1997

An analysis of student reaction to the use of interactive video and hypermedia to enhance post-secondary biological science education

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An Analysis of Student Reaction to the Use of Interactive Video and Hypermedia to Enhance Post-Secondary Biological Science Education

A Graduate Research Project

Submitted to the

Division of Educational Technology

Department of Curriculum and Instruction

in Partial Fulfillment

of the Requirements for the Degree

Master of Arts

UNIVERSITY OF NORTHERN IOWA

by

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December 19, 1997

This Research Project by: Paulette A. Church

Titled: An Analysis of Student Reaction to the Use of Interactive Video and Hypermedia to Enhance Post-Secondary Biological Science Education

has been approved as meeting the research requirement for the

Degree of Master of Arts.

July 3, 1997
Date Approved

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Abstract

The perceived effect on student learning provided by interactive technology in the biological sciences has been studied on a small, private, two-year college campus. The first portion of the study was the perceived effectiveness of interactive video when used for class presentations for biological science majors. The second portion of the study evaluated five campus-produced interactive laserdisc tutorials designed for individual and group use for students taking a general introductory biology lab course.

Introduction

Increasingly post-secondary institutions are adding interactive video, one form of hypermedia, as an instructional tool for an ever increasing variety of courses. This is evident in professional post-secondary educational conference offerings, in professional journal articles, and in current research being done on its effectiveness. Hypermedia is used for classroom presentations, tutorials, student-prepared projects and reports, as well as for information evaluation and retrieval.

Bevilacqua (1989) offers an operational definition of hypertext, "The essence of hypertext is a dynamic linking of concepts allowing the reader to follow preferences instantaneously and to be in control" (p. 158). She suggests the phrase "interactive hypermedia" as a replacement for the hypertext term to incorporate all the digital links to sound, text, and images available through computer technology.

This research project was developed in an effort to determine the perceived effectiveness of interactive hypermedia on student learning in the biological sciences. Creating interactive tutorials and presentations is very time consuming and requires expensive equipment. Faculty wanted to determine if the investment of resources actually enhanced student

learning in required courses. Since the teaching styles of the two biology faculty members is rather diverse, the study was designed to examine perceived effectiveness among students when hypermedia was used directly by students in tutorials and when it was used by faculty in lab and classroom presentations.

Methodology

The project was developed as a collaboration between two biology faculty members, Nowicki and Hadley, and the Director of Applied Technology, Church. The faculty members previewed the two laserdiscs BIO SCI and BIO SCI II published by Videodiscovery and selected the still images and video clips they wanted to use. The text, screen layout, and navigation design was created jointly with the faculty member serving as the content expert and Church serving as the HyperCard stack developer.

When developing the tutorials to be used directly by students, a quiz providing immediate feedback was included in the stack. Navigation links enabled students to easily move back and forth between tutorial segments and quiz segments. Graphics, and audio clips when available, were selected based on their accuracy and clarity in relation to the objective the faculty member had designed for student learning.

HyperCard stacks created for lab and/or classroom presentations were very simple in comparison. Their primary function was to enable the professor to bring up the stills and video clips in any sequence desired on a specific topic. Text was limited to a simple title, an outline format, and/or button labels. These programs were designed to enable the professor to navigate easily on the laserdisc on a particular topic.

Jonassen (1988), after describing the conceptual basis for hypertext, suggested further research in the field. He indicated that hypermedia, including interactive video, seem to be promising tools for the educator attempting to work with students with a wide variety of learning styles and in light of current learning theories. While a few studies (Fritz, 1991; Huang & Aloi, 1991; Jones & Smith, 1992; Kramer, 1991) of the use of hypertext and interactive video exist related to post-secondary instruction, this research project was designed to focus on perceived effectiveness of these tools when used in conjunction with traditional materials and methods by students.

Minsky (1988), the inventor of the field of artificial intelligence, writes in *Society of the Mind* :

> The secret of what something means lies in how it connects to other things we know. That's why it's almost always wrong to seek

> the "real meaning" of anything. A thing with just one meaning has scarcely any meaning at all. (p. 55)

He postulates that the learner does not understand material until they understand it in more than one way. By presenting information and concepts in a variety of formats, and requiring learners to make active decisions about the pathways of learning, hypermedia enables, and in some cases requires, students to understand material from a variety of perspectives.

Parnell (1991) writes in the Chronicle for Higher Education about the wide variety of learning styles and the need to meet the audio and visual needs of the "Sesame Street Generation." It follows that the extensive use of both modes in hypermedia would better meet the learning style needs of today's college students. Bevilacqua's (1989) findings support this position: The navigational confusion which is present in some interactive applications at this early phase of development of interactivity will end as standards are set. She postulates, "Over time and use, hypertext will probably change our way of thinking" (p. 162). How students obtain, organize, and store information may change based upon the increasing use of hypertext in a variety of content areas.

Research on the effectiveness of hypermedia at Vanderbilt University, reported by Goldman and Barron (1990), found it "moves traditional college and university courses away from a teacher-directed lecture format and into a problem-solving/analytical mode" (p. 29). They also found that hypermedia provided an emphasis on process using higher order thinking skills, and the students were required to manage their own learning and develop strategies to construct meaning from the information and ideas presented.

Upon reviewing current literature on hypermedia and learning theory, Ambrose (1991) found that "research examing the relationships between hypermedia and learning has an unfinished quality" (p. 52). Phillipo (1989) proposed that hypermedia information is organized by association between words and the images in the mind. Kearsley (1988) noted the organization of human memory by these word associations parallels the hypertext structure and the interactive format. With these supportive studies in mind, the project was developed.

The Project

The first portion of the study was designed to determine the perceived effectiveness of interactive video as a teaching tool when used for class presentations for biological science majors. The second portion

of the study was to evaluate the perceived effectiveness of five campus-produced interactive laserdisc tutorials designed for individual and group use by students taking a general education biology laboratory course.

The first professor recruited was Alan Nowicki, Assistant Professor of Biology at Waldorf College and instructor for BIO 150: Zoology. He reported in a personal interview on November 12, 1992, about his first exposure to interactive video and his positive response to the political science videodisc and computer program entitled Election 88. During his graduate study, he reviewed this program with another graduate student and was impressed by the power of this new instructional tool.

Nowicki believed interactive video would be very useful in teaching biology. In this science, professors often discuss organisms and processes which are unfamiliar to most students. Many of the most difficult concepts require them to visualize complicated, three-dimensional processes. To have students see everything for themselves would be ideal, but it is currently impractical and the cost is prohibitive in most college biology laboratories.

The instructor for the general education BIO 105: Introduction to Biology, Sue Hadley, was the second recruit. She has a background in education and an understanding of students with learning disabilities. At

the time of the study, she was seeking new ways to present the material in a more visual format and to provide guided independent practice.

There were 16 students who remained registered throughout the semester in the majors' zoology course, BIO 150. In the general education introductory biology course, BIO 105, 45 students remained registered throughout the semester. These were the only students from whom written feedback was obtained.

This study focused on the use in college biology courses of the visual and auditory data bases contained on the BIO SCI and BIO SCI II laserdiscs. The images and information were accessed through HyperCard, an interactive program included in the factory-installed software bundle on Macintosh SE computers.

A Sony large screen LCD projection system and sound system were used when the laserdisc images were presented with the lecture or to a lab section as a whole. When the HyperCard screens also provided valuable information and/or terminology, a LCD overhead projection panel was used to create a two-screen, side-by-side presentation. One screen provided the images and sound from the laserdisc while the other displayed the computer screen.

Nowicki used interactive video as a review of lecture presentations. Once a week he set aside time, at the end of class, for students to see still images and video sequences of animals, processes, and concepts they had discussed during the week in lab and/or class. He used both videodiscs BIO SCI and BIO SCI II, each of which contains over 53,000 still images and several dozen video sequences on a wide variety of biological topics.

Normally, Nowicki would review 10-15 still images and several short video sequences in each weekly session. Students already had the information they needed in their notes, so they could concentrate on the images and audio track, when available. He noted that using the images and video clips stimulated student interest as evidenced by the many perceptive questions posed by students during class after viewing the images and motion sequences.

One example of a complex process for which interactive video was used was animal development from a single egg to a fetal organism. The key to learning the stages was for students to actually see the entire process. Unfortunately, to watch the development of frog eggs in the laboratory would have required delicate manipulation of the eggs and then observing them with a strong microscope for several days. The two

minute videodisc sequence which used time-lapse photography of frog development was shown. This allowed students to see the entire process of development, and it was stopped at critical stages and replayed as questions arose.

Other full-motion sequences which were particularly helpful provided examples of animal locomotion. The movement of the starfish is very difficult to describe verbally, yet very clear when the movement is viewed. Likewise, the jetting of a squid and the locomotion of a scallop are best understood when seen, especially in slow motion.

Hadley wanted to create a series of interactive tutorials with the BIO SCI II laserdisc and HyperCard. Specific topics were causing students to experience difficulty mastering the material, so self-contained study sessions which included self-evaluation with immediate feedback would be beneficial. She served as the content specialist and Church created the HyperCard stacks using Hadley's screen design, terminology, organization, and selected images. The topics for the tutorials produced were: monera, protista, fungi, embryonic development and plant mitosis.

Hadley used some of these with a LCD large screen projection unit for lecture and lab. She frequently used the tutorial as a lab station for lab partners. The tutorials were also available in the Academic Achievement

Center, a student learning center, from 6:30 in the morning until 10 p.m. five nights per week for individuals and groups to review the materials.

At the end of the semester, an anonymous survey of students in both classes was conducted to obtain student opinions regarding the effectiveness of interactive video for lecture and lab presentations, as well as for individual and small group tutorials (See Appendix A and B). Students were asked to rate the use of interactive video on a three-part scale that ranged from very useful to of little use. Further, they reported which, if any, programs they had used independently during the semester.

Results

Biology 105 data. The survey form for this course, provided in Appendix A, was administered to 45 students. As shown in Figure 1, 96% of the students in this general education biology course found the interactive tutorial programs to be very or somewhat useful when used as part of a classroom lecture. Similarly, as shown in Figure 2, 96% of these students found the interactive program to be very or somewhat useful as a part of the lab experience.

Figure 1. Forty-five students in Biology 105 (general education biology) responded to the question of how useful the interactive video presentations were during lecture.

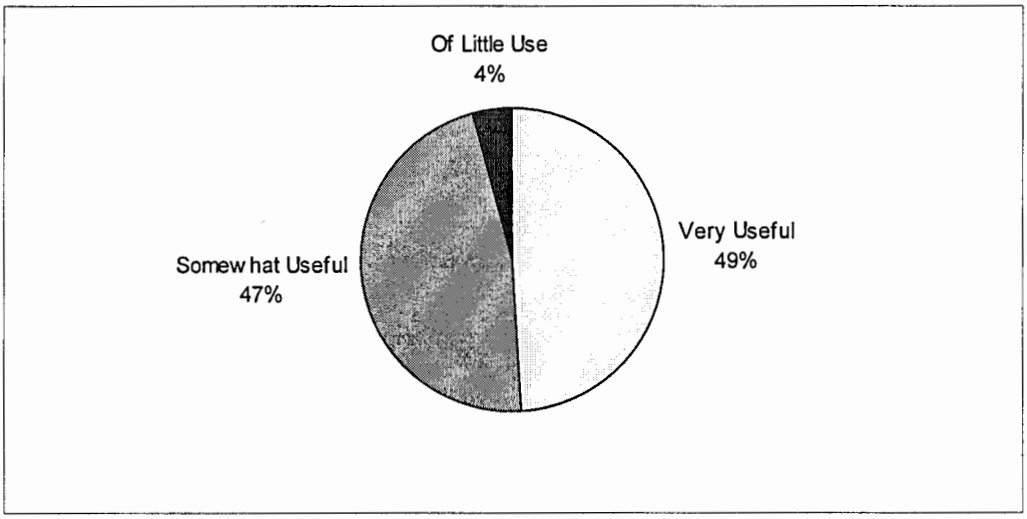
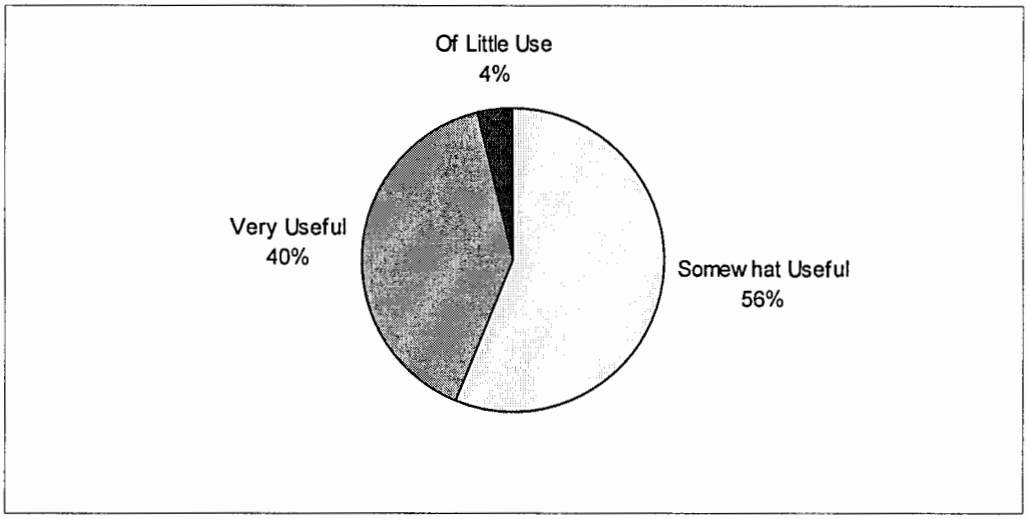


Figure 2. Forty-five students in Biology 105 responded to the question of how useful the interactive video presentations and tutorials were during labs.



An important component of this study was to survey the effectiveness of these programs in preparing students for tests. Student responses shown in Figure 3 indicate 93% found the interactive programs to be very or somewhat useful for test preparation. When used to present new vocabulary, 84% of the students, as indicated in Figure 4, found the programs to be very or somewhat useful. It was Hadley's belief that the 16% who found the program to be of little use with vocabulary probably corresponded to the number of students who had a good biology background from high school.

Figure 3. Forty-five Biology 105 students responded to the question of how useful the interactive video presentations and tutorials were for quizzes and tests.

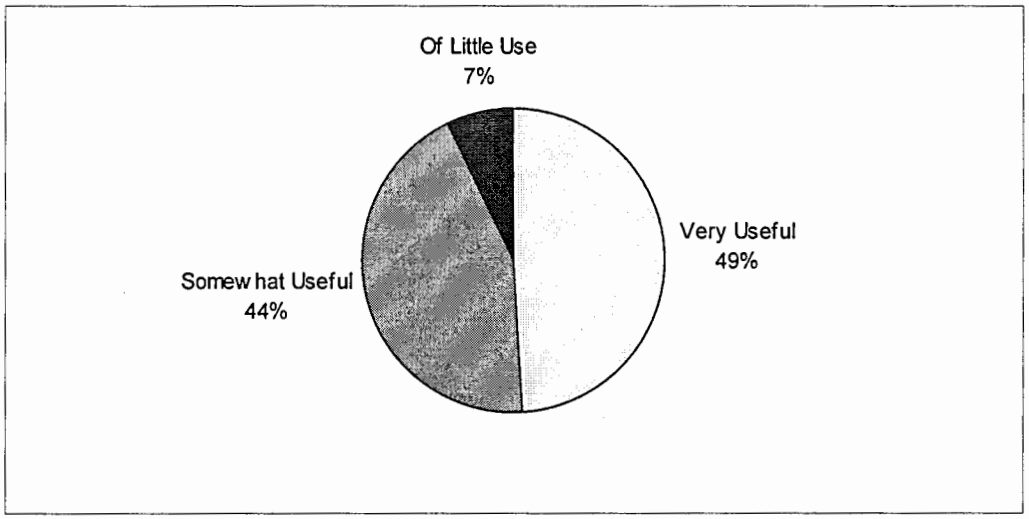
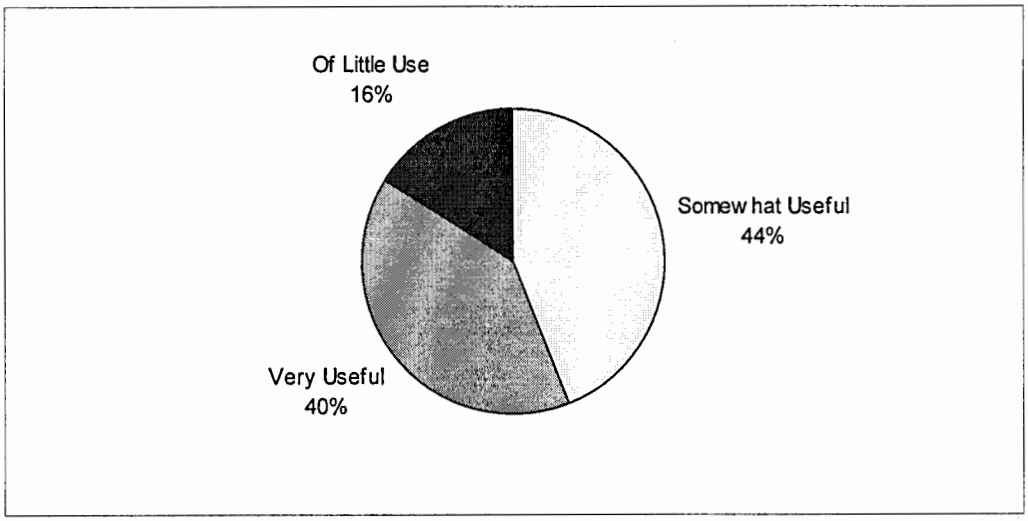
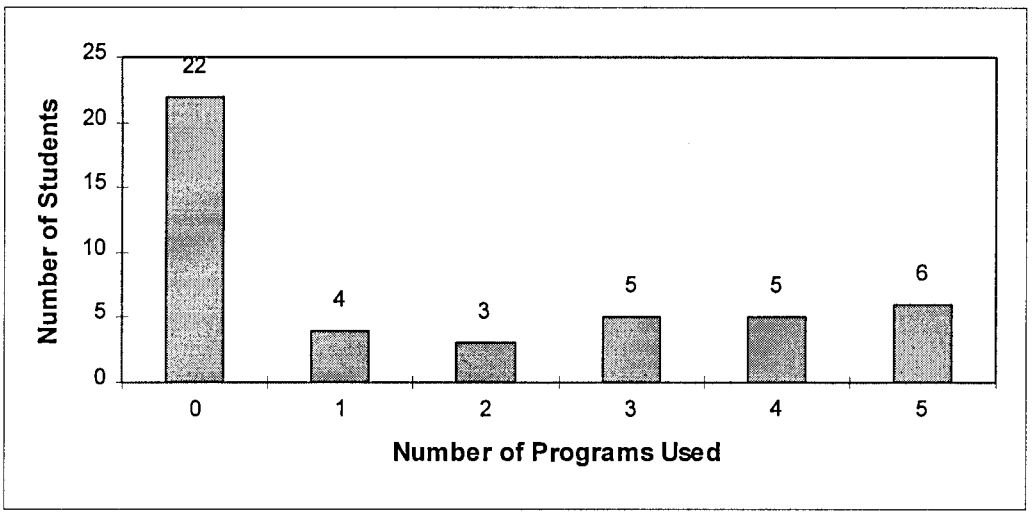


Figure 4. Forty-five Biology 105 students responded to the question of how useful the interactive video presentations and tutorials were for learning new terminology.



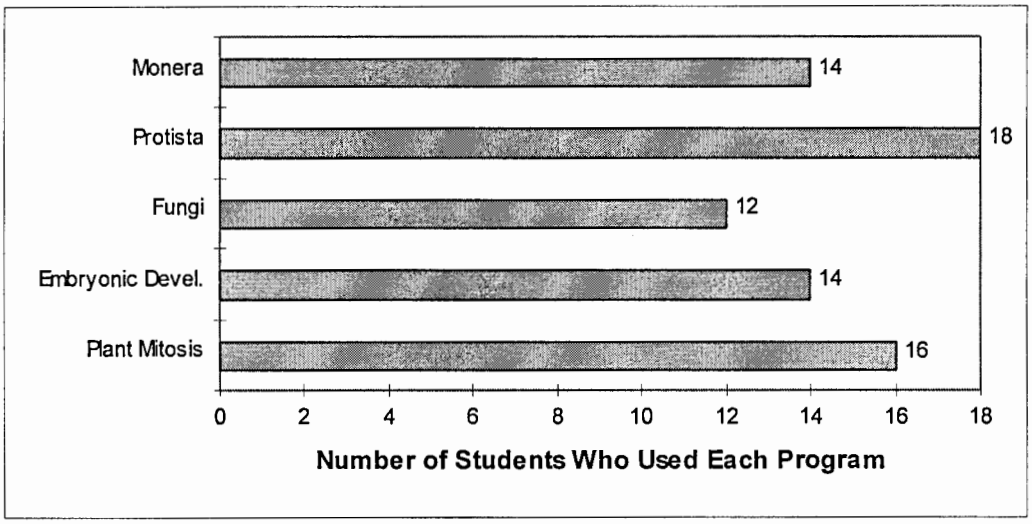
Another means of measuring the perceived effectiveness of these programs was to document how many students had chosen to use them on their own time in the Academic Achievement Center (AACE). As shown in Figure 5, over 50% of the students used the tutorials at least once, which demonstrated an interest by the students in the interactive video format and a perception of it as educationally valuable.

Figure 5. The number of topics used independently by students. Note that 51% of the 45 students surveyed used the tutorials independently at least once in AACE.



In an attempt to determine if one topic was clearly better adapted to the interactive format, students were asked which of the five programs they had used. As shown in Figure 6, the most frequently accessed program was on the protista kingdom and the least used was on the fungi kingdom. It is interesting to note that on average each program was used by at least one-third of the students, which indicates all topics were found valuable.

Figure 6. The number of students who independently used each of the five tutorial programs in AACE. The mean number of students who used each program is 15.



Biology 150 data. The survey form used to judge effectiveness of interactive video is in Appendix B and was administered to 16 students. The interactive programs designed for the zoology course were intended primarily for classroom presentation of information. When the perceived effectiveness of the programs used during lectures was evaluated, students had a strong positive response. As shown in Figure 7, all students found them very or somewhat helpful, with 56% rating them very helpful. When the programs were used to review material which had been

covered earlier in the week during lecture, all students found them to be somewhat or very useful, as noted in Figure 8.

Figure 7. Sixteen students in Biology 150: Zoology responded to the question of how useful the interactive video presentations were for understanding new material.

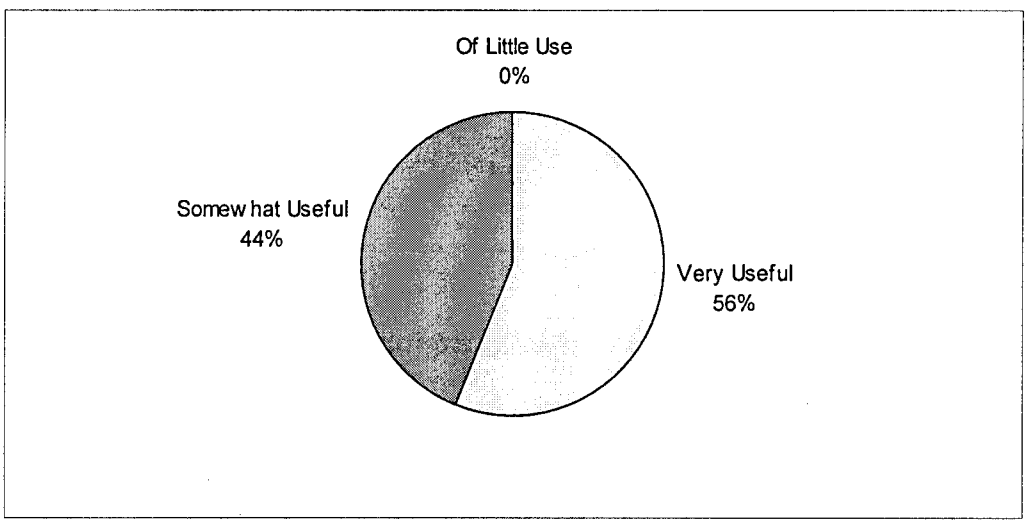
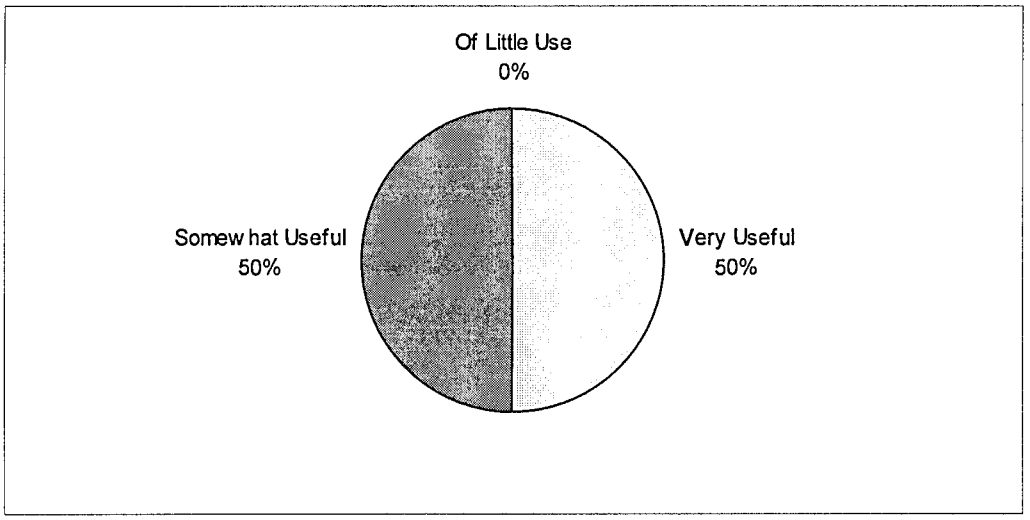
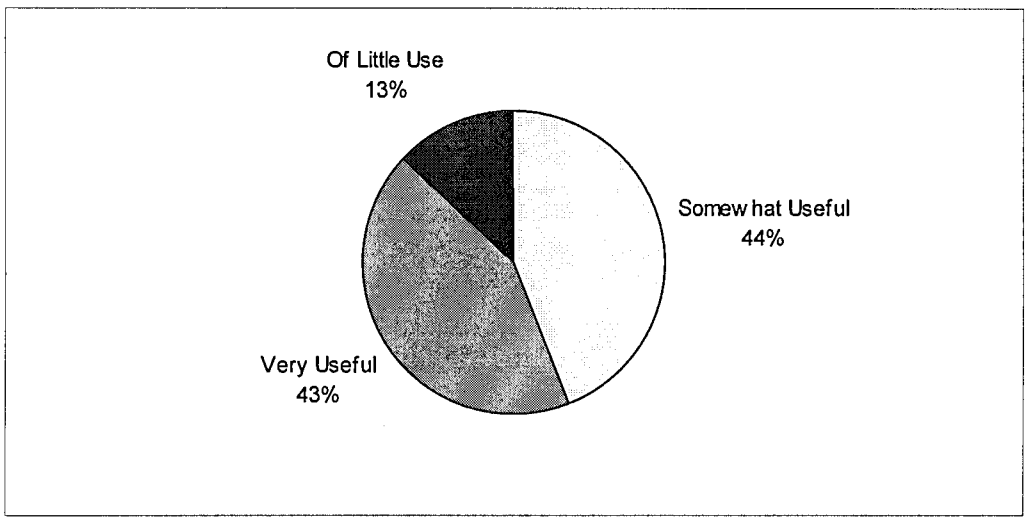


Figure 8. Students in Biology 150 responded to the question of how useful the interactive videos were in reviewing material covered earlier.



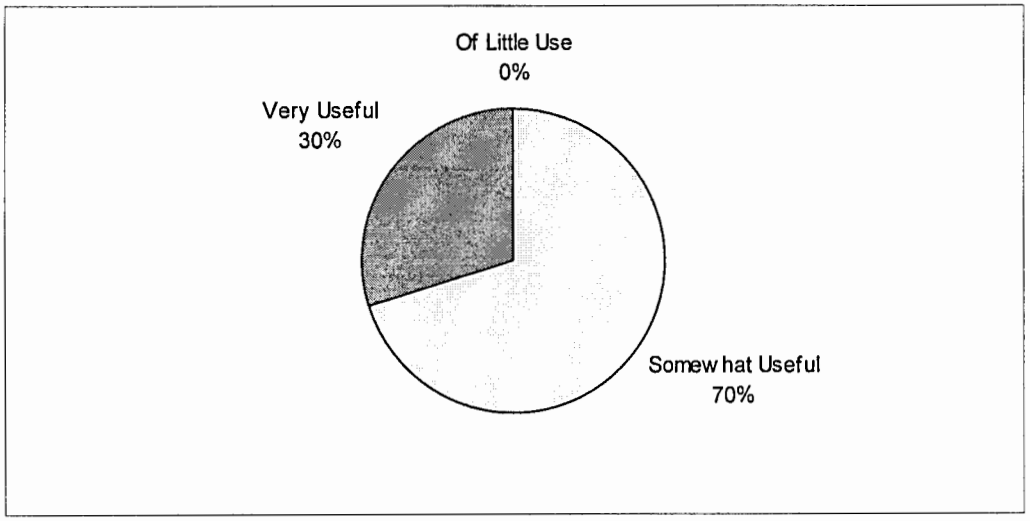
When asked about the effectiveness of the programs in learning new vocabulary, 88% found them somewhat or very helpful, while only 12% found them of little use, note Figure 9. Again, the professor believed those who found them of little use may have had a strong biology background or preferred a text-based learning style.

Figure 9. Students in Biology 150 responded to the question of how useful the interactive videos were in learning new vocabulary.



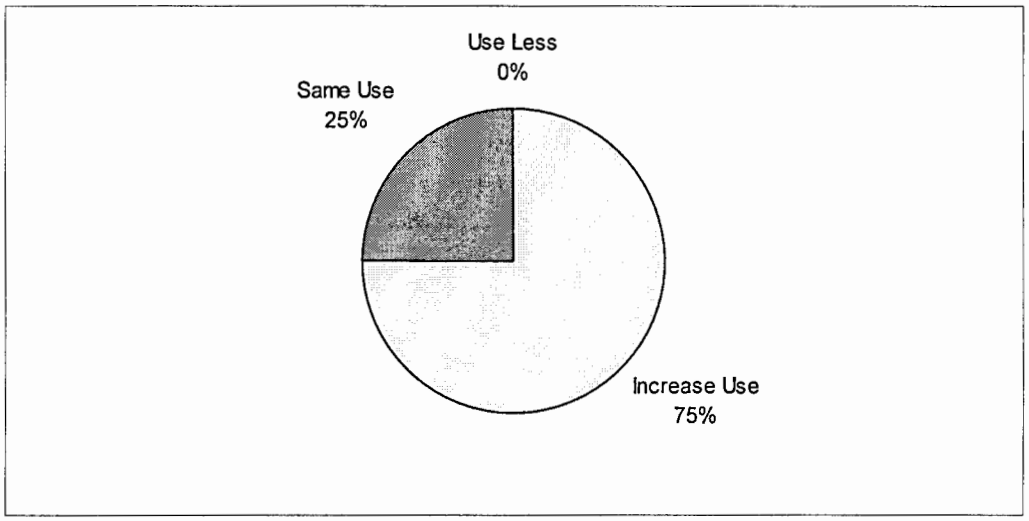
The affective domain is difficult to evaluate, but an attempt was made to do so by asking if the interactive programs generated more interest in the lectures. As Figure 10 indicates, students overwhelmingly found the visual format a strength. Over 80% responded that the interactive programs were very useful in developing interest in the lectures. This response seems to confirm the notion that "TV babies" are more comfortable learning in a visual-rich environment.

Figure 10. Students in Biology 150 responded to the question of how useful the interactive videos were in developing their interest in lecture material.



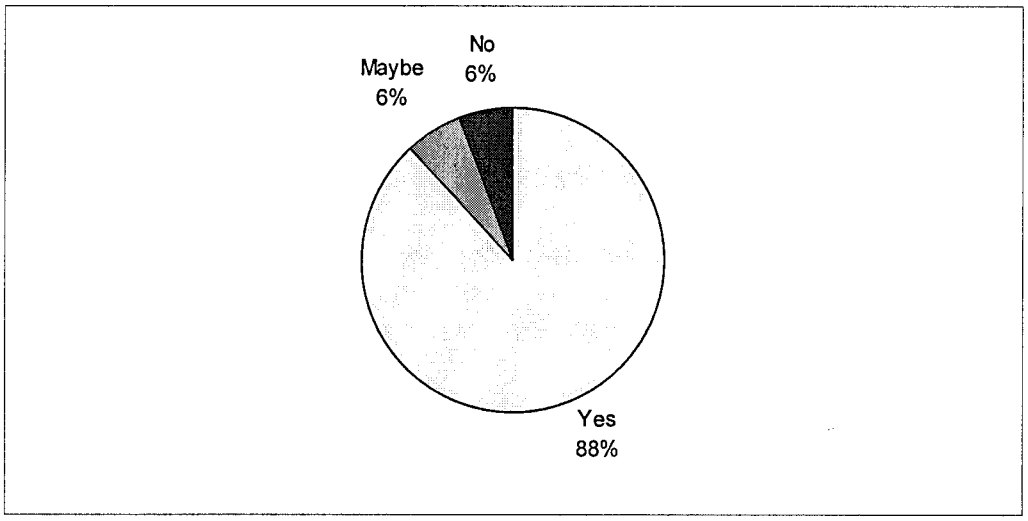
Confirming the assumption that traditional students prefer material presented in a graphic format were the responses shown in Figure 11. When asked about the use of these interactive videos in the classroom in the future, 75% requested increased use with 25% suggesting the use stay at the same level. It is notable that no students suggested they be used less or not at all.

Figure 11. Students in Biology 150 responded to the question of how they would like to see interactive video used in this class in the future.



Again, in an attempt to further evaluate the effectiveness of these video tutorials, students were asked if they would have used them independently if they had been available in AACE. As indicated in Figure 12, 88% said they would use them, while 6% said maybe they would use them and another 6% said they would not use them.

Figure 12. Students in Biology 150 were asked if they would use interactive video tutorials if they were available in AACE.



Conclusions and Recommendations

Based on the survey results presented, and the results of the literature search on interactive video, it may be concluded that this tool is a valuable one for the college educator. Interactive videos are perceived to be very effective by students and faculty when used in the lecture hall, the laboratory, or independently in a tutoring center.

Traditional-aged college freshmen have grown up in an environment which is rich in graphic and auditory information. From Sesame Street to MTV, they gain a great deal of information about their world from video, rather than from reading texts.

Professors can increase student learning and interest by being aware of this learning style preference and including interactive video materials in their course design. One question faculty face is how to teach to "high-tech teens" in a low-tech classroom. Adding interactive technology is time consuming and expensive, especially on a per-capita basis on a small campus. However, because it has been found to be perceived as effective by college students and is supported by current thinking in educational psychology (Kearsley, 1988), continued development of materials in this format is suggested.

Since interactive materials generated in-house can easily be revised and updated, they can be used over the course of many semesters with a variety of textbooks. The faculty in this study believed the initial investment of their time was wise in light of the long term effectiveness of the programs. In fact, honors students have been recruited to create new interactive tutorial video programs in chemistry and physical science. These will be generated as guided studies as capstone projects.

With the increased interest and use of interactive video programs, it is anticipated that more titles will be professionally produced to support college courses. Just as many publishers offer videos and computer

software to support their texts, it is logical to anticipate their offering accompanying interactive video presentations and tutorials in the future. These will most likely be offered in the CD-ROM based format as home computers become more sophisticated and be sold in the bookstore as a supplement to the textbook, as text-based study guides are currently marketed. They may be made available to the professor free of charge or for a nominal fee upon adoption of a textbook for a course.

As post-secondary educators become more aware of the diverse learning styles of today's students, they may become more open to new tools of technology and teaching methods to meet the needs of their students. These new approaches would be used in conjunction with traditional materials, such as printed textbooks and lab manuals.

As a result of these findings, Waldorf College has continued to develop other tutorials for biology classes. New tutorial and presentation topics completed include: plant kingdom, animal kingdom, cell structure, and tropical rain forests. A new format was developed for the program on the tropical rain forest, using interactive video and text to illustrate the problems in the rainforests. This class presentation was designed to motivate students to explore and conduct research in an independent assignment to develop and propose solutions to this global problem.

Further evaluation of the effectiveness of these new programs will be conducted as a part of our on-going study of the use of interactive video and hypertext in college courses.

Appendix A

Biology 105 Interactive Videodisc Survey

How useful to you were the interactive videos in helping you:

a) understand new material presented in class lectures?

VERY USEFUL SOMEWHAT USEFUL OF LITTLE USE

b) understand assignments and activities in lab?

VERY USEFUL SOMEWHAT USEFUL OF LITTLE USE

c) understand, review and remember information for quizzes and exams?

VERY USEFUL SOMEWHAT USEFUL OF LITTLE USE

d) learn new vocabulary and terminology?

VERY USEFUL SOMEWHAT USEFUL OF LITTLE USE

Check which of the following videodisc programs you used in the AACE:

_____Monera

_____Protista

_____Fungi

_____Embryonic Development

_____Plant Mitosis

_____Biomes

Appendix B

Biology 150 Interactive Videodisc Survey

How useful to you were the interactive videos in helping you:

a) understand new material presented in class lectures?

VERY USEFUL SOMEWHAT USEFUL OF LITTLE USE

b) reviewing material covered earlier?

VERY USEFUL SOMEWHAT USEFUL OF LITTLE USE

c) learning new vocabulary?

VERY USEFUL SOMEWHAT USEFUL OF LITTLE USE

d) developing an interest in lecture material?

VERY USEFUL SOMEWHAT USEFUL OF LITTLE USE

How would you like to see interactive video used in this class in the future?

INCREASED USE SAME USE USED LESS

Would you use interactive video tutorials if they were available in the AACE?

YES MAYBE NO

Appendix C

Commercial Software Used in This Research Project

BIO SCI videodisc: Complete image database for biological science. (1983). Seattle: Videodiscovery, Inc.

BIO SCI II videodisc: Complete image database for biological science. (1990). Seattle: Videodiscovery, Inc.

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