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Canada
A STUDY OF THE EFFECTIVENESS OF AN INTERACTIVE VIDEODISC LEARNING SYSTEM AS AN ADJUNCT TO INSTRUCTION

by

Euclid Seeram

B.Sc., Carleton University, 1975

THESIS SUBMITTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE (EDUCATION)

in the Faculty

of

Education

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SIMON FRASER UNIVERSITY

July 1990

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(c) Flowchart of the Interactive Videodisc Lessons
(d) Table 3 in your thesis.

Thank you for conducting this study of our Interactive Learning System. We look forward to a copy of the thesis.

Sincerely,

Dave Martin, B.Sc.(Hons)
Basic Health Sciences.
APPROVAL

Name: Euclid Seeram
Degree: Master of Science (Education)
Title of Thesis: A Study of the Effectiveness of an Interactive Videodisc Learning System as an Adjunct to Instruction.

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ABSTRACT

This study was designed to investigate the effectiveness of an Interactive Videodisc (IVD) Learning System as a tool to help students revise, clarify and consolidate materials received from lectures. Opportunities to review and refine new knowledge on a more individualized basis have been the identified learning needs of students enrolled in the Anatomy and Physiology course at the British Columbia Institute of Technology, and these needs arise from the lack of small group tutorials and visual enrichment activities. The study also examined the application of an instructional intervention procedure, labelled knowledge lack identification procedure (KLIP), for enhancing the effectiveness of the system. The third goal of the study focussed on the strategies students used when working with the videodisc materials.

Fifty-one students participated in the study on a voluntary basis. The students took a pretest, after which they attended lectures and were subsequently randomly assigned to three groups, each under a different instructional condition, to revise, clarify and consolidate knowledge introduced to them in the lectures. These groups included (a) an interactive videodisc group using the disc materials and subjected to the KLIP (IVD KLIP Group), (b) an interactive videodisc group using the disc materials but not subjected to the KLIP (IVD...
Group) and (c) a tutorial group mediated by a teacher (Teacher Group).

After the treatment phase, all groups wrote a posttest and students in the two videotape groups completed two questionnaires. Data analyses revealed that there were no significant differences among the groups on achievement. The mean posttest score of the groups, however, was significantly different from the mean pretest score. This showed that the Learning System and the small group tutorial mediated by a teacher were equally effective in providing revision, elaboration, and refinement opportunities in learning. The use of the KLIP was not powerful enough to generate greater learning as measured by the test items.

Students were positive toward the Learning System and the application of the KLIP generated more considered comments on the use of the system. With respect to how students used the videotape lessons, two major patterns emerged. The first and most popular was the linear survey employed by both videotape groups. The second was the selected review strategy. It is important to note that while 36% of the IVD KLIP Group used the selected review strategy, only 5% of the students in the IVD Group chose this strategy. This suggested that the identification of knowledge lacks might have guided students to explicitly think about their learning and make selections of materials addressing areas of concern.
DEDICATION

This thesis is dedicated with love and affection to my wife, Trish, a very special person in my life.
"In a world where pictures are literally in the air, the use of electronic imagery as a visualization tool seems obvious. What is not so obvious is how to grasp the tool."

Massachusetts Institute of Technology
ACKNOWLEDGEMENTS

It is always a pleasure to acknowledge the assistance of those individuals who have supported and contributed to the growth and development of this thesis from the point of conception to its completion.

First, the idea for this work came from Dr. Brian Gillespie, the former Dean of Health Sciences, and now Vice President of the British Columbia Institute of Technology (BCIT). Thanks Brian, for giving me the opportunity to conduct this study. I am also grateful to Professor Wolfgang Rothen, formerly of Simon Fraser University, who not only assisted me in developing the initial research proposal but introduced me to the three paradigms upon which the Computer in Education is based. This thesis is related to the instructional systems paradigm.

I owe special thanks to my senior supervisor, Dr. Evelyn Ng, who has given much of her time to review, discuss, evaluate and shape not only the research proposal, but every phase of the research process and documentation. She has provided me with a good deal of support and encouragement and I am indebted to her for her careful and valuable reviews. I must also express my sincere appreciation to Dr. Glenn Kirchner, who has also offered critiques of the thesis. His good counsel and encouragement have shaped the manuscript.
I am grateful to all the individuals at BCIT who willingly participated in the study. These include the students from Medical Radiography, Electrophysiology and Nursing; Dave Martin and Len Brownlie (the two instructors who graciously contributed their time and allowed me to observe their own teaching), and Shirley Hundvik. Shirley acted as an observer during the small group tutorials and gave up four hours of her own class time to assist me in scheduling the students.

I must also thank Dr. John Emes and Tom Nowak for making up the achievement examination used in this study. Thanks to Griff Richards and Peter Fenrich of the Interactive Videodisc Development Center (BGIT) for providing a workable schedule for the students and for answering my numerous questions on the Interactive Learning System.

Last, but not least, I must acknowledge the assistance of Dr. Nand Kishor of Simon Fraser University (SFU) for statistical analyses of the data using SPSS software on the SFU mainframe, and to Shirley Heap for typing the manuscript.

Finally, my family's encouragement and support are not to be overlooked. I am especially grateful to my lovely wife Trish, a very warm, caring and special person in my life, for her endless support and encouragement throughout the many years, and to my son, Dave, a very special young man.
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CHAPTER 1

The Nature and Scope of the Study

Introduction

Learning systems which support instructional processes that require the student to be an active participant in learning have received increasing attention (Barker, 1987). One such system is the computer-based interactive learning system which involves two different technologies, computer and video display technologies (Hon, 1982) -- "merging the interactive benefits of the computer with the realism of video" (Dalton, 1986, p. 122). By virtue of its design interactive video offers unique capabilities (dynamic presentation and retrieval of text, computer graphics, animation, video and audio) for teaching and learning of visually-oriented subject matters. These capabilities make interactive video a potential tool for use in education and already, several projects are being explored (Bolton, Every & Ross, 1990; Chandra, Hinton, & Phillips, 1990; Litchfield & Mattson, 1989; Stokes & Stafford, 1989).

Study Background, Practical Problems and Needs

Background

In December, 1986, a joint project between the British Columbia Institute of Technology (BCIT) and International Business Machines (IBM) Canada, was undertaken to investigate the application of
Interactive Videodisc Technology in education, particularly in Health Sciences education. This effort evolved as a result of a plan to IBM and the British Columbia Ministry of Education regarding IBM's public information system (IBM InfoWindow Display System coupled to a laser videodisc player) used at the EXPO-86 World's Fair held in Vancouver, British Columbia. The plan came at the same time when BCIT was moving ahead in its development of computer-based learning activities.

Once preliminary efforts had been established, faculty members at BCIT were invited to submit proposals for an interactive videodisc project to the School of Health Sciences. Several proposals were submitted but only two were accepted, one of which was titled "The Anatomy and Physiology of the Heart" and the other was related to patient care technology. It is interesting to note that the author of this thesis submitted a proposal (dealing with computed body scanning techniques), however, it was not accepted since it did not meet the practical needs of the joint project.

Practical Problems and Need for the Study

BCIT is a postsecondary technological institute which offers two-year diploma programs in the fields of Engineering, Business and Health Sciences. Within the School of Health Sciences, there are twelve Health Technology Programs (see definition of terms) which admit over three hundred full-time students every year.

Common to all these programs is a course on Human Anatomy and
Physiology which every student must take in order to fulfill the requirements of his/her individual program. The proposal to build an interactive videodisc on the Anatomy and Physiology of the Heart was centered around the practical problems encountered by the Basic Health Sciences department which has the responsibility of delivering this course.

As illustrated in Table 1, this course is conducted in the form of lectures. No tutorials and laboratory exercises are available. It was felt by the teaching staff that this course needed a component to provide visual reinforcements and enrichment activities to clarify, consolidate, and elaborate on material prior to mid-term and final examinations (IVD Preliminary Needs Assessment, 1986; Martin, 1988).

Some of these concerns have been supported by Yong (1989) who argues that large class sizes tend to foster problems for teachers. These problems range from difficulties in getting to know students, lack of personal coaching, increased teacher workloads and a one way flow of information from teacher to student. Moreover, since students do not learn at the same pace, the delivery of instruction has to be balanced accordingly. Yong (1989) emphasizes that:

a small class with a size of 10 students is ideal for this approach; such a classroom environment can provide closer interaction among learners and the subject expert. In addition, one-to-one coaching and personal tuition can be practised without too much difficulty. (p. 79)
Table 1

**Delivery Details of the Course Entitled Anatomy and Physiology**

<table>
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<th>Subject</th>
<th>Human Anatomy and Physiology (about fifteen topics)</th>
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<td>Population</td>
<td>About three hundred students enrolled in the day school (full time) Health Technology Programs, divided into several groups of various sizes as per technology.</td>
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<td>Staff</td>
<td>4.2 available</td>
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<td>Delivery of Instruction</td>
<td>The course is conducted in the form of lectures, on an average of four hours per week for lectures.</td>
</tr>
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<td>Resources</td>
<td>Similar lecture notes for all classes especially introductory sessions such as Cardiac Basics and Anatomy of the Heart. There are deviations in content and level of presentation for other topics which are relevant to the technologies themselves.</td>
</tr>
<tr>
<td>Evaluation</td>
<td>Short quizzes, two mid-term tests and one final examination. All tests are primarily of the multiple choice format.</td>
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However, group tutorials and laboratory exercises cannot be arranged at BCIT owing to the small number of teachers, the problems of acquiring and maintaining equipment and other problems in scheduling students and cost constraints relating to equipment, servicing and hiring of laboratory instructors. Alternatives therefore, would have to be devised to meet the needs and concerns of teachers and the needs of students.

This resulted in the final approval to build an interactive videodisc program on the Anatomy and Physiology of the Heart. The project was perceived as a practical solution to the above problems. The interactive videodisc lessons would provide students with a visual support system and an opportunity to interact with the materials on an individual or group basis (revising, reviewing, and consolidating knowledge at their own pace).

An equally important issue in teaching a visually-oriented subject such as Human Anatomy is that very few teachers can accurately represent complex phenomena in real time on the chalkboard or with an overhead projector. While few two-dimensional illustrations can provide precise, accurate and easy-to-understand representations of three-dimensional objects, some students may have difficulty in trying to visualize three-dimensional anatomy from two-dimensional illustrations. It is quite possible that these students may benefit with more realistic visual reinforcements.

The development of the interactive videodisc on the Anatomy and
Physiology of the Heart proceeded with much enthusiasm and dedication. While this venture has a number of goals, one central objective was to evaluate the Interactive Videodisc Learning System for use at BCIT. Evaluation is mandatory to provide decision makers with credible evidence about the effectiveness of such a costly instructional system. Also, evaluation results should help to provide meaningful directions to the logistics of effective implementation of such Interactive Learning Systems at BCIT. This study was designed to evaluate the effectiveness of the Interactive Videodisc Learning System as a tool to enhance learning by addressing the needs of the instructional environment.

The evaluation study falls under the category of "Research with Media" (Clark, 1983) of which the literature is replete with studies reporting the effects of various types of learning systems on student achievement and attitudes.

**Problems with Media Research**

Several studies on the use of interactive video for educational applications have been published and Bosco (1986) has conducted a meta-analysis of evaluation studies of interactive video. Bosco's analysis indicates that typical evaluation studies compared experimental and control groups in which case the "control group usually receive the instruction which the disc or tape was intended to replace" (p. 8). In this regard, most of the studies appeared to have
compared interactive video with the more traditional forms of instruction using the videodisc to teach a particular topic in its entirety. Bosco suggests that future evaluations of interactive learning technologies be directed at exploring practical classroom applications and not simply as stand-alone competitors to human instruction.

Also, comparative media studies have been criticized by several workers, most notably Clark (1983) for attributing achievement gains to the delivery medium. In addition, several methodological problems with this approach preclude the possibilities of even producing interpretable data. The treatments are too grossly defined and they are confounded with differences in content, instructional strategy and the novelty effects of newer media.

If however, the competing treatments in an experiment of this kind were controlled the conceptual problems would then become apparent. If the only difference between the treatments were the medium it would become clear that "media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers groceries causes changes in our nutrition". (Clark, 1983, p. 445)

Clark (1983) asserts that achievement gains in learning from media is primarily due to the instructional strategies employed as well as the messages conveyed by the media. He therefore suggests that future research in this area be directed at examining these factors.

This study was designed to investigate the use of the Interactive Videodisc Learning System on the Anatomy and Physiology of the Heart as a tool to enhance learning.
Objectives of the Study

As discussed earlier, the instructional environment for students enrolled in the Anatomy and Physiology course is void of tutorials and visual enrichment activities. From the very beginning of the joint project, it was strongly emphasized that:

the "Anatomy and Physiology of the Heart" is designed to support instruction and learning and is not designed to completely replace any current method of instruction. (IVD Development Project, 1987, p. 1)

Keeping this goal in mind and the problems previously identified, this study has attempted to address the following objectives:

1. To evaluate the effectiveness of the Interactive Videodisc Learning System using three different instructional conditions intended to help students revise, clarify, elaborate and consolidate knowledge received in lectures.
   To this end, achievement and attitudes were used as measures of effectiveness.

2. To investigate an instructional intervention procedure, labelled knowledge lack identification procedure (KLIP), for enhancing the effectiveness of the system.

3. To explore how students interact with the Interactive Videodisc lessons.
Definition of Terms

The terms used in this study are defined as follows:

1. **Authoring Language**
   
   "A computer language which is specifically designed for developing computer-assisted instruction. In order to be effective, the user requires some knowledge of computer programming" (Schwier, 1987, p. 171)

2. **Achievement**
   
   Students’ learning from the lesson materials on the Anatomy and Physiology of the Heart used in this study. This is expressed as a per cent score obtained on a multiple-choice test.

3. **Attitudes**
   
   Feelings or opinions of students toward the Interactive Videodisc Learning System used in this study. These feelings or opinions are recorded using a Likert-type scale with an inventory of statements to which responses ranging from strongly agree, agree, and neutral to disagree and strongly disagree, are noted about the statements.

4. **Basic Health Sciences Department**
   
   The core department which delivers instruction in Human Anatomy and Physiology, immunology, pathophysiology, microbiology, human development, organizational
psychology and sociology.

5. **Flowchart**

"A diagram which illustrates the path a user can follow through an instructional treatment" (Schwier, 1987, p. 172).

6. **Health Sciences Programs**

These refer to two-year Diploma of Technology Programs in Health Sciences offered at BCIT. They include Biomedical Engineering, Diagnostic Medical Sonography, Electrophysiology, Environmental Health, Health Information, Medical Laboratory, Medical Radiography, Nuclear Medicine, Nursing, Occupational Health and Prosthetics and Orthotics.

Students who participated in this study came from Electrophysiology, Medical Radiography and Nursing. These three technologies are described in Appendix A.

7. **InfoWindow Display**

This is a Display monitor which includes an advanced touch-sensitive screen as the interface between the user and the computer. This allows the InfoWindow Display to be used in setting where a keyboard is not desirable or practical. The touch-sensitive screen is regarded as a "friendly" interface (IBM, 1990).
8. **Interactive**

"Involving the active participation of the user in directing the flow of the computer or video programme" (Parsloe, 1983, p. 259).

9. **Interactive Video**

"The convergence of computer and video technology: a video programme and a computer programme running in tandem under the control of the person in front of the screen. In Interactive Video, the user's actions, choices, and decisions genuinely affect the way in which the programme unfolds" (Parsloe, 1983, p. 259).

10. **Interactive Videodisc Learning System**

The Interactive Videodisc system which includes a videodisc player coupled to the IBM InfoWindow System used in this study.

11. **Instructional condition**

An instructional condition to help students review, revise, elaborate and consolidate the understanding of knowledge introduced in the lectures. (This is further elaborated in Chapter 4.)

12. **Knowledge Lack Identification Procedure**

An instructional intervention procedure in which students are asked to identify uncertainties and confusions about material received from lectures.
(This is further elaborated in Chapter 4.)

13. **Likert-scale**
A scale based on five points, strongly agree(5), agree(4), neutral(3), disagree(2) and strongly disagree(1), used to determine students' attitudes toward the Interactive Videodisc Learning System used in this study.

14. **Observation**
The use of a video camera to record how students use the Interactive Videodisc Learning System.

15. **Touch-sensitive screen**
"In computer-based technology, a screen which acts as a control device under the user's touch. Basic functions are executed by touching or stroking certain parts of the screen, and specific responses made by touching appropriate words, messages or pictures as they appear" (Parsloe, 1983, p. 271).

16. **Interaction strategies**
The main ways in which students work through the interactive videodisc lessons.

17. **Videodisc**
"an electronic communications medium that has audio and video messages encoded in grooves on a flat surface. The grooves are read by a stylus (capacitance disc) or
by an optical laser. Laser discs offer random access and are more durable; thus they are better suited than capacitance discs to interactive video" (Iuppa, 1984, p. 126).

Organization of the Study

This thesis is organized into six chapters. The first chapter lays the groundwork for the study. Chapter 2 deals with a review of the literature on videodisc technology, the educational potential and applications of interactive videodiscs and evaluations of these systems.

Chapter 3 presents a description of the Interactive Videodisc Learning system used in this study including the hardware, software, instructional content and program pedagogy. There is also a brief description of the interactive videodisc learning center where the study was conducted. Chapter 4 explains the methodology of the study, describing the pilot study, the variables, subjects, design, procedures and measures. Chapter 5 reports the analyses and results of the data collected during the study. Finally, Chapter 6 presents a discussion of the findings of the study. In addition, conclusions, recommendations and suggestions for future research are reported.
CHAPTER 2

Review of the Literature

Introduction

It is perceived that interactive, individualized forms of instruction which can accommodate different academic backgrounds and learning styles may attain the desired goal of educational flexibility. While traditional computer-assisted instruction (CAI) offers many advantages for interactive learning, it lacks the power to present visual representations which are important in many learning situations. As a result other forms of instructional innovations are needed. One such form of innovative system is interactive video. Recently, interactive videodisc learning systems have received increasing attention in the literature in a wide variety of learning contexts (Ackerman, 1989; Bayard-White, 1986; Branch, et al., 1987; Bunderson, et al., 1984; Dalton, 1990; Hon, 1982; Lehman, 1986; Redland & Kilmon, 1986).

This chapter presents a review of the literature on interactive video within the context of instructional effectiveness. First, a brief review of videodisc technology is presented, followed by an introduction to the educational potential of interactive video. Second, the literature on instructional effectiveness is discussed with particular emphasis on the effectiveness of interactive video learning systems dealing with heart concepts.
Since one of the instructional conditions used in this study is based on the use of an instructional intervention procedure for enhancing the effectiveness of the interactive videodisc learning system, the literature on this procedure will be reviewed as well. Additionally, the literature on how students use videodisc learning systems will be presented.

**Videodisc Technology**

The history of video technology can be traced back to the 1920's when John Baird used a mechanical scanning disc to transmit television images (Ullmer, 1989). In the 1970's, three different and incompatible videodisc systems emerged; the capacitance electronic disc, the video high density disc and the optical laser disc manufactured by Sony, Pioneer and Magnavox. A chronology of optical disc development can be found in a document by Ullmer (1989).

**Interaction Features**

Most videodisc systems can provide some form of interaction with the user, and several levels of interactivity have been identified. Each of the levels is characterized by the hardware and software capabilities as is shown in Appendix B. Appendix C illustrates the hardware components associated with Levels 1, 2 and 3.

While level 1 systems are easy to use and consist of a videoplayer (with a remote control keypad) coupled to a monitor, they are the
least interactive. They are, however, relatively inexpensive and have the capacity for still frames and forward and reverse features including random or sequential frame access. Level 3 systems on the other hand, are very expensive since they use an external computer coupled to a videotape or videodisc unit. These systems provide a much higher level of interactivity and offer other capabilities such as branching, animation, feedback and so on.

In this study, a level 3 Interactive Videodisc Learning System, the IBM InfoWindow™ system coupled to a Pioneer LD-V6000 videodisc player, was used.

**Uses of Interactive Video**

The capabilities of Interactive video provide a very powerful multi-media presentation tool which can be used to support a wide variety of educational and training needs (Bayard-White, 1986).

In industry/military, interactive video has been used to provide skills training and upgrading in equipment operation and maintenance, communications and life skills (Bosco, 1986; Bosco & Wagner, 1988). Recently, interactive video has been applied to Health Sciences with a view of developing generic discs which will serve as databases for large quantities of visual information, such as slides, film, video clips of patient encounters and diagnostic images of the human body (Frazer, 1990; Jaffe, Lynch & Smeulders, 1989).
Educational Potential of Interactive Video

While it may be viewed as a merging of two different technologies, computer and video, interactive video is seen by many as a synergistic union resulting in a medium with more power to educate than the sum of its component parts. (Smith & Lehman, 1988, p. 25)

Perhaps the most important advantage of interactive video is that it provides and encourages interaction.

The potential of interactive video as an instructional tool has been discussed by Laurillard (1982) who points out that as a learning medium, "it can provide rich and sophisticated visual and auditory exposition of its subject" (p. 173). Recently Seal-Wanner (1988) has discussed the potential of auditory and visual imagery of interactive video. Current research suggests that the visual and auditory stimuli inherent in interactive video can dramatically improve learning (Clark, 1984) and can improve instructional efficiency (Erber, et al., 1984).

This potential has been exploited and already interactive video is being used to teach concept acquisition, procedural skills development and problem solving. This is clearly apparent in the Interactive Media Science Project, an inquiry-based multi-media science curriculum (Litchfield & Mattson, 1989). This project, funded by the National Science Foundation and the Houghton Mifflin Company is based on a level 3 interactive videodisc learning system, with a content covering life/earth/space and the physical sciences (Litchfield & Mattson,
This project provides students with "meaningful experiences where they are able to develop problem solving skills and begin to see science as an integral part of their daily lives" (Litchfield & Mattson, 1989, p. 42).

Other educational uses of interactive video range from Mathematics and Science (Engelmann & Carnine, 1989; Straker, 1988) and specialized areas such as Biology (Bunderson, 1984), Chemistry (Stevens, Zech, & Katkañant, 1988); Physics (Bolton, Every, & Ross, 1990) and Nursing (Craig, 1988; Redland & Kilmon, 1986). In addition, Bosco (1986) has identified other subject areas such as Economics, Spanish and Special Education.

In summary, there is no question that interactive video has instructional potential. Early results have shown that interactive video has promise for the future. Current research continues to address educational uses of interactive video and, in particular, practical classroom applications.

**Instructional Effectiveness of Interactive Video**

In view of this potential, the effectiveness of interactive video as an instructional tool across a wide variety of educational and training situations has been investigated and has largely been supported by several studies (Bosco, 1986; Bosco & Wagner, 1988; Bolton, Every, & Ross, 1990; Branch, et al., 1987; Hon, 1983; Stokes & Stafford, 1989).
Evaluation studies of interactive video instruction have been examined in a meta-analysis study by Bosco (1986). His analysis was based on twenty-nine reports selected on the basis that they were (a) all instructional applications, (b) data-based, and (c) "all reports were in the public domain. Proprietary reports, those for which secondary source information has been published were not included" (Bosco, 1986, p. 7). The analysis is organised into four sections covering the nature of the evaluation, information on effectiveness, the results of formative evaluations and finally a discussion of the implications of these studies for the design of future evaluations. Each of these will be reviewed briefly.

First, the studies examined dealt with applications in the military (10 studies), higher education (8 studies), elementary education (4 studies), junior high school (2 studies) and social services (1 study) with sample sizes ranging from five to seven hundred subjects. While the content for the military included equipment use, service and maintenance, other topics ranged from Spanish, color matching, mathematics, teacher evaluation, economics and keyboard skills to topics in biology (genetics) and Anatomy (heart concepts).

The second question addressed by Bosco (1986) related to the instructional effectiveness of interactive video. Bosco found that for the majority of these studies instructional effectiveness was measured by the outcome variables of achievement (written tests and
tests built into the interactive video program), performance
demonstration of a skill taught by the program), learning time (time
taken to learn the material) and user attitude. In general, most of
the studies employed an experimental design using a treatment group
(the group exposed to the interactive video instruction) and a control
group, the group receiving the traditional instruction for which
interactive video was substituted. Statistical analyses common to
these experiments were analysis of variance (ANOVA) or the t test.

Of the variables studied student attitudes and learning time
affected learning outcomes the most (the third important point in
Bosco's analysis). Of the nineteen studies that used achievement
scores as the dependent variable, only three studies showed that
interactive video was not effective as an instructional method. The
remainder of the studies showed that students achieved more (or as
much as) with interactive video compared to the traditional
instruction. In terms of attitudes, Bosco's analysis revealed that
students demonstrated more positive attitudes towards interactive
video instruction compared to the traditional instruction. Background
variables such as age, prior training, education, cognitive or
personality variables, generally did not affect learning outcomes.

Finally, in discussing the implications of previous evaluations
for the design of future evaluations, Bosco identified several useful
bases for examining differences in the results of effectiveness
studies. These relate to the design and use of the interactive video
program under study and criteria for effectiveness. Of the twenty-eight evaluation studies analysed, nineteen failed to describe the design of the interactive video program and Bosco (1986) felt that when "information on the specifics of the instruction in lacking, it is impossible to look for clues which might explain differences in findings on effectiveness" (p. 15). With respect to the effectiveness criteria, it was suggested that alternatives for data collection which would advance understanding of how to develop and use interactive video instruction, be considered.

One such alternative suggested was the use of structured observation. Only three of the studies in Bosco's analysis utilized this approach (Bunderson, 1984; Kirchner, 1983). Recently, this approach has been supported in a paper by Topham (1989).

The findings of Bosco's analysis have been largely supported by a number of other studies which appeared later, and which have employed essentially, the same approach (Bolton & Every, 1990; Bosco & Wagner, 1988; Stokes & Stafford, 1989; Straker, 1988). Only three of these studies will be reviewed here since they are pertinent to the nature of this thesis.

The first study is one done by Dalton (1986) to investigate "the effects of interactive video versus stand-alone video instruction and CAI on performance and attitudes" (p. 122) of junior high school students. The study involved 134 subjects using a 3x2 randomized block design with three methods of instruction (CAI, videotape and
interactive video) covering the same content, on high and low achievers.

Before exposure to one of the three instructional treatments subjects were designated "high" or "low" achievers, after which they received the treatment conditions. Following this, they wrote an achievement posttest (a criterion-referenced test based on 27 rules covered in the lessons) and completed a 20-item Likert-type attitude questionnaire. The results showed that both CAI and interactive videotape groups had significantly higher scores on the achievement posttest compared to the stand-alone videotape group. The attitude scores were also higher for the interactive videotape group than for the other two groups.

The second study is one conducted by Bosco and Wagner (1988) in which they investigated the effectiveness of an interactive program (compared to classroom instruction) for teaching handling of hazardous substances to workers at General Motors (GM) plants. The design of the study was based on two parallel treatments developed to present the same topics to workers. Again, the criteria for effectiveness were achievement, attitude and learning time. Background variables of age, sex, years of experience at GM and education were examined for their effect on achievement and attitude.

Two hundred and nine workers participated in the study. They ranged from 22 to 66 years of age and they were randomly assigned to one of the two groups, the interactive videotape group and the
classroom group. After the groups received the instruction, they were asked to complete all data collection instruments (achievement test, attitude questionnaire and an opinion questionnaire). In addition, an open-ended interview was conducted.

The results indicated that workers who used the interactive videodisc instruction responded more favourably and had significantly higher scores than their counterparts in the classroom group. While the amount of learning time did not differ from group to group, 80% of the workers preferred the interactive videodisc and felt that 75% of other GM workers would prefer the interactive videodisc instruction.

The third study (Stevens, Zech, & Katkanant, 1988) is one which examined the use of interactive videodisc instruction in conjunction with traditional laboratory experience. The experiment was conducted at the University of Nebraska-Lincoln, using a level 3 interactive videodisc learning system to enable students to perform an experiment on titration. The interactive learning program allowed students to control the pace and sequence of the lesson, obtain instant feedback and repeat the experiment over and over.

Students (n = 26) were placed into one of two groups. One group was first exposed to the laboratory exercise followed by the interactive video lessons, while the other group used the interactive video lessons first, followed by the laboratory exercise.

All students first received lectures on titration, followed by the treatment phase. The teacher's role in this study was one of
"facilitator" of learning. Data collection was completed in seven days during which time students and teachers were observed, using classroom observers, and video camera. Following this phase, students wrote an achievement test on titration (15 questions) designed to measure knowledge and concept of titration, titration techniques and procedures, and concentration calculations. They also completed an attitude questionnaire based on a five-point Likert-scale.

The results of the study showed that there were no significant differences in achievement and attitude between the two groups. However, observational data showed that students who used the interactive videodisc first were more efficient in conducting the lab experiment than students who first conducted the experiment in the lab" (Stevens, Zech, & Katkanant, 1988, p. 303).

Perhaps one of the most recent studies on interactive videodisc instruction is one by Bolton, Every, & Röss (1990), who conducted a study to determine the effectiveness of an interactive videodisc learning system for teaching physics to students enrolled at the Open University in Great Britain.

The investigators first describe the development of the project followed by a description of the content of the videodisc program and a discussion of an evaluation study using the system. The interactive program was not designed to provide stand-alone instruction but rather to help students review key concepts while at the same time allowing them to develop problem solving and deductive skills. The program...
covers the complex physical properties of water through a coverage of topics on icebergs, desalination, floating ice and specific heat of water. The program also allows the user to interact with the material through the use of menus controlled by the keyboard (special function keys).

In using the program, the student was first presented with an introduction to the problem solving activities on the disc followed by a brief explanation of how to use the program. Students then chose a problem and proceeded to work out a solution which took 2 - 3 1/2 hours to complete.

The study was based on an observation of 128 students (who were randomly placed into one of several groups) during their use of the learning system. The goals of the study were to examine group size and group dynamics as well as to determine the time spent on various sections of the problems. Two groups of students were also videotaped during their use of the interactive learning system. A questionnaire was developed to obtain information on the use of the interactive videodisc in a physics course. One hundred and seventeen students completed the questionnaire. The results of the study are summarized by the authors as follows:

The response to the videodisc as a teaching/learning medium was overwhelmingly enthusiastic. Apart from a small minority (12%) who felt that the sessions were rather long for concentration on the video screen, there was almost complete satisfaction with the nature of the videodisc experience. 95% of the students said
they had become involved with the physics problems. More than 96% had enjoyed the videodisc sessions; indeed, almost one-third had found them at least as enjoyable as experiment-based laboratory sessions (and this in an Open University context in which opportunities for direct laboratory experience are rare and precious). Most importantly, 94% considered that the videodisc medium was useful and provided a good method of learning. (Bolton, Every, & Ross, 1990, p. 171)

**Instructional Effectiveness of Interactive Video Dealing with Heart Concepts**

This section of the literature review will examine the studies involving interactive video on heart concepts from 1980 to the present.

The first was a study carried out by Andriessen and Kroon (1980) who conducted an evaluation study of an interactive videodisc entitled "The Work of the Heart" using a very small sample of students (n = 12) in higher education.

The content of the interactive program was based on the function of the heart, the influence of hormones and administered drugs, the action of the heart during sleep and physical effort, and surgical replacement of one of the valves.

The interface of the learning system was a control box (although a normal keyboard was used to start and stop the program) with keys labelled 1 to 5, "t", "m"; and "H0" to help students access the various materials on the disc. For example, activation of the "+" key allowed the student to begin a chapter. The movement through the
materials is under full control of the user.

This study did not compare the interactive learning system to any other form of instruction but rather, it was designed to obtain student reactions and opinions once they had completed the course. Students were observed during the use of the system, after which they wrote a posttest (seven questions) and participated in an interview.

The results indicated that the time to complete study of the materials ranged from twenty-six minutes to two hours with an average time of fifty-five minutes. An important finding showed that students moved through the material linearly until they arrived at the point of film viewing. In general most students preferred to view the entire film rather than selected parts of it. Performance on the written posttest was good demonstrating that students had learned the subject matter. The results of the interview revealed positive opinions about the use of the interactive learning system.

The next interactive videodisc relating to the heart was one developed by the American Heart Association, dealing with cardiopulmonary Resuscitation (CPR). The system combines computer and videodisc technologies coupled to a mannequin to provide instruction in life saving techniques (Hon, 1982).

Later, two studies surfaced in the literature reporting the results of evaluation studies using the American Heart Association CPR Interactive Learning system. These studies were done by Richards (1983) and by Edwards and Hannah (1985).
The study by Richards (1983) was a case study conducted in Trenton, Ontario, to investigate the effectiveness of the interactive learning system for CPR training. The study employed 17 students from the Canadian Forces Base in Trenton, who used the interactive system for learning CPR skills. A pre-post Likert-type questionnaire and a 25-item semantic differential were administered to find out student attitudes towards the interactive videodisc learning system. In addition, the group who were taught by the interactive system was compared to a "conventionally-taught" CPR group (n = 18).

The results showed that there were no significant differences in student attitudes and achievement; however, subjects were receptive to the videodisc instructional method. Interestingly enough, those students who watched television (a background variable collected during the study) found the system significantly more acceptable than those subjects who did not watch television.

In 1985, Edwards and Hannah, conducted a pilot study to investigate the usefulness of the American Heart Association interactive learning system on CPR training.

Sixty-two subjects participated in a study which was designed to measure skill performance and cognitive knowledge on two different time periods ranging from a three-month to a one-year follow-up.

Subjects were divided into two groups, an experimental group who received instruction from the CPR Videodisc training system, and a control group, who received traditional instruction on CPR. Subjects
were pre-tested and wrote a posttest on cognitive knowledge immediately after instruction, and later at three months and one year. Subjects also did a skills performance test immediately following instruction and then again at three months and one year after the instruction.

Results of this study indicated that there were no significant differences between the two groups on the measures of cognitive knowledge and skill performance initially, and at the two follow-up periods of three months and one year.

Another study of the effectiveness of interactive video dealing with heart concepts is one by Kirchner, Martyn and Johnson (1983) who conducted an evaluation study of a videodisc entitled "How Your Heart and Circulatory System Works". The content of the program includes the heart and circulation, function of the blood, monitoring heart beat, factors affecting heart rate, blood pressure, diseases and disorders.

The study was a formative evaluation based on structured observations of student activities during the use of the interactive videodisc learning system. No comparison was made with any other form of instruction. The study was conducted on four classes of upper elementary school children.

During students' use of the learning system, they were observed by human observers as well as by video camera, after which both students and teachers completed the questionnaires regarding the interactive
learning system. Two hundred and eighteen students were videotaped while using the learning system. The taped information was analysed and compiled. The results of this study showed that although there were a few mechanical problems with the videodisc player and the remote control unit, both teachers and students liked the multi-media presentation features, and their reactions and opinions were positive toward the interactive video learning system. As summarized by the authors:

The essence of the project is summed up in the question, "Did you learn a lot from the videodisc?". Of the 94 children, 89 said yes, 4 said no and 1 child left it blank. A 94% positive response to this question coupled with unsolicited comments, such as "I hope I do it again" and "It was fun" would indicate that the videodisc learning system may well have a strong role to play in future educational programs. (Kirchner, Martyn, and Johnson, 1983, p. 58)

Yet another videodisc study of the heart is one done by Branch, Ledford, Robertson and Robinson (1987) who conducted a study to validate the instructional effectiveness of the videodisc system compared to the traditional lecture.

The interactive learning system contained material to teach auscultation (analyzing sounds associated with cardiovascular function) of the canine heart to eighty-seven veterinary medical students enrolled in a cardiology course. The program contains a main menu listing topics such as the normal heart and mitral insufficiency. In addition sub-menus and various playback options (recording,
description, still frame) were used to assist the user through the instructional materials.

This study was similar to many of the previous studies discussed earlier. It was a comparative study in which achievement scores and attitudes were used as criteria for measuring effectiveness. Students were randomly assigned to an experimental group and a control group, however, both groups attended lectures first, on auscultation theory and were given copies of canine heart sounds. In the treatment phase of the study, the control group listened to audio recordings of heart sounds (as was done in the conventional instruction), while the experimental group used the videodisc system. After this initial lab, both groups practiced on their own with only the experimental group using the videodisc. No significant difference was found between the two groups on the test scores, and the results showed that interactive video was just as effective as the traditional technique for teaching auscultation of the canine heart. Students were very receptive to interactive video instruction.

It is interesting to note that since animals have to be used in teaching auscultation techniques, they have to be brought into the classroom for this demonstration. This is often very difficult and time consuming. In view of this, the authors suggest that interactive video would be ideal in these situations "where it can substitute for animal experiments especially in substituting for abnormal animals which may not be available when needed" (Branch, et al., 1987, p. 21).
In summary, interactive video is effective in educational and training applications. The outcome variables of achievement and attitude were commonly used as measures of effectiveness. Several studies reported that users learned as much as or more using interactive video instruction compared to traditional teaching methods. In terms of attitudes, students using interactive video instruction were significantly more positive about their experiences compared to students taught by traditional methods. These findings support the educational value of interactive video.

Evaluation studies indicate that interactive videodisc systems have been assessed as stand-alone competitors to conventional classroom lectures. Very few studies reported on how interactive video can best be implemented to support instruction. None reported on the use of interactive videodisc learning systems to help students review, revise, clarify, elaborate and consolidate knowledge received from conventional lectures. This study was designed to investigate this particular use of interactive video. The results obtained from this study may contribute to instructional design issues and to the integration of interactive video into the classroom.

**Instructional Intervention Applied to Interactive Videodisc Learning Systems**

In examining the effectiveness of the interactive videodisc learning system used in this study, one of the instructional
conditions to which students were exposed included the use of an instructional intervention procedure intended to enhance the effectiveness of the system. The instructional intervention was called knowledge lack identification procedure (knowing what one does not know). Scardamalia, et al., (1988) indicate that this procedure would facilitate learning by pointing out that:

wherever possible, educational software should provide means for students to identify what they don't know or need to find out or are curious about. Whenever possible the accurate identification of knowledge lacks should have positive consequences within the functioning of the program, resulting in enhanced possibilities for achieving the goals that are motivating use of the program in the first place. Identified knowledge lacks can also serve as valuable material for analysis both within computer-assisted activities and in related classroom discussion. (pp. 6-7).

This procedure has not been applied to interactive video systems however.

In this thesis, one group of students completed the knowledge lack identification procedure on a paper (on which prompts to help students identify problems were given) since it was not feasible to incorporate this procedure into the computer program for the IBM/BCIT interactive videodisc on the heart at the time of the evaluation.
Interaction Strategies and Interactive Video

The term interaction strategies, implies the ways in which students select the instructional material (on the interactive video program) and proceed through various topics using for example, the control options (fast forward, reverse, skip video, freeze frame) of the interactive learning system.

Only two studies can be found which examined how students used the learning system. The first has been discussed earlier and it was done by Andriessen and Kroon (1980) who found that the most common strategy was a linear path through the material until they encountered a film in the program; however, only a few students preferred to view the entire film. Most preferred to view selected portions of it.

The second study was one done by Bunderson, et al. (1984) which was an extensive study of the effectiveness of a videodisc in Biology. Not only did the study examine student achievement and attitudes, but it also focused on interaction strategies of students.

The researchers examined students' use of the videocontrol options to find out which strategies and tactics were popular. They used observers to record strategies as well as to conduct follow-up interviews with students. Five major patterns were noted:

The first was a linear, step-by-step pattern with no deviations. Three students used this strategy. In the second pattern, the students went through the lesson rapidly, skipping material as they thought they already understood. Two students used this fast skipping strategy. The third pattern involved initial viewing
of the motion sequences for a general overview and then stopping and reviewing motion sequences to take notes the second time through. Key points in the motion sequences or rule frames were noted before progressing. Seven students followed this strategy.

The fourth pattern involved a careful review of the motion sequences and still frames during the initial pass through the lesson. Seven students used this incremental review strategy.

The fifth pattern involved a moderately linear path through the motion sequences, rules, example and discussion frames. However, when these students had difficulty with the practice exercises, they would review the still frames or motion sequences for information needed for the practice exercises. Six students used this test/review strategy. (Bunderson, et al., 1984, pp. 206-207).

After a careful review of the IBM/BCIT Interactive videodisc program on the Anatomy and Physiology of the Heart and based on the results of the Bunderson, et al. (1984) study an instrument to record interaction strategies during this investigation was developed. Students completed this instrument immediately after they had used the learning system. Because Bunderson, et al. (1984) reported that perhaps the observers might have influenced the strategies students chose, a video camera was used in this study to record observations as well.

With interactive video, the opportunities for investigating how students use learning materials is enormous especially with the introduction of more and more interactive video programs in education. Litchfield and Mattson (1989) for example point out that the interactive media science project designed to teach life/earth/space
and the physical sciences provides great potential for research into the strategies students use to study science.

**Summary of Research Findings**

The research literature suggests that evaluation studies of interactive videodisc learning systems reflect a consistent message. Interactive video is equally as effective in delivering instruction compared to conventional methods. Students using interactive videodisc learning systems demonstrated significantly more positive attitudes compared to students exposed to conventional teaching methods.

The use of instructional interventional techniques to enhance the effectiveness of computer-based instruction is limited and non-existent for interactive video. One instructional intervention technique, the knowledge lack identification procedure was reported for a computer course in BASIC programming involving computer-managed instruction. The use of the procedure did not significantly affect student performance in BASIC programming (Ng, 1988).

Finally, how students interact with videodisc materials is a topic of limited research. One study reported that students are engaged in specific use strategies when studying with interactive video programs. These strategies range from a step-by-step linear pattern to various branching patterns through the lesson materials.
Recommendations from the Literature

There is little doubt that interactive video has great potential as an instructional tool in a wide variety of learning and training contexts. Interactive video continues to generate interest and enthusiasm as a viable educational tool. As Bosco (1986) concluded in his meta-analysis study, interactive video research needs to be directed at how this technology can best be implemented and integrated into the curriculum. Recently, Litchfield and Mattson (1989) suggested that to examine the learning patterns using interactive video is important for future research studies.

This study examines the use of an interactive videodisc learning system as an adjunct to instruction (resource tool) and not as a stand-alone competitor to conventional classroom lectures. Specifically, the study investigates the use of the learning system as a tool to help students revise, clarify, elaborate and consolidate knowledge received from lectures. Also, the study investigates the application of an instructional intervention procedure for enhancing the effectiveness of the learning system as a resource tool. Finally, this study investigates how students use the interactive lessons in order to contribute to this area of limited research on interactive video.

In summary, this study examines a practical classroom application of interactive video.
CHAPTER 3

Description of the Interactive Videodisc Learning System

Introduction

The Interactive Videodisc Learning System under investigation in this thesis provides the opportunity for multi-media presentations. This system is the IBM InfoWindow™ System which includes an IBM InfoWindow display with an advanced touch screen, an IBM personal computer and an optional non-IBM videodisc player. The basic configuration is shown in Figure 1.

This chapter will describe the hardware, the software tools and the content and pedagogy of the interactive videodisc. In addition, the interactive videodisc classroom will be described.

Hardware

The InfoWindow Display with Touch Screen

The IBM InfoWindow system is based on the use of piezoelectric crystals positioned on each corner of the screen. When the screen is touched a pressure differential is experienced and is subsequently used to calculate the center of the pressure point (Richards, 1990). The IBM InfoWindow touch screen is easy to use and is very accurate and provides up to 60 touch points (Ullmer, 1989).

The IBM InfoWindow Display is a 13-inch screen which is capable of displaying unlimited colours for both still and moving video images.
Figure 1

The IBM/BCIT Interactive Videodisc Learning System
and graphics. The display unit has its own microprocessor to control both video and audio and to facilitate synthetic speech and sound effects. An additional feature of the display is a microprocessor which allows the videodisc player to be coupled directly to the display, rather than to the computer (Figure 2). The purpose of this is to make the expansion slots in the computer available for other devices or options.

One of the key features of the InfoWindow Display is the advanced touch-sensitive screen which not only provides a "friendly" interface but an easy method of interaction with the computer by using the most intuitive pointer, the finger. As pointed out by Cleal and Heaton (1988):

> the touch-sensitive screen provides a good example of how the input device determines the characteristic of the interaction. Such devices work best on menus -- it is simpler for inexperienced users to point to what they want rather than to type it (even if only one letter is required). (p. 31)

**The Computer and Videodisc Player**

The Interactive Videodisc Learning System evaluated in this study uses an IBM AT personal computer. The AT computer was introduced in 1984 and uses the 80286 microprocessor in which case the programs run much faster than the IBM XT personal computer. The AT computer is used to control the InfoWindow display and to provide computer-generated text and graphics. The computer is equipped with a 5.25-
Figure 2

Functional Diagram of the Interactive Videodisc Learning System
inch floppy disk drive as well as a 20 MByte hard disc which stores the programs for text, graphics and animations. [The interactive videodisc programs comprise some 10 - 12 hours of instruction totalling 2MBytes, 1MByte for the computer graphics and 1 MByte of source code (Fenrich, 1990).]

The videodisc player is a Pioneer LD-V6000 which is an optical laser videodisc player. A laser diode emits a fine pencil beam of laser light to read the surface of the videodisc which contains the signals. The reflected light (from the disc) is received by a photodiode which reads the signals recorded on the disc. The player allows for quick random access to any of the image frames on the disc as well as for freeze frame action, fast and slow speeds and forward or reverse directions under program control.

The Videodisc

The disc is a 12-inch optical laser videodisc of the reflective type. It is a shiny hard disc which has pits etched onto its surface which reflects the light when the disc is played.

Each side of the disc can hold up to 54000 frames of still images and up to about 30 minutes of moving video or a combination of both. In addition, each side of the disc has two audio tracks, each of which can be used to support sound and commentaries which may accompany still or moving video sequences and graphics.
Software

Authoring Tools

The development of the videodisc lessons for use with the Interactive Learning System included extensive work in creating very sophisticated programs needed to drive the system. These programs comprise the software of the system. As Miller III (1987) points out:

When applied to interactive videodiscs, the term software applies to both the content of a program that the user sees and the controlling computer code that makes the system operate. (p. 19)

The software tools for the project are discussed in a summary report by Penny, et al. (1989). These include the use of TenCORE language to meet the programming needs and Deluxe Paint II to meet the graphics needs of the project.

The TenCORE authoring language consists of over 150 English-like commands (for example, branch, color, computer, copy, do, restart, write, pause, press) which are easy to use and recall. The menu-driven organization of TenCORE authoring utilities and the command language provide the freedom to use any particular lesson structure or pedagogy (Klaus, 1984). Also TenCORE editing tools facilitate custom character fonts and can import and store Deluxe Paint II pictures within a lesson. TenCORE is designed for the personal computer environment and can run on the IBM PC/XT/AT's and PS/2's as well as compatibles. It also supports leading interactive videosystems.
**Instructional Design**

Effective instructional programs depend upon the design of the learning activities (Binsted, 1987). Computer-based instructional design has been influenced by ideas from different schools of psychology. Computer-based instructional technologies have firm roots in behavioural psychology and recently in cognitive psychology; however, most computer-based instruction "has followed more traditional instructional design models that have evolved based principally on behavioral principles" (Hannafin & Rieber, 1989, p. 91). Carefully-designed computer-based instructional programs seem to address four design components outlined by Yong (1989): man-machine interaction\(^1\), learner control of the learning process, material organization and graphics display design.

The IBM/BCIT interactive videodisc program is based on an Instructional Systems Development (ISD) Model developed to meet not only the needs of the project but to guide the development process. This model makes use of the ideas pointed out by Yong (1989). The model ensures:

---

\(^1\) "Man-machine interaction emphasizes learner participation by promoting the learner's ability to initiate actions called events. The computer then interprets these events and then responds appropriately. In other words, the computer system is expected to be event-driven and the learner's responses should be to the creation or removal of displayed information." (Yong, 1989, p. 83)
1. good man-machine interaction through the use of menu-driven lessons and rapid computer response to the user's input.

2. that the learner has some degree of control over content selection and instructional sequence, as will be discussed subsequently.

3. logical and meaningful organization of the lesson materials. These will be discussed in the next subsection.

Program Content

The content of the interactive videodisc program includes materials organized within three contexts, the introduction, technology section and instructional content.

1. Introduction
This section presents general program information and includes hints on using the touch screen, options for moving around and study hints.

2. Technology Section
This includes a screen which shows the following technology programs offered at BCIT:

   General Nursing
   Health Information Technology
Environmental Health Studies
Occupational Health and Safety
Nuclear Medicine Technology
Medical Radiography
Medical Laboratory Technology
Biomedical Engineering Technology
Electrophysiology
Prosthetics and Orthotics
Diagnostic Medical Sonography

It is important to note here that the selection made here (that is, the technology selection) determines the instructional sequence for the student in that particular technology.

3. Instructional Content

The instructional content for the program was determined by subject matter experts: three instructors who have had extensive experience in teaching students at BCIT. Not only did they organize the content into modules, lessons and segments, but they also played key roles in performing task analysis, developing objectives, designing simulations, checking the disc for accuracy of content and other important tasks (Penny, Richards, & Fenrich, 1988).
The instructional content is organized into six modules, each of which deals with specific issues:

A. **Cardiac Basics:**
   This module provides the background needed for the study of the heart.

B. **Anatomy of the Heart:**
   This module explores the internal features of the heart including the myocardium and pericardium.

C. **Mechanical Events:**
   This module deals with fundamental cardiac mechanics as well as the source and relevance of heart sounds.

D. **Cardiac Physiology:**
   In this module, the cardiac conduction system and echo-cardiography are described.

E. **Dynamics of Cardiac Output:**
   Factors affecting stroke volume and heart rate are identified and cardiac output is also calculated in this module.

F. **Common Cardiac Pathologies:**
   This module explores the origins and patterns of coronary disease.
In addition to these modules a comprehensive glossary of terms is available.

Table 2 shows a breakdown of the major topics in each of the six modules, and twenty-three objectives associated with these modules.

**Pedagogy**

While each module is organized around a series of topics, each topic is based on the following instructional components (Penny, et al., 1988).

(a) **Overview:**
This is a brief introduction to the content of the specific module. It informs the student about the terminal objectives. It is intended to serve as an advanced organizer and to provide motivation to study the lessons.

(b) **Presentation:**
This is the audiovisual instructional unit featuring materials which the students "need to know". During the presentation, some form of interaction between the student and the program is possible through the use of the touch screen. It is possible, for example, for the student to control the presentation (particularly the animations and video sequences) by using the control
Table 2
The Objectives Associated With Each of the Six Modules of the Interactive Videodisc Program on the Anatomy and Physiology of the Heart (Courtesy of BCIT)

<table>
<thead>
<tr>
<th>A. Cardiac Basics</th>
<th>A1. Explain the role of the heart</th>
<th>A2. Locate the heart</th>
<th>A3. Describe the heart’s relationships to thoracic structures</th>
<th>A4. Identify the surfaces and borders of the heart</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Anatomy of the Heart</td>
<td>B1. Describe the structure and function of the pericardium</td>
<td>B2. Describe the myocardium</td>
<td>B3. Describe the internal structures of the heart</td>
<td>B4. Describe coronary circulation</td>
</tr>
<tr>
<td>C. Mechanical Events</td>
<td>C1. Explain basic cardiac mechanics</td>
<td>C2. Explain the source and relevance of heart sounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Cardiac Physiology</td>
<td>D1. Describe the structure and function of the CCS</td>
<td>D2. Explain electrocardiography</td>
<td>D3. Describe a 12-lead ECG</td>
<td>D4. Explain the details of cardiac function</td>
</tr>
<tr>
<td>E. Dynamics of Cardiac Output</td>
<td>E1. Identify factors affecting stroke volume</td>
<td>E2. Identify factors affecting heart rate</td>
<td>E3. Calculate cardiac output</td>
<td></td>
</tr>
<tr>
<td>F. Common Cardiac Pathologies</td>
<td>F1. Identify causes and features of pericardial disease</td>
<td>F2. Describe patterns of congenital cardiac defects</td>
<td>F3. Describe the cause &amp; effect of 2 a. valve disorders</td>
<td>F4. Describe pathogenesis of coronary artery disease</td>
</tr>
</tbody>
</table>
options (such as slow motion, stop action and so on). In the presentation, questions are embedded in the lesson structure to act as reinforcement exercises.

(c) **Exploration:**

The purpose of this component of instruction is to provide the student with an opportunity to study a topic to a greater depth. This is partially done through the use of diagnostic medical images such as x-rays, ultrasound and magnetic resonance images to illustrate concepts. For example, if the topic under study is the size of the heart, then diagnostic images are used to show different common cardiac pathologies (enlarged heart). In addition, when a simulation is part of the presentation, the exploration allows the student to practice and explore the dynamics of the simulation. This component has not been fully developed and was not used in the study.

(d) **Summary:**

This component provides a brief summary of the main points of the lesson for reinforcement purposes and to allow review of the material without having to go through the presentation mechanics. The summary also relates each topic to the overall theme of the module.
(e) **Test:**

At the end of each topic presentation, the student is provided with the opportunity to take a test. Five questions are selected from a test bank for each module. The questions are mainly of the multiple-choice format similar to those used in the achievement test, although other formats (true/false and matching) are available. Feedback (in the form of one word answers, such as "correct", "incorrect", "wrong", etc.) is also provided to the student. On completion, a score is given and the student is told whether a review of the materials is needed.

Figure 3 shows how these components appear on a computer screen.

**Moving Around the Program**

So far, a description of the content and its basic organization has been given. A flowchart showing the program logic is shown in Figure 4. A close examination of the flowchart shows that the content is organized and presented within three contexts as is illustrated in Figure 5. This figure shows a macro organization of the content which helps to show how students may move from context to context.

Context 1 deals with the introduction, technology selection and the main menu selection. While Context 2 deals with the subtopics of
Figure 3

The Organization of the Instructional Components of the Interactive Videodisc Program on a Computer Screen
Figure 4

Flowchart Showing Program Logic for the Interactive Videodisc Lessons

START

TITLE PAGE

RESTART

PROGRAM INFO.

WARNING

PROGRAM INFORMATION MENU

CONTINUE

TECHNOLOGY SELECTION

1) SELECT
2) MORE INFO.
3) MAIN MENU

MAIN MENU

BANDS A-E

CHAPTER MENU

TOPIC MENU

PLAYS VIDEO intro. on first entry from the main menu

PLAYS VIDEO overview on first entry from chapter menu

OVERVIEW

PRESENTATION

EXPLORATION

SUMMARY

TEST
Figure 5

The Organization of the Information on the Interactive Videodisc as Seen in Three Contexts

CONTEXT 1
- Introduction
- Technology Selection
- Main Menu Selection

CONTEXT 2
- Subtopics of the Main Menus

CONTEXT 3
- Instructional Components
  - Overview
  - Presentation
  - Exploration
  - Summary
  - Test
the main menu, Context 3 addresses the instructional components and pedagogy of the lesson. Finally, the ease with which the student can move from context to context as well as within contexts is facilitated by a number of conventions. These are listed and explained in Table 3. Thus, movement from context to context as well as movement within a context were given careful consideration in the design.

Using the Interactive Videodisc Program

Interaction Strategies

When students use the interactive videodisc program, they have the opportunity not only to move from context to context but also to move around within a context. It is of relevance then to investigate the nature of these strategies to find out which strategies are most popular with students and to find out how they might affect learning.

These interaction strategies, as they are referred to in this study, could range from a linear step-by-step path through the program with no deviations, a selected review strategy and a test strategy, to other strategies relying on review of materials and tests as shown in Appendix G.

The Interactive Videodisc Learning Center

One of the goals of the joint IBM/BCIT project was to establish an interactive videodisc learning center. Two rooms at BCIT which are now a part of the interactive videodisc development center were
Table 3

Conventions Used to Facilitate the Ease with Which the User Can
Move from Context to Context as Well as Within a Context of the
Interactive Videodisc Program (From the Interactive Videodisc

- From any page, a single touch allows the student to:
  0 continue
  0 go to the previous page
  0 see the help page
  0 go to the previous menu

- From the help page, students can:
  0 return to where they were
  0 go to the next page
  0 go to the previous page
  0 see the course map, which highlights what the student should
    cover
  0 see the glossary
  0 exit the program

- From the course menu help, students can:
  0 return to the menu
  0 go to the first introduction page
  0 see further information about each subject
  0 see the glossary
  0 exit the program
  0 select a new user map

- In the glossary, students can choose a word from a menu. From
  any word students can go to the next or previous word.

- From any page, after five minutes with no screen touches, the
  computer will give a warning. Students then have 99 seconds to
  make a choice. If there is no response, the program will return
  to the title page.

- While reviewing video sequences, students can control the
  playing speed. Options are available to play fast forward, play
  slow forward, advance one frame, show a still frame, reverse one
  frame, play slow reverse, play fast reverse.
designated for such use. The two rooms are adjacent to each other. One room is designated the interactive video classroom while the other is labelled the Interactive Videodisc Laboratory.

In this study the interactive videodisc classroom was equipped with a videotape player and one interactive videodisc learning system coupled to a projection system with a large screen. Seating was available for at least 25 students. In general, this room was used to orient individuals to the interactive videodisc learning system and to demonstrate the interactive learning lessons.

The interactive videodisc laboratory was designed to house 10 workstations (IBM InfoWindow Display System plus videodisc player). Each workstation was set up in its individual compartment as shown in Figure 6.

In this study a video camera was positioned in the interactive videodisc laboratory and focussed on the screen of one of the workstations, as seen in Figure 6, to record students' interaction strategies.
Figure 6

Arrangement of the Furniture and Equipment in (a) the Interactive Videodisc Classroom and (b) the Interactive Video Laboratory
CHAPTER 4
Method

Introduction

This chapter describes the method employed in the study through a discussion of the subjects and setting, the research design procedures of the study, instruments used to collect the data and the pilot study. The chapter concludes with an introduction to the statistical treatment of the data.

The Setting and Subjects

The subjects in this study consisted of 51 Health Sciences students enrolled in a first year course in Anatomy and Physiology, offered by the Basic Health Sciences department, one of the core academic departments at BCIT. The majority of the students were from the Medical Radiography Program (n = 30) while the others were from Nursing (n = 13) and Electrophysiology (n = 8). Both males and females ranging from 17 to 35 years of age with a mean age of 24 years old, participated in the study. It should be noted that at the time of this study, other technologies, such as Biomedical Engineering, and Nuclear Medicine, for example, chose not to participate owing to the concerns of the instructor who taught these groups.
Research Design and Procedures

Research Design

This study was conducted using a randomized pretest-posttest design since it controls for most of the threats to internal validity (Graziano & Raulin, 1989). In this design, three groups of students were used, with each group receiving a different instructional condition during the treatment phase. The three conditions are explained below:

Instructional Condition 1

The students in this group received lectures in the usual way. They were then subjected to an instructional intervention procedure, the knowledge lack identification procedure (KLIP) before using the interactive videodisc (IVD). These students will henceforth be referred to as the IVDKLIP students (group). The KLIP required students to identify confusions, uncertainties and difficulties about material from the lectures before they used the videodisc learning system. The KLIP also provided prompts for helping the students to note these problems. These prompts required students to make a list of words, statements and/or questions about the identified knowledge lacks (Appendix D).
Instructional Condition 2

The students in this group received lectures in the usual way, followed by the use of the interactive videodisc (IVD) lessons. They were not subjected to the knowledge lack identification procedure. These students will be referred to as the IVD students.

Instructional Condition 3

The students in this group received lectures in the usual way, followed by a small group tutorial mediated by a teacher. These students will be referred to as the Small Group Tutorial. In this group, the teacher responded to students' queries using transparencies of diagrams, lecture notes and anatomical models for clarification and elaboration.

The study design is shown in Table 4. As can be seen, all students took a pretest and received lectures before the treatment phase, when they worked with either the interactive learning system or the system plus the intervention procedure or the small group tutorial, meant to enhance learning by providing an opportunity to revise, review, clarify, elaborate and consolidate knowledge received from the lectures. After the treatment phase, all students wrote a posttest.
Table 4: The Research Design Used in the Study

<table>
<thead>
<tr>
<th>Group</th>
<th>Pretest</th>
<th>Lectures</th>
<th>IVDKLIP</th>
<th>IVD</th>
<th>Small Group Tutorial</th>
<th>Posttest</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVDKLIP</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>----</td>
<td>----</td>
<td>yes</td>
<td>19</td>
</tr>
<tr>
<td>IVD</td>
<td>yes</td>
<td>yes</td>
<td>----</td>
<td>yes</td>
<td>----</td>
<td>yes</td>
<td>17</td>
</tr>
<tr>
<td>Small Group Tutorial</td>
<td>yes</td>
<td>yes</td>
<td>----</td>
<td>----</td>
<td>yes</td>
<td>yes</td>
<td>15</td>
</tr>
</tbody>
</table>
Procedure

The procedure used in this investigation involved a number of steps. These steps as illustrated in Figure 7 are as follows:

Step 1

The study was first explained to the students in order to secure their participation. Students read and signed the document shown in Appendix E. This document explained the nature of the study, that participation was voluntary and would not affect their final grades in any way. Sixty students signed up initially out of a total of seventy-eight. Only fifty-one students, however, actually participated.

Step 2

At the beginning of the course, students took the pretest consisting of twenty multiple-choice questions drawn from a database of 25 items on two topics of the course (owing to time constraints, it was not possible to cover the entire scope of instructional materials on the heart).
Figure 7
An Algorithm Explaining the Procedure Used in the Study

EXPLAIN STUDY

PRETEST

LECTURES All Students

RANDOM ASSIGNMENT

IVD Group

View 10-min tape on IVD

Complete KLIP

Use IVD System

Complete Use Strategy

Complete Attitude Invent.

Complete Use Strategy

Complete Attitude Invent.

Teacher Group

Observer

Small Group Discussion

Posttest
Step 3
All students received lectures on the two topics, Cardiac Basics and Anatomy of the Heart, in the conventional manner. The instructor gave explanations using handouts and an overhead projector in a large classroom. Two weeks were needed to complete lectures (six hours of instruction) on the two topics.

Step 4
Participants were then assigned randomly to one of the three groups for the different instructional conditions discussed earlier. At this point the students completed a demographic data sheet (to be discussed subsequently) as shown in Appendix F.

Step 5
Two weeks after the lectures, students in all three groups met for two, one hour sessions on two consecutive days to review, clarify and consolidate materials received from lectures. The interactive videodisc groups viewed a 10-minute videotape on how to use the interactive learning system before the two sessions. (This was done in the interactive video classroom using the projection system.) The tape
featured a topic which was not required of the students in this study. The purpose of this viewing was to try to minimize the novelty effect of the medium.

**Step 6**

During the two sessions the knowledge lack identification procedure was then administered to the IVDKLIP group only, as follows:

- During the first hour, these students were asked to identify knowledge lacks using the procedure outlined in Appendix F before using the disc. After they had completed the KLIP, the group commenced using the Learning System.

- At the end of the first session (1-hour) these students were asked to state whether they had solved all their problems or whether they were still having difficulties with the material. Students took these sheets home with them.

- In the second one-hour session, these students first reviewed the notes they had made the first time, followed by an identification of knowledge lacks for the second time just prior to using the disc. Again, they completed the sheet just after using the disc. These sheets were collected by the
researcher.

The IVD Group just used the Learning System. The Teacher Group met with the teacher for review, consolidation and clarification of lecture material.

Step 7

During the two sessions when the videodisc groups used the interactive learning system, a video camera was set up to record how students used the interactive video lessons. Specifically, four students (two from each of the videodisc groups, who were chosen at random) were videotaped for the entire time on the system.

Step 8

On completion of the videodisc lessons students were asked to complete first, the interaction strategies questionnaire shown in Appendix G to capture data on how they used the interactive lessons. Secondly, students completed the attitude inventory shown in Appendix H.

Step 9

Finally, 51 students wrote the posttest the week after the treatment phase consisting of twenty multiple-
choice questions drawn from the same data base as the pretest. The stem posttest questions and the distractors were re-sequenced.

In summary, all students wrote a pretest after which they received lectures in the conventional manner. Students were then randomly assigned to one of three instructional conditions for the treatment phase of the study. After the treatment phase, the videodisc groups completed the required questionnaires. Finally, all groups of students wrote the posttest.

Measures

During the study data were collected for the following measures:

1. Achievement

The achievement test items were twenty multiple-choice questions selected from a data base of items on facts, concepts and processes on two topics (Cardiac Basics and Anatomy of the Heart).

These questions were similar to the ones available in the interactive videodisc lessons. Each question consists of a stem and five distractors. An example is given below:

The myocardium is supplied with oxygen and nutrients from blood flowing through:
(a) the chambers of the heart.
(b) blood vessels in the pericardium.
(c) coronary arteries.
(d) cardiac veins.
(e) pulmonary circulation.

The test was validated by a panel of experts chosen from the Basic Health Sciences department. The panel was made up of three members who are experienced classroom teachers in Anatomy and Physiology.

In validating the test, the panel members reviewed the lesson objectives on which the course content and test were based, and the test questions. Given this information, the panel concluded that the test had content and face validity and measured the stated objectives of the two topics used in the study.

The achievement test is shown in Appendix I.

2. **Attitudes**

The attitudes of individuals to an activity are important to the success of that activity. Attitudes are also an essential variable to successful implementation of that activity. The literature suggests that attitudes towards computer-assisted instruction may be an important variable in studying the effectiveness of interactive learning systems (Skinner, 1988).

An instrument for measuring attitudes towards the interactive
learning system, the Heart disc used in this study, is not available in the literature. One was developed to suit the needs of this investigation. The attitude inventory (Appendix H) was developed by the author of this thesis based on a study of the design components of the videodisc program. The response choices are based on a 5-point Likert scale to express different degrees of agreement or disagreement (Sax, 1989). The choices were coded and range from 5 for strongly agree which was interpreted to represent a very positive attitude, to 1 for strongly disagree, which was interpreted to represent a very negative attitude. A code of 3 represented a neutral attitude or feeling.

The inventory consisted of thirty-five items which related to five major components of the interactive videodisc program. These components and the items associated with them are shown in Table 5. The five components include:

1. Directions and Instructions for Use of the System
2. Content
3. Technical Elements
4. Instructional Design
5. Suitability of Interactive Video for Teaching and Learning
Table 5

The Major Components of the Interactive Videodisc Program and Their Associated Items from the Attitude Inventory As Explained in Appendix H

<table>
<thead>
<tr>
<th>Major Components</th>
<th>Refers To</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directions and instructions for use of the system</td>
<td>how to use the interactive video lessons and the touch screen</td>
<td>1,2</td>
</tr>
<tr>
<td>Content</td>
<td>organization, appropriateness and level of difficulty of the topics and the heart</td>
<td>3,4,5,6</td>
</tr>
<tr>
<td>Instructional Design</td>
<td>the objectives and instructional strategy to present the material using illustrative material summaries, tests and feedback to guide and facilitate learning</td>
<td>7,9,10,11,12,13,14,15,23</td>
</tr>
<tr>
<td>Technical Elements</td>
<td>the use of menus, learner control system control options, graphics video and audio presentations</td>
<td>8,16,17,18,19,20,21,22</td>
</tr>
<tr>
<td>Suitability of Interactive Video for Teaching and Learning</td>
<td>roles of the system in the course</td>
<td>24,25,26,27,28,29,30,31,32,33,34,35</td>
</tr>
</tbody>
</table>
3. Interaction Strategies

Since an instrument for examining how students interacted with the videodisc lessons could not be found in the literature, one had to be developed. A review of the interactive videodisc of the heart and the two studies (Andriessen & Kroon, 1980; Bunderson et al., 1984) suggested seven different strategies students might use when studying the materials of the disc. The instrument is shown in Appendix G.

In addition to the data collected in the interaction strategies questionnaire the video camera-recorded information was also available on how students interacted with the interactive videodisc lessons.

4. Demographic Data

The instrument shown in Appendix F was designed to record variables such as age, sex, technology, education, experience with self directed learning and experience with computers. The purpose of such data was to determine if these background variables would have any effect on achievement.

The Pilot Study

A pilot study was conducted in June 1989 to check the suitability of the instruments, to refine the instruments, and to gain some experience in the logistics of the study. Six students in the Medical Radiography Program participated and they were randomly placed into one of two groups who received videodisc instruction.
The study was first explained to the students and a pretest was written followed by student use of the interactive videodisc learning system. During use of the system two students were videotaped. After using the learning system students immediately completed the interaction strategies questionnaire, the attitude inventory and wrote a posttest. Students also completed the demographic data sheet, followed by a short discussion of their experiences with the system.

On the basis of the results of the pilot run, three questions on the achievement test were corrected and the various instruments were revised. In addition, two encouraging indications were noted. First, the six students were all very positive about the interactive videodisc learning system, affirming its usefulness in providing learning opportunities not possible with large class environments. Students, however, would not agree to having human instruction replaced by the system. Interestingly, all students preferred the keyboard to the touch screen. Second, the introduction of the knowledge lack identification procedure appeared to have had some impact on achievement and how students used the lessons. The three students who were exposed to the knowledge lack identification procedure before they used the interactive video lessons performed better than those students who were not exposed to the knowledge lack identification procedure.
Statistical Treatment of the Data

The pretest and posttest scores of students in the three groups were analysed using repeated measures ANOVA. The attitude ratings were tabulated to obtain the mean rating score on each item in each of the two disk groups. Also, a t test for a difference between two independent means was performed on each of the items on the attitude inventory.

Further, the interaction strategy questionnaire data and the camera-recorded observational information were examined for major patterns of material use when learning with the system. Percentages of students using particular strategies were computed. Finally, background variables of age, educational level, experience with self study and experience with computers were analysed using t tests and ANOVA to examine associations between these variables and performance scores. A Scheffe test was conducted on the background variable of educational level.
CHAPTER 5

Results of the Study

Introduction

The primary objective of this study was to evaluate the effectiveness of an interactive videodisc learning system as a resource tool to enhance learning. Specifically, achievement and attitudes were used as measures of effectiveness. First, achievement was measured on three groups of students using three different instructional conditions/treatments to help students revise, clarify, elaborate and consolidate materials received in the lectures. These groups included a videodisc group (IVDKLIP) who was subjected to an instructional intervention procedure (the knowledge lack identification procedure (KLIP)), a videodisc group (IVD) who did not receive the procedure and a small group tutorial mediated by a teacher. Second, attitudes of the two videodisc groups were measured to determine students' feelings about the interactive learning system as well as to determine whether the application of the KLIP had any effect on attitudes.

The study also attempted to find out how students interacted with the videodisc lessons. This chapter presents the results of the data.
Results of the Achievement Analysis

The summary statistics describing the pretest and the posttest for each of the three groups of students are shown in Table 6. It is clear that all three groups of students averaged higher on the posttest than the pretest and that the posttest score for the interactive videodisc group exposed to the knowledge lack identification procedure (IVDKLIP Group) was highest for the three groups. Another interesting finding is that the posttest score for the Teacher-mediated small group tutorial (Teacher Group) was higher than the interactive videodisc group not exposed to the knowledge lack identification procedure (IVD Group).

A repeated measures analysis of variance was conducted on the pretest and posttest scores for each of the three groups. The results are shown in Table 7. It can be seen that there was no significant group by time (or treatment by test) interaction, neither was there a significant difference among the three treatment groups in their posttest scores or their means of pretest and posttest scores. The posttest mean score of the three groups, however, was significantly different from the pretest mean, $F(1,48) = 93.22, p = .001$.

This result showed that the groups learned from the three treatment conditions for revision, clarification, elaboration and consolidation. The treatments produced no significant difference in achievement.
Table 6

The Mean and Standard Deviation on Achievement Measure by Group

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>(\bar{X})</th>
<th>SD</th>
<th>(\bar{X})</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>IVDKLIP</td>
<td>19</td>
<td>35.78</td>
<td>12.93</td>
<td>63.94</td>
<td>19.33</td>
</tr>
<tr>
<td>IVD</td>
<td>17</td>
<td>40.00</td>
<td>17.23</td>
<td>58.82</td>
<td>18.24</td>
</tr>
<tr>
<td>Teacher</td>
<td>15</td>
<td>34.00</td>
<td>19.65</td>
<td>60.00</td>
<td>18.61</td>
</tr>
</tbody>
</table>

* Achievement scores by percent

Table 7

Analysis of Variance Summary Table

Between Subject Factors are:

A - Treat : IVDKLIP, IVD, Teacher Group

Within Subject Factors are:

B - Test : Pretest, Posttest

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean of Squares</th>
<th>(\frac{\text{F}}{\text{Ratio}})</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>160.003</td>
<td>2</td>
<td>80.001</td>
<td>0.172</td>
<td>0.843</td>
</tr>
<tr>
<td>S-within</td>
<td>22380</td>
<td>48</td>
<td>466.252</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>14951.188</td>
<td>1</td>
<td>14951.188</td>
<td>93.220</td>
<td>0.001</td>
</tr>
<tr>
<td>AB</td>
<td>402.310</td>
<td>2</td>
<td>201.155</td>
<td>1.254</td>
<td>0.294</td>
</tr>
<tr>
<td>BS-within</td>
<td>7698.500</td>
<td>48</td>
<td>160.385</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results of the Attitude Analysis

Positive and Negative Reactions

The means of the responses to each of the items on the attitude inventory for each of the two interactive videodisc groups as well as for both groups combined are given in Table 8.

Students in the two groups expressed strong agreement with practically all item statements (on average, 29 items carrying a mean rating above 4, and two less than 4 but above 3.5) reflecting very positive attitudes toward the different aspects of the system. The few items which students ranked less than 3 involved students' views on the role of the system. These item statements included:

- It would be better for students to use the interactive videodisc rather than attend lectures.
- Students should use the interactive videodisc on their own, with the opportunity to meet with the instructor 3-4 times during the entire course.
- The interactive videodisc learning system can totally replace the human instructor.

Attitudes Toward Major Components of the Interactive Videodisc Program

The attitude inventory was designed to capture not only the overall feelings or opinions to the interactive learning system but also to major components of the interactive videodisc program and to interactive learning in general. Table 5 shows these major components and their associated items from the attitude inventory.
Table 8
The Means of the Responses to Each of the Items on the Attitude Inventory for the Videodisc Students

<table>
<thead>
<tr>
<th>Items</th>
<th>Groups</th>
<th>t Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IVD</td>
<td>KLIP</td>
</tr>
<tr>
<td>1. The directions for using the videodisc lessons were clear and easy to understand.</td>
<td>4.63</td>
<td>4.29</td>
</tr>
<tr>
<td>2. The hints on using the touch screen and how to study the videodisc lessons were helpful.</td>
<td>4.47</td>
<td>4.29</td>
</tr>
<tr>
<td>3. The videodisc lesson content was at the right level of difficulty for my technology.</td>
<td>4.36</td>
<td>4.17</td>
</tr>
<tr>
<td>4. The lessons were easy to understand.</td>
<td>4.52</td>
<td>4.17</td>
</tr>
<tr>
<td>5. The reading level and vocabulary were appropriate for my technology.</td>
<td>4.57</td>
<td>4.64</td>
</tr>
<tr>
<td>6. The content is organized in a logical manner.</td>
<td>4.57</td>
<td>4.64</td>
</tr>
<tr>
<td>7. The goals of the lessons are clearly defined.</td>
<td>4.36</td>
<td>4.17</td>
</tr>
<tr>
<td>8. The lesson menus helped me through the material in a systematic way.</td>
<td>4.68</td>
<td>4.52</td>
</tr>
<tr>
<td>9. The use of graphics and animations served to illustrate important ideas.</td>
<td>4.73</td>
<td>4.47</td>
</tr>
<tr>
<td>10. The video segments reinforced important concepts.</td>
<td>4.31</td>
<td>4.41</td>
</tr>
</tbody>
</table>
Table 8 (Continued)

<table>
<thead>
<tr>
<th>Items</th>
<th>Groups</th>
<th>IVD (n=19)</th>
<th>Both IVD (n=17)</th>
<th>KLIP IVD Groups (n=36)</th>
<th>t Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. The ability to explore the topic (explorations) is an important component in videodisc instruction.</td>
<td></td>
<td>4.26</td>
<td>4.11</td>
<td>4.18</td>
<td>0.50</td>
</tr>
<tr>
<td>12. The lesson summaries are useful component of interactive videodisc instruction.</td>
<td></td>
<td>4.68</td>
<td>4.47</td>
<td>4.57</td>
<td>0.99</td>
</tr>
<tr>
<td>13. The test questions are useful and helped to check my understanding of the material.</td>
<td></td>
<td>4.73</td>
<td>4.94</td>
<td>4.83</td>
<td>-1.39</td>
</tr>
<tr>
<td>14. I was encouraged by the responses given to my answers of the questions.</td>
<td></td>
<td>4.00</td>
<td>4.11</td>
<td>4.05</td>
<td>-0.49</td>
</tr>
<tr>
<td>15. Knowing how I performed on the practice test was beneficial.</td>
<td></td>
<td>4.36</td>
<td>4.52</td>
<td>4.44</td>
<td>-0.73</td>
</tr>
<tr>
<td>16. Learner control of the rate and sequence of the presentation, summary, and test questions is very beneficial.</td>
<td></td>
<td>4.63</td>
<td>4.64</td>
<td>4.63</td>
<td>-0.07</td>
</tr>
<tr>
<td>17. Interactive videodisc instruction provides a useful mechanism for reviewing course notes.</td>
<td></td>
<td>4.52</td>
<td>4.70</td>
<td>4.61</td>
<td>-0.09</td>
</tr>
<tr>
<td>18. The touch screen is easy to use.</td>
<td></td>
<td>4.21</td>
<td>4.52</td>
<td>4.36</td>
<td>-1.15</td>
</tr>
<tr>
<td>19. The options for controlling the presentation of the lessons are effective.</td>
<td></td>
<td>4.36</td>
<td>4.52</td>
<td>4.44</td>
<td>-0.69</td>
</tr>
<tr>
<td>20. It is important for students to control the video segments using fast, slow, reverse and skip controls.</td>
<td></td>
<td>3.94</td>
<td>4.29</td>
<td>4.11</td>
<td>-1.34</td>
</tr>
</tbody>
</table>
Table 8 (Continued)

<table>
<thead>
<tr>
<th>Items</th>
<th>Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IVD KLIP IVD Both Groups</td>
</tr>
<tr>
<td></td>
<td>n=19 n=17 n=36</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>21. The keyboard (instead of the touch screen) would have been more effective in controlling the lesson presentation.</td>
<td>2.00 2.11 2.05 -0.46</td>
</tr>
<tr>
<td>22. Audio is vital to videotape lessons.</td>
<td>4.42 4.11 4.26 1.24</td>
</tr>
<tr>
<td>23. The layout of materials on the screen was helpful to learning.</td>
<td>4.63 4.47 4.55 0.96</td>
</tr>
<tr>
<td>24. While using the videotape lesson, I was actively involved in my own learning.</td>
<td>4.68 4.76 4.72 -0.53</td>
</tr>
<tr>
<td>25. The interactive video helped me to learn topics I did not understand in the lectures.</td>
<td>4.52 4.29 4.40 1.07</td>
</tr>
<tr>
<td>26. I found the use of the videotape learning system motivational.</td>
<td>4.73 4.52 4.62 1.29</td>
</tr>
<tr>
<td>27. Interactive videotape lessons stimulates creativity in students.</td>
<td>3.94 3.64 3.79 1.05</td>
</tr>
<tr>
<td>28. The videotape learning system allowed me to learn at my own pace.</td>
<td>4.63 4.70 4.66 -0.35</td>
</tr>
<tr>
<td>29. My interest in Anatomy and Physiology of the Heart has increased because of this interactive videotape learning experience.</td>
<td>4.10 4.00 4.05 0.36</td>
</tr>
<tr>
<td>30. More courses should be taught by interactive videotape instruction.</td>
<td>4.51 4.47 4.49 0.44</td>
</tr>
</tbody>
</table>
Table 8 (Continued)

<table>
<thead>
<tr>
<th>Items</th>
<th>Groups</th>
<th></th>
<th></th>
<th>t Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Groups</strong></td>
<td>IVD</td>
<td>KLIP</td>
<td>Both</td>
<td>n=19</td>
</tr>
<tr>
<td><strong>t</strong> Value</td>
<td>0.83</td>
<td>0.90</td>
<td>1.65</td>
<td>-0.19</td>
</tr>
<tr>
<td>31. I would recommend learning by interactive videodisc to my friends.</td>
<td>4.73</td>
<td>4.58</td>
<td>4.65</td>
<td></td>
</tr>
<tr>
<td>32. It would be better for students to use the interactive videodisc rather than attend classroom lectures.</td>
<td>3.21</td>
<td>2.88</td>
<td>3.04</td>
<td></td>
</tr>
<tr>
<td>33. Students should use the interactive videodisc on their own, with the opportunity to meet with the instructor 3-4 times during the entire course.</td>
<td>3.52</td>
<td>2.82</td>
<td>3.17</td>
<td></td>
</tr>
<tr>
<td>34. A resource person should be present during student use of the interactive videodisc to answer questions about the material on the disc.</td>
<td>3.94</td>
<td>4.00</td>
<td>3.97</td>
<td></td>
</tr>
<tr>
<td>35. The interactive videodisc learning system can totally replace the human instructor.</td>
<td>2.21</td>
<td>1.82</td>
<td>2.01</td>
<td></td>
</tr>
</tbody>
</table>
The numbers as well as percentages of students responding to each of these components are given following Table 8.

**Directions for using the interactive videodisc lessons**

Students were very positive toward this component. Their responses were as follows (there is a total of 36 students responding):

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>1</td>
<td>30</td>
<td>83</td>
<td>5</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
<td>50</td>
<td>15</td>
<td>42</td>
<td>2</td>
</tr>
</tbody>
</table>

**Lesson Content**

Students expressed very positive attitudes toward this component as shown below:
Strongly Agree | Agree | Neutral | Disagree | Disagree
--- | --- | --- | --- | ---
7 | 18, 50 | 11, 30 | 6, 17 | 1, 3 | 0, 0
9 | 24, 67 | 10, 28 | 2, 5 | 0, 0 | 0, 0
10 | 19, 50 | 11, 30 | 6, 17 | 0, 0 | 0, 0
11 | 16, 44 | 12, 33 | 7, 20 | 1, 3 | 0, 0
12 | 24, 67 | 9, 25 | 3, 8 | 0, 0 | 0, 0
13 | 31, 86 | 4, 11 | 1, 3 | 0, 0 | 0, 0
14 | 10, 28 | 18, 50 | 8, 22 | 0, 0 | 0, 0
15 | 17, 53 | 14, 39 | 3, 8 | 0, 0 | 0, 0
23 | 20, 56 | 16, 44 | 0, 0 | 0, 0 | 0, 0

Technical Elements

Very positive attitudes were seen toward this component. Item number 21 relating to the use of the keyboard was rated negatively.
Suitability of interactive video for teaching and learning

There are twelve items relating to this component. In general, students were very positive to the items except to Items 32 and 35. The responses were as follows:

<table>
<thead>
<tr>
<th>Items</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>8</td>
<td>23</td>
<td>64</td>
<td>12</td>
<td>33</td>
<td>1</td>
</tr>
<tr>
<td>16</td>
<td>26</td>
<td>72</td>
<td>8</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>17</td>
<td>24</td>
<td>67</td>
<td>10</td>
<td>28</td>
<td>2</td>
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<tr>
<td>18</td>
<td>19</td>
<td>54</td>
<td>13</td>
<td>36</td>
<td>2</td>
</tr>
<tr>
<td>19</td>
<td>19</td>
<td>54</td>
<td>15</td>
<td>40</td>
<td>1</td>
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<td>39</td>
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<td>0</td>
<td>0</td>
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<td>11</td>
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<tr>
<td>22</td>
<td>16</td>
<td>44</td>
<td>14</td>
<td>39</td>
<td>6</td>
</tr>
<tr>
<td>Items</td>
<td>Strongly Agree</td>
<td>Agree</td>
<td>Neutral</td>
<td>Disagree</td>
<td>Strongly Disagree</td>
</tr>
<tr>
<td>-------</td>
<td>----------------</td>
<td>-------</td>
<td>---------</td>
<td>----------</td>
<td>------------------</td>
</tr>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>24</td>
<td>26</td>
<td>72</td>
<td>10</td>
<td>28</td>
<td>0</td>
</tr>
<tr>
<td>25</td>
<td>18</td>
<td>50</td>
<td>15</td>
<td>42</td>
<td>3</td>
</tr>
<tr>
<td>26</td>
<td>23</td>
<td>64</td>
<td>13</td>
<td>36</td>
<td>0</td>
</tr>
<tr>
<td>27</td>
<td>7</td>
<td>20</td>
<td>17</td>
<td>47</td>
<td>11</td>
</tr>
<tr>
<td>28</td>
<td>26</td>
<td>72</td>
<td>9</td>
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<td>30</td>
<td>23</td>
<td>64</td>
<td>10</td>
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<td>2</td>
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<td>10</td>
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<td>32</td>
<td>4</td>
<td>11</td>
<td>9</td>
<td>25</td>
<td>9</td>
</tr>
<tr>
<td>33</td>
<td>6</td>
<td>17</td>
<td>11</td>
<td>30</td>
<td>8</td>
</tr>
<tr>
<td>34</td>
<td>9</td>
<td>25</td>
<td>19</td>
<td>53</td>
<td>6</td>
</tr>
<tr>
<td>35</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>8</td>
</tr>
</tbody>
</table>

**Students' comments about the Interactive Videodisc Learning System**

In addition to rating the attitude items, students made a good effort to write additional comments about their experiences and feelings about the use of the Interactive Videodisc learning system. Of the 36 students from the two videodisc groups (IVDEKLIP, n = 19 and
IVD, n = 17) 11 from the IVDKLIP Group and 7 from the IVD Group wrote comments. These comments are quoted in Appendix J.

A careful reading of these comments indicated that the IVDKLIP students wrote more considered comments -- comments going beyond repetitions of the attitude questionnaire. The following are examples of these:

2. "I really like using it. It would be great for study, review and clarification. I don't believe that it could effectively teach the course by itself, but for people who miss a large number of classes or the class is just too fast, it would be excellent to help them keep up or even study ahead."

7. "This system is an extremely useful tool for people who learn well with audio and visual techniques. I feel that it is important however, that instructional class time can be used more effectively if students use the IVD first and then have instructors answer questions or expand on any necessary material."

9. "This is an interesting concept in learning and I like it. I think that the students might need a course overview (written) indicating the importance of each
area and what subjects must be reviewed for the required course. I was looking at areas of interest and feel that if a course was taught this way, there should be some form of recording what you have viewed and where you are in the program.”

Also, the t test performed on the mean ratings of the items in the two disk groups showed no significant difference, indicating that the application of the knowledge lack identification procedure did not affect students' attitudes towards the interactive videodisc system.

**Interaction Strategies**

The ways in which students interacted with the videodisc lessons were examined using the interaction strategy questionnaire data and the camera-recorded observational information. Thirty-six student questionnaires and eight hours of videotape information were analyzed for major patterns of interaction.

**Questionnaire Data**

The instrument used to record how students used the interactive learning program was developed to capture seven strategies. Figure 8 illustrates the overall strategy patterns of use for both videodisc groups during both scheduled sessions (two one-hour sessions scheduled on consecutive days) as well as the percentages of students using
Figure 8

The Strategy Patterns of Students During Their Use for the Interactive Videodisc Program for Both Sessions

Step by Step
Linear Survey

Quick Linear
Survey

Selected
Review

Test Strategy

Summary/
Test

Summary/Test/
Review

Test + Review

S1 = Session 1
S2 = Session 2

% of Students
various strategies.

It can be seen that 69% of the students employed a step-by-step linear survey of the materials during their first session on the system. In the second session however, even though 41% of the students used the linear step-by-step survey of the materials, 22% of the students used the selected review strategy. The third most popular strategy in session two, was the quick linear survey (14% of the students used this strategy) followed by the summary/test/review strategy (11% of the students used this particular strategy).

A further insight into the interaction strategies was obtained by examining the strategies of each of the two videodisc groups on each of the sessions. The results are illustrated in Figure 9. Two major points should be noted. First, in session one, while the major pattern of interaction for both groups was the linear step-by-step strategy, only the IVDKLIP group utilized the quick linear survey strategy. Secondly, while the major interaction strategy was the linear step-by-step strategy in session two for both groups (47% of the IVD students and 36% of the IVDKLIP students), 36% of the IVDKLIP students used the selected review strategy.

Camera-Recorded Observational Data

Camera-recorded observational information was collected for two IVDKLIP students and two IVD students chosen at random. Each student was videotaped for the length of each of the sessions (two hours).
Figure 9

Interaction Strategies for Each of the Two Videodisc Groups on Each of the Two Sessions

<table>
<thead>
<tr>
<th></th>
<th>SESSION 1</th>
<th>SESSION 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step by Step</td>
<td>IVD</td>
<td>IVD</td>
</tr>
<tr>
<td>Linear Survey</td>
<td>KLIP</td>
<td>KLIP</td>
</tr>
<tr>
<td>Quick Linear Survey</td>
<td>KLIP</td>
<td>IVD</td>
</tr>
<tr>
<td>Selected Review</td>
<td>IVD</td>
<td>KLIP</td>
</tr>
<tr>
<td>Test Strategy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summary/Test</td>
<td>IVD</td>
<td>IVD</td>
</tr>
<tr>
<td>Test/Review</td>
<td>KLIP</td>
<td>IVD</td>
</tr>
<tr>
<td>Summary/Test/Review</td>
<td>IVD</td>
<td>KLIP</td>
</tr>
</tbody>
</table>

% of Students
Eight hours of videotapes were studied carefully to examine how students interacted with the lesson materials. Such interactions could be facilitated through the use of the control options (fast forward, slow forward, advance one frame, show a still frame, reverse one frame, slow reverse, fast reverse and skip video). These options were available to give the learner as much control in determining his/her own pathway and pace through the lessons.

The video tape analysis reflected the following:

(a) The four students in both groups (IVDKLIP and IVD) used the linear step-by-step strategy most of the time for both sessions one and two. This was in total agreement with the student questionnaire data.

(b) The two IVDKLIP students utilized the selected review strategy more than the IVD students through the use of the options to control video sequences, text, graphics and animations more frequently than the IVD students.

(c) All four students answered the reinforcement questions embedded in the lessons and scored reasonably good marks (80% - 100%).

(d) All four students took the self test at the end of each topic presentation and scored very good marks (90% - 100%).

(e) Two students demonstrated use of the glossary.
(f) There were no difficulties in using the touch screen and the disc materials.

**Analysis of Background Variables**

The background variables of age, education experience with self-directed study and experience with computers were collected using the questionnaire shown in Appendix F. The purpose of these data was to determine whether these variables affected achievement test scores. ANOVA and t tests were conducted on the respective data.

With respect to the variable of age, students were placed into two age groups. While Group 1 (n = 27) students ranged from 17 to 22 years old, Group 2 students were considered older and ranged from 23 to 35 years of age. The results of the analysis are shown in Table 9. There was no association between the variable of age and achievement.

In examining the variable of education, students were placed into three groups. Group 1 students were those with Grade 12 (secondary) education; Group 2 students had 1 - 2 years of College education or a College Diploma (post secondary); Group 3 students had 1 - 2 years of University education or a University Degree (Bachelor's Degree). In order to test for significance an ANOVA was conducted on the posttest scores. The results are presented in Table 10. The critical value is 3.19 at .05 level of significance as determined by the F distribution with 2 and 48 degrees of freedom. The calculated test statistic was
Table 9

**Summary Statistics for the Background Variable of Age and Achievement**

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>T</th>
<th>DF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17-22 years (younger)</td>
<td>23-35 years (older)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>27</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>55.148</td>
<td>62.292</td>
<td>-.770</td>
<td>49</td>
</tr>
<tr>
<td>SD</td>
<td>14.881</td>
<td>23.077</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

p < .999

Table 10

**Analysis of Variance on Education Between Groups**

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p</th>
<th>.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>2101.24</td>
<td>2</td>
<td>1050.62</td>
<td>3.34</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td>Within Groups</td>
<td>15064.44</td>
<td>48</td>
<td>313.84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>17165.68</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.34. There was an association between education and achievement. A Scheffe test showed that students with a university-based education (1-2 years university or university degree) did significantly better than those with Grade 12 level.

The third background variable examined was experience with self-directed study. Students were placed in two groups, those with experience and those without experience. A t-test was conducted on the posttest scores to determine significance and the results are given in Table 11. There was no association between experience with self-directed study and achievement.

Finally, the background variable of experience with computers was examined for significance. Students were placed into three groups, those with some experience (Group 2) and those with no experience (Group 3). Table 12 shows the results of ANOVA conducted on the posttest scores, which indicate that there was no association between experience with computers and achievement.
Table 11

Summary Statistics for the Background Variable of Experience with Self-Directed Study and Achievement

<table>
<thead>
<tr>
<th></th>
<th>Group 1 Experience</th>
<th>Group 2 No Experience</th>
<th>T</th>
<th>DF</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>36</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>62.917</td>
<td>56.667</td>
<td>1.10</td>
<td>49</td>
</tr>
<tr>
<td>SD</td>
<td>18.531</td>
<td>18.387</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

p < .552

Table 12

Analysis of Variance on Experience with Computers Between Groups

<table>
<thead>
<tr>
<th>Source</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>p &lt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>586.83</td>
<td>2</td>
<td>293.41</td>
<td>.850</td>
<td>1.000</td>
</tr>
<tr>
<td>Within Groups</td>
<td>16576.48</td>
<td>48</td>
<td>345.39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>17165.68</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 6
Discussion

Introduction

This study was designed to investigate the use of an interactive videodisc learning system as a tool to enhance learning by addressing the needs of the instructional environment. The interactive learning system was made available as a result of a joint project between IBM and BCIT, to build interactive video discs for educational applications. The first of these discs entitled "The Anatomy and Physiology of the Heart" was developed on the basis of the problems and needs of the Basic Health Sciences department (BCIT) in delivering instruction on a course Anatomy and Physiology to eleven Health Technology Programs at BCIT.

Summary

The study had three objectives. The first objective was to evaluate the effectiveness of the interactive videodisc system as a tool in meeting the learning needs of students. The second objective was to investigate the application of an instructional intervention procedure (the knowledge lack identification procedure) for enhancing the effectiveness of the learning system. The third objective was to determine how students interacted with the videodisc materials.

To achieve these objectives, the study was designed involving 51
participants who took a pretest at the beginning of the course. Students then received lectures in the conventional manner: the instructor gave explanations, using handouts and an overhead projector in a large classroom. Two weeks after completion of the lecture series, students were randomly assigned to one of three groups (IVDKLIP, IVD and Teacher group) for the treatment phase of the study. At the conclusion of this phase, all students took a posttest. Only the two videodisc groups completed attitude and system interaction questionnaires.

During the treatment phase, students attended two one-hour sessions held on consecutive days to revise, clarify, elaborate and consolidate learning of the knowledge introduced in the lectures (enhancing learning). Students in the Teacher group spent two sessions with the instructor who engaged in discussion with students on queries they raised. The instructor used transparencies of diagrams, lecture notes and models of objects for clarification or elaboration. Students in the two disc groups spent two one-hour sessions taking charge of their own learning on an individual basis using the interactive videodisc learning system. Students in the IVDKLIP group, in addition, were subjected to the knowledge lack identification procedure. At the beginning of each of the two sessions, students in this group were asked to identify on a piece of paper, questions, confusions or difficulties they still had concerning the lecture materials. At the end of each session, these students
were asked to summarize what they had learned about the identified lacks of knowledge, and to state questions about which they needed to check further.

Data analyses revealed that there was no significant difference in achievement among the three groups of students exposed to the three instructional conditions (treatments) for revising, clarifying, elaborating and consolidating knowledge received from lectures. It would appear that this finding provides a solution to the problems of providing additional learning opportunities such as small group tutorials and visual enrichment activities for students taking Anatomy and Physiology at BCIT. Since such small group tutorials are not possible at BCIT (for reasons identified earlier), then the disk provides a good alternative in providing additional instructional activities to enhance learning through clarification, elaboration, visual reinforcement and consolidation of lecture material. The interactive learning system could therefore be implemented to provide such opportunities for learning. In addition, there was no significant difference between the two videodisc groups in attitudes towards the videodisc system. Both groups were very positive toward the interactive learning system. The majority of the students in the two videodisc groups reported using the linear step-by-step survey of the materials during the first session. Interestingly, in the second session, 47% of the students in the IVD group still used the same strategy while only 36% of the students in the IVDKLIP group employed
Finally, the background variables of age, education, experience with self-directed study and experience with computers were examined to determine whether these variables affected achievement. The only significant difference related to education. Students with a University-based education did significantly better than students with secondary Grade 12 education.

This chapter will discuss these findings. Problems and limitations of the study will be identified and recommendations will be made. The chapter concludes with suggestions for future research.

Discussion

There are three major findings in this study that warrant further discussion:

(a) When used as a tool to enhance learning (that is, to revise, clarify, elaborate and consolidate new learning introduced in the lectures), the interactive videodisc learning system appeared as effective as a small group tutorial mediated by a teacher.

(b) Students' attitudes towards the interactive videodisc learning system were very positive.

(c) The use of the instructional intervention procedure (KLIP) appeared to have influenced the interaction
strategies of students during their study of the interactive videodisc lessons.

In view of these findings, the interactive videodisc learning system would be appropriate for use in learning environments where small group tutorials are unavailable due to lack of instructors, and time and cost constraints. A small group tutorial mediated by a teacher is considered a preferred condition which fosters teaching and learning, because "it lends variety to learning, encourages participation and promotes a measure of active thinking among students" (Glidden & Kurfiss, 1989, p. 7).

This result may be useful to planners/instructors in higher education faced with the difficulty in arranging tutorial consultation for students. The difficulty often stems from large class sizes and great diversity of programs in which students are enrolled.

The use of the instructional intervention procedure (KLIP) was not powerful enough to induce a significantly greater performance outcome, although students applying the procedure obtained the highest posttest mean score.

It appears from this study that the interactive learning system is at least as good as the small group tutorial for helping students to revise, clarify and consolidate learning Anatomy and Physiology of the Heart. It is possible though that the Hawthorne effect could have been operating in this study, especially since this was the first
study of this kind at BCIT.

The attitudes of students toward the interactive videodisc learning system were very positive. This finding is consistent with the results obtained by several investigators (Branch, et al., 1987; Dalton, 1986, 1990) as well as those identified in Bosco's (1986) meta-analysis study of interactive video. More specifically students' attitudes toward interactive video as a tool for teaching and learning were very positive affirming its usefulness in providing learning opportunities not possible with large classes. Additionally, the written comments of students support the positive responses on the attitude questionnaire with such words and phrases as, "excellent", "enjoyed", "fun", "like using it", "useful", "positive and enriching experience", "extremely useful", "interesting concept", "incredible", "amazed", "thoroughly enjoyed" and "resourceful and informative".

Additionally, students' high ratings (above 4.5) on several items (as shown in Table 13) reflected five main features about which students were most concerned:

1. Clarity of directions for using the materials.
2. Clarity of content organization.
3. Ease of exercising control over pace and selection of materials.
4. Provision of summary information and mechanism for reviewing course materials.
Table 13

**Attitude Items With a Mean Rating of Above 4.5**

- The directions for using the videodisc lessons were clear and easy to understand.
- The lesson menus helped me through the material in a systematic way.
- The layout of materials on the screen was helpful to learning.
- The content is organized in a logical manner.
- The use of graphics and animations served to illustrate important ideas.
- The lesson summaries are useful component of interactive videodisc instruction.
- The test questions are useful and helped to check my understanding of the material.
- Interactive videodisc instruction provides a useful mechanism for reviewing course notes.
- Learner control of the rate and sequence of the presentation, summary, and test questions is very beneficial.
- The videodisc learning system allowed me to learn at my own pace.
- While using the videodisc lesson, I was actively involved in my own learning.
- I would recommend learning by interactive videodisc to friends.
5. Provision of graphics and animations to illustrate concepts.

The students' positive attitudes towards the disc and strong disagreement with the idea of replacing human instruction by the system indicated their interest in the use of the system as an integrated learning resource rather than as a substitute for human instructional interaction.

There are several possible explanations for these findings. The interactive videodisc program provides learners with control over the lessons thus allowing them to make effective use of their time. Knowles (1981) points out that this type of instruction appeals to the sense of self directedness. Such pacing of the lessons as suggested by Dalton (1990) is often "beneficial in developing positive attitudes towards learning" (p. 9).

In addition to this, Steinberg (1989) points out that learner control of instruction is intuitively appealing. The argument is that students will be more motivated if allowed to be in control of their own learning. Learner control can alleviate boredom, frustration, and anxiety, because it enables students to skip over materials they have previously learned or avoid materials which they are not prepared to study. Learner control will maintain attention longer, involve students more deeply and perhaps give students more insights. (p. 117)

This argument is supported by student written comments such as:
"it held my attention for longer than an instructor could."

"keeps attention more than classroom lecture because I was active in learning."

"I was looking at areas of interest."

"Feel that I have learned from the system and come away with more knowledge."

Despite the literature which argues that students do not perform well under learner control because they exit the lesson too soon, view fewer examples and complete the lesson very quickly (Tennyson, Tennyson & Rothen, 1980), this study shows somewhat different findings. This could probably be attributed to the fact that students had prior knowledge of the subject matter from lectures.

Also the multi-media presentation characteristics of the interactive videodisc learning system provided not only motivational properties but also auditory and visual aids to enhance learning. Graphics, animations and video sequences of actual events were readily available and could be used repeatedly until content is mastered.

In the opinion of the author, these positive attitudes could also have been related to the simplicity of the touch screen as the
interface between the student and the computer. Perhaps the keyboard would have generated problems especially for those students with no computer experience.

Before students used the interactive learning system, they viewed a 10-minute videotape on how the system works. They also used the system briefly before they began study of the materials. Could these activities have influenced the students in making these positive responses, since they felt comfortable with the system?

One small observation is worth mentioning here. Students who used the interactive videodisc lessons were keen on the review questions in the disc materials. The attitude item which received the highest mean rating was:

"The test questions are useful and helped to check my understanding of the material." (4.84)

The videotaped recording of the four students in the disc groups showed that they all completed the review questions embedded in the lessons and the test questions at the end of each module. Might increased use of the system, a wider scope of materials, and student awareness of the similarities of examination and module questions (on the disc) encourage students to use review materials exclusively? This concern points to design issues that go beyond material presentations, user-system interface, and learner control mechanism.
It is important therefore to consider instructional intervention procedures and strategies that support a focus on learning and pursuit of knowledge over and above what's expected or required in an instructional program (Scardamalia, et al., 1989).

Equally important in this study, therefore, are the observations of the types of interaction strategies students were engaged in during their use of the interactive videodisc lessons. The results of the interaction strategies data suggest that students were mainly engaged in two strategies, the linear survey of the materials and the selected review strategy. Most of the students (69%) utilized the linear step-by-step approach. These findings are consistent with Bunderson, et al. (1984), in a study of the effectiveness of an Intelligent Videodisc in Biology. Another popular strategy which was particularly used by the IVDKLIP students during the second session on the learning system was the selected review of the materials.

The linear step-by-step strategy appeared to be a logical way of using the lessons initially to find out more about the content and perhaps to match the content of the lectures to that on the disc. During the second session most students continued to use this linear strategy. It could be that the students were trying to return to the point they had left off during the first session. In fact, casual observation in the lab indicated that this was indeed the case for some students through the use of the remark, "How do I get back to this?".
The application of the KLIP appeared to have had an effect on interaction strategies of these students. In session one, about 5% of the students were engaged in the selected review. In session two, however, 36% of the IVDKLIP students used the selected review strategy. This may suggest that identification of knowledge lacks might have guided students to explicitly think about their learning and make selections of materials addressing areas of concern. The use of the KLIP coupled with the use of a multi-media learning system would possibly allow learners to select strategies most suitable to their individual learning styles, thus supporting the use of systems which provide individualized instruction.

In summary, it appears that the KLIP influenced not only the achievement scores but also the interaction strategies of the students during their use of the interactive learning materials. Use of the knowledge lack identification procedure apparently also led to more involved use of the disk as shown in the greater number of comments students made on how the disk might be used in the course (for example, as an alternative or substitute to laboratory experiences, visual aids to lectures) None of the students in the IVDKLIP group expressed any negative reactions toward the use of the procedure.

The findings on the background variables are not surprising. The fact that there were no associations between the variables of age and experience with computers and achievement scores can perhaps be explained by the simplicity of the touch screen as the input device.
Had the instructional material been oriented to problem solving activities such as is evident in the Water Videodisc (Bolton, Every, & Ross, 1989) which requires alpha-numeric inputs using the keyboard, then the computing background might have been significant.

With respect to the background variable of education, University educated students scored higher than secondary Grade 12 students and those who had a college-based education. This was not surprising since most of the university-educated students had a background in science and had taken a course in Biology (this was confirmed in an informal "interview" with the students after they wrote the posttest).

**Problems**

The problems encountered in this study were few and mainly related to the scheduling of students to each of the treatment sessions. It was difficult to make arrangements that met the needs of all students and some students had to be scheduled outside regular class time. As a result some students did not attend the small group tutorials and had to be eliminated from the study. This absence could be viewed as an advantage of the disc over the small group tutorial in that students could utilize the disc in their own time.

In very few instances, a few students encountered difficulty with the touch screen. They had to touch the screen repeatedly for changes to occur. This was perhaps due to parallax. This problem was corrected by adjusting the seating position of the student, or by
having the student use a rubber eraser at the end of a pencil to touch the screen.

**Limitations**

This study was designed to determine the effectiveness of an interactive videodisc learning system as an instructional tool in resolving conflicts between identified learning needs and practical educational constraints.

Interpretation and generalization of the study results were subject to several limitations. First, perhaps the sample size was too small; however, it was the maximum sample size that could have been obtained on a voluntary basis during the study period. Second, there was no previously available data to support the validity and reliability of the achievement test and attitude inventory. Face and content validity were obtained using a panel of experts. Third, the topics covered in the study were limited to two, Cardiac Basics and Anatomy of the Heart, due to time constraints. The two topics in turn limited the number of questions that comprised the achievement test. Additionally, the time for data collection was too short due to logistical problems in scheduling students for the treatment phase of the study. Last, but not least, efforts were made to remove the novelty effects of the medium but were constrained by time. There was not enough time for students to use another disc to practice using the interactive learning system. Although there were other discs
available, it was difficult to load them onto the ten systems which were already set up to run the videodisc program on the Heart.

The author speculates that perhaps different results might have been obtained if the study were conducted over a longer period of time using more content to span the entire range of topics on the interactive video program on the Anatomy and Physiology of the Heart. In this way more questions could have been generated for the achievement test. A longer data collection time might have demonstrated that, indeed, the application of the knowledge lack identification procedure (KLIP) would have generated significantly higher scores of this group. Perhaps the KLIP students would only make use of the selected review strategy during their use of the materials.

**Recommendations**

On the basis of the results of this study the following are recommendations for use of the interactive learning system at BCIT.

1. **The interactive videodisc learning system should be used as a tool to enhance learning.**
   (a) The results of the achievement scores analysis show that the interactive learning system is equally as effective as a small group tutorial (mediated by a teacher) in helping students
clarify, reinforce, elaborate, consolidate and review material. Such small group tutorials are non-existent at BCIT, and hence the interactive learning system can be effectively substituted to provide these kinds of learning experiences.

This view is supported by the following student comments:

"I really like using it. It would be great for study, review and clarification. I don't believe that it could effectively teach the course by itself, but for people who miss a large number of classes or the class is just too fast, it would be excellent to help them keep up or even study ahead."

"Videodisc is useful in conjunction with lectures."

"This is an excellent way to upgrade your background and I feel that it should be used along with classroom classes, maybe every two weeks have a couple of hours use on them."

"Effective in review of previously taught material."

"I feel that it is a useful tool for studying."

(b) The Attitude data indicates that students were very positive towards the multi-media characteristics of the interactive learning system. Such multi-media can be used to
illustrate material which is rich in visual (three dimensional anatomy) and dynamic content (blood flow through the heart). Two comments which supported this idea are as follows:

"I feel that the disc would be (and should be) an integral part of physiology/anatomy type courses where structures must be learned, but where access to specimens/radiographs etc., is limited."

"It makes a big difference to actually see what I am learning about."

(c) In view of (b) above, the interactive videodisc learning system can be used as a multi-media presentation tool in the classroom to help teachers enhance their own teaching strategies. In this regard one student wrote:

"I think it would be beneficial to have instructors lecture and highlight lectures, etc. with the videodisc."

(d) The interactive videodisc learning system can be implemented to serve as an advanced organizer. This is stated quite nicely by one student who wrote:

"I feel that it is important however, that instructional class time can be used more
effectively if students use the IVD first and then have instructors answer questions or expand on any necessary material."

(e) When used to consolidate, review, clarify and elaborate lecture material, the use of the interactive video learning system should be coupled with the knowledge lack identification procedure as used in this study, since it appears to lead to higher posttest scores and affect ways students interact with the materials. The knowledge lack identification procedure does not only appear to be of benefit to students when planning to review, revise, clarify, elaborate and consolidate lecture material but it may also benefit the teacher especially in tutorial situations. Since students identify uncertainties, confusions and difficulties about the lecture material the knowledge lack identification procedure would also indicate to the teacher areas of weakness in his/her own presentation/explanation of the lecture material.

(f) For those students who have difficulty understanding and keeping up with the pace of the lectures, the interactive video learning system
should be an integral part of the students' own learning scheme to allow them to study at their own pace and to review repeatedly until they master the material. This method of implementation would make full use of the benefits of individualized instruction. In this regard, the learning system can be placed in an easily accessible area such as the library, for example.

2. The interactive videodisc learning system should not be the primary vehicle for the delivery of instruction.

Although the use of the learning system received full marks as a tool for teaching and learning, from the students, they ranked highly, the availability of human consultation and strongly disagreed with having human instruction replaced by the system. In this respect, student comments are as follows:

"I would highly recommend the program but I don't think instructors should be eliminated totally."

"Being an older student with five years university under my belt, I can't see the disc replacing the human instructor, totally."

"At the same time, I feel that it is important to see my instructor on a regular basis."

"I believe that it should be incorporated into the curriculum but strongly disagree that it can replace the human instructor."
These feelings however, might have been related to the fact that students' use of the system was limited to two hours covering only two topics. Despite these feelings, it is possible that there might be certain situations where the interactive learning system can deliver the instruction without the instructor being present, such as in distance learning courses. This is supported by one student who stated:

"I can't see the disc replacing the human instructor, totally except where it may be necessary (i.e., correspondence type programs)."

**Suggestions For Future Research**

Based on the findings of this study as well as the recommendations, future research studies with the interactive videotisc learning system should address the following:

1. This study should be replicated with a larger sample size to include students from all the technologies represented on the disc over a longer period of time (perhaps six months). It should include all the topics (modules) on the disc. A longer data collection time should allow more exposure to the use of the knowledge lack identification procedure to further investigate the use of this procedure for enhancing the
effectiveness of the system. This would be possible if data collection is made a part of the regular scheduled classroom activities.

2. In view of the multi-media presentation characteristics of the interactive learning system, an interesting study would be one which investigates the usefulness of the system as a "high tech" audio visual projection system to enhance lectures in subject matter rich in visual content.

3. Studies investigating the use of the system as an advanced organizer, or to provide prerequisites for secondary students who lack the necessary background knowledge of Anatomy and Physiology, should be conducted.

4. Since there are only ten work stations, a study which involves small group use of the system instead of individual users may provide insights into using the technology to enhance learning in small groups. It would also be of interest to investigate the implications of the use of the KLIP in conjunction with the system, in small group settings as well.
Conclusion

In conclusion, the purpose of this study was not to show that interactive video systems are the best solutions to problems in education, but rather to address issues relating to the effectiveness of the system as a tool for teaching and learning and the ways for effective implementation of this technology. This study provides some insights and suggestions on workable collaboration between human and system instruction. Most notably, the application of the knowledge base identification procedure has provided several interesting indications. First, when instructional intervention procedures are used with interactive learning systems, they appear to help students study the material more effectively. In this study the KLIP group had the highest posttest scores and, as reflected in their written comments, they thought more carefully about how the learning system should be used. The KLIP group also demonstrated more diversified interaction strategies during their use of the videodisc materials.

Second, when instructional intervention procedures are used in conjunction with interactive learning systems, they seem to help students to make better use of the multi-media aspects of interactive video systems. For example, in this study the KLIP group made more use of the program control options to suit their own individual learning styles.

The use of the interactive learning system as a tool to enhance teaching and learning is worthy of consideration when implementing and integrating instructional technology into the curriculum.
APPENDIX A

The three Health Technologies that participated in the study and prerequisites for entry into each program.

* **Electrophysiology Technology**

This technology prepares graduates to operate electro-neurophysiological testing equipment and other related biomedical equipment in hospitals and health care clinics.

**Prerequisites:** English 12; Mathematics 12; Physics 12 and Chemistry 12 with C+ average

* **Medical Radiography Technology**

This technology prepares graduates to perform radiographic (X-ray) examinations on patients, in hospitals and private clinics.

**Prerequisites:** English 12; Mathematics 12; Biology 11; Physics 11; Physics or Biology 12, with C+ average

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From the BCIT, 1990-1991 Full-Time Technology Calendar.
* Nursing

This program prepares graduates to meet the health needs of patients in hospitals and other health care agencies.

Prerequisites: English 12; Mathematics 11; Chemistry 11; Biology 12, with C+ average.
APPENDIX B

The hardware and software features of five levels of interactive video. (From Phillips, 1988). (Reproduced by permission of Electronic Learning)

<table>
<thead>
<tr>
<th>Level</th>
<th>Hardware Configuration</th>
<th>Playback Features</th>
</tr>
</thead>
</table>
| Level 0 | • Videodisc Player  
        • Monitor/Television | • Direct, Non-Stop Playback                               |
| Level 1 | • Videodisc Player  
        • Remote Control Keypad  
        • Monitor/Television | • Motion Control  
                                 • Random Frame & Chapter Access  
                                 • Audio Control  
                                 • Scanning Search  
                                 • Step Framing |
| Level 2 | • Videodisc Player with Built in Microprocessor  
        • Remote Control Keypad  
        • Monitor/Television | • Motion Control  
                                 • Random Frame & Chapter Access  
                                 • Audio Control  
                                 • Scanning Search  
                                 • Step Framing  
                                 • Simple Branching via Computer Program Located on the Videodisc |
| Level 3 | • Videodisc Player  
        • Remote Control Keypad  
        • Monitor/Television  
        • Microcomputer  
        • System Interface  
        • Operating Software | • Motion Control  
                                 • Random Frame & Chapter Access  
                                 • Audio Control  
                                 • Scanning Search  
                                 • Step Framing  
                                 • Complex Branching & Learning Loops  
                                 • Rapid Answer Processing & Reinforcement |
| Level 4 | • Videodisc Player  
        • Remote Control Keypad  
        • Monitor/Television  
        • Microcomputer  
        • System Interface  
        • Operating Software  
        • Computer Software that makes extensive use of Artificial Intelligence Techniques | • Motion Control  
                                 • Random Frame & Chapter Access  
                                 • Audio Control  
                                 • Scanning Search  
                                 • Step Framing  
                                 • Complex Branching & Learning Loops  
                                 • Rapid Answer Processing & Reinforcement  
                                 • Expert Systems Simulations |
APPENDIX C

The hardware components for three levels of interactive videodisc systems. (From Currier, 1983). (Reproduced by permission of High Technology)
APPENDIX D

Knowledge Lack Identification Procedure

In studying Anatomy and Physiology of the heart, you examined a number of topics through lectures.

In this knowledge lack identification procedure, we are asking you to write down on the sheets provided, what you are still not very clear about two subtopics; Cardiac Basics and Anatomy of the Heart.

In doing so, you may want to write a statement, or formulate a question, or even make a list of words about what it is you are uncertain about, confused about, or still have some difficulties understanding. Examples are given below:

- List of words: fibrous, pericardium, myocardium, coronary arteries, coronary circulation

- Statement: As far as the pericardium is concerned, I am still having difficulty understanding the function of the fibrous pericardium.

- Question: How is blood prevented from flowing back into the heart as it contracts and pushes blood into a ventricle or out of the heart through an artery?
KNOWLEDGE LACK IDENTIFICATION PROCEDURE

SESSION ONE

NAME ________________________________

TECHNOLOGY ________________________________

BEFORE USING THE INTERACTIVE VIDEODISC

Please write down in the space below any problems, uncertainties, confusions, difficulties and/or questions you may have concerning Cardiac Basics and Anatomy of the Heart.

You may refer to this list when using the Interactive Videodisc Learning System.
AFTER USING THE INTERACTIVE VIDEODISC

Answer the following question. Have I solved all the problems identified above?

Yes [ ]  No [ ]

Please make a list of what it is you are still having problems understanding.

Please submit this sheet to the instructor at the end of the review session.
KNOWLEDGE LACK IDENTIFICATION PROCEDURE

SESSION TWO

NAME ____________________________

TECHNOLOGY ____________________________

BEFORE USING THE INTERACTIVE VIDEODISC

Please make a list of various topics, concepts/questions you are still having difficulty understanding.
AFTER USING THE INTERACTIVE VIDEODISC

At the end of the session, summarize in the space below, what you have learned about your own questions, confusions, uncertainties and so on, concerning Cardiac Basics and Anatomy of the Heart.

Please return this sheet to the instructor.
We are conducting an evaluation of an Interactive Videodisc on Anatomy and Physiology of the Heart developed by IBM of Canada and BCIT, and we are seeking your participation in a study which will examine the use of the disc for teaching and learning.

This study will be conducted by a BCIT Health Science Faculty member who is also a graduate student at Simon Fraser University and is completing research on this topic. Issues and concerns about the study may be addressed to Dr. Shapson, Associate Dean, Education, Simon Fraser University.

The study involves that you take a pretest, after which you will be randomly assigned to one of three groups. After all groups have received the same lectures, two of the groups will use the Interactive Videodisc while the third group will be in a teacher-mediated review class. After completing review of the material, you will be given a posttest and a few other forms to complete.

All the information collected will be kept strictly confidential. Your participation in this study will not affect your grades in any way. Although names will be collected, they will be used strictly for identifying your scores between the pretest and posttest and will not be used in any other way.

We urge you to assist us in this study and we look forward to your participation.

Please sign below to indicate your willingness to be a part of the study.

Thank you.

( signature of the student) (date)
APPENDIX F

Interactive Videodisc Project

Demographic Data Sheet

In order to assist us in evaluating the interactive videodisc on Anatomy and Physiology of the Heart, please complete the following questionnaire. All information is strictly confidential. Thank you.

Name _______________________________ Technology __________________________

Age: ______ Group: Teacher [ ] IVD only [ ] IVKLIP [ ]

Sex: Male [ ] Female [ ]

Marital Status: Married [ ] Single [ ]

Educational background:

<table>
<thead>
<tr>
<th>Grade</th>
<th>12</th>
<th>1-2 years of college</th>
<th>College diploma</th>
<th>1-2 years of university</th>
<th>University degree</th>
<th>Bachelors</th>
<th>Masters</th>
<th>Other</th>
</tr>
</thead>
</table>

Experience with self-directed study (student studies on his/her own, using the available resources as a workbook and/or textbook, etc.).

Yes [ ] No [ ]
Experience with computers

Extensive experience (regular use of computers)

Some experience (occasional use of word processing or easy-to-use software)

No experience with computers
APPENDIX G

Interactive Videodisc Evaluation Study

**Interaction Strategies**

NAME ____________________________

TECHNOLOGY ____________________________

GROUP:  IVD only ___  IVDKLIP ___

Which of the following strategies did you use most often? Choose **only one** for each session.

<table>
<thead>
<tr>
<th>SESSION ONE</th>
<th>SESSION TWO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **STEP BY STEP** linear survey and study of the material with no deviations.
  - [ ]

- **QUICK LINEAR** survey of the material (using "skip video" and/or "Fast Forward" video control selections).
  - [ ]

- **SELECTED REVIEW STRATEGY** whereby you reviewed only topics unclear to you.
  - [ ]

- **TEST STRATEGY** whereby you took the test only.
  - [ ]

- **SUMMARY-TEST STRATEGY** whereby you studied the summaries first, then took the test or vice versa.
  - [ ]

- **SUMMARY-TEST-REVIEW STRATEGY** whereby you studied the summary, then took the test, then reviewed materials unclear to you.
  - [ ]

- **TEST AND REVIEW STRATEGY** whereby you took the test and reviewed materials unclear to you.
  - [ ]

- **VIEW AND TAKE NOTES FROM THE INFORMATION ON THE SCREEN.**
  - [ ]

If your strategy is not listed above, please comment on the strategy you used during the study of the Interactive Videodisc lessons.
APPENDIX H

Attitude Toward Interactive Videodisc Instruction

This is not a test and therefore there is no correct answer to any of the items. Please circle the response that best indicates how you feel about each of the items. Your responses will be confidential.

<table>
<thead>
<tr>
<th>Item</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The directions for using the videodisc lessons were clear and</td>
<td>SA</td>
<td>A</td>
<td>N</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>easy to understand.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The hints on using the touch screen and how to study the</td>
<td>SA</td>
<td>A</td>
<td>N</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>videodisc lessons were helpful.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. The videodisc lesson content was at the right level of difficulty for my technology.</td>
<td>SA</td>
<td>A</td>
<td>N</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>4. The lessons were easy to understand.</td>
<td>SA</td>
<td>A</td>
<td>N</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>5. The reading level and vocabulary were appropriate for my</td>
<td>SA</td>
<td>A</td>
<td>N</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>technology.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. The content is organized in a logical manner.</td>
<td>SA</td>
<td>A</td>
<td>N</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>7. The goals of the lessons are clearly defined.</td>
<td>SA</td>
<td>A</td>
<td>N</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>8. The lesson menus helped me through the material in a systematic</td>
<td>SA</td>
<td>A</td>
<td>N</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>way.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. The use of graphics and animations served to illustrate important ideas.</td>
<td>SA</td>
<td>A</td>
<td>N</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>10. The video segments reinforced important concepts.</td>
<td>SA</td>
<td>A</td>
<td>N</td>
<td>D</td>
<td>SD</td>
</tr>
<tr>
<td>11. The ability to explore the topic (explorations) is an important component in videodisc instruction.</td>
<td>SA</td>
<td>A</td>
<td>N</td>
<td>D</td>
<td>SD</td>
</tr>
</tbody>
</table>
12. The lesson summaries are useful component of interactive videodisc instruction.

13. The test questions are useful and helped to check my understanding of the material.

14. I was encouraged by the responses given to my answers of the questions.

15. Knowing how I performed on the practice test was beneficial.

16. Learner control of the rate and sequence of the presentation, summary, and test questions is very beneficial.

17. Interactive videodisc instruction provides a useful mechanism for reviewing course notes.

18. The touch screen is easy to use.

19. The options for controlling the presentation of the lessons are effective.

20. It is important for students to control the video segments using fast, slow, reverse and skip controls.

21. The keyboard (instead of the touch screen) would have been more effective in controlling the lesson presentation.

22. Audio is vital to videodisc lessons.

23. The layout of materials on the screen was helpful to learning.

24. While using the videodisc lesson, I was actively involved in my own learning.

25. The interactive videodisc helped me to learn topics I did not understand in the lectures.
26. I found the use of the videodisc learning system motivational.

SA A N D SD

27. Interactive videodisc lessons stimulates creativity in students.

SA A N D SD

28. The videodisc learning system allowed me to learn at my own pace.

SA A N D SD

29. My interest in Anatomy and Physiology of the Heart has increased because of this interactive videodisc learning experience.

SA A N D SD

30. More courses should be taught by interactive videodisc instruction.

SA A N D SD

31. I would recommend learning by interactive videodisc to my friends.

SA A N D SD

32. It would be better for students to use the interactive videodisc rather than attend classroom lectures.

SA A N D SD

33. Students should use the interactive videodisc on their own, with the opportunity to meet with the instructor 3-4 times during the entire course.

SA A N D SD

34. A resource person should be present during student use of the interactive videodisc to answer questions about the material on the disc.

SA A N D SD

35. The interactive videodisc learning system can totally replace the human instructor.

SA A N D SD

Please write any comments on your experiences or feelings while using this interactive videodisc learning system.
APPENDIX I

Interactive Videodisc Evaluation Study

Achievement Test

PLEASE WRITE YOUR NAME ON THE COMPUTER SHEET.

ANSWER ALL QUESTIONS ON THE COMPUTER SHEET

For each of the following multiple choice questions, choose only one correct answer.

1. In the pulmonary circulation:
   (a) highly oxygenated blood is found in the arterial system.
   (b) carbon dioxide is in higher concentration in the pulmonary arteries.
   (c) blood moves from the lung to the right atrium.
   (d) blood is moving away from the heart in the pulmonary veins.
   (e) carbon dioxide is in low concentration in the pulmonary arteries.

2. Blood returning to the heart from the systemic circulation enters the:
   (a) right atrium.
   (b) left auricle.
   (c) left ventricle.
   (d) left atrium.

3. Each cardiac muscle cell:
   (a) is part of a cardiac myofibril.
   (b) has a single peripheral nucleus.
   (c) contracts independently of the cells with which it is in contact.
   (d) has a motor end plate on its surface.
   (e) is separated from its neighbors by intercalated disc.
4. The pericardium:
   (a) has a fibrous component called the myocardium.
   (b) protects the chordae tendineae.
   (c) is formed of visceral membrane.
   (d) contains a thin layer of serous fluid between its inner two membranes.
   (e) contains a thin layer of serous fluid between its outer two membranes.

5. The coronary sinus drains into the:
   (a) left atrium.
   (b) right atrium.
   (c) superior vena cava.
   (d) carotid sinus.
   (e) inferior vena cava.

6. The fibrous pericardium can be described as:
   (a) being attached to the myocardium.
   (b) attached to the interventricular septum.
   (c) lining the inner ventricular surface.
   (d) supporting the parietal pericardium.
   (e) the source of pericardial fluid.

7. During diastole the:
   (a) ventricular myocardium contracts.
   (b) aorta is filling.
   (c) mitral valve is open.
   (d) cuspid valves are closed.
   (e) semilunar valves contract.

8. The aortic semilunar valve prevents backflow into the:
   (a) left atrium.
   (b) left ventricle.
   (c) right atrium.
   (d) pulmonary artery.
   (e) aorta.
9. The cardiac apex is formed by the:
   (a) atria.
   (b) base of the coronary vessels.
   (c) great vessels and atria.
   (d) interventricular vessels.
   (e) ventricles.

10. The chambers of the heart that contain blood with a high oxygen content are the:
    (a) right and left ventricles.
    (b) right ventricle and left atrium.
    (c) right atrium and right ventricle.
    (d) right and left atria.
    (e) left atrium and left ventricle.

11. The pericardial sac:
    (a) contains a double layer of mucous membrane.
    (b) serves to anchor the heart to the vertebral column.
    (c) is also known as the endocardium.
    (d) is lubricated to allow for unrestricted heart motion.
    (e) has fibrous tissue filling the pericardial space.

12. During systole, high pressure is found in the:
    (a) left atrium.
    (b) vena cavae.
    (c) systemic veins.
    (d) pulmonary arteries.
    (e) right atrium.

13. The myocardium is supplied with oxygen and nutrients from blood flowing through:
    (a) the chambers of the heart.
    (b) blood vessels in the pericardium.
    (c) coronary arteries.
    (d) pulmonary circulation.
14. Blood from the pulmonary veins:
   (a) leaves the right ventricle.
   (b) enters the right atrium.
   (c) enters the right atrium.
   (d) leaves the left ventricle.
   (e) enters the lungs.

15. The part of the myocardium which separates the ventricles is the:
   (a) paraventricular divider.
   (b) interventricular septum.
   (c) chordae tendineae.
   (d) apex.
   (e) myocardial wall.

16. During contraction of the left ventricle:
   (a) the bicuspid valve prevents backflow into the right atrium.
   (b) blood is pumped into the pulmonary artery.
   (c) blood is pumped through the open tricuspid valve.
   (d) the aortic semilunar valve is forced open by the increased ventricular blood pressure.
   (e) the left atrium is fully contracted.

17. The bicuspid valve:
   (a) is opened during systole.
   (b) is housed in the inter-atrial septum.
   (c) has chordae tendineae associated with it.
   (d) controls the flow of CO2 rich blood.
   (e) contracts during systole.

18. In the heart:
   (a) the mitral valve is formed of two cusps of tissue.
   (b) the pulmonary semilunar valve prevents backflow into the right atrium.
   (c) blood passes through the semilunar valves under their chordae tendineae.
   (d) ventricular contraction occurs at the same time as atrial contraction.
   (e) oxygen rich blood passes through the tricuspid valve.
19. The heart is lined:

(a) internally by the endocardium.
(b) internally by the parietal membrane.
(c) externally by the myocardium.
(d) internally by the visceral pericardial membrane.
(e) internally by the serous pericardium.

20. The tricuspid valve prevents backflow of blood from:

(c) left atrium to pulmonary veins.
(d) aorta into left ventricle.
(e) right ventricle to right atrium.
(b) left ventricle to left atrium.
(a) pulmonary artery to right ventricle.
APPENDIX J

Student Comments on the Use of the Interactive Videodisc Learning System

(a) Comments from the IVDKLIP Group

1. "Found it very useful but took longer to acquire information than from lecture notes."

2. "I really like using it. It would be great for study, review and clarification. I don't believe that it could effectively teach the course by itself, but for people who miss a large number of classes or the class is just too fast, it would be excellent to help them keep up or even study ahead."

3. "I found this to be a very positive and enriching experience. I enjoyed working on the interactive videodisc and it held my attention for longer than an instructor could. I would highly recommend this program, but I don't think instructors should be eliminated totally."

4. "Very good. Interesting and easy to follow. Keeps attention more than classroom lecture because I was active in learning."

5. "Enjoyed using."

6. "Headphones would be an asset to block out room noise. Computer talk is definitely not needed. Overview area with the woman is good. Tests are good."

7. "This system is an extremely useful tool for people who learn well with audio and visual techniques. I feel that it is important however, that instructional class time can be used more effectively if students use the IVD first and then have instructors answer questions or expand on any necessary material."

8. "Videodisc is useful in conjunction with lectures."

9. "This is an interesting concept in learning and I like it. I think that the students might need a course overview (written) indicating the importance of each area and what subjects must be reviewed for the
required course. I was looking at areas of interest and feel that if a course was taught this way, there should be some form of recording what you have viewed and where you are in the program."

10. "The whole program on videodisc is incredible. I'm amazed at the amount of work and detail put into the videodisc. Being an older student with 5 years under my belt, I can't see the disc replacing the human instructor totally, except where it may be necessary (i.e. for correspondence type programs), BUT: I feel that the disc would be (and should be) an integral part of physiology/anatomy type courses where structures must be learned, but where access to specimens/radiographs, etc. is limited. Thanks a lot. It was FUN."

11. "The robotic voice for test answers/questions was annoying. I think it would be beneficial to have instructors lecture and highlight lectures, etc. with the videodisc instead of have the disc totally replace instruction (human)."

(b) Comments from the IVD Group

1. "I enjoyed the interactive videodisc. I learn at my own pace. I could take a break when I wanted. I was in step by step order. I was distracted by the fingerprints on the screen and how the light reflected on it from the room."

2. "Excellent way of learning."

3. "This is an excellent way to upgrade your background and I feel it should be used along with the classroom classes, maybe every two weeks have a couple of hours use on them."

4. "Feel that I have learned from the system and come away with more knowledge than prior to use of the program. Effective in review of previously taught material."

5. "I thoroughly enjoyed and benefited from my experience, the videodisc is a very resourceful and informative disc and method of learning. At the same time, I feel it is important to see my instructor on a regular basis to reinforce concepts and factual information. I think the whole process should be taken further and provided
in schools and colleges, it really does motivate learning at an individualized pace."

6. "I feel that it is a useful tool for studying, but I find that it takes longer to cover the material by using IVD than it would to review notes. I believe that it should be incorporated into the curriculum, but **strongly disagree** that it can replace the human instructor."

7. "I found it very helpful to have the information spread out, simply and concisely, as well as having diagrams. It makes a big difference to actually see what I am learning about. I now know my weaknesses."
LIST OF REFERENCES


