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Computer-based training and its impact on training and education

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Abstract

Computer-based training is an area of training that is growing at a rapid pace. Although it is becoming more and more popular, we must determine the actual impact it has on training in order to assess its usefulness and relevance. This study was developed by researching and compiling available data on the subject of computer based training, and then forming an assessment of this type of training based on that information. It was found that computer based training offers many positive features as well as advantages and appropriate applications, but it does have its limitations, and is not the answer for all training situations. This type of training is still in its infancy, and its full impact and significance remains yet to be seen.

Computer-Based Training

and its Impact on Training and Education

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Computer-based training is an area of training that is growing at a rapid pace. Although it is becoming more and more popular, we must determine the actual impact it has on training in order to assess its usefulness and relevance. This study was developed by researching and compiling available data on the subject of computer based training, and then forming an assessment of this type of training based on that information. It was found that computer based training offers many positive features as well as advantages and appropriate applications, but it does have its limitations, and is not the answer for all training situations. This type of training is still in its infancy, and its full impact and significance remains yet to be seen.

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Chapter One

Introduction

Computer-based training (CBT) is one of the fastest growing areas of training. While the concept of CBT is becoming more and more popular, the impact and effects of this type of training are still being explored. There are many different definitions of computer-based training, depending upon who is doing the defining. For the purpose of this paper, computer-based training (CBT) is an all-encompassing term describing the use of a computer as an educational or training tool. Computer-based training is sometimes referred to as computer-assisted learning (CAL), technology-based training, technology-delivered training, computer-based instruction (CBI), and others. CBT can take many forms, including CD-ROM courseware, web-based training (WBT), games, simulations, virtual reality, tutorials, drill-and-practice, and Intelligent CBI (ICBI). CD-ROM courseware is usually customized courseware for specific training needs. Web-based training (WBT) is any sort of training delivered via an Internet or intranet. Games may or may not simulate reality, but are nearly always characterized by providing participants with entertaining challenges (Alessi & Trollip, 1991). A simulation is a contrived situation designed to parallel a real life situation, using a responsive system model that can be manipulated by the learner. Virtual reality is a term that describes a type of exploration world, one that responds as the participant operates in a physically realistic manner (Towne, 1995). The tutorial is one of the earliest and most basic uses of computers in the instructional process. Many people use the terms "computer-assisted instruction" and "tutorial" interchangeably. A tutorial presents material to the trainee for the first time.

The primary focus is on the trainee's acquisition of new facts and concepts (Rockart & Morton, 1975). Drill-and-practice is the second major type of presentation system. Drill-and-practice takes over the main responsibility for developing the student's skill in the use of a given concept. It typically leads the trainee through a series of examples to practice previously-learned materials or have them repeated. Drill-and-practice assumes some familiarity with the concept and is designed to provide reinforcement of previously acquired concepts. It permits practice and allows trainees to gain familiarity and competence with the material (Rockart & Morton, 1975). Intelligent CBI is one of the more recent advance in the field of CBT. It involves the use of artificial intelligence programming to make the CBT more responsive than traditional CBT. Three dimensions of CBT are important in determining intelligence in a CBT system – intelligent diagnosis of error patterns, intelligent feedback, and intelligent dialogue between the computer and the trainee (Criswell, 1989).

Early taxonomies distinguished between four types of computers in teaching – drill-and-practice, tutorial, dialogue, and management (Atkinson, as cited in Kulik, 1994). Recent taxonomies have altered these categories to include only three types of CBT (Taylor, 1980) – use of the computer as a tool, to aid and facilitate learning, the use of the computer as a tutor, where the computer delivers the instruction, and the computer as tutee – the participant "teaches" the computer, and learns by doing so. In the majority of computer-based training, the most common application of CBT is the second type, where the computer delivers the instruction. As stated by Easton (1998), author of Computer Based Training, "CBT incorporates the best features of video, classroom instruction, and written materials" (p. 2).

Many companies and distributors of CBT claim that this type of training has revolutionized the training world and makes a significant difference in the effectiveness of training; other sources claim that this is mostly hype and promises yet unfulfilled. The literature currently available on this subject consists mostly of books, magazine articles, and Internet articles. Books are a good source of history on the subject, but very few are current and up-to-date on the newest trends and technologies of CBT. Magazine and Internet articles are a good source of a wide variety of current information, but most deal with only one or two aspects of CBT, and few are comprehensive. Any article directly addressing the impact or effect of CBT on the overall training or educational arena as yet has remained elusive in the scope of this research.

Purpose

This study attempts to remedy that gap in available information. There may be some truth to the extravagant promises, yet also some truth to the conservative skeptics, and the balance between the two is what is to be discovered through the research of this subject.

The question remains – how much of an impact does CBT really have on training? The purpose of this study is to answer that question. It will provide a comprehensive look at the past, present, and future of CBT, as well as the current and projected impact of this type of training.

Methodology

This study was performed by researching available materials on the subject of CBT. A search was conducted first at the local university library, as well as on the

Internet. In addition, a variety of trade journals and magazines were used as a resource for relevant articles. Additional information was gleaned from presenters at trade organization conferences. The procedure used was to identify relevant material, read through the material looking for specific information, find any additional relevant information not falling within the confines of the specific questions, and combine all of the pertinent information as well as "reading between the lines" to form my own assessment of the impact of CBT.

Organization

The remainder of this paper contains a literature review and conclusion. The literature review is divided into seven major subjections: History, Instructional Theories, Features, Applications, Effective CBT Design, Advantages and Disadvantages, and Current Trends and Technologies.

Chapter Two

Literature Review

History

The beginning of computer use in education can be traced back hundreds of years – both analog computers, like the slide rule, and digital computers, the first one of which is the abacus. It is only with the recent computer revolution that computers have become faster than a man with an abacus.

In the 1700's, Blaise Pascal invented a calculating machine to help his father count the French census (Adams, 1985). A similar machine was developed by Leibniz. Charles Babbage devised the difference engine in the 1820's, which later became the model for IBM's 80-vertical-column punch cards. Babbage used 10 digits; in the 50's the binary code of two digits came into use (Adams, 1985).

Herman Hollerith developed a mechanical device, called the Hollerith card, to tabulate the 1890 census (Adams, 1985). In the 1890's, Hollerith founded the Tabulating Machine Company, which later became IBM. His design formed the basis of IBM until 1960 (Adams, 1985).

As early as 1926, Pressey conceptualized a device that sought to apply then-contemporary learning theory to automated instruction. The mechanical device, consisting of multiple-choice questions and answers by the teacher, would drill the student on the questions and offer immediate feedback to support learning (Regian & Shute, 1994).

Today's concept of CBT has been around since the first use of computers, in the 1970's (Alessi & Trollip, 1991). In 1960, the groundbreaking PLATO (Programmed

Logic for Teaching Automated Operations) project by the University of Illinois was one of the first to use computer assisted learning and eventually enabled the integration of text and graphics. A great amount of federal monies were spent on modularized self-paced instruction, including CBT (O'Neil, Jr., 1981). Most of the projects enjoyed brief success, and then died. However, four types of CBT product forms were successful enough to make it past this point: conventional presentational packages, packages containing interactivity, packaged performance aids, and testing systems (O'Neil, Jr., 1981). In 1972, the Mitre Corporation's TICCIT (Time-Shared Computer-Controlled Information Television) project introduced computer-based instruction on minicomputer, and was also the first to use the concept of learner-controlled instruction as well as component design theory (Alessi & Trollip, 1991).

Initially, some early CBT machines were dedicated systems, with one mainframe computer whose only function was computer-based training (Alessi & Trollip, 1991). In 1978, Apple II, the first widely available microcomputer, was released. It was followed in 1981 by IBM. The next major advance was the AppleMac release in 1984, when the first computer with a mouse was introduced. In 1989, NeXT computer was released. This computer combined graphical user interface with greater speed, storage, networking potential, multi-tasking, and flexibility than Macintosh (Alessi & Trollip, 1991). CBT gained popularity in the 1980's with computer tutorials for word processing and other basic computer applications. However, there were still factors of incompatibility and other technological constraints, as well as a shortage of people skilled in developing quality courseware. A major revolution occurred with the introduction of CD-ROMs and

video clips, and the continued growing prevalence of computers equipped with CD-ROM drives – today, it is almost as standard as a floppy disk drive. In addition, the availability of authoring software has aided the ability of corporations to develop their own courseware, further enhancing the use of CBT in training.

Society has had a great impact on the development of CBT. For example, the demands of World War II helped accelerate the development of the computer, and the Vietnam War brought the first widespread usage CBT (Shlechter, 1991). The need for economic protection has been a major impetus for the development of computers in the U.S. The computer-based training medium was initially developed by IBM for corporate training, and had limited experimental use in the civilian educational sector. A 1965 memorandum issued by Secretary of Defense Robert McNamara called for the different services of the Army, Navy, and Air Force to examine new innovations for military training (Fletcher & Rockaway, as cited in Shlechter, 1991). McNamara's goal was to provide standardized and cost-efficient training for the war effort. These military projects led to marked improvements in CBT courseware, and the military has continually supported the research and development of CBT throughout the 1970s and 1980s. Another catalyst for CBT development was the Russian launching of Sputnik, in response to which President Eisenhower pledged a national commitment to teaching science and mathematics. CBT programs were developed to support this commitment (Shlechter, 1991). In recent years, politicians and educators have been encouraging CBT as a means of helping Americans to develop the job skills necessary for today's technological world. Hardware and

software manufacturers have also been a strong mediating force in the use of CBT (Shlechter, 1991).

Instructional Theories

Although societal pressures rather than educational theories have determined much of CBT development, educational theories have played an important role in its development. These educational theories include both behavioral and cognitive theories.

Behavioral theories of learning, particularly B.F. Skinner's theory of operant conditioning, have had a tremendous influence on the early development of CBT systems. Skinner's basic learning principles of personalized instruction, "controlled operant," immediate feedback, linear sequence, and instructional prompts were all important aspects in the development of the PLATO II Computer System (Shlechter, 1991). One major change from Skinner's theory was the use of a branching sequence, first devised by Crowder in 1962 (Shlechter, 1991).

Throughout the progression of CBT, many programs changed to a more cognitive orientation. The cognitive orientation is derived from the belief that students need to develop an understanding of the underlying concepts associated with a task; this understanding is developed by allowing students to actively interact with the environment (Shlechter, 1991). The instructional design of the TICCIT project contains elements of cognitive theories. Piaget's theory of cognitive influence greatly influenced Papert, who helped design the LOGO system. As computer technology became more sophisticated, the cognitive influence on CBT became more prevalent (Shlechter, 1991).

Features

Traditionally, training has had three major drawbacks: a cost factor, time factor, and consistency factor (Kurtus, 1997). In each of these areas, the features of computer-based training can be an effective solution. Although CBT has a high initial start-up cost, once developed, CBT can be used multiple times, offering a significant cost savings over time. The time factor, both in terms of efficiency and convenience, is significantly improved with the use of CBT. And, of course, with each participant using the same CBT, the consistency rate is considerably greater than traditional forms of training.

Some of the features of computer-based training include interactivity, the integration of multimedia, automatic scoring, and the ability to reach a wide audience (Hannafin & Peck, 1988). In addition, CBT is convenient, self-paced, and standardized. Interactivity is one of the key features of CBT. The participant is able to make decisions and select various paths to take through the courseware and see a result. Multimedia, such as the combining of text, graphics, animation, voice, music and video, can easily be incorporated into CBT, especially with the technological advances of today. However, an effective training solution can also be developed using only text, questions and graphics.

CBT has the ability to automatically score and keep track of participants' answers. It can also be distributed to multiple trainees at one time, either by disk, CD, or via the Internet. It can be made available whenever or wherever it is needed, as long as there is a computer available. CBT is self-paced, where trainees can go at their own pace, and repeat any portions as necessary. Because the training is self-

contained and can be widely distributed, a standard message can be communicated to all trainees. This allows for the promotion of best practices and the input of all relevant subject matter experts (Easton, 1998).

CBT can either teach knowledge structures or dynamic skills (Munro, Fehling, & Towne, 1985). Much of the CBT developed in the past, as well as most of the research performed on computer-based training, has involved CBT programs that teach knowledge structures. Knowledge structure refers to "coherent bodies of essentially propositional information" (Munro et al., 1985, p. 50). It can be characterized as consisting of a repeating cycle of instruction by the machine, followed by a performance by the student. Dynamic skill refers to a "complex of perceptual, motor, and decision-making skills such as are called for in many real world tasks" (Munro et al., 1985, p. 50). These types of skills might include piloting or driving vehicles, or performing the responsibilities of an air traffic controller (Munro et al., 1985).

There are a variety of methods by which CBT can be delivered (Easton, 1998). Beyond programs that are delivered via disk or CD-ROM, there also delivery methods that involve conferencing and the Internet (Munger, 1997). Conferencing refers to any training in which participants at different locations interact; it can take place electronically using networked computers, via audio, using telephone lines, and through live video, using microwave, satellite, or compressed video. There are four types of computer-based training delivery methods (Munger, 1997) – asynchronous computer conferencing (ACC), video teleconferencing (VTC), two-way digital teleconferencing (2DTC), and training via the Internet. ACC uses computers as the

delivery system, and provides trainer-to-trainee and trainee-to-trainee interaction in an electronic setting. It is best used when trainees are in different time zones or have different work schedules, or when the subject matter expert requires individual study and group discussion. VTC enables instructors to be televised live to multiple locations. It works well when many individuals in widespread locations need to be trained simultaneously. 2DTC uses compressed video technology and requires telecasting equipment at trainees' sites as well as the trainer's site. It permits a much larger degree of interaction than VTC. This delivery method can be effective when a high degree of visual and auditory interaction among participants and instructors at different locations is needed. Finally, training via the Internet can bring multimedia-enhanced training to a widely dispersed audience on demand. Many Internet courses are transmitted using e-mail, on-line and real-time conferencing, and can range from simple, text-based, question-and-answer format to elaborate courses with multimedia presentations, hypermedia links, and live videoconferencing (Munger, 1997).

Applications

CBT works better in some situations than others (Criswell, 1989). CBT tends to work best for mathematical skill practice, simulations in hazardous conditions, troubleshooting skills, and decision-making skills. It traditionally has not been good for most hands-on skills (with the exception of computer applications), training dealing with sensitive issues, and replacement of the "real thing," such as flying an airplane. To a point, a pilot can learn how to fly a plane using some type of CBT, but most people would not want to ride on a plane where the pilot had not already flown a real plane. There are five functions that computers can do, as related to CBT:

arithmetic, comparisons, storage of information, information retrieval, and branching (Hannafin & Peck, 1988).

The Office of Technology Assessment (OTA) identified the most promising current uses and demonstrations of computers in education (Office of Technology Assessment, 1988). The uses for Colleges of Education include the following:

- Drill and practice to master basic skills
- Development of writing skills
- Problem-solving
- Understanding abstract mathematics and science concepts
- Simulation in science, mathematics, and social studies
- Manipulation of data
- Acquisition of computer skills for general purposes, and for business and vocational training
- Access and communication for traditionally unserved populations of students
- Access and communication for teachers and students in remote locations
- Individualized learning
- Cooperative learning
- Management of classroom activities and record keeping

The use of CBT in higher education will continue to grow and develop as experiences with CBT continue to help educators develop more confidence as well as new possibilities and solutions (Deaton, 1991).

Effective CBT Design

Effective CBT should gain the learner's attention, inform the learner of the objectives, stimulate recall, guide learning, provide informative feedback, assess performance, and enhance retention and learning transfer (Hannafin & Peck, 1988). It should allow for individualization, interactivity, and an appropriate amount of learner control. It is important for developers of CBT to design screens carefully, maintaining consistency and offering adequate options at each step. Additional media can be added as appropriate, but designers should take care not to go overboard adding in sounds, movies, and other media.

There are five types of feedback that can be incorporated in CBT design (Hannafin & Peck, 1988) – correct answer, knowledge of correct response, knowledge of correct response and forced correct response, knowledge of correct response and anticipated wrong answer remediation, and knowledge of correct response and a second try to respond. When to give feedback, and which type to give, depends upon the type of task.

When evaluating a particular CBT and its effectiveness, it is important to look at several factors (Alessi & Trollip, 1991). These can include determining if the CBT matches its objectives, if it is logical for the learner, and how user-friendly it is. The sequence of the presentation should be logical, and the screen design should be aesthetically pleasing, with complementary use of color, contrast, audio, and other media. There should be a way for the user to identify where they are in the CBT at any given time, with an option available to go back to the starting point. An effective CBT will allow flexibility in customizing the software, offering different levels of

challenge for different students. CBT programs should present a non-biased view and provide suitable and reinforcing feedback. They should also include an internal option where a novice can go for help (Hannafin & Peck, 1988).

Instructor interaction has been shown to positively influence achievement when students work on CBT individually; however, studies show that instructor interaction has no effect on achievement when students work CBT in pairs (Stephenson, 1992). Many if not all of the social functions, feedback, and support provided by the instructor in the traditional classroom can be provided by a CBT team partner. There is a general consensus that achievement of students working CBT in dyads or triads is equal to or surpasses achievement of students working alone. In cases where CBT will be used for pairs or groups of three, the CBT software should be written to acknowledge that more than one student may be working on the terminal at the same time, possibly by requiring more than one response at each step (Stephenson, 1992). Stephenson (1992) suggests that "transitioning to CBT does not automatically guarantee success. Many factors must be considered before a CBT system reaches its full potential" (p. 33).

There are several basic characteristics that are essential to effective CBT. First, the CBT must be based on sound instructional objectives. It should be designed for specific audiences and match those learner characteristics. Interactions should be maximized, taking full advantage of this auspicious feature of CBT. The ability to individualize the CBT is key, allowing the user to adapt the sequence to the individual learner. CBT lessons should create and maintain interest in order to be the most effective, and should approach the learner positively. A variety of feedback

should be provided, depending on the task as well as the intended audience. The CBT should be designed to fit the instructional environment, and should evaluate performance appropriately, avoiding ambiguity. A good CBT designer will make wise use of the computer resources available, and will base the instruction on instructional design principles. Before the CBT is distributed, it should be thoroughly evaluated, like any other instructional design material (Hannafin & Peck, 1988).

Advantages and Disadvantages

There are many significant advantages to using CBT, which is one reason that the use of CBT is becoming more popular (Easton, 1998; Kurtus, 1997; Shlechter, 1991). Interactivity is one of the most powerful strengths of CBT, which gives it a considerable edge over text-based instruction and other strictly linear media. Another advantage is the ability to provide immediate feedback. Many drill-and-practice programs in particular, as well as several other types of CBT, provide immediate, edifying feedback to inform the student of the accuracy of their response. CBT has also been shown to increase motivation, especially when the student is new to the CBT and has fun with it. Well-designed feedback can add to that motivation. Flexibility and improved access to training are also advantages of CBT. CBT offers relevance, and can mean a cost savings for a large number of employees. Most CBT courseware can be customized, and is modular and mastery-oriented. This individualization allows trainees to concentrate only on those specific areas they need, including remediation. The time saved in learning only pertinent information, as well as travel time, reduces lost productivity. The standardization of training and immediate feedback provided by CBT assures quality control (Microcraft

Corporation, 1998). CBT also offers the ability to perform at high speed with a high degree of accuracy. It also provides the ability to collect and manage information. Unlike human instructors, CBT can repeat tasks as many times as necessary without getting bored or frustrated. The overall non-threatening nature of a CBT environment is another advantage over human instructors.

Some of the promises of CBT that have come to fruition include:

1. Stabilizing educational costs – with CBT, more students are able to complete a course without hiring additional instructors, and data shows that CBT drastically reduces training time (Shlechter, 1991).
2. Increasing student achievement – several reviews of CBT research have shown that CBT does moderately raise student levels of achievement, and it has proven to be more effective than conventional instruction for teaching certain areas of mathematics (Shlechter, 1991).
3. Handling individual differences and needs – many educators and researchers believe that computers are ideally suited to handle individual learning differences. Drill and practice programs in particular provide low-ability students with needed additional structure of and practice with instructional materials (Becker & Sterling, as cited in Shlechter, 1991).
4. Increasing student motivation – CBT advocates claim that learner motivation is high for CBT programs because it is fun and easy to use; a study done by Avner and associates (as cited in Shlechter, 1991) at the University of Illinois found that students consistently favored PLATO over other instructional media.

Other benefits of CBT include CBT's motivational aspects helping "at-risk" students complete educational programs, freeing up instructors' time to be able to devote more time in other areas, and helping with retention of quality instructors in remote areas (Shlechter, 1991).

Although there are many positives to using CBT, there are also some disadvantages to its use (Easton 1998; Shlechter, 1991). There is a large initial development cost, which can be too costly to justify the development of CBT for a limited number of employees or limited usage. It is also more difficult to design than traditional training, and is not always appropriate. In some cases, too many bells and whistles can detract from the message, and poor design has often been a problem. CBT lacks the human element of face-to-face learning, and requires initiative and motivation on the part of the learner. Motivation is not always intrinsic to the use of CBT, especially as the novelty wears off and people become more familiar and used to CBT as another form of training. Another disadvantage to CBT is its inability to react spontaneously. CBT does not work well to do large-group instruction effectively. It is also unable to teach or model certain types of behavior.

There are several problems with CBT that have acted as barriers to its full implementation and use in the classroom, such as the following:

1. Inadequate funding – although costs have decreased significantly in the last few years, an extensive capital investment is still required. There are also considerable expenditures associated with maintenance and upgrading of the system, teacher training, power for terminals, peripheral equipment, support

personnel, disk storage space, and lifetime authoring privileges for some systems (Shlechter, 1991).

2. Inadequate software – after more than 30 years of CBT, the curricula for this medium are still in their infancy (Strudler & Gall, as cited in Shlechter, 1991). This is due to several factors, including the concentration of CBT developers on hardware rather than courseware, the practically non-existent involvement of teachers in the development of commercially published software, and the lack of proper knowledge in the selection of courseware.
3. Inadequate planning and preparation – sufficient planning and preparation are frequently not carried out, which leads to available computers not being fully utilized (National Task Force on Educational Technology, 1986).
4. Unrealistic expectations – many educators have unrealistic expectations of CBT, and then become discouraged when outlandish promises are not met (Shlechter, 1991).

Current Trends and Technologies

With computer processor speeds getting faster and faster, and with more and more capacity of storage space available on disks or CD-ROMs, CBT is becoming bigger, better, and more comprehensive (Easton, 1998). CBT use is growing rapidly, and WBT in particular has experienced a high growth rate. This $12 billion dollar industry of today is expected to reach $27 billion by the year 2000 (Baruch, 1997). WBT experienced 80% growth in 1996, with 150% growth predicted for the year 1997, and sales should reach $1.5 billion by the year 2000 (Hall, 1997b).

In the past, the difficulty of using the available authoring systems was a big problem (Criswell, 1989). Innovations with automatic programming have greatly improved the use of authoring systems, combining the simplicity of authoring packages with the flexibility of languages. A CBT programmer can now enter a simple command, and the software writes the corresponding lines of computer code. The top authoring programs, according to "The Computer-Based Training Report" for 1997 (Filipczak, 1997), were (in order of number of citations by respondents): Authorware (Macromedia), Toolbook (Asymetrix), Director (Macromedia), Quest (Allen Communications), IconAuthor (Aimtech), and Designer's Edge (Allen Communications).

The growing use of networks and the Internet will bring major changes in the way people learn in the future (Tucker, 1997). According to Tucker (1997), it will "alter the whole pattern of learning and make lifetime learning a reality" (p. 55). The responsibility for learning will shift from the institutions to the individual. According to Filipczak (1997), "the hottest trend in the training industry these days is web-based training – instruction delivered over the Internet or corporate intranets" (p.72).

One of the newer technologies in the CBT arena is the hybrid CD (Hall, 1997a). This combines the best of both worlds of the customization and depth of CBT and the up-to-date, latest information of WBT. Courseware is distributed on a hybrid CD, and the latest information is then downloaded from the Internet to combine with the information on the CD (Hall, 1997a).

According to "The Computer-Based Training Report" for 1997, CBT was a firm 10 percent in 1995 and 1996 of all training conducted in respondents'

organizations; in 1997 the figure jumped to 15 percent (Filipczak, 1997). However, these numbers may be conservative. A 1997 study by Kemske, editor of CBT Solutions magazine, showed that the median size of the 1,184 respondents' companies dropped from 3,800 employees in 1996 to 2,000 employees (Filipczak, 1997). This suggests that CBT is gaining popularity in progressively smaller organizations. Another factor to consider is that respondents' overall training budgets were down in 1997 as compared to 1996, and therefore the median CBT budget actually rose as a percentage of total training expenditures – from 12 percent in 1996 to 18 percent in 1997 (Filipczak, 1997).

Chapter Three

Conclusion

While this is still a fairly young and evolving technology, there is significant potential for CBT. It offers many benefits, and can be particularly effective for certain applications. In some cases, it has even been shown to help learners to learn and retain more than they would with traditional training methods. CBT has had a significant impact for delivery of training to remote locations, large staff situations, multiple offices, a variety of training levels, and organizations with high turnover of staff.

Although CBT can have many benefits, there are still a few caveats that need to be kept in mind in regards to its use. CBT must be well designed to add value, and can only be as good as the person who develops it. Too many bells and whistles can detract from the message, and often the training would be better if it were simpler and focused more on the content. In addition, the availability of technology should never dictate the training used (Kurtus, 1997). Different media have different advantages, and may be more appropriate in certain situations than others. Like any training, it is most important to use sound instructional design to develop the training, test it thoroughly and keep it up to date.

Many studies have shown that computer-based training programs usually have positive effects on student learning (Kulik, 1994). However, results are not the same in every study, and no study has reported that all types of CBT increase student achievement in all types of settings. CBT is an imprecise category of innovations, and covers some practices that usually work and others that have little to offer. Computer

tutoring in particular has consistently had favorable results that are clearly greater than those produced by instructional technologies relying on print materials (Kulik, 1994). According to Lesgold (1994), an "effective long-term strategy would be for workers to acquire some of the knowledge they need to work intelligently and adaptively through apprenticeship experiences simulated by intelligent and adaptive software" (p. 115).

CBT is still in its infancy, and can be compared to the initial use of the motion camera (Stoll, 1996). Movie directors were still unaware of the full potential and possible uses of this technology, and at first, they would simply record plays and theater productions (Stoll, 1996). WBT is even younger than CBT, and is the area that will probably have the most growth and future impact.

CBT does have its advantages, but it will never replace the instructor. As comprehensive as some CBT courseware attempts to be, it will never be able to answer every question. Questions that ask why are the most central to scholarship, yet these are the ones that computers have the most difficulty with (Stoll, 1996). Just like Thomas Edison's failed prediction that the motion picture would revolutionize education and get rid of textbooks, neither will CBT be the end-all be-all of training and education. It takes people to inspire people. As Stoll (1996) points out, most people can easily name three teachers who have made a difference in their lives, but few, if any, can name three filmstrips they watched in school. No form of technology will ever be able to replace the essential human element crucial to prolonged inspiration and motivation.

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