EFFECTIVE LEARNING OF NX THROUGH COMPUTER BASED TRAINING AT P.E.S. INSTITUTE OF TECHNOLOGY

Sunith Babu L ¹ Sai Sashankh Rao ²

E Mail: sunithbabu@pes.edu, sashankhrao@gmail.com

ABSTRACT

Elite universities across the globe require a fast, effective and low cost method to update their staff and students on existing software packages, processes and standards. Computer Based Training (CBT) provides the requisite solution. With CBT, training is provided through the use of a computer and software, and is a method to train someone at any time and at any place with the help of computer based applications. The concept of "learning by doing" has been emphasized in this paper. The application of CBT to the automotive sector has been discussed and its effect on Return on Investment (ROI) has been analyzed. The influence of CBT on a small, local student population has been studied. To supplement the above, a comparison has been made between a group of 15 students of PES Institute of Technology, a recently recognized PACE Institution, who have been trained in the high end CAD package – UG NX4 by the CBT based technique with a similar group of 15 students who have been trained in the traditional classroom manner. The various aids and techniques utilized in maximizing the productivity of a CBT, like - animations, videos, narrated step-by-step instructions, hands-on exercises, quizzes and practice exams have been discussed. The umpteen advantages of CBT, including – reduced training time, real world training without the inconvenience of physical mock-ups and classroom training, increased retention, increased safety, flexibility in time and learning style and reduced budgets along with a host of other factors have been depicted. To conclude, the application of Web Based Training (WBT) – an advanced level of CBT, to link PACE Institutions worldwide has been studied, and potential benefits indicated.

Keywords: Return on Investments (ROI), Local Student Population, Web Based Training.

INTRODUCTION

Today's rapidly changing world requires continual learning. Everyone has a preferred method of learning. Now one can choose to increase one’s skill set by taking courses that best meet one’s learning style. The concept behind this is using a Computer Based Training (CBT). Computer-based training is any training that uses a computer as the focal point for instructional delivery. In the past, computer based training was not as easily accessible or viable for businesses as it required a prodigious amount of hardware and software, items that were much more exorbitant in price than today. Nowadays, nearly everyone has access to a personal computer at home, at work or at computer labs in schools or libraries. With CBT, training is provided through the use of a computer and software, which guides a learner through an instructional program. It takes into account the different teaching methods available. This paper focuses on the numerous advantages of CBT and how PACE institutions from across the globe
could implement this technique to modernize a course and enhance the quality of information delivery.

CONCEPT AND IMPLEMENTATION OF COMPUTER BASED TRAINING

Computer Based Training is a process of learning that is not executed in the traditional manner one would find in the educational environment. Rather than the conventional classroom and instructor or professor setting, computer based training involves learning using software applications installed in computers. The student is, in effect, trained by the computer. A CBT is very convenient and extremely flexible. It is an electronic interactive technique that provides a
series of self-paced, hands-on training exercises in an installable format and is used to train someone, independent of time and place of residence on almost any subject with the help of computer based applications. The programs and data used in CBT are known as "courseware." The material is usually presented in the form of a CD-ROM or through LAN. Developing a CBT would require authoring tools, digital video, digital photography, 3D modeling, custom artwork, animation and sound editing software. CBT engulfs Computer-Assisted Instruction (CAI), Computer-Based Instruction (CBI), Computer-Assisted Learning (CAL) and Computer-Assisted Testing (CAT). Figure 1 indicates the procedural steps that one must adopt in order to implement a computer based training.

**COMPUTER BASED TRAINING TECHNIQUES**

One of the primary advantages of a Computer Based Training over the Traditional Tutoring is that it brings the curriculum to life. This can be achieved if the concept of ‘Fun in Learning’ is emphasized. CBT techniques are used to maximize the productivity of a CBT. Some of the techniques utilized in developing an effective and knowledge rich CBT are:

1. **Tutorial**
   
   It is used to introduce new information that must be taught in a sequential manner. It is useful for teaching factual information, simple discrimination, rules and simple application of rules. This is possible by using narrated step-by-step instructions (i.e. Audio-Enabled Learning), animations, videos, 3D cutaways, high resolution videos and detailed drawings.

2. **Drill and Practice**
   
   It provides opportunities for practice when mastery of a new skill or information is desired. It should be used after initial instruction. These include the hands on interactive exercises and hands on practice labs.

3. **Training Games**
   
   Training games supplement other instruction and are used to provide motivating and engaging opportunities for practice after a skill or new information is taught. Training games capitalize on the competitive interests of learners and add entertainment value to instruction.

4. **Simulation**
   
   The technique of simulation is most often used when practicing a skill in its real context is too costly or dangerous. It provides an opportunity for experimentation, and allows students to test assumptions in a realistic context. It builds a sense of realism and relevance into the training situation.

5. **Problem Solving**
   
   It helps students develop skills in logic, solving problems, and following directions, and is generally used to augment higher order thinking skills. This is supplemented with practice exams, quizzes and assessments.

6. **Demonstration/Presentation**
Demonstration or presentation is best used to support the introduction of new information. It can also be used as a review tool.

**COMPUTER-BASED TRAINING FEATURES**

CBT has a number of distinct and unique features, including:

1. **Immediate Feedback**
   The immediate feedback most computer-based training provides on trainee progress allows both instructors and trainees to monitor progress and adjust instruction accordingly. This feature is important for all skills, because it ensures that students are actually learning what they need to know.

2. **Placement**
   Placement via on-line testing that matches a trainee with needed training is also built into many CBT systems. By using this feature, you avoid any unnecessary training for an individual. The CBT can accommodate each individual's needs by "branching" to the level of training that is appropriate for that individual.

3. **Integration of Text, Graphics, Video and Sound**
   If the training is particularly content dense (many new concepts presented close together) or uses a hierarchy of skill acquisition (where current concept mastery is dependent on mastery of earlier concepts), CBTs integration of text, graphics, video, and sound facilitates the learning process.

**THE CONCEPT OF “LEARNING BY DOING”**

Computer-based training (CBT), also called computer-assisted instruction (CAI) is a type of education in which the student learns by executing special training programs on a computer. CBT is especially effective for training people to use computer applications because the CBT program can be integrated with the applications so that students can practice using the application as they learn.

Records suggest that on an average, people remember [1]:
20% of what they see,
40% of what they see and hear, and
70% of what they see, hear and do.

CBT's rich, multi-sensory delivery system can facilitate greater retention of new knowledge. An example to demonstrate this is as follows. PESIT now has a large number of PACE sponsored UGNX4 licenses. Using a CBT to handle the volume of students using these licenses seems to be appropriate. While the students are being trained with the computer assisted instruction, they can simultaneously verify and put into practice all that they have learnt in the training, since they have the target software on-hand. The advantage of this kind of system is that all of the information is right there at their desktop in one place versus going to a class, having time lapse before they can get access to a computer.
APPLICATION OF A CBT TO THE AUTOMOBILE INDUSTRY

Our world is shrinking. The automotive sector is growing at a rapid pace. There is a direct connection between the success of an organization and the effectiveness of its personnel. One way to enhance the skills and increase the effectiveness of personnel is through good training. Today’s automobile industries face certain problems like - hands-on training is expensive, current multimedia and print techniques are not immersive (i.e. traditional manuals are sometimes not sufficient for complex training) and time lags in critical training. Traditional classroom training is expensive and it normally cannot be repeated locally, at a worksite. The number of technicians and staff to be trained is larger than ever before, while the floor area required to deliver the training, is depleting at a rapid rate. Automobile industries can reduce training costs without affecting training quality by adding CBT courseware to their training curriculum. CBT identifies major fields of interest including training for new work structures and new methods and approaches for learning while working, especially in the automotive sector. CBT offers real world training without the cost, delays, and inconvenience of physical mock-ups and classroom training. Some of the benefits derived by applying CBT to the automobile industry are increased retention, improved safety and budgetary savings.

![Diagram of CBT Application in the Automobile Industry]

Figure 2: Application of CBT to the Automobile Industry

Take the case of an automobile firm. Every firm has various departments branches of which may be spread across the globe. Applying the CBT technique to train the staff would
ensure uniform and quality service to customers across all geographical locations. Suppose you want to service your car and do so in a small town, the CBT training would ensure that the technicians even at this remote location would be well equipped to provide the quality service that is available in larger cities. Moreover, suppose the company has implemented new standards and techniques in production and would like to update all its branches, the CBT would turn out to be a useful tool. Also, now - a - days automobile development centers use CAD packages in creating and enhancing new designs. Whenever a new version of the CAD package has been released the staff has to be trained to adapt to the revised package - CBT provides an effective solution. A CBT can be created at the headquarters by experts and distributed to various branches and then receive feedback so that there is continuous improvement. This is as indicated in the Figure 2.

ANALYSIS OF RETURN ON INVESTMENT (ROI)

Though the investment in implementing a CBT is quite high as compared to the traditional training, the returns obtained are impressive and cannot be matched by the traditional training technique. Some of the ways in which one would obtain returns are:

1. Reduction in employee travel costs
   Technology based training allows remote staff to receive high-quality training without incurring costs for transportation, meals and lodging.

2. Reduction in training administrative costs
   Because the training content is delivered online, trainees can access it from any computer at any time. A single trainer can reach a much larger portion of the training audience, acting more as a facilitator than an instructor.

3. Reduction in employee downtime spent in training classroom
   Staff will return to work sooner, equipped with the necessary knowledge and skills. This reduces overtime and scheduling conflicts. A CBT has proven to reduce training time by up to 50 percent when compared to traditional classroom training [2]. It also allows remote workers to spend more time in the field, increasing visits to customers and, thereby, revenues.

4. Retain and update training content for the long term
   After the initial training effort, new hires can be trained immediately, with little or no advance preparation. The course content can also be updated without incurring printing costs.

A flowchart illustrating the ROI and savings obtainable by implementing a CBT when compared to the traditional classroom technique is as shown in the Figure 3. Though the development costs are high for a CBT, the monetary gains obtained due to zero expense on other significant parameters generates an overall saving.
EFFECT OF CBT ON A SMALL LOCAL STUDENT POPULATION

As the volume of students that have to be coached within a stipulated time frame increase the need for a fast, effective and low cost technique of training emerges. Computer based training provides the requisite solution.

Since the recognition of PES Institute of Technology (PESIT) as a PACE institution, it has been funded with umpteen licenses of various software, one of them being the high end CAD package of UGNX4. Presently, students of the Mechanical Engineering Department are being trained on this software using the traditional classroom technique. Under this technique a group of students assemble in the training lab where the instructor briefs them regarding the software’s capabilities and then introduces them to new concepts and techniques regarding the use of the software. He then demonstrates the step by step procedure of how to perform a given task using the software. Once the instruction session is complete, the students are allowed to practice what they have learnt on the system. However the above method of training induces a time gap between the learning period and the practice period. When the student gets down to practicing, it is difficult for him to remember all of the instructions mentioned by the instructor. Hence there exists a transmission loss. This is just one of the drawbacks of the traditional classroom based technique. Others include, lack of flexibility in time, place of work and information content.
Hence it was decided to evaluate the CBT method to check whether or not it would overcome these drawbacks. To accomplish this, a group of 15 students were trained on UGNX4 using a CBT. A similar group of 15 students were trained on UGNX4 through the traditional technique. Finally feedback from both the groups was analyzed.

The CBT training was conducted as follows. Students were made to assemble in the training lab and were provided with a computer each. The pictures in Figures 4 indicate the training in progress at the PACE – PESIT Center. The system configuration necessary for the training was minimal. The CD ROM is undoubtedly a key component in such an activity. Headphones were provided to the students because it was a video cum audio assisted CBT. The CBT was created on campus with the use of a free trial version of Camtasia Studio. The CBT layout and structure is as shown in Figure 5. The entire NX4 course was divided into various modules. Students had the option of jumping from one module to the other and back to the previous one as per their learning style and speed of learning. A time of two hours was allotted for the training which is the same as that allotted to the regular training. The students first went through a particular chapter and then practiced it immediately on the same system as the NX4 software was readily available. The students were found repeating this cycle of ‘learning and doing’ until they felt confident with that particular concept. This feature of replaying a particular topic which is inherent in all CBTs greatly influences the learning process and retention curve. It must also be observed that the time lag between learning and doing, as discussed earlier is overcome by this method.

Figure 4: A CBT session in progress
Once the training was complete the students were given feedback forms to provide transparency and uniformity in the evaluation process. These feedback forms had a set of 18 questions which were designed in such a manner so as to obtain the accurate feedback in the most crucial areas of the training. A feedback form that was designed along similar lines was created and handed over to the 15 students who had been trained on UGNX4 through the traditional technique. The analysis of the two feedback forms have been indicated in Figures 6, 7 and 8.
In Figure 6 the two techniques are compared based on the evaluation parameters mentioned on the y axis of the bar chart. The average rating of the 15 students of each training method has been plotted along the x axis. From the bar chart, it is clear that the CBT is more favorable as it has been given a higher rating when compared to the classroom based training technique. Looking at the evaluation parameter - ‘Learning at your own pace’, indicates that the students were greatly influenced by the fact that there was no time pressure on them to learn quickly. The comment from one of the students’ is as follows,

“An easy to understand method of learning medium where the learner can acquire knowledge at his/her own pace and style” – Kini Nishit Shivanand.

Figure 7: Pie chart indicating the rating for the whole programme.

Figure 8: Pie chart indicating the rating for the use of CBT as a reference tool.
Further, Figure 7 and Figure 8 are pie charts which give us an idea about the rating provided by students regarding the overall evaluation of the CBT training and the use of CBT as a reference tool for the future. Figure 7 indicates that 60% of the students gave a rating greater than 9 out of 10 towards the overall evaluation of the CBT training and 33% of the students rated it higher than 8. On similar lines, as in Figure 8, 60% of the students provide a rating greater than 9 towards using a CBT as a reference tool and 27% of the students gave a rating greater than 8. This shows that, not only did the students appreciate the training, but would also prefer to use it as a reference tool.

The CBT was also found to be a useful reference tool in the PACE sponsored Global Vehicle Collaboration Project – 2007. CAD modeling of various components had to be created. The CBT cleared the doubts regarding the use of certain features of the software and provided the requisite recap.

From the above analysis it is clear that a CBT has significant benefits to offer to the student community. It could be applied to PACE institutions to assist in the teaching, especially in areas where animations and videos could enhance the learning activity. Contests of creating CBTs could be held across the PACE institutions. This would encourage students to enhance their creativity and showcase their talent. It would also help in sharing quality information between institutions.

**ADVANTAGES OF CBT**

Qualitative information obtained from students, teachers, and education supervisors suggest that CBT may be useful in motivating students and supports the potential educational benefits of CBT [3]. The primary advantages offered by CBT include:

1. CBT is Self-Paced, Flexible and Individualized
   A CBT enables students to work at their own pace. Fast learners can zip through the training program while slower learners or students with less free time for studying can take a slower approach. CBT can sequence training to match the trainee's needs. At no extra cost, a CBT can be tailored to include specialized mix of topics from standard classes to help address specific training objectives [4]. Custom courseware can be developed to fit specific learning styles. CBT can reach trainees outside the traditional classroom, providing instruction on the job or at home. CBT provides immediate feedback to trainees on their progress. CBT does not have to be delivered to all employees at the same time, thus allowing the company to maintain coverage of critical positions.

2. Increased Retention
   Studies show that students typically retain twice as much information from a CBT course that covers the same material as an instructor-led course. This is due to the intense interaction inherent in the CBT format, the ability to move through the material at the student's own pace and the ability to review material as many times as required. It teaches with hands-on participation, not lectures. 3D training replicates the real world experience and is proven to increase trainee participation and retention.

3. Time Savings and Just-in-time Learning
Studies show that CBT typically reduces the time required to learn material by 40-60 percent when compared to instructor-led courses. Travel time is saved. The time delay between the end of a scheduled class and the students’ first opportunity to use what they have learnt results in a reduction in retained knowledge. A standalone CBT course allows the student to take the course when it is needed and put the new knowledge to work immediately. Deploying lessons on laptop or tablet computers directly into the field allows personnel to train on updated procedures or to refresh knowledge of infrequently used processes. CBT courses include search tools built into the program that make them fast and efficient reference sources.

4. Cost Effectiveness
   After initial costs, you have a 24 hour per day trainer. Using CBT, a trainer can teach any number of trainees at the same time. Because CBT may enable you to reduce or eliminate travel for trainees, your total training costs can also be lessened. Unnecessary use of expensive equipment and prototypes is achievable by training remotely on standard desktop PCs.

5. Improve Safety
   Trainees can explore solutions to instructor-specified problems in a risk-free, realistic environment that encourages learning and experimentation. CBTs provide visual directions for dangerous or difficult tasks in interactive manuals.

6. CBT is Tireless
   It is always there. It never needs a break. It can train greater numbers of students in a given time frame compared to other methods. It meets the need for round-the-clock (continuous) training.

7. CBT works with an adult population
   The trainee feels in control. The computer is non-judgmental and non-threatening. It provides a privacy factor that reduces learners' embarrassment about taking "remedial" classes or making mistakes while answering questions in the training materials. The computer actively engages the trainee in the training process, providing increased trainee satisfaction.

8. Accelerate Training Timelines
   Existing CAD data can be used to develop training programs that can be initiated before products even reach the market. Also, automatic update of existing training programs with current techniques and processes is possible.

9. CBT can reduce resource requirements
   You can have a higher trainee-to-trainer ratio, where the instructor serves as facilitator, assisting trainees as needed. There is less need for a centralized training facility. Facilitators can serve more than one company with a CBT program, lessening the investment each company would have to make.
10. CBT can be a change agent

CBT may be the catalyst for a paradigm shift to new training approaches within an organization. Companies might begin to look beyond traditional classroom instruction to meet their training needs. CBT can provide computer literacy skills to employees, resulting in improved personal and organizational productivity.

WEB BASED TRAINING (WBT)

The introduction of Internet and Web-based technologies has resulted in changes in the way instructional design models are applied in the creation of instruction delivered [5]. WBT is a new, creative, anywhere, anytime method for delivering computer-based training to widespread, limitless audiences. WBT represents a shift from the current paradigm of CBT, where the information presented is usually stored on the local machine, a local server, or a local CD-ROM, to a system where information is distributed via the World Wide Web (WWW) and most likely is stored at a distant location. There are two primary models of Web-based instruction: synchronous (instructor-facilitated) and asynchronous (self-directed, self-paced). Instruction can be delivered by a combination of static methods (learning portals, hyperlinked pages, screen cam tutorials, streaming audio/video, and live Web broadcasts) and interactive methods (threaded discussions, chats, instant messaging, bulletin boards and desk-top video conferencing). A WBT may employ a variety of educational technologies, including web-based course management software, video capture technology, on-line testing and surveys, downloadable lecture notes, etc. The Web Delivery Mechanism is as indicated in the Figure 9.

Figure 9: Web Based Training Delivery Mechanism
Nearly all Web Based Instruction (WBI) is delivered in this manner. A remote server (it can be anywhere in the world) is connected to the Internet and thus to the World Wide Web. A local computer is connected to the World Wide Web by either a direct connection or via a modem and is running a piece of software called a browser that translates the electronic signals from the web into text, graphics, sounds, movies, and so on. Please note that a modem connection to the WWW is much slower than a direct connection. This is reflected in the diagram with a thinner link. Just as more water can travel through a larger pipe in a given time, so can more information pass through a direct connection than through a modem in the set time.

By using the technology of a WBT it is possible to link the PACE Institutions across the globe and derive numerous benefits. Students can access the course content from their residence or while traveling through a wi-fi enabled area using their laptops. They can choose their time and place of work as long as they have internet access and a web browser. The students just have to log on to begin their learning within the virtual classroom environment. A WBT is more flexible and one can adapt to it rather easily as it can be calibrated to suit one’s learning style. Timetables, schedules, assignments, notes and tests can be posted online, thus enhancing accessibility for the students. The WBT provides an evaluation and comparison basis on a global scale. Moreover PACE institutions need not buy CBT material from vendors, but instead create their own WBTs and link them throughout the PACE network. This will reduce the expenses incurred by the PACE institutions as well as motivate students to come up with new ideas, develop WBTs, as well as work on a collaborative basis. Another example illustrating the benefit of WBT to PACE is as follows. Imagine a case where a student has identified a new and unique technique in using any of the PACE tools. This student can create a WBT based on his idea and other PACE institutions can gain access to this through a secured link. This would not only motivate students to create their own WBTs and share their ideas, but also improve the quality of knowledge being shared. A WBT also ensures better connectivity among the student community. E-mail, bulletin boards, and synchronous and asynchronous chats all add a dimension to WBT that is difficult if not impossible to obtain in other delivery media. There is no limit to data storage and connection to external resources like WWW sites, on-line databases, on-line documents, etc is possible. With WBTs comes the option of using hyperlinks. This makes it easier to show how different concepts relate to one another, and to present the same content in different ways. In addition updating content is easier using this technique. To summarize, the main advantage of WBT is that, it is dynamic. Courseware content is in real time and online expert help is available 24X7.

CONCLUSION

CBT is an easy, fun, and powerful tool for learning or being tutored in any field of interest in the most exciting and innovative way. Faculties can use this new training method as an elegant way of modernizing the way a student learns. It will lead to a new breed of engineers who will be better prepared to meet the demands off the campus. A CBT could prove to be a useful tool in information update or tutoring in other PACE sponsored packages between the geographically dispersed PACE Institutions. With regard to the automobile industry, a CBT could be used to create an automotive product life cycle team which will be capable of tackling real life situations as soon as they graduate, without actually being trained using the physical mockups. With the advancement of mobile phone technology, mobile phones that are GPRS enabled and have a web browser could soon be used to access a WBT. CBT is the perfect source
for one’s never ending thirst for knowledge and the goal - know, learn, appreciate, and understand can be achieved.

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