ISBN 0-315-59188-9

The Development and Formative Evaluation of an Interactive Videodisc Program for Teaching Contamination Assessment and Decontamination of Radioisotopes

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A Thesis
in
The Department
of
Education

Presented in Partial Fulfillment of the Requirements
for the Degree of Master of Arts at
Concordia University
Montreal, Quebec, Canada

September, 1990

ABSTRACT

The Development and Formative Evaluation of an Interactive Videodisc Program for Teaching Contamination Assessment and Decontamination of Radioisotopes

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There are a number of potential problems for those students who must learn to work with radioisotopes and with the fragile equipment used to detect radioactivity. Michael Palmer, in collaboration with the Chemistry Department and the Department of Occupational Health and Safety of Concordia University, developed an interactive videotape program to help train third year undergraduate and graduate chemistry students in carrying out the contamination assessment and decontamination procedures in the university laboratories. The evaluation of this videotape program gave positive indications that interactive video was a viable approach towards meeting the training needs of the students. The problem addressed by the author was to redesign the interactive videotape program and adapt it to an interactive videodisc medium of delivery. The redesign developed new instructional strategies which exploited the inherent capabilities of the videodisc medium, a more powerful computer, and a more sophisticated authoring system for programming. The program was evaluated throughout the developmental process. Self evaluation, expert review, individual testing and one-to-one testing were the evaluation strategies used. One-to-one testing involved 7 subjects from the target audience. The results of the one-to-one testing showed that the program was effective in meeting its objectives and was technically reliable.

ACKNOWLEDGEMENTS

I wish to thank the team members for their invaluable contributions to the project, namely: Michael Palmer, Chris Boer, Miriam Posner, Steve Skitt, Jo-Anne Dubois-Finn, Paul Taslini and Roger Kenner.

Acknowledgement for their support of this project goes to:
Department of Chemistry, Concordia University;
Occupational Health & Safety, Concordia University;
Department of Education, Concordia University;
Audio-Visual Department, Concordia University;
Learning Development Office, Concordia University;
CFCF Television, Montreal.

Special Acknowledgements to:

Mr. Michael Palmer
for producing and evaluating the videotape prototype upon which this project is based, and

Dr. Mariela Tovar
for sharing her knowledge in multi-media production, project coordination and evaluation, as well as providing inspiration as a caring and encouraging academic advisor and friend.

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Chapter 1

Background

The Problem

As part of their curriculum, undergraduate and graduate students studying biochemistry at Concordia University use radioisotopes in laboratory experiments. Two major concerns of the teaching staff and of the department of Occupational Health and Safety are the risk of radioactive contamination to humans, and the possible damage to sensitive radioactivity detecting equipment by poorly trained students.

In January of 1984, Michael Palmer produced a slide-tape presentation for the purpose of teaching chemistry students the safe handling of radioisotopes. Students who were to use radioisotopes in laboratory experiments were required to attend a class session and view this production. This presentation was given at the beginning of the semester and covered all aspects of the subject matter which were deemed necessary for competency in handling radioisotopes. It was then followed by a twenty minute examination.

Following the implementation of the slide-tape production, an evaluation of its effectiveness was conducted. The findings revealed that the instructional methods and evaluation techniques covering the radioisotope contamination assessment and decontamination procedures were not sufficient to ensure replication of the procedure in the laboratory setting. Since the students needed to learn to carry out procedures, real or simulated experience and practice should be a part of the training. Furthermore, because of the important safety concerns of carrying out these procedures, a mastery learning criteria was required.

A possible solution to the problems was to allow the students to practice the procedures (without handling radioactive materials) in the laboratory. However, this would call for an increase in supervisory staff and laboratory facilities availability which could not be accommodated. Therefore the alternative was to select and develop a more adequate presentation of the subject matter which would permit the students to learn on their own time, do simulated practice and be thoroughly tested on their understanding and recall of the procedures.

These considerations led Palmer to investigate the possibility of developing an interactive videotape program which would meet the needs that had been identified. Interactive video could provide the learner with realism (analog video), control of path (menu options), control of time on task, as well as probe the learner (practice and test questions), and provide immediate and delayed corrective feedback. Also, the fact that the subject matter (radiation detection and decontamination procedures) is not subject to change, a requirement identified by Pribble (1985), indicated another reason for choosing interactive video. Finally, the literature has already shown that interactive video was used, with some measure of success, to teach chemistry at the university level (Russell, Staskum, & Mitchell, 1985; Brooks, Lyons, & Tipton, 1985) and has been used successfully for teaching procedures (McLean, 1985).

Having come to the conclusion that an interactive video program would meet the training needs for the laboratory procedures, the next decision to be made concerned the type of interactive video program to produce; a videotape based or videodisc based program. Because of financial considerations, a videotape based program could be rapidly undertaken. Later, funding for a videodisc based program would be available. This prompted the practical approach of producing a videotape based program as a formative evaluation stage (prototype) to be followed by a videodisc based program.

The interactive videotape program was produced and evaluated by Palmer. He designed the program to provide the learner with a demonstration, step-by-step breakdown, review, practice, testing, feedback and remediation on each of the two procedures for contamination assessment and two procedures for decontamination.

His evaluation included validation of the content of the program, the effectiveness of the instructional format, the appropriateness of the instructional design of the program, the learning outcomes, the learner attitudes and the technical reliability of the delivery system (Palmer, 1988). The evaluation indicated that:

1. in some areas of the video the visuals were not well sequenced with the audio.

2. some of the graphics were complicated, cluttered and

difficult to understand.

3. the principles of the procedures needed to be discussed in the introductory segment.

4. an actor, reading from a teleprompter or having memorized the script, should be used for the demonstrations.

The evaluation revealed that the instructional design approach, as developed, was sound. However, some of the content (steps in the procedures) needed to be more clearly defined. A redesign of the program would clearly maintain the instructional approach of providing the user with an instruction section (an introduction, a demonstration and a review segment), a practice section, a test section, and immediate and delayed feedback to input. The evaluation findings with regards to the video production showed that in some cases the instruction section was too long and in some places the video image did not support the audio. Also, the script and storyboard used for shooting the video needed to be developed in greater detail and adhered to in order to produce a better quality video program.

After obtaining funding from the Learning Development Office of Concordia University, development of the videodisc program began. The problem addressed by this thesis equivalent was to redesign the interactive videotape program developed and evaluated by Palmer and adapt it to an interactive videodisc medium of delivery. The redesign would take into consideration not only the formative evaluation results of the videotape prototype, but would also consider the development of new strategies which would exploit the inherent capabilities of the videodisc medium, a more powerful computer, and a more sophisticated authoring system to be used for programming.

Chapter 2

Literature Review

Videodisc Technology

Alexander Graham Bell (USA), James Logie Baird (UK) and Reginald Friebus (USA) all separately conceived or produced pre-1940 disc based video playback devices. But it was not until the early 1960's that 3M engineers came up with the first videodisc that was capable of recording and playing back full bandwidth images. This was then followed, in the early 1970's, by the development of the first laser disc at MCA/Universal Pictures Inc. and Phillips Laboratories. Wishing to follow the great success of the music recording industry, laserdiscs were targeted for the home movie consumer market.

The first group to start talking about the real potential of the videodisc were those involved in developing computer assisted instruction. DeBloois (1988) commented that this touched-off a flurry of activity in universities and research organizations. Computer hardware companies and governmental departments also began to explore the possibilities.

At the end of 1978, the first videodisc players became available and one year later at least a dozen organizations were experimenting with their use as an educational tool. At that time, the Brigham Young University's Spanish department was developing a disc which focused on language instruction. Other institutions and corporations working on their own projects were: the Nebraska Educational Television Network, Lister Hill Library of Medicine, University of Utah, MIT, Westinghouse and Control Data.

Today, interactive program delivery systems are often classified in levels of interactivity based on hardware configuration. The classification from the Nebraska Videodisc Design/Production Group (Daynes & Nugent, 1980), has been widely adopted. This classification can be outlined as:

1. Level One: a stand-alone, non-programmable system. Level one systems deliver video with limited interactivity at minimal cost. They consist of a basic consumer videodisc player and a video monitor. These systems are justified by their ease of use and disc durability.

2. Level Two: a stand-alone, programmable system. In level two systems, digital data encoded on a videodisc is read by the system CPU. Limited interactivity can thus be programmed to permit simple selections by the user. Features include timed response delays, conditional branching, numeric input branching, automatic jump capability and controlling data.

3. Level Three: an external computer-controlled system. A level three system requires a videodisc player driven by an external computer. The computing speed and complexity of programming now available on micro-computers is used to manage the interactivity components of CAI and the analogous live image. Systems provide the user with an environment of tailored individualized instruction, evaluation and directed feedback in a true-to-life visual setting.

4. Level Four: a multi-task system. New developments in delivery system capabilities are constantly redefining this level of interactivity. The capability of having immediately available content-related digitized or analogue visuals or audio, graphics and text, along with the necessary navigational software, is now an interactive intelligent multi-media information storage, retrieval, processing and presentation system.

Essentially, interactive video is the merging of characteristics commonly attributed to computer assisted instruction (CAI), with the visual expository qualities of video (Palmer & Tovar, 1987). The unique combination of these technologies creates a powerful instructional medium (DeBloois, 1982; Hannafin & Phillips, 1987). However, although many researchers have lauded this new instructional tool (Butcher, 1986; Clark, 1984; Howe, 1985) others have indicated that the empirical evidence needed to support claims of the instructional effectiveness of interactive video is lacking (Hannafin, 1985).

A novel approach to the effective examination of interactive video has been proposed by Brody (1984). Brody suggests that research should focus on two aspects: (a) determining theoretical and empirically substantiated instructional characteristics to develop a design model, and (b) examining the attributes of the medium to define the role of interactive video in relation to other delivery systems.

Videodisc Program Design

The instructional design of an interactive program is dependant upon the nature of the content, the objectives to be reached and the limitations of the system that will carry it. The interactive aspect of the program is reflected in the determination of control over access and manipulation of the content. The instructional design, while taking into account the system attributes, must justify and determine the scope of control which will provide the greatest contribution towards achieving the educational or training goals of the program.

Some researchers have examined this issue (Hannafin, 1984; Hannafin, 1985; Hannafin & Colamaio, 1988; Hannafin & Phillips, 1987). It centres on enabling the user with partial or full control of the selection of activities within a program or disabling the user and imposing a path and sequence to be followed. Enabling the user to have control is promoted as providing responsiveness to user needs, a better motivation for learning and as having the potential to increase learner efficiency at meeting objectives (Blum-Cohen, 1984; Tovar & Coldevin, 1989; Laurillard, 1984; Pawley, 1983; Steinberg, 1977).

Hannafin and Phillips (1987), indicate that the type of intended learning influences the effectiveness of different program control options. They point out that imposed control should be most effective for procedural and unfamiliar learning, while learner control should be most effective for contextual and higher-order learning. However they also note that in one of their recent studies, imposed and learner selected lesson control strategies were equally effective for learning facts, procedures and problem solving skills.

Recently, new developments in artificial intelligence have added to the choice of control within an interactive video program. Adaptive designs, sensitive to learner differences, can vary the content and structure of a program based upon such considerations as the learner's cognitive ability, prior knowledge and on-going performance. Several adaptive designs have been proposed. Park (1984), describes response sensitive sequencing, Ross (1984), proposes embedding uniquely individual learner information within a lesson, while Tennyson, Christenson and Park (1984), discuss lesson features such as the amount of instruction, instructional sequences and presentation display time being adapted to the learner.

Although current research indicates several disadvantages in allowing the learner unrestricted control, when provided with relevant advice, learners decisions have been proven effective (Goetzfried & Hannafin, 1978; Hannafin, 1984; Hannafin, 1985; Ross, 1984; Steinberg, 1977; Tennyson, 1980; Tennyson & Buttrey, 1980; Tennyson, Christensen & Park, 1984). In order to direct the user to choose a particular path or activity in the program, orienting activities are proposed (Hannafin & Hughes, 1986). Examples of orienting activities are: pre-tests, statement of lesson objectives (Kaplan & Simmons, 1974), orienting questions (Felker & Dapra, 1975; Watts, 1974), overviews and advance organizers (Ausubel, 1960; Mayer, 1979). The effects of orienting activities on learners show that they help facilitate learning.

Hannafin and Reiber (1989) propose a meta-model for designing computer-based instruction. This model emphasizes the relationships among the capabilities of new technologies (i.e., interactive videodisc), learning objectives, incidental learning, and the learners processing capabilities. Their model, ROPES +, outlines the implications of research from varied sources to CAI design. Research is classified according to its components of classification and prescription: retrieving, orienting, presenting, encoding, sequencing and other components addressing the influence of contextual factors to mediate the effectiveness of instruction.

Examples of the retrieving component include lesson activities such as; self-regulated student note taking, approximating retrieval contexts (Clark & Voogel, 1985), embedding elaborative as well as summarizing opportunities, and providing post-tests (Gagné, Wagner & Rojas, 1981). The presenting component covers other lesson activities such as: designing multimodal lessons, providing lesson content organization (Baggaley, 1973; Glaser, 1976), establishing frame protocol (Heines, 1984), and including lesson emphasis (Hannafin & Peck, 1988).

Lesson activities designed to address the encoding component are: providing practice activities (Baggaley, 1973; Salisbury, 1988), providing informative feedback (Kulhavy, 1977; Schimmel, 1988), designing strategies to monitor comprehension (Di Vesta & Finke, 1985), providing learner guidance and providing embedded analogies (Mayer, 1984). The sequencing component refers to lesson activities such as: designing program optional features (i.e. help, hypertext, etc.) (Merill, Schneider & Fletcher, 1980), designing response sensitive sequencing (Park, 1984), embedding place-holders for lesson interruptions (Hannafin & Peck, 1988), embedding advisement strategies (Hannafin, 1984; Tennyson, 1984), and designing adaptive branching (Tennyson, Christensen & Park, 1984).

Finally, the "+" component of ROPES + covers activities such as; matching varied student styles, designing cooperative learning activities (Johnson & Johnson, 1986), and embedding motivational activities (Keller & Suzuki, 1988; Herndon, 1987; Seymour et al, 1987). Hannafin and Reiber (1989) constructed the ROPES + model for prescribing instructional strategies and add that its components are not mutually exclusive but function interactively during a lesson. They emphasize that technocentric perspectives have led to poor computer-based instructional design and propose that more thought and effort be devoted to the learning task and performance, as well as the selective use of media capabilities.

Other media research relevant to videodisc program design is in the field of visual media message design. Since learners are familiar with video in the form of commercial television, they may have high expectations for video quality (Hoekema, 1983). Because of this, Smith (1987), suggests that interactive video should be produced at, or as close to, commercial broadcast standards.

Several features of visuals, such as colour, contrast, motion, image quality and realism are potentially important presentation variables (Alesandrini, 1984; Brody, 1984; Heines, 1984). However, Dwyer (1978), indicates that colour often has the conflicting effect of both attracting and distracting learner attention and other research has also shown that colour or contrast is often insufficient to improve learning (Hannafin & Peck, 1988). Similarly, some researchers emphasize that the pace of video and image quality are important (Daynes, 1982; Smith, 1987; Hoekema, 1983), while others do not find these to be essential requirements (Glover, Plake & Zimmer, 1983; Hannafin & Phillips, 1987; Levin, 1983).

Music and voice are also important considerations of message design and research suggests that aural narrative can be an effective supplement to visual presentations when the narrative and visuals are congruent (Haring & Fry, 1979; Hannafin & Phillips, 1987; Levin & Lesgold, 1978; Pressley, 1977). Music, like other variables related to an individuals taste, is subjective; what may benefit one group of learners may actually hinder the performance of another (Bovy, 1981; Cronbach & Snow, 1977). Providing various types of music, as well as the option for no music, may be the best approach.

The design of interactive video involves a complex interaction of instructional design theory, computer assisted instruction and video program design. No part of the design is isolated, but decisions must be based upon learner and task characteristics, and not exclusively on computer capability. The allocation of effort during instruction, the provision of activities and techniques to support encoding, and the progressive building of lesson activities are the most important components of videodisc program design (Hannafin & Phillips, 1987).

Chapter 3
Program Design and Development

Program Design

Target Audience

The interactive videodisc program is designed to be used by undergraduate and graduate students of the Chemistry Department at Concordia University. The program will be a pre-requisite for students (third year undergraduates) who will be handling radioisotopes in their laboratory experiments. Any graduate student employed as lab assistants will also be required to complete the program before being allowed to work in the laboratories.

Students using the program will need a pre-requisite knowledge equivalent to a completed second year of undergraduate level chemistry. It is also recommended that users of the program have successfully completed an introductory undergraduate biochemistry course in order to be familiar with the terminology used throughout the program. Finally, it is assumed that the users of the program will have some familiarity with micro-computers.

Objectives

It was agreed by the Chemistry Department that the primary goal of the project is to help the students master the contamination assessment procedures (The Direct Check and The Swipe Check) and the procedures for the decontamination of work areas and skin surfaces. Along with this overall objective, the program stresses the importance of safety and the adherence to established safety procedures when handling radioisotopes.

Within each procedure three objectives are addressed. First, the students must know when or in which circumstance each procedure will be used. Secondly, the students must know which tools and materials are required in order to carry out each procedure. Thirdly, the students must know, in the appropriate sequence, the actions and criteria for decisions necessary to carry out each procedure.

Rationale for Media Selection

The rationale for using interactive video delivery of instruction had been made before proceeding to develop the videotape prototype. Subsequently, the evaluation of the videotape prototype gave positive indications that interactive video was a good approach towards meeting the training needs of the Chemistry Department and those students who would be working with radioisotopes in the laboratories. The development of the interactive videodisc delivery system was undertaken for two major reasons: (a) to finalize a program, which was still at the prototype stage, and deliver it to the client (the Chemistry Department), and (b) to provide the Department of Education of Concordia University with a videodisc production to be used for research purposes.

Other reasons for developing the videodisc program were based on the capabilities of the technology. The use of a narration tract for concise demonstrations and single frames for the description of tools and materials, could condense the one hour videotape prototype to the maximum of 30 minutes permissible on a Constant Angular Velocity (CAV) videodisc. For ease of reading and concentration, two monitors instead of one would also be used, thereby enabling a video image to be kept on the screen while the computer text is viewed or changed.

The videodisc program would be faster at responding to input from the user. Whereas the videotape player must alternate between the play mode and the stop mode, the videodisc player uses the pause mode and is ready to access any part of the program within two to six seconds (depending on the player type). The videotape player search-time for a one hour tape is measured in minutes.

Finally, the videodisc itself is far more durable than videotape. Videotape deteriorates rapidly with use, especially when subjected to the stop-start, fast-forward and reverse requirements of interactive video. The tape becomes stretched and worn from contact with the player parts and this leads to the breakup of both the image and the time code, making the tape unusable. The videodisc does not have any of these drawbacks and is even protected from scratches and liquid spills by a plastic coating. Although not indestructible, videodiscs are, by far, a better long-term video format than video-tape.

Program Content and Structure

The design of this program is structured to offer the user three major sections: (a) an introductory section; (b) a section on contamination assessment; and (c) a section on decontamination. Upon start-up of the program the user can choose any one of these three sections (see Figure 1).

<u>Figure 1</u>. The program content and objectives

Section	***Content***	***Objective***
INTRODUCTION		
	The introduction consists of a brief video presentation starting with a news clip of the Chernobyl reactor accident.	After viewing this introduction section, the student will be aware of the importance of safety when handling radioisotopes.
CONTAMINATION ASSESSMENT		
	THE DIRECT CHECK (LESSON)	
	This lesson describes the tools and the steps of the procedure to follow in order to correctly carry out the Direct Check. Exercise and Test questions are Computer-generated.	By the end of this lesson, the student should be able to carry out the correct procedures necessary to carry out contamination assessment of high energy radioisotopes.
	THE SWIPE CHECK (LESSON)	
	This lesson describes the tools and the steps of the procedure to follow in order to correctly carry out the Swipe Check. Exercise and Test questions are Computer-generated.	By the end of this lesson, the student should be able to carry out the correct procedures necessary to carry out contamination assessment of low energy radioisotopes.
DECONTAMINATION		
	DECONTAMINATION - WORK AREAS - (LESSON)	
	This lesson describes the tools and the steps of the procedure to follow in order to correctly carry out decontamination of areas. Exercise and Test questions are Computer-generated.	By the end of this lesson, the student should be able to carry out the correct procedure necessary for the decontamination of areas work where radioisotopes have been detected.
	DECONTAMINATION - CLOTHES & SKIN - (LESSON)	
	This lesson describes the tools and the steps of the procedure to follow in order to correctly carry out decontamination of clothes and skin surfaces. Exercise and Test questions are Computer-generated.	By the end of this lesson, the student should be able to carry out the correct procedure necessary for the decontamination of clothes and skin surfaces in the event of a spill of radioisotopes.

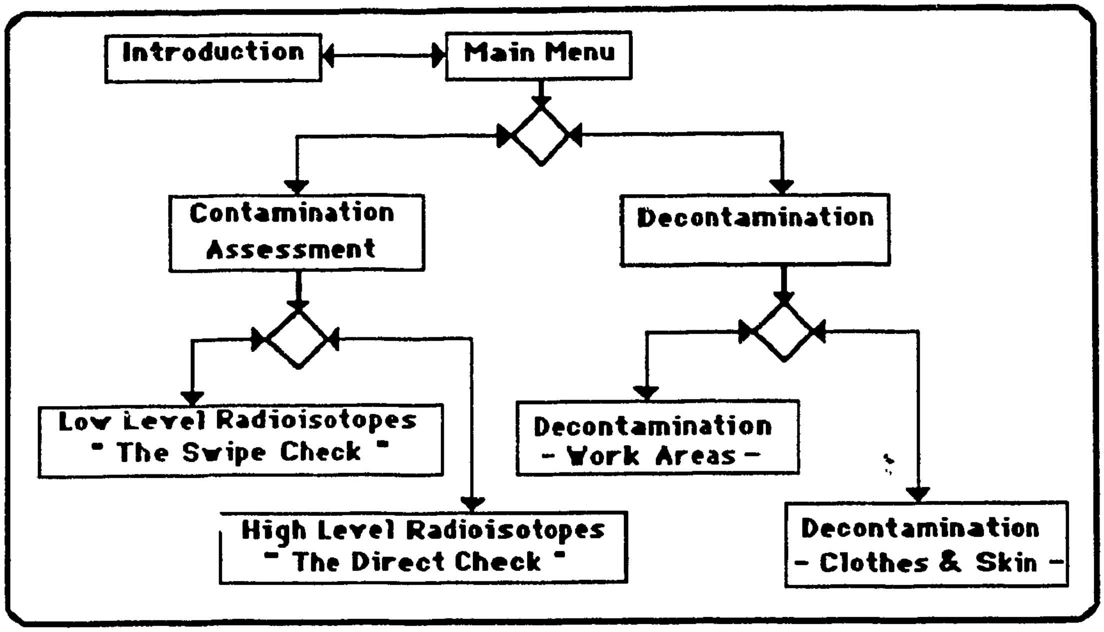
The introduction promotes good working habits, respect, and adherence to safety considerations. Users are reminded, that although they may think that they are not working with highly dangerous radioisotopes, no dosage level has been deemed safe for humans. Since some users will most likely handle more dangerous radioisotopes after they leave university, they are also reminded of the environmental consequences of accidents.

The example of the Chernobyl reactor fire in the U.S.S.R. is used to illustrate the point. Video footage of the most serious nuclear accident in the world to date is presented to the user as a reminder of the serious hazards to health and environment generated from radioactive contamination. The content and objectives of the program are outlined in Figure 1.

The section on contamination assessment is divided into two sub-sections: (a) the assessment of low level radioisotope contamination "The Swipe Check"; and (b) the assessment of high level radioisotope contamination "The Direct Check". The section on decontamination is also divided into two sub-sections: (a) the decontamination of work areas; and (b) the decontamination of clothes and skin (see Figure 2).

Each sub-section (except for the decontamination of clothes and skin) has a structure which includes: (a) an instruction option; (b) a exercise option; and (c) a test option (see Figure 3 and Figure 4). The decontamination of clothes and skin section does not have these options. Its structure includes only: (a) an instruction option; and (b) a test option.

Figure 2. The program menu structure.



These options may be viewed in any sequence. For example, the user can view the instruction and exercise options as many times as needed. If the user feels that the exercise is not required, the test option may be selected immediately after the instruction. This

Figure 3. The contamination assessment menu structure.

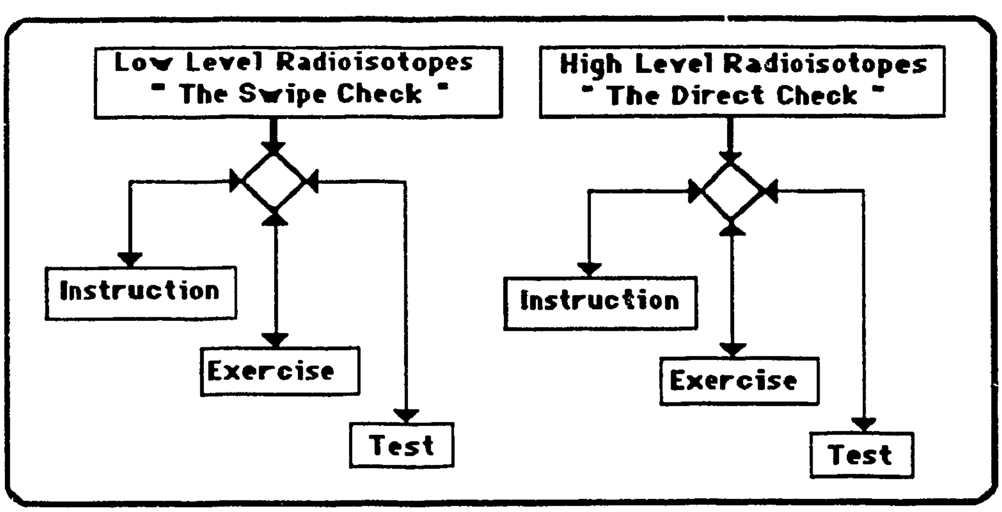
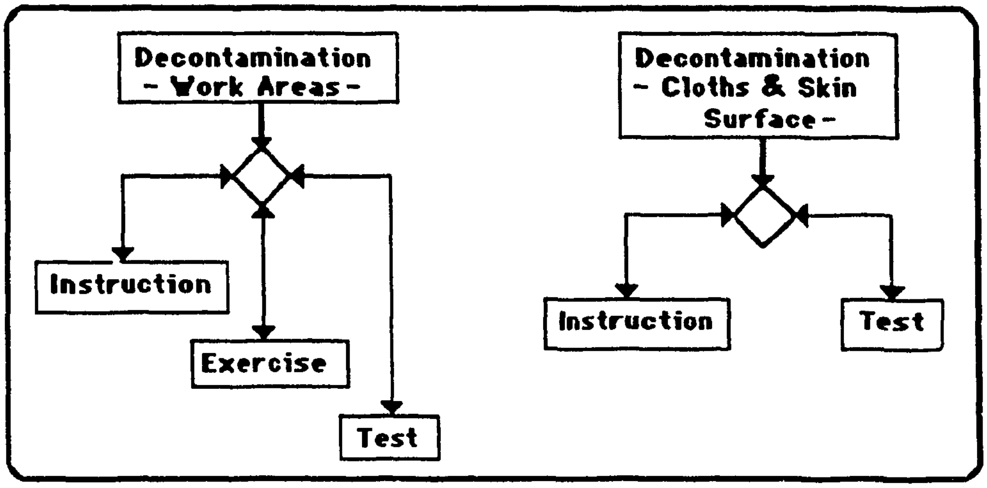


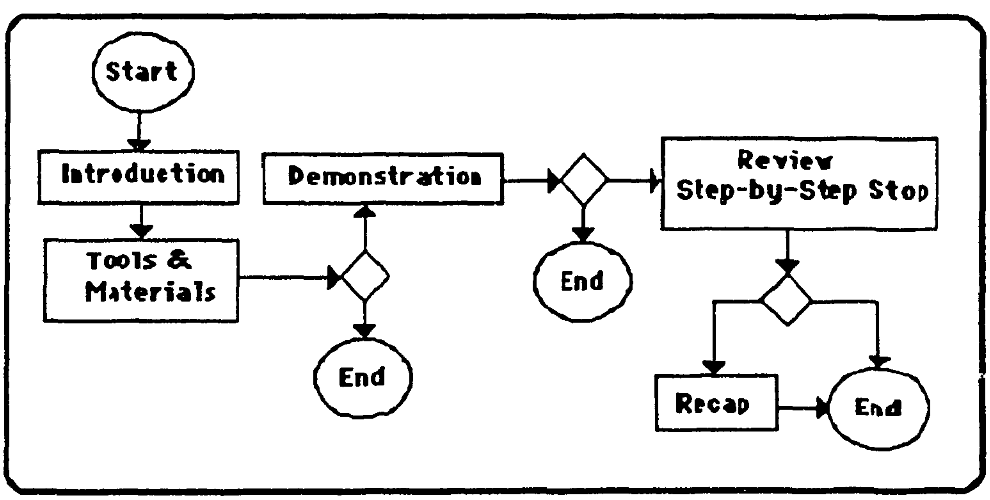
Figure 4. The decontamination menu structure.



strategy allows the users to achieve the lesson objectives at their own pace and with greater control over their learning.

Each option (instruction, exercise and test) has a structure that is consistent throughout the program. The instruction option structure is shown in Figure 5. It starts with a video segment giving a general introduction to the procedure. The video presentation (2 to

Figure 5. The instruction option structure.

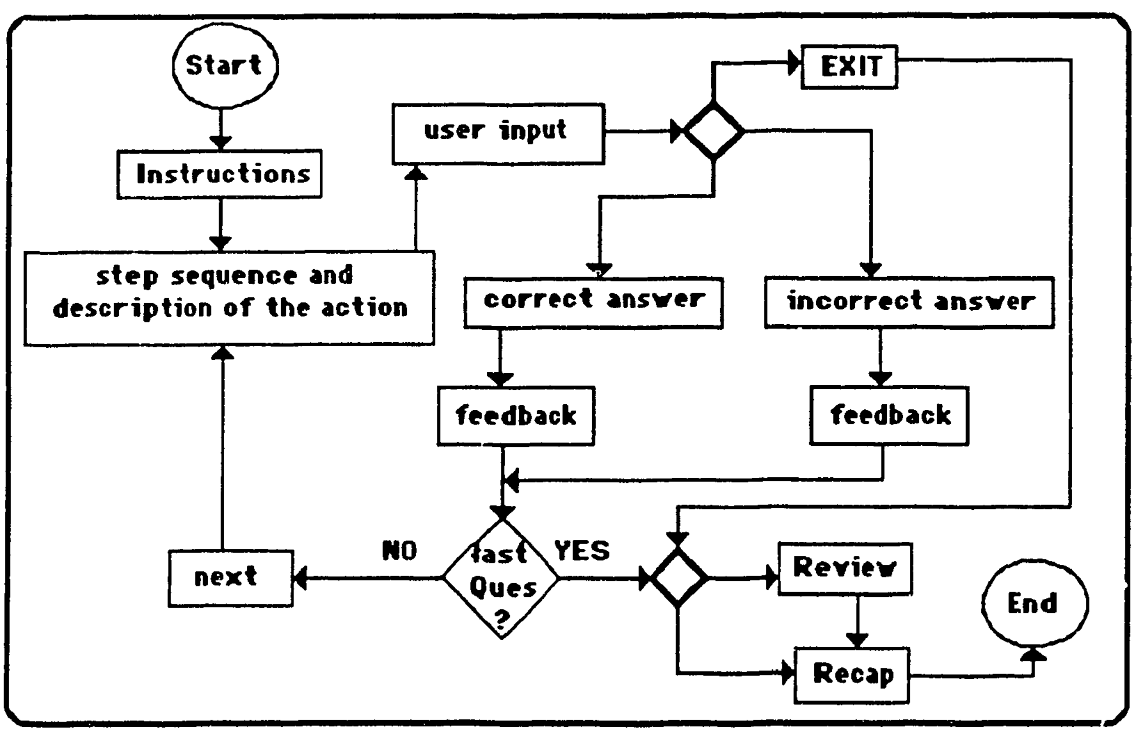


5 minutes), includes a brief introduction to the procedure (covering the "when? " and "why?" questions of carrying out the procedure), a description of the tools to be used, and a demonstration of the procedure by a laboratory technician.

This is followed by a complete step-by-step review of the procedure in which additional text information was inserted. The video is still-framed after each distinct step of the procedure and that step is described in computer text. The user moves from step to step on their own time. At the end, a recap of all the steps is presented on the computer screen.

The structure of the exercise option is described in Figure 6. The exercise option consists of between 6 to 14 computer-generated scenarios, each accompanied by a slide or short video

Figure 6. The exercise option structure.



sequence pertaining to each step of the procedure of a lesson. The user must determine if the steps, which have been presented, are in the correct sequence and are correctly represented.

To answer, the user is able to select from three options: CONTINUE, MAKE THE CORRECTION and EXIT. If the scenario of the step is in the correct sequence and is correctly represented, the user should choose "CONTINUE". However, if the scenario of the step is not in the correct sequence and/or is not correctly represented, the user should choose "MAKE THE CORRECTION".

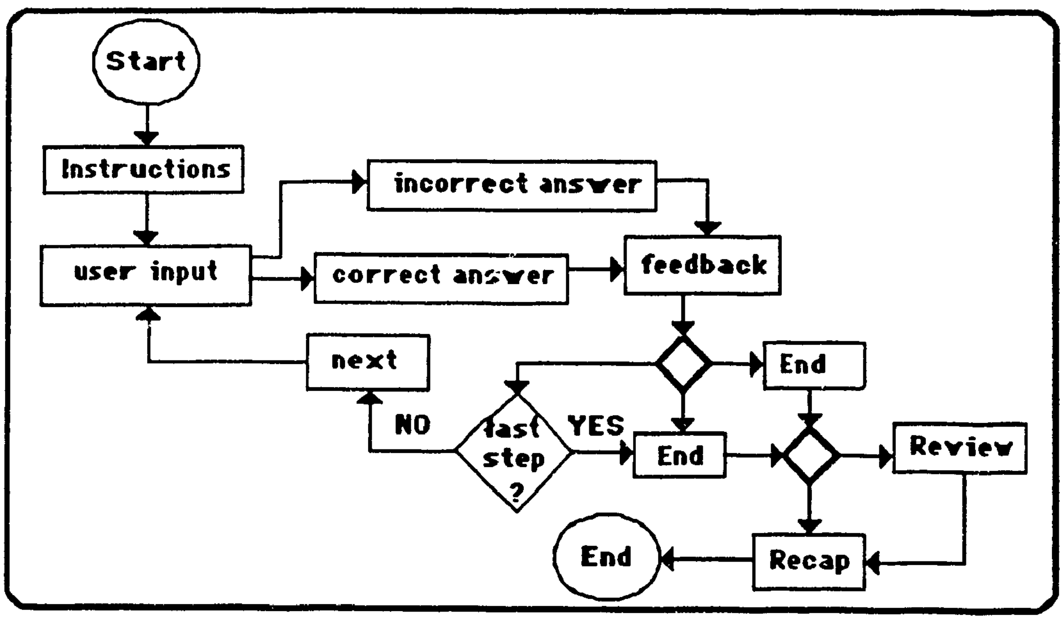
The user makes the correction by typing, from the computer keyboard, a description of the correct scenario. The input from the keyboard is analyzed by the computer for the appropriate key words. The keyword check allows for certain acceptable variations from the actual text of the correct answer. Bad sentence structure and acceptable spelling errors do not result in answers being incorrect.

Feedback is given by displaying a message on the screen indicating whether or not the answer is correct and the score is automatically tabulated. The user may choose to terminate the exercise at any time before the last question by selecting the "EXIT" option.

Upon completion of all the exercise segments or after selecting "EXIT", the users score and test results are displayed. The screen indicates those answers which were answered correctly or incorrectly. At this time, the user may choose to review a particular scenario or be presented with the overview of the procedure before returning to the lesson menu.

The structure of the test option is described in Figure 7. The test segments consist of between 6 to 14 computer-generated questions corresponding to each step of the procedure in a lesson. The instruction text screen explains that in the test the user is required to type in the description of the procedure, one step at a time, starting from the first step.

Figure 7. The test option structure.



After a step description is typed in, feedback is given by showing both the correct text description and the video segment or still-frame corresponding to that step in the sequence. The user input is analyzed by the computer for the appropriate key words and then recorded as a correct or incorrect answer.

The user may choose to terminate the test at any time before the last question by typing "EXIT". Upon completion of the test or after typing "EXIT", the score, and a screen showing which questions were answered correctly and incorrectly, is presented. At this time, the user has the option of reviewing any question from the test or being presented with the overview of the procedure before returning to the lesson menu.

Instructional Strategy

In order to facilitate the learning and retention of procedures, a strategy which uses an approach recommended by Romiszowski (1981), is used throughout the program. This approach proposes that three essential points need to be addressed when teaching procedures:

1. Providing a demonstration of the skill that is required, both in its entirety and in segments, showing the main parts or key points.

2. Providing for simplified or prompted practice of the skill by the learner.

3) Providing supervised "free" practice of the complete skilled activity by the learner, and feedback in the form of test results and appropriate praise or other reinforcers.

Although Romiszowski cautions about the problems of long term recall with this approach, this was not a major concern in the development of the program. The users of this program will be applying their newly gained knowledge on a continual basis in their laboratory work and they are also closely supervised by the lab assistants; thereby ensuring constant reinforcement of the knowledge being acquired.

Specific design considerations were incorporated in the video production and computer program. The video production was based on an objective camera perspective, and takes on the view of the observer (Coldevin, 1981). Another consideration for video production was to reinforce the demonstration sequences with a full review as proposed by Coldevin (1975).

The computer program took into consideration the importance of learner control over the program. The menu structures and program options permit the user to navigate freely throughout the program, choosing their path and proceeding at their own pace (Blum Cohen, 1984). Also, when answering questions, the input type (keyboard) requires that the user verbalize the answer and this according to Wagner and Wagner (1985), can serve as an aid in promoting the retention of information.

Learner Control Strategies

This program was designed with specific options that allow the user a measure of control in the way they can manipulate the information in order to achieve their learning objectives (see Figure 8). The user can navigate forwards or backwards within the instruction option of a lesson, move from menu structure to menu structure and exit or end the program from any menu option. These program capabilities are designed to give the user extended control over the structure of the program.

Figure 8. The program user control options

MAIN MENU

The MAIN MENU is displayed at the beginning of the program and can be accessed within the program through the EXIT option in the CONTAMINATION ASSESSMENT or DECONTAMINATION menus. It allows the user to END the program or select the INTRODUCTION or the section menu of their choice.

CONTAMINATION ASSESSMENT Menu (section menu)

This menu is accessed from the MAIN MENU. It allows the user to select either the DIRECT CHECK or THE SWIPE CHECK lesson, to EXIT (return to MAIN MENU) or END the program.

DECONTAMINATION Menu (section menu)

This menu is accessed from the MAIN MENU. It allows the user to select either the DECONTAMINATION -WORK AREAS- or -CLOTHES & SKIN- lesson, to EXIT (return to MAIN MENU) or END the program.

LESSON Menu

This menu is accessed when choosing a lesson from either the CONTAMINATION ASSESSMENT or DECONTAMINATION menus. Each lesson menu has the same options: It allows the user to select either INSTRUCTION, EXERCISE, TEST, EXIT (return to the section menu) or END the program.

END option

This option can be accessed through the MAIN MENU, the section menus, or the lesson menus. It allows the user to stop the program at any time if they wish to terminate the session.

EXIT option

This option can be accessed through the section menus, the lesson menus or within the lesson options. It allows the user to exit any part of the program whenever they desire and return to the previous menu.

[ ]---> option

This option is accessed within the lesson options. It allows the user to move forwards throughout the INSTRUCTION, EXERCISE and TEST options at their own pace.

<---[ ] option

This option is accessed within the lesson options. It allows the user to move backwards throughout the INSTRUCTION.

Evaluation Strategies

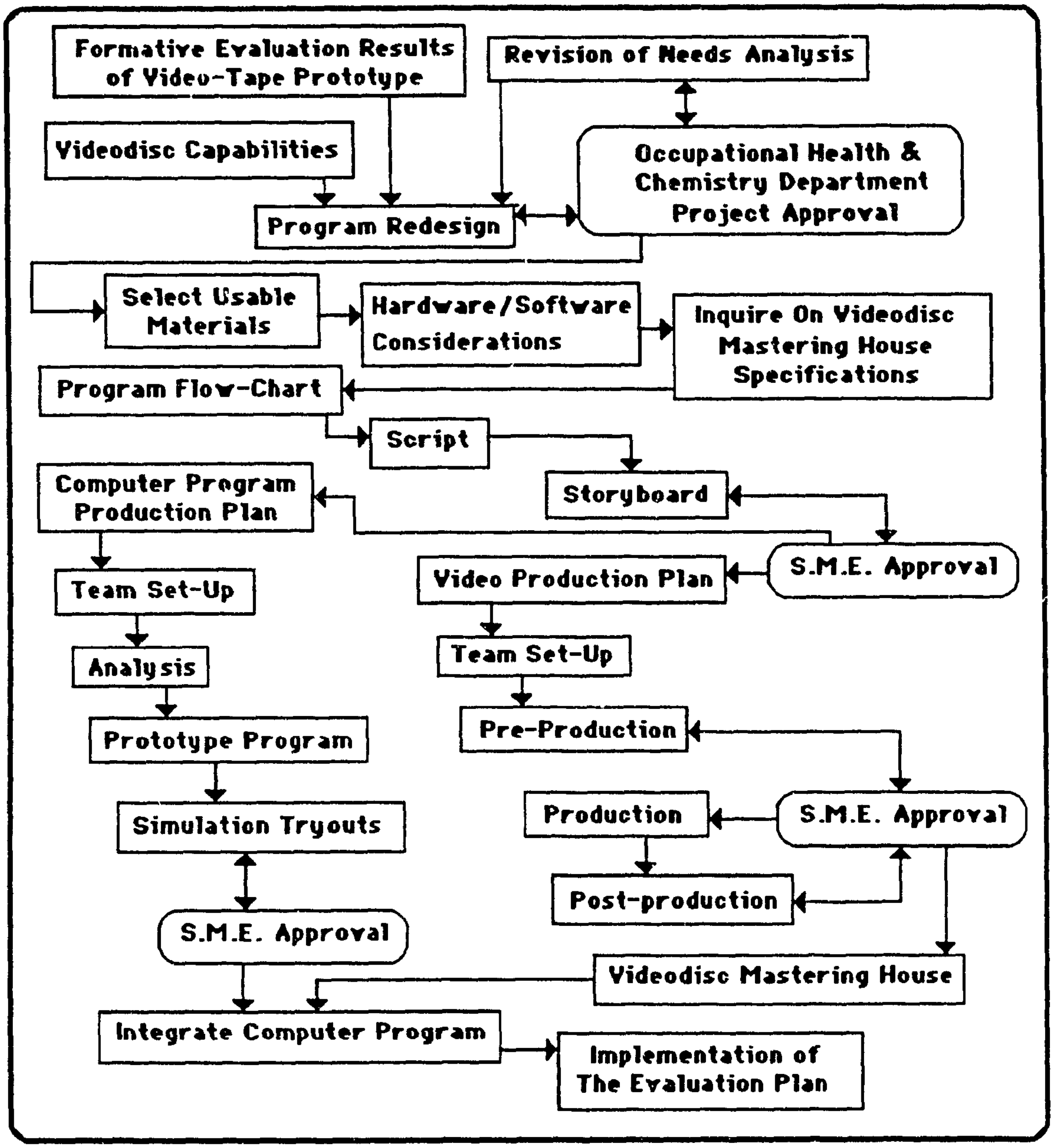
In order to evaluate the extent to which the users of the program have met the learning objectives, as detailed in the program content and objectives, a procedural checklist is provided with the program. This procedural checklist is to be used after the student has gone through any lesson from this program.

A student who has used this program to learn any of the procedures must correctly answer questions and perform a simulated demonstration of the procedure. Although students practice and test their knowledge, they must correctly complete the procedures they have learned in a safe or simulated laboratory setting before they are allowed to handle radioisotopes. The lab assistant uses the checklist to conduct the evaluation and can identify, through either the students actions or responses, any serious problems or misunderstandings. If necessary, an alternate or additional solution to this program such as personal tutoring or job aid flowcharts, could be prescribed.

Program Development

The program development outlines the pre-production, production, post-production and evaluation phases of the project. The project development plan (Figure 9) shows the activities that had to be undertaken during the development of the program. It indicates that the first step was to make a revision of the original needs analysis.

Figure 9. The production development plan



Revision of the Needs Analysis

The original needs analysis had been established at the onset of development of the interactive videotape program by Palmer. Although the videotape program was to serve as a formative evaluation tool for the future interactive videodisc program development, during the year and a half that it took to produce the prototype the needs may have changed. It was therefore necessary to re-evaluate and re-assess these needs.

After meeting with the departments involved it was established that the project needs analysis had not changed. Chemistry students working with radioisotopes in the laboratory were in need of better learning tools to acquire a basic competency in the carrying out of contamination assessment and decontamination procedures. Development of the videodisc program could therefore proceed as originally intended.

Program Redesign

The next step was to review the evaluation results of the prototype and examine the capabilities of the videodisc technology. This was seen as the best approach to take in order to arrive at a sound redesign, or new design, for the videodisc program. As previously stated, the interactive videotape program evaluation had revealed that the instructional design approach was sound but that some of the steps involved in the procedures needed to be more clearly defined.

In his evaluation of the prototype Palmer (1988) indicated that:

1. the "Introduction to Radioisotopes" section had too much information, and that graphic and narrative information needed to be clarified and simplified.

2. the "Isotope Information" section had too much information.

3. the "Direct Check" section required clarification of content and treatment of the content (i.e. the practice segment questions should address one procedural step at a time).

4. the "Swipe Check" section had too much information and required clarification of content and treatment of content.

5. the "Decontamination Procedure" section required clarification of content and treatment of content.

6. the "Body Decontamination Procedure" section needed additional information and required clarification of content.

A redesign of the video script and storyboard was still necessary, not only because the evaluation findings indicated that in some cases the video instruction sections were too long, but also because the capabilities of the different media involved (videodisc) demanded a modified approach and content (i.e. objective camera style, single frame requirements, etc.). Therefore, a proposed redesign of the interactive videotape prototype was presented to the Occupational Health & Safety and Chemistry Departments for their approval.

Selecting Usable Materials

The next activity of the project development plan was to select usable materials which were to be incorporated into the new design. It was decided that the videotape production be used as a guideline for script and storyboard development. Also, the procedure flow charts from the videotape prototype would be used to develop slightly modified flow charts for the videodisc thereby correcting some ambiguities.

Defining Hardware And Software Needs

Hardware and software requirements were evaluated on the basis of their ability to provide a more efficient environment for the production and delivery of the program. As such, the interactive videodisc delivery system is quite different from the interactive videotape prototype delivery system (see Figure 10).

Figure 10. The prototype and videodisc system comparison

Videotape Prototype	Videodisc system	Comments
Apple II Computer	IBM PC Computer	IBM has serial ports for direct communications with an industrial videodisc player, greater speed of execution and larger RAM.
BCD VCR control card	Videodisc Driver Program	Driver program was custom designed for the needs of the program.
One Screen System	Two Screen System	Two screen system can display text and video at the same time.
SuperPilot Authoring Language	Scenario Authoring System	Scenario is menu driven and easier to use. Developers of Senario were easy to contact (Longueuil, P.Q.)
Video Cassette Player	Videodisc player	Videodisc player has faster search time, is frame accurate and can hold a clear still frame.

The new videodisc delivery system gives the program a more rapid execution time because the random access memory (RAM) of the IBM computer is greater than that of the Apple II computer used in the videotape prototype. Increased RAM is also needed in order to run the authoring system (Scenario) rather than the authoring language (Super-Pilot) of the prototype.

The Scenario authoring system was seen as a better tool for programming because it is faster at creating code than any authoring language and makes it easier to create screen layouts, user input recognition and program organization. However, this authoring system does not support the overlay of computer and video screens and because of this, the hardware configuration calls for a two screen system; a computer screen and a television screen.

This two screen system is one of the most important attributes of the program as it permits a full page of text to be displayed on one screen while the video image is displayed on another. The videotape prototype had one screen which alternated back and forth between the video and the computer making it awkward for the users because they could not see a video image and read computer text at the same time.

Although the Scenario authoring system required that the computer be equipped with a special control card to control the videodisc player, the control capabilities of this card unfortunately did not meet the design requirements of the program. Rather than change the program design, the author searched for alternative solutions and a videodisc driver program was developed by Roger Kenner, of the Audio-Visual department at Concordia University, to meet these requirements.

Videodisc Mastering Specifications

The videodisc mastering house specifications were obtained from Technidisc Inc. in Troy, Michigan, U.S.A.. The video production used a three-quarter inch videotape format, post-produced with a continuous time code and within broadcast video luminance and audio peek levels. Technidisc Inc. required that the program be delivered for mastering on a one inch "C" type videotape format.

The Audio-Visual Department of Concordia University was equipped for three-quarter inch videotape production and editing facilities. However, in order to deliver a one inch "C" type videotape, a video transfer from three-quarter to one inch "C" had to be done in a commercial studio.

Program Flow Charts, Storyboards And Scripts

Miriam Posner and Chris Boer, from the Department of Chemistry at Concordia University, assisted the author in clearly defining the sequence of events to be followed in order to achieve mastery in each of the four procedures. A flow chart was constructed for each procedure: The direct check; the swipe check; the decontamination of work surfaces; and the decontamination of clothes and skin. Storyboards and scripts were developed from the program flow charts.

The flowcharts, developed initially as an outline for video and computer program production, can also be used as training aids. They offer a concise description of the actions and decisions to be taken and a clear representation of the sequence of events.

The only section of the program without a developed flowchart is the introduction. However, the script and storyboard were developed following a treatment of the content and it was established that this section would: (a) introduce the host/narrator, (b) introduce the people doing the demonstrations, (c) emphasize the need for safe handling of radioisotopes and (d) provide a general introduction to the program.

After subject matter expert (SME) validation and approval of the storyboard, the production phase was undertaken. A computer program production plan and a video program production plan, outlining the tasks to be completed and timelines for completion, were developed. Each production plan had three major phases. The computer program production phases were: the analysis, the prototype, and the simulation trials (testing and debugging). The video program production phases were: pre-production, production, and post-production.

Video Production

The first activity in the video production was to secure the services of a video director, a technical production director and an assistant director. The video production team was headed by Steve Skitt as director and Jo-anne Dubois-Finn as assistant director, both graduate students in the Educational Technology program at Concordia University. The technical director was Michael O'Keefe of the Audio-Visual Department at Concordia University. Pre-production activities, facilities bookings, equipment bookings, set construction, casting, production assistants and technical personnel duties for rehearsals and shooting were coordinated by the video director and assistant director. Location shooting was done in a Concordia University laboratory where radioisotopes are used. The crew consisted of the director, assistant director, lighting director, camera operator, VTR operator, production assistant and a 35mm still photographer. Both SME's and the author were also present. One full day of shooting (9:00 a.m. - 9:00 p.m.) was required.

The studio work was done in Studio "A" at Concordia University. Along with the host/narrator, the studio crew consisted of the director, assistant director, technical director, lighting director, switcher, audio operator, CCU operator, VTR operator, floor manager, three camera operators, two production assistants, and a slide projector operator. Both SME's and the author were also present. The talent and crew had one evening of 4 hours for rehearsal before a 6 hour evening taping session.

The author, director and assistant director, in consultation with the SME's, completed the video off-line. After approval of the video sequences by the SME's, the on-line edit was undertaken. The author worked with the VTR editor to produce the 3/4 inch video master in the Concordia University Studio "A" editing facilities. Video on-line took two weeks to complete.

After the voice-over narration was taped, the assistant director worked with the talent host/narrator and the studio technicians to produce a synchronized voice-over for the video demonstrations. A final audio mix was completed in Studio "A" at Concordia University before dubbing the 3/4 inch tape to a 1 inch "C" type tape format. The tape was then sent to Technidisc Inc. of Troy Michigan, U.S.A. and two check discs were produced.

Computer Program Production

The author, having good workable knowledge of micro-computer technology, undertook the responsibilities of computer program development. The first stage was to analyze the proposed structure of the program. This analysis took into consideration the hardware configuration limitations and the development software capabilities, both of which would affect the writing and the running of the program.

The questions to be addressed were:

1. What is the maximum file size which can run in RAM while the authoring system is loaded?

2. Which videodisc control (control card or driver program) will meet the needs of the storyboard?

3. Can the authoring system meet the instructional design and storyboard needs?;

4. How much time (approximate man-hours) will be needed to write the program?

Meetings with the developers of the Scenario authoring system provided valuable information. It was established that although the Scenario program only needed 512 Kb to run, the RAM space left to load was only 150 Kb. This meant that on the IBM-PC the running of the program would be slowed down considerably because of the constant reading of the diskettes in the drives. However, by adding a memory expansion board to the IBM-PC and increasing RAM to 640 Kb, a file of approximately 250 Kb could be loaded into a virtual drive (a memory-resident drive). Running large sections of the program without the constant reading from a diskette was now possible and the running speed was greatly improved.

The videotape prototype had used a BCD Associates Inc. videotape player control card for the Apple II computer. It was thought that the BCD card for the IBM computer would meet the needs of the production. However, the BCD videodisc control card and the videodisc control features within Scenario did not permit the desired flexibility of control over the videodisc player capabilities.

The most important drawback to BCD and Scenario was that a video still-frame could not be maintained while computer text was changed. Scenario would turn the video screen off before computer text could be called. The videodisc player control had to be independent of the Scenario program.

After calls to BCD and meetings with Scenario developers, the author contacted Roger Kenner of the Audio-Visual Department at Concordia University. Kenner, while working on another project, had already written a computer program which made videodisc control possible. As the Scenario authoring system allowed external programs to be called and run within its structure, it could therefore control the videodisc player through an external videodisc driver program.

The videodisc driver program would allow a still-frame to be displayed while handling of the text screens was managed by Scenario. A prototype of the driver program, written in "Quick Basic", was put together in one afternoon. A streamlined version was developed a short time later. This development made the BCD control card obsolete. Control of the videodisc player is now handled by sending code via the computer communications port, through an RS-232 null-modem configuration cable, to the videodisc player.

The Scenario authoring system was therefore chosen for the following reasons: (a) it made programming available to non-programmers, (b) it helped organize the programming structure, (c) it would speed up development, (d) the program developers were easily accessible for consultation and (e) it was very affordable when compared to other systems on the market.

Tests and sample programming in Scenario showed that this authoring system did meet expectations, and except for its inadequate control of a videodisc player, satisfied the instructional design and storyboard requirements.

After further tests to build the structure of the program, it was projected that the total structure would take at least 5-6 weeks to complete. Input of the content was estimated at 3-4 weeks and allowing 2 weeks for testing, the program would take approximately 10-12 weeks to complete. Estimates were for one full time programmer and included changes and corrections from formative evaluation findings.

The author completed the programming task in 10 weeks. The program is over 0.4 Mb large and is divided into three main segments. It is an auto-boot program which loads when the computer is turned on and the two diskettes are in the appropriate disk drives. The first files to load into RAM will start the program and permit the user to see a general introduction section or choose access to either the contamination assessment procedures or the decontamination procedures.

Only one set of procedures can reside in the memory at one time. For example, the decontamination files are loaded into the memory when that option is selected from the main menu. If, after that, the user chooses to access the contamination assessment procedures, the decontamination procedure files are then erased from memory in order to make room for the contamination files. This is made possible by using an external batch file written for this purpose. The files in each case take less than 1 minute to load and once loaded, no other delays in accessing information are encountered.

Print Production

The student manual for the videodisc program was developed from the student manual written by Michael Palmer for the videotape prototype. Its structure and content outline were used as the basis from which the videodisc program student manual was evaluated.

Design and development team members, SME's, and students who reviewed the program read the manual and were asked to comment on the structure and clarity of the content and check for errors. The final draft of the student manual (see Appendix A) was used for the one-to-one testing.

Testing and debugging of the program will be discussed in the next chapter along with all other aspects dealing with the evaluation of the videodisc program.

Chapter 4
Evaluation of the Program

Objective

In order to meet the objectives of evaluation, and still work within the constraints imposed by having no budget for evaluation and difficulty in recruiting participants, the author selected an evaluation approach that would provide feedback and information in five areas.

The five areas chosen for evaluation were:

1. the content of the program. Information gathered to determine whether facts and procedures were correctly explained and/or demonstrated.

2. the instructional format. Information gathered to determine whether the format used (i.e. vocabulary, quantity of information, etc.) was appropriate for the audience.

3. the learning outcomes. Information gathered to identify what had been correctly learned, not learned or misunderstood by the user.

4. the learner attitudes. Information gathered to determine whether users have positive or negative attitudes about learning through this type of program.

5. the technical quality. Information gathered to validate the manuals and determine whether or not the program is easy to use.

Methods

A number of methods were used to gather the evaluation data. First, the "self evaluation" method (Kandaswamy, 1980) was used to help the production team refine their approach towards design and production planning. The decisions were made in a cooperative atmosphere where options were discussed and the course of actions revised.

As suggested by Geis (1987) and Weston (1986), experts were consulted at every stage of development and were asked to provide comments and criticisms on the accuracy, completeness, and technical quality of the program. Contributions to this area of evaluation were made by subject matter experts, systems (computer) analysts, instructional design experts and video technical production experts.

Individual students from the target population were enlisted to help revise the program as it was being produced. This "individual testing" approach as described by Kandaswamy (1980), is a "debugging" process in which careful monitoring of the students reactions, responses, remarks and scores are recorded, thereby providing valuable data which can later be used for program revisions.

Finally, a small group of students completed a one-to-one testing session with the program. Their learning outcomes, attitudes, comments and the technical reliability of the system were examined.

How these methods (self-evaluation, expert review, individual testing and one-to-one testing) were applied throughout the development of the program will now be described. Each method outlined covers its participants, instrumentation, criteria, procedures for evaluation, data analysis procedures and a summary of the actions taken.

Self-evaluation

Participants.

The author and members of the design and production teams.

Instrumentation.

No formal instrumentation was used. The decisions were made in a cooperative atmosphere where options were discussed and the course of actions were revised.

Criteria.

Discussion during design and production meetings was focused on making the most appropriate decisions for achieving the training objectives.

Evaluation Procedure.

The self evaluation method was used to help the production team refine their approach towards design and production planning. This involved reviewing drafts, clarifying objectives and discussing content presentation.

Data Analysis Procedure.

Suggestions were discussed with team members.

Actions.

Revisions were acted upon immediately.

Expert Review

Participants.

Throughout the development stage two subject matter experts were responsible for reviewing and validating the work of the production teams. Systems analysts and design experts from Scenario, BCD Associates Inc., along with David Wells, a technician in the Education Department at Concordia University, used their expertise to suggest improvements to the computer hardware and software for development. Video technical production experts from CFCF Television, Technidisc Inc. and the Audio-Visual Department at Concordia University greatly helped clarify video production issues.

Instrumentation.

Interviews with experts were conducted.

Criteria.

The criteria was related to the design and production issues and the work involved during development. The SME's had specific criteria when reviewing the work of the design and production teams. These criteria were that the content be free of errors with regards to: (a) the information and explanations presented (verbal and text), and (b) the actions of the demonstrator (visual). The SME's also commented on the appropriateness of the vocabulary used and the clarity of the content presented.

Evaluation Procedure.

As sections of the program were completed the SME's would check for mistakes and make comments on content. Other expert review came in the form of discussion and review of the program at critical stages of development, thereby enabling the design and production teams to revise their course of action as necessary.

Data Analysis Procedure.

Interviews were recorded and suggestions were discussed with team members.

Actions.

Some minor changes in vocabulary were made, but no major programming changes or extensive content revisions were necessary. All the changes requested by the SME's were made to their satisfaction.

Individual Testing

Participants.

Eight subjects were enlisted for individual testing. Four subjects were students with the prerequisites needed for accessing the program, as described for the target audience. The other four were graduate students from the department of education. Students from the education department were used because of their availability. Regardless of the content, these subjects could effectively test the program for bugs, spelling errors, ambiguity of instructions and difficulties in navigating through the program.

Instrumentation.

Observation of the individuals while interacting with the program and interview.

Criteria.

The criteria are related to design and production issues and the work involved during development. The author had specific criteria to investigate while monitoring individuals who were testing sections of the program. These were: (a) that the hardware and computer program work properly (bug free), (b) that the program content be free of spelling errors, (c) that the vocabulary used be appropriate and (d) that the content, explanations, demonstrations and program navigation be clear and unambiguous.

Evaluation Procedure.

Students were instructed to go through a section of the program while being monitored by the author. The author noted any problems encountered and asked the student for comments on the clarity of the presentation, the explanations and the demonstrations.

Data Analysis Procedure.

Observations notes and comments were discussed and acted upon.

Actions.

Some minor changes were made (spelling errors, sentence structure), but no major programming changes or content revisions were necessary. Changes to the program content from individual testing were made after consultation and approval from the SME's.

One-To-One Testing

Participants.

Seven subjects were enlisted for one-to-one testing, 5 were undergraduate (third year chemistry) and 2 were graduate chemistry students. The subjects all had the prerequisites needed for accessing the program as described for the target audience.

The method for enlisting these subjects was not random. The Chemistry Department provided the author with a list of 12 names of undergraduate (third year) and graduate students registered for biochemistry courses. The author called each student and asked them, on a voluntary basis, to participate. For a number of reasons, some could not participate.

Instrumentation.

For each procedure, the pre-test and post-test instrument for evaluation (see Appendix B) was a checklist. The author indicated the response and actions of the subject. The students were asked to; (a) answer a question on when to use the procedure, (b) choose the equipment and materials needed to carry out the procedure, and (c) execute the procedure in a step-by-step fashion.

Also, a 5 point Likert scale attitude questionnaire was constructed to examine the students feelings and reactions to the program, as well as their attitudes to the learning environment (see Appendix C).

Criteria.

The checklist for the pre-tests and post-tests were graded to give 0.5 points for correctly answering the question on when to use the procedure, 0.5 for each correct piece of equipment and material chosen and 1.0 point for each step of the procedure that was correctly executed. The scores were totalled and converted to percentage. In order to ensure that the subjects had no prior knowledge of the subject matter to be covered, a student with a score of over 10% on the pre-test would not be a participant in this evaluation.

The specific criteria used for evaluation in the attitude questionnaires were:

1. the clarity of information presented.
2. the quantity of information presented.
3. the length of instruction.
4. the interest in the segments presented.
5. the manipulation of the program.
6. the clarity of the instruction screens.
7. the clarity of the demonstrations.
8. the clarity of review.
9. the clarity of questions.
10. the difficulty of questions.
11. the helpfulness of feedback.

Other criteria pertaining to the program in general included:

1. attitudes towards learning with interactive video.
2. the difficulty of the lessons.

3. the technical quality.
4. the background music.
5. the operation of the computer.
6. the open question answering.
7. the clarity of the menu and option screens.

The students also had the opportunity to write their personal comments about the program. A detailed description of the criteria can be found in Appendix D.

Evaluation Procedure.

The students were given the pre-test for each procedure and if they scored less than 10%, they were given the student manual of the videodisc program and asked to read it before returning for the testing session. Then, individual appointments for two one and one half hour testing sessions were made.

When a student returned for the first testing session, he/she was asked to go through the program. They were first asked to view the introduction of the program, then the questionnaire section on the introduction was given to be completed. They were next asked to choose any of the four lessons, and go through that lesson one option at a time (instruction option, exercise option and test option). As the student completed each option of the lesson, the questionnaire section of that option was answered. When the lesson had been completed, a post-test was given.

Data Analysis Procedure.

Pre-test scores were used to establish eligibility to participate in the evaluation and were compared with the post-test scores to show the effectiveness of the program. Data gathered from the questionnaires were summarized and mean scores were evaluated for each criteria.

Actions.

Discussion and recommendations follow in Chapter 5.

Chapter 5
Results and Discussion

Introduction

The following is a more detailed summary of the one-to-one testing evaluation results. Pre-test and post-test scores are presented and student attitudes and comments are examined. The evaluation results, along with issues of program implementation, will be discussed.

As previously stated, the one-to-one testing involved seven students from the Chemistry Department at Concordia University. None of the subjects had ever worked with radioisotopes and consequently they had no previous knowledge about how to execute the procedures covered by the videodisc program.

One-To-One Testing Results

The pre-test results are shown in Table 1. The scores clearly indicate that the students who participated in this evaluation had no prior knowledge of the subject matter. Only one student (a graduate student) answered a pre-test question correctly. Although she did not know how to use it, the student identified the Geiger counter as the tool for detecting high level radiation.

The post-test results are shown in Table 2. All scores are 90% and above and complete mastery (100%) was achieved in most cases.

Table 1.

Student Pre-Test Scores

	STUDENTS 1	2	3	4	5	6	7
D.C.	0%	0%	0%	0%	5.5%	0%	0%
S.C	0%	0%	0%	0%	0%	0%	0%
D.W.A.	0%	0%	0%	0%	0%	0%	0%
D.C.S.S.	0%	0%	0%	0%	0%	0%	0%

Table 2.

Student Post-Test Scores

	STUDENTS 1	2	3	4	5	6	7
D.C.	100%	100%	100%	100%	90%	100%	100%
S.C	94.7%	100%	100%	100%	100%	100%	100%
D.W.A.	100%	100%	100%	100%	100%	100%	100%
D.C.S.S.	93.3%	90%	100%	100%	100%	100%	100%

Note. **D.C.** = Direct Check, **S.C.** = Swipe Check,
D.W.A. = Decontamination - Work Areas -,
D.C.S.S = Decontamination - Clothes and Skin Surfaces procedure

The post-tests, as their results indicate, did not reveal any problems with the program. The errors made by the students were: (a) forgetting to check the battery of the Geiger Counter in the Direct Check; (b) forgetting to mark the vial in the Swipe Check; and (c) forgetting to remove rings, watches and bracelets, as well as not choosing the dry radiation waste container as necessary material for the decontamination of clothes and skin.

Learner Attitudes

The following is the complete learner attitude questionnaire results. Student comments are included and the results are discussed after each section. Mean scores have been calculated and included with the raw data.

The Program Introduction Section

1) The information presented in this segment was? — Mean

								Mean
	Clear	1	2	3	4	5	Confusing	1.14
SUBJECTS		6	1					

2) The length of the segment was?

	Too Long	1	2	3	4	5	Too Short	3.29
SUBJECTS				5	2			

3) The content presented was?

	Interesting	1	2	3	4	5	Boring	1.43
SUBJECTS		4	3					

4) The background music was?

	Distracting	1	2	3	4	5	Enhancing	3.57
SUBJECTS		1		2	2	2		

As indicated by the results, most students found this segment clear, just long enough and interesting. There was mixed reaction to the background music. Although most responses were either positive or neutral, one student did find it distracting.

Student comments.

1. Good introduction - caught my attention right at the beginning.

The Instruction Sections

1) The video introduction presented in this segment was?

SUBJECTS:	Confusing 1	2	3	4	5 Clear	Mean
S.C.				1	6	4.86
D.C.					7	5.0
D.W.A.					7	5.0
D.C.S.S.					7	5.0

2) The video demonstration presented in this segment was?

SUBJECTS:	Confusing 1	2	3	4	5 Clear	Mean
S.C.					7	5.0
D.C.				1	6	4.86
D.W.A.				1	6	4.86
D.C.S.S.				2	5	4.71

3) The amount of information presented in this section was?

SUBJECTS:	Too Much 1	2	3	4	5 Too Little	Mean
S.C.			6	1		3.14
D.C.			7			3.0
D.W.A.			6	1		3.14
D.C.S.S.			6	1		3.14

4) The length of this section was?

SUBJECTS:	Too Long 1	2	3	4	5 Too Short	Mean
S.C.			7			3.0
D.C.		1	6			2.86
D.W.A.			6	1		3.14
D.C.S.S.			7			3.0

5) The text in the review segment was?

SUBJECTS:	Confusing 1	2	3	4	5 Clear	Mean
S.C.				2	5	4.71
D.C.			1	2	4	4.43
D.W.A.			2	1	4	4.29
D.C.S.S.				2	5	4.71

6) The content presented was?

	Boring 1	2	3	4	5 Interesting	Mean
SUBJECTS:S.C.				3	4	4.57
D.C.			1	4	2	4.14
D.W.A.				3	4	4.57
D.C.S.S.				1	6	4.86

7) The background music was?

	Distracting 1	2	3	4	5 Enhancing	Mean
SUBJECTS:S.C.			4	1	2	3.29
D.C.			4		3	3.88
D.W.A.			4	1	2	3.29
D.C.S.S.			4	1	2	3.29

8) Navigation through this section of the program was?

	Difficult 1	2	3	4	5 Easy	Mean
SUBJECTS:S.C.					7	5.0
D.C.					7	5.0
D.W.A.					7	5.0
D.C.S.S.				1	6	4.86

OVERVIEW

1) The information presented was?

	Confusing 1	2	3	4	5 Clear	Mean
SUBJECTS:S.C.					7	5.0
D.C.				3	4	4.57
D.W.A.					7	5.0
D.C.S S.				1	6	4.86

2) The overview of the procedures was?

	Very Helpful 1	2	3	4	5 Not Helpful	Mean
SUBJECTS:S.C.	5	1		1		1.57
D.C	2	2		2	1	2.71
D.W.A.	4	3				1.43
D.C.S.S.	4	3				1.43

As indicated by the results, most students found the instruction section of the Swipe Check to have a clear introduction and demonstration segment. The section contained ample information, the length seemed appropriate and the text from the review was clear. Students judged the content to be interesting, with the background music marginally enhancing. Navigation (menu selection, forward, back, etc.) through the instruction section was very easy. Finally, the overview was clear and helpful for most students. It should be noted that one student did not feel that the overview was helpful.

Student comments.

1. I like the idea of the review.

2. The steps are broken down in a very comprehensive manner. This information is very helpful.

Students found the instruction section of the Direct Check to have a clear introduction and demonstration segment. The section contained ample information, the length seemed appropriate and the text from the review was found to be clear. Students judged the content to be interesting, with the background music somewhat enhancing. Navigation through the instruction section was very easy. Finally, although the overview was very clear and students found it only somewhat helpful, three students did not feel that the overview was at all helpful.

Student comments.

1. Helps remember the important steps.

Students found the Decontamination - Work Areas - instruction section to have a clear introduction and demonstration segment. The section contained ample information, the length seemed appropriate and the text from the review was found to be clear. Students judged the content to be interesting, with the background music marginally enhancing. Navigation through the instruction section was very easy. Finally, the overview was very clear and helpful.

Student comments.

1. No problem understanding this procedure.

2. The segment was short, simple and efficient.

Students found the Decontamination - Clothes & Skin - instruction section to have a clear introduction and demonstration segment. The section contained ample information, the length seemed appropriate and the text from the review was found to be clear. Students judged the content of this section to be the most interesting of all sections. The background music was marginally enhancing and the navigation through the instruction section was easy. Finally, the overview was very clear and helpful.

Student comments.

1. Too many steps.

The Exercise Sections

1) The information screen explaining how to work through this section was?

	Easy to Understand 1	2	3	4	5 Difficult to Understand	Mean
SUBJECTS:S.C.	5	2				1.29
D.C.	5	2				1.0
D W.A.	7					1.0
D C S.S.	6	1				1.14

2) The questions presented were?

SUBJECTS	Clear 1	2	3	4	5 Confusing	Mean
S.C.	6	1				1.14
D.C.	4	3				1.42
D.W.A.	6			1		1.42
D.C.S.S.	6	1				1.14

3) The questions presented were?

SUBJECTS	Easy 1	2	3	4	5 Difficult	Mean
S.C.	5	1	1			1.14
D.C.	4	2	1			1.57
D.W.A.	4	1	2			1.71
D.C.S.S.	4	1	2			1.71

4) The feedback presented was?

SUBJECTS	Not Helpful 1	2	3	4	5 Very Helpful	Mean
S.C.		1	1	2	3	4.0
D.C.			1	2	4	4.14
D.W.A.			1	2	4	4.14
D.C.S.S.	1		1	2	3	3.89

5) Participating in this section was?

SUBJECTS	Boring 1	2	3	4	5 Interesting	Mean
S.C.				3	4	4.57
D.C.				4	3	4.43
D.W.A.			1	2	4	4.43
D.C.S.S.				2	5	4.71

As indicated by the results, most students found that the information explaining how to work through the Swipe Check exercise section was easy to understand. The questions presented were clear and the feedback was helpful although one student did not find the feedback helpful. Finally, students found their participation in this section interesting.

Students found that the information explaining how to work through the Direct Check exercise section was very easy to understand. They indicated that the questions presented were clear and easy to understand. Students found the feedback to be helpful and their participation in this section interesting.

Students found that the information explaining how to work through the Decontamination - Work Areas - exercise section was very easy to understand. They indicated that the questions presented were clear (except for one student who found them somewhat confusing). Students found the feedback to be helpful and their participation in this section interesting.

Students found that the information explaining how to work through the Decontamination - Clothes & Skin - exercise section was easy to understand. They indicated that the questions presented were clear and easy to understand. Students found the feedback to be somewhat helpful (one student did not find the feedback helpful) and their participation in this section interesting.

The Test Sections

1) The information screen explaining how to work through this section was?

Easy to Understand	1	2	3	4	5	Difficult to Understand	Mean
SUBJECTS: S.C	7						1.0
D.C.	7						1.0
D.W.A.	7						1.0
D.C.S.S.	7						1.0

2) Answering questions using your own vocabulary was?

	Interesting 1	2	3	4	5 Boring	Mean
SUBJECTS:S.C.	4	2	1			1.57
D.C.	1	4	1	1		2.29
D.W.A.	5	2				1.29
D.C.S.S.	3	4				1.57

3) The feedback presented was?

	Not Helpful 1	2	3	4	5 Very Helpful	Mean
SUBJECTS:S.C.			1	2	4	4.43
D.C.			1	1	5	4.57
D.W.A.			2	1	4	4.29
D.C.S.S.	1			2	4	4.14

4) Participating in this test was?

	Boring 1	2	3	4	5 Interesting	Mean
SUBJECTS:S.C.				3	4	4.57
D.C.				3	4	4.57
D.W.A.				2	5	4.71
D.C.S.S.				2	5	4.71

As indicated by the results, most students found the Swipe Check test section information screen very easy to understand. Answering questions using their own vocabulary was found to be interesting and the feedback helpful. Finally, students found their participation in this section interesting.

Students found the test section of the Direct Check to have an information screen that was very easy to understand. Answering questions using their own vocabulary was found to be interesting for most students (one student found it boring) and the feedback helpful. Finally, students found their participation in this section interesting.

Students found the Decontamination - Work Areas - test section to have an information screen that was very easy to understand. Answering questions using their own vocabulary was found to be interesting and the feedback helpful. Finally, students found their participation in this section interesting.

Students found the Decontamination - Clothes & Skin - test section to have an information screen that was easy to understand. Answering questions using their own vocabulary was found to be interesting and the feedback helpful (except for one student who did not feel the feedback was helpful). Finally, students found their participation in this section interesting.

Questions About the Program in General

1) Learning contamination assessment and decontamination procedures of radioisotopes in the laboratory through the use of an Interactive Videodisc System environment was? Mean

							Mean
	Interesting 1	2	3	4	5	Boring	
SUBJECTS	7						1.0

2) Overall, the lessons presented in this program were?

							Mean
	Easy 1	2	3	4	5	Difficult	
SUBJECTS	3	4					1.57

3) The technical quality of the video images were?

							Mean
	Very Good 1	2	3	4	5	Very Poor	
SUBJECTS	3	4					1.57

4) The instructions given to operate the system ("Press Spacebar to select", "Press Return to access selection" and "Press Any Key") were?

							Mean
	Easy To Follow 1	2	3	4	5	Difficult To Follow	
SUBJECTS	5	2					1.29

5) The way the information was structured (four lessons divided into Instruction, Exercise and Test) was? **Mean**

								Mean
	Easy to Follow	1	2	3	4	5	Difficult to Follow	1.0
SUBJECTS:		7						

6) Operating the computer was?

	Difficult	1	2	3	4	5	Easy	
SUBJECTS:						7		5.0

7) The menu and option screens presented in this program were?

	Confusing	1	2	3	4	5	Clear	
SUBJECTS:					1	6		4.89

As the results indicate, the students felt that learning these procedures through the use of an Interactive Videodisc System environment was very interesting. Overall, they found that the lessons presented in this program were easy, that the technical quality of the video images was good and that the instructions given to operate the system were easy to follow.

They also indicated that because of the way the information was structured, it was easy to follow. Finally, students found that the information from the menu screens was clear and that operating the computer was easy.

Student comments.

1. An interesting and useful way to teach somebody about a practical topic. It allows a person to work at their own pace and reinforce knowledge.

2. This was a very interesting way to learn about so important a subject.

Closing Remarks

At this time, no changes to the content, structure or design of the program are necessary. The evaluation of the program indicated that:

1. the content of the program is correctly explained and/or demonstrated.
2. the instructional format is appropriate for the audience.
3. the learning outcomes are satisfactory.
4. the learner attitudes are positive.
5. the technical quality is good.

It is also important to note that no hardware related problems were encountered during the one-to-one evaluation stage. The computer, videodisc player and TV monitor were operating 3 to 10 hours at a time without over-heating or deterioration of the image quality.

The computer program worked without flaw. The only complaint was that, after the initial start-up of the program, the waiting time (approx. 1 min.) in loading a section was bothersome. The program is divided into two sections which load separately; the contamination assessment section and the decontamination section. However, once the section is loaded the program runs quickly.

The author recognizes that the hardware configuration of this program is a major administrat've drawback for its implementation. A dedicated work station, specifically configured for this program, limits the variety of other programs able to run on the system, especially off-the-shelf programs running on industry standards, such as the IBM Infowindow, Sony View, or Matrox EIDS systems.

Decisions on hardware acquisitions need to reflect the long term considerations for the optimum utilization of a system and the best return on investment of resources for training. It is probable that in the future the program may need to be adapted or redesigned for delivery on a system available to all university students, and on which many other programs will run.

Although the results of the evaluation are very encouraging, it must be pointed out that the evaluation process was conducted in conditions different from those intended for field use. Constant monitoring of the students by the author, as well as having the students answer an attitude questionnaire after each option of a lesson and after each lesson, is an interaction with the program different than that of field use after implementation. The ultimate role of the program, to increase the Chemistry Department's effectiveness in a specific area of training, can only be truly measured through its effect derived from its implementation. A further study of the effectiveness of the in-the-field use of this program is therefore recommended.

As stated previously, the program was also produced to generate additional research into designing instruction for interactive videodisc delivery. The production of educational materials is of paramount importance to the investigation and continued development of better teaching tools and learning environments. The program has fulfilled the secondary objective and has already generated further research from professors and students in the Education Department at Concordia University.

Finally, this thesis has also provided invaluable experience to the author. The teamwork and managing of human resources as well as the instructional design aspects are challenges which need to be experienced for those who have aspirations of developing projects of this kind. As educational technologists and producers of materials for education and training, one important task is to focus the energy and expertise of many contributors towards one target; meeting the educational or training goals of the program. Artistic and technical input to a production must be guided to this purpose.

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Appendix A

The Student Manual

STUDENT MANUAL

INTERACTIVE VIDEODISC PROGRAM

RADIATION

Laboratory Procedures

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TABLE OF CONTENTS

INTRODUCTION

An important concern of anyone who works or experiments with radioactive isotopes is the risk of radioactive contamination. As well, there is also the risk of damage to the fragile equipment used when detecting radioactivity.

In an attempt to minimize these potential dangers, a unique training program has been developed to teach the appropriate contamination assessment and decontamination procedures for the safe handling of radioisotopes.

Through the use of a microcomputer/videodisc system and the courseware " RADIATION - Laboratory Procedures ", you will have access to the instruction on procedures for handling them, exercises to reenforce the procedures, and tests to ensure your understanding of them.

The unique features of an interactive video system have been used to help you to learn independently in an interesting manner and at your own pace with some control over the selection and sequence of your learning.

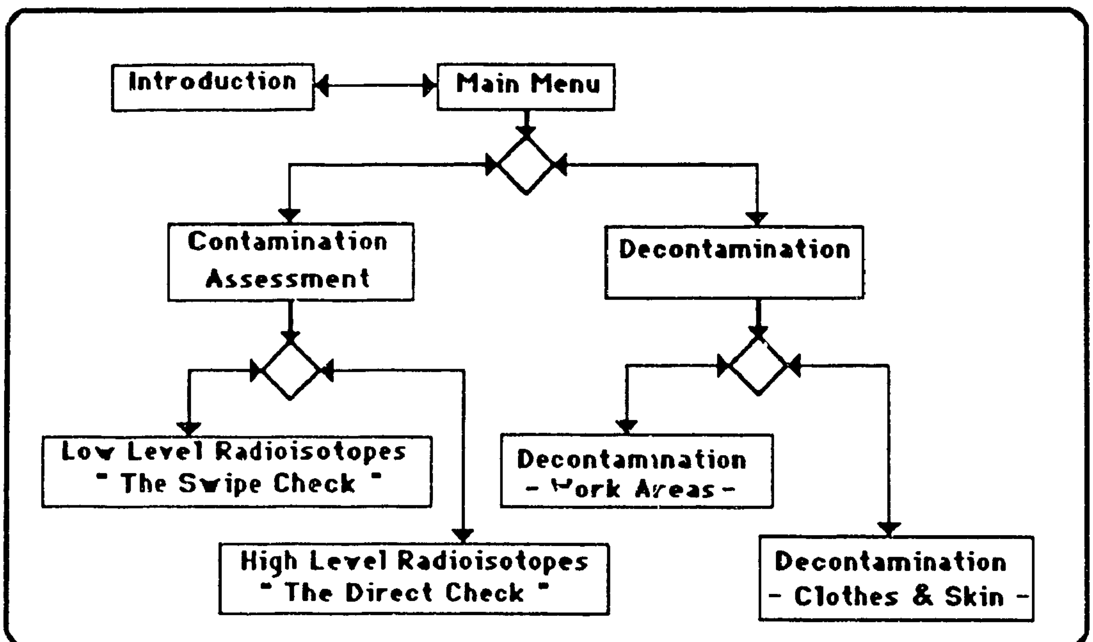
This Student Manual has been made available to help you to use the courseware in a way that will accommodate your own learning style and objectives. It will also explain how to operate courseware as well as describe the special user-control options that have been built in.

It is assumed in this manual, that you have been familiarized with the components of your interactive video system. If you are uncertain about how to operate the interactive video system components, you should request help from your lab technician or audio-visual technician.

WHAT YOU CAN EXPECT TO LEARN

What you can expect to learn from this courseware will depend on the section of the courseware you have selected. Three sections are accessed from the Main Menu of the courseware. As illustrated in Figure 1., Contamination Assessment and Decontamination sections each have two lessons.
This part of the Manual will outline the content and objective of each section and lesson of the courseware.

Figure 1



The " INTRODUCTION " section is designed to promote the importance of safety when handling radioisotopes. A news clip on the Chernobyl reactor accident is presented in order to reenforce and stress the reasons for following approved safe work procedures.

The remaining two sections give access to either the contamination assessment procedure lessons or decontamination procedure lessons. Each lesson offers an " INSTRUCTION ", " EXERCISE " and " TEST " option which may be viewed in any sequence.

A description of the content and objective of each section and lesson follows in Figure 2.

Figure 2

Section	*Content*	*Objective*
INTRODUCTION	The introduction section consists of a brief video presentation starting with a news clip on the Chernobyl reactor accident.	This section was designed to promote the importance of safety when handling radioisotopes.
CONTAMINATION ASSESSMENT		
	THE DIRECT CHECK (LESSON)	
	This lesson describes the proper and steps of the procedure to follow in order to correctly carry out the Direct Check. Exercise and Test questions are Computer-generated.	By the end of this lesson, you tools should be able to carry out the correct procedures necessary to carry out contamination assessment of <u>high energy</u> radioisotopes.
	THE SWIPE CHECK (LESSON)	
	This lesson describes the proper tools and steps of the procedure to follow in order to correctly carry out the Swipe Check. Exercise and Test questions are Computer-generated.	By the end of this lesson, you should be able to carry out the correct procedures necessary to carry out contamination assessment of <u>low energy</u> radioisotopes.
DECONTAMINATION		
	DECONTAMINATION - WORK AREAS - (LESSON)	
	This lesson describes the proper tools and steps of the procedure to follow in order to correctly carry out decontamination of areas. Exercise and Test questions are Computer-generated.	By the end of this lesson, you should be able to carry out the correct procedure necessary for the decontamination of areas work where radioisotopes have been detected.
	DECONTAMINATION - CLOTHES & SKIN - (LESSON)	
	This lesson describes the proper tools and steps of the procedure to follow in order to correctly carry out decontamination of clothes and skin surfaces. Exercise Test questions are Computer-generated.	By the end of this lesson, you should be able to carry out the correct procedure necessary for the decontamination of clothes and skin surfaces in the eventand of a spill of radioisotopes.

HOW YOU WILL BE LEARNING

Each time you select a lesson, you will be given three options for learning the lesson: INSTRUCTION, EXERCISE, and TEST.
These options can be viewed randomly or in sequence. For example, you can view the instruction and exercise segments as many times as you feel is needed. If you feel that you do not require the exercise, you can choose the test segment immediately after the instruction.
Giving you these options allows you to achieve your objectives at your own pace and with more control over your learning.
In this section of the Manual, a brief explanation of each of these options is presented.

INSTRUCTION

The instructional segments consist of a two to five minute video presentation which includes a brief introduction to the procedure, a description of the tools to be used and a demonstration by a lab technician of how the procedure is carried out. This is followed by a complete step-by-step review of the procedure in which additional text information has been inserted.
The segment concludes with an overview which emphasizes steps to be remembered.

EXERCISE

The exercise segments consists of between six to fourteen computer- generated scenarios accompanied by a slide or short video sequence which pertain to each step of the procedure in a lesson.
You will have to determine if the scenario of the step is in the correct sequence of events in the procedure and that the step is correctly represented.
To answer, you will be able to select from three options: CONTINUE, MAKE THE CORRECTION and EXIT.
If the scenario of the step is in the correct sequence and is correctly represented, then you should " CONTINUE ".
However, if the scenario of the step is not in the correct sequence and/or is not correctly represented, then you should " MAKE THE CORRECTION ".

You will be able to make the correction through typing a description of the correct scenario from the computer keyboard. You will receive a message indicating that your answer is correct or incorrect and your score is automatically tabulated.
You may choose to terminate the exercise at any time before the last question by selecting the option to " EXIT ".
Upon completing the exercise or after selecting " EXIT ", your score and a screen showing which questions were answered correctly and incorrectly is presented. At this time you also have the option to review any question.
You will be presented with the overview of the procedure before returning to the lesson menu.

TEST

The test segments consist of between six to fourteen computer-generated questions corresponding to each step of the procedure in a lesson.
You will be asked to describe, in sequence, each step of a procedure as it was presented in the " INSTRUCTION " option of the lesson.
You will be able to type, in your own words, the description of each step from the computer keyboard. After each answer, you will receive a message with the correct description and the slide or short video sequence which accompanies it. Your score is automatically tabulated.
You may choose to terminate the exercise at any time before the last question by typing " EXIT ".
Upon completing the test or after typing " EXIT ", your score and a screen showing which questions were answered correctly and incorrectly is presented. At this time you also have the option to review any question.
You will be presented with the overview of the procedure before returning to the lesson menu.

RUNNING THE COURSEWARE

This section of the manual outlines instructions to run the courseware. If you are uncertain about how to turn on/off any of the interactive video system components, you should request help from your lab technician or an audio-visual technician.

1. ***Start up the system by following these steps:***
   - Turn on the videodisc player (press button "POWER" on the top of the player)
   - Open the lid of the videodisc player (press button "OPEN" at the front on the left side of the player)
   - Insert the videodisc "RADIATION - Laboratory Procedures" (sliver side up)
   - Close the lid of the videodisc player
   - Turn on the television monitor.
   - Turn on the computer monitor.
   - Insert floppy disk 1 into disk drive A.
   - Insert floppy disk 2 into disk drive B.
   - Turn on the computer (switch is located at the rightside of the computer towards the back)

USER-CONTROL OPTIONS

This courseware has been designed with options that will allow you some control over the way you can use this courseware to achieve your learning objectives. This section of the manual lists and describes each of these options.

Main Menu option	The Main Menu is displayed at the beginning of the courseware and can be accessed within the courseware through the EXIT option from the CONTAMINATION ASSESSMENT or DECONTAMINATION Menu. It allows you to END the program or to select the INTRODUCTION or the instructional section of your choice.

CONTAMINATION ASSESSMENT Menu

This Menu is accessed from the MAIN MENU. It allows you to select either the DIRECT CHECK or THE SWIPE CHECK lesson, to EXIT (return to the Main Menu) or END the program.

DECONTAMINATION Menu

This Menu is accessed from the MAIN MENU. It allows you to select either the DECONTAMINATION - WORK AREAS or - CLOTHES & SKIN - lesson, to EXIT (return to the Main Menu) or END the program.

LESSON Menu

This Menu is accessed when choosing a lesson from either the CONTAMINATION ASSESSMENT or DECONTAMINATION Menu. Each lesson Menu has the same options: It allows you to select either INSTRUCTION, EXERCISE, TEST, EXIT (return to the Section Menu) and END the program.

END option

This option can be accessed through the Main Menu, the Section Menus, the Lesson Menus. It allows you stop the program at any time, if you wish to terminate the session.

EXIT option

This option can be accessed through the Section Menus, the Lesson Menus and within the lesson options. It allows you to exit any part of the program whenever you desire and return to the previous menu

[ ]---> option

This option is accessed within the lesson options. It allows you to move forward throughout the INSTRUCTION at your own pace and in the EXERCISE and TEST options sends you to the next question.

<---[ ] option

This option is accessed within the lesson options. It allows you to move backward throughout the INSTRUCTION.

Appendix B

The Procedural Checklists

THE SWIPE CHECK

Procedural Checklist

The student is asked to identify when the procedure is used, to choose the tools and materials for carrying it out and then demonstrate how the procedure is carried out. Check the items correctly answered, chosen or carried out.

1. Is the Swipe Check used when monitoring high or low level radioisotopes?

answer:_____(A LOW LEVEL RADIOISOTOPE)

2. What tools and materials are needed in order to carry out the procedure?

FORCEPS___ FILTER PAPERS___ 50% ETHANOL SOLUTION___ MARKER PEN___
SCINTILLATION VIALS___ SCINTILLATION FLUID___ SCINTILLATION VIAL RACKS___
LIQUID SCINTILLATION COUNTER___ BEAKER___

3. Carry out the procedure.

Step #1:__ Place a filter paper in the tongs.

Step #2:__ Over a beaker, wet the filter paper held by the forceps.

Step #3:__ For a background radiation check, choose an area where no contamination has taken place.

Step #4:__ Swipe an area of approx. 100 cm. sq..

Step #5:__ Place the filter paper in a scintillation vial.

Step #6:__ Fill at least half (1/2) the vial with scintillation fluid.

Step #7:__ Cap the vial tightly and shake it.

Step #8:__ Mark the cap of the vial with the code for the background check and put the vial in the scintillation vial rack.

Step #9:__ Repeat the procedure where a contamination assessment is required.

Step #10:__ Mark the cap of the vial with the code indicating the area checked and put the vial in the scintillation vial rack.

THE SWIPE CHECK
Procedural Checklist

Step #11:__ After all Swipe Checks have been completed, bring the racks to the liquid scintillation counter.

Step #12:__ Operate the counter.

Step #13:__ Record the results in the radiation monitoring log book and compare the CPM from each vial to the CPM of the background check.

Step #14:__ Apply decontamination procedures over an area where the CPM is greater than the background CPM.

THE DIRECT CHECK

Procedural Checklist

The student is asked to identify when the procedure is used, to choose the tools and materials for carrying it out and then demonstrate how the procedure is carried out. Check the items correctly answered, chosen or carried out.

1. Is the Direct Check used when monitoring high or low level radioisotopes?

answer:_____(A HIGH LEVEL RADIOISOTOPE)

2. What tools and materials are needed in order to carry out the procedure?

GEIGER-MULLER COUNTER OR GEIGER COUNTER ___

3. Carry out the procedure.

Step #1:__ Turn the Geiger counter on to the optimum sensitivity level.

Step #2:__ Check the battery level of the counter.

Step #3:__ Raise the volume of the speaker.

Step #4:__ Detach the probe from the counter.

Step #5:__ For the background radiation check, choose an area where no contamination has taken place.

Step #6:__ Pass the probe slowly at approx. 3 mm (1/8 in.) over the surface.

Step #7:__ Check the perimeter of the work area.

Step #8:__ When radiation counts exceed the background levels; decontaminate.

DECONTAMINATION PROCEDURES

- WORK AREAS -

Procedural Checklist

The student is asked to choose the tools and materials for carrying it out and then demonstrate how the procedure is carried out. Check the items correctly answered, chosen or carried out.

1. What tools and materials are needed in order to carry out the procedure?

   CHALK___ DRY RADIOACTIVE WASTE CONTAINER___

   ABSORBENT TOWELETS___ 2% DECONTAMINATION SOLUTION___

2. Carry out the procedure.

Step #1:__ With a piece of chalk, mark off a perimeter 30 cm larger than the contaminated area.

Step #2:__ Take one absorbent towelet.

Step #3:__ Spray one side of the towelet or spray the marked off area with the 2% decontamination solution.

Step #4:__ Starting at the perimeter of the marked off area and working towards the centre, wipe the area clean.

Step #5:__ Dispose of the used towelet in the dry radioactive waste container.

Step #6:__ Make a contamination assessment over the area and decontaminate until the area CPM is as close as possible to the background CPM.

DECONTAMINATION PROCEDURES

- CLOTHES & SKIN -

Procedural Checklist

The student is asked to choose the tools and materials for carrying it out and then demonstrate how the procedure is carried out. Check the items correctly answered, chosen or carried out.

1. What tools and materials are needed in order to carry out the procedure?

   LIQUID SOAP___ DRY RADIOACTIVE WASTE CONTAINER___

   ABSORBENT TOWELETS___ TOOLS & MATERIALS FOR THE SWIPE CHECK___

2. Carry out the procedure.

Step #1:__ Do not spread contamination (do not touch anything).

Step #2:__ Ask for help.

Step #3:__ Remove contaminated clothes.

Step #4:__ Dispose of the clothes in a dry radioactive waste container.

Step #5:__ Over a dry radioactive waste container, remove your gloves and dispose of them in the dry radioactive waste container.

Step #6:__ Remove articles such as watches, rings and bracelets.

Step #7:__ Have the tape water turned to a warm temp.

Step #8:__ Have the liquid soap and absorbent towelets brought to a sink.

Step #9·__ Have the soap applied.

Step #10:__ Wash and rinse thoroughly.

Step #11:__ Dry with absorbent towelets.

Step #12:__ Dispose of the towelets in the dry radioactive waste container.

Step #13:__ Swipe check the contaminated area.

Appendix C

The Student Feedback Questionnaire

STUDENT FEEDBACK QUESTIONNAIRE

Name: ______________________________

Age: ______

Educational Status:

a) Undergraduate Student ____ No. of credits completed ____

b) Graduate Student ____ No. of credits completed ____

The Questionnaire is to be filled out by circling the number which best indicates your response to the question. If you have any comments pertaining to the courseware, please feel free to report them to the observer.

QUESTIONNAIRE

INTRODUCTION SECTION

1) The information presented in this segment was?

Clear 1 2 3 4 5 Confusing

2) The length of the segment was?

Too Long 1 2 3 4 5 Too Short

3) The content presented was?

Interesting 1 2 3 4 5 Boring

4) The background music was?

Distracting 1 2 3 4 5 Enhancing

COMMENTS:

QUESTIONNAIRE

Lesson:________________

INSTRUCTION

1) The video introduction presented in this segment was?

Confusing 1 2 3 4 5 Clear

2) The video demonstration presented in this segment was?

Confusing 1 2 3 4 5 Clear

3) The amount of information presented in this segment was?

Too Much 1 2 3 4 5 Too Little

4) The length of this segment was?

Too Long 1 2 3 4 5 Too Short

5) The text in the review segment was?

Confusing 1 2 3 4 5 Clear

6) The content presented was?

Boring 1 2 3 4 5 Interesting

QUESTIONNAIRE

Lesson:_______________

7) The background music was?

Distracting 1 2 3 4 5 Enhancing

8) Manipulation of courseware.

Difficult to use 1 2 3 4 5 Easy to use

OVERVIEW

1) The information presented was?

Confusing 1 2 3 4 5 Clear

2) The overview of the procedures was?

Very Helpful	1	2	3	4	5	Not Helpful

COMMENTS:

QUESTIONNAIRE

Lesson:_______________

EXERCISE

1) The information screen explaining how to work through this section was?

Easy to Understand 1 2 3 4 5 Difficult to Understand

2) The questions presented were?

Clear 1 2 3 4 5 Confusing

3) The questions presented were?

Easy 1 2 3 4 5 Difficult

4) The feedback presented was?

Not Helpful 1 2 3 4 5 Very Helpful

5) Participating in this section was?

Boring 1 2 3 4 5 Interesting

COMMENTS: (Use the back of this page.)

____

____

____

QUESTIONNAIRE

Lesson:________________

TEST

1) The information screen explaining how to work through this section was?

Easy to Understand	1	2	3	4	5	Difficult to Understand

2) Answering questions using your own vocabulary was?

Interesting 1 2 3 4 5 Boring

3) The feedback presented was?

Not Helpful 1 2 3 4 5 Very Helpful

4) Participating in this test was?

Boring 1 2 3 4 5 Interesting

QUESTIONNAIRE

GENERAL

1) Learning contamination assessment and decontamination procedures ofradioisotopes in the laboratory through the use of an Interactive Videodisc System environment was?

Interesting 1 2 3 4 5 Boring

2) Overall, the lessons presented in this courseware were?

Easy 1 2 3 4 5 Difficult

3) The technical quality of the video images were?

Very Good 1 2 3 4 5 Very Poor

4)The instructions given to operate the system (" Press Spacebar to select ", " Press Return to access selection" and " Press Any Key ") were?

Easy To Follow 1 2 3 4 5 Difficult To Follow

QUESTIONNAIRE

GENERAL

5) The way the information was structured (four lessons divided into Instruction, Exercise and Test) was ?

Easy to Follow 1 2 3 4 5 Difficult to Follow

6) Operating the computer was?

Difficult 1 2 3 4 5 Easy

7) The menu and option screens presented in this program were?

Confusing 1 2 3 4 5 Clear

COMMENTS:

Appendix D

<u>The Student Questionnaire Criteria</u>

THE STUDENT QUESTIONNAIRE CRITERIA

CLARITY OF VIDEO INFORMATION
Criteria applies to the clarity or the ability of the student to understand the information presented in the video segment.

QUANTITY OF VIDEO INFORMATION
Criteria applies to the amount of information presented in the video segment.

LENGTH OF INSTRUCTION
Criteria applies to the length of the video segment presented.

INTEREST OF SEGMENT
Criteria applies to the interest level of a particular segment.

MANIPULATION OF COURSEWARE
Criteria applies to the amount of difficulty experienced by the student in using the specified keys to work through the courseware.

CLARITY OF INSTRUCTION SCREENS
Criteria applies to the amount of difficulty experienced by the student in understanding the instruction screens.

CLARITY OF DEMONSTRATION
Criteria applies to the clarity or ability of the student to understand the procedures demonstrated in a segment.

CLARITY OF TEXT FOR REVIEW
Criteria applies to the clarity or ability of the student to understand the text which describes the procedures demonstrated in a segment.

CLARITY OF QUESTIONS
Criteria applies to the clarity or ability of the student to understand the questions presented.

THE STUDENT QUESTIONNAIRE CRITERIA (cont)

DIFFICULTY OF QUESTIONS
Criteria applies to the level of difficulty of the questions presented.

OPEN QUESTION ANSWERING
Criteria applies to the interest generated from answering open ended questions using one's own vocabulary.

HELPFULNESS OF FEEDBACK
Criteria applies to the helpfulness of the feedback screens (video & text) offered in the courseware.

LEARNING WITH INTERACTIVE VIDEO
Criteria applies to the interest generated through the use of an Interactive Video system environment for learning.

DIFFICULTY OF LESSONS
Criteria applies to the overall level of difficulty experienced in the courseware.

TECHNICAL QUALITY
Criteria applies to the technical quality of the courseware.

CONTENT STRUCTURE
Criteria applies to the structure used to present the content in the courseware.

OPERATING THE COMPUTER
Criteria applies to the level of difficulty experienced when using the computer.

USEFULNESS OF MENU AND OPTION SCREENS
Criteria applies to the ability of the student to understand the menu and option screens.