U.S. Army Research Institute
for the Behavioral and Social Sciences

Research Report 1808

Web-Based Collaborative Learning: Communication Between Learners Within a Virtual Tactical Operations Center

20030724 125

James Belanich
U.S. Army Research Institute
Kara L. Orvis
Consortium Research Fellows Program
Robert A. Wisher
Office of the Secretary of Defense

June 2003

Approved for public release; distribution is unlimited.

AUTHENTICATED
U.S. GOVERNMENT
INFORMATION
GPO

U.S. Army Research Institute for the Behavioral and Social Sciences

A Directorate of the U.S. Total Army Personnel Command

ZITA M. SIMUTIS
Director

Technical review by

Elizabeth Brady, U.S. Army Research Institute
Mark Sabol, U.S. Army Research Institute

NOTICES

DISTRIBUTION: Primary distribution of this Research Report has been made by ARI. Please address correspondence concerning distribution of reports to: U.S. Army Research Institute for the Behavioral and Social Sciences, Attn: TAPC-ARI-PO, 5001 Eisenhower Ave., Alexandria, VA 22333-5600.

FINAL DISPOSITION: This Research Report may be destroyed when it is no longer needed. Please do not return it to the U.S. Army Research Institute for the Behavioral and Social Sciences.

NOTE: The findings in this Research Report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy)	2. REPORT TYPE	3. DATES COVERED (from. . . to)
June 2003	Interim	November 2001 – January 2003

4. TITLE AND SUBTITLE	5a. CONTRACT OR GRANT NUMBER
Web-based Collaborative Learning: Communication Between Learners within a Virtual Tactical Operations Center	5b. PROGRAM ELEMENT NUMBER 633007A
6. AUTHOR(S) James Belanich (U.S. Army Research Institute), Kara L. Orvis (George Mason University), and Robert A. Wisher (Office of the Secretary of Defense)	5c. PROJECT NUMBER A792
	5d. TASK NUMBER 208
	5e. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Research Institute for the Behavioral and Social Sciences Advanced Training Methods Research Unit 5001 Eisenhower Avenue Alexandria, VA 22333-5600	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Research Institute for the Behavioral and Social Sciences 5001 Eisenhower Avenue Attn: TAPC-ARI-II Alexandria, VA 22333-5600	10. MONITOR ACRONYM ARI
	11. MONITOR REPORT NUMBER Research Report 1808

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT *(Maximum 200 words)*:

In 2001, the U.S. Army Armor School designed a blended course for reserve officers with both distributed learning and in-residence components. The distributed portion consisted of an asynchronous phase, where officers completed lessons on their own time, and a synchronous phase, where they used a virtual tactical operations center (VTOC) simultaneously but from different locations. One primary method of communication during synchronous VTOC training was computer-based text messaging. The text messages for five teams consisting of seven to nine members were recorded. The analysis of these text messages revealed that a majority of the communication was related to the operational task. The second most frequent type of text messaging was social in nature, and this type of communication peaked during the initial training sessions and during the final session. The least frequent type of communication was technology-related text messages, those where the user was having difficulty with the system and asking for help or a person replying to a help query. Technology-related communication occurred modestly during the initial sessions, buttailed off dramatically as sessions progressed. The students, instructors, and course designer all took part in interviews about their opinions on the distributed learning components of the course. The overall ratings of the distributed -learning portion of the course were positive.

15. SUBJECT TERMS

distributed learning, distance learning, virtual tactical operations center, text chat, text messaging, collaboration, training technology, synchronous communication

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON (Name and Telephone Number)
16. REPORT Unclassified	17. ABSTRACT Unclassified	18. THIS PAGE Unclassified	Unlimited	25	James Belanich 703-617-2362

Research Report 1808

Web-Based Collaborative Learning: Communication Between Learners Within a Virtual Tactical Operations Center

James Belanich
U.S. Army Research Institute
Kara L. Orvis
Consortium Research Fellows Program
Robert A. Wisher
Office of the Secretary of Defense

Advanced Training Methods Research Unit
Franklin L. Moses, Chief

U.S. Army Research Institute for the Behavioral and Social Sciences
5001 Eisenhower Avenue, Alexandria, Virginia 22333-5600

June 2003

Army Project Number
2O262785A790

Personnel, Performance and Training

Approved for public release; distribution is unlimited.

Preceding Page Blank

FOREWORD

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI), as part of its WEBTRAIN project, is investigating the use of distributed-learning technology for use by soldiers. ARI seeks to provide guidance to the Army as it transforms from classroom-based instruction to more distributed, soldier-centric, and collaborative instruction methodologies.

With the U.S. Army transforming many of its courses to a distributed-learning format, new methodologies are needed to take full advantage of current technology. In this report, the distributed-learning portion of the Armor Captains' Career Course for Reserve Component Officers was examined. Findings of this report are relevant to course designers interested in implementing collaborative tools for distributed learning. This research was briefed to Assistant Deputy Chief of Staff -Training, TRADOC on 17 October, 2002. Some portions of the research were published in journal form (Orvis, Wisher, Bonk & Olson, 2002) and as an ARI Research Note (Bonk, Olson, Wisher, & Orvis, 2002). The results and recommendations of this research were also presented at the Army Science Conference on 3 December 2002.

MICHAEL G. RUMSEY
Acting Technical Director

WEB-BASED COLLABORATIVE LEARNING: COMMUNICATION BETWEEN LEARNERS WITHIN A VIRTUAL TACTICAL OPERATIONS CENTER

EXECUTIVE SUMMARY

Research Requirement:

The U.S. Army Armor School (USAARMS) redesigned the Armor Officers' Advanced Course for Reserve Component officers (AOAC RC) so that the first phase could be delivered via web-based instruction instead of via the previous method, written correspondence. The Director of the USAARMS requested that the U.S. Army Research Institute's Advanced Training Methods Research Unit (ARI-ATMRU) evaluate the distributed learning phase.

Procedure:

During synchronous collaborative instruction, students used a computer-based text messaging function to communicate with other students in a Virtual Tactical Operations Center (VTOC). The content of the text messages between students was analyzed across six training sessions. Additionally, to determine strengths and weaknesses of the distributed learning portion of the course, interviews were conducted with two groups of four students, three instructors, and the course supervisor.

Findings:

Three types of text communication were identified: task-related, social, or technology-related. Task-related messages involved statements oriented toward the course exercise. Social interactions were messages not related to the task, but involved personal content. Technology-related interactions involved the equipment used for the exercise. The relative frequency of the different types of text messaging changed across sessions. During the initial session, moderate levels of on-task, social, and technology-related communication occurred. Over the next few sessions, the level of social communication dropped, but rebounded during the final session, while the frequency of technology-related communication dropped and remained low. The relative frequency of on-task communication peaked during the middle sessions, but was usually the most frequent type of communication across sessions.

The interviews with students, course instructors, and the course supervisor revealed additional information. For example, during the synchronous distributed learning phase, the role of the instructor was seen as a facilitator instead of as a lecturer. Also, to limit the frequency of problems that may interfere with instruction, the course supervisor recommended that course designers should not stretch the limits of the instructional technology.

Utilization of Findings:

The change in relative frequencies in the nature of text messaging provides insight to the development of a virtual training team, and should be useful to both course developers and instructors interested in such social interaction and problem solving. In addition, the findings

from the participant interviews regarding the facilitative role played by instructors should be particularly useful to instructors of distributed courses.

WEB-BASED COLLABORATIVE LEARNING: COMMUNICATION BETWEEN LEARNERS WITHIN A VIRTUAL TACTICAL OPERATIONS CENTER

CONTENTS Page

INTRODUCTION **1**

WEB-BASED COLLABORATIVE LEARNING 1
ARMOR CAPTAINS' CAREER COURSE (AC3) BACKGROUND 2

METHOD **4**

PARTICIPANTS 4
PROCEDURE 5

RESULTS AND DISCUSSION **6**

TEXT MESSAGING DATA 6
INTERVIEWS WITH STUDENTS 9
INTERVIEW WITH COURSE INSTRUCTORS 11
INTERVIEW WITH DL EDUCATION ADVISOR 13

SUMMARY **14**

COMMUNICATION TRENDS 14
PARTICIPANT REACTIONS 15

REFERENCES **1**

APPENDIX A - FOCUS GROUP QUESTIONS **A-1**

APPENDIX B - INSTRUCTOR INTERVIEW QUESTIONS **B-1**

Web-based Collaborative Learning:
Communication between Learners within a Virtual Tactical Operations Center

INTRODUCTION

The U.S. Army is embracing distributed learning (DL) as an agent of change in the areas of training and education. The Army is in the process of developing more than 525 DL courses by 2010. Hundreds of digital training facilities are currently available in both the regular Army and reserve components to provide access to technology and learning content (Program Management Office, 2000). As of April 2003, the Army University Access Online program, also known as eArmyU, has enrolled 35,000 soldiers, equipped them with laptops and Internet access accounts, and encouraged them to earn a college degree while serving on active duty. In the National Defense Authorization Act of 2002, Congress passed legislation allowing reservists to be compensated for completion of asynchronous DL courses. Clearly, the interest in DL from an infrastructure and policy perspective is growing, although questions surrounding its optimal use remain.

While delivery of DL over the Web is still relatively new, the benefits have already been demonstrated in many ways, such as decreased cost and increased time management (Army Logistician, 2001; Sanders & Burnside, 2001; Deloughry, 1995; Howard, 1992; Kulik, & Kulik, 1991; Metzko, Redding & Fletcher, 1996). Metzke, Redding, & Fletcher (1996) reviewed 30 studies on DL instruction and found that students needed a median of 30 percent less time to complete distributed courses as compared to traditional instruction. In addition, students who completed courses via DL attained a higher level of achievement when compared to traditional instruction, an average increase of nearly 0.5 standard deviations.

While DL has its advantages, there are some areas where it still lags behind face-to-face instruction, such as ease of communication and the development of deeper relationships at a faster pace (Olson & Olson, 2000). In the current research, we analyzed the use of text communication for Web-based collaboration by students during synchronous DL.

Web-based Collaborative Learning

Collaboration is a key part of the "Learner-Centered Psychological Principles" promoted by the American Psychological Association (APA, 1997). Through collaborative tasks, such as discussing, summarizing, clarifying, and integrating course content into an overall framework, learners acquire knowledge and gain a deeper understanding (Deatz & Campbell, 2001; Palincsar, 1998). Collaboration among learners allows for the synergistic building of knowledge. Numerous studies have shown that the use of collaborative learning exercises leads to improved knowledge acquisition as compared to traditional classroom instruction without collaborative exercises (Alkhateeb & Jumaa, 2002; Bonk & Wisher, 2000; Fisher & Coleman, 2001-2002; Kang, 1998).

The use of collaborative tools during on-line exercises can be helpful, not only for completing the task at hand, but also for social functions such as team building and group cohesion (Bonk & Wisher, 2000; Kang, 1998). People in DL courses sometimes feel isolated because there is a lack of natural interaction with class members as compared to traditional

classrooms where learners have the opportunity to meet one another. Collaborative tools can help to reduce these feelings of isolation experienced by distributed learners (Muilenburg & Berge, 2001).

Two of the more frequent Web-based tools used for collaboration are text messaging (e.g., instant messaging or text chat) and e-mail. Text messaging allows one learner to transmit a string of text that immediately is presented to another online learner. It is considered synchronous because there is essentially no delay in information transmission between the sender and the receiver. E-mail, however, is considered asynchronous because there is typically a delay in the receipt of the message, since only one participant might be online at a given time. When used properly, both e-mail and text messaging are useful in DL courses (Bonk & Wisher, 2000; Kang, 1998).

Asynchronous text communication has advantages, such as allowing for more time flexibility. However, because of the immediacy of the communication users feel more connected with synchronous communication. Pena-Shaff, Martin, & Gay (2001) found that synchronous text messaging provided for more task collaboration than communication via asynchronous methods. In addition, participants also showed increased socializing using text messaging in comparison to asynchronous communication. Hudson and Bruckman (2002) concluded that the "realtime" aspect of text messaging is a key factor leading to effective social interactions. These studies suggest that when users simultaneously work together, or collaborate, text messaging is an effective communication mode.

In the course examined in this report, a text messaging system was used during synchronous online training, allowing the participants to communicate spontaneously. In the current research, we assessed the use of text messaging and the perspectives of students, instructors and the course administrator through the use of group interviews.

Armor Captains' Career Course Background

The purpose of the Armor Captains Career Course (AC3) is to train captains both for command positions and positions as assistant operations officers in a tactical operations center (Sanders & Burnside, 2001). In an earlier version of the course for reservists, the first of two phases was presented via written correspondence before a two-week in-residence training phase. This training schedule was required because training in the reserves is limited to 39 days per year, generally as one weekend per month and one two-week period. The course requirements, therefore, had to be tailored for such an intermittent training schedule. The use of DL, with its ability to offer training anytime and anywhere, offers obvious flexibility within such a restricted training schedule.

The current version of the AC3-DL course uses a blend of two instructional phases. The first phase was divided into one asynchronous Internet-based set of lessons (Phase 1a), followed by a series of synchronous, collaborative, Internet-based exercises during weekend training sessions (Phase 1b). The final phase (Phase 2) consisted of face-to-face resident training for two-weeks. According to Sanders and Burnside (2001), the students who participated in early iterations of the AC3-DL course finished the DL lessons in significantly less time than students who completed the traditional correspondence version. On average, students who attended the

AC3-DL course also achieved slightly higher scores on a knowledge test than students who completed the traditional classroom-based course (Sanders & Burnside, 2001). This finding approached statistical significance (p=.055), suggesting that the conversion of the course from a traditional classroom-based course to a blended learning approach yielded better learning.

The initial phase of the AC3-DL (asynchronous lessons) consisted of lessons provided over the Web followed by end-of-lesson tests. The soldiers could access course material and take the tests at any time from any computer with Internet access. During this phase, students learned basic terms and concepts for use later in the course. Students needed to pass each multiple-choice test with a score of at least 70 percent correct in order to proceed to the next lesson. If students scored lower than 70 percent, they were allowed to retake the tests until successful. Students received feedback immediately from the computer and via email from the instructor. This self-paced set of lessons was comparable to a 3-credit college level course. The soldiers in Sanders and Burnside (2001) averaged 7.5 months to complete this phase.

For synchronous exercises (Phase 1b), students "convened" in the virtual tactical operations center (VTOC) for training sessions lasting between four and eight hours on two consecutive weekend days. The VTOC was a web-based rendition of an actual tactical operations center (see Figure 1). This phase consisted of students in separate locations completing collaborative exercises. The lessons, scheduled for weekend training sessions, involved each student performing a specific role in time-limited exercises requiring the participation of all students. To collaborate during this phase, students used: a) audio conferencing where they could speak to any of the other team members and be heard by all of the team members; b) a text messaging application where they could type a text message to either all members or a subset of the team; c) a virtual image of the team so that the function of each member could be identified; and d) shared applications. For additional detail of VTOC and the AC3-DL, see Sanders and Burnside (2001) and Sanders and Guyer (2001).

In the VTOC, there were four shared applications: a shared text program where students could write operation orders, warning orders and other planning documents; a shared bookshelf where students could display field manuals; a Mapedit program where students could display and modify map images; and a 3-dimensional virtual environment which allowed the students to "walk" and symbolically comment on the terrain of the mission. With these collaborative tools, they collectively solved problems concerning military operations and generated work products, such as a mission analysis.

The final phase of the course consisted of in-residence collaborative exercises, where students met face-to-face for the first time. In this phase, the students engaged in real-life tactical operations exercises, applying the skills and competencies that they learned during the DL phase of the course. As with previous phases, the instructors monitored each student's performance.

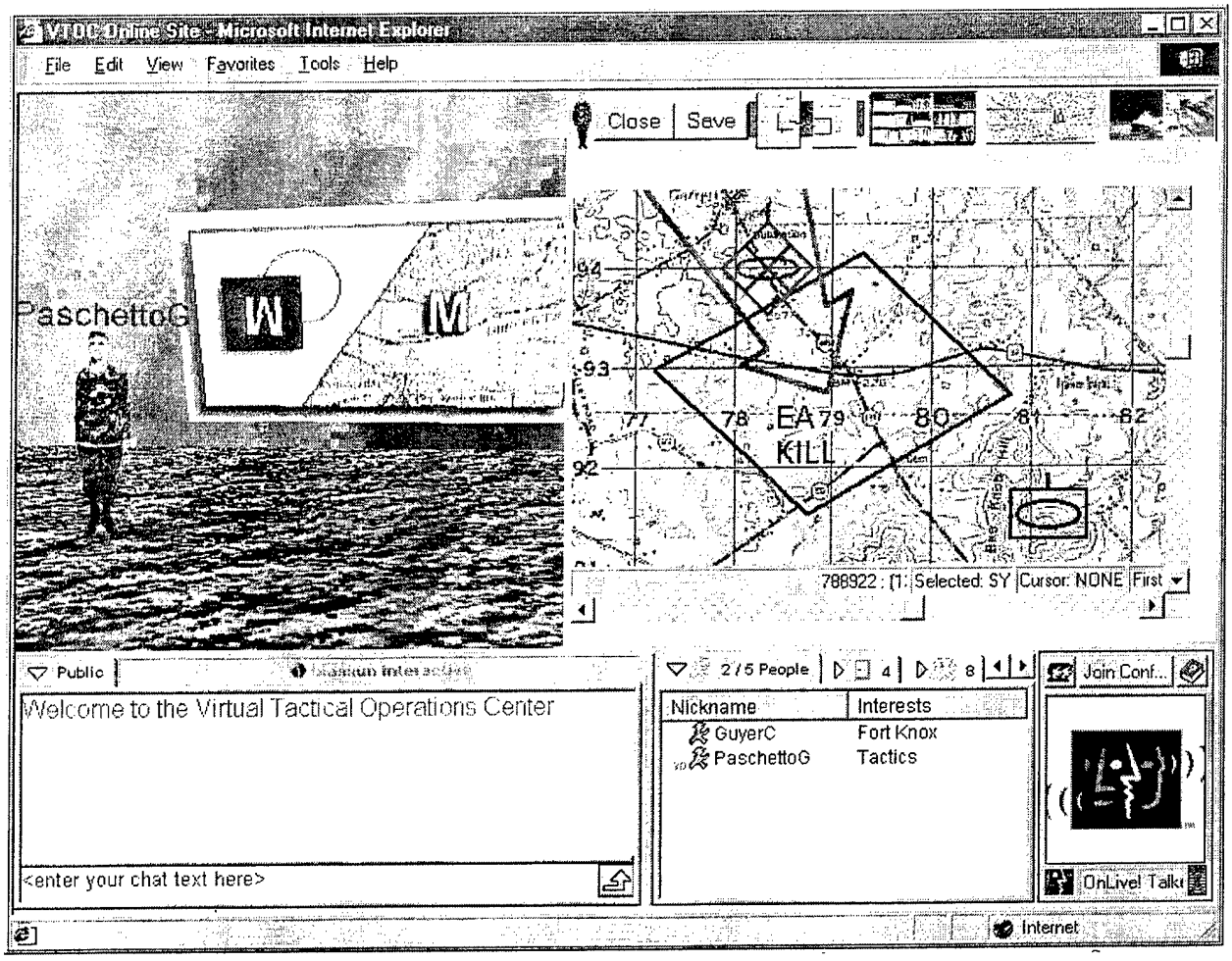

Figure 1. The Virtual Tactical Operation Center, as it appears on the computer screen of a user.

In the current research, two different types of data were collected: text communication and reactions to the DL phase of the course. First, during the collaborative exercises of Phase 1b, all of the text messages among the students were recorded and analyzed. The analysis of the text messaging data revealed insight into the ongoing process of VTOC training team development and performance. Second, midway through the face-to-face classroom section (Phase 2), the researchers conducted interviews with students, instructors, and the course advisor to obtain reaction data regarding the DL components of the course (Phase 1a and Phase 1b). This provided a qualitative assessment of the blended learning approach used during this course.

METHOD

Participants

A total of 41 students who enrolled in the AC3-DL course conducted by the U. S. Army Armor School at Fort Knox, Kentucky, participated in this research. All participants were male reservists in the Army National Guard. The participants were geographically dispersed across the United States and had never previously met face-to-face. For the synchronous phase, the course administrator assigned participants to five teams consisting of between seven and nine members.

Following completion of the two distributed learning phases and midway through their participation in the face-to-face section of the course (Phase 2), the researchers interviewed eight students from one of the teams. The researchers also interviewed two of the course instructors and the course supervisor.

Procedure

Text messages. During VTOC exercises in Phase 1b, groups were scheduled to meet for 12 hours on each of seven weekends at monthly intervals. The first session introduced the technology, and the remaining six sessions were task-oriented training using the VTOC. The researchers recorded and analyzed six sessions of text messaging data, each session spanning two days. Each session began with 30 minutes devoted to a communications check, followed by approximately 12 hours of online training per weekend.

The definition of one text message was an act of messaging with "a single, uninterrupted verbalization, typed in the message box," in accordance with Lebie, Rhoades, and McGrath (1996). Based on a variation of the coding scheme used by Lebie et al., two raters categorized each text message as one of three types: task-related, social, or technology-related. Task-related messages involved statements related to the VTOC exercise and the course topic. Social interactions were messages involving personal content that were not related to the training task. Social topics included hobbies, holidays, and plans for getting together during the in-residence phase at Fort Knox. Technology-related messages involved discussion of the VTOC equipment used for the exercise, which included how the interactive tools were used or if team members were having problems with the technology. Table 1 shows examples of each type of text message.

Table 1
Examples of Task, Social, and Technology Interactions in the Text Messaging Data

Task	• "Remember in the BDE OPORD-the BDE CMDR wants this to occur at about this time" • "I don't see anything about obstacles in the CLOSE section" • "I think obstacles in the Close section of the COA statement is a necessary evil"
Social	• "Kids are great we made breakfast for Mom (wife)" • "Did you go out for a run last night?" • "Tell her I said "Happy Mothers Day" • "3 miles in 24 mins all hills" • "If God had meant for us to run, he wouldn't have given us tanks"
Technology	• "Cannot talk or hear...will try to reconnect....." • "Is anyone talking right now? I think I dropped audio" • "Going to reboot"

Inter-rater reliability. Prior to final coding of the text message, inter-rater reliability was assessed. Approximately 15 percent of all messages were selected at random, and each of the two raters separately coded 1,034 messaging acts. Cohen's Kappa of inter-rater reliability between these two raters was deemed acceptable at k=. 90. Cohen's Kappa is a measure of the degree to which two raters concur when placing items into nominal categories. The range of k is 0 – 1.0, and like other correlation measures higher values indicate greater inter-rater reliability. Accounting for the proportion of agreement expected by chance, it is better than using percent agreement between two raters (Fleiss, 1981).

Focus groups. Midway through the final phase of training, one team of eight students was divided into two groups of four to participate in focus groups. During the focus groups, one researcher asked each of the two groups a set of questions while a second researcher recorded the students' responses. The questions covered the asynchronous phase and the use of the VTOC during the synchronous portion of the class (Phase 1b). The questions are presented in Appendix A. All participants who were interviewed had worked together in the synchronous phase of the course and in the face-to-face setting during Phase 2.

Researchers also interviewed two course instructors and the DL Education Advisor. The questions asked to the instructors are presented in Appendix B. A structured set of questions was not prepared for the course supervisor. Instead, a researcher asked the supervisor about her opinion of the AC3-DL course, specifically, and DL courses in general to discern what advice she would give to potential developers of DL projects.

RESULTS AND DISCUSSION

Two sets of data were assessed. The first set was quantitative data generated from the analysis of the text messages during the synchronous VTOC training in Phase 1b. The second set was qualitative data from the transcripts of the interviews conducted during Phase 2. These two sets of data apply to different aspects of the research; therefore, the results from each data set below was followed immediately by a discussion of the findings for that particular data set.

Text Messaging Data

A total of 6,806 text messages were recorded across all sessions. Two raters coded 6,705 of the 6,806 messages into one of the three interaction categories; 101 of the messages lacked sufficient information for coding, and therefore were not included in the following analysis. Of the 6,705 messages, 54 percent were rated as task, 30 percent were rated as social, and 16 percent were rated as technology related (see Table 2).

Percentages of the types of messages were used instead of frequency counts in order to standardize the results across the six sessions because the number of individuals and teams differed across sessions. Data for some teams were not available for all sessions, and a few data files were accidentally truncated during the recording process, resulting in some losses. For example, for one team, we may have recorded both days of sessions one through four and only the Saturday data of session five. For all sessions, the data of at least two teams were recorded.

Table 2. The percentage of text messages types during synchronous VTOC training.

Type of Message	# of Messages	Percentage of Total Messages
Task	3614	54%
Social	2003	30%
Technology	1088	16%
Total	6705	100%

The percentages of all three message types changed over the six sessions of training with the VTOC. Task-related messages ranged from slightly over 40 percent of the messages during the first session to over 60 percent during the middle sessions, and then fell to about 40 percent during the last session. Complementary to this trend, social text messaging was more frequent during the first and last training sessions than during the middle sessions. The level of technology-related messages steadily decreased over sessions, from 30-40 percent during the first three sessions to less than 5 percent during the last session. Different trends were revealed for task, social, and technology messages, as illustrated in Figure 2.

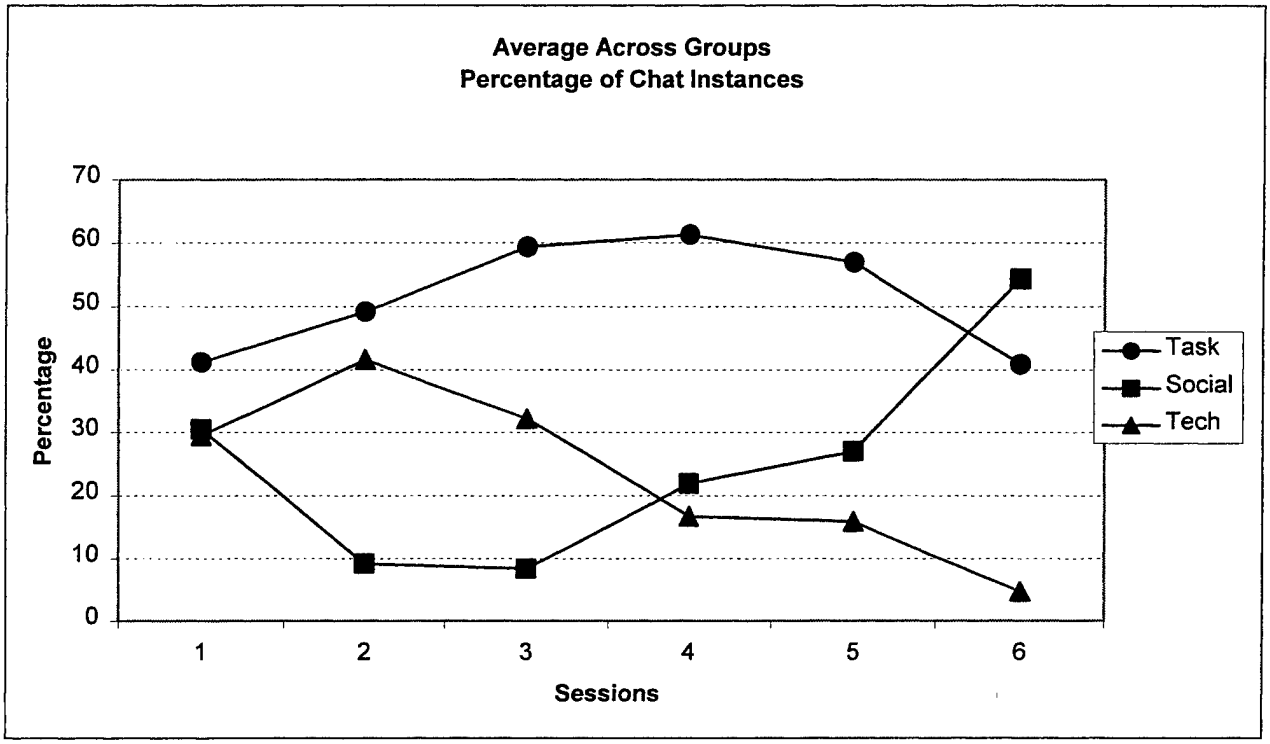

Figure 2. The percent of text messaging types (task, social, and technology related) across the six Phase 1b sessions using the VTOC.

Three separate ANOVAs were conducted to test for statistically significant differences between the six sessions for each individual category of interaction. For these analyses, the percentage of messages within each category (task, social, and technology) for each participant was compared across sessions. There were significant differences across sessions for task

messages ($F=5.41$, $p<.05$), social messages ($F=14.20$, $p<.05$), and technology messages ($F=6.54$, $p<.05$). Post hoc analyses (Tukey's test of honest significant difference) were conducted to determine where the significant differences occurred across sessions. For task-related messages, there was a significantly smaller percentage of messages in Session 1 compared to Sessions 3, 4, and 5. In addition, task messages during Session 4 were more likely than during Sessions 1, 2, and 6. For social messages, there was a significantly greater percentage during Session 1 compared to Sessions 2 and 3, while a significantly higher percentage of social messages occurred during Session 6 than during any of the other sessions. Finally, for technology-related messages, Session 2 produced a significantly higher percentage than Sessions 4, 5, and 6. Additionally, a lower percentage of technology-related messages occurred during Session 6 than during sessions 1, 2, and 3. All other comparisons were not significant.

The results document that the use of text messaging methodology for tracking group interaction is viable. During the initial sessions, almost equal time was spent on the task, getting to know one another, and figuring out how the equipment worked. As the team progressed into the middle sessions, the soldiers focused on the task more and needed less help with the equipment. As the training sessions concluded, almost no help was needed regarding the equipment. Also, during the last session the social interactions increased (the participants were either saying good-bye or planning for meeting one another during the next phase of training). The results provide insight into collaborative learning and how the teams and communication change over time.

Previous research indicates that when Web-based groups develop, the types of interactions among members change over time. In research by Lebie, Rhoades, and McGrath (1996), the change was similar to the pattern demonstrated by participants in the current research. In both, the frequency of communication regarding how to use the technology or how to complete the functions of a particular task decreased over time as the users became more familiar with the equipment or more skilled with the technology. In addition, the frequency of on-task communication was maintained at a high level across all sessions, and the frequency of social interaction started high and decreased during the initial sessions.

One of the trends of text messaging was the steady decrease in technology-related messages as sessions progressed. This most likely was due to increased familiarization with the equipment and decreased equipment difficulties over sessions. Technology-related problems are one of the main barriers to distributed education (Muilenburg & Berge, 2001; Lebie, Rhoades, & McGrath, 1996; Olson & Olson, 2000). Some of the difficulties in the AC3 course were due to some students not being familiar with the technology. When students are introduced to new technology they may have difficulty at first, however, previous experience using technology should increase the pace at which new skills are acquired (Schaab & Moses, 2001). It might be helpful to start the course with technology related training for those who are not familiar with the technology. Once these skills are learned, they may then be maintained and more easily transfer to novel situations and new training exercises.

Lebie, Rhoades, and McGrath (1996) found that text-based communication across a distributed network followed similar patterns to interactions in face-to-face groups. However, the patterns took longer to develop in the distributed groups. This suggests that the nature of

communication in both distributed groups and face-to-face groups may be similar, but that social relationships may develop more slowly.

Interviews with Students

Each student participated for approximately 70 hours in synchronous online instruction. They each also had a personal computer available for use and access to the Internet at both their home and work settings. Overall, the students favorably evaluated their experience working in groups online.

Students noted technological obstacles. During the focus group sessions, students noted several technological problems and obstacles related to the AC3-DL course. The map editor and virtual messaging rooms were responsible for the majority of students' technology problems. Such problems can frustrate students, interfere with learning, and negatively impact course completion rates (Olson & Olson, 2000).

The decreased frequency of technology-related text messages across sessions suggests that students overcame the difficulties that they experienced with the VTOC. This would be in agreement with Lebie, Rhoades and McGrath (1996), who demonstrated that the need for technological assistance was reduced as users became more experienced with the program. In addition, Olson and Olson (2000) demonstrated that students work more effectively as they overcome technological problems. The initial difficulties, therefore, may be considered "growing pains," or part of the learning curve where students become proficient with the particular technology.

Low course attrition during Phase 1b. Attrition is a pervasive problem in DL courses in higher education and training environments (Olson & Wisher, 2002; Phipps & Merisotis, 1999). In the focus group discussions, students were asked if they had ever considered dropping out and why. Seven of the eight students never considered it because they needed the course for career progression. Lack of time, was the reason given by the one student who contemplated dropping out, but did not. The most common reason for completing the course was that the course provided opportunity for career progression.

Cohesiveness in the learning environment. Students' opinions were mixed regarding the effectiveness of the team building process during the synchronous sessions. One group reported that, although they had never met face-to-face during Phase 1b, they were truly a team before arriving for Phase 2. These students said that text messaging allowed for both training task communication and social interaction. It enabled group members to get to know one another's strengths and weaknesses. In addition, everyone in this group stated that allowing different students to assume various leadership roles helped them learn to be "followers" and trust others. The second group, however, stated that they did not feel much of a sense of group cohesiveness, but instead were like "individuals struggling to work together as a team." At this point, there is no clear reason for the difference in opinions between the groups, and the question of what influences group cohesiveness warrants further investigation.

Instructor's role as a facilitator. The eight students agreed that the role of the instructor during Phase 1b was more of a facilitator than a lecturer. In accordance with the original course

design goals, a key role of the online instructors was to provide direction and guidance that facilitated learning instead of just lecturing. The students stated that feedback from the instructor was important, and therefore they sought feedback on a consistent basis throughout the course in order to assess their own progress.

One popular pedagogical technique used by the instructors in this course was early online introductions, allowing students and the instructor to get to know each another. The purpose of these introductions was to develop common ground among the students and instructors. Also, as instructors monitor the students' text messaging, they can make a concerted effort to get everyone to participate and to contribute to the real-time discussions. According to the students, these facilitative techniques used by the instructors were successful in helping the students succeed in the course.

Perceived advantages. Since the course was designed for reservists, most of whom had full-time jobs and families, it was not surprising that the students mentioned convenience as the primary advantage for the online course. The use of a DL format allowed the students to complete the course according to their own schedules.

Also important to students was the "active" learning environment embedded in the course. They appreciated the immediate feedback and mentoring from instructors, and most students were not hesitant to contact the instructor via e-mail for such feedback. Some students also stated that they learned to work as a team while online, and that the online environment fostered more thoughtful comments than normally found in conventional classroom settings.

Perceived disadvantages. The students stated that a key disadvantage of the course involved the length of the asynchronous and synchronous components. This is in agreement with both Sanders and Guyer (2001) and Sanders and Burnside (2001), who reported that students felt the asynchronous portion (Phase 1a) of AC3-DL was too long and filled with too much detailed information. During Phase 1a, the tests for each completed section used different formats, which students found confusing. In addition, when students did complete a module, they could not proceed to the next module without instructor permission, which detracted from the "learn anywhere, learn anytime" benefit of online learning. This situation led most of the students to skip portions of Phase 1a just to get through it, while others simply dropped the course[1].

In contrast, the students claimed that the synchronous portion (Phase 1b) was too short. Some students, for instance, mentioned that the length of Phase 1b did not allow every group member to play all roles in the simulated exercises. They suggested that additional VTOC sessions would allow all members to experience the XO (Executive Officer) and S-3 (Operations and Training) positions.

[1] Initial attrition rates for the first phase of AC3-DL was 50 percent for students who actively participated and approached 75 percent if all students who enrolled were included (Sanders & Burnside, 2001). Discussions with AC3-DL course developers and instructors indicated that the attrition rate was significantly reduced in later cohorts as the course delivery methods were modified.

Students were concerned with the reliability of the VTOC system and usefulness of some of its components. At times, the program removed students from the messaging rooms without warning, causing the loss of valuable training time while disrupting workflow. In addition, the map editing tool tended to freeze some computer systems, and the terrain viewer was not found useful. Most students stated that they did not like the avatar representing their physical presence in the VTOC operations areas and that the VTOC was not compatible with the Macintosh computer platform.

To alleviate some of these problems, students recommended that the course designers and instructors focus on basic technology shown to function effectively rather than the latest gadgets or innovations. This is not surprising, since research shows that online instructors and students tend to rely on simple tools such as e-mail, Web links to course material, and posting lecture notes online (Bonk, 2001; Bonk 2002). Significantly fewer instructors use online chatrooms, multimedia lectures, online examinations, animation, and streaming video. Using new technology (e.g., voice over the Internet) can be a mistake if it does not add perceived relevance and effectiveness to the course or solve a key problem.

In addition to technological concerns, students mentioned a few other disadvantages. For instance, the online examinations during Phase 1a offered minimal feedback other than test scores. They also stated that some of the modules could have been delivered and tested in smaller chunks, thereby focusing on specific accomplishments. Students seemed concerned with information overload and a reduced sense of accomplishment early in the course, which could result in attrition.

Interviews with Course Instructors

The interviews with course instructors yielded primarily positive results. Topics covered included: a) their role during Phase 1a and Phase 1b, b) the instructional techniques they used, and c) the perceived advantages and disadvantages of presenting the course in its current form. Interviews with the course instructors provided further insight into the pros and cons of teaching this complex, Web-based course.

Instructor's role as facilitator. The online instructors did not view their roles as much different than in the classroom. While instructors reported that they served more of a facilitative role, providing students with the means, tools, and guidance to learn effectively, they contended that the only major differences between teaching online and teaching in a classroom were that: a) they could not see their students and b) instead of writing grades on students' assignments, they sent them e-mails. Two instructors emphasized that they allocated the bulk of their time to course planning, but the third instructor indicated that he had spent much more time on the administrative aspects of the course. They all mentioned the importance of facilitating good decision-making and problem solving so that students can apply what they learn to real-life exercises.

Instructional techniques. The instructors stated that particular instructional strategies and pedagogical approaches were useful in specific online environments. During the asynchronous phase, instructors used directive and one-way instructional techniques aimed at teaching basic concepts and information, while during the synchronous phase instructors used indirect

questioning, prompting, and nudging. It is possible that during the asynchronous phase, the students may have needed a structured approach because they lacked background knowledge. In contrast, during the synchronous phase the students may have had a deeper level of understanding to build from and were able to respond well to constructivist techniques. This difference in teaching techniques may have been due to the asynchronous-synchronous difference, or it may be due to other variables, such as the students' level of understanding during a particular phase.

The instructors indicated that they were genuinely interested in student progress throughout the course and made attempts to be available to the students. For example, they sent out weekly reminders about assignments and used indirect questioning and prompting to engage students. Where possible, they also attempted to place each person in a leadership position within their groups to boost individual confidence levels. Instructional tactics, such as selecting students to be in charge of activities, were intended to boost student participation during the synchronous component. The instructors also found that matching weaker students with strong leaders was beneficial. In fact, they noted that this often resulted in the respective groups supporting poor performers on their own with little help needed from the instructors.

Perceived advantages. As a whole, the instructors stated that the online course fit nicely into a small group instruction model and strongly complemented the Army's "crawl, walk, run" philosophy of learning. In effect, the asynchronous portion (Phase 1a) provided the basic foundation ("crawl"), the synchronous portion (Phase 1b) allowed the students to put their knowledge to use in electronic and paper formats ("walk"), and the resident portion (Phase 2) prompted the students to fully apply their knowledge and skills in real-life scenarios ("run").

No instructor reported difficulties with the technology or the instructional methodology. One of the advantages of the Web-based course mentioned was the ability to provide detailed feedback to students, which promoted greater learning and application of knowledge by students. In terms of the asynchronous phase, the instructors claimed that students were effectively mentored as they progressed through the course learning new concepts and ideas. Moreover, they felt that feedback was promptly provided during Phase 1a and was based on progress as well as performance. Most of this feedback was provided through e-mail. Additionally, the synchronous component (Phase 1b) offered students immediate feedback from both instructors and peers using either messaging or voice communication. Overall, the course instructors gave the course design a positive rating.

The instructors stated that another key advantage of the synchronous course sections involved teaching students how to work with others as a team to solve a problem. In addition to problem solving and teamwork, instructors contended that using Web-based communication applications enhanced students' communication skills. The rise of communications technology and the need for team skills in most work settings support claims that distance technologies have a positive impact and promote important skills.

As an added benefit, instructors mentioned that interactive courses could give students the most current and updated material, equipping reservists with skills and training equal to that

of active duty soldiers. The DL course also provides an additional avenue for those who want to advance their military careers and earn credits towards an advanced university degree.

Overall, the instructors stated that they enjoyed teaching the course online and using the technology. The instructors reported that the students going through the DL course were better trained than those taking it through a previous correspondence version. They added that DL students gain general skills such as problem solving and group communication that are applicable to any position in the Army and could not be gained from a correspondence course. In fact, they recommended replacing all correspondence courses with distributed learning versions, especially for Army recruiters and commanders spread out across the United States.

Perceived disadvantages. While these instructors did not indicate many disadvantages with the overall course, they did report fairly high attrition rates during the asynchronous phase (Phase 1a). They sensed that part of the problem was not being able to control the size of modules. As a result, these students had to fit a fairly robust and demanding curriculum into their already full lives. According to the instructors, early modules in the asynchronous phase were particularly difficult. However, those who made it to the later modules usually had the stamina and motivation to complete the entire course.

Interview with DL Education Advisor

Overall perspective. The DL Education Advisor for the Armor School provided some valuable information concerning the design of DL courses, which echoed many of the findings from interviews with students and instructors. The DL Education Advisor indicated that she was quite pleased with the program and was an avid supporter. At the same time, she was interested in additional course evaluation, specifically how to improve student completion rates, fine-tune course production and system resources, and enhance online Web-based instruction tools and strategies. She emphasized the fact that anyone involved in the development of DL technology must be flexible and adaptable. The technology is changing so rapidly that one cannot just look at where the technology is now, but must also consider where it will be a year from now.

The DL Education Advisor said that applying the skills learned during the course was key to its success. She pointed to practical exercises that were embedded in the course to help students learn the content. For the purpose of training students to command companies and perform other duties at battalion and brigade levels, it was imperative to focus on bottom-line command readiness.

Advice. For those wanting to replicate aspects of this program, the DL Education Advisor provided several caveats and tips. She offered six important considerations in the design of DL courses. First, all courses should involve direct, e-mail feedback. Her rationale was that students need to feel connected to other students and to the instructor. Second, she claimed that courses should have meaningful content that students can directly apply to real-life exercises. Concerning the AC3-DL course, meaningful content typically involved combat situations and combat readiness. Third, there should be minimal extraneous content (e.g., extra graphics and non-essential information) to limit student confusion and course complexity. Her team found that students skipped optional or peripheral materials if they felt overwhelmed. Fourth, designers of DL courses should carefully analyze their target audiences so they can

accurately determine what the students want and need. Fifth, it is vital to create an active learning environment with a balance between flexibility and learner accountability. Not surprisingly, she readily admitted that the instructor is a key part of that environment, providing direction and feedback. With prompt instructor feedback, students were not isolated in their online learning endeavors. Lastly, designers should limit their visions and not stretch the expectations of technology too far beyond the tools and options that have been proven to work. When technology is pushed to the limits of its capabilities, then breakdowns are more likely. The DL Education Advisor argued that there would always be room for improvement in the future, but that one has to start somewhere.

Limitations. The DL Education Advisor noted several problems with the current system. First, many students wanted printed copies of the course materials. Given the online availability of the course materials, however, she felt that this would amount to an excessive waste of paper. Second, the learner-management system was not flexible enough for most of the students and instructors. For instance, some students voiced frustration that they could not move on to another volume if they missed too many items on the gate test. Third, since there was not ubiquitous access to the Internet, some activities and events were not always available to students across settings. Fourth, in addition to Internet access, some students wanted access to course materials via CD-ROM. The DL Education Advisor noted that the reason for Internet delivery of the course was so that student's progress through the course could be easily tracked.

SUMMARY

Previous research specific to this course found that the blended approach, a combination of Web-based and face-to-face lessons, used in the AC3-DL course was at least as effective as the correspondence version (Sanders & Burnside, 2001; Sanders & Guyer, 2001). In the initial version of the AC3-DL course, the synchronous section was not started until the asynchronous phase was completed. The course, however, has been modified once again, so that the asynchronous and synchronous phases are intermingled. This approach seems to be time efficient, allowing students to complete the training in a shorter timeframe.

Communication Trends

The communication trends noted during synchronous training (Phase 1b) provide insight to the developmental process during virtual team training. During the initial sessions, time and resources must be allocated for social bonds to develop and for the familiarization of technology. Course developers and instructors who incorporate computer-supported collaborative teams into curricula should be aware of the time/resource requirements for both social interaction and developing reasonable skills with the course technology.

In the current research, a majority of the messaging discussions focused on the task. Although always high, there was an increased likelihood that task-related text-messaging instances occurred during the middle sessions rather than the beginning or end. This was unanticipated, because the exercises across all meetings, similar in content and difficultly, required the same attention on task. However, the findings on social interaction may point to a reason for the inverted U shape found in the task data. During the first and last session, there were elevated levels of social text messages. The text messaging data showed that the first

session was influenced by initial greetings and getting to know one another conversations. During the last session, individuals spent quite a bit of time saying goodbye and planning to meet up and carpool to the "in-residence" training which followed. This social chat trend was complementary to the task related messaging trends; when social messaging decreased, task related messaging increased.

Participant Reactions

Qualitative interviews were useful in identifying aspects of the course that made it successful or inhibited it from being even more successful. While the participants stated that length of Phase 1a was a problem leading to high levels of attrition, they also acknowledged that all course material should be covered. The recommendation of the participants was that material should be segmented into more sections, so that they can be learned in smaller chunks.

The course supervisor and the instructors offered a different perspective to the course. One suggestion was that the development of a DL course should focus on content and not on the tools of technology. This is in agreement with prior research (Wisher & Curnow, 1999) demonstrating that additional non-content related information did not improve learning.

Interviews with students, course instructors, and the course supervisor, revealed some interesting findings. During the synchronous DL phase, the role of the instructor was that of a facilitator instead of a lecturer. Also, learning how to use the technology was a concern to both the students and the instructors. Therefore, the course supervisor suggested that for instructional purposes course designers should not attempt to stretch the technology to the limits of its capabilities because that increases the frequency of problems. Taken together, the results from the analysis of text chat communication and participant reactions provide a broad picture of an effective blended approach to course delivery.

REFERENCES

Alkhateeb, H. M., & Jumaa, M. (2002). Cooperative learning and algebra performance of eighth grade students in united arab emirates. *Psychological Reports, 90,* 91-100.

American Psychological Association. (1997). *Learner-centered psychological principles: A framework for school redesign and reform.* Washington, DC: Author. Retrieved May 7, 2002 from http://www/apa.org/ed/lcp.html.

Army Logistician (2001). *Deployable campus enhances training.* (PB 700-01-5) 33 (5), p.42.

Bonk, C. J., Olson, T. M., Wisher, R. A., & Orvis, K. L. (2002). *Reflections on blended distributed learning: the armor captains career course.* (Research Note 2003-06). Alexandria, VA; U.S. Army Research Institute for the Social and Behavioral Sciences.

Bonk, C. J. (2002). *Online training in an online world. Bloomington, IN: CourseShare.com.* Retrieved on January 15, 2003, from http://publicationshare.com/docs/corp_survey.pdf.

Bonk, C. J. (2001). *Online teaching in an online world. Bloomington, IN: CourseShare.com.* Retrieved on January 15, 2003, from http://publicationshare.com/docs/corp_survey.pdf.

Bonk, C. J., & Wisher, R. A. (2000). *Applying collaborative and e-learning tools to military distributed learning: a research framework.* (Technical Report 1107). Alexandria, VA; U.S. Army Research Institute for the Social and Behavioral Sciences.

Deatz, R. C., & Campbell, C. H. (2001). *Application of cognitive principles in distributed computer-based training.* (Research Product 2001-03). Alexandria, VA: U.S. Army Research Institute for the Social and Behavioral Sciences.

Deloughry, T. D. (December 8, 1995). Making connections. *The Chronicle of Higher Education.* A21-A24.

Duffy, T. M., & Cunningham, D. J. (1996). Constructivism: Implications for the design and delivery of instruction. In D. H. Jonassen (Ed.), *Handbook of research on educational communications and technology* (pp. 170-198). New York: Scholastic.

Fisher, M., & Coleman, B. (2001-2002). Collaborative online learning in virtual discussions. *Journal of Educational Technology Systems, 30(1),* 3-17.

Fleiss J. L. (1981). *Statistical methods for rates and proportions. 2nd ed.* (pp. 38-46). New York: John Wiley.

Garrison, D. R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distributed education. *The American Journal of Distributed Education, 15 (1)*, 7-23.

Hillman, D. C. A. (1999). A new method for analyzing patterns of interaction. *The American Journal of Distributed Education, 13 (2),* 37-47.

Howard, F. S. (1992). *Distributed Training Pilot – MOS 75B Distributed Training Course Training Effectiveness Analysis.* (TRAC-WSMR-TEA-92-031) US Army TRADOC Analysis Center-White Sands Missle Range.

Hudson, J. M. & Bruckman, A. S. (2002). IRC francais: the creation of an internet-based SLZ community. *Computer Assisted Language Learning, 15(2),* 109-134.

Kang, I. (1998). The use of computer-mediated communication: Electronic collaboration and interactivity. In C. J. Bonk & K. S. King (Eds.), *Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse* (pp. 315-337). Mahwah, NJ: Erlbaum..

Kulik, C. C., & Kulik, James A. (1991) Effectiveness of computer-based instruction: an updated analysis. *Computers in Human Behavior, 7,* 75-94.

Lebie, L., Rhoades, J. A., & McGrath, J. E. (1996) Interaction process in computer-mediated and face-to-face groups. *Computer Supported Cooperative Work, 4,* 127-152.

Mezko, J., Redding, G. A., & Fletcher, J. D. (1996). *Distributed learning and the reserve components.* Institute for Defense Analysis (Document D-1941).

Moore, M. G. (2001) Surviving as a distance teacher. *The American Journal of Distance Education, 15(2),* 1-5.

Muilenburg, L., & Berge, Z. L. (2001) Barriers to distributed education: a factor-analytic study. *The American Journal of Distributed Education, 15 (2)*, 7-24.

Olson, G. M. & Olson, J. S. (2000). Distance matters. *Human-Computer Interaction. 15,* 139-178.

Olson, T. M. & Wisher, R. A., (October, 2002). The effectiveness of web-based instruction: an initial inquiry. *International Review of Research in Open and Distance Learning* (Online Journal). Retrieved January 15, 2003 from http://www.irrodl.org/content/v3.2/olsen.html.

Orvis, K. L., Wisher, R. A., Bonk, C. J., & Olson, T. M. (2002). Communication patterns during synchronous web-based military training in problem solving. *Computers in Human Behavior, 18,* 783-795.

Palincsar, A. S. (1998). Social constructivist perspectives on teaching and learning. *Annual Review of Psychology, 49,* 345-75.

Pena-Shaff, J., Martin, W., & Gay, G (2001). An epistemological framework for analyzing student interactions in computer mediated communication environments. *Journal of Interactive Learning Research, 12(1),* 41-68.

Phipps, R., & Merisotis, J. (1999). *What's the Difference? A Review of Contemporary Research on the Effectiveness of Distance Learning in Higher Education.* Institute for Higher Education Policy. Retrieved January 15, 2003, from the World Wide Web: http://www.ihep.org.

Program Management Office, The Army Distance-learning Program (2000). *The Army Distance-learning Program Brochure*, Fort Monroe, VA: Department of the Army. Retrieved from http://www.tadlp.army.mil/brochure.pdf

Sanders, W. R. & Burnside, B. L (2001). *Assessment of initial delivery of the armor captains' career course (distributed learning).* (Research Report #1775). Alexandria, VA; U.S. Army Research Institute for the Social and Behavioral Sciences.

Sanders, W. R., & Guyer, C. W. (2001). *Commanders' survey: Armor captains'career course (distributed learning).* (Research Report #1771). Alexandria, VA; U.S. Army Research Institute for the Social and Behavioral Sciences.

Schaab, B. B., & Moses, F. L. (2001) *Six myths about digital skills training.* (Research Report #1774). Alexandria, VA; U.S. Army Research Institute for the Social and Behavioral Sciences.

Wisher, R. A., & Curnow, C. K. (1999). Perceptions and effects of image transmissions during internet-based training. *The American Journal of Distributed Education. 13 (3)*, 37-51.

APPENDIX A - FOCUS GROUP QUESTIONS

Questions to Students

1. What was the most facilitative aspect of the online chats?

2. What were the advantages of taking this course online versus in a classroom?

3. How did you view the role of the instructor in this course? Did this view change over the course of the class? What did you like best about the instructor? What did you like least about the instructor?

4. How did the tools foster student interaction?
(terrain viewer, map edit, text chat, voice chat, bookshelf, word, role-playing as Avatar, e-mail, Spearhead simulation)

5. What advice could you give people just entering this course concerning the most effective ways to interact with others online?

6. How did you know that you were "off-track" when communicating with others online?

7. Did you have a sense that someone was facilitating or leading the chars? How did you know?

8. When did you use the online chats versus the audio chats?

9. What were the most common technology-based problems that you encourtered throughout the course?

10. What methods did you use to develop a sense of "team identity" with your other team members?

11. How often did you seek feedback from the instructor? How often did you seek feedback from peers? What methods did you use to obtain this feedback?

12. What percentage of time during the course did you work without interaction with another team member or the instructor?

13. Did one person emerge as the "leader" of the team during the course? How did this individual behave to indicate to you that he was the leader?

14. How did you and the other group members resolve conflicts that arose?

15. Do you see the impact of what you learned in Phase I training in Phase II? Do any of the simulation skills transfer? If so, how do they help you in Phase II?

16. How often do you play simulation-based computer games? Did that help you in Phase II training?

17. Did you ever think of dropping out? If so, when and why?

APPENDIX B - INSTRUCTOR INTERVIEW QUESTIONS

1. What tools do you think were the most helpful in getting students to learn online?
2. What instructional strategies or pedagogical approaches were particularly useful? How do you know that they were useful?
3. How did you assess student learning? How would you change your assessment of student learning in the future?
4. What did you like best about teaching online?
5. What do you like least about teaching online?
6. What advice would you give other instructors who were considering teaching a course online?
7. What advice would you give potential funders of online projects?
8. What goals did you have in mind when teaching this class?
9. Where and when do you think the most learning took place?
10. Would you teach this way again? Why or why not?
11. What aspects of the online course do you think students had the most problems with? Were you able to deal with those problems effectively?
12. How did you view your role as an instructor? Do you think your role would have been different if you had taught in a classroom instead of online? How would it be different?
13. How often did students request feedback? How did you provide this feedback?
14. Did you have any students that were not as actively participating as the rest? What methods did you use to increase their participation?
15. What percentage of time did you allocate to planning and preparation? Online teaching? Administration? Interaction with students? Interaction with content?
16. Who typically drops out of the live and online courses? Why?
17. What are the key outcomes you want from the online course?