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# A Study to Determine the Effects of an Interactive Audio/Video Classroom on Retention Test Performance

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# A STUDY TO DETERMINE THE EFFECTS OF AN INTERACTIVE AUDIO/VIDEO CLASSROOM ON RETENTION TEST PERFORMANCE

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# APPROVAL PAGE

This research paper was prepared by Timothy R. Barry under the direction of Dr. John M. Ritz in OTED 636, Problems in Education. It was submitted to the Graduate Program Director as partial fulfillment of the requirements for the Degree of Master of Science in Education.

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This research study is dedicated in memory of Dr. John J. DeRolf III, who encouraged me to pursue this degree.

Timothy R. Barry

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# CHAPTER I

# INTRODUCTION

Two developments in the last few decades have had a tremendous impact on the development and use of training programs in business and industry. First, the massive expansion of the higher education system has created a talent pool of highly skilled human resource professionals. Second, the arrival of the computer, particularly the personal computer, "has given this talent pool leverage" (Watson and Bostrom, 1991, p. 333).

The costs of training and education programs in business and industry have always been high. When you add the salaries of trainers, the cost of equipment and classrooms, and employees time off the job, the dollar amounts can be staggering. It's no wonder why organizations are looking to get the *most* and the *best* training for their employees for the smallest dollar investment.

Although initial start-up costs can be high, the use of a computer-driven, interactive audio-video classroom can actually save an organization money in the long run. By providing instant feedback on the comprehension of the material, less time is wasted going over material that the class already understands. Feedback is provided to both the facilitator and the class. This means that more material can be taught in a shorter amount of time, and in training, *time is money.*

But can this state of the art training technique improve the retention of the material learned when compared to a traditional lecture style teaching format? While there is an increasing body of knowledge about the effectiveness of interactive A/V training, few studies have focused on the differences in the retention of the material learned when compared to the more traditional teaching methods.

## Statement of the Problem

The problem of this study was to determine if the use of an interactive A/V classroom in technical training can improve retention test scores after six months in use.

## Research Goals

The objectives of this study were established to determine:

1. If traditional lecture was replaced by a computer driven interactive A/V teaching format in a technical training environment, would "retention test" scores improve?
2. Will retention test scores improve after only one week-long class using an interactive A/V classroom?

# Background and Significance

In April, 1991, a new training program was developed at Newport News Shipbuilding in response to poor retention test scores achieved by RadCon Monitor qualified personnel. The Continuing Education Program (CEP) was modeled after similar programs in other shipyards and all "monitor" qualified individuals were required to attend. These quarterly one week classes reviewed older material that the employees were required to know (according to Navy training standards), as well as new material and changes to the operating manuals. Prior to this program, employees were expected to maintain the required knowledge level on their own. To ensure employee knowledge levels are satisfactory, 10 percent of the entire group is randomly selected each year by the department to participate in a comprehensive written retention examination. These grueling exams can last up to eight hours and examinees receive no advance notification that they have been selected to take the test.

Although retention test scores did improve to "acceptable" levels over the last three years, there was still much room for improvement. In January of 1994 a "new" CEP was introduced which replaced the "straight ahead" lecture format with an interactive A/V classroom environment. This computer-driven classroom afforded the instructors a virtually "unlimited" source of real life and "real time" visuals in the form of a powerful and flexible instructional delivery system (Litchfield, 1990, p. 23). The question remains: Will this "new" format finally bring retention test scores from merely acceptable to *exceptional?*

## Limitations

This study was limited to only "fully qualified" RadCon monitoring personnel including supervisors, instructors and technicians and took place over a six month period. Only performance was measured in this study. This performance was based on retention test scores and fail/pass rates. Measurement of participant's attitudes toward the program were not included in this study.

## Assumptions

Three basic assumptions were established for this study:

1. All participants received the same initial training.
2. All participants were chosen at random and represent a cross-section of the population.
3. The test score results of the participants can be generalized to the study population.

# Procedures

The method used to evaluate performance in this study was a written knowledge retention test. It was administered at the completion of the interactive A/V CEP class (April 1994). The test scores were then compared to the test scores from a previous retention exam administered prior to the program (October 1993).

# Definition of Terms

The following terms are provided to clarify meaning for the reader.

RadCon

RadCon is an accepted acronym for radiological control. Radiological control usually refers to radiation exposure control and radioactive contamination control during nuclear work.

RadCon Monitor

RadCon Monitors and Senior Monitors provide direct coverage or supervision of all nuclear work performed by trade personnel at Newport News Shipbuilding. Monitors must attend a six month initial training program to become fully qualified and must requalify every three years.

RadCon Supervisor

RadCon Supervisors supervise RadCon Monitors and must also be fully qualified.

RadCon Instructor

RadCon Instructors provide initial and continuing training for all fully RadCon qualified personnel.

Retention Test Scores

A retention test is a written exam designed to measure how much theoretical and practical job knowledge is retained by RadCon qualified personnel between requalifications. The grade achieved on these tests are referred to as a *retention test score.*

## Summary

The first chapter of this study introduced the reader to the interactive A/V classroom. This study will compare test performance before and after the use of interactive A/V in a technical training program. The researcher provided research goals, the background and significance of the problem, limitations, assumptions and a much needed definition of terms.

The following chapters of this study include a review of pertinent literature (Chapter II), the methods and procedures used in this study (Chapter III), the findings of the data collected (Chapter IV), and summary, conclusions and recommendations (Chapter V).

# CHAPTER II

# REVIEW OF LITERATURE

The purpose of this chapter is to provide an overview of the impact that interactive video has had on classroom instruction in various settings. The material contained in this chapter will provide a clearer definition of interactive video as well as previous research which express the thoughts and opinions of experts in the field of instructional technology. Of particular interest to this study is the review of previous research linking interactive video to the improved retention of material presented using this instruction method. This chapter is organized to reflect the research goals stated in Chapter I.

Once again, the objectives of this study were to determine: (1) If traditional lecture was replaced by a computer driven interactive A/V teaching format in a technical training environment, would "retention test" scores improve? And (2) will retention test scores improve after only one week-long class using an interactive A/V classroom?

# Interactive Video: What is It?

What's so different about interactive video? Why has it become the leader of the electronic training crowd, and how do we recognize it? Commonly interactive video is television that is broken into segments, rather than presented in a linear fashion. These "pieces" may be made up of motion sequences, still frames, questions, menus, or audio (to name a few), and they define an array of paths the viewer may follow through the presentation. To facilitate this "pathfinding", interactive video incorporates periodic and structured input from the participant (Schwier, 1987, p. 36). In a classroom setting this input can be used to fuel discussion and interactivity between students with the facilitator acting as a "referee".

Another feature of interactive video is its intentional design. Because interactive video is pre-authored and computer driven, the facilitator has limited control over the sequence of "events" presented. Thus, a good general definition of interactive video is as follows:

> *Interactive video is a program intentionally designed in segments, in which viewer responses to structured opportunities (menus, questions, timed responses) influence the sequence, size and shape of the program* (Schwier et al., 1987, p. 36).

In his 1986 book, entitled *Developing Auto-Instructional Materials,* A. J. Rominszowski also gives an excellent definition: "The term *interactive video* may be understood in a general or highly specific way. In the most general sense, interactive video simply means audiovisual communications which has a way of interacting with the viewer/listener in some way. In the specific sense, however, the term *interactive video* has more recently come to be used to describe the latest and most sophisticated audiovisual communication for individual (or classroom use); the laser videodisc linked to a microcomputer with graphics and text generation capabilities, through a special interface, which allows the computer to be used to control the videodisc, transforming it into a random-access store of moving images, stills and text. This, according to the author, is the ultimate of current technology. He points out however that simpler systems, such as user-controlled random-access videocassette players are also referred to by many as `interactive video'. And why not? It is video and it does interact with the audience. But it is the interactivity controlled videodisc that seems to have grabbed the imagination of many media experts in the educational and training fields" (p. 381).

A videodisc is much like a standard LP (Long-Playing) record, covered by a clear coating of durable, mar-resistant plastic. Because information is embedded within the disc and protected by the plastic, the product is extremely rugged.

Unlike videotape, which can be torn, stretched, or crumpled by inept users, a videodisc can suffer extreme abuse and still reproduce an undamaged image (Schwier, 1987, p. 16).

Other reasons for this success are not hard to identify. The videodisc, as a storage and playback medium, offers a number of distinct advantages over its rivals. According to Romiszowski (1986, p. 382) some of these are:

* ***a very high storage capacity for its size*** (a single laser videodisc about the size of an LP record, may store over 100,000 still images or pages of text, or about 500 hours of audio recording, or about two hours of full audiovisual, twin soundtrack stereo video programming);

* ***flexibility of storage*** (the same disc can be used to store any combination of stills, moving images, text, or indeed any information that can be digitized-computer programs for example);

* ***easy and rapid access to specific items of information*** (as in the case of the LP record, the reading head may move instantly to any given track on the disc -- in contrast to magnetic tape, which must be laboriously fast forwarded or rewound to locate specific sections);

* ***robustness and long life*** (no contact between the disc surface and reading head so wear is negligible);

* ***cheapness when mass produced;***

* ***security of copyright*** (due to the cost of the master and special equipment used for pressing copies, the problem of copyright infringement is much smaller than in the case of video tape).

A modern interactive video system has four principle components: (1) a videodisc player; (2) a computer; (3) an interface unit or card designed to link the player and the computer; (4) and a video monitor or television receiver. These are the basic hardware requirements, but of course there are many variations in the system characteristics and complexity.

The substantial advantages claimed by proponents of interactive videodisc instruction are increasingly being supported by empirical research evidence (which will be reported later) and by learning research. Computer-based instruction offers the learner an opportunity to respond to stimuli and to receive appropriate reinforcement, enhancement or remediation. According to Fleming and Levie (1978) this feature alone (interaction) is a sound principle of instructional message design. Add to this feature the images and sound of videodisc--providing learners high quality simulations of realistic objects, situations, or procedures--and you create an optimal condition for learning.

Instructional Message Design (Fleming and Levie, 1978) lists theoretical design principles which, when implemented, should improve learner performance.

> In general, where the learner reacts to or interacts with criteria stimulus, learning is facilitated, and that facilitation increases with the degree of learner activity or involvement (p. 138).

Fleming and Levie offer examples of interaction which should be designed into lessons in order to implement the intent of this principle. These include:

1. answering learners questions immediately after instruction;
2. timely corrections of mistakes;
3. timely reinforcement of correct answers;
4. learner initiated repetition of material;
5. repetition of previously missed items;
6. learner control over lesson sequence.

(et al., p. 139)

Another principle of interaction listed by Fleming and Levie (1978, p. 137) suggests that more learning will occur as the learner deepens his or her degree of involvement in the prepared materials: moving from simple (1) attending (reading, looking, listening), to (2) covert responding (repeating words subvocally), to (3) overt responding (responses taking the form of some observable action such as writing, typing, drawing, speaking, choosing options, etc.). The interactive videodisc offers educators and trainers an opportunity to expand beyond the limitations that are present in almost all computer-aided instructional systems. When used as described above, the computer/videodisc system represents a powerful approach to training, incorporating the best of all other media. Industry, business, the military, government and, of course, education are exploring the potential of interactive videodisc. Current training applications include everything from low level knowledge transmission to skill development and high level simulations and complex problem solving.

# Experimental Studies

The number of scientific studies performed to assess the effectiveness of interactive videodisc instruction is small. Many of the reports written to date reflect a technology which is still in its beginning stages. According to Michael DeBloois (1984, p. 52) of Utah State University, himself an interactive video researcher:

> Many of the studies use inadequate research models, too few subjects to generate any power, non-randomized approaches, inadequate controls, and so on. Critics of these early projects will certainly point to validity and reliability problems with the data reported, and subsequent projects will devote greater time and money to an adequate assessment of the effectiveness of the systems.

All this not-with-standing, DeBloois reports that early research suggests a number of general statements about interactive videodisc systems:

> 1. Interactive videodisc represents a new medium, unique from earlier approaches, containing the many strengths, but few of the weaknesses of other media. It should be treated as distinct and separate from either educational videotape or computer assisted forms of instruction.
>
> 2. New instructional design methods and models should be used to develop new types of instruction if the benefits of the new technology are to be realized.
>
> 3. Interactive videodisc instruction which is thoughtfully and systematically developed, and shows creative new instructional strategies is beginning to demonstrate consistent positive results.

> 4. Typically, learners who use interactive systems are achieving scores which are significantly higher thal learners using other approaches. They often do this although they spend less time in instruction. Uniformly, these learners report they enjoy and prefer working with interactive videodisc systems over conventional mediated approaches.
>
> 5. The concept has been proven, interactive videodisc lessons can be created, the equipment can be successfully integrated, and it stands up, (often better than other video systems) under thousands of hours of use (p. 53).

Current studies on the effectiveness of interactive video as a classroom training method (with a facilitator present) are lacking. Most studies focus on the use of interactive video by individuals or one-on-one systems, and most of these studies focus on participant opinion rather than performance.

It is however generally agreed that not only do student's attitudes toward learning improve when interactive video is used in the classroom, but according to Brenda Litchfield of Florida State University (1990, pp.23), they participate more and learn more.

## Summary

A review of the literature concerning interactive video revealed a wealth of knowledge on the subject, but very little empirical data on the effectiveness of this powerful training tool in the classroom. This chapter presented an overview of interactive video as well as a brief discussion of the experimental studies, or lack there of, as well as expert conclusions on the subject. Because the field of interactive video is growing at such a rapid pace, research conducted even a few years ago has, for the most part, become outdated. It is for this reason that the researcher is committed to further pursue the research goals stated in Chapter I.

Chapter III discusses the methodology used to accomplish the research goals. This chapter also considers instrument design and administration.

# CHAPTER III

# METHODS AND PROCEDURES

The purpose of this chapter is to explain the methods and procedures used to administer the test instruments used in this study. Topics addressed in Chapter III are population, materials and measures, procedures and statistical analysis.

## Population

The twenty-eight subjects for this study were chosen by a random computer program from an eligibility list of fully qualified RadCon personnel at Newport News Shipbuilding. Personnel that had recently requalified were not eligible to take the exam. The subjects participating in this study included four (4) supervisors, twenty-two (22) monitors and two (2) instructors. All of the participants were male and most had at least some college background. All of the subjects had received the same radcon training prior to this study.

## Materials

Five interactive laserdisc/audiovisual tape lessons (four to five hours each) constituted the instructional materials. Each lesson was subdivided into five to seven individual topics or "scripts". A description of the topics is found in Appendix A. A personal computer controlled the interface between the laser disc player and the video tape player. The instructor controlled the system using a small wireless remote control. The software program chosen to run the system was the Interactive Multi-Media Classroom (IMMC)™ produced by IBM®.

## Instrument Design

The test instruments consisted of two different written knowledge retention examinations. Because this was an actual testing situation, the same exam could not be used for both the *pretest* and *postest*, although the material contained in each test was similar in content. The test instuments were divided into two parts. Part I consisted of general knowledge questions which required short narrative type answers. Part II contained a large casualty situation which required a long narrative answer and associated mathematical calculations. The passing score for both tests was 80 percent for instructors, 80 percent for supervisors, and 75 percent for monitors.

## Procedures

Prior to the implementation of the program, a one week pilot program was conducted with a typical sample of the study population. This made it possible to revise any material that may have contained incorrect or confusing information. The program was implemented in January 1994 and continued until April 1994. During this period the entire study population attended the weekly classes. The classes were limited to a maximum of ten (10) and a minimum of six (6) employees.

A control group was tested and graded in October 1993. The subjects (chosen by a random computer program) included two (2) supervisors, eleven (11) monitors and one (1) instructor. The group who received the interactive instruction was tested and graded in May 1994. Again, the subjects for the test included two (2) supervisors, eleven (11) monitors and one (1) instructor.

## Statistical Analysis

The test instruments were scored on a scale from zero to one hundred percent. Questions on the exam ranged in point value from one (1) to twenty (20) points each. The average point value was four (4). Each exam was reviewed by three instructors to ensure grading consistency. The means and standard deviations for both sets of test scores were calculated. A *t*-test was used to compare the mean scores of the control and experimental groups respectively to determine whether there were significant group differences in test scores.

## Summary

This chapter dealt with the methods and procedures used to conduct this study. Selection of the sample populations were outlined. Materials and measures were covered. Finally, the statistical analysis method was discussed. In Chapter IV the researcher will report the findings of this study.

# CHAPTER IV

# FINDINGS

The problem of this study was to determine if the use of an interactive A/V classroom in technical training can improve retention test scores after six months in use. This chapter will report the results of two written retention exams, one administered prior to, and one administered after the use of an interactive A/V classroom in the training of RadCon qualified personnel.

The control group was tested and graded in October 1993. The fourteen subjects (chosen by a random computer program) included two (2) supervisors, eleven (11) monitors and one (1) instructor. An experimental group was tested and graded in May 1994. Again, the fourteen subjects chosen for the experimental group included two (2) supervisors, eleven (11) monitors and one (1) instructor.

## Explanation of Table

A Summary of the retention exam results for both test groups can be found in Table 1. Overall passrates, mean scores and standard deviations were calculated for both groups of examinees. Using the mean scores from the control group and the experimental group (*Control* - 83.3, and *Experimental* - 86.6), a *t*-Test was computed to compare the results of the two test groups. The calculated t-ratio indicated that the value did not exceed at the .01 (2.977) or .05 (2.145) levels of significance, using the total number of examinees and "Table II Critical Values Of *t* (Tuckman, 1992, p. 490) (See Table 1). The *overall passrate* reflects two failures in the control group and one failure in the experimental group.

Table 1

Summary of Retention Exam Results

| Group 1 (pretest) | Group 2 (posttest) |
|---|---|
| 94.1 | 98.2 |
| 93.9 | 97.7 |
| 92.4 | 95.9 |
| 90.9 | 94.4 |
| 88.2 | 90.8 |
| 85.9 | 90.0 |
| 85.4 | 87.5 |
| 84.8 | 86.7 |
| 84.2 | 86.5 |
| 81.7 | 80.6 |
| 79.8 | 79.5 |
| 75.8 | 78.2 |
| 68.4 | 75.8 |
| 67.4 | 71.4 |
| ------ | ------- |
| *N*=14 | *N*=14 |

| Passrate | *M* | *(SD)* | Passrate | *M* | *(SD)* | *t* |
|---|---|---|---|---|---|---|
| 86% | 83.3 | (8.24) | 92.8% | 86.6 | (8.86) | .891 |

## Summary

This chapter reported the results of the two tests that were administered to gather data. The data was recorded, and the mean scores and standard deviations for both test groups were calculated. A t-Test was computed to determine if a significant difference existed between the two means. Chapter V will provide the Summary, Conclusions and Recommendations of the study.

# CHAPTER V

# SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

## Summary

The problem of this study was to determine if the use of an interactive A/V classroom in technical training can improve retention test scores after six months in use. The objectives of this study were established to determine:

1. If traditional lecture was replaced by a computer driven interactive A/V teaching format in a technical training environment, would retention test scores improve?
2. Will retention test scores improve after only one week-long class using an interactive A/V classroom?

To evaluate performance in this study, a written knowledge retention test was administered at the completion of the interactive A/V class (April 1994). These test score results were compared to test score results from a retention exam administered prior to the introduction of the interactive A/V class (October 1993).

The mean scores of the control and experimental groups were calculated and a *t*-Test was computed. This method was used to determine if there was a significant difference between the two group mean scores.

## Conclusions

The findings of this study showed that there was, indeed an improvement in retention test scores after the use of interactive A/V classroom, however, it was only a slight improvement. According to the data presented in Chapter IV, the mean scores were: Control group, 83.3 and Experimental group 86.6. These scores were used to determine the level of significance.

As presented in Chapter IV, the result of the *t*-Test was .891. This *t*-score did not exceed either the .01 *or* .05 levels of significance (2.977 *or* 2.143). Because the experimental group scored only slightly higher than the control group, the researcher cannot accept that the use of the interactive A/V classroom significantly improved retention after only six months in use.

## Recommendations

Based on the research findings and conclusions, the researcher believes that the results of this study indicate that different people learn in different ways. Some learners may actually prefer a lecture type format in the classroom while others prefer the interactive A/V format.

The researcher suggests the following recommendations:

1. Additional research is needed to determine if the interactive A/V classroom is a more effective instructional approach than lecture.
2. This study be repeated after the interactive A/V classroom has been in use for one year to determine if its use significantly improves instruction and retention.

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# APPENDICES

# APPENDIX A

## Overview of Topics

TOPIC #1 (Day one)

**Radiological Work Practices and Radiological Surveys**

a. Surveys for Radioactive Contamination

b. Radiation Surveys

c. Collection and Analysis of Solid Samples

d. Collection and Analysis of Water Samples

TOPIC #2 (Day two)

**Radiological Spills**

a. Liquid Radioactive Spill Control

b. Dry Radioactive Spill Control

TOPIC #3 (Day three)

**Radiological Incidents**

a. Prevention of Incidents

b. Review of Past Incidents

c. Control of High Radiation Areas

TOPIC #4 (Day four)

**Radiation Exposure Reduction Methods**

a. Review of Radiation Exposure Reduction Methods

b. Group Problem Solving Activity

TOPIC #5 (Day five)

**Radioactive Contamination Control**

a. Contamination Control Methods

b. Group Activity