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Comparing the effectiveness of instructor-led training to stand-alone web-based training : a case study

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ABSTRACT

COMPARING THE EFFECTIVENESS OF INSTRUCTOR-LED TRAINING TO STAND-ALONE WEB-BASED TRAINING: A CASE STUDY

by
Robert P. Myre

Web-based Training (WBT) is still a relatively new technology, and the full extent of WBT functionality has yet to be realized. Most of corporate America recognizes the necessity of a well-trained workforce; however, instructor-led training is often difficult to implement due to a variety of logistical issues. These issues include cost constraints, location issues, and limited resources.

WBT has been touted in recent years as a viable alternative to traditional, instructor-led training. However, the effectiveness of WBT versus instructor-led training has been questioned by its many critics. This case study tested the effectiveness of a stand-alone web-based training program and compared the results to that of an identical instructor-led course. The course provided highly task-oriented instruction for a computer software package and was developed using a proven instructional design methodology.

The data from this study indicate that WBT is as effective as instructor-led training for purposes of software application training.

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by
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COMPARING THE EFFECTIVENESS OF INSTRUCTOR-LED TRAINING TO STAND-ALONE WEB BASED TRAINING: A CASE STUDY

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To my wife and best friend, Maureen,

and to our children, Ian and Shannon

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CHAPTER 1

INTRODUCTION

1.1 Objective

Web-based Training (WBT) is still a relatively new technology, and the full extent of WBT functionality has yet to be realized. Most of corporate America recognizes the necessity of a well-trained workforce; however, this training is often difficult to implement due to a variety of logistical issues. These issues include

- Cost constraints
- Location issues
- Limited Resources

1.1.1 Cost Constraints

Training development and implementation costs can be very high. Many issues factor into these costs, including software purchases, document development and production, travel-related expenses (airfare, hotels, car rentals, audio/visual equipment rentals, etc.), and off-site training facility rentals. In many cases, these costs are not fully considered when a project is started. As a result, the training is often scaled back significantly or, in some cases, cut altogether, particularly if the project is already over budget.

1.1.2 Location Issues

Many corporations today compete in national and international markets. To do this, they often maintain a number of offices throughout the country or the world. The

implementation of a multiple site training program opens a Pandora's Box of logistical issues, including shipping, customs, data/telephone connectivity, and time zone considerations.

1.1.3 Limited Resources

Training departments typically are not large, particularly in today's downsized work environment. As a result, many companies simply do not have enough trainers to support a large-scale training effort. Some companies turn to training consultants. However, consultants are very expensive, and they face a significant "learning curve," particularly with highly technical or proprietary topics.

1.2 Background Information

This thesis focuses on two training methodologies:

- Instructor-led training
- Web-based Training (WBT)

1.2.1 Instructor-led Training Analysis

Instructor-led training is a format in which one or more instructors provide training to a class. The instructor may enhance his or her presentation through the use of audio/visual media such as overheads, video, or presentation software (i.e. Microsoft Powerpoint, Gold Disk's Astound, etc.).

Instructor-led training has a number of advantages, including the following:

- There are many instructional designers and trainers with experience in the development and presentation of instructor-led training.
- Instructors can provide immediate, specific feedback.
- Instructors can answer ad-hoc questions.

The disadvantages include the following:

- All students must work at a reasonably similar pace.
- Training occurs at a specific time and place.
- Since trainers have their own styles and capabilities, training may not be consistent among multiple classes.

1.2.2 Web-based Training Analysis

WBT is a method in which the training is provided through a computer via the World Wide Web (WWW). WBT has a number of advantages, including the following:

- Students can work at their own pace and on their own schedule, and can repeat sections that they find difficult.
- Since all students receive the same WBT package, training is consistent among all students.
- WBT can take advantage of multimedia (i.e. audio, animation, graphics, video, etc.).

The disadvantages of WBT include the following:

- Students cannot ask ad-hoc questions, and may not receive immediate, specific feedback unless an additional utility is employed, such as a chat room, conferencing software (i.e. WebBoard, WebCT or NetMeeting), or email.
- Students with a pre-determined negative attitude toward WBT may not respond well.

- There is not a broad base of knowledge regarding WBT development using modern technology.

1.2.3 Comparison of Instructor-led Training and WBT

The development of an instructor-led training course is generally less expensive than the development costs for an equivalent WBT. However, the implementation costs can be significantly more expensive than those for WBT, particularly when the training is to occur on a national or international level. Therefore, instructor-led training is best used in situations where the training will be conducted in a central location, or a small number of sites. Instructor-led training is also used in situations where the expertise to develop WBT is not available, or when the high costs of WBT development are not feasible.

WBT is best used in situations where large-scale, long distance training (particularly on a national or international level) is required. WBT enables corporations to take advantage of the cost savings associated with WBT distribution, and to ensure that each student receives the same training.

Given the fact that WBT lends itself to large-scale training initiatives, it would seem likely that every company would adopt WBT for such needs. However, this is not the case. Often, companies rely on mailings or email to disseminate information and on costly help desk support for questions. The concern among many companies is that WBT is expensive to develop, and they are not convinced that the effectiveness (or lack thereof) of the medium justifies the cost.

1.2.4 Definitions of WBT-Related Terms

While WBT technology is relatively new, Computer-based Training (CBT) has been in use since the early 1960s. Since then, CBT and the terminology used to describe it have evolved. The following definitions describe the terminology in use today.

CBT, or Computer-Based Training, is an instruction method that relies solely on the computer to deliver the training. Since no instructor is present, courses delivered via CBT must be self-contained and include adequate instruction and feedback to the student in order to be successful. CBT is typically distributed on CD-ROM and can contain a tremendous amount of information including graphics, animation, sound, and even full motion video. CBT is often used in large scale, high volume training situations, especially where the students are geographically dispersed.

CBI, or Computer-Based Instruction, is often used interchangeably with CBT. The use of the term CBT in this document will refer to both CBT and CBI.

CAI, or Computer-Assisted Instruction, is a method in which instructor-led training is supplemented by computer training. The term CAI has been used to describe a number of very different scenarios. For example, an instructor could incorporate computer-based graphics, animation, video, audio, etc. in his or her lecture to a class. Additionally, the instructor could divide the class time to present material in lecture form, and then enable students to work with an on-line tutorial. Both of these examples can be considered CAI. The most significant difference between CBT and CAI is that in CAI the instructor is typically present, or is at least available, to provide feedback.

WBT, or Web-Based Training, is a means of delivering CBT via the World Wide Web (WWW). While this method is similar to CBT and CBI, WBT differs in three

primary areas. First, the WBT application is typically developed as a series of Hypertext Markup Language (HTML) pages that contain embedded code to allow for training functions (i.e. testing, grading). Many software packages are available that enable the instructional designer to create CBT and convert it to WBT (Click2Learn [formerly Asymetrix] Toolbook), or to create WBT directly (Macromedia Director). The second significant difference is that WBT is delivered via the Internet, or a company's Intranet, and is accessed through an Internet browser (i.e. Netscape Navigator, Microsoft Internet Explorer). Unlike a CBT delivered via CD-ROM, WBT development must address internet-related issues of multimedia support, transmission speed, and bandwidth. For example, full motion video will run well from a CD-ROM, but may take an excruciatingly long time to download or may display poorly on a WBT. Finally, internet features enable this medium to cross the line between CBT and CAI. WBT can be designed to provide access to live instructors via "chat rooms" and email (Lyons and Clark, 1999), thereby enabling the instructor to be virtually "present" and to provide feedback or instruction.

1.2.5 Prior Research of WBT/CBT Effectiveness

Since WBT is a relatively new technology, the literature review for this thesis includes a research conducted with CBT, CBI and CAI in addition to WBT.

Early studies, while important in their time, may not be valid today due to the advances in technology since the early 1990s (i.e. graphics, animation, audio/video). However, they are mentioned here for a historical perspective. One of the earliest studies of CBT effectiveness was performed in 1968 by Suppes and Morningstar (Wang and Sleeman, 1993). In this study, the Stanford Achievement Test was used as a tool to

compare the scores of 925 elementary school students who used CAI versus the scores of 1028 students who received instructor-led training. The study revealed that the CAI students did as well as, or better than, the students who were taught with the instructor-led methods.

Studies conducted through the 1970s and 1980s typically came to the conclusion that the effectiveness of CAI depended on the situation. These studies included Castleberry, 1973; Kulik, Kulik, and Cohen, 1980; Cavin, Cavin, and Lagowski, 1981; MacQueen; 1983; and McKenzie and Karnau, 1985.

Studies conducted in the 1990s capture current CBT technology and its effectiveness as a training medium. These studies include the following.

Stephenson (1991) performed an experiment to measure the affect of student-instructor interaction on CBT performance. In this experiment, two groups (Group I consisted of 13 students and Group II consisted of 12 students) of college students in a Business Statistics class used a CBT tutorial for a spreadsheet application. The first group received no instructor-initiated interaction. The second group received multiple instructor-initiated interactions. The interaction provided was identical in both groups, in that the instructors were limited to a series a phrases that they could provide to the students. Therefore, since the information provided was identical, the only difference would be whether the student requested the information voluntarily, or whether the instructor initiated the interaction. The CBT tutorial itself consisted of 12 lessons and a statistics exercise, which tested the students mastery of the spreadsheet application. The results of this experiment show that the students that received the instructor-initiated interaction performed significantly better on the exercise than students that received no instructor-initiated interaction.

The Stephenson study is significant because, like the research presented in this thesis, it measured CBT instruction for a software application. The results of this experiment are also interesting because it showed that students performed better when they received instructor-initiated interaction. Stephenson hypothesized that one of the reasons for this outcome was due to the design of the CBT tutorial, in that it enabled the user to scroll through the screens, including the exercises, by simply hitting the space bar. As a result, if a student had questions on how to proceed in the tutorial, but for reasons of his or her own did not ask for help, he or she could simply hit the space bar and move on to the next screen. Stephenson noted that this practice (although not measured in the study) seemed to occur more with the Group I students than with the Group II students.

Owens and Waxman (1994) performed a study to measure the effectiveness of CAI vs. instructor-led instruction in the teaching of algebra and geometry to African-American college students. The topic of this study differs from the research discussed in this thesis in that the goal of this CAI was to teach mathematical skills, as opposed to the use of a software package. However, the results of this study are significant because this study measured CAI as the sole instructional method, as opposed to other situations where CAI was incorporated into an instructor-led training setting. Additionally, this study measured the attitudes of the students toward mathematics using a mathematics attitude scale, to determine whether a student's attitude regarding mathematics had an effect on the results. The study consisted of 231 college freshmen students that required remedial mathematics classes, based on their scores in a placement test. The CAI course was presented using a program called CRS-Integrated Learning System. This program provided instruction for a concept in three steps: (1) introducing the concept, (2) providing rules and examples of the

concept, and (3) providing a 20 question posttest. A student mastered a concept if he or she correctly answered 80% of the problems in the posttest. The program would automatically return to the appropriate point in the CAI if the student demonstrated difficulty in the posttest. The instructor-led course was provided in a conventional, lecture-style format, and the posttest was administered after completion of the 12 week program.

The study measured three dependent variables: (1) geometry skills, (2) algebra skills, and (3) attitudes toward mathematics. Results of this study showed that CAI students performed significantly higher in geometry (24% higher), and performed as well as the instructor-led students in algebra (instructor-led students scored 3% higher, which is not statistically significant). In terms of attitudes, the study showed that CAI students had a significantly higher attitude toward mathematics (25.52% higher) than students instructed via the instructor-led format.

Lee (1994) performed a study in which 26 schoolteachers were taught the BASIC programming language using CBI. While the type of training is not entirely similar to the present research (teaching a programming language as opposed to teaching a software package), this study is significant in that it recognized the importance of developing a CBI that focused on the needs of the learner, rather than the perspective of the developer, and also employed an attitude measurement. As a result, the CBI was designed using a systems methodology, in an attempt to produce high instructional results.

The students were given a pre-test to determine their prior experience with the BASIC programming language. Upon completion of the CBI, the students were given two post-tests (one immediately after the CBI, and the second test one week later), and an attitude questionnaire. The results of this study showed that the students did not perform well on

either the immediate (the average score was 7.64 out of 15) or the delayed post-test (average score was 6.95 out of 15). Additionally, the students attitudes toward the training was negative (the average score was 31.26 out of 50), indicating a dissatisfaction with the CBI. This study indicates that CBI was not effective for this particular type of training (i.e. programming language instruction). However, the author noted that this research was a case study and that a number of factors could have contributed to the results, including the fact that most of the students took this course because it was required by their departments, and not because they had any desire to learn BASIC.

Bowman, Grupe, and Simkin (1995) compared the effectiveness of CBT versus instructor-led training. This study is significant to the research in this thesis in that it provided instruction on software applications. The curriculum in this case focused on skills taught in beginner-level computer courses, including operating system, word processing, spreadsheet, and database skills. An experimental group of 15 college students was given CBT courses using the "Teach Yourself" series developed by American Training Institute. Three control groups (42 students in total) were given instructor-led courses. To maintain consistency, one graduate instructor served as a consultant for the CBT students (available to answer questions, clarify homework requirements or explain test results), and served as the instructor in the instructor-led courses. The authors also administered a pre-course survey to obtain demographic and background information in order to maintain equivalence in the CBT and instructor-led groups.

The results of this experiment indicated that the CBT group performed as well as the instructor-led groups in that there was no statistically significant difference in the results of

homework or examination scores. Additionally, a satisfaction survey indicated that the CBT and instructor-led students were equally satisfied with the training they received.

Wilson, Majsterek, and Simmons (1996) performed a case study of four elementary students with learning disabilities and examined the effectiveness of CAI vs. instructor-led training. Like the Owens and Waxman study, this study differs from the research discussed in this thesis in that the goal of this CAI was to teach mathematical skills, as opposed to the use of a software package. However, it is significant to the present research in that the instruction was developed using proven assessment and learning methods. The four students were given pre-tests to determine areas to be developed, and were given post-tests to measure their performance after each lesson. The lessons consisted of instruction regarding multiplication facts and consisted of three components: (1) demonstration, (2) controlled practice, and (3) "game-style" practice. The CAI students used a well-known program called Math Blaster. The instructor-led students were provided similar training using flash cards. The results of this study showed that all four of the students performed better in the instructor-led setting than in the CAI setting.

Williams and Zahed (1996) performed a study in which 54 employees at a chemical processing plant were given hazardous chemical safety training. The topic of this study concerned procedures and compliance requirements, which is different than the topic of the study for this thesis. However, this study is significant in that it provided a direct comparison between the CBT and the instructor-led groups, and because it employed a computer attitude scale to measure computer anxiety of the CBT students. The group was divided into two sections of 27 students each. One section was given instructor-led training and the other was given a CBT. The CBT course was administered using a commercially

available program called HazCom Courseware developed by Human Resources Development Press. The instructor-led course was performed by a professional trainer employed by the company, using modules developed directly from the HazCom courses. In order to maintain consistency, the same trainer performed all of the training.

Prior to the training, each student was asked to complete a pre-test questionnaire which requested demographic information such as age, sex, work shift and education level, and a knowledge form to test their prior subject knowledge. Additionally, the CBT students completed a computer anxiety index questionnaire to measure their attitudes toward computers in general and computers in the classroom. Upon completion of the course, the students completed a posttest knowledge form to determine how well they learned the material. Finally, the students completed a follow-up knowledge form one month later, to test retention.

The study showed that there was no significant difference in learning immediately after the training (average scores of 91.96% for instructor-led students, and 89.78% for CBT students). However, the CBT students scored higher on a post-test given one month after the training (average scores of 85.30% for CBT students and 78.74% for instructor-led students). The authors theorize that the higher retention could be the result of a number of factors, including the high level of interactivity inherent in CBT, as well as the segmented format of CBT, in which training is provided in "chunks" of information.

Bohlen & Ferratt (1997) compared the effectiveness and efficiency of CBT to instructor-led training for college students. This study is related to the study in this thesis in that it measured the effectiveness of software training, namely a word processing

application. This study differs from the present research in that it divided the subjects based on learning style, using the Kolb Learning Style Inventory (Kolb LSI).

The Kolb LSI states that learning occurs in four phases: (1) concrete experience, (2) reflective observation, (3) abstract conceptualization, and (4) active experimentation. Kolb believes that although all learners go through these phases, individual learners have phase preferences. As a result, there are four types of learners: (1) convergent (prefer abstract conceptualization and active experimentation), (2) divergent (prefer concrete experience and reflective observation), (3) assimilation (prefer abstract conceptualization and reflective observation), and (4) accommodative (prefer concrete experience and active experimentation). Kolb states that the different types of learners prefer different types of training. For example, Assimilators and Convergers, by nature, prefer CBT training more than Divergers and Accommodators. This is because Divergers and Accommodators tend to rely on personal experience and help from others, rather than their own skills.

The study consisted of 120 students in a college-level introductory computer course who reported having little or no prior word processing experience. Of the 120 students, 60 participated in the CBT and 60 participated in the instructor-led class. There were equal numbers of each learning type in each class, and the curriculum for both classes was identical.

The CBT class used a commercially-available product called FastStart, developed by ComTrain, Incorporated. The instructor-led class was a traditional lecture-style format, in which the instructor used a chalkboard, overhead projector, and a projection device to display the computer images on a large screen. There was no "hands-on" component for this group.

In both cases, effectiveness and efficiency were measured. Effectiveness was measured based on the student test, practicum and assignment scores, and efficiency was based on the number of keystrokes and amount of time required to complete the practicum and assignments. Additionally, satisfaction was measured using a ten-item, Likert-type scale.

In terms of effectiveness, the results of this study showed that, overall, CBT users performed better on the practicum, and as well on the tests (90.93% for CBT students and 83.56% for instructor-led students). However there was no significant difference among learning styles. In terms of efficiency, the CBT group performed the practicum using less keystrokes than the instructor-led group (66.29% for CBT students and 59.57% for instructor-led students). Again, there was no significant difference by learning style. In terms of satisfaction, CBT users indicated a higher level of satisfaction (1.62 out of 5 for CBT and 2.77 out of 5 for instructor-led, where the lower number indicates higher satisfaction). There was no significant difference among learning styles

Couret (1999) reports on a WBT program implemented by the city of Austin, Texas, in conjunction with the University of Texas, and CBT Systems, a CBT/WBT development company. The program offers 400 courses in software skills for, among other things, Microsoft Office packages (i.e. Word, Excel, Access, PowerPoint). Although no empirical research has yet been performed on the effectiveness of this program, it is significant to the present research in that the program provides software training. The program appears to be successful from two perspectives: (1) student learning (student averages to date are 90 or better, out of a possible 100), and (2) student satisfaction (nearly 1,000 courses have been taken).

Lawson (1999) performed a comparison of CBT to instructor-led training using 46 college students. In this study, 25 students received instructor-led training and 21 received CBT instruction for the Occupational Safety and Health Administration (OSHA) bloodborne pathogens standard. The study is significant in that it was the most recent in terms of computer technology, even though the topic (OSHA standards) differed from the study in this thesis.

The students in Lawson's study were given a pretest to determine their prior knowledge of the OSHA standard. Following the training, the students were given a posttest to measure the resultant learning. This was followed up with an additional, identical posttest three weeks later to measure retention. In addition to the scores of these tests, the time required to complete the course was also measured.

The results of this study indicated that the CBT students scored higher on the immediate post-test than the instructor-led students (an average of 85.7% for CBT students and an average of 64.7% for instructor-led students). The students did equally as well in the delayed post-test in that scores marginally decreased for both sets of students (a 2.3 point decrease for CBT students and a 2.2 point decrease for instructor-led students). Additionally, the average time required to complete the course was significantly less for CBT students (an average of 35.3 minutes for CBT students and 70 minutes for instructor-led students). Of course, all instructor-led students required 70 minutes because they all worked at the same pace.

Overall, the research conducted to date has produced a mixed review of CBT. Many researchers have reported positive results for CBT in their tests, while others have found that CBT had little or no impact on learning. Still others, as in the case of Wilson,

Majsterek, and Simmons, and Lee found that CBT/CAI students performed worse than those who received instructor-led training.

There are a number of lessons to be learned from the studies mentioned above. Specifically, interaction is crucial to the success of CBT, as indicated by Stephenson and Owens and Waman. Therefore, it is important to ensure that the user of the WBT receive timely and appropriate feedback without having to ask for it. For example, the user should not be allowed to simply scroll through the tutorial. Rather, the student should be required to respond appropriately and to automatically receive help from the WBT.

Attitude toward computers in general and computers in the classroom must be considered, as indicated in Owens and Waxman; Lee; Bowman, Grupe and Simkin; Williams and Zahed, and Boylen and Ferratt. As stated earlier, Lee believes that the lack of effectiveness of the CBT in her study may be due to the negative attitude toward the topic and/or the CBT itself.

There is evidence to indicate that CBT, and therefore WBT, effectiveness depends upon the topic of instruction and the students receiving the training. In terms of the topic of instruction, in this case software training, Bowman, Grupe and Simkin; Bohlen and Ferratt; and Couret all indicate CBT effectiveness that is equal to, or exceeds, instructor-led training. Additionally, Stephenson's study indicated that CAI was more effective when used with instructor-initiated interaction. Therefore, a factor in the design of the present research is to simulate instructor-initiated feedback in the WBT. In terms of the students receiving the training, the study by Wilson, Majerstek and Simmons indicated that CAI was not an effective tool for elementary students with learning disabilities. However, Owens and Waxman showed a 24% higher score for geometry mastery for college students

taking a remedial math course. The student population for the present study will be asked to complete a pretest questionnaire to determine deficiencies in the ability to learn the software application, or conversely, prior mastery of the application.

And finally, in order to establish a baseline by which to accurately measure effectiveness, and to ensure the proper distribution of students between groups, pretest and posttest questionnaires or exercises must be administered. This was done in all of the studies described.

It should be noted that of the studies described above that were conducted since 1995, all but one (Wilson, Majerstek and Simmons) indicated that CBT was at least as effective as instructor-led training. This pattern is likely due to a number of factors, including:

- Higher-skilled CBT/WBT instructional designers
- More computer-savvy students
- Advanced multimedia authoring tools
- Improved, less expensive technology.

1.3 Domain

The research conducted for this thesis is a case study, in which similar students are taught identical subject matter either by similar instructors or by the WBT system. The students are then evaluated on their ability to perform tasks described in the training. Therefore, this research is categorized as Case Study research, as indicated in the Lauer & Asher Research Taxonomy (Figure 1).

The training programs are designed using the theoretical approach described by Robert M. Gagne in *The Conditions of Learning for Training Applications* (Gagne, 1996). Lyons and Clark (1999) state that many of the negative impressions of CBT and WBT are based on the poor design of the instruction and not necessarily on the medium through which it is presented. Theoretically, if the design of the training program follows a proven theoretical approach (i.e. The Conditions of Learning), the WBT medium will be as effective as instructor-led training.

Additionally, prior to performing the actual training, the students in the course must be equally distributed based on prior knowledge, computer skills, and attitudes toward computers, training and WBT. This research falls into the Survey/Sampling category of the Descriptive Research section of the taxonomy.

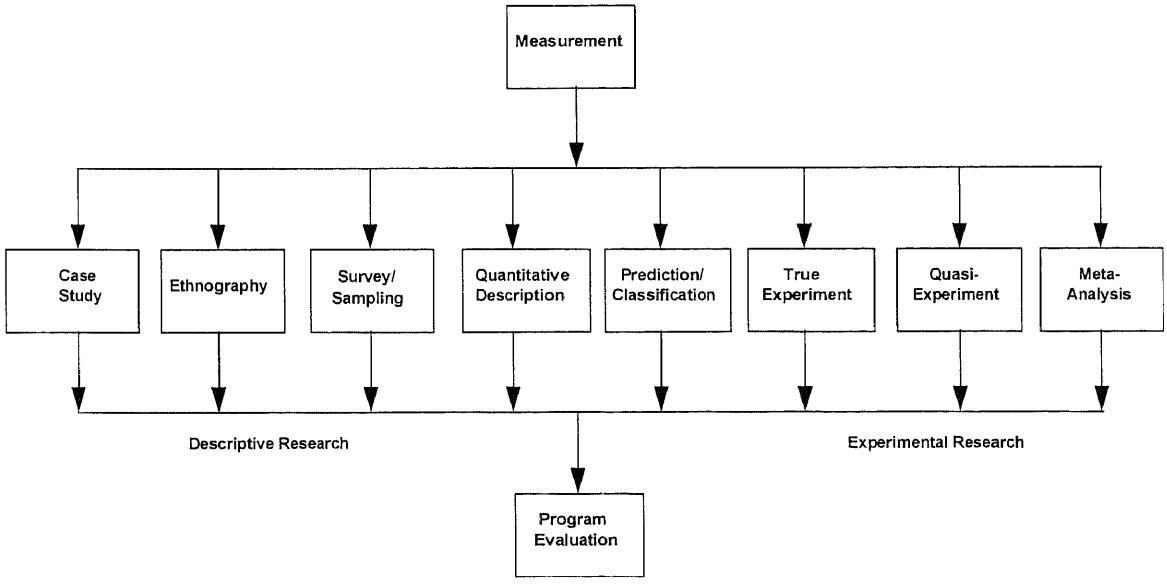

Figure 1 - Lauer and Asher's Research Taxonomy

1.4 Theoretical Approach

This study uses the theoretical approach provided by Robert M. Gagne's *The Conditions of Learning*, modified specifically for training (Gagne, 1996). Gagne's theory states that there are five categories of human Learned Capabilities, and that each category requires certain internal and external conditions in order to be successful. These categories are

1. Verbal Information
2. Intellectual Skills
3. Motor Skills
4. Attitudes
5. Cognitive Strategies

1.4.1 Verbal Information

Verbal Information is information that a person can simply recall, without having to analyze or modify it. The information is generally recalled in the same form it was originally learned. For example, being able to recall the words to a song, or the tools needed to change a flat tire, are examples of verbal information.

1.4.2 Intellectual Skills

Intellectual skills are those that allow a person to interact in an environment using symbols, sounds or language. These skills require analysis on the part of the individual so that the information can be generalized and used in different situations. For example, an individual may see an object and recognize it as a bird. This is an example of a basic intellectual skill. The person may also be able to recognize the type of bird, thus distinguishing it from other

birds. This, too, is an intellectual skill. Gagne determined four hierarchical levels of intellectual skills:

- **Discriminations**: the ability to distinguish different physical phenomena
- **Concepts**: the ability to classify these phenomena using attributes
- **Rules**: the ability to specify relationships between or among concepts
- **Higher Order Rules**: the ability to combine multiple rules

1.4.3 Motor Skills

Motor skills are those capabilities that require physical movement(s) on the part of the individual. Examples of this type of skill are driving a car, operating a computer, and clicking through the channels on a remote control. Motor skills can require hand-eye coordination, balance, and kinesthetic feedback.

1.4.4 Attitudes

Attitudes are the states within an individual that cause a person to behave in a certain fashion. Positive and negative attitudes play a very real role in the effectiveness of a training program. For example, a person with a negative attitude toward computers is not likely to do well in a computer related class, such as a software training course. Conversely, a person with a positive disposition toward computers is likely to do well, or at least have positive comments about the same class. As shown in the previous research, attitudes are typically evaluated in experiments or case studies to determine a pre-disposition toward the topic.

1.4.5 Cognitive Strategies

Cognitive strategies enable individuals to improve and enhance their own thinking and learning processes. Cognitive strategies are actually used to manage the learning of the other four types of learned capabilities. For example, using the name "Roy G. Biv" to recall the colors of the spectrum (red, orange, yellow, green, blue, indigo, violet) is an example of a cognitive strategy employed to memorize verbal information.

1.4.6 The Cognitive Learning Theory

Gagne's theory is aligned with cognitive learning theory, which considers internal learning processes. As a result, Gagne advocates the use of the Information-Processing Model, a model whose development is based on work by Atkinson and Shiffrin (1968).

1.4.6.1 The Information Processing Model

The Information-Processing Model describes the internal processing of information in the form of a computer metaphor and can be used to follow the process of an act of learning.

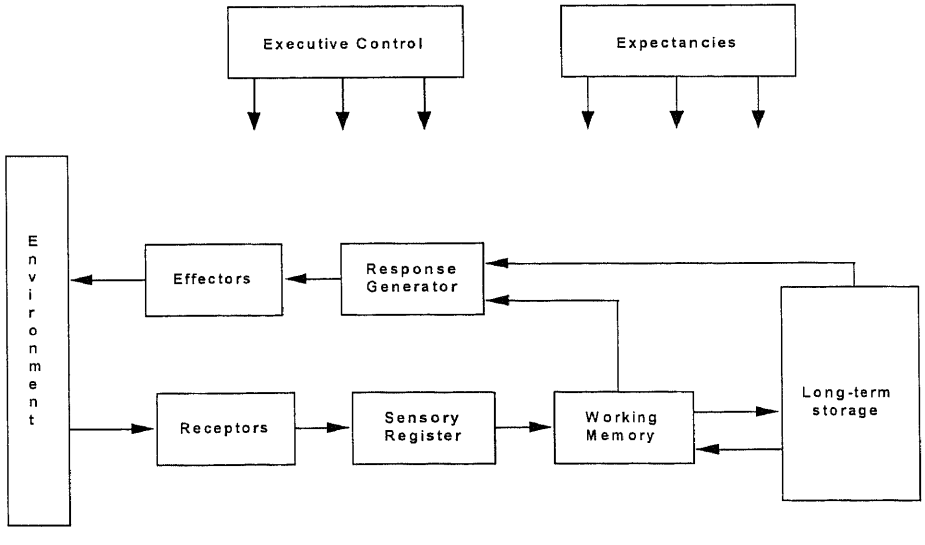

Figure 2 - The Information Processing Model

The individual receives a stimulus from the environment to his or her receptors. A receptor can be any sensory organ, such as eyes, ears, or nose. The receptor converts the stimulus into neural information required for comprehension by the person's brain, and releases the information to the central nervous for transmission to the brain.

The converted information enters the sensory register, where it is either allowed to continue on in the process, or is ignored. This determination, which takes less than a second, is made using pattern recognition (where the individual searches for a familiar feature on which to focus) and selective perception (where the individual has the capability to filter out unwanted information). Information that is permitted through this register enters into working memory.

Working memory, also referred to as short-term memory, is both an area of temporary storage and a work area in which the information can be combined with previous knowledge and then manipulated. Information remains in working memory for approximately twenty seconds, although techniques such as rehearsal (repetition of the information), and chunking (breaking the information into manageable segments) can increase this time. The final function of working memory is to prepare the information for long-term storage, using a process called encoding. The process of encoding is considered to be the point where true learning occurs, for it is at this point where the information is identified as something meaningful to the individual, and as a result, is learned.

Once the information has been encoded in a way that is meaningful to the individual, it is placed in long-term storage. Once the information is placed into long-term storage, it is available for retrieval.

The purpose of retrieval is to generate a response. Information is typically retrieved back into working memory, where it is combined with new information. However, some responses are considered automatic (such as riding a bicycle) and are taken directly from long-term storage. Once the information is retrieved, it is transmitted to the response generator.

The response generator prepares the individual's response. This response can be either verbal or physical. Once the response has been determined, it is transmitted to the effectors, which are the actual muscles that perform the response. This is the point where the learning can be evaluated, since this phase provides an external, observable representation of the learned information.

The learning process loop closes at the Environment link, which again provides input to the receptors. In terms of a learning event, this input takes the form of feedback, which indicates the level to which the individual's response was correct.

As indicated earlier, the Information-Processing Model uses a computer metaphor to illustrate the learning process. However, each human approaches learning differently, thus the introduction of Executive Control and Expectancies.

Executive Control processes are essentially the cognitive strategies discussed above. They are involved in the entire process, from determining what contents of the sensory register are transmitted to working memory, to the format of the response selected in the response generator.

Expectancies are another type of control process. The individual is able to select the appropriate cognitive strategy based on the knowledge of what he or she is expected to learn.

1.4.6.2 Information Processing Model Training Implications

As described above, there are nine internal processes that comprise a learning event (Gagne, Briggs, Wager, 1992):

1. Reception of stimuli by receptors
2. Registration of information by sensory registers
3. Selective perception for storage in short-term memory
4. Rehearsal to maintain information in short-term memory
5. Encoding for storage into long-term memory
6. Retrieval from long-term memory into working memory
7. Response generation to effectors
8. Performance in the learner's environment
9. Control of processes through executive strategies.

The goal of a training program is to ensure that the information presented is encoded properly and moved into long-term memory. Gagne's theory is that learning can be facilitated if the design of the training program takes into account how the mind processes information, particularly in steps 3 through 6 above, where the information is perceived, rehearsed, encoded, and retrieved. The information that is perceived takes the form of one or more of the five Learned Capabilities (i.e. Verbal Information, Intellectual Skills, Motor Skills, Attitudes, Cognitive Strategies). If and how this information is processed into long-term memory is dependent upon the internal and external stimuli that are present when the Learned Capability is presented. This stimuli are the Conditions of Learning, and each Learned Capability reacts to different Conditions of Learning. By understanding what Conditions of Learning are best suited for the Learned Capability being presented and employing those conditions properly, a training program can optimize the learning for the capability.

For example, when teaching verbal information, an instructor may provide the same information several times is different ways. This technique, called "repetition," is an external Condition of Learning for Verbal Information in that it reinforces the information to ensure that it is encoded properly and stored in long-term memory.

1.5 Purpose Statement

As a result of the logistical issues cited in Section 1.1, instructor-led training is often less effective than it should be. This translates into a lower-skilled workforce that is not prepared for today's highly competitive economy.

WBT, by its design, can eliminate many of the logistical hurdles faced by training departments in corporate America. However, while WBT use continues to increase, there remains a reluctance by some because of the belief that WBT is simply not as effective as instructor-led training. For example, OSHA has issued several directives clearly stating that companies can employ CBT or WBT only in **conjunction with** instructor-led training for OSHA certification courses (Rekus, 1999). Additionally, Hewlett-Packard Educational Services has begun offering CBT in conjunction with other instruction methods because they feel that instructor-led hands-on training is vital to the success of their programs (Kavanagh, 1998).

This thesis presents the results of a case study performed at the Consumer Network Services (CNS) division of Electronic Data Systems Corporation (EDS). The purpose of this case study is to determine whether a WBT course is as effective as an identical, instructor-led training course for software training.

The results of this study show that WBT was as effective as instructor-led training for the purposes of software instruction.

CHAPTER 2

MATERIALS & METHODS

2.1 Materials

The case study required the development of the following materials:

- Consent Form
- Candidate Questionnaire
- WBT Course
- Instructor-led Course
- Post-Course Test
- Field Test Form

2.1.1 Consent Form Analysis

The consent form is the formal document through which the potential student (candidate) agrees to participate in the study. This document provides information regarding the study, including the purpose of the study, a student's role in the study, and any risks and benefits of participation. The candidate is also advised that they are free to terminate participation in the study at any time. The candidate must complete and return the consent form in order to be considered for the study.

A sample of the consent form is provided in Appendix A.

2.1.2 Candidate Questionnaire Analysis

Each candidate is required to complete a three-page questionnaire. This questionnaire contains a series of statements regarding the candidate's experiences with the English

language, computers, and training. The candidates respond using a six-point Likert-type scale.

The purpose of the questionnaire is two-fold. First, the questionnaire is used to determine each candidate's prior knowledge of the English language, computer skills, and computer-based or web-based training. Second, the questionnaire is used to measure each candidate's attitude toward computers and training.

As stated in Chapter One, Attitude is one of the five Learned Capabilities. This case study is not designed to alter a student's attitude toward computers and/or training (external stimuli). Rather, the questionnaire is used to measure each student's pre-disposition toward computers and training (internal stimuli).

The questionnaire begins with a question: "Have you ever used the EDS product called ClientView?" If a candidate answers "Yes" to this question, they are precluded from participation in the study. Each of the following statements in the questionnaire is designed to measure a specific Learned Capability. The statements, and their corresponding Learned Capabilities are listed in Table 1.

Statement	Learned Capabilities
Section One: Prior Knowledge	
English is my first and best language.	• Verbal Information • Intellectual Skills
I am proficient with the pointing device commonly referred to as a mouse.	• Verbal Information • Intellectual Skills • Motor Skills
I am proficient with the Microsoft Windows operating system (either Windows95, Windows98 or WindowsNT).	• Verbal Information • Intellectual Skills • Motor Skills
I am proficient with the Internet/World Wide Web (WWW).	• Verbal Information • Intellectual Skills • Motor Skills
I am proficient with either the Netscape Navigator or Microsoft Internet Explorer web browser software.	• Verbal Information • Intellectual Skills • Motor Skills

Statement	Learned Capabilities
I am proficient with web-based training (WBT) or computer-based training (CBT) courses.	• Verbal Information • Intellectual Skills • Motor Skills
Section Two: Computer Experiences*	
My prior experience with WBT or CBT was a positive one.	• Attitude
I feel confident using computers.	• Attitude
Computers can allow me to do interesting and imaginative work.	• Attitude
Computers make it possible to work productively.	• Attitude
I hesitate using a computer for fear of making mistakes I can't correct.†	• Attitude • Intellectual Skills
I need an experienced person nearby when I use a computer.†	• Attitude
I am in complete control when I use a computer.	• Attitude
If I get problems using the computer, I can usually solve them on my own.	• Attitude • Intellectual Skills
Section Three: Training Experiences	
I prefer to learn at my own pace.	• Attitude
I enjoy interacting with students and the trainer.	• Attitude
I learn more on the job than I can in a class.†	• Attitude
Computers can teach a person.	• Attitude
I enjoy taking training classes.	• Attitude
I seek out courses given completely via the computer.	• Attitude

* *Section Two contained statements used in a previous Computer Attitude Scale (Selwyn 1997). Some of the statements were modified for this study.*

† *These statements were written as unfavorable to avoid a "halo effect."*

Table 1 - Candidate Questionnaire

A sample Candidate Questionnaire is contained in Appendix B.

2.1.3 WBT Course Analysis

This case study was performed at the Consumer Network Services (CNS) division of Electronic Data Systems Corporation (EDS) in Morris Plains, New Jersey during the week of April 3, 2000. The course instructs users to download reports and search for data using a proprietary application called ClientView. The content of both the instructor-led training

and the WBT course is identical, and both courses were designed using the theoretical approach of The Conditions of Learning. The theoretical approach was put into practice using the principles described in *Principles of Instructional Design* (Gagne, Briggs, Wager, 1992), which provides practical applications for The Conditions of Learning theory.

ClientView was selected as the topic of training for several reasons, particularly:

- The package is fairly easy to learn, which mitigates the risk of presenting course material that is beyond the comprehension of the students.
- The package is relatively new, so there is a large pool of people within EDS who have no prior knowledge of ClientView.
- ClientView training is required by EDS. Therefore, this training program, as well as this study, will have a direct and practical impact on this and future training programs.

The WBT version of the course is a Type 3 WBT course, as described in the Web Based Training Cookbook (Hall, 1997). A Type 3 WBT course is considered to be the most technologically advanced, and contains interactive multimedia and judged interactions.

The architecture of the course is directive, as described by Ruth Colvin Clark (Lyons and Clark, 1999). Directive architecture is geared toward training users and procedures, and divides the course into segments that contain frequent tests or quizzes.

The course itself was developed using ToolBook II by Click2Learn Corporation (formerly Asymetrix Corporation). This package enables the creation of WBT in either or two forms:

- As HTML pages for text and graphics, and Java or ActiveX-enabled utilities for quizzes and demonstrations.
- As a native ToolBook II application that can be viewed as WBT using an Internet "plug-in" called Neuron.

The second option was selected for this study because it is the most likely choice for CNS' actual on-line training curriculum. It offers the flexibility of distributing the training in either CBT or WBT format.

The WBT course contains four lessons. At the conclusion of each lesson, the student completes an exercise that reinforces the lesson. The four lessons are:

- Introduction
- Logging On To ClientView
- Reading a Report
- Searching In ClientView

A Learning Task Analysis was developed for each lesson to identify all of the tasks that comprise the lesson. The following sections provide a description of each lesson and the Learning Task Analysis for each of the tasks in that lesson.

2.1.3.1 Introduction

The Introduction provides the student with facts regarding what ClientView is, how it works, and why it is used. The Learning Task Analysis for this lesson is:

Given the successful completion of the Candidate Questionnaire and the ClientView Introduction lesson, state specific facts regarding ClientView, in response to questions posed by the WBT.

This lesson provides Verbal Information, as per Gagne's Learned Capabilities. The internal Conditions of Learning related to the Verbal Information were determined by the Candidate Questionnaire, and include the following:

- Knowledge of the English language
- Knowledge of basic computer terminology.

The external Conditions of Learning for Verbal Information that applied to this lesson consist of the following:

- Stating the objective
- Providing the information
- Providing repetition to reinforce the facts.

The Introduction lesson concludes with an exercise. This exercise tests the students understanding of the Verbal Information using three questions. The question formats are true/false, multiple choice, and fill-in-the-blank, and the student receives feedback after each response.

2.1.3.2 Logging On To ClientView

This lesson provides step-by-step procedures for logging on to the ClientView site. The Learning Task Analysis for this lesson is:

Given an active web browser, demonstrates the ClientView logon procedure by accessing the ClientView web site, typing the user name and password, and clicking on the arrow with the mouse.

This task is further segmented into the following steps:

2.1.3.2.1 Type the ClientView URL

Given an active web browser, accesses the ClientView web site by typing the ClientView URL.

2.1.3.2.2 Type User Name

Given the ClientView home page, executes the log on procedure by typing the user name in the "Username" field.

2.1.3.2.3 Type Password

Given the ClientView home page, executes the password procedure by typing the password in the "Password" field.

2.1.3.2.4 Submit Information

Given the ClientView home page and the successful completion of the ***Type User Name*** *and* ***Type Password*** *steps, executes the log on procedure by clicking on the arrow directly to the right of the "Username" and "Password" fields.*

In addition to Verbal Information, this lesson also provides instruction requiring Intellectual Skill and Motor Skill Learned Capabilities. The internal Conditions of Learning for these Learned Capabilities are verified through the Candidate Questionnaire and include the following:

- Knowledge of the skills required to access a web site, including the ability to use a mouse and keyboard, navigate the Microsoft Windows operating system, access the internet, and use a web browser.

The following external Conditions of Learning for the Learned Capabilities are employed in the WBT:

- The order of the steps is listed
- The steps are taught in the correct order
- Screen images illustrate the proper completion of each step
- The opportunity for discovery is provided via the exercise.

The applicable internal Condition of Learning for the Motor Skills Learned Capability is determined via the Candidate Questionnaire, specifically:

- Knowledge of the proper order of procedures and how to perform them.

The applicable external Condition of Learning is provided by the WBT, specifically:

- Provide positive and negative feedback upon completion of a task.

Upon completion of the lesson, the student completes an exercise to test his or her understanding of the task. The student has the option of performing the task with or without assistance. If the student opts to attempt the task without assistance, he or she is presented with the CNS Home Page. The student must access the ClientView site and successfully log on to the ClientView server. The WBT program provides a simulated environment that is identical to the actual ClientView environment. If the student has

difficulty, the option to jump to the assisted lesson is available. If the student opts for the assisted lesson, step by step instructions are overlaid on the simulated environment. In either case, the external Conditions of Learning for the Intellectual Skill Learned Capability are provided through "discovery," and the external Conditions of Learning for the Motor Skill Learned Capability are provided through feedback.

2.1.3.3 Reading Reports

This lesson provides step-by-step instructions for downloading a report through ClientView. The Learning Task Analysis for this lesson is:

Given the ClientView main page, demonstrates the ability to retrieve reports by typing the document name, identifier, and date, and clicking on the "Read Page" button with the mouse.

The task is further segmented into the following steps:

2.1.3.3.1 Select Document Name

Given the ClientView main page, executes the selection of the report name by typing the name in the "Document Name" field.

2.1.3.3.2 Select Identifier

Given the ClientView main page, executes the selection of the client identifier by typing the client's Logo in the "Identifier" field.

2.1.3.3.3 Select Date

Given the ClientView main page, executes the selection of the report date by typing the date in the "Date" field, or selecting the date from a drop-down list box.

2.1.3.3.4 Submit Request

Given the ClientView main page and the successful completion of the ***Select Document Name***, ***Select Identifier***, *and* ***Select Date*** *steps, executes the document request procedure by clicking on the "Read Page" button.*

This lesson provides instruction for Verbal Information, Intellectual Skill and Motor Skill Learned Capabilities. The internal and external Conditions of Learning for these Learned Capabilities as described in sections 2.1.3.1 and 2.1.3.2 are applied to this lesson.

Upon completion of the lesson, the student again performs an exercise to test his or her understanding of the task. As with the Logging On To ClientView exercise (section 2.1.3.2), the student has the option of performing the task with or without assistance. If the student opts to attempt the task without assistance, he or she is presented with the ClientView Main Page in the simulated environment. The student must enter the appropriate data in the correct fields and click on the "Read Page" button to submit the request. The student has the option of jumping to the assisted lesson at any time. The external Conditions of Learning for the Intellectual Skill Learned Capability are provided through "discovery," and the external Conditions of Learning for the Motor Skill Learned Capability are provided through feedback.

2.1.3.4 Performing a Search

The fourth lesson provides the steps required to perform a generic, single index search. This type of search enables the ClientView user to type a string of data, and have

ClientView locate every occurrence of that string in the specified report. The Learning Task Analysis for this lesson is:

Given the ClientView main page, demonstrates the ability to search for a string within a report by clicking on the "Search" button, selecting the search type, typing the search criteria, and clicking on the "Search" button in the Search page.

This task is further segmented into the following steps:

2.1.3.4.1 Select Search Page

Given the ClientView main page and the successful completion ***of the Select Document Name***, ***Select Identifier***, *and* ***Select Date*** *steps, executes the Search request by clicking on the "Search" button.*

2.1.3.4.2 Select Search Type

Given the ClientView search page, execute the selection of the search type by selecting the search type from the drop-down list box.

2.1.3.4.3 Select Search Criteria

Given the ClientView search page, execute the selection of search criteria by typing a search string in the search field.

2.1.3.4.4 Submit Search Request

Given the ClientView search page and the successful completion of the ***Select Search Criteria*** *task, execute the search request by clicking on the "Search" button with the mouse.*

This lesson provides instruction for Verbal Information, Intellectual Skill and Motor Skill Learned Capabilities. The internal and external Conditions of Learning for

these Learned Capabilities as described in sections 2.1.3.1 and 2.1.3.2 are applied to this lesson.

Upon completion of the lesson, the student performs an exercise to test his or her understanding of the task. As with the lessons described in sections 2.1.3.2 and 2.1.3.3, the student has the option of performing the task with or without assistance. If the student opts to attempt the task without assistance, he or she is presented with the ClientView Main Page in the simulated environment. The student must access the Search Page, enter the appropriate data in the correct fields and click on the "Search" button to initiate the search. The student has the option of jumping to the assisted lesson at any time. The external Conditions of Learning for the Intellectual Skill Learned Capability are provided through "discovery," and the external Conditions of Learning for the Motor Skill Learned Capability are provided through feedback.

2.1.4 Instructor-led Course Analysis

The instructor-led course was designed to be identical to the WBT in terms of content and methodology. The lessons provided instruction on the same topics, taking into account the same conditions of learning. The exercises were also identical. The only difference was that the students in the instructor-led course used the actual ClientView system, rather than the simulated system created within the WBT.

A 15 page training manual was developed to facilitate the instruction. This manual provided the same content and screen images as that of the WBT. Although the screen images were captured in color, the manual was printed in black and white. This was done to simulate a real world environment, since all of CNS' training documents are black and white to reduce costs.

Training was provided by two Advanced Training Specialists from the EDS CNS Documentation and Training department. Both trainers have provided ClientView instruction in the past, using materials developed by their group. The trainers were provided with a lesson plan, a lesson task analysis, an overview of the pertinent Learned Capabilities and their associated external Conditions of Learning, and a copy of the training manual. The trainers were instructed to avoid any deviation from the lesson plan or the material presented in the training guide, to maintain consistency with the WBT.

2.1.5 Post-Course Test

At the conclusion of the course (either instructor-led or WBT), each student is asked to complete a brief post-course test. This test consists of four sections, and determines the student's ability to state ClientView facts, and perform the tasks he or she learned in the course, using the actual ClientView application. The first section consists of three questions about ClientView (one multiple choice and two True/False). The second section prompts the user to log on to ClientView using a specified username and password. The third section prompts the user to read a report using a specified document name, identifier, and date. And the fourth section requests that the user search for a specified string in a given report.

As the student performs the test, a judge monitors his or her progress to determine how well he or she is able to perform each task.

A sample Post-Course Test is provided in Appendix C.

2.1.6 Field Test Form

The Field Test form is used by the judge to evaluate each student during the Post-Course Test. The form follows the same flow as the test and provides areas for the judge to rate each task as it is performed by the student. The first section provides areas for the judge to indicate whether the student answers the ClientView questions correctly, incorrectly, or not at all. Sections Two, Three and Four lists each of the tasks to be performed by the student, and provides a four-point Likert-type scale to measure the degree to which the student is able to perform each task.

A sample Field Test Form is provided in Appendix D.

2.2 Methods

This case study was performed in a five step approach:

- Solicit Students
- Distribute Consent Forms and Candidate Questionnaires
- Evaluate Candidate Questionnaires and Determine Students
- Administer Training Courses and Post Course Tests
- Analyze Test Results and Determine Effectiveness

2.2.1 Solicit Students

The population for this study was limited to twenty students (N=20), of which ten would participate in the instructor-led course, and ten would participate in the web-based course. Prospective students would have no prior experience with the ClientView application.

Department managers were notified of the training course and the case study on March 8, 2000, and were asked to recommend employees who would benefit from ClientView training. This request yielded forty potential students.

2.2.2 Distribute Consent Forms and Candidate Questionnaires

Each of the potential students was provided with a package containing the consent form and the Candidate Questionnaire, were informed as to the purpose of the study and their role as a participant, and were asked to complete the package if they were interested in participating. To ensure anonymity, a Control Number was entered on each package, and this number was used to track each student during the course of the study. Of the forty packages distributed, thirty-two (32) people responded.

2.2.3 Evaluate Candidate Questionnaires and Determine Students

Returned packages were logged in a spreadsheet, and the Candidate Questionnaires were scored. As indicated in the Materials section, the questionnaire consisted of twenty (20) six-point Likert-type statements designed to measure the candidate's prior experience with computers, and attitudes toward computers and training. Each statement was scored with a value ranging from five to zero, where five corresponded to "Very Strongly Agree," and zero corresponded to "Very Strongly Disagree."[1] The maximum possible score was 100 points.

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[1] Three statements were reversed to prevent the "halo" effect. As a result, they were graded so that a five corresponded to "Very Strongly Disagree" and a zero corresponded to "Very Strongly Agree."

Of the thirty-two questionnaires received, nine candidates had prior ClientView experience, and were therefore ineligible. Additionally, three candidates subsequently withdrew prior to the course. This resulted in a final population of twenty students.

The students were placed into quartiles based on their questionnaire scores. The students were then distributed between the WBT or instructor-led training course, based on their quartile. This was done to ensure an even distribution between training types, as illustrated in Table 2.

Control #	Score	Quartile	Training
33	60	1	Instructor-led
19	69	1	Instructor-led
40	73	2	Instructor-led
11	74	2	Instructor-led
03	76	2	Instructor-led
37	77	3	Instructor-led
08	80	3	Instructor-led
16	81	4	Instructor-led
20	84	4	Instructor-led
22	85	4	Instructor-led
10	65	1	WBT
18	70	1	WBT
13	71	2	WBT
39	72	2	WBT
04	76	2	WBT
12	77	3	WBT
14	80	3	WBT
06	81	4	WBT
15	83	4	WBT
27	84	4	WBT

Table 2 - Student Distribution

The students were notified of the type of training to which they were assigned, and when the training would take place.

2.2.4 Administer Training Courses and Post Course Tests

The instructor-led training courses were held in two sessions of five students each, at the EDS CNS Parsippany, New Jersey training room on April 7, 2000. The course was provided in a hands-on format, in that each student, as well as the instructor, had a PC connected to ClientView. As the instructor taught each lesson, the student had the ability to perform the same functions. Each student also performed the exercises using the actual ClientView application.

The WBT courses were administered during the week of April 3, 2000 either at the students' PCs or at a stand-alone PC set up for the study. Each student participated in the WBT at his or her own pace. Exercises were performed in a simulated ClientView environment built into the WBT program.

At the completion of the training (both WBT and instructor-led training), the judge administered the Post Course Test. Each student began by answering three questions about ClientView. The student would then attempt to perform the ClientView functions learned during the training, while the judge evaluated their performance using the Field Test form. In order to ensure consistency, one judge evaluated all twenty students.

2.2.5 Analyze Test Results and Determine Effectiveness

At the conclusion of the training sessions, the results of the post-course test were tallied by student, based on the data provided in the field test form. The values of the field test form were calculated as follows:

- Section One: A correct answer to a question was worth one point. An incorrect or unanswered question received a score of zero. As a result a total of three points was possible for Section One.
- Sections Two through Four: A task that was completed with ease received a score of three points. A task completed with some difficulty received a score of two points. A task completed with much difficulty received a score of one point. A task that could not be completed received a score of zero. As a result, the maximum score for each section was 12 points. Therefore, the maximum score for the entire test was 39 points.

CHAPTER 3

RESULTS

3.1 Detailed Results

The average scores for the WBT and instructor-led training students are 37.5 (or 96.2%) and 37.3 (or 95.6%), respectively. Therefore, on average, the students in the WBT course performed marginally better than the students in the instructor-led course. This is further supported by the median scores for each type, 38 (or 97.4%) for WBT and 37.5 (or 96.2%) for instructor-led training. This information is detailed in Table 3.

Control #	Quartile	Training Type	Post-Course Test Score
33	1	Instructor-led	36
19	1	Instructor-led	39
11	2	Instructor-led	36
40	2	Instructor-led	39
03	2	Instructor-led	39
08	3	Instructor-led	34
37	3	Instructor-led	37
22	4	Instructor-led	36
20	4	Instructor-led	38
16	4	Instructor-led	39
10	1	WBT	36
18	1	WBT	38
39	2	WBT	32
13	2	WBT	38
04	2	WBT	39
12	3	WBT	38
14	3	WBT	38
15	4	WBT	38
06	4	WBT	39
27	4	WBT	39

Table 3 - Post-Course Test Scores by Quartile and Training Type

The modes for each type of training show that the most common score for WBT is 38 (or 97.4%) and the most common score for instructor-led training was 39 (or 100%). However, further analysis of the results shows that 80% of the WBT students scored 38 or higher, compared to only 50% of the instructor-led training students.

The standard deviation is 2.12 for WBT and 1.77 instructor-led training. However, the higher standard deviation for WBT is the result of a single person scoring a 32, or 82%. This, of course, is one of the inherent hazards of a small population

3.2 Implications of Results

These results indicate that WBT is a viable alternative to instructor-led training methods, for purposes of software training. This claim is substantiated by the fact that the majority of the WBT students scored 97.4% on the Post-Course Test, indicating an exceptionally high level of learning. However, two issues should be noted. First, this study concerned the training of a computer program, and these results should not be extrapolated beyond that type of content. Second, the training was developed using a proven theoretical approach, namely Gagne's *The Conditions of Learning*. WBT courses developed without a sound theoretical approach may not yield the same results.

This study is important for three reasons. First, from a broad perspective, it shows that WBT can be effective for computer program training, if it is designed and developed properly. This study is a real world example of a WBT implementation, complete with all of the workplace distractions and other issues that are common with self-paced training. Second, this study is important to EDS CNS in that it may help to justify the feasibility of developing a WBT curriculum. And finally, this study is important because it was conducted in a corporate environment, using company employees, their PCs, and the computing infrastructure, and providing subject matter that the employees wanted to learn, or needed for their jobs.

CHAPTER 4

DISCUSSION

4.1 Theoretical Implications

The results of this study validate the theoretical approach described in Gagne's *The Conditions of Learning*. Four Learned Capabilities were identified for this study (Verbal Information, Intellectual Skills, Motor Skills, and Attitudes).

Internal Conditions of Learning for each Learned Capability were assessed based on the results of the Candidate Questionnaire by determining the level of prior computer knowledge and experience, the level of knowledge of the English language, and determining each student's attitude toward computers, training, and CBT/WBT.

External Conditions of Learning for each Learned Capability were presented in the design of the course. Conditions of Learning for Verbal Information were provided by a strong objective statement, the use of reinforcement through repetition, and feedback during the exercises. Conditions of Learning for Intellectual Skills were provided by listing the order of steps for each task, presenting the steps in the correct order, illustrating the proper completion of each step with a screen image, and providing the opportunity for discovery through the exercise. Conditions of Learning for Motor Skills were provided through the use of positive and negative feedback during the exercises.

The student scores for both WBT and instructor-led training are consistently high, indicating that *The Conditions of Learning* theory was applied accurately. Low scores in both training types would have indicated an improper application of the Conditions of Learning, insufficient use of the Conditions of Learning, or an inaccurate assessment of the Learned Capabilities.

4.2 Comparison to Previous Research

The results of this study are consistent with many studies performed since 1995. Studies performed by Bowman, Grupe, and Simkin; Williams and Zahed; Bohlen and Ferratt; and Lawson all indicate that CBT students performed as well, or better than students that were provided with instructor-led training. Additionally, the WBT program implemented by the city of Austin, Texas (Couret) reported similar results in that the student average for the courses was in the 90% range.

The Bowman, et al and Bohlen and Ferratt studies are particularly relevant in that the topic of instruction is a software application. Bowman, et al indicate that there is no significant difference in student performance between the CBT and instructor-led groups, while Bohlen and Ferratt show that the CBT group scored more than 7% higher overall than the instructor-led group.

The study presented in this thesis incorporated several observations from previous studies:

- Stephenson found that instructor-initiated interaction resulted in improved performance for CAI students. The ClientView WBT incorporated automatic feedback throughout the exercises thereby simulating interaction that was not requested by the student. As stated earlier, feedback is also a Condition of Learning for Intellectual and Motor Skill Learned Capabilities.
- Attitude was determined to be a factor by Owens and Waxman; Lee; Bowman, Grupe and Simkin; Williams and Zahed, and Boylen and Ferratt. Although not directly indicated in these studies, Attitude is also a Learned Capability in *The Conditions of*

Learning theory and is addressed in the present study through a computer attitude scale in the Candidate Questionnaire.

- The type of student is determined to be a factor in the studies by Owens and Waxman, and Wilson, et al. The Owens and Waxman study shows that elementary school students with learning disabilities did not perform well in a CAI environment, while the Wilson, et al study shows that CAI students in a remedial mathematics course performed significantly better than the instructor-led students in geometry, and performed as well in algebra. Taking this observation into account, the student population for the present study was asked to complete a Candidate Questionnaire to determine deficiencies in the ability to learn the software application, or conversely, prior mastery of the application. The Candidate Questionnaire results show that none of the students in the present study were deficient in the skills required for participation (i.e. English grammar, computer skills). However, some students were prohibited from participation due to prior use of the ClientView application.
- Finally, all of the previous studies employed an instrument to establish a baseline of prior knowledge and experience, in order to ensure an equal distribution of students between the CBT and instructor-led groups. The present study used the scores of the Candidate Questionnaire to evenly distribute students based on a composite of their prior experience of and attitudes toward computers and training.

The study presented in this thesis differs from all of the previous research cited in that it measures the effectiveness of WBT rather than CBT. This is significant for three reasons:

1. Critics of WBT doubt its effectiveness based on the results of some studies conducted using CBT. A study using WBT as the training vehicle more accurately measures WBT effectiveness to that of instructor-led training. Positive studies using WBT may result in increased and hopefully high quality WBT applications. Conversely, negative studies could reduce the use of WBT.
2. WBT, while similar to CBT, is a new technology with unique advantages and limitations. For example, WBT offers immediate and inexpensive implementation over the Internet or a company's Intranet, whereas CBT is typically "burned" onto CD-ROM and then mailed to students. However, current transmission technology limits the speed at which WBT operates, particularly when the WBT employs large graphic, animation, sound or video files. Therefore, studies performed using WBT accurately reflect the current state-of-the-art for WBT, including the speed and size limitations.
3. Currently, WBT is growing in popularity as the technology becomes easier to use and less expensive. For example, Dow Chemical has begun the implementation of a corporate wide WBT training program (Hanner, 1999). Dow explored WBT as a cost reduction effort and expects to save $20 million over the next three years. A study comparing the effectiveness of WBT to instructor-led training can validate or refute investments in WBT.

4.3 Practical Applications

This study has two primary practical implications. First, the WBT developed for this study is now available for all employees of the Consumer Network Services (CNS) division of Electronic Data Systems Corporation (EDS). After the study was completed, the

ClientView WBT tutorial was made available on the company's Intranet. This enabled employees who could not attend an instructor-led class due to scheduling conflicts or geographical issues to receive ClientView training. Second, and on a much larger scale, the results of this study have a practical impact on the direction of the EDS CNS Documentation and Training department. The department plans to use this research as a feasibility study to determine whether or not WBT is a viable alternative to instructor-led training. The results of this study indicate that WBT is an effective training medium, and this could justify the development of additional WBT courses.

4.4 Areas for Further Research

There are many areas for further research as a result of this study. A larger sample size, in a true experimental setting would verify the results documented here. Since this research was a case study, an attempt was made to provide a "real world" scenario for both types of training. As a result, the instructor-led training environment was generally more conducive to learning, since it was more controlled than the WBT sessions, particularly when the WBT students participated via their own PC in their own cube. A number of students reported that they were interrupted by work issues while participating (i.e. phone calls, people stopping by). Ironically, some students saw this as an advantage of WBT in that they were able to take a training class and work at the same time, and they were unaffected by the interruptions. Of course, others found this to be a distraction.

A controlled WBT environment could be established so that the WBT courses could be administered in a separate room to reduce distractions. Also, both types of courses could be held at similar times of the day, preferably late morning, to reduce the

effects of fatigue. This study did not consider fatigue as a factor, and in fact, the WBT training courses were administered at various times of the day (as early as 9:00 AM and as late as 4:30 PM). However, a review of the data did not indicate that fatigue played a role in terms of student scores. There were two sessions of instructor-led courses, one at 10:00 AM and the other at 1:00 PM, so fatigue could not be considered a factor.

Another area of future research could focus on learning retention. In both training types, the Post-Course Test was administered immediately after the training. A follow-on study could evaluate students a week or a month after training to determine how well the students retained the training. In such a study, it would be important to consider which students had used ClientView since the training, since those students would have received reinforcement of the learned tasks.

Finally, research could also focus on different subject matter. This study was concerned with software training. Further research could be done to measure the effectiveness of other types of training, such as business policies and procedures.

APPENDIX - DOCUMENTS

This appendix contains the following items:

- Sample Consent Statement
- Sample Candidate Questionnaire
- Sample Post-Course Test
- Sample Field Test Form

Appendix A - Consent Statement

Consent Statement

Control #: _____

Name of Project Director: Robert Myre

Title of Project: Comparing the Effectiveness of Stand-Alone Web-Based Training and Traditional Training

I acknowledge that on _____(Date), I was informed by Robert Myre (Investigator) of the Electronic Data Systems Corporation (Institution) of a project concerning or having to do with the following:

Experiment to measure the effectiveness of Web-Based Training and traditional training using the EDS ClientView application.

I was told with respect to my participation in said project that:

(1) the following procedures are involved:

a. complete a pre-test questionnaire

b. if accepted, participate in a ClientView course in a traditional classroom format, or via Web-Based Training

c. complete a post-course test

(2) The following possible risks are involved:

None; confidentiality of the data will be fully protected.

(3) The following possible alternative procedures that may be advantageous to me include:

None.

(4) The following benefits are expected by my participation:

Provide data for a statistical analysis in order to measure the effectiveness of Web-Based Training and traditional training.

Opportunity for me to learn about, and learn how to use, ClientView.

I am fully aware of the nature and extent of my participation in said project and possible risk involved or arising there-from. I hereby agree, with full knowledge and awareness of all of the foregoing, to participate in said project. I further acknowledge that I have received a complete copy of this consent statement.

I also understand that I may withdraw my participation in said project at any time.

_____
Date

_____
Signature of Subject or Responsible Agent

_____
Printed Name of Subject or Agent

Morris Plains, New Jersey
Location of Study (City & State)

_____
Residence Address of Subject or Agent

_____
Local Telephone Number

Appendix B - Candidate Questionnaire

Candidate Questionnaire

Control #: _____

Thank you for offering to participate in this study. In order for this study to accurately measure training effectiveness, the students must be selected based on a number of criteria. Therefore, please take a few moments to complete this questionnaire.

Please be assured that your responses in this questionnaire will be kept strictly confidential and the results will be used solely for determining candidates for the study. Your honest responses are crucial to the success of this study.

Also, please note that you may not be selected for participation in this study for a number of reasons. This in no way indicates a deficiency on your part. It simply means that your prior experience is not in line with the needs of this study. In either case, I want to thank you again for agreeing to participate.

Section One: Prior Knowledge

1. Have you ever used the EDS product called ClientView? V
   Yes _____ No _____

2. English is my first and best language. VI

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

3. I am proficient with the pointing device commonly-referred to as a mouse. VIM

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

4. I am proficient with the Microsoft Windows operating system (either Windows95, Windows98 or WindowsNT). VIM

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

5. I am proficient with the internet / World Wide Web (WWW). VIM

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

6. I am proficient with either the Netscape Navigator or Microsoft Internet Explorer web browser software. VIM

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

7. I am proficient with web-based training (WBT) or computer-based training (CBT) courses. VIM

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

Section Two: Computer Experiences[1]

8. My prior experience with WBT or CBT was a positive one. A

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

9. I feel confident using computers. A

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

10. Computers can allow me to do interesting and imaginative work. A

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

11. Computers make it possible to work productively. A

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

12. I hesitate using a computer for fear of making mistakes I can't correct. A

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

13. I need an experienced person nearby when I use a computer. A

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

14. I am in complete control when I use a computer. A

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

15. If I get problems using the computer, I can usually solve them on my own. A

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

Section Three: Training Experiences

16. I prefer to learn at my own pace. A

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

17. I enjoy interacting with students and the trainer. A

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

18. I learn more on the job than I can in a class. A

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

19. Computers can teach a person. A

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

20. I enjoy taking training courses. A

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

21 I seek out courses given completely via the computer. A

Very Strongly Agree	Strongly Agree	Agree	Disagree	Strongly Disagree	Very Strongly Disagree
☐	☐	☐	☐	☐	☐

[1] Selwyn, N. 1997. *Students' Attitudes Toward Computers: Validation of a Computer Attitude Scale for 16-19 Education*, Computers Educ. Vol. 28, No. 1, pp. 35-41

Appendix C - Post Course Test

Post-Course Test

Part 1: ClientView Facts

Please answer the following ClientView questions (circle the correct answer):

1. ClientView uses a distributed architecture that consists of _____ tiers.

   Two Three Four Five

2. ClientView is accessed through a dial-up connection or direct connection to the Internet.

   True False

3. ClientView requires the installation of a special web browser called "The Viewer."

   True False

Part 2: Logging On To ClientView

Please log on to ClientView at the following address using the following username and password:

Address:	http://www.cns.clientview.com:9000/
Username:	cvuser
Password:	cvuserpswd

Part 3: Reading Reports

Please read a report with the following attributes:

Document Name:	IF65
Identifier:	L029
Date:	March 12, 2000

Part 4: Searching In ClientView

Please perform a generic search for the following string on the report you read in step 3.

String: 389.46

Appendix D - Field Test Form

Field Test - ClientView Training

Control#: _____

ClientView Facts

Question 1:	Answered Correctly	Answered Incorrectly	Not Answered
Question 2:	Answered Correctly	Answered Incorrectly	Not Answered
Question 3:	Answered Correctly	Answered Incorrectly	Not Answered

Logging On

Task	Performance			
	With Ease	With Some Difficulty	With Much Difficulty	Could Not Perform Task
Access web site				
Type username				
Type password				
Click Enter arrow				

Reading a Report

Task	Performance			
	With Ease	With Some Difficulty	With Much Difficulty	Could Not Perform Task
Select document				
Select identifier				
Select date				
Submit request				

Searching

Task	Performance			
	With Ease	With Some Difficulty	With Much Difficulty	Could Not Perform Task
Click Search button				
Select search type				
Type search string				
Click Search button				

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