It can present questions using audio, text, or color visuals. The time in testing can be reduced because of the ability of an interactive system to monitor pupils and make changes in the test based on the patterns of pupil responses. An interactive disc system can analyze responses and prepare prescriptions.

To explore the potential of the videodisc for assessment, we are developing a math assessment disc. This videodisc will contain assessment items for math skills K-3 in either English or Spanish. Test items will assess performance on 364 specific instructional objectives using either of the two audio tracks. The selection of these tracks is under computer software control, and the educator can move easily between the English and Spanish tracks.

The authoring system is going through major modifications to accommodate flexible assessment functions. One of the major production challenges is the designing of disc content so that the disc can be used with any of the following hardware configurations:

1. Videodisc, with computer and touch sensitive screen;
2. Videodisc and computer;
3. Videodisc, with supporting print materials.

In the third configuration, the intelligence necessary for interactive procedures has to be stored as a computer program on the audio track. This computer program is then "dumped" from the disc into the computer memory of the videodisc.

We are hopeful that this math disc will facilitate a wealth of research opportunities including:

1. The study of optimal item sampling procedures for different populations of learners, e.g., comparing the needs of learners in developmental sequences versus learners in remedial sequences;

2. Comparisons between language tracks to assess the effectiveness of each language. For learning disabled pupils, we know little about the validity of designations of the "strongest language" or "native language."

3. The application of wrong answer information. Many of the incorrect answer selections being built into the math videodisc items have been selected because of their value as indicators of specific incorrect procedures (Brown & Burton, 1979).

Summary

The value of the videodisc technology for CAI is rather obvious and most of the educational applications have stressed this application (Hofmeister & Thorkildsen, 1981; Thorkildsen, Williams & Bickle, 1979; Thorkildsen et al., 1979; Allard & Thorkildsen, 1981; Kemph, 1981). The use of videodisc technology to advance our knowledge in areas outside of CAI has received little attention. With the development of educationally relevant disc content and powerful authoring software, a host of research opportunities will be created. Through reference to concept analysis and assessment, I hoped to exemplify some of the possibilities. I have no doubt that such examples are but a small and possibly nonrepresentative sample of future efforts in the application of videodisc technology to educational research.

References

Allard, K. & Thorkildsen, R. Intelligent videodisc for special education. Videodisc News, 1981, 2(4), 6-7.

Brown, J. S., & Burton, R. R. Diagnostic models in basic mathematical skills. Testing, Teaching, and Learning, Washington, D. C.: U.S. Department of Health, Education and Welfare, 1979.

Engelmann, S. Conceptual Learning. San Rafael, CA: Dimension Publishing Co., 1969.

Hofmeister, A. M. & Thorkildsen, R. Videodisc technology and the preparation of special education teachers. Teacher Education and Special Education, 1981, 4(3), 34-39.

Kemph, J. Videodisc comes to school. Videodisc/Teletext, 1981, 1(2), 94-97.

Markle, S. M. & Tiemann, P. W. Some principles of instructional design at higher cognitive levels. Address presented to Lehrsysteme 72, International Congress for Instructional Technology, Berlin, Germany, April 1972. Published in proceedings: Fortschritte Und Ergebnisse Der Unterrichtstechnologie, 1972.

News and notes: Dartmouth to explore Laser videodisc. Videodisc/Videotex, 1981, 1(3), 142.

Paris, J. Videodisc technology: Debunking some myths. Videodisc/Teletext, 1981, 1(2), 74-77.

Schipma, P. B. Videodisc for storage of text. Videodisc/Videotext, 1981, 1(3), 168-172.

Sustik, J. M. Art history interactive videodisc project at the University of Iowa. Videodisc/Teletext, 1981, 1(2), 78-85.

Thorkildsen, R., Williams, J. G. & Bickle, W. K. A microcomputer/videodisc CAI package to teach the retarded. Educational and Industrial Television, 1979, 2(5), 40-44.

Thorkildsen, R., Williams, J. G., & Bickle, W. K. Videodisc/microcomputer technology: Implications for the handicapped. Journal of Special Education Technology, 1979, 2(3), 45-51.

Wilhelms, F. T. The ABC/NEA schooldisc program. Videodisc Teletext, 1981, 1(1), 30-32.