EMERGING TECHNOLOGIES IN TRAINING AND DEVELOPMENT

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Pervasive technologies such as PC-based distance learning and multimedia, affordable high resolution data/video projection systems, full screen/full motion MPEG encode/decode, low-cost custom CD-ROM production, and widespread Internet access are revolutionizing the learning environment. The result: instructors and students alike are confronted with an unprecedented choice of means and methodologies. In particular, putting the right tools in the hands of the instructor can significantly increase individual and overall productivity. Easy to learn/easy to use icon-based multimedia authoring software means that instructors can play a far greater role in developing and modifying course materials to suit individual class and student needs; PC-based classroom and in-classroom aids such as multimedia lecterns, data/video displays, and PC-based student monitoring and response systems vastly improve the efficiency of courseware delivery. Many of these options have been carefully evaluated and prototyped in electronic classroom upgrades taking place at the Special Operations Mission Training Support System (MTSS) at Kirtland AFB in Albuquerque, New Mexico. This paper describes the initial performance and procurement criteria, problems and solutions involving new facility application, and subsequent experiences in implementing a flexible, multi-aircraft training environment for the 58th Special Operations Wing.

About the Authors

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Lou Gallo, Vice President, Mediatech, Inc. is an experienced multimedia computer designer and has successfully provided on-going technical support for a variety of existing multimedia systems in diverse applications. He has accumulated over 20 years of experience in electronics, system design and integration of presentation systems, video editing suites and computer training devices. He is a communications professional with hands-on experience in photography, video, audio visual production and staging, and computer based technologies such as real time computer image generation, computer graphics, interactive video disc, and MPEG-CBT training.

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INTRODUCTION

In August of 1990, the 1550th Combat Crew Training Wing (now the 58th Special Operations Wing (SOW)) at Kirtland AFB established a requirement to convert all MH-53J and MH/HH-60G paper- and slide-based courseware to Computer-Aided Instruction (CAI). Along with supporting materials, this CAI development effort was contracted with the initial delivery of the MH-53J Weapon System Trainer/Mission Rehearsal System (WST/MRS).

This multi-year effort, which ended in December of 1994, produced over 300 hours of CAI-converted courseware using Quest version 4.1 authoring software.

Courseware design, development and maintenance continues at the 58th SOW today under Lockheed Martin's Military Training Support System (MTSS) contract for the MH-53J, M/HH-60G, UH-1N, MC-130H, and MC-130P/N.

HISTORY

From the time the 58th SOW began operations as the 1550th Aircrew Training and Test Wing (ATTW) in the 1970s at Kirtland AFB, standard, instructor-led curriculum was the order of the day. The advent of 35mm slide-tape programs in the late 1970s was considered to be a major breakthrough in technology. When the MH-53J WST was delivered in 1990, the determination was made to convert all existing curriculum (with the exception of end-of-phase testing) to electronic CAI format.

The Conversion Project

The conversion project involved a team of 15 developers, graphic artists, instructional designers and management working over a period of 4 years to complete.

Minimal research was done up front for this conversion project. There was some confirmation that early research into the use of computers and CAI with adult learners was contradictory and inconclusive. Gerver (1984) stated that there are "a number of indications that using computers may be a popular means of learning, at least for certain adults" (p. 4). Gueulette (1982) cited a study involving the Myers-Briggs Type Indicator that showed CAI programs may favor "those learners who have the ability to quietly concentrate, pay attention to details, memorize facts, and stay with a single task until its completion. Extroverts (or perceptive learners), on the other hand, may not fare as well" (p. 1). Gerver (1984) felt that "older adults may have a deep-seated fear of computers in particular" (p. 15). The reasons postulated for this fear were, (1) adults think the computer is too difficult to use, (2) they may be embarrassed to use them with other people watching, or (3) they suspect the computer is secretly tracking their capabilities (Gerver, 1984). These inconclusive results were not viewed as applicable information to the average Special Operations crew member.

These findings, however, did not deter the conversion project, and the conversion process was begun. Some problems incurred during this conversion included the lack of any formal front end analysis data to support the conversion of media from the traditional overhead viewgraphs to CAI. This caused much confusion when it came to the media validation portion of the conversion process. In addition, the conversion project involved parallel development along with the teaching of existing lessons. This meant that developers and subject matter experts were converting courseware that was simultaneously being taught.

Problems

As with any new project, this conversion program experienced its share of difficulties. Although originally designed in accordance with the hardware spec in effect at the time, the fidelity levels became obsolete before the project was finished. The subcontractor continued to develop courseware as originally contracted, while the government customer began to search for new hardware and software solutions to the problem

Initially, the courseware was viewed by the school faculty as being effective. However, during formative evaluation, many of the students and instructors involved complained about the lack of instructor involvement in teaching procedural topics. This caused the government customer to revisit the media requirements for the project. After carefully considering other alternatives (returning to overheads and classroom instruction, video, and 35 mm slides) the decision was made to build and integrate an electronic classroom environment.

EC-CAP Solution

An initiative was developed to support presentation of converted CAI in a classroom environment. Some options addressed included high end classroom multimedia systems. However, the requirement dictated that the units selected must be cost effective, expandable, and be capable of being upgraded. At the time, there existed no commercial off-the-shelf product that would support those requirements.

The Electronic Classroom Computer Aided Podium (EC-CAP) was the result of a design proposed by Mediatech, Inc. of Ormond Beach, FL. Designed, built and integrated by Mediatech, the initial eight podiums were coupled with Mitsubishi 35" monitors to provide an electronic classroom presentation capability that would support current requirements (Figure 1.)

These first podiums were delivered in the summer of 1992 complete with 386-33 PCs and removable 420Mb hard drives, PC controllable VCRs, Wireless Mouse, and 35" display monitors. These were the first of an eventual 19 podiums that are currently in operation at the MTSS facilities at Kirtland AFB.

The use of the EC-CAP to replace some of the self-paced CAI for the MH-53J and M/HH-60G programs at Kirtland has significantly improved student information retention and higher test scores.

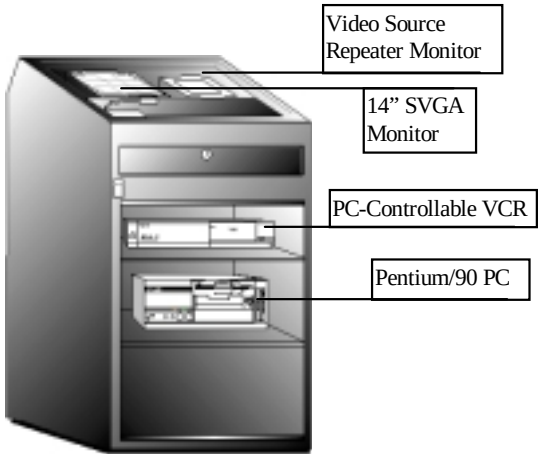

Figure 1. EC-CAP

Initial reception by the government instructors was very positive. The electronic classrooms provided a well-balanced compliment to the self-paced CAI. The syllabi were rewritten to reflect an initial instructor-led seminar (ILS) introducing the students to the topic being trained, followed by the applicable CAI, and finally another short ILS to recap and discuss questions. However, minor concerns soon began to arise. Concurrent courseware conversion and digitization created configuration management problems. While each podium was capable of displaying courseware from any of the removable hard drives, it rapidly became very difficult to maintain by the single person assigned to keep these podiums updated with current courseware. As courseware updates or additions occurred, they could only be loaded on the machines as quickly as the curriculum maintenance person could make it happen. This sometimes resulted in delays between updating all CAI stations and the electronic podiums. Consequently, non-current information was contained on the courseware hard drives.

Networking the Classrooms

In the fall of 1993, these electronic classrooms were networked to a common courseware file server. This file server provided courseware not only to the EC-CAPs, but to the self-paced learning center as well. The learning center was initially constructed in 1991 with 8 stand alone machines that each required files installation every time a new lesson was delivered or an additional lesson was developed. In mid 1992, this problem was solved by networking the original 8 stations with a small file server. By the fall of 1993, these original eight 386/16 PCs had evolved to a networked set of fifty 486/33 machines. The configuration enabled the presentation of standardized, sharable curriculum over a single local area network.

Instructors had previously noted that the available courseware on individual EC-CAP machines differed, and therefore required them to teach given classes in specific classrooms. This was true to the point that Air Force-developed courseware using Microsoft Powerpoint and DPaint software packages was available on a few of the drives. The file server solved this problem by providing a single, sharable file source for all rotary and fixed wing courseware at the 58th. Configuration management of courseware files was made much easier through this networking solution (Figure 2.)

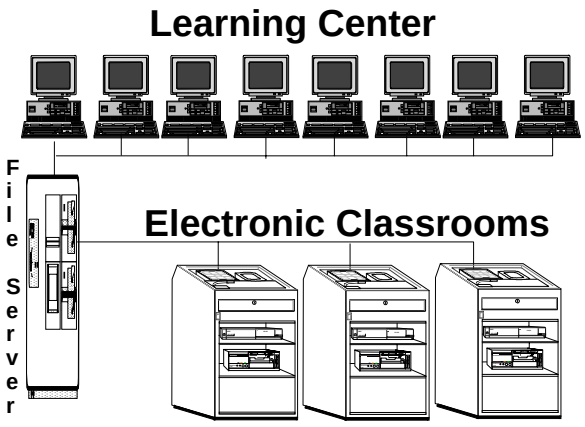

Figure 2. Network Configuration

NEW HORIZONS

As the initial courseware conversion contract wound down in December of 1994, new challenges were faced with increasing courseware modification requirements due to technical changes on the aircraft. It was at this point that multimedia was emerging and being touted as the "new" training solution. A review of the existing courseware resulted in the following findings:

1. Courseware that was initially designed in 16 colors to run on 386/16 PCs was fast becoming viewed as "ancient" technology by students and instructors.

2. Graphics that had been developed to support the initial courseware effort were viewed as primitive and non-conducive to training in some cases.

3. Instructional design reviews determined that an alternative media would be more effective in many cases throughout the curriculum.

Much of the information extracted during the reviews was determined to be a result of emerging technologies. Digital video, sound and animations were abundant in PC games that were flooding the market at the time. Students that had been exposed to these games were expecting the same types of interaction and displays that existed in the games.

Integration of Multimedia

About the same time that the review was going on, the government tasked Lockheed Martin with converting selected CAI lessons to multimedia format for use in the EC-CAP classrooms. Multimedia lessons were to be developed using Quest 4.1 and existing PC-controllable VCRs. A prototype lesson was developed and demonstrated. The initial reception by instructors was overwhelmingly positive. However, issues of concern that soon arose temporarily halted production of further lessons:

1. The amount of cueing and access time for the PC-VCR VHS video tape caused delays of up to 1 minute during lesson presentation each time the lesson had to access a video clip from the tape. Although the instructors liked the concept of using video, strong opposition was evident due to these delays.

2. Logistics and cost of producing and maintaining video on tape.

3. This version of courseware would not be exportable without very specific and non-portable hardware support requirements.

Hardware Changes

In September of 1994 a proof of concept was demonstrated at Kirtland that used MPEG video compression with full-frame playback at 30 frames per second using a Visionetics MPEG Master card, along with an updated release of Quest (version 4.2, which allowed for VESA BIOS high color support). Lockheed Martin instructional designers and developers along with government customers determined that classroom multimedia presentations using anything less than full frame video was inadequate when required to support specific objectives. The Visionetics card was selected due to its compatibility with this requirement as well as compatibility with courseware being produced to support the MC-130H Combat Talon II. The government agreed, and an additional multi-session capable CD-ROM authoring station was installed along with a real-time MPEG video encoder. The 58 SOW multimedia project was again on track.

At about the same time, the learning center and EC-CAP computers were upgraded to Pentium 90 machines complete with 4X multi session CD-ROM, sound cards, and MPEG decoder cards. Instructor feedback is positive, and virtually all of the existing training video has been digitized and converted to CD-ROM format.

Multimedia development at the 58th SOW continues today with Quest 4.2 and MPEG. Development for new programs using Quest Net+ has begun, and will become the new standard for future development.

New Facilities

A new academic training facility is currently under construction at the 58th SOW and will provide an additional 12 electronic classrooms and a 144 seat auditorium. The facility is designed for optimum training use, and instructor input was one of the key factors during the design process. This facility will use the latest in classroom projection technology to present unclassified and classified training for the students transiting the school.

Using EC-CAP hardware from existing classrooms, this state of the art instructional facility will use LCD projectors in place of the 35" monitors. Instructor control of these systems will be provided through the EC-CAP.

In addition, a new simulator facility, complete with mass briefing and conference rooms is also under construction. These rooms will double as multimedia classrooms and will provide additional capability for instruction of classified curriculum.

Instructor Involvement

Designing the new facility required absolute involvement and input by the assigned contractor and government instructors. Improvements to the original design of the EC-CAP are being made to include enhanced sound systems, upgraded Pentium PCs, infrared wireless mouse, and increased memory. These enhancements were made based on input by the instructor cadre concerning software performance. As the new facilities are built, information for fine tuning of classroom configuration, layout and anticipated uses are solicited from the instructors to ensure the most effective training environment is provided.

FUTURE DEVELOPMENT OPTIONS

Fast Ethernet or ATM and 166 MHz Pentium-class machines should be making a showing in the next several years as the CAI standard. The Internet and world-wide web should become the pipe that all distance learners will be using to connect CAI facilities in the future.

The training future at Kirtland will rely more heavily on distance-based and other technologies to provide training for their student populations. The emergence of advanced web-based technologies and wider band width will enable the 58th to realize a wider training audience in the near future. Some of the current and anticipated development projects include web-based courseware and scheduled distance training.

WWW-based connection and distance learning

In looking for new methods to present training to a wider group of trainees, institutions of higher education have been reporting successes with the applications of technology to the learning environment. New York University has enjoyed success with their "Virtual College" for midcareer training. Students use their own computers to access "electronic 'lectures' delivered as multimedia presentations, obtain required course readings, contribute to discussion topics, and e-mail to one another and the instructor (Reinhardt, 1995, p.56). One faculty member, surprised at the effect on student participation, commented "the amount of interaction among students, and between students and instructors, is an order of magnitude higher than that of a normal classroom….and it works partly because students are highly motivated" (p. 56).

A world-wide web-based curriculum is currently in development, with anticipated prototype delivery in the spring of 1997. This system will provide a connection for 58th SOW courseware to populations previously not serviced by delivered courseware. Aircraft systems and refresher training will be available for units throughout the world, without them having to leave their home station. It is hoped that this project will serve as a prototype for other applications including Professional Military Education, advanced technical schools and other mandatory and optional Air Force education and training programs.

Virtual reality becomes reality

At Kirtland, the Air Force's first virtual reality trainer was deemed ready for training in early 1996. This aerial gunner and scanner simulator (AGSS) provides virtual world training for MH-53J and M/HH-60G aerial gunners and scanners (Figure 3.)

Figure 3. Aerial Gunner and Scanner Simulator

This device uses helmet-mounted displays and is capable of operating as a stand-alone device or networked with other training devices.

This same technology is being looked at as a possibility for conducting classroom VR training. Using an inexpensive helmet-mounted display and Pentium based machine, a 3-D reconstruction of the aircraft fuel (or other mechanical) system will be used to enable the instructor to "inject" the student into the system. An instructor-guided virtual tour will take place with each component within the system being labeled and functional. A study is currently underway to examine the feasibility of this project.

The emergence of the Lockheed Martin Pro-1000 system, a desktop simulation and rehearsal image generator, is anticipated to provide a whole new realm of training possibilities. Combined with CAI, this system will generate virtual worlds where students can review aircraft systems and procedures in real time using the high quality data base imagery detailed to photo-specific realism. Hosted on a Pentium PC system, this device is anticipated to revolutionize desk top CAI.

Scheduled distance training

LAN/WAN quarter screen 10 fps and analog full screen 30 fps video teleconferencing have been evaluated for application to distance learning projects at Kirtland. The consensus shows that until standards are adopted, or fast Ethernet or ATM prove effective, the best system proven effective at providing the necessary "training transfer" is analog VTC.

Of the analog VTC systems evaluated, Datapoint's Video Minx provided the best video image and system flexibility for adaptation to distance learning.
With the advances being made in desktop teleconferencing, the 58th SOW anticipates being able to soon provide scheduled training over a teleconferencing system. This will open up a whole new world of requirements for instructor training and certification.

SUMMARY

As we approach the Twenty-First Century, it is imperitive that we examine a broader perspective of training beyond today's classrooms of 'four walls with desks'. Crucial decisions need to be made about how we will use the unlimited time and space aspects of networks such as the World Wide Web, as well as the ever-appearing new and improved technologies.

The future of training at Kirtland is bright, with new technologies being tested and implemented on a regular basis. The 58th SOW has found that the ROI for implementing multimedia courseware and electronic classrooms is high. Instructors have found that the addition of the EC-CAP has enabled them to better prepare and present instructional materials. The man-machine interface used at Kirtland is significantly reducing the amount of time required to qualify new instructors to teach. Students are retaining more information, and test scores are increasing.

While technology must not be looked at as a fix-all for training problems, it is helping to solve the instructional problems faced with today's student populations. Let us look to the technologies of tomorrow for answers today. Realizing that the traditions of old (stand-up lecture) can be made better with those technologies is an important discovery. Perhaps Bloom said it best when he remarked "As soon as tradition has come to be recognized as tradition, it is dead" (1987).

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