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ABSTRACT

An economics learning package which utilized a videocassette recorder (VCR) and an Apple II computer was successfully developed and field tested. The videocassette tape material used in the project was a lesson--"To Buy or Not To Buy"--from "Trade-Offs," a series of economics films for 9- to 13-year-olds. All programming was done using the computer language BASIC. The interface between the VCR and the microcomputer was developed by an electrical engineering student at Purdue University. The homemade interface device costs a fraction of what commercial interface packages cost. The learning package, which consisted of (1) introduction and pretest, (2) viewing of the "Trade-Offs" film, (3) questions and instruction on concepts covered in the film, and (4) posttest, was field tested with sixth graders from a private school. Students were tested individually, and each completed a questionnaire. Students seemed genuinely pleased with the materials; some learning about economics did take place (the average pretest score was 59% correct, the average posttest score was 78% correct); and there were very few technical problems. (RM)

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Interfacing the Videocassette Tape with the Apple II Microcomputer

Harlan R. Day

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The many technological advances made in the development of the stand-alone microcomputer will probably have a significant effect on education. Not only hasthe computing capability of these personal computers been vastly improved, but at the same time their cost continuesto decline. Thus, educators now have increasing access to quite satisfactory computing capabilities at costs that are becoming increasingly affordable. Many elementary and secondary schools are expanding their curricula to include this "computer revolution". Not only are courses being offered in computer use and programming, but educators are beginning to explore the many possible uses of the microcomputer as an instructional tool in their own classrooms. To be sure, the use of the microcomputer in education is really just beginning to be explored, but educators are becoming increasingly aware of the potential impact of these incredible machines upon their profession.

During the past decade great advances have also been made in the area of home video technology. These home video systems use the videocassette tape or the videodisc to record or play high quality video/audio materials. The videodisc is the newest of these technologies. Video/audio information is stored within extremely small grooves that are embedded in the thin plastic videodisc. The information can be "read" by a laser light source and then transmitted to a television set or some other cathode ray tube monitor. Literally vast amounts of many kinds of video/audio materials can be stored on these remarkable videodiscs. They are durable, relatively

inexpensive to mass-produce, and are difficult to duplicate (thus protecting developers of materials from copyright infringements).

One of the exciting new possibilities in education is the "marriage" of the videodisc with the microcomputer. That is, with the proper interfacing technology, the student can interact with the videodisc and microcomputer simultaneously. The computer will guide the lesson, integrating the video material into the computer-assisted instruction (CAI). The student thus has access to the full range of visual and audio material. Charts, films, slides, visual simulations, audio sequences, etc. can all be placed on the videodisc and integrated into the instruction when needed.

The use of the "intelligent videodisc", as this combination of technology is sometimes called, is certainly on the cutting edge of instructional technology and development. Yet cost is a major problem. The prices of computer and videodisc hardware are indeed declining, but this new hardware is still expensive relative to the more conventional educational media and materials.

Related to this is the high cost of research and development of new videodisc software. While the actual cost of making a plastic videodisc is small, the cost of developing and producing the information stored on the videodisc is not. Only when the videodiscs are mass-produced can the per unit price be low enough to be readily affordable. At this time high quality educational videodisc materials that can be interfaced with CAI are just not available.

The thirteen intelligent videodisc lessons recently

developed by the Minnesota Educational Computing Consortium (MECC)/Rockefeller Family Fund Project illustrate the cost problem in developing intelligent videodisc materials on the local level. In an article describing their project the authors write:

> Because videodiscs offer many options concerning the type of pictures to be used, the development of software takes on significant added costs. These added costs do not surprise media persons who work in film and television, however, they usually come as a rude surprise to computer software developers. For example, before a disc may be printed, a master tape must be produced that includes all visuals. These visuals are limited by creativity, availability and budget. The economics materials contain motion pictures with and without sounds, stills, and cartoons plus charts and graphs. These segments had to be purchased from existing sources or developed from scratch. Seven thousand ($7,000) was needed to cover the costs associated with the production and editing of the video material. Premastering (i.e. sequencing the slides, film, and so forth into a videotape for transfer to a disc), cost an additional $4500. The production of a master disc and the replication of 30 copies required $2,500. These added costs increase significantly the overall development costs for a project and act as a major inhibitor of development[1]

Costs such as these are prohibitive for most educators interested in developing intelligent videodisc instruction. Until cheaper, high-quality videodisc materials become more available educators will have to explore other approaches. The "Project" described below is such an approach. It avoids the high cost of developing videodisc materials locally since it uses existing, high-quality videocassette tape materials. It also uses a "homemade" electronic interface device that costs a fraction of what commercial interface packages cost. Hence, it allows the educator to use this new instructional

technology at minimal cost.

The videocassette tape material used in the project was a lesson from Trade-Offs, a series of economics films for students aged from 9 to 13 years old. These popular 20-minute films are used widely in schools throughout the United States and Canada, and research has shown that they are very effective in raising the level of economic understanding and in motivating students to learn economics.[2]

We used a JVC videocassette recorder (VCR), model CR 6300V in the project, which was joined to a standard 21-inch color television. This equipment produced a high-quality color picture that greatly enhanced the instruction.

Our basic piece of computer equipment was the Apple II microcomputer, which was linked to a color television monitor. The resulting color graphics improved greatly the quality of the instruction. All programming was done using the BASIC computing language.

The interface between the two technologies was developed by an electrical engineering student at Purdue. The device he developed was able to "read" the audio tones that were placed at selected places on the videocassette tape, and to relay these signals to the microcomputer. Thus, in this manner, the VCR was able to "communicate" with the computer. The microcomputer could also control the VCR, causing it to "fast-forward", "rewind" or "stop". Exactly how the interface between the computer and the VCR worked in the instruction will be explained

below. The main point here is that this relatively simple (at least to an electrical engineer!) interfacing device cost no more than $40, whereas commercial videodisc interface packages cost close to $600.

In designing the economics lesson I worked closely with the computer science major who did all the programming. He also provided valuable input in the sequencing and in the overall planning of the lesson. The first step in the development of this instructional package was to establish some goals. My goals were basically twofold:

1. To develop a technically-workable interface between the VCR and the microcomputer.
2. To test the new instructional design on a small group of students and to get from them some informal feedback on its efectiveness.

While the engineering student continued the work on developing the interface device, I began to design the economics lesson. The completed lesson consisted of four basic parts: 1) Introduction and pre-test 2) Viewing of the Trade-Offs film 3) Questions and instruction on concepts covered in the film 4) Post-test.

The first step was choosing which of the fifteen Trade-Offs films would be most suited for my purposes. I reviewed carefully the fifteen lessons and chose Lesson Ten, "To Buy or Not to Buy", which explains the economic concepts of demand and quantity demanded. Since this film covered specific economic concepts that could be tested readily, it had interesting graphics, and it contained a good bit of humor,

I felt that it was ideal for my purposes.

Next I designed an eight-question multiple-choice test that covered the major concepts presented in the lesson. This test served as the pre-test and post-test for the project.

The instruction in Part 3 of the lesson also contained seven multiple-choice questions. In addition, there were various explanations and graphs to illustrate the basic concepts on market demand presented in the film. If the students answered most of these seven questions correctly they would proceed directly to Part 4, the post-test, thus concluding the lesson. However, if the students missed several of the seven questions they would be directed to review a segment of the film that explained the concepts they did not grasp correctly. After viewing the segment of the film again the students would re-do the incorrect questions. If the students still answered them incorrectly the computer would explain the correct response and then direct them to the next part of the lesson.

After much editing I felt that the complete lesson was ready for programming. In several weeks the programmer had most of the lesson completed and we were able to analyze it on the microcomputer. There were, of course, many additional changes, deletions, correction, etc. that had to be made. In designing the program we were careful to take advantage of the microcomputer's motivational capabilities vis à vis the printed page and other forms of media. Some of these

capabilities were color graphics, scrolled writing, "flashing" words, various computer "noises", and personalization of directions.

By now the interface device was ready to be tested. Here a problem developed. The device was not consistently "picking up" the three tones that were placed on the videocassette tape. However, by making the interface device much more sensitive to the tones we were able to eliminate almost completely this problem.

The last major hurdle was assuring that the program "accessed" the precise teaching segments of the film that the students needed to review after missing some instructional questions. For example, if a student missed several instructional questions the computer might say: "Mary, you missed two out of the last three questions. Why don't you review a small part of the film again. Please push Key #1" When Mary pushes Key #1 she must only see the appropriate film segment that deals with the concepts that were giving her difficulty. The computer accomplishes this by telling the VCR to "rewind" or to "fast-forward" a specified number of seconds in order to arrive at the appropriate point on the film. Split-second timing is required (as well as accurate tone detection by the interface device) but with some trial and error we were able to achieve precision access. The flow chart diagram in Appendix A illustrates in detail how the lesson was designed.

In order not to frustrate the students the lesson began with the simpler concepts then proceeded to the more difficult. Also, the students were positively reinforced by the computer for correct responses and were encouraged to try again in case of incorrect responses. These steps were taken, of course, to help make the learning experience a successful one for the students, most of whom would be using a computer for the first time.

After repeated "de-bugging" I was satisfied that the completed lesson was ready to be tested. The purpose of this informal testing of fifteen students was not to do controlled research. Rather, it was to see if the interface technology would work under actual teaching conditions, to see if any improvement in learning took place as a result of doing the lesson, and to get some feedback from students as to their liking or disliking of the learning experience.

The students I tested were 6th graders (11 or 12 year olds) from a local private school. As an incentive to participate ten of the fifteen students earned $5.00 each for their efforts. Also their school was given $50.00 for helping with the project. The children's parents brought them to the testing site at prearranged times. I tested each child individually and had each child complete a questionnaire (Appendix B). I was pleased with the results, which are summarized in Appendix C. There were very few technical problems. The interface device worked well, except for a few times when it did not "pick up" a tone from the film. However, I was present during the testing and

was able to rewind quickly the videocassette tape for a split second and replay the tone, which was "picked up" the second time. Any disturbance in the lesson was minimal. Lengthening the tone on the videocassette tape should solve this problem completely.

The students seemed genuinely pleased with the lesson. In response to the question, "What did you like best about doing this computer lesson?", most of the students indicated that they liked the personal interaction with the computer i.e. "answering the questions". From the smiles on their faces it was evident that they enjoyed "being talked to" by a computer, especially when reinforced for a correct response. Thirteen of the fifteen students "really liked this computer lesson a lot", and wished that they "could do more like it". However, they did not find the lesson "easy". Ten of the fifteen students classified the lesson as "somewhat difficult". I was concerned beforehand that the lesson might be too long (the average student time was almost 49 minutes); however, only one student indicated that the lesson was "too long". I was pleased with this result, especially considering the fact that almost all of the students worked the lesson in the late afternoon after a long day at school.

The average pre-test score was 59% correct, whereas the average post-test score was 78% correct. It appears that some learning about economics did indeed take place, although it is really not possible to conclude much more, considering the small size of the sample and the lack of control data.

What implications does this project have for education? I think that it is safe to say that computers (especially microcomputers) will have an increasing impact on our educational system. Computers offer educators an exciting new tool with which to work, a tool much more flexible and interesting than perhaps any technology in the field today. The intelligent videodisc promises even more exciting possibilities. With this new learning package educators can:

1) Better individualize instruction to meet varied student needs

2) Develop instruction that makes use of a large variety of media forms

3) Develop creative, motivational lessons that better explain difficult concepts

4) Develop lessons that provoke student interaction with the materials being studied

One could easily expand this list. But if instructional development in only these four areas is improved by the use of the intelligent videodisc/videocassette, our educational system will be greatly enhanced.

New instructional technologies will not replace the personal warmth and interaction of a human being. But they <u>can</u> be used effectively in a variety of ways to help students to learn.

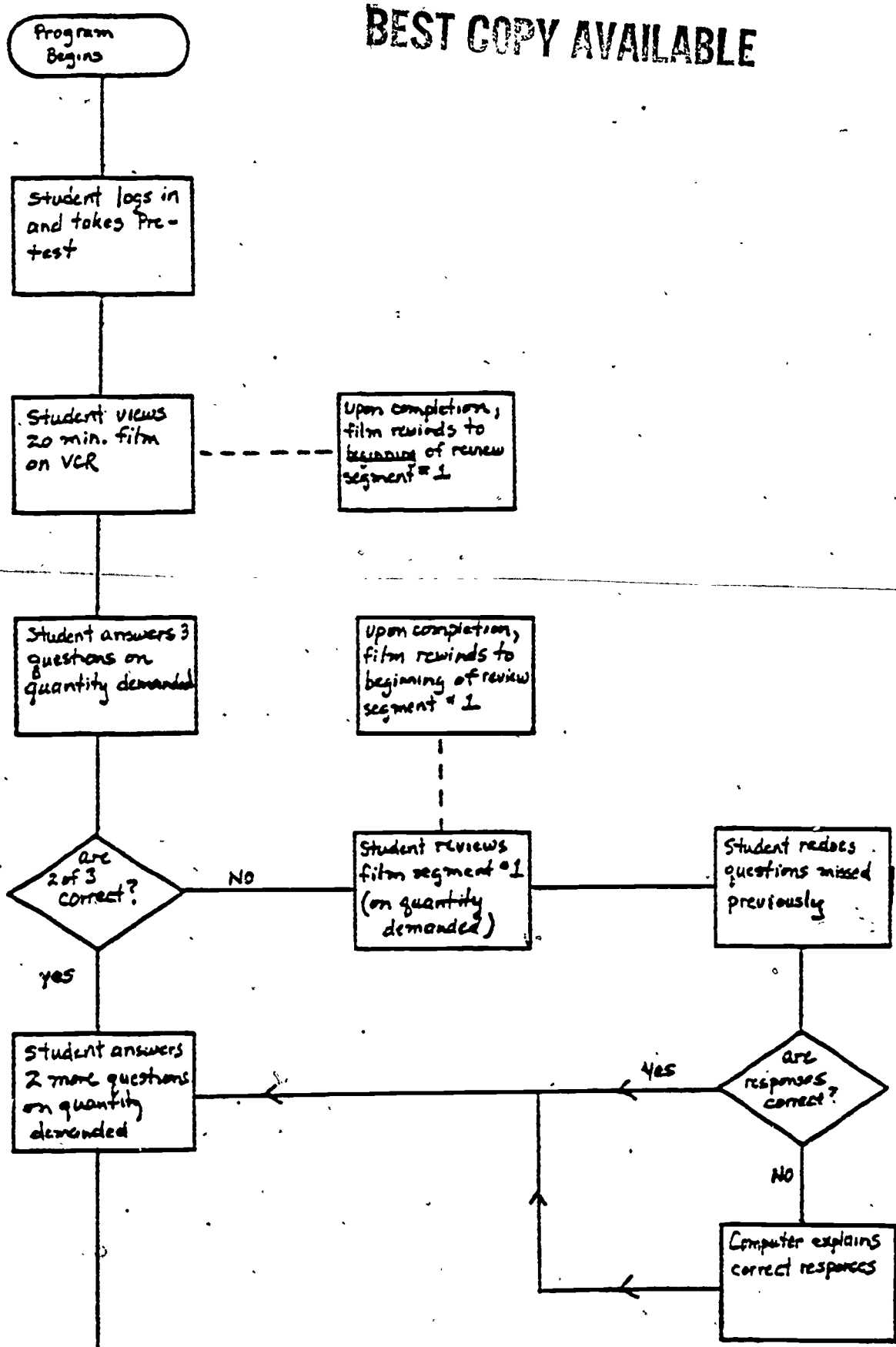
Footnotes

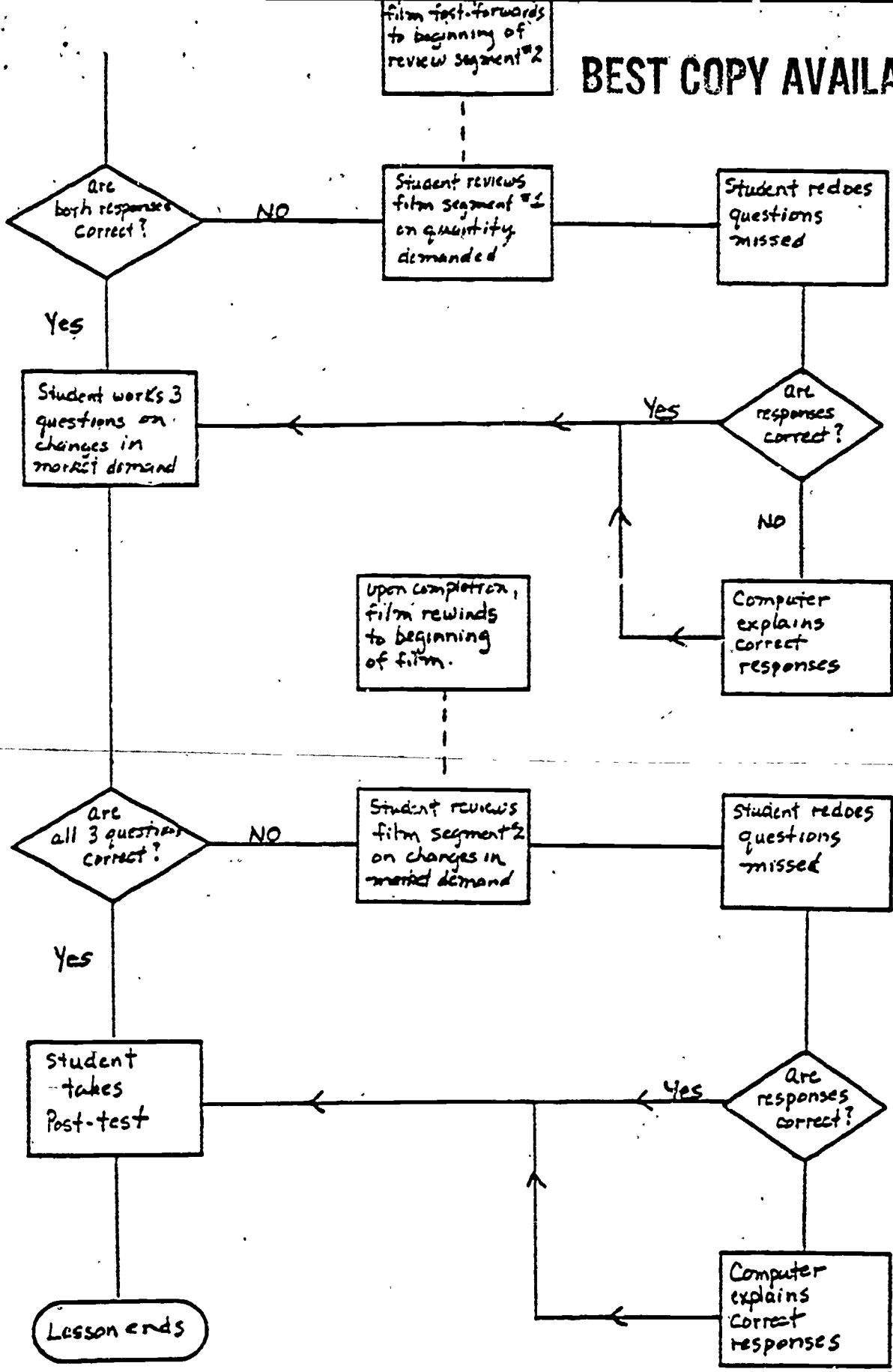
1. Allen D. Glenn and Kent T. Kehrberg, "The Intelligent Videodisc: An Instructional Tool for the Classroom," Minnesota Educational Computing Consortium/Rockefeller Family Fund Project (Typewritten), pp. 6-7.

2. Trade-offs: What the Research is Saying (Agency for Instructional Television, Canadian Foundation for Economic Education, Joint Council on Economic Education)

Appendix A

Lesson Design





STUDENT QUESTIONNAIRE: Apple II Project

Pre-test Score_____ Name:_____

Post-test Score_____ Date:_____

Beginning Time:_____ Age:_____ Grade:_____

Ending Time:_____

1. I have used a micro-computer like the Apple II:

   a. many times b. a few times c. never

2 I thought that this computer lesson was:

   a. too long b. just long enough c. too short

3. I thought that this computer lesson was:

   a. very interesting b. somewhat interesting c. not very interestin

4. In general I felt that this computer lesson was:

   a. easy b. somewhat difficult c. difficult

5. I felt that the directions given on the computer were:

   a. easy to understand b. fairly easy to understand
   c. difficult to understand

6. Circle the letter of the statement below that you <u>most</u> agree with:

   a. I really liked this computer lesson a lot and I wish that I could do more like it.

   b. This computer lesson was OK, and I might like to do some more like it.

   c. I didn't like doing this computer lesson very much, and I wouldn't like to do another one.

7. What did you like best about doing this computer lesson?

Appendix C

Tabulation of Questionnaire

1.	Many times 1	Few times 2	Never 12
2.	Too long 1	Just long enough 11	Too short 3
3.	Very interesting 11	Somewhat interesting 4	Not very interesting
4.	Easy 3	Somewhat difficult 10	Difficult 2
5.	Easy to understand 12	Fairly easy to unders. 3	Dif. to understand
6.	Really liked 13	O.K. 2	Didn't like