Interactive Videodisc Training of Cardiopulmonary Resuscitation

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ABSTRACT

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In a case study conducted at CFB Trenton, Ontario, adult subjects (N = 17) were monitored while learning cardiopulmonary resuscitation (CPR) from an interactive videodisc-based system. Responses to the method of instruction were measured by pre-post Likert-type questionnaires and a 25 item semantic differential. Initial, delayed (7 months) and recertification (9 months) responses and test scores were compared as within group repeated measures. No significant changes in attitude towards the course content occurred with treatment or time.

Comparisons made between the recertification phase and a conventionally-taught CPR recertification course in Montreal (N = 18) suggest that although the videodisc system is perceived as being more "original", "creative" and "experimental" ($p < .025$), the conventional method is more "likeable" and "two-way" ($p < .05$). No significant difference was found in the overall acceptance of the methods of instruction, nor in the results of the written

CPR examination.

Although the results suggest that subjects are receptive to interactive video instruction, television watchers found the system significantly ($p < .05$) more acceptable than did non-TV watchers.

In open responses, subjects appreciated many of the features offered by the system - particularly the ability to review video demonstrations, and the instant feedback provided during skills practice. Subjects thought the system particularly useful for recertification training, but that a live instructor was required for practical coaching in initial training.

The study recommends that further research be conducted to examine the effectiveness of the system, particularly as a means of increasing the frequency of CPR retraining.

DEDICATION

This study took on a highly personal meaning when my father suffered cardiac arrest this spring. For twenty minutes, while I paced nervously in the hall, staff of the Coronary Care Unit of the Edmonton General Hospital practiced advanced CPR, until they could successfully re-start his heart. This thesis is dedicated to them and to people everywhere who give a few days of their lives to learn skills which extend the days of others.

ACKNOWLEDGEMENT

I wish to thank all of the people who have made this thesis possible. Special thanks go to Gary Boyd for the continued encouragement he has given me over the past five years.

Several individuals and organisations helped get the project underway in its initial stages: While I was at Canadian Forces Training System Headquarters, CFB Trenton, Major Ray Sapp sparked our videodisc project and Major Jean Belanger gave me time to work out the details. Mel Chan of SONY Canada helped arrange the procurement of the CPR Videodisc system, and Jim Arkwright of CRAD arranged to pay for it. David Hon, who developed the system for the American Heart Association, has been unfailing in his support.

Only with the able assistance of MCpl Al Chapman of 426 (Transport) Training Squadron, could I have collected the data for this study. Al spent many days and nights keeping our prototype system alive, training potential rescuers in CPR, and riding shotgun for dog and pony shows in Trenton, Toronto, Ottawa and Montreal. Thanks too, to Serge Halle for keeping the lines of communication open after I returned to Concordia, and to the many people of CFB Trenton who assisted in this project.

I am very appreciative of the assistance I received at Concordia University from Janet Rokas, who let me collect data in her CPR course, and to Richard Schmid, Jesus Vasquez-Abad and Thomas Wilson in interpreting statistical analyses.

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CHAPTER ONE

INTRODUCTION

"CAL systems to date are sad examples of visual poverty." (Derrick Unwin, 1983)

The conventional method of message presentation in computer-assisted learning (CAL) has primarily been via alphanumeric characters presented on a cathode-ray tube (CRT) (Jones, 1980). While examples of integrating adjunct visual materials through computer graphics, 16 and 35mm film-based systems, or using video may be found on the PLATO, IBM 1500, NATAL and TICCIT systems respectively, the coordination and interfacing of more than one medium has historically been fraught with mechanical and production problems (Pagliaro, 1983; Jones, 1980; Sugarman, 1978). With the availability of the optical videodisc on which up to 54,000 video frames can be randomly accessed as stills or motion sequences, new futures for visual information in interactive learning are possible. Indeed, the videodisc has been hailed as "the most revolutionary educational technology since the book" (Heuston, 1978), and is often referred to as the "omnibus medium" for computer-assisted learning (Jones, 1980).

Project U-Train/CAL is a Canadian Forces (CF) research and development project currently being conducted to explore

the role of CAL in military training and to determine hardware and software best suited for CF training applications (Belanger and Richards, 1982). Within the scope of the project two main questions arose concerning the use of videodisc in CAL:

Question 1. Given the CF training population, how receptive will the trainees be to interactive videodisc-based training (Richards, 1982)?

Question 2. What is the feasibility of using the videodisc as the distribution medium for existing adjunct visuals of videotape and 35mm slides in CAL?

While the above questions are quite broad, they are typical of research questions faced by potential field users of new technology. While a lot of experimentation with videodiscs is taking place (Bunderson, 1982), the research does not give the specific answers required nor does it yield the first-hand experience desired by potential videodisc producers. The ability to store all of the adjunct visual information for a course or courses on a single low-wear, low maintenance system such as the optical videodisc not only increases the options for instructional designers but increases the feasibility of remoting courses to isolated training sites for on-job-training. First-hand observations of one's training population interacting with a new training device can contribute immensely to the design of future

training devices of a similar nature, while simultaneously shedding light on the acceptability of such training devices by instructors and students (La Follette, 1982).

It is the first question which is of primary concern to instructional designers and educational psychologists, since it deals with the "why" rather than the "how" of educational technology. While the second question is important, the findings of any study will depend greatly on the particular hardware and software available and will deal more with the physical capacity of the technology rather than its human interface. It is for this reason that the first question, the question of human interaction with a new technology, has been selected as the topic of this thesis.

To answer Question 1, a prototype of the American Heart Association's state-of-the-art interactive training system for the instruction of Cardio-pulmonary Resuscitation (CPR) (Hon, 1982) was acquired and a case-study conducted to observe the training of CF personnel in this new training environment.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Interaction With Visuals in Computer-Assisted Learning

Although some applications of computers in training involve the active modelling of a conversant "thinking" partner in some pedagogical dialogue (Pask, 1969; Burton, 1981; Clancy, 1982), their most common function in Computer-Assisted Learning (CAL) is in the selection and presentation of pre-stored intructional messages according to some pre-programmed computer algorithm (Jones, 1980).

In the early 1960's days of computer-assisted instruction (CAI) when programmed learning lessons were being experimented with on computer systems, the most commonly available interface between man and the machine were teletype-style terminals. With this device, alphanumeric characters were the means of presentation and storage of the instructional messages. Manipulation of these same symbols allowed the presentation of boxes and crude graphs, but the terminal technology of the time severely restricted expansion in this area. Early efforts at incorporating visual information in courseware had to use adjunct visual materials in the form of picture books or randomly selected slides or still-frame films. For example, the student station of the IBM-1500 Instructional System

consisted of:

> "a cathode ray tube display screen; a picture projector with rear image screen; a modified typewriter keyboard ... a light pen; and an audio system."(Pagliaro, 1983)

Also in the early 1960's, the PLATO II system appeared with a similar array of options attached to a plasma display storage screen which retained characters or lines as drawn until they were actively erased. Since the plasma display did not have to be continually "refreshed" by the central computer, images could be progressively built up or even somewhat animated. In addition, since the screen was semi-transparent, a slide projector could be fitted to rear-project onto the plasma screen and images could then be labelled by the computer-generated text.

Both the IBM and the PLATO II system were plagued by the problem of local storage of pictorial information. While the courseware could be accessed electronically from a central computer, someone had to physically load the slides or film-strips into the computer terminal. In addition, the production of the IBM filmstrips required a rather complicated process to shoot single frames of 16 mm film and then encode the film with optically-read frame identification numbers (IBM, 1969). Systems which used 35 mm slides were prone to the normal hazards of burnt-out light bulbs, mixed-up slides and the usual limit of 80

slides per slide tray. One Canadian built terminal used a GAF projector which held up to 120 slides in each tray, but was prone to accidents since a sudden jar in handling could release some of the slides through the bottomless tray onto the nearest convenient surface (Drake, 1980).

When using a single slide projector, neither motion nor animation can be portrayed since the best time access from slide to slide is about 2 seconds. However, despite their handling and storage problems, 35 mm slides remain the best quality still image available.

In the early 1970's, a television display system was introduced by the MITRE corporation's minicomputer-based Time-shared Interactive, Computer-Controlled, Information Television (TICCIT). Since the video-display unit (VDU) was in fact a modified colour television set, it could be used to display television signals as well as the system's own seven colour graphics and alphanumeric information. The television signal could be introduced from a video-tape or, later on, from a video-cassette player and a computer-selected segment of tape played to one or more terminals. Further refinements in video-tape technology permitted limited still-frame presentation from video, and in some American military establishments, automatic selection and loading devices to give random access to a

library of video-cassettes (Hazeltine, 1981).

With the development of micro-electronic and chip-based technologies in the mid-1970's, processing power and inexpensive random-access memory (RAM) could be placed into terminal devices to increase the number, type and resolution of alphanumeric characters displayed on cathode-ray tubes (CRT). Computer graphics could be generated with some facility on many CRT devices, and on the new micro-computers. While the cost of these raster scan devices continued to decrease and their capabilities increase (Sugarman, 1978), computer graphics remain distinct from "real" pictorial images. Indeed, while a CAL terminal designed in 1982 for the Canadian Forces Project U-Train/Computer-Assisted Learning contained a very sophisticated colour computer graphics display system, it still relied on the earlier technology of random-access 35mm slides for "real" images (Belanger and Richards, 1982).

Despite the recent progress in colour, resolution and dynamic animation of computer graphics, high-fidelity applications are all but prohibitive for training applications where there is a requirement for "real" pictorial information (Wein, 1983). Even with expensive, sophisticated systems the student must watch the graphic generate over a period of time. While this may have some novelty at first, repetition soon becomes irritating to the

student and the painting process limits animation potential. Either the images must be pre-stored on a random access storage medium such as 35 mm slides or optical videodisc, or the amount of information presented, and ergo the "reality" be decreased as in the computer-generated imagery (CGI) currently used for flight simulators (FAA, 1983) to allow for real-time presentations. A third alternative for some applications is to merge images from two sources mixing stable real images from, for example, a videodisc while CGI is used to present a dynamic foreground.

Emergence of the Videodisc

The idea of placing video signals on a disc storage medium has been around for quite some time:

> "As early as 1928 John Baird, the British television pioneer, experimented with the recording of video signals on a wax disc but it was not until the 1960s that Westinghouse and the 3M Company developed a way to record a single frame of video on an audio type disc." (Cameron, 1982, p. 48)

Cameron goes on to explain that by the late 1970s there were about 40 different videodisc systems under various stages of development, and that two of these systems had already been unsuccessfully marketed by 1978. Indeed, by 1978 over eleven different recording materials, let alone signal recording protocols were under consideration for optical videodisc systems alone (Bartolini, Bell, Floy, Lurie, and Spong, 1978). Magnetic videodiscs, such as those used for instant replays on television sports broadcasts, were available in the mid 1970s but these proved too costly, complex and limited in storage capacity to be effective in educational settings (Jones, 1980).

At the end of the 1970s, three videodisc formats had emerged as the probable standards: a) the capacitance disc, read by a contact stylus, inexpensive, but not capable of random-access uses; b) the optical transmissive disc, read

by a laser beam focused through the clear plastic disc and capable of random-access of materials from either side of the disc, and c) the optical reflective disc, read by a laser beam focused through a clear protective coating before reflecting off of a metallic coating, and also capable of random-access uses (Cameron, 1982).

The educational uses of videodisc were seen not only to be the cost-effective replacement of existing audio-visual storage systems such as slide-projectors, film-strip projectors, 16mm and 8mm film projectors, and videotape, but also in the potential for sophisticated interactive instruction where the videodisc is coupled with computer control (Schneider, 1975). Where videotape systems have their weaknesses in slow random-access, limited use of still or freeze frames, high mechanical maintenance requirements, and videotape wear, the optical videodisc has its greatest strengths. The optical reflective disc is particulary robust since its information is protected by a layer of clear plastic. Without any surface contact, there is no wearing away of the information, and the disc can withstand a fair amount of abuse in terms of greasy fingerprints, dust, scratches and even small cracks before the disc becomes unusable (Crowell, 1982). While the optical transmissive system offers the greatest amount of information access, it must be stored in a protective caddy and the disc is highly vulnerable to dirt and fingerprints.

Videotape does have advantages over videodisc in ease of editing and local production and reproduction. Additionally, it should be noted that although direct read-after-write (DRAW) discs are becoming available, mass produced videodiscs still require "pre-mastering" assembly on videotape.

Five levels of classifying videodisc systems in relation to their intended uses were suggested by Daynes (1982):

Level 0 - Continuous TV displays only, inherently no capability for still frames and random-access. Examples are the stylus-read capacitance players of RCA Selectavision and JVC, and optical discs recorded in Constant Linear Velocity (CLV) format.

Level 1 - Consumer optical systems capable of some frame search and freeze frame. Stop codes embedded on the disc may be recognized. Examples are the Pioneer VP-1000 and Magnavox 8000 players.

Level 2 - Educational/Industrial optical systems equipped with an on-board microprocessor cabable of small control programs. Programs may be hand-loaded or "dumped" from the audio-track of the videodisc. Students may interact with the program through the player's calculator style

key-pad. Examples are the Thomson CSF, DiscoVision PR-7820 series and SONY LDP-1000.

Level 3 - Optical system controlled by an external computer system. This allows easier programming via high-level languages and the possibility for use as an adjunct video-display to a CAL workstation with two screens.

Level 4 - As with level 3, but with the ability to overlay output from the computer onto the videodisc signal so that a single VDU may be used. Examples of level 4 systems are rare, but prototypes have been developed at Alberta Vocational Centre using a modified Commodore VIC-20 computer (L. Katz, 1983), and at Hazeltine where the new micro-TICCIT marries a videodisc player to an IBM Personal Computer (S. Katz, 1983).

Excellent descriptions of videodisc technolgies and applications can be found in Daynes (1982), Jones (1980), Bartolini et al. (1978) and Cameron (1982) and on Videodisc - Canada (Clement, 1982) and need not be elucidated further in this thesis.

Educational Involvement With Videodisc

Schneider's 1975 presentation to the U.S. National Science Foundation is among the first papers to discuss the advantages of using videodisc technology in education (Schneider, 1975). From that time on, the infusion of the technology into education has been a relatively slow yet continuous process. Most of the hesitancy of educational institutions to become involved might be attributed to waiting for the product to settle down. Early prototypes of the disc players were few and expensive, and researchers could get involved in the production of a trial disc and then find themselves without a player (Sapp, 1980). By 1977 the Thompson CSF optical transmissive player was available in very limited numbers, and the PLATO system had been successfully interfaced to it for control of a demonstration disc (Mark, 1979). At the same time, a serious educational system for instruction of the hearing impaired, DAVID, rejected use of the disc technology for interactive video requirements since it was relatively unavailable except for costly prototypes, of unknown reliability and quality, and it was very expensive to develop and revise videodisc materials (vonFeldt, 1978).

Knowledge of interactive videodiscs progressed as a

variety of agencies experimented with computer interfaces and demonstration discs, then with the transfer of existing audio-visual materials to discs, and finally designing and producing discs for specific educational purposes (Jones, 1980). Production techniques in interactive television were transferred from CAL experiences (Bennion, 1976 in Bunderson, 1980) and then slowly emerged as more production experience was gained and shared with increasing development in the field. Two organizations in particular contributed to the progress of instructional design/production of interactive videodiscs for education: WICAT in Orem, Utah developed from its TICCIT background of interactive video through the National Science Foundation (NSF) and US ARMY funded projects (Bunderson, 1980), and the University of Nebraska which gained experience producing discs for the hearing impaired and sponsored several intensive Videodisc Design/Production Workshops since the spring of 1980 (Daynes, 1982).

Interest and research increased with the supply of reliable optical videodisc players. By the middle of 1980 both DiscoVision Associates and SONY had geared up production lines to meet the demands for several thousand videodisc players for General Motors and the Ford Motor Company respectively (Propp, 1980). With the credibility of the videodisc now established, and with technical support and production incentives offered by the manufacturers, the

number of research and development projects have increased tremendously.

Probably the most extensive study on user interactions with videodisc training was conducted by WICAT Incorporated for the National Science Foundation. Conducted from 1979 to 1981, the study examined the usefulness of videodisc in teaching developmental biology at the college level. The study progressively increased in sophistication as it passed through three phases, each of which examined a new mode of videodisc usage: manual control, limited microprocessor control, and an intelligent videodisc system.

> "By intelligent videodisc system is meant an optical videodisc having all the features of optical videodisc players, viz random access, freeze frame, variable speed motion, and the large storage capacity of 54,000 individual video frames. These systems, when interfaced with a powerful microprocessor, become "intelligent" in that random accessing can be based on complex algorithms or on learner choice. The computer can keep score, provide answer analysis, answer judging, simulations, games, overlays of computer-generated information on the video screen...." (Bunderson, Olsen, Baillio, 1981, p. iii)

In the phase III controlled group experiment comparing student achievement between intelligent videodisc and conventional classroom methods of instruction, Bunderson et al. (1981) found that the videodisc group took significantly less time (30 per cent), and achieved significantly higher test scores (15 to 21 per cent).

Student affect towards the videodisc instruction was

> "...very high to the extent that some students actually changed their attitudes toward biology in a positive direction." (abstract)

Of course, the improvements in training time cannot be attributed to the use of the videodisc alone, since the investment in instructional design and courseware is bound to be more intensive then that of the normal classroom. These results should be interpreted bearing this in mind.

Bunderson et al. (1981) speculate on the law of diminishing returns with regard to the development of high-technology training aids. There comes a point at which the investment in more sophisticated training methods will not justify their cost in terms of student achievement or time savings. The appropriateness of any medium of instruction, and of the instruction itself depends upon the particular needs of a training problem and selections should not be made merely on the basis of being possible, traditional, or in vogue.

Cardiopulmonary Resuscitation

Cardiopulmonary resuscitation (CPR) is a method of maintaining the flow of oxygenated blood in a victim of cardiac arrest by means of mouth-to-mouth breathing and external chest compressions. Introduced in the early 1960s, CPR has become an established part of para-medical training and has been widely taught to interested groups of the general public.

When cardiac arrest occurs, brain damage due to a lack of oxygen can begin within four to six minutes. If a well-trained rescuer can reach the victim and begin CPR within those few minutes, the chances of survival are greatly increased. In many cases, the victim can be assisted merely by opening the airway or by rescue breathing. The training of CPR to lay (non-medical) personnel is of particular importance in areas where emergency ambulance service can not reach a victim quickly. The Canadian Forces, which operates many stations, exercises and aircraft distant from emergency medical facilities, has an active interest in CPR and provides training each year for personnel operating in these conditions.

In contrast to mouth-to-mouth resuscitation, inappropriately or incorrectly administered CPR is potentially injurious. A "victim" can suffer broken ribs

and damage to internal organs (Winchell and Safar, 1966). CPR training in Canada is therefore conducted to standards set by provincial heart foundations. In addition, the Canadian Heart Foundation serves national needs, particularly with respect to funding heart research and international liason. In the United States, the American Heart Association (AHA) fulfils a similar role, indeed, many of the training materials used in the United States and Canada originate with the AHA.

> "Because of the rapidly increasing demand for CPR training ... the [American] Heart Association re-examined the scope and direction of its efforts. Three major obstacles were identified:
> 1. As training programs grow in size, there is a greater liklihood of difficulties in presenting standardized courses.
> 2. Logistics and personnel difficulties, including instructor turnover, increase immensely with any attempt to offer a larger volume of live education.
> 3. Traditional media forms are limited ... and are designed to assist the instructor who alone is vital to the hands-on skill training." (Newman, 1982)

As a means to solving the obstacles described above, the American Heart Association developed the interactive, computer-controlled videodisc system for the training of CPR (Hon, 1982), which is used in this thesis.

At Canadian Forces Base Trenton, the 426 (Transport) Training Squadron provided CPR training to aircrew of transport aircraft. The conventional training to meet the

Ontario Heart Foundation's Basic Rescuer Level standard involves a two-day course consisting of theory and demonstrations, followed by a written examination and a practical coaching session. In the hands-on session, students are drilled in one- and two-rescuer CPR until they can perform satisfactory strip readouts on a "Recussi-Anne" practice manikin. Students must also demonstrate correct techniques of checking for heart stoppage and for clearing airway obstructions, and perform all of these skills on an infant manikin.

The certification of Basic Rescuer is valid for one year, after which re-certification may be achieved annually through a one-day re-fresher course. If re-certification is not achieved within eighteen months, trainees must attend the two-day session. While the current method of training at 426 Squadron has graduated well-trained personnel, and some CPR rescues have actually been effected, bottlenecks arise each year in scheduling operational flight personnel into training slots. A similar bottleneck occured at the 13 Dental Clinic at CFB Trenton, where the staff were required to be CPR-trained, but inadequate training facilities meant extended delays in initial training and in annual recertification. A different, more schedule-free means of instructing CPR was clearly required for these groups.

Previous Research on CPR Skills Retention

One of the earliest and most extensive studies addresssing the effectiveness of training lay CPR rescuers was conducted by Winchell and Safar (1966). They compared the retention of CPR skills of various community groups with that of para-medic groups trained with and without manikin practice. In all, 2027 individuals were trained, of whom 971 returned for re-testing about three months later. Only 12 per cent of the unpracticed groups and 30 per cent of the practiced groups retained sufficient skills to perform acceptable CPR. Practiced para-medical trainees were slightly better than practiced lay trainees, who in turn were better than both of the unpracticed groups. Winchell and Safar recommended that CPR training be formalized, taught only with manikin practice, repetition and simplicity, and only to highly motivated groups of physically robust individuals.

Mandel, DeMers, Olsen, and Cobb (1977) investigated the use of Recording Recussi-Anne manikins in CPR training after their preliminary study showed that only 34 per cent of the manikin-trained individuals developed adequate CPR skills. In contrast to the standard manikin, the recording manikin produces a paper strip showing the depth and timing of each external chest compression and each rescue-breathing ventilation. Significant improvements in CPR skills were noted when this feedback device was used in training.

Gombeski, Effron, Ramirez and Moore (1982) compared one-year retention of single-rescuer CPR skills and theory between 8 hour (3 sessions) and 4 hour (1 session) courses. Although the 8 hour group peformed significantly better on the theory and assessment tests, actual CPR prformance for both groups was "below certification level". Gombeski et al. also noted that only 12 per cent of the original trainees responded when invited to return for re-certification training, 60 per cent of them women. This is particulary interesting since Winchell and Safar (1966) also noted that those most reluctant to return for re-certification were middle-aged men who were involved in part-time ambulance services. CPR training of lay individuals should heavily emphasize the importance of frequent re-certification.

Gass and Curry (1983) examined 6 and 12 month retention of knowledge and skills of CPR-trained physicians and nurses in a Halifax hospital. While physicians retained significantly more knowledge than nurses at 6 months, the skills of both groups had declined considerably. By 12 months, knowledge and skills for both groups were only slightly but not significantly better than pre-training levels.

In the same study, Gass and Curry also compared the subjects' self-estimates of their knowledge and skills with

the actual six month test scores. That no relationships were found would indicate that only by performing CPR with feedback can potential rescuers ascertain the effectiveness of their technique.

The Manitoba Heart Foundation conducted two studies on CPR skills retention. In one, the entire Winnipeg police force (n= 900) was taught CPR to the Basic Rescuer level using overlearning techniques in recording-manikin practice. Surprise random sampling (n= 116) occurred between 12 and 18 months later. Average cognitive test scores dropped from 92 to 70 per cent yet 85 per cent of those re-tested were able to perform adequate CPR on the recording manikins. Almost all of the failures were due to forgetting to call for help, or for inadequate amounts of time checking the victims' carotid pulse (Tweed, Wilson and Isfeld, 1980). A second surprise sampling (n = 78) was carried out between 24 and 28 months. At this time, knowledge retention appeared to have stabilized (average test score = 78 per cent) as had calling for help (82 per cent) yet ability to perform CPR had slightly, although not significantly, increased. Even though only 68 per cent of those tested performed adequate pulse checking, these results are surprisingly high. Wilson, Isfeld and Tweed (1980) credit the high retention to the motivation and maturity of the subjects, the intensity of initial training, previous experience in first aid, and the fact that one-half of the subjects actually used their

CPR sometime in the two-year period, while a full two-thirds had reviewed their CPR pamphlets at least once. It would appear then, that actual use of CPR skills constitutes practise and reinforcement, and contributes to motivation to review and perhaps mentally rehearse (Hon, 1983) the skills involved.

In the second study conducted in Winnipeg (Wilson, Brooks and Tweed, 1983) 950 employees of a public utility were taught CPR to the Basic Rescuer level. Sampling at 11 to 18 months (n= 40) and between 19 and 30 months (n= 24) showed that in lay workers, in contrast to the police, CPR skills declined to about 40 per cent after one year, and to about 30 per cent after two years. Wilson et al. (1983) suggested that

> "...there are many poorly understood factors which may influence skills retention, including method and intensity of initial training, motivation, reinforcement or retraining, and opportunity for use.... To maintain adequate performance it appears necessary to reinforce CPR skills during the first twelve months...." (p. 4)

Wilson et al. further suggest that selection for and intensity of training should be determined by need, that training fewer employees more thoroughly and having an educational programme on recognising symptoms and where to get help, would be a more effective training programme for a

large organization.

Summary

CPR appears to be a complex subject requiring intense hands-on training of highly motivated students. Frequent reinforcement - particularly in the first few months after initial training - seems to maintain the retention curve (Wilson, Brooks and Tweed, 1983). Furthermore, there seems to be a reluctance to attend re-certification courses (Winchell and Safar, 1966; Gombeski, 1982), perhaps due to over confidence or ignorance of skill deterioration (Gass and Curry, 1980) or to just plain inconvenience such as the case at CFB Trenton. These factors, plus the logistical problems of increasing the trained population (Newman, 1966) give support to the development of better, more engaging CPR training systems such as that developed by the AHA (Hon, 1982).

CHAPTER THREE

GOALS AND HYPOTHESES

As reported in the review of literature, most of the prior research on videodisc applications in education and training fails to address much more than the technology itself. According to Salomon (1974)

> "Education is a puposeful undertaking in which means are selected to serve particular ends. The psychological effects of a mode of presentation must therefore, be considered in terms of the contributions they make to definite educational objectives.... Thus, while effect is related to the interaction between mode of communication and the person communicated to, its effectiveness depends on the desired goal and outcome." (p. 387)

There are two aspects to educational communications effectiveness: firstly, the ability of a course to meet its desired instructional goals and secondly, other benefits measured in dollars saved, longer retention, faster revision or development of courseware, etcetera, which are also desireable. It is these latter criteria which are commonly used to determine whether one mode of instruction is "more effective" than another, although "more useful" or "more appropriate" are perhaps better terms. In addition to effectiveness and appropriateness it is also important to study the effects of an educational package.

The first goal of this study was to determine the effectiveness of a new instructional device. Could the stand-alone, interactive, videodisc-based system instruct subjects in cardio-pulmonary resuscitation to the standard which is currently required of the conventional small-group classroom approach?

The second goal of this study was to probe the appropriateness of the system for initial and re-current training in CPR at the Basic Rescuer level.

Thirdly, this study was to examine student affect towards such a new delivery system. Did the new method of instruction create problems for some students, or was pre-conditioning to the medium or content necessary for optimal acceptance or learning?

It was hoped that answers to questions such as these would be of benefit to educators and trainers in the design and selection of appropriate systems for instructional purposes.

Hypotheses

1) Cognitive achievement for students trained on the

experimental CPR training system will meet or exceed the Ontario Heart Foundation standard for CPR training as measured by a fifty-item multiple-choice written examination.

2) Student attitude towards the course content will not decrease as a result of the treatment.

3) Subject self-perception as learner as measured by a five-level Likert scale will not change due to exposure to the treatment.

4) Student acceptance of the training method as measured on a 25 item semantic differential will not change with repeated exposure to that treatment over time.

5) Student pre-experience with a) computers, b) television watching, or c) first aid training will not affect the acceptance of the training method.

6) Retention of psychomotor and cognitive skills by the study group will be no different than that expected of a similar conventionally trained group.

7) Overall acceptance of the experimental training method will be comparable to that of a similar groups' acceptance of the conventional training method.

Operational Definitions

Cognitive achievement - the score obtained on a standardized, multiple-choice criterion test administered subsequent to the treatment. The score on the fifty items is expressed as per cent.

Retention - the Cognitive achievement measured at a given period of time (seven months) after the treatment.

Attitude - the aggregate score obtained on pertinant items of a Likert-type scale questionnaire.

Acceptance - the aggregate score obtained on a 25 item, seven-level semantic differential designed by Russell (1982) to measure "the affective response of students to CAI".

CHAPTER FOUR

METHOD

A Case Study of Training with Interactive Video

DESIGN

A case study approach was selected for this initial study since both hardware and software were in prototype form and it was anticipated that several modifications would take place. It would be hardly be fair or scientific to subject an instructional system still undergoing formative evaluation to controlled group experimentation. Additional constraints were imposed by operational training requirements placed on instructors, students, and the recording Resusci-Anne manikins which made convenient long-term planning difficult. A case study approach, while lacking in experimental rigour (Campbell and Stanley, 1976), can nevertheless yield much valuable information on the receptiveness of students to a new method of instruction, and contribute to the formative evaluation of an instructional package.

Table 1 illustrates the design of this case study. The re-certification comparison group was used to compare affect towards the videodisc method of instruction with that of a

conventional CPR course. This comparison was conducted with re-certification CPR subjects in both cases so that all subjects would have experienced the same method at least once before.

TABLE 1. Design of Time-Series Case Study

Group	INITIAL (0 months)	DELAYED (7 months)	RECERT. (9 months)
VIDEO DISC	O1 Pre Affective X1 Treatment O2 Post Affective RO3a/b Method SD O4 Written C O5 Practical	O6 Written C O7 Practical	X2 Treatment O8c Method SD O9 Affective O10 Written C O11 Practical
COMPARE			CPR Recert O8c Method SD O10 Written O11 Practical

SUBJECTS

Seventeen subjects, nine males and eight females, from the 13 Dental Clinic at CFB Trenton participated in the study. In addition to having a professional requirement for CPR training, the group presented a very heterogeneous background in age (from 23 to 56 years, mean= 33, sd = 8.7), and education (from 9 to 22 years, mean = 14, sd = 3.3). The group consisted of 5 dentists, 6 dental assistants, 4 dental technicians and 2 dental administrators (clerks). One dentist and four of the assistants were civilians, the remainder were serving members of the Canadian Forces.

While eight of the subjects had some prior training of CPR, only two were considered current for recertification standards, having trained within the preceeding eighteen months. All of the subjects had a working knowledge of English, three of the dental technicians had French as their mother tongue.

The subjects were made available for the study as they all required CPR training, and there was no other available resource for them to be trained en masse without necessitating the closure of the Dental Clinic for two days. Participation in the study offered a means of training the subjects with minimal disruption of the normal routine, and involving half the number of man-days.

RE-CERTIFICATION COMPARISON GROUP

As no group could be found at CFB Trenton to serve as a control for the retention training, the Department of Occupational Health Services at Concordia University was approached for assistance. A group of 18 subjects (8 males, 10 females) ranging in age from 16 to 50 years and of no specific trade or educational level was found in a CPR Recertification course conducted at Concordia University in Montreal 08 June, 1983. All of the subjects were currently certified in CPR, having passed either an initial or recertification CPR course within the previous 12 to 18

months.

INSTRUCTIONAL MATERIALS

A prototype system for the instruction of Cardiopulmonary Resuscitation under development by the American Heart Association was purchased through SONY of Canada Limited. A description of the development of this system and its courseware can be found in Hon (1982).

The courseware consisted of thirty minutes of video messages stored on one side of an optically-reflective videodisc, approximately forty minutes of audio messages stored on three tracks of a randomly accessible (very fast spooling) audio cassette tape, and two single-sided, single density five and one-quarter inch floppy magnetic computer diskettes. A number of modifications to the control software were received throughout the test period, but the actual instructional messages were unchanged.

HARDWARE

The best description of the hardware used is contained in Hon (1982). Stated briefly for the sake of clarity, the student interaction took place through receipt of directly accessed messages from two colour monitors placed side by side. One monitor displayed the video output from the

videodisc player, the other monitor displayed output from the APPLE II computer. Audio signals emmanated from the speaker on either monitor depending on whether the video instructor, "Doc", or the computer instructor, "Compy", was giving the instructions. Thus, the audio signal cued the student as to which monitor screen to attend to at any given time. A light pen permitted the student to interact with the computer moinitor to select menued items and a "CHOICE" button allowed the students to interrupt the program at any time to display a course menu for learner control of the process. A modified Recussi-Annie recording manikin was wired to the computer to give feedback on student hands-on activities in response to directions given by the instructor. A diagram of the system's components is given in Figure 1.

Figure 2 shows how the computer and other components were assembled into a purposly built metal cabinet for transport, storage and use. A single 110 volt alternating current outlet was required for the cabinet-mounted assembly. An indoor-outdoor carpet (twelve feet by five feet) was purchased to provide a clean, padded working surface for students since a great deal of the instruction required students to be on their knees manipulating the manikin. A padded chair was also provided for each student and a small desk and chair was provided for the course instructor - system technician. The above was placed in a

quiet well-lit area free from distractions in Room 11, Building 34, at CFB Trenton.

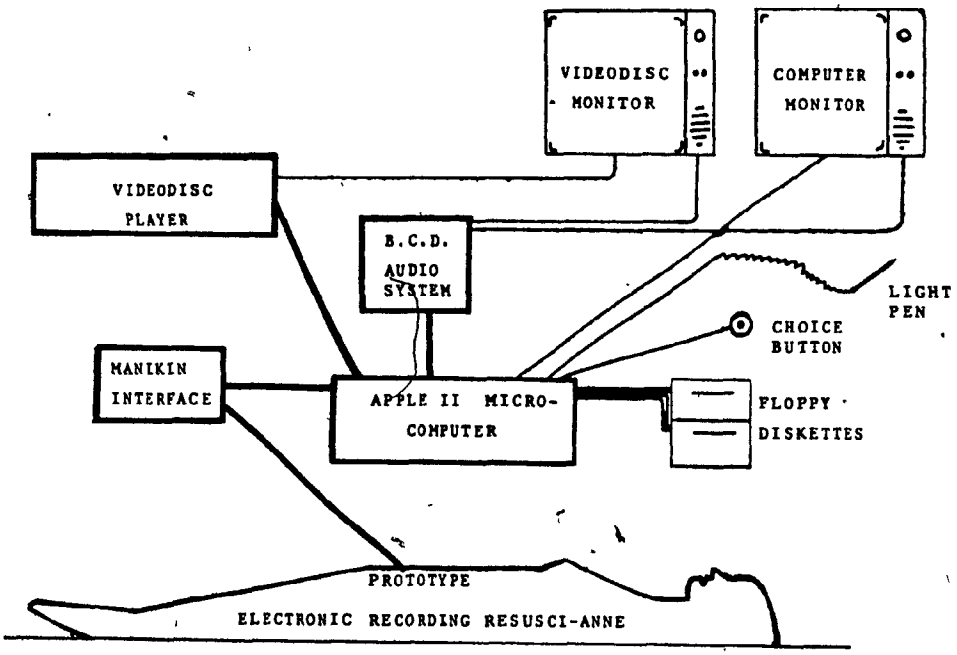

Figure 1, The AHA Videodisc CPR System

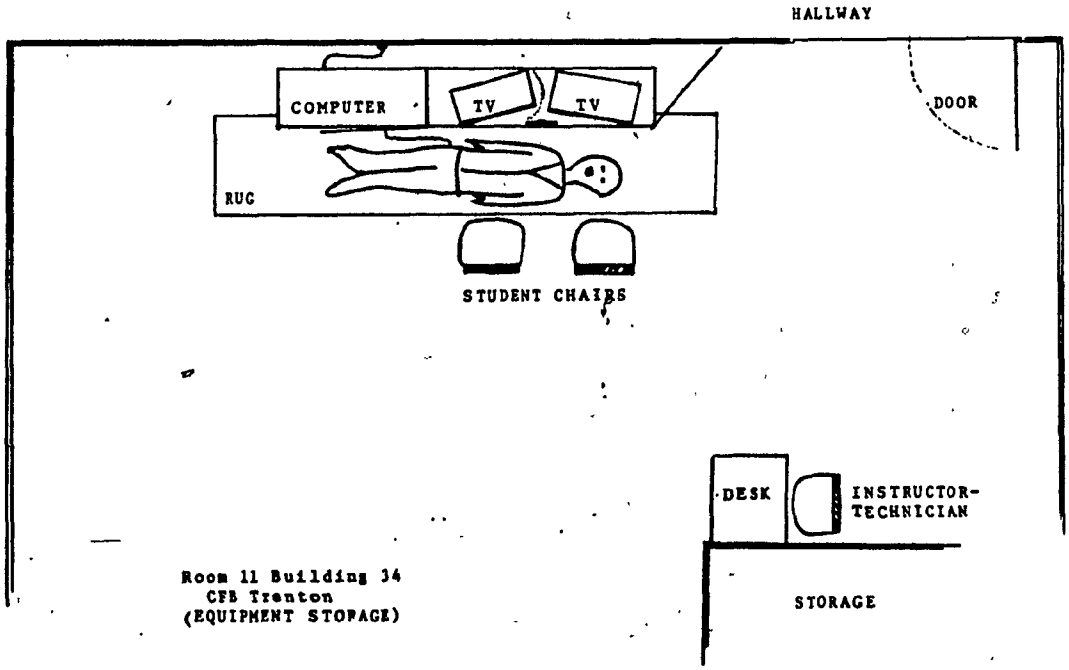

Figure 2, Arrangement of Apparatus

SELECTION AND DEVELOPMENT OF INSTRUMENTS

Examples of the questionnaires used in this study are attached in Appendix 1.

Registration Form CPR. I was created specifically to gather personal information from the participants in this study. It is very straightforward, and warrants no further discussion.

Pre-Post Affective Questionnaire CPR II was created specifically for this study by the author after the methods described in Tuckman(1972) to form Likert-type scales. A total of 26 items were created. Respondents were requested to respond along a five level scale from Strongly Agree to Strongly Disagree for each of the 26 items. The form is attached in Appendix 1. Items, while randomly sequenced on the form, pertained to three general questions:

A. Attitude towards subject matter

Five questions were asked to gauge the students' motivation to learn cardiopulmonary resuscitation. Four of these items were paired in an attempt to check for internal reliability of the test results:

RESP1 Members of the CF should know CPR

RESP2 I am taking this course because I want to.

RESP13 I need this course for my job.

RESP9 Personally, it is important to me to know CPR.

RESP17 I really don't need this course.

Since a willingness to help others might also correlate with motivation to learn CPR, the following pair of questions was included:

RESP7 I like to help other people.

RESP22 If I could help someone else, I would.

Finally, while first aid training is mandatory for most members of the CF, continued currency in it might give a further reflection of motivation to learn and retain CPR skills (Curry,1983):

RESP4 I am qualified to give First Aid.

B. Attitude towards the method of instruction

Component One - Self-pacing versus traditional classroom instruction:

RESP3 People should be allowed to learn at their own

speed.

RESP14 I like to have control over my own learning.

RESP25 I prefer to learn in the traditional classroom setting.

Component Two - Small group versus large group learning:

RESP10 It is easier to learn in a large group than a small group.

RESP23 I learn best when I'm teamed with someone I like.

Component Three - As the experimental system uses television as a large component of communication, it was desired to identify the television watchers:

RESP6 I hardly ever watch television.

Subject impressions of learning from watching television were also checked:

RESP20 I find it difficult to learn from watching TV programs.

RESP24 Videotapes (videodiscs) are easy to learn from.

Component Four - overall attitude towards the experimental method was checked:

RESP8 I would rather learn CPR from a person.

RESP15 Teachers can not be replaced by machines.

RESP18 Computers can help people to learn.

RESP26 More topics should be taught by videodisc and computer.

C. Self-Perceptions of Learners

It was thought that some students might have perceptions of themselves as learners which may interfere with methods of instruction. While it was not within the scope of this study to delve into the morass of Aptitude Treatment Interaction a la Cronbach and Snow (Snow, 1982), is was felt that a few simple questions might yield informative results:

Component One - Slow Learners

RESP5 I tend to learn slower than most people.

RESP16 I don't like to be in a class that is held back by one or two slow learners.

Component Two - Individualism

RESP12 If I was having a problem, I would rather work things out for myself.

RESP21 I prefer to learn things by myself.

Component Three - Enactive versus Symbolic (Bruner,1966)

RESP11 I need to get my hands on equipment before I really understand it.

RESP19 I tend to learn skills better than theory.

In all, 26 questions were arranged in random sequence on Form CPR II, which was administered before and after the treatment. It was hoped that the information gathered would allow an in-depth examination of the study population, and that any significant changes in responses would highlight interesting interations between the method of instruction and the students.

Form CPR II was pilot tested on four military persons similar to the study population - two initially for readability and format of the form, and then two in a full experimental pilot study setting. No difficulties with the questionnaire were encountered. Seven out of the eight pairs of items, when checked for internal reliability to see

if answers were consistant within subjects, were within one point of range on the five point scale and always of the same direction (agree versus disagree).

Form CPR III was essentially a blank sheet of paper with an identification block and instructions telling subjects to use the sheet for comments on specific problems or general impressions of the training system.

Form CPR IV was designed to measure affect towards the method of instruction.

> "Learning and liking may go hand in hand. Scales can be constructed to measure the intangibles of the affective domain, though the results are hardly exact." (Russell, 1982, p105)

Form CPR IV is a 25 item instrument originally developed by Russell (1982) to measure "the affective response of students to CAI" after the techniques developed by Osgood, Suci and Tannenbaum (1957). A semantic differential consists of paired, bi-polar adjectives separated by a seven level scale. Respondents are asked to place an X in the level which represents their response to the stimulus. Sub-scales can be created according to themes or similarities of the adjectives used. Each pair of adjectives has an inherent positive and negative direction (Osgood et al, 1959). For the example GOOD--BAD, GOOD arouses a more positive or unmarked feeling than does the

word BAD. In the semantic differential, the adjective pairs are arranged out of their theme groups and random in respect to direction. After cursory pilot testing and subsequent modifications to increase its readability, the instrument used by Russell was supplied with a title and directions appropriate for this study and appears in APPENDIX 1 to this thesis as form CPR IV.

Three different sets of directions were placed above the semantic differential - the original, requesting students to indicate their perception of the use of computers in this course; the second, similar but with videodisc replacing the word computers, and the third version, used by the recertification groups, requested perceptions of the method of instruction.

The forms used with the COMPARE had to be altered slightly to protect the identities of the students (a more stringent requirement than existed with the military) and to tailor to the civillian world.

PROCEDURE

Subjects were assigned into 7 groups of 2 and 1 group of three subjects each by the dental clinic. Most of the groups were normal working groups such as a dentist and dental assistant. All of the groups received the treatment

in the last two weeks of August, 1982.

Subjects reported to the study site at 0730 on their scheduled days. Upon arrival, subjects were requested to complete registration form CPR I and the pre-affective questionnaire CPR II .

Briefing

After the forms had been completed, the instructor - technician briefed the subjects on how the system worked, and demonstrated the use of the light pen and choice button to answer questions and control the course for review and coffee breaks. Students were told that the system was a new prototype learning system and that their participation was to help find the bugs in the control program. Subjects were asked to keep track of any problems or misunderstandings and were given pencils and comment sheets (CPR III) with which they could submit their impressions and suggestions. It was stressed that while the students could take their own time learning the materials, they were expected to finish the course in that day. The methods to be used for final testing were also covered and it was pointed out that the instructor would not usually be present, but would always be in the vicinity in case problems with the machine were encountered. Directions to the washrooms and student lounge were given and the instructor retired to the back of the

room to the desk where he could observe the start of the course while doing miscellaneous paper work.

Testing

After completing the sections on theory, airway obstructions, one-rescuer and two-rescuer CPR, the subjects informed the instructor that they were ready for the Ontario Heart Foundation certification examination. The subjects were asked to complete the post-affective questionnaire (CPR II) and then a semantic differential on the method of instruction (CPR VI). Upon completion of these forms, the instructor reviewed the methods of resusciation for infants and small children since those portions of the training course were not yet operational. Next, the fifty-item OHF BASIC RESCUER EXAMINATION "C" was administered with the standard thirty minute time limit. Subjects were then coached to mastery production of one-rescuer and two-rescuer strips on the recording Resusci-Annies, and given practical examination of infant resuscitation techniques. Upon completion of the day, the subjects were reminded to hand in their observation forms, and were thanked for their participation in the study.

NOTES ON DATA GATHERING

1. While all students were able to complete the

videodisc-based course in one day, not all students were able to meet the OHF test standards. It is to be noted that two groups of subjects were required to return for further practice on the recording manikins, and two subjects for re-writing of the OHF examination. In these cases, subjects were allowed free access to the videodisc system to review at their own pace, the areas in which they were deficient.

2. All groups experienced some minor problems with hardware and software failures, but prompt intervention by the instructor/technician prevented any delays lasting longer than a few minutes. Students were encourage to make use of the "down-time" for stretch breaks, since interactions with the system tended to be intensive.

RETENTION TESTING

After six months a convenient time slot for retention testing was looked for so that all of the subjects could be re-examined on one-person CPR and the OHF written test. The ultimate choice of date was left to the coordinator of the 13 Dental Clinic who selected a one-week period in April, 1983.

Subjects reported back to the training site in as close to the original groups as possible. Testing was counter-balanced with one-half of the students writing the

OHF test first, and the other half performing one-rescuer CPR on the recording manikin first.

RE-CERTIFICATION TRAINING

After review of the results of the retention test, the Dental Clinic requested that a refresher course be conducted as soon as possible, and in early June of 1983, the subjects were re-trained again using the videodisc system.

To further examine the flexibility of the system, it was transported to the Dental Clinic and set up in a spare room. Subjects were scheduled as before, but the system was made available to any subjects to use for individual review when there was no scheduled user.

A research assistant (not a CPR intructor) was either present or in the proximity of the retraining site during scheduled training sessions to assist in the operation of the instructional system. Subjects were instructed to advise the assistant when they were finished with the instruction and were prepared to write the written examination. Although the subjects were informed that they could write the test any time in the week, all chose to write immediately after their scheduled sessions.

Immediately before writing the standardised achievement test, subjects were asked to complete the affective questionnaire (CPR II) and the semantic differential (CPR IV).

Two weeks after the retraining session, when both a qualified CPR examiner and a pair of recording Recussi-Annies were available, the subjects were given the practical coach-to-mastery examination.

RECERTIFICATION COMPARE

On 08 June, 1983, the recertification comparison group undertook a one-day conventional CPR Recertification Course at Concordia University in Montreal. Three instructors were present for the 19 students. After a brief welcome message to the group as a whole, the researcher was introduced. The group was informed that a thesis research project was being conducted about the instruction of CPR, and that participation was strictly voluntary and had nothing to do with the recertification program that day. Questionnaires would be handed out to all subjects in the group, and participants were asked to make some identifying mark - perhaps two initials - that could be used to match up the questionnaires at the end of the day. Immediately after his introduction, the researcher gave a personal information

sheet similar to form CPR I to each member of the group. A second seven-item questionnaire regarding confidence, which was being pilot tested, was also handed out at this time. All subjects completed and returned both questionnaires.

Immediately before the writing of the standardized criterion test similar to that used in Trenton, the subjects were asked to complete a semantic differential identical to that on form CPR IV asking for responses to the method of instruction.

A second confidence questionnaire (pilot test) was administered by one of the course instructors immediately after each subject had finished all phases of the coach-to-mastery session. The final scores on the standardized exams were provided by a member of the Concordia staff, again concealing the identities of the participants.

CHAPTER FIVE

RESULTS

All responses to form CPR II, the Likert-type questionnaire, were scored positively such that each response SA (strongly agree) was coded 5 and SD, (strongly disagree) was coded 1. The raw data for each sampling O1 (PRE), O2 (POST), and O9 (RECERT), are tabulated by group in Appendix 4.

All items of the semantic differential CPR IV were first oriented positively, and then scored numerically such that the position closest to the positive adjective was coded 7; the position closest to the negative adjective was coded 1. The raw data for each sampling O3a/b, and O8c appear by group in Appendix 3.

Statistical Analyses

All statistical analyses were performed using Statistical Package for the Social Sciences (Nie, Hull, Jenkins, Steinbrenner, and Bent, 1977) as implemented on the CDC Cyber computer at Concordia University. The sub-program FREQUENCIES was was used to tabulate the raw data and generate descriptive statistics. Sub-program T-TEST was used for between group comparisons of interval data such as the percentage scores from the written standardised tests.

While argument may be made on the ordinal nature of data gathered on a semantic differential, the group averages of these scores are treated as interval data. Although Osgood, Suci and Tannenbaum (1957, p. 308) suggested using the Wilcoxon Matched-Pairs Ranked-Signs Test for ordinal data, this test is not adequate between independant groups, and would result in much lost information if subject mortality was high. A recent discussion by Blair (1981) strongly supports the use of the Mann-Whitney U Test for ordinal data. Sub-program CROSSTABS was used for between group comparisons of data on the Likert-type questionnaire CPR II. This program is particularly effective since it produces tables for each comparison by which cell sizes can be quickly inspected. Collapsing of cells was conducted whenever necessary based upon the following rule-of-thumb for Chi-square calculations:

> "... when the expected number in a cell is less than 5 - worry; when it is less than 2 - panic!" (British Army, 1978, p. 5.16)

Results of written examination

The grouped results from the standardized multiple-choice examinations are given in Table 2.

In the immediate group, two of the subjects failed to meet the 426 (T) Training Squadron's internal pass criteria

of 85 per cent, and were given the opportunity to review the material on the videodisc CPR system and re-write the examination within one week. Their initial scores of 66 and 82 per cent went to 94 and 90 per cent respectively. The initial scores are included in the grouped data.

TABLE 2

Results of Standardized CPR Written Examinations

					t-TEST
GROUP	N	RANGE	MEAN	SD	t-VALUE
IMMEDIATE	17	66 - 98	88.4	7.8	
					3.56 *
DELAY	15	66 - 94	77.5	9.5	
IMMEDIATE	17	66 - 98	88.4	7.8	
					-1.58
RECERT	11	80 - 100	92.7	6.0	
RECERT	11	80 - 100	92.7	6.0	
COMPARE	18	74 - 100	92.7	6.7	

* P < .001 with 30 df

There is a difference between the immediate and delayed (7 months) written scores, but the retention is similar to that found by Gass and Curry (1983) in their study of retention in nurses. The results of the practical skills test are best described as disasterous, the only acceptable CPR performed in the 7 month delay group was by the two

individuals who were currently CPR certified at the time of the initial treatment.

The t-test between initial and recertification written scores shows no significant difference. However, the t value is sufficiently high ($P < .13$) that one might suspect that there is a small but not significant amount of test-familiarity or re-learning facility occurring.

The written scores of the recertification course at 8 months, when compared with those obtained from the comparison group in a t-test, show there is no significant difference between the groups in terms of ability to write the standardized, multiple-choice examinations.

The above information supports acceptance of null hypotheses 1 and 6. This study indicates no differences in the effectiveness of learning or retention of cognitive CPR skills between interactive videodisc and conventional methods of instruction.

Results of Pre-Post Questionnaire CPR II

The grouped results of the Likert-type scale are tabulated in Tables 3 through 5. Although 17 subjects participated in the study, one subject failed to complete the pre-questionnaire and the corresponding data from the

post-questionnaire has been removed from the tabulation.

TABLE 3

Attitude Towards Course Content

	Pre (% of n=16)					Post (% of n=16)				
RESP	SD	D	U	A	SA	SD	D	U	A	SA
motivation to learn cpr										
1.			6	44	50				44	56
2.				44	56				50	50
13.		19		56	25		12	6	44	38
9.		6		38	56			6	50	44
17.		12		50	38			6	50	44
willingness to help others										
7.				69	31				56	44
22.				69	31				56	44
first aid qualified										
4.	6	25	19	38	12	6	25	19	50	

no significant pre-post differences were found using Chi-Square ($p < .05$)

TABLE 4

Attitude Toward Method of Instruction

	Pre (% of n=16)					Post (% of n=16)					
RESP	SD	D	U	A	SA	SD	D	U	A	SA	
conventional vs. self-pacing											
3.			12	69	19				69	31	
14.		6	6	75	13				87	13	
25.		31	50	13	6	12	7	13	25	12	
small vs. large groups											
10.	25	50	12	6	6	25	56	6	6	6	
23.		12	19	44	19		12	6	63	19	
hardly ever watch TV											
6.		63	6	31			63		37		
easy to learn from TV											
20.			50	38	12		12	19	56	12	*
24.		12	69	12	6	6	33	31	50	6	
machine vs. person											
8.		6	50	31	12	12	25	31	31		**
15.		25	44	25	6	6	31	19	38	6	
computer usefulness											
18.			6	63	31		6		69	44	
26.	6		63	25	6	6	12	25	50	6	

no significant differences Chi-square $p < .05$
* data for RESP 20 has been inverted since question was negatively worded
** $p = .051$ using Wilcoxon M-P R-S

It should be noted that RESPONSE 6 - I hardly ever watch TV was very useful in splitting TV watchers from non-TV watchers. RESPONSES 20, 24, 8 and 26 had Chi-square probabilities which, after re-clustering to compensate for small cell sizes, fell between .1 and .07. While outside of the confidence range ($p < .05$), this may indicate a positive

shift in attitude towards the videodisc-computer system as a method of instruction due to exposure to the method. Indeed, cross-checking with the Wilcoxon Matched-Pairs Ranked-Signs test revealed a shift towards the "machine" in Response 8 - "I would rather learn CPR from a person".

TABLE 5

Self-Perception of the Subject as Learner

	Pre (% of n= 16)					Post (% of n=16)					
RESP	SD	D	U	A	SA	SD	D	U	A	SA	
slow learners											
5.		31	38	25	6		19	38	44		
16.		18	25	56		6	25	12	50	6	
individualism											
12.		31	25	38	6	19	44	12	25		*
21.		38	25	38		12	31	12	38	6	
prefer enactive over symbolic											
11.	6	6	31	50	6			6	81	13	**
19.	6	19	19	50	6	6	25	25	38	6	

no significant differences using Chi-square ($p < .05$)

* $p = .028$ using Wilcoxon M-P R-S

** $p = .018$ using Wilcoxon M-P R-S

Because of the confounding nature of small cell sizes for Chi-square testing, and the shifts that seemed apparent from visual inspection of the data, a Wilcoxon Matched-Pairs Ranked-Signs test for repeated measures was conducted. Two items - Response 11 "I need to get my hands on equipment

before I really understand it" and Response 12 "If I was having problems, I would rather work things out for myself" - showed significant ($p < .05$) changes due to the treatment.

Since the shift in Response 11 may be attributed to the hands-on nature of CPR rather than the method of instruction (ie. it looks easy but is actually quite difficult), the overwhelming lack of significant differences in other items supports the acceptance of null hypotheses 2 and 3. There is no indication of an overall change in attitude towards the course content or in subject self-perception as learner which may be attributed to the interactive videodisc method of instruction although there appear to be specific effects.

Acceptance of the Method Over Time

Wilcoxon's Matched-Pairs Ranked-Signs test for repeated measures was used to compare the videodisc group's IMMEDIATE and RECERT scores on the semantic differential. No significant differences for any of the items were encountered. A t-test on the average of scores per individual (LIKE) between groups revealed that there was no significant differences (t for separate variance estimates = -.79 with 24.20 df, p =.440) in the means. Table 6 shows the mean and standard deviation for each item and the average score LIKE for both groups.

It should be noted when examining these results, that although subject mortality is about 35 per cent, the mortality was due to personnel transfers, annual leave and temporary duty - factors which were independant of the study.

TABLE 6

Acceptance of the Training Method Over Time

	IMMEDIATE (N=17)		RECERT (N=11)	
ITEM	mean	sd	mean	sd
1.	5.8	0.9	5.6	1.2
2.	4.9	1.7	5.7	1.1
3.	4.8	1.8	5.7	1.0
4.	5.6	1.2	5.4	1.3
5.	5.6	0.7	5.8	1.1
6.	4.9	1.0	5.1	0.8
7.	5.9	0.7	5.5	1.2
8.	5.7	0.9	5.6	0.9
9.	5.8	0.8	5.5	0.9
10.	5.2	1.0	5.1	0.9
11.	4.5	1.4	4.2	1.7
12.	4.9	1.3	5.4	1.1
13.	5.1	1.0	5.1	0.9
14.	5.8	0.9	5.9	1.3
15.	5.4	1.1	5.8	1.0
16.	5.2	1.2	4.9	1.2
17.	5.9	1.0	5.9	1.3
18.	5.2	1.1	5.1	0.9
19.	5.6	1.1	5.6	1.0
20.	5.8	1.0	6.1	0.8
21.	5.8	0.9	5.7	0.8
22.	6.3	0.6	5.8	1.2
23.	5.9	1.0	5.7	1.1
24.	6.2	1.0	5.7	1.1
25.	6.5	0.6	6.2	1.0
LIKE	5.2	1.4	5.5	0.7

no significant differences ($p < .05$) between groups were found

These results lead to the acceptance of null hypothesis 4. There is no indication that acceptance of the interactive videodisc training method will change with repeated exposure to that method.

Effects of Pre-Experience on Acceptance of Method

Of all the subjects in the case study group, only one had any previous experience with computers and only one subject had not had prior first-aid training. No further consideration of these independant variables will be given in this chapter.

RESPONSE 6, I hardly ever watch TV, quite nicely split the group into 11 "TV watchers" and 6 "non-TV watchers". Table 7 shows the results of a t-test for grouped data which was performed to examine the acceptance level (LIKE) between these groups.

TABLE 7

t-Test Method Acceptance by TV Watchers

tv = TV Watcher x = NOT TV Watcher						
ITEM	N	mean	sd	t	df	P (2 tail)
LIKE average of all scores						
tv	11	5.7	.4	6.64	14	.003*
x	5	4.9	.5			

With the t-test indicating significant differences ($p < .05$) in the acceptance of the method between TV watchers and non-watchers, a supplementary Mann-Whitney U test was conducted to ferret out differences between items (Table 8).

TABLE 8

Mann-Whitney U: Method Acceptance by TV Watchers

(Supplementary to testing of Hypothesis 5b.)

tv = TV Watcher x = NOT TV Watcher

ITEM	N	mean rank	U	W	corrected for ties Z	2-tailed P
12. annoying-pleasing						
tv	11	10.6				
			4.0	10.0	2.98	.006
x	5	3.8				
14. bad-good						
tv	11	10.64				
			4.0	19.0	2.95	.003
x	5	6.60				
17. useless-useful						
tv	11	10.68				
			3.5	18.5	2.93	.003
x	5	3.70				
20. irrelevant-relevant						
tv	11	10.14				
			9.5	24.5	2.23	.024
x	5	4.90				
21. diminishing-enhancing						
tv	11	9.86				
			12.5	27.5	1.96	.050
x	5	5.50				
22. wasteful-effective						
tv	11	9.91				
			12.0	27.0	2.06	.040
x	5	5.40				
23. distant-involved						
tv	11	10.41				
			6.5	21.5	2.50	.012
x	5	4.30				
24. dull-interesting						
tv	11	10.32				
			7.5	22.5	2.46	.014
x	5	4.50				

table includes only those items with p <= .05
conducted to ferret out differences between items (Table 8).

While null hypotheses 5 a) and 5 c) could not be tested due to the subject sample, the above results lead to the rejection of null hypothesis 5 b). In Table 7 the t-test shows that there is a clear and significant difference between the acceptance of the videodisc as a method of instruction between self-proclaimed television watchers and those who say they hardly ever watch TV. An analysis of variance was also conducted to check for influences of AGE, MARK, and EDUCATION but no significant effects were found.

Comparison of Acceptance Between Two Methods of Instruction

Relative acceptance was determined by comparing the results of the semantic differential from the recertification videodisc group (RECERT) and the recertification group (COMPARE) at Concordia University. Any items of significant difference ($p < .05$) on a Mann-Whitney U between groups are listed in Table 9.

In interpreting the SPSS output of the Mann-Whitney U test, it should be noted that W represents the sum of the scored ranks for the compared variable v and hence is also equal to N of v times the mean rank of v. $Uv = NvNc + (Nv(Nv + 1)/2) - W$ and Uc can be calculated from the equivalent formula after first determining W of c from

the mean rank of c times Nc. U is the smaller of Uv or Uc. Since a large number of ties are encountered in the data the SPSS corrected value of p is shown in Table 9. The direction of the effect is indicated by the sign of Z - negative being an effect towards the compared variable v.

TABLE 9

Relative acceptance by method

Mann-Whitney U	c = conventional	v = videodisc			
ITEM	N	mean rank	U	W	corrected for ties Z 2-tailed P
2. conventional-original					
c	17	10.68			
			28.5	224.5	-3.14 .002
v	11	20.41			
3. routine-creative					
c	18	12.28			
			50.0	214.0	-2.28 .023
v	11	19.45			
4. cautious-experimental					
c	18	11.92			
			43.5	220.5	-2.56 .011
v	11	20.05			
8. hostile-likeable					
c	18	17.78			
			49.0	115.0	2.43 .015
v	11	10.45			
16. one-way - two-way					
c	12	16.31			
			51.0	117.0	1.98 .048
v	11	10.64			

table shows only those items with p < .05

While the videodisc group considered their method of instruction significantly more "original", "creative" and "experimental" than the comparison group considered the conventional method, the relative average acceptance (LIKE) of both groups was very similar (C = 5.46 and V = 5.50). The last two items in Table 9, in which the conventional method outshines the videodisc method, probably balance out the differences in LIKE.

While noting that there are strong differences in the ways in which the methods of instruction are accepted, the results support the acceptance of null hypothesis 7. Overall acceptance of the interactive videodisc method is similar to that of the conventional method.

Open Responses of Students

At the end of the initial training session subjects were reminded to hand in their comments on form CPR III. These comments are included (in edited form) in Appendix 4 and their gist is discussed below.

The bulk of the negative comments were directly related to the stage of development of the videodisc system. Bugs in the control software, difficulties reading the APPLE II's character set, and the differences in chest tension between the modified manikins and the testing manikins were all

mentioned. These should disappear as progress on the system continues.

Negative comments directly related to the instructional design concerned tedious explanations, and the occasional lack of clarity in how and when to interact with the manikin. One student commented that "less talk and more practice" was needed.

In their positive responses, the subjects appreciated many of the features offered by the system - particularly the ability to review video demonstrations, and the instant feedback provided during manikin practice. That the computer was more demanding in terms of skills performance than an instructor might be, was perceived to be a positive aspect of the system.

Many of the subjects thought that the system would be particularly useful for recertification training, but thought that a live instructor was required for practical coaching in initial CPR training.

Summary

With the unfortunate exception of the performance strips which were unquantifiable, all of the data collected has been presented above. There are several significant

relationships, not the least of which is the difference between television watchers and non-television watchers. These effects will be discussed in the next chapter.

CHAPTER SIX

DISCUSSION

This study attempted to assess the effectiveness, appropriateness and effect of using an interactive, computer-controlled videodisc-based system to teach cardiopulmonary resuscitation (CPR). Due to the prototypic nature of the apparatus and the scope of the case study approach used, a definitive statement of the system's effectiveness or appropriateness is beyond the power of this study. Such a statement would require a controlled-group study consisting of a large sample size representative of all the groups currently undergoing CPR training.

This study has been able to show that the videodisc is capable of imparting the knowledge required to pass the standardized multiple-choice CPR examinations, and that the retention of this knowledge, is similar in means to that found in other investigations (Tweed et al, 1980; Gass and Curry, 1983). The finding that immediate written scores are very comparable with those of the conventional group in recertification CPR training suggest an appropriateness of the system for that purpose.

While the system is still under development and improvements in software and hardware engineering are constantly being made; the variety of possible errors in

posture, hand placement, and body position that can be committed when learning CPR cannot be matched by a computer system which only "knows" if the manikin has been compressed deep enough and fast enough in a manner non-injurious to the "victim". In this situation it is felt, particularly by the subjects themselves as observed in Response 12's significant ($p < .03$) shift towards acceptance of help in problem solving, that the eye of the experienced instructor is required during initial training of practical skills.

One interaction observed between a student and the system serves to illustrate this point. A student was encountering difficulty in learning how to perform mouth-to-mouth rescue breathing. The system repeatedly prompted video sequences and stills to demonstrate how to open the airway, pinch the nose, position the mouth and blow hard. The student would repeatedly respond by opening the airway, pinching the nose, sealing the mouth and blowing, but the manikin's chest would not inflate. Eventually, the instructor/technician intervened to check the mechanical condition of the manikin. The airway was opened, nose pinched, mouth sealed and then the instructor blew hard and inflated the manikin. The system responded "TERRIFIC" and the student retorted "I didn't think it meant to blow <u>that</u> hard!"

Beginners at CPR do not have a set frame of reference

of what is going to be required of them. This probably accounts for the significant ($p < .02$) pre-post difference of Response 11 - I need to get my hands on equipment before I really undertand it. Students simply didn't know what was required to perform CPR. By contrast, in recertification training, students know what is expected of them - they merely have to brush up on timing and technique. When working in small groups or in pairs, another student by virtue of experience gained in initial CPR training, is able to fulfil the role of objective coach for things intangible to the computer system. This is very important, because the interaction with the system during skills practice becomes as intense as any Space Invaders game, and as the students try and try to "beat the machine" they also become physically fatigued and even less able to cope with their errors.

Another area highlighted in this study is the very significant differences in acceptance of interactive video as a method of instruction between TV watchers and non-TV watchers. This could simply be explained by saying that TV watchers like watching TV ergo they would like learning by watching TV. However, there may be a deeper significance in a shifting of the responsibility of learning from the learner to the instructor. Salomon (1981, p. 146) discusses the importance of the amount of invested mental effort (AIME) in learning from television. Recreational

television viewers tend to view passively, that is, they tend not to process the information presented. A study of high school students indicated that the assignment of television watching by teachers tended to increase the amount of information processed by the students, that is, they attended more to the program's content (Salomon, 1981, p. 231). Perhaps a similar effect is happening in interactive video, where the AIME is substantially increased by question-answer and prompt-perform interactions. While passive television viewing may be regarded by many as the villain of education, using television interactively may provide the requisite variety to combat television abuse in a television literate society.

Suggestions For Further Research

A large scale study of the effectiveness of the videodisc CPR system should be performed after formative evaluation and modifications of the system are finished. Throughout the present study, the system was used only to present information and provide practice drills, since subjects were required to undergo the standard Ontario Heart Foundation certification procedures. The ultimate study will not only cover the system's ability to teach CPR, but also its effectiveness as an automated CPR testing device (Hon, 1983).

In terms of interactive teaching devices, this system is probably one of the most complex and advanced in terms of the presentation strategies that may be selected. Pask (1969) and Bunderson (1981) describe progressive levels of interactivity in "conversational" CAL systems. The videodisc CPR system easily meets the criteria for their Level 0 (interactive capabilities) by virtue of having conversational hardware and software tools. It also meets the Level 1 (learner control) criteria in having a menu-driven learner-control system through which the student may make choices to interrupt the instruction and ask for review, challenge tests, browse through the modules of instruction, or engage in extra manikin practice.

As sophisticated as these features may be, experience has shown on PLATO, which has highly developed conversational tools, and on TICCIT, which has highly developed learner-control tools, that truly interactive or conversational systems require a further meta-structure to encourage adaption between man and the machine (Bunderson, 1981). Such Level 2 (adaptive) systems would help the students determine which modules would be best suited for their particular learning modes and entry level behaviours, while at the same time building historical models of successful patterns of interactions for adaptation of the adaptation models.

The videodisc CPR system, because it is so highly developed now, would provide an excellent device for research in Level 2 computer assisted learning systems.

A third area for further research, which is directly related to the findings of this study, is the exploration of the interactions of interactive videodiscs with TV watchers and non-TV watchers. Possibly non-TV watchers have different expectations of interactive video which should be taken into account in the design and production of instructional materials.

In immediate practical terms, since plans for effectiveness evaluation have already been made (Hon, 1983), the next research step from this study would be to install the CPR system in a location available to those personnel having difficulty attending conventional CPR recertification courses, and see if any of them take advantage of its capabilities. Since the review of previous literature indicates that a high probability that a subject will have to use CPR provides motivation to review CPR skills, it may be useful to examine the motivation of those who make use of a freely available recertification tool. Perhaps some methodology could be developed to help CPR rescuers estimate their requirement for recertification training, and become motivated to act accordingly.

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APPENDIX 1

Instruments Designed For This Study

CONFIDENTIAL (when filled in)

SIN (last 3 digits) _____

LAST NAME _____

TODAY'S DATE _____

CPR FORM I

REGISTRATION

Thank you for taking a few minutes to help us!

The information requested is for research purposes only and will remain confidential. You are asked to identify yourself in case we need to contact you further.

Please answer each question completely. If you have any difficulties with the questions please ask the research assistant for help.

SIN number _____ LAST NAME _____ FIRST NAME _____

RANK _____ MOC _____ SEX M ___ F ___ AGE (YEARS) _____

UNIT _____ LOCAL _____

CURRENT PLACE OF DUTY _____

JOB DESCRIPTION _____

How many years of "formal" education do you have (include school, high school, university and civilian technical institutes)? _____ years

Have you taken CPR before? Yes ____ No ____
If yes, when was your last course _____
and where did you take it _____

Have you taken First Aid before? Yes ____ No ____
If yes, when was your last course _____
and where did you take it _____

How long have you wanted/waited to take this course? _____

Have you worked/studied with computers before? Yes ____ No ____
If yes, please briefly describe your experience. _____

CONFIDENTIAL (when filled in)

SIN (last 3 digits) 86

LAST NAME

TODAY'S DATE

CPR FORM II

PRE POST

This scale has been prepared so that you can indicate how you feel about new training methods. Please circle the letters on the left indicating how you feel about each statement. (SA strongly agree, A agree, U undecided, D disagree, SD strongly disagree).

SA A U D SD	1.	Members of the Canadian Forces should know Cardio-Pulmonary Resuscitation (CPR).
SA A U D SD	2.	I am taking this course because I want to.
SA A U D SD	3.	People should be allowed to learn at their own speed.
SA A U D SD	4.	I am qualified to give emergency First Aid.
SA A U D SD	5.	I tend to learn faster than most people.
SA A U D SD	6.	I hardly ever watch television.
SA A U D SD	7.	I like to help other people.
SA A U D SD	8.	I would rather learn CPR from a person.
SA A U D SD	9.	Personally, it is important to me to know CPR.
SA A U D SD	10.	It is easier to learn in a large group than a small group.
SA A U D SD	11.	I need to get my hands on equipment before I really understand it.
SA A U D SD	12.	If I was having problems, I would rather work things out for myself.
SA A U D SD	13.	I need this course for my job.
SA A U D SD	14.	I like to have control over my own learning.
SA A U D SD	15.	Teachers can not be replaced by machines.
SA A U D SD	16.	I don't like being in a class that is held back by one or two slow learners.
SA A U D SD	17.	I really don't need this course.
SA A U D SD	18.	Computers can help people to learn.
SA A U D SD	19.	I tend to learn skills better than theory.
SA A U D SD	20.	I find it difficult to learn from watching television programs.
SA A U D SD	21.	I prefer to learn things by myself.
SA A U D SD	22.	If I could help someone else, I would.
SA A U D SD	23.	I learn best when I'm teamed with someone I like.
SA A U D SD	24.	Videotapes (videodiscs) are easy to learn from.
SA A U D SD	25.	I prefer to learn in the traditional classroom setting.
SA A U D SD	26.	More topics should be taught by videodisc and computer.

THANK YOU

CONFIDENTIAL (when filled in)

SIN (last 3 digits) _____

LAST NAME _____

TODAY'S DATE _____

CPR FORM III

COMMENTS

Please use this sheet to write down any comments/problems that come up while taking the CPR course. Your comments will remain confidential and are for research purposes to help us improve the program of instruction. Thank you for your constructive criticism!

CONFIDENTIAL (when filled in)

88

SIN (last 3 digits) ___

LAST NAME _____

TODAY'S DATE _____

CPR FORM IV

Place an X in that one space of the seven between each adjective pair that best indicates your perception of the use of computers in this course. The closer you place your X toward one adjective or the other, the more you think that adjective better describes the use of the computer in this course than the other.

	1 2 3 4 5 6 7	
unpleasant	_:_:_:_:_:_:_	pleasant
original	_:_:_:_:_:_:_	conventional
creative	_:_:_:_:_:_:_	routinized
cautious	_:_:_:_:_:_:_	experimenting
unfriendly	_:_:_:_:_:_:_	sociable
beautiful	_:_:_:_:_:_:_	ugly
passive	_:_:_:_:_:_:_	active
hostile	_:_:_:_:_:_:_	amiable
timid	_:_:_:_:_:_:_	adventurous
gentle	_:_:_:_:_:_:_	harsh
slow	_:_:_:_:_:_:_	fast
pleasing	_:_:_:_:_:_:_	annoying
dively	_:_:_:_:_:_:_	tedious
bad	_:_:_:_:_:_:_	good
encouraging	_:_:_:_:_:_:_	superfluous
one-way	_:_:_:_:_:_:_	two-way
meaningful	_:_:_:_:_:_:_	superfluous
sharp	_:_:_:_:_:_:_	dull
boring	_:_:_:_:_:_:_	satisfying
relevant	_:_:_:_:_:_:_	irrelevant
enhancing	_:_:_:_:_:_:_	diminishing
wasteful	_:_:_:_:_:_:_	effective
involved	_:_:_:_:_:_:_	distant
dull	_:_:_:_:_:_:_	interesting
beneficial	_:_:_:_:_:_:_	nonconsequential

APPENDIX 2

Grouped Data Tables - Form CPR II

CPR II PRE-POST QUESTIONNAIRE

GROUPED DATA

	PRE (N=16)					POST (N=16)					RECERT (N=11)				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
1.			1	7	8				7	10				3	8
2.				7	9				8	9				7	4
3.			2	11	3				11	6				7	4
4.	1	4	3	6	2	1	4	3	9		2	1	1	7	
5.		5	6	4	1		3	6	8			5	3	3	
6.		10	1	5			11		6		1	8	2		
7.				11	5			1	9	7			1	7	3
8.	0	1	8	5	2	2	4	6	5		1	4	5	1	
9.		1		6	9			1	9	7			1	9	1
10.	4	8	2	1	1	4	10	1	1	1	4	6	1		
11.	1	13	5	8	1			1	14	2		2	2	7	
12.		5	4	6	1	3	7	2	5		3	4	4		
13.		3		9	4		2	1	8	6		1		7	3
14.		1	1	12	2				15	2		1		9	1
15.		4	7	4	1	1	5	3	6	2	1	1	6	3	
16.		3	4	9		1	4	2	8	2	1	2	1	6	1
17.	6	8		2		8	8	1			6	4	1		
18.			1	10	5		1		11	5				6	5
19.	1	3	3	8	1	1	4	5	6	1		1	5	5	
20.	2	6	8			3	9	3	2		1	9	1		
21.		6	4	6		2	5	2	7	1		6	4	1	
22.				11	5				10	7		1	7	3	
23.		2	3	8	3		2	1	11	3		3	1	5	2
24.		2	11	2	1	1	1	5	8	2			3	7	1
25.		5	8	2	1	3	6	2	4	2	1	6	3	1	
26.	1		10	4	1	1	2	4	8	2		3	6	2	

1 = Strongly Disagree 5 = Strongly Agree

APPENDIX 3

Grouped Data Tables – Form CPR IV

TABLE 3.C CPR IV COMBINED

IMMEDIATE CPR IV - GROUPED (N=16)

		1	2	3	4	5	6	7	x	sd
1	UNPLEASANT-PLEASANT	:				2	2	8	3	5.8	0.9
2	CONVENTIONAL-ORIGINAL	:		1	4	2	2	3	4	4.9	1.7
3	ROUTINE-CREATIVE	:	1	1	2	2	3	5	2	4.8	1.8
4	CAUTIOUS-EXPERIMENTAL	:			1	3	1	8	3	5.6	1.2
5	UNFRIENDLY-FRIENDLY	:				1	6	8	1	5.6	0.7
6	UGLY-BEAUTIFUL	:				8	3	4	1	4.9	1.0
7	PASSIVE-ACTIVE	:				1	2	11	2	5.9	0.7
8	HOSTILE-LIKEABLE	:				2	3	9	2	5.7	0.9
9	TIMID-ADVENTUROUS	:					6	7	3	5.8	0.8
10	HARSH-GENTLE	:				6	2	7	1	5.2	1.0
11	SLOW-FAST	:		2		7	4	1	2	4.5	1.4
12	ANNOYING-PLEASING	:			3	3	3	6	1	4.9	1.3
13	TEDIOUS-LIVELY	:			1	3	5	7		5.1	1.0
14	BAD-GOOD	:				2	2	9	3	5.8	0.9
15	DISCOURAGING-ENCOURAGING	:			1	2	5	5	3	5.4	1.1
16	ONE-WAY-TWO-WAY	:			1	4	4	5	2	5.2	1.2
17	USELESS-USEFUL	:				2	2	8	4	5.9	1.0
18	DULL-SHARP	:		1		1	8	5	1	5.2	1.1
19	BORING-SATISFYING	:			2		1	12	1	5.6	1.1
20	IRRELEVANT-RELEVANT	:			1	1	2	9	3	5.8	1.0
21	DIMINISHING-ENHANCING	:				2	2	10	2	5.8	0.9
22	WASTEFUL-EFFECTIVE	:					1	10	5	6.3	0.6
23	DISTANT-INVOLVED	:				1	5	4	6	5.9	1.0
24	DULL-INTERESTING	:				2	1	5	8	6.2	1.0
25	HARMFUL-BENEFICIAL	:					1	6	9	6.5	0.6

TABLE 4.B CPR IV VDEODSC RECERT (N=11)

	1	2	3	4	5	6	7	x	sd
1.			1		4	3	3	5.6	1.2
2.				2	2	4	3	5.7	1.1
3.				2	1	6	2	5.7	1.0
4.				4	2	2	3	5.4	1.3
5.				2	1	5	3	5.8	1.1
6.				3	4	4		5.1	0.8
7.			1	2		7	1	5.5	1.2
8.				2	1	7	1	5.6	0.9
9.				2	3	5	1	5.5	0.9
10.				3	5	2	1	5.1	0.9
11.		3		4	1	2	1	4.2	1.7
12.			1	1	3	5	1	5.4	1.1
13.			1	1	5	4		5.1	0.9
14.				2	2	1	5	5.9	1.3
15.			1		1	7	2	5.8	1.0
16.			1	4	2	3	1	4.9	1.2
17.			1		3	2	5	5.9	1.3
18.			1	1	5	4		5.1	0.9
19.				2	3	4	2	5.6	1.0
20.					3	4	4	6.1	0.8
21.					5	4	2	5.7	0.8
22.				2	2	3	4	5.8	1.2
23.				2	2	4	3	5.7	1.1
24.				2	2	4	3	5.7	1.1
25.				1	2	2	6	6.2	1.0
LIKE								5.5	0.7
AGE								31.1	6.4
MARK								92.7	6.0

TABLE 4.A CPR IV COMPARE (N=18)

	1	2	3	4	5	6	7	x	sd
1.				1	3	9	5	6.0	0.8
2.	1		4	7	4		1	4.0	1.3
3.	1	1	1	6	4	4	1	4.5	1.5
4.	1	1	6	5	2	2	1	3.9	1.5
5.					2	6	10	6.4	0.7
6.			1	6	4	3	2	4.9	1.2
7.					5	6	7	6.1	0.8
8.					2	6	10	6.4	0.7
9.				6	8	3		4.8	0.7
10.		1		6	5	3	2	4.8	1.3
11.			1	7	6	4		4.7	0.9
12.				1	7	6	3	5.6	0.9
13.				4	5	4	4	5.5	1.1
14.			1		2	6	8	6.2	1.1
15.				1	3	9	4	5.9	0.8
16.				1	3	11	1	5.8	0.7
17.				1	1	4	12	6.5	0.9
18.				3	5	5	4	5.6	1.1
19.			1		5	7	5	5.8	1.0
20.			1		2	6	9	6.2	1.1
21.				2	3	7	6	5.9	1.0
22.					1	7	9	6.5	0.6
23.					2	9	6	6.2	0.7
24.					3	8	6	6.2	0.7
25.				1	1	4	12	6.5	0.9
LIKE								5.5	0.9
AGE								27.4	7.2
MARK								92.7	6.7

TABLE 3.A CPR IV VDSC

	1	2	3	4	5	6	7
1.				1	1	4	2
2.		1	3			2	2
3.	1		1	1	2	2	1
4.				1		5	2
5.					4	4	
6.				5	1	2	
7.				1	6	1	
8.					3	4	1
9.					3	4	1
10.				1	1	6	
11.		1		4	1	1	1
12.			1	2	1	3	1
13.			1	1	2	4	
14.				1		5	2
15.			1	1	1	4	1
16.			1		3	2	2
17.					1	4	3
18.					3	4	1
19.			1			6	1
20.					1	6	1
21.				1	1	5	1
22.						5	3
23.					2	2	4
24.				1		2	5
25.						3	5

TABLE 3.B CPR IV COMP

	1	2	3	4	5	6	7
1.				1	1	4	1
2.			1	2	2	1	2
3.		1	1	1	1	3	1
4.			1	2	1	3	1
5.				1	2	4	1
6.				3	2	2	1
7.				1	1	5	1
8.				2		5	1
9.					3	3	2
10.				5	1	1	1
11.		1		3	3		1
12.			2	1	2	3	
13.				2	3	3	
14.				1	2	4	1
15.				1	4	1	2
16.				4	1	3	
17.				2	1	4	1
18.			1	1	5	1	
19.			1		1	6	
20.			1	1	1	3	2
21.				1	1	5	1
22.					1	5	2
23.				1	3	2	2
24.				1	1	3	3
25.					1	3	4

APPENDIX 4

Written Test Scores

CFB TRENTON IMMEDIATE WRITTEN CPR TEST SCORES

MARK PER CENT SCORE

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)
66.	1	5.9
78.	1	5.9
82.	1	5.9
86.	2	11.8
88.	3	17.6
90.	3	17.6
92.	1	5.9
94.	3	17.6
98.	2	11.8
TOTAL	17	100.0

MEAN	88.353	STD ERR	1.881	MEDIAN	89.333
MODE	88.000	STD DEV	7.754	VARIANCE	60.118
KURTOSIS	3.484	SKEWNESS	-1.544	RANGE	32.000
MINIMUM	66.000	MAXIMUM	98.000	SUM	1502.000
C.V. PCT	8.776	.95 C.I.	84.366	TO	92.339

VALID CASES 17 MISSING CASES 0

CFB TRENTON DELAYED (7 MONTH) CPR TEST SCORES

MARK PER CENT SCORE

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)
64.	1	6.7
66.	1	6.7
68.	2	13.3
72.	2	13.3
74.	1	6.7
78.	2	13.3
82.	3	20.0
90.	1	6.7
92.	1	6.7
94.	1	6.7
TOTAL	15	100.0

MEAN	77.467	STD ERR	2.457	MEDIAN	77.500
MODE	82.000	STD DEV	9.516	VARIANCE	90.552
KURTOSIS	-.909	SKEWNESS	.366	RANGE	30.000
MINIMUM	64.000	MAXIMUM	94.000	SUM	1162.000
C.V. PCT	12.284	.95 C.I.	72.197	TO	82.736

VALID CASES 15 MISSING CASES 0

CFB TRENTON RECERTIFICATION WRITTEN CPR TEST SCORES

MARK PER CENT SCORE

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)
80.	1	9.1
88.	3	27.3
94.	2	18.2
96.	2	18.2
98.	2	18.2
100.	1	9.1
TOTAL	11	100.0

MEAN	92.727	STD ERR	1.815	MEDIAN	94.500
MODE	88.000	STD DEV	6.018	VARIANCE	36.218
KURTOSIS	.350	SKEWNESS	-.912	RANGE	20.000
MINIMUM	80.000	MAXIMUM	100.000	SUM	1020.000
C.V. PCT	6.490	.95 C.I.	88.684	TO	96.770
VALID CASES	11	MISSING CASES	0		

CONCORDIA COMPARISON WRITTEN CPR TEST SCORES

MARK PER CENT SCORE

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)
74.	1	5.6
84.	1	5.6
86.	1	5.6
88.	2	11.1
90.	1	5.6
92.	2	11.1
96.	4	22.2
98.	5	27.8
100.	1	5.6
TOTAL	18	100.0

MEAN	92.667	STD ERR	1.576	MEDIAN	95.500
MODE	98.000	STD DEV	6.686	VARIANCE	44.706
KURTOSIS	2.153	SKEWNESS	-1.411	RANGE	26.000
MINIMUM	74.000	MAXIMUM	100.000	SUM	1668.000
C.V. PCT	7.215	.95 C.I.	89.342	TO	95.992
VALID CASES	18	MISSING CASES	0		

APPENDIX 5

Open Responses of Subjects

Student comments about learning with the interactive videodisc training system were gathered at the end of the initial training session. Comments have been edited for clarity.

One picture is worth a thousand words. With what the eye sees there is no misrepresentation.

I think that it is imperative to have both the computer and the instructor available in the classroom. More practice time is needed.

Once the bugs are ironed out of the computer it will be a very good course. There is more involvement with the course than having an instructor standing at the front of a classroom.

I enjoyed the program and thought it was worthwhile. However, my personal prefeence would be to take the course from a live instructor. There is some problems with the equipment that I am sure are correctable eg. writing hard to read - too small and close together.

Explanations tended tobe a bit tedious at times. Sometimes difficult to satisfy the computer. The light pen is awkward to use. Thorough and interesting although slow at times. The graphs for compressions are excellent - immediate feedback.

Computer worked just fine.

I really enjoyed taking the CPR course. When you get all the bugs worked out it should be a real good course. I think there should be an instructor available at all times when you need one.

Good for requalification. Problems with the program. Enjoyed the experience of working with the computer. Would go faster if novices were put with novices and advanced with advanced.

Specific instructions are not clear enough with regard to manual exercises. Instructor's constant presence required. Writing on the computer screen very hard to read.

Generally the CPR course was very enjoyable and educational.

Language problems. Should have it in French.

Everbody gets the same course. CPR not needed by everybody.

Was good. More individual, a person can better comprehend. It helped having an experienced person close by [as a student partner]. Timing somewhat confusing. In comparison to two other courses I have attended, this is far superior in effectiveness and comprehensibility.

More practice, less talk.