

## COMPUTERS BRING NEW OPPORTUNITIES TO EDUCATION & TRAINING IN SCIENCE & TECHNOLOGY

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### Introduction

All of us at Pusdiklat know very well that our country, through the GBHN statements, and also Batan, through its mission & vision statements, stressed the highest priority of human-resources development as an important element in our attempt to survive -- even to make progress -- in the 21-st century that will come soon. Naturally, as the education & training center of Batan, Pusdiklat must shoulder most of this heavy burden. Unfortunately, with our limited education & training budget, especially in the face of our country's problem of financial crisis, the burden on Pusdiklat's shoulders is extra heavy, and we really have to think and work very hard to accomplish Pusdiklat's "mission impossible."

### Using Computers for Better Education Effectiveness and Efficiency

One way to help solve the above-mentioned dilemma is by using as much personal computers as possible in every aspect of education & training in nuclear science & technology. Simpson and Thornton in his comment entitled *Computers Bring New Opportunity to Science Education* also stressed the same thing. Batan's Pusdiklat during the last three years have also been using computers to assist education & training programs, albeit very sparingly. In 1997, Pusdiklat received several units of computers as part of a technical assistance program from Japan. Several Pusdiklat staff members visited Japan to get training on how to use computers to enhance the effectiveness of

Pusdiklat's education & training programs, followed by a visit of several Japanese experts to Pusdiklat to teach our personnel on how to use the computers properly. This is a big opportunity for Pusdiklat to catch up in computer usage in education & training. After some time and some experience for Pusdiklat's personnel in using the new machines, they should start thinking of a) how to increase the usage of the new machines to the machines' maximum capability, and b) how to imitate the machines' capabilities, and if possible, to make better machines, so as not to leave us dependent on foreign assistance forever. This is the right moment for Pusdiklat to make real progress.

The big question for many of us is: Is it true that computers improves the quality and reduce the costs of science & technology education & training? And if so, why? The following arguments try to justify, the large scale use of computers in education & training, especially in science & technology.

First of all, never forget that Batan is an R&D institute in nuclear science & technology. Therefore it is natural that education & training programs in Batan, are directed mainly to the researchers, especially the young ones. The goal of the education & training is to make them more mature and more productive in doing their research duties. It is a fact that R&D in science & technology are nowadays done through the experimental and modeling & simulation methods, both of which are

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highly dependent on computer usage. The experimentalists depend on computers for experimental design, data acquisition & control system and for statistical data processing & visualization. The need for computers for the simulationists is obvious. All these explain why our young researchers should be given computer knowledge as soon as possible, whether they are experimentalists or simulationists. In planning the contents of the education & training material, we have no other choice but to follow the steps taken by the technologically more advanced countries, and that means using computers a lot.

From many years of experience in the advanced countries, education & training experts learned that the subjects in education & training were absorbed by the participants about 80% through their eyes and about 20% through the ears. That is why every class room is equipped with overhead projectors and / or other audio-visual aids. With the availability of low cost but high performance computers, especially their ability to visualize colored computation and simulation results, including 2-D and 3-D animation, computers proved to be very useful in education & training, especially in front of the class rooms.

Besides being used in front of the class rooms to enhance the understanding of the material given in the lectures, computers can also be used by the participants themselves in the computer laboratory for practicing simulation runs, which may be done in parallel with -- or instead of -- laboratory experiments.

Due to the low cost, high performance, and easy availability of computers in the market the participants themselves can afford to buy one for practicing simulation runs at home or doing their homeworks. Besides the desktop model, which is cheaper, but bulky and heavy, computer companies also market smaller & portable versions called laptop or notebook, which is more expensive. However, its lightweight and portability is a real advantage worth the extra cost.

Once they have their own computers at home, the participants can use it also for communicating through Internet with their lecturers or with their fellow participants for

asking questions or sharing data / information. They even can use their computers to access needed information from the library database, as if the library is open for 24 hours, including holidays.

### Computer-based Education & Training System

When computers are equipped with the newly developed computer-related products, it will enable us to create a new education & training system without face-to-face contact between participants and lecturers and without tight lecture schedule, called Computer-based Education & Training System / CBETS. The March 1995 issue of BYTE computer magazine presented a cover story entitled *New Ways to Learn* that explain some developments in CBETS in the USA. CBETS is made possible mainly through the developments of three technologies, namely networking, multimedia and mobility.

Networking is the ability of many computer users scattered in a city, or in many cities, or even in many countries, to communicate with each other through their computers linked with a communication network. In CBETS, the course materials are already stored on a harddisk in a central computer called server, and the course participants are working in their homes accessing the course materials through their computers acting as clients. Therefore in CBETS, there are no contacts between participants and lecturer unless necessary. Besides theories, the course materials include problems that must be worked out by the participants to test their understanding of the theories.

The advantages of networking in CBETS are:

- virtual class rooms, meaning that there are no real ones
- lecturer as a resource person, meaning that he is consulted only when his advice is needed
- tailor-made courses
- distributed source of information
- one participant with many lecturers.

Multimedia is useful in CBETS because when provided with these facilities, a computer can perform as a computer and at the same time also as a television set. Therefore a computer equipped with multimedia facilities can assist CBETS in performing complex modeling and simulation with outputs in the form of complex 2-D or 3-D visualization with appropriate sound system. The full benefits of multimedia in a computer are:

- analog & digital video
- audio
- complex modeling & simulation
- 2-D / 3-D visualization / animation.

Mobility is achieved by obtaining a laptop or notebook computer which is lightweight & portable, but very powerful. Equipped with networking and multimedia facilities, these notebooks can do wonders. Some of the things linked to the concept of mobility are:

- use notebooks and wireless LAN / Internet
- virtual workgroups
- anytime / anywhere learning.

The overall benefits of using CBETS are as follows:

- ability to simulate real-life systems
- enabling self-paced learning
- lowering intimidation factor
- reducing behavioral problems in the class rooms
- increasing I-to-I interaction
- access to more information
- learning by doing => increase retention
- lowering education & training costs.

As a summary of CBETS, note the following. In the information economy, knowledge is power, and knowledge can be gained only through education. However, traditional teaching is expensive and slow. New technologies make learning more productive. In companies, centralized education & training is now giving way to *distributed, just-in-time learning*. The result is increased flexibility and retention at a lower costs. In universities, students surf the Internet, use Lotus Notes, exchange e-mail, peruse multimedia CD-ROMS, and perform simulations. These techniques breakdown

barriers, customized instruction, and make education more cost-effective.

The problem for us related to CBETS is the following: Is it necessary for Pusdiklat to have a CBETS? The answer is: YES, because Pusdiklat cannot afford to have many full-time lecturers in as many disciplines that is needed. Therefore CBETS is a dream that someday, somehow, must come true.

#### **Education & training must meet quality standards**

In the past, Pusdiklat received technical assistance from the International Atomic Energy Agency / IAEA in the form of the visit of DR. Chapman and his team. His mission in Pusdiklat was to teach us on matters involving education & training system that meet a certain quality standard, particularly ISO-9004. They call it the Systematic Approach to Training or the Systems Approach to Training. One rule in this education & training system is the following:

#### **TO HEAR IS TO FORGET** **TO SEE IS TO REMEMBER** **TO DO IS TO UNDERSTAND**

THIS RULE says that learning by *listening* alone is not enough, because everything said by the lecturer will soon be forgotten. A better way of learning is, besides listening, that they also can *see* something so that it can be remembered. This can be done through the use of an OHP in the class room. But remembering alone without understanding is no good in science & technology, and that is why *doing* is so important. Experimenting and simulating involve both seeing and doing.

This line of thinking is more or less parallel to the theory that people learn about 80% through their eyes and about 20% through their ears, and doing is certainly seeing. If *seeing* and *doing* play a very important role in a good education & training system, then the use of computers as part of seeing and doing must also be very important in

education & training, especially in science & technology.

There is one more reason why we have to use computers to enable the trainees to see and do, especially in nuclear science & technology education & training systems. For example, when a lecturer is teaching the trainees about nuclear radiation such as alpha / beta / gamma rays, then seeing is impossible, and doing is dangerous. This is where computers come to the rescue to help the trainees "see" and also "do" something about radiation without being exposed to danger.

#### Conclusion and Recommendation

From the discussion above it is easily seen that the use of computers in science & technology education & training is nowadays a must, especially in Batang. The benefits are clear, namely that education & training effectiveness and productivity can be increased, and this is achieved at a reduced costs. Remember that high productivity in education & training as part of human resources development program is a must, because as a developing country, we are supposed to catch up the more advanced countries. The problem is, the countries we are trying to catch up are not standing still waiting for us, but they are running very fast, of course with the help of computers.

Therefore the author is recommending the authorities of Pusdiklat to increase the portion of computer usage in every education & training program in nuclear science & technology, so that maximum benefit can be gained from it.

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