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TITLE PERFORMANCE, THROUGHPUT, AND COST OF IN-HOME TRAINING FOR THE ARMY RESERVE: USING ASYNCHRONOUS COMPUTER CONFERENCING AS AN ALTERNATIVE TO RESIDENT TRAINING

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MASTER

Performance, Throughput, and Cost of In-Home Training for the Army Reserve: Using Asynchronous Computer Conferencing as an Alternative to Resident Training

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Asynchronous computer conferencing (ACC) was investigated as an alternative to resident training for the Army Reserve Component (RC). Specifically, the goals were to (1) evaluate the performance and throughput of ACC as compared with traditional Resident School instruction and (2) determine the cost-effectiveness of developing and implementing ACC. Fourteen RC students took a module of the Army Engineer Officer Advanced Course (EOAC) via ACC. Course topics included Army doctrine, technical engineering subjects, leadership, and presentation skills. Resident content was adapted for presentation via ACC. The programs of instruction for ACC and the equivalent resident course were identical; only the media used for presentation were changed. Performance on tests, homework, and practical exercises; self-assessments of learning; throughput; and cost data were the measures of interest. Comparison data were collected on RC students taking the course in residence. Results indicated that there were no performance differences between the two groups. Students taking the course via ACC perceived greater learning benefit than did students taking the course in residence. Resident throughput was superior to ACC throughput, both in terms of numbers of students completing and time to complete the course. In spite of this fact, however, ACC was more cost-effective than resident training.

INTRODUCTION

In its efforts to maintain overall readiness, the U. S. Army is faced with some unique challenges in training its two Reserve Components (RC) -- the Army Reserve and the National Guard. Training is a key aspect of readiness; however, geographical dispersion and limited training time make it difficult to provide adequate training for the RC. These difficulties are further complicated by the inability of resident training, commonly viewed as the best the Army has to offer, to accommodate civilian job and family responsibilities and by the costliness of resident training. Indeed, training soldiers at resident schools has become so expensive that the U. S. Army Training and Doctrine Command (TRADOC, 1983) has proposed a 50% reduction in the number of soldiers attending resident programs by 2007.

The importance of a well-trained RC cannot be overemphasized, however, for it makes up more than 50% of the total Army strength. Clearly, then, alternative means of meeting the educational requirements of the RC are needed. The purpose of this paper is to summarize an investigation of one such alternative. The goals of the investigation were to (1) develop and test a new training option, which used asynchronous computer conferencing (ACC) along with an integrated package of computer-administered and traditional media that could be delivered in the soldiers' homes and which would maintain the quality of training typically found in the resident school, and (2) determine the cost-effectiveness of developing and implementing the ACC alternative.

Background on Asynchronous Computer Conferencing

Asynchronous computer conferencing is a means for communicating from different locations at different times (i.e., asynchronously) using a computer network. For training purposes, an "electronic classroom" is established by connecting all students with each other and with the instructional staff. A student or instructor can participate in the classroom from any location at any time using existing telephone lines and a computer equipped with a modem. Students can work individually by accessing prepackaged learning materials or can use ACC as a vehicle to work together in groups, ask questions of the instructor, tutor their classmates, or share their thoughts and experiences. Instructors can direct individual study, conduct small group instruction, answer questions, give remedial instruction, and provide performance feedback to the students.

As the name implies, most of the instruction delivered via ACC is accessed asynchronously. That is, not everyone must participate at the same time. This flexibility of scheduling makes ACC quite adaptive to personal time constraints. However, it also means that there are built-in time delays before all students receive the instruction and that certain activities, such as group discussions, will take longer than they would in the face-to-face environment. When time delays are not practical, ACC allows for synchronous communication. Here, all students access ACC at the same time and work together to accomplish a given task. When the task is completed, they return to the asynchronous mode.

METHOD

Participants

Students. Fourteen RC officers (13 males; 1 female) took Phase III of the Engineer Officer Advanced Course (EOAC) by ACC (see below for a description of the course). Comparison data were collected on a control group, which consisted of RC students taking the same course in residence at the U. S. Army Engineer School (USAES) during the period from October 1986 through June 1989.

Instructors. The instructional staff consisted of a civilian full-time course manager/administrator responsible for the overall operation of the course and three part-time instructors. The part-time instructor responsibilities included directing the group discussions, providing remedial instruction, and/or monitoring student progress.

Course Description

The course consisted of Module 6 of the EOAC as it was taught by the USAES in 1987-88. EOAC is a mid-level course for officers in the grades of lieutenant and captain. Engineer officers must complete EOAC before they can be promoted to major. It was felt that the participants in this group would be mature, be committed to the RC, and be more apt to have either personal computer experience or the ability to learn quickly to use computers.

Further, the 66-hour Program of Instruction (POI) for Module 6 of EOAC includes a mix of technical and leadership objectives. There is a stated instructional goal for the development of group skills through small group instruction and group interaction, an ideal application of ACC. Nine technical topics, which included Army doctrine (eg., rear operations) and engineering (eg., bridging, asphalt production), were taught. The POI was identical for the ACC and resident classes.

Course Design

The structure and content of courses as taught at the Resident School were adopted, as they were judged to be the best training the Army had to offer. Thus, materials from the EOAC resident course were adapted for use in the ACC environment. When taught in residence, Module 6 of EOAC consists of a mix of classroom lectures, lead through practical exercises, computer-assisted instruction, and a culminating practical exercise. The ACC course was adapted to include paper-based readings and problems, computer-assisted instruction, video tapes, and computer conferencing discussion. Procedures for accomplishing such an adaptation are fully discussed in "Distributed Training for the Reserve Component: Course Conversion and Implementation Guidelines" (Hahn, Harbour, Wells, Schurman, and Daveline, 1990).

Procedure

Each student was provided with an IBM XT computer with 20-megabyte hard disk, color monitor, and printer. Software and courseware loaded on each computer consisted of: (1) a specially developed course management system and communications package (which was hosted on the CONFER II conferencing system at Wayne State University); (2) computer-assisted instruction and tests; (3) a word processing package; and (4) a spreadsheet. Printed course materials were also provided.

The course was conducted from September 1988 to April 1989. Students were mailed their computer equipment with written assembly and operating instructions and course materials. In addition, they were provided with a toll free "hot line" telephone number for resolving hardware/software problems.

Part-time instructional staff were provided with equipment and software identical to that of the students. In addition, they were given a 40-hour training course on operating the hardware/software, instructional responsibilities, and teaching/motivational techniques. Instructional staff and researchers met together to conduct this training using a combination of lecture and hands-on practice with the computer.

Data Collection and Analysis

Four types of data were collected: (1) performance measures -- test, practical exercise, and homework scores; (2) attitudinal measures -- pre- and post-course student perceptions of their amount of knowledge on the course topics; (3) throughput measures -- rates of course completion, and (4) cost measures -- costs of converting and executing the course. Comparisons of the resident to the ACC course were made using appropriate analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA) procedures for a two-group design.

RESULTS

Performance

As shown in Table 1, there were no reliable differences between the test, homework, or practical exercise scores of students in residence vs those in ACC. The marginally significant MANOVA on overall homework scores was explored using univariate ANOVAs on the individual homework scores. No significant differences between groups were found.

Table 1
Student Performance Scores

Score Type	ACC	Resident	Test Statistic	Significance
Tests	92.0%	86.4%	F = 1.80	$p < 0.18$
Homework	88.8%	92.0%	Lambda = 0.95	$p < 0.06$
Practical Exercise	90.4%	89.9%	F = 0.20	$p < 0.90$

Perceived Performance Benefits

Both ACC and resident students provided ratings of their skill level in the content areas both before and after taking the course. Pre-course skill ratings did not differ between the two groups.

Pre-post differences were analyzed to determine the perceived performance benefits of the two groups. A MANOVA performed on these difference scores was marginally significant (Wilks Lambda = 0.49, $F_{(15,28)} = 1.96$, $p < 0.06$). As shown in Table 2, where univariate ANOVAs showed statistically significant differences between the two groups, ACC students always perceived a greater learning benefit than resident students.

Throughput

Resident training is superior to ACC training with respect to both the duration of time needed for training and the percentage of students who complete the training. Completion of the equivalent amount of content material to that taught in the ACC course is accomplished in two weeks at resident school. ACC administration took 31 weeks. Further, the drop-out rate at the resident school is quite low (5% or less) compared with a 36% drop-out rate via ACC.

Table 2
Pre-Post Differences on Skill Ratings

Content Area	ACC Mean (SD)	Resident Mean (SD)	F	p
Rear Operations	1.125 (0.64)	0.136 (1.13)	5.73	0.02
Airfield Damage Repair	1.875 (0.83)	0.409 (1.13)	13.40	0.01
Pipelines	1.500 (1.60)	0.452 (1.13)	4.69	0.04
Asphalt Production	1.875 (0.99)	1.250 (1.09)	2.00	0.16
Flexible Pavements	2.125 (0.99)	0.932 (1.07)	8.67	0.01
Bridging	0.625 (0.92)	0.500 (1.08)	0.08	0.77
Roads and Airfields	2.250 (1.17)	0.809 (0.99)	15.42	0.01

Note: Scores were obtained by subtracting pre-course ratings from post-course ratings. Ratings were based on a 1-5 scale.

Cost-Effectiveness

Cost data were computed separately for (1) converting an existing course for delivery by ACC, and (2) executing each iteration of the course. Figure 1 shows the total course conversion, start-up (equipment purchase and instructor training), and recurring costs over 10 course iterations. Initially, resident and ACC (developed within government) costs are similar, with ACC (contractor-developed) costs being nearly twice as much. However, when the costs of conversion and execution are amortized, ACC (contractor) becomes less costly than resident training after four course iterations. After five iterations, ACC (within government) would save 43% and ACC (contractor) would save 2%.

Cost-effectiveness (CE) ratios were computed by combining the cost and completion rate data according to the following formula:

$$CE = \frac{(\text{Class Size} * \%\ \text{Throughput})}{\text{Cost} * 100\%}.$$

The ratio was greatest for ACC developed by government staff (1.18), second for resident training (0.82), and lowest for ACC developed by contractor staff (0.68).

CONCLUSIONS AND RECOMMENDATIONS

In this paper, it has been demonstrated that ACC courses are effective, as compared with resident programs, with respect to actual and perceived performance. ACC courses suit students' needs for flexibility of scheduling and are generally more available to a wider range of RC students than are resident programs. Further, the cost effectiveness of contractor-developed ACC programs is similar to that of resident school, in spite of lower throughput.

ACC is very effective in meeting the needs of the RC because it can do the following:

- overcome geographical dispersion and low density military occupational specialty training requirements by bringing students together remotely,
- stretch training resources (instructors) by making an instructor in one location available to students in many locations,
- accommodate civilian and personal commitments because of its asynchronous nature, and
- provide a means for maintaining Army contacts.

However, our experiences with developing and implementing this course have shown that ACC courses will not be successful unless certain implementation requirements are met, including the following:

- providing each student with a suitably equipped computer, preferably a portable rather than a desk-top model;
- providing well-supported, well-documented software to support communications, conferencing, and special applications;
- giving special attention to logistical coordination, including access to telephone lines and adequate power supplies;
- setting deadlines for completion of activities and providing both incentives and penalties to encourage compliance;
- being aggressive in the application of motivational techniques, such as performance feedback;

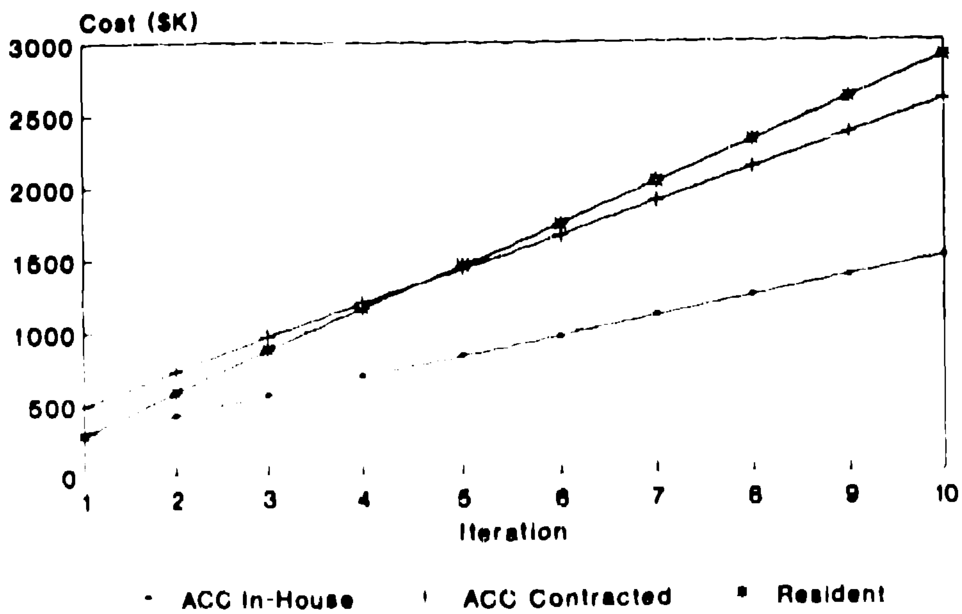

Figure 1. ACC vs Resident Costs

- orienting students to the nature of activities and explicitly stating requirements;
- scheduling the course to accommodate civilian jobs, family commitments, and other military duties;
- using a variety of media, including both group and individual learning activities, for the presentation of instruction; and
- providing support communications (i.e., a telephone hotline), which are available during hours when students are most likely to be working on the course.

Based on the results found in the implementation test, ACC appears to be able to provide acceptable throughput, performance, and availability at reasonable cost. The use of ACC for Army training should be further pursued.

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