TEAMWORK TRAINING FOR TACTICAL OPERATIONS CENTER BATTLE STAFFS

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ABSTRACT

The Digital Battle Command Team Training (DBCTT) courseware is designed to improve the coordination skills of Army battle staff teams involved in dynamic mission planning and execution within the digital Tactical Operations Center (TOC). The DBCTT Training Support Package (TSP) includes didactic training, a series of progressively more complex interactive practical team exercises, performance feedback, and a Performance Evaluation System (PES) to measure team coordination performance. The DBCTT TSP incorporates essential Army Battle Command Systems (ABCS) functionality through emulations to provide practical exercises in teamwork and is designed for use on currently available computer systems. The DBCTT Train-the-Trainer TSP provides training for DBCTT instructor/facilitators. This paper describes the DBCTT TSP course design and key findings from the summative evaluation. The evaluation of the DBCTT TSP showed that teamwork performance ratings for the trained group exceeded those of an untrained control group by 29%. In addition, the evaluation revealed that situation awareness was improved by 30% in the teamwork trained group. The DBCTT and Train-the-Trainer TSPs are available for use by institutional and unit trainers of battle staff in echelons brigade and below digital TOCs.

ABOUT THE AUTHORS

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Dr. Belinda Hartnett is a research scientist at Dynamics Research Corporation and was the principal investigator for the DBCTT program. Dr. Hartnett is the program manager for the Defense Acquisition University Communities of Practice; the Air National Guard's Chemical, Biological, Nuclear, and highly-yield Explosive course; and the Knowledge Management and Continuity Project for the Directorate of Training, Doctrine, Combat Development, and Experimentation at Fort Knox. Belinda is a former Air Force officer with experience as a squadron commander. She holds a Ph.D. in Human and Organizational systems and an M.A in Organizational Development from the Fielding Graduate Institute, an M.S. in Public Administration from Troy State University, and a B.S. in Biology from Sul Ross State University.

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INTRODUCTION

Team coordination training promotes a set of team coordination skills that can increase mission effectiveness, while decreasing errors that can lead to mission degradation and failure. The goal of the Digital Battle Command Team Training (DBCTT) program is to improve the effectiveness of Army battle staff teams in risk analysis, dynamic mission planning, and mission execution within the digital Tactical Operations Center (TOC). Leader development and team coordination training play key roles in the successful employment of sophisticated, highly lethal, and technologically complex combat systems. Likewise, good digital battle command leader and team training can ensure the effective use of these combat systems enabled by digital Army Battle Command Systems (ABCS).

Team coordination is a skill that needs to be deliberately developed and trained, particularly in complex, distributed, high risk, and high stress environments like the TOC. Unfortunately, the occasions in which battle staff teams are able to train together are often restricted to operational exercises. A complete operational exercise is expensive and resource intensive, both in terms of personnel and equipment, as it requires a complete communications and battle staff infrastructure. Soldiers need more opportunities to develop and practice team coordination skills while attending battle-staff intensive Training and Doctrine Command (TRADOC) courses and during garrison operations in operational units to train and sustain performance on tasks accomplished as a team.

The DBCTT program is built on and extends the Army's Aircrew Coordination Training Enhancement (ACTE) and Battle Command Advanced Team Train (BCATT) programs. These projects showed that team coordination training improves mission performance and reduces error (Kambe, Kline, Price, & Grubb, 2005; Katz & Grubb, 2003). The training that was developed and lessons learned from these programs was extended to DBCTT which focuses on a fully integrated battle staff in echelons brigade and below digital TOCs.

This paper provides an overview of the development of the DBCTT training support packages (TSP), a description of the instructional content, and a summary of the evaluation research which was conducted on the student and train-the-trainer TSPs. The discussion and conclusions summarize the program, its potential applications, and its availability.

TEAMWORK TRAINING NEEDS FOR THE TOC

Subject Matter Experts (SMEs) conducted a review of battle staff performance problem areas in brigade and battalion TOCs at the Center for Army Lessons Learned (Hartnett, Tremlett, Kline, Riedel, & Grubb, in preparation d). SMEs gathered information from Initial Impression Reports and After Action Reviews that focused on Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF). SMEs also examined battle staff performance at the Combat Training Centers looking particularly at their training trends analysis. These analyses identified battle staff problems in the Army's digital Brigade Combat Team (BCT) TOC that could be mitigated through team coordination training (Tremlett, 2006). Since these problem areas did not identify critical task deficiencies, a collective task analysis of TOC operations was conducted by experts in digitally-based battle staff operations (Hartnett, et al., in preparation d). This analysis of specific collective tasks, recognized by Army senior leadership as critical to battle staff performance, identified four tasks that are especially difficult, important, and frequently performed: (a) establish command post operations, (b) manage tactical information, (c) control tactical operations, and (d) monitor continuous operations. Currently, the Army is not training the teamwork component in any of these collective tasks. The DBCTT teamwork objectives and coordination skills that support these critical tasks are described in the next section.

DBCTT TEAM COORDINATION OBJECTIVES AND COORDINATION SKILLS

The selection of the team coordination skills and objectives to train in DBCTT was based on research on aircrew performance, teamwork and organizational process (Grubb, Simon, Leedom, & Zeller, 2001). These skills are neither innate to the individual nor automatically acquired through experience (Katz & Grubb, 2003). Such knowledge and skills must be consciously defined, taught, and practiced for the staff to effectively perform as a synchronized decision-making team. As the tempo and complexity of operations increase, so does the need for standardized approaches to synchronize team and organizational decision-making behaviors.

While each battle staff member must effectively perform his or her own individual tasks, the battle staff must also perform effectively as a team. The basic DBCTT team coordination skills, based on team coordination skills indentified by Grubb, et al. (2001), are:

1. Clarify roles and contributions
2. Cultivate positive team climate
3. Establish a strategy for knowledge management
4. Conduct situational planning and rehearsal
5. Apply appropriate decision-making methods
6. Ensure statements and directives are clear, timely, relevant, complete, and verified
7. Manage and prioritize information flow
8. Maintain situation awareness
9. Prioritize actions and distribute workload
10. Manage unexpected events
11. Ensure team members actions are cross monitored
12. Conduct a teamwork-focused after action review

Although executing technical tasks is the context for performing teamwork behaviors, DBCTT focuses on training of the team behaviors and processes identified by Grubb, et al. (2001) and not on the training of technical tasks. The foundation for the DBCTT training and performance evaluation system is a hierarchical construct of team outcomes and processes that consist of three elements: (a) Team Coordination Objectives (TCOs), which are abilities and team outcomes at the highest level; (b) Coordinating Skills (CSs), which are behavioral skills and team processes at the intermediate level; and (c) Performance Competencies (PC), which are team task actions at the lowest level of the hierarchy. The two top levels of the hierarchy are shown in Table 1. These two levels provide the framework for teamwork instruction and team performance evaluation.

Content and definitions for each element in the hierarchy are based on the analysis of battle command related problems identified and documented in Hartnett, et al. (in preparation d). Reports from units deployed to operations OEF and OIF confirmed the persistent challenges faced by Army battle staffs that were identified from the literature. Our SMEs identified global and specific examples of operational problems and related them to a set of draft DBCTT TCOs. The SME team constructed a global problem statement for each battle command draft CS and then prepared a discussion section of specific problems. Next, the SMEs prepared a narrative description of the recommended battle command TCOs and CSs. Battle command (team training) SMEs reviewed the draft TCOs and incorporated insights from interviews with commanders and battle staff members recently returned from deployed units.

Table 1. Relationship between DBCTT Team Coordination Objectives (TCO) and the Coordination Skills (CS)

TCO 1: Establish Teams and Procedures	**TCO 2: Plan and Problem Solve**	**TCO 3: Exchange Mission Information**	**TCO 4: Manage Situations and Workload Levels**	**TCO 5: Monitor and Adjust Team Processes**
CS 1: Clarify roles and contributions	CS 4: Conduct situational planning and rehearsal	CS 6: Communicate effectively	CS 8: Maintain situation awareness	CS 11: Cross-monitor Team members actions
CS 2: Cultivate positive team climate	CS 5: Apply appropriate decision making methods	CS 7: Manage and prioritize information flow	CS 9: Prioritize actions and distribute workload	CS 12: Conduct teamwork-focused after action reviews (AAR)
CS 3. Establish strategy for knowledge management			CS 10: Manage unexpected events	

COURSEWARE DESIGN

The DBCTT program consists of two TSPs. The DBCTT TSP is the teamwork training courseware and the Train-the-Trainer TSP is the instructor training courseware. Both TSPs use a blended approach whereby a variety of instructional methodologies, best suited to the instructional goal of the lesson or topic, are applied to the training. The specific training methodologies used are:

- Tutorials
- Embedded Comprehension Checks
- End of Module Tests
- Demonstrations/Vignettes
- Facilitated Discussions
- Practical Exercises
- Emulations
- Case Study

All modules of the DBCTT and Train-the-Trainer courses are presented as computer-based training. The courseware is hosted on a local area network (LAN) of eight laptop computers (workstations) supported by a LAN server.

DBCTT TSP

The DBCTT TSP is delivered in a group training environment and provides students with initial teamwork skills training. Training begins with individual self-paced instruction on the TCOs and CSs and the DBCTT Performance Evaluation System (PES), as well as progressive (Crawl-Walk-Run) interactive exercises. During these exercises, the student interacts with the courseware to identify instances of good and bad battle staff team performance in video enactments. The student then identifies and explains how the application of the appropriate TCOs and CSs may have contributed to the good performance or rectified the bad performance. A facilitated discussion using graphical displays of student responses follows each interactive exercise. Next, during the case study, students use the PES scoring system to evaluate the battle staff performance depicted in video segments of actual TOC teams. The final section of the courseware enables the transition from learner to performer as the class forms into two-person teams to conduct simulated missions using emulations of four ABCS components: Maneuver Control System (MCS), Force XXI Battle Command, Brigade-and-Below (FBCB2), All Source Analysis System (ASAS), and Advanced Field Artillery Tactical Data System (AFATDS). The four laptop computers serving as the ABCS system hosts for a two-person teams are referred to as workstations. For these practical exercises (PE), the instructor can choose one or more missions from a library of nine one hour missions based on Contemporary Operating Environment (COE) scenarios. The teams conduct the "mission" in real time, rate their own teamwork behavior using the PES, and then engage in a facilitated discussion of their teamwork performance. Figure 1 shows the arrangement of the workstations.

Figure 1. DBCTT classroom arrangement.

The target audience for the DBCTT TSP is the Army leaders and staff members at the brigade and battalion levels who are currently assigned to, or will be assigned to, a digital TOC. In addition, any member of the digital TOC who controls the information flow or prepares any of the TOC products will benefit from this training. Students are strongly advised to be familiar with one or more component systems of the ABCS.

Train-the-Trainer TSP

The DBCTT Train-the-Trainer TSP provides instructor candidates with the knowledge and skills to plan, prepare, and deliver the DBCTT TSP. Training includes instruction on instructor presentation techniques, facilitation skills, and instruction and practice on the DBCTT PES. Additionally, students are trained in courseware setup and management. They also review the courseware content for the DBCTT TSP. During the teach-back exercise, students have an opportunity to deliver a portion of the training and receive valuable feedback during a peer and cadre review. As a prerequisite for this TSP, students must have successfully completed the DBCTT TSP and been selected by their commanders

to receive additional training to become DBCTT instructor-facilitators.

DBCTT TSP EVALUATIONS

In collaboration with the Army Research Institute at Ft. Leavenworth, KS, the DBCTT program began in June 2005 and progressed through three phases that were completed in December 2008. During Phases 1 and 2 eight formative and summative evaluations were completed on various versions of the TSPs. These field evaluations involved 73 Soldiers from operational units across the United States that collectively captured the intended target audience for this training (Hartnett, Morey, & Riedel, in preparation a; Hartnett, Morey, Tremlett, & Riedel, in preparation c). A description and results of an initial formative evaluation were reported earlier (Tremlett, Hartnett, & Riedel, 2007).

The DBCTT Train-the-Trainer TSP underwent a summative evaluation during Phase 2. In Phase 3, the components of the originally separate didactic and advanced practical exercise modules of the DBCTT TSP were combined into a final courseware package that was assessed in a summative evaluation (Hartnett, Morey, & Riedel, in preparation b). A description of this DBCTT TSP summative evaluation is provided in the next sections.

EVALUATION QUESTIONS

To evaluate the DBCTT TSP's learning and performance objectives, a variety of evaluation questions were posed, three of which are selected for presentation here:

1. Does teamwork improve after completing didactic training and a series of PEs?
2. Which of the exercises in a suite of six PEs are the most effective?
3. What is the effect of teamwork training on situation awareness (SA)?

METHOD

Participants

Twenty-six Soldiers, 25 males and 1 female, from units at Ft. Bragg, NC, Ft. Benning, GA, and Ft. Hood, TX participated in the evaluations during four site visits. Participants at locations for the first and fourth TSP evaluations were assigned to the control condition (n = 12), and participants for the second and third TSP evaluations were assigned to the experimental condition (n = 14). The first evaluation was assigned to the control condition because of a courseware programming limitation which was subsequently resolved. The remaining three evaluations were randomly assigned to the experimental and control groups. Each group was evenly balanced by participant age, total time in service, active time in service, and time in current duty position. Class size varied between six and eight students.

Training Procedures

A class of students was seated at laptop computers in a standard classroom equipped with the DBCTT LAN. Program SMEs briefed participants on the research project, obtained informed consent from each participant, and assisted them in enabling the TSP courseware. After completing the required network logon procedures, the participants completed the demographic data survey, and then initiated the courseware.

For the experimental group, the five modules of the TSP were presented in the order as designed for a normal training class. One exception to the standard training was introduced for evaluation purposes. In the practical exercise module the students engaged in three PEs in succession. This number of PEs may not be the recommended or normal level of presentation of PEs for one training session. At one site the experimental group received PEs 1, 2, and 3 and at the other site the experimental group received PEs 4, 5, and 6. All the PEs consist of asymmetric warfare scenarios set in the COE of Southwest Asia. These scenarios were developed as a result of discussions with combat veterans from Iraq and Afghanistan. The scenarios were assessed for realism and relevance by current battle staff members in active Army brigades and battalions during the DBCTT program.

The control group received the three PEs immediately upon initiating the courseware, while the experimental group received the team training instruction modules prior to doing the PEs. As in the experimental group, the control group completed the PEs 1, 2, and 3 at one site and PEs 4, 5, and 6 at the second site. The control group did not complete the PES teamwork scoring or engage in a facilitated discussion at the conclusion of the PEs. Once the set of three PEs was completed, the control group continued with the instructional modules. This was done so that the control group would benefit from the DBCTT training. Like the experimental group, the

control group completed the course critique at the completion of all the training and practical exercise modules.

Performance on the PEs was used as a measure of team performance for both the control and experimental groups. Observer-evaluators (OEs) were assigned to each of the four ABCS workstations to provide teamwork ratings for the workstation teams. Ratings were made on a PES-based rating instrument.

Situation Awareness Assessment Procedures

Using the Situation Awareness Global Assessment Technique (SAGAT) protocol (Endsley, 1995, 1999) that entails interrupting an ongoing mission to assess SA, five PEs were designed with four pauses for SA assessment. The sixth PE did not lend itself to four pauses because of the mission events; this PE contained three pauses.

At unannounced times, the mission paused. The first pause occurred at anywhere from 10 and 15 minutes into the mission, the second at the mission midpoint (about 30 minutes), the third at between 10 to 15 minutes beyond the midpoint, and the fourth pause at the end of the mission (approximately one hour after the start of the PE). For two-person teams which had been working at one workstation, the team members split to use individual workstations to respond to the SA questions. Therefore, team members were individually queried for SA with a common set of questions presented to all participants.

The participant responded to the questions addressing the three levels of SA: (a) Level 1 - Perception of Elements in the Environment, (b) Level 2 - Comprehension of the Current Situation, and (c) Level 3 - Projection of Future Status. Question format included fill-in-the-blank, multiple choice, and true-false formats. Questions related to overall mission events for which team situation awareness was necessary or might be expected. A pause for an SA query resulted in between four to nine questions (median = 7) being presented. SA was scored as the percentage correct identifications of the actual or emergent events.

RESULTS

Teamwork Performance

Observer-evaluators (n = 4) observed each experimental and control group workstation team and rated teamwork performance at the team level for each PE. To conduct the analysis of the teamwork ratings, for each of the four workstations the ratings on the five TCOs (see Table 1) were averaged for the PE. Figure 2 shows the mean teamwork ratings for the two sets of PEs for both groups. The overall mean teamwork performance by workstation was analyzed with a repeated measures analysis of variance (ANOVA) with the between-subjects factor of group (experimental and control) and the within-subjects factor of PE. The workstation factor was not included since the resulting model was not full factorial. The within-subjects factor was evaluated for trend by comparing the mean performance of each PE with the mean performance of the immediately preceding PE. An ANOVA was conducted for the experimental and control groups that completed PEs 1, 2, and 3 and a separate ANOVA for PEs 4, 5, and 6. The significance level was $p < .05$ for these and all subsequent statistical tests.

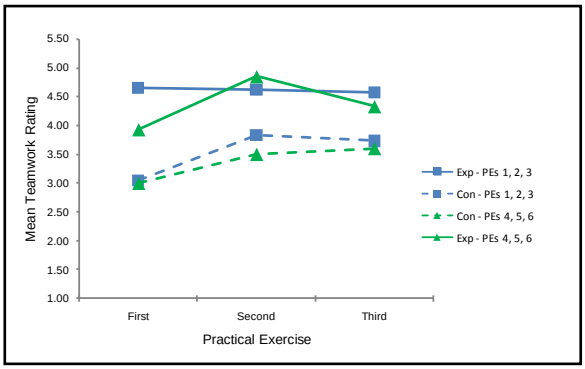

Figure 2. Mean teamwork ratings for the experimental and control groups.

Both analyses revealed higher teamwork ratings for the experimental group than for the control group. For the PE 1, 2, and 3 set, the mean teamwork rating for the experimental group was 4.62 (on a 7-point scale) and for the control group was 3.53, a statistically significant difference, $F(1,6) = 7.15$, $p = .037$. For the PE 4, 5, and 6 set, a statistically significant difference was obtained between the mean teamwork rating for the experimental group ($M = 4.37$) and the control group ($M = 3.37$), $F(1,6) = 6.07$, $p = .049$.

The ANOVAs also evaluated the differences among teamwork ratings for the three PEs within a set, and the effect of training on PE ratings (examined with the group by PE interaction). For the PE 1, 2, and 3 set, a significant trend was revealed only for the

group by PE interaction of PE1 and PE2, $F(1, 6) = 15.69$, $p = .007$, reflecting the performance improvement in the control group.

For the PE 4, 5, and 6 set, the trend analysis among the three PEs showed that the teamwork improvement from PE 4 to PE 5 was statistically significant ($F(1,6) = 15.16$, $p = .008$), but the decrease from PE 5 to PE 6 was not, $F(1,6) = 2.15$, $p = .193$. With the inclusion of the experimental-control group factor with the PE trend to test the interaction, neither interaction tested was statistically significant. Taken together, the main effect and interaction results for the PE 4, 5, and 6 set show that teamwork improved for both groups from the first to second mission (PE 4 to PE 5), and that the advantage for the experimental group was maintained from the second to third mission (PE 5 to PE 6).

To examine which, if any, of the PEs was most effective in eliciting teamwork performance, comparisons were carried about at each stage of practice using independent groups *t*-tests. Comparisons were made between PE 1 and PE 4, PE 2 and PE 5, and PE 3 and PE 6. Separate analyses were carried out for the experimental group and the control group. None of the six *t*-tests showed a significant difference between the pairs of mean teamwork ratings indicating the two sets of PEs are comparable for instructional purposes.

The effect of the teamwork skills instruction prior to the practical exercises is evident in Figure 2 with the higher level of teamwork ratings for the experimental groups. The levels of teamwork measured for PEs 1, 2, and 3 set were equivalent as the teams moved through the three exercises. Therefore, this set of PEs does not reveal a learning effect over missions. However, the data from PEs 4, 5, and 6 show the effects of practice in teamwork between the first two practical exercises completed, and no significant reduction in the teamwork performance from the second to third exercise.

Situation Awareness

The mean percent correct SA responses (measured individually for each team member for each PE) are shown in Figure 3. Level 1 SA improved with teamwork training as demonstrated in the main effect comparison of the experimental and control groups, $F(1,11) = 6.43$, $p = .028$. The experimental group mean SA score was 65.6% and the mean for the control group was 49.7%. A statistically significant

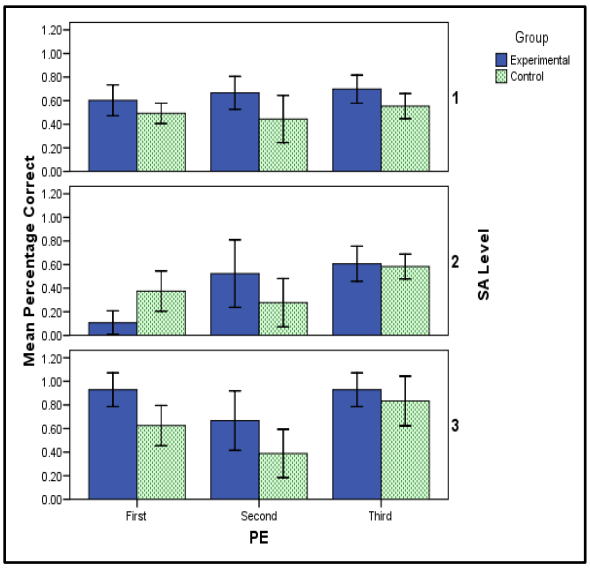

Figure 3. Mean percentage correct for Level 1, 2 and 3 SA responses (error bars are ± 2 standard errors of the mean).

effect for SA improvement over the three PEs was not obtained. Level 2 SA revealed a statistically significant improvement in SA scores for the PEs, $F(2,22) = 8.12$, $p = .002$. Examining this improvement in more detail with the group by PE interaction, the comparison of the groups for PE 1 and PE 3 showed a significant improvement, $F(1,11) = 5.48$, $p = .039$. This statistical test is sensitive to the initially lower performance of the experimental group as compared to the control group in PE. The experimental group showed a marked improvement in PE 3 when compared to PE 1.

Level 3 SA revealed a significant main effect of training for the experimental group, $F(1,11) = 6.50$, $p = .027$. The improvement of SA with practice was demonstrated in the planned comparison between PE 2 and PE 3, $F(1,11) = 10.12$, $p = .009$.

These results from the analyses of the three levels of SA support the hypothesis that teamwork training results in higher levels of SA. Teamwork-trained teams had an advantage in Level 1 SA that is evident in their first mission and the maintenance of their SA over successive missions. Level 2 SA demonstrated improving SA over successive missions. Evidence of the teamwork training effect on Level 2 SA is evident in the improvement in the experimental group between PE1 and PE 3, but this effect was influenced by the unexpectedly low SA performance of the experimental group for PE 1. Level 3 SA showed a

clear advantage for teamwork training from the first mission undertaken after training.

Course Critique

Five questions of the course evaluation survey asked students specifically about their subjective reactions to the learning and performance outcomes of the course. The mean ratings for these questions are shown in Figure 4. A multivariate analysis of variance (Wilks' lambda = .582, $F(5, 19) = 2.73$, $p = .05$) showed a statistically significant but small effect for the experimental group ($M = 4.23$) when compared to the control group ($M = 4.16$).

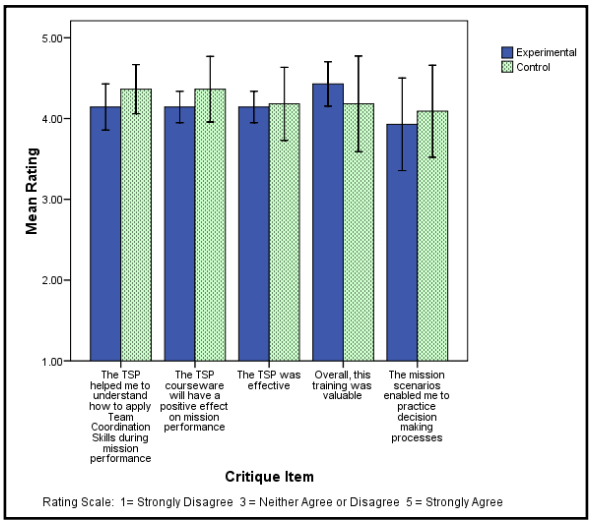

Figure 4. Mean ratings for general critique questions (error bars are ± 2 standard errors of the mean).

However, univariate analyses of variance (ANOVA) on each of the five questions revealed no statistically significant experimental and control group differences for any of the questions. With the exception of the experimental group that had a mean rating of 3.9 for Item 5 (The mission scenarios enabled me to practice decision making processes), all responses were at or above the agree level. These results reveal that student reaction to the course was positive. The ratings indicated that the students felt the training was effective and valuable and would have a positive effect of mission performance for those who complete the course. Even the control group that had the practical exercises first without the benefit of the training responded at the same level of positive evaluation as the experimental group that received the course in the planned sequence of didactic training followed by practical exercises.

DISCUSSION

To the first evaluation question of whether the DBCTT teamwork training leads to better team performance, the answer is that the courseware is effective. The main measure of the effectiveness of the training was the rating of teamwork performance during simulated TOC missions. These ratings were made by evaluators who observed the four workstation teams perform during the practical exercises. Ratings were made on a 7-point scale where 1 is below standard, 4 is meets standard, and 7 is exceeds standard. The experimental group showed a clear advantage in better teamwork that exceeded the ratings of the control group by 29%. The control group mean score of 3.5 was at the slightly less than "meets standards" level on the teamwork rating scale. The experimental group mean at 4.5 was slightly greater than the "meets standards" level on the 7-point rating scale. Statistical comparison of the means for the experimental and control groups demonstrated that the experimental group had higher teamwork ratings that reflected better teamwork performance. One potential confounding factor is that the raters may have been biased in their ratings since they knew which teams were in the experimental and control groups. But the situation awareness scores, based on responses provided individually by team members, were higher for the teamwork trained group. This suggests that the observer-evaluators' ratings were not biased.

The first training evaluation question also addressed whether teamwork performance changed as a function of practice on the three practical exercises. The data reveal a mixed picture on this question. For one set of PEs the trained group showed initially better skills than the untrained group with no further increases in teamwork performance as a result of practice. In the other set of PEs the trained group showed better teamwork than the untrained group in its initial exercise with improvements in teamwork at a rate comparable to the untrained group. Teamwork performance did not appreciably change between the second and third exercises. Equally important, however, was the finding that the control group did not "catch up" with the experimental group with respect to teamwork skills with either set of PEs. The experimental group, on average, maintained better teamwork skills over all its missions than the control group. The conclusions are that the teamwork training improved the teamwork of the experimental group and that the control group did not develop teamwork skills simply as a function of performing together over the three missions.

The second evaluation question addressed the issue of potential effectiveness differences among the six PEs. Performance outcomes were shown not to be a result of content differences among the practical exercises.

The third evaluation question asked if SA improves with teamwork training. The SA data show that teamwork trained participants increased their SA by 30% over the untrained participants. This is a significant advantage for the battle staff. Not only must a battle staff coordinate and communicate together effectively, they must also maintain a high level of SA to set the right conditions on the battlefield to achieve the commander's desired results. The results of this experiment also contribute to a growing body of evidence that teamwork training results in improved situation awareness (e.g. Salas, Prince, Baker, & Shrestha, 1995; Salas, Prince, Bowers, Stout, Oser, & Cannon-Bowers, 1999). In this experiment SA assessment was at the individual level and performance assessment was at the team level (i.e., teamwork ratings by outside observers). The trained groups showed superior teamwork performance which is a necessary precondition for asserting that improved teamwork results in improved situation awareness. The gain or advantage in situation awareness for team members taught the principles of teamwork was empirically verified.

Noteworthy in these results is that inexperienced crews that had not worked together previously as a TOC team showed gains in SA accuracy after training in teamwork skills. Moreover, situation awareness as a separate skill was not taught as such, although many of its enabling skills are a part of teamwork training (e.g., sharing of information). During the teamwork training no expectation was established for the students that the levels of SA were performance measures of interest for the practical exercises. However, as demonstrated by the analysis of the three levels of SA, the better perception of events in the mission environment (Level 1 SA) and projection of future events (SA Level 3) for the trained group was immediately evident from the first mission attempted after the didactic portion of the training. Comprehension of the meaning of events (SA Level 2) improved over the missions to a greater extent for the trained group than for the untrained group. Had the experimental group not shown such an unusually low level of SA in the first PE (mission), the Level 2 SA results may have mirrored those of the other two levels with respect to the initial advantage of training.

Students evaluated the course with solidly positive scores. Experimental and control groups were not differentiated by their course critique ratings. The mean overall course ratings for the experimental group were 4.5 and for the control group was 4.4 (where 5 was the highest rating).

CONCLUSIONS

The DBCTT TSP was developed using technically sound methods including a needs analysis, blended learning techniques, iterative user testing and content revision, on-going SME input, and oversight by the Army Research Institute and an Army Advisory Board. The training underwent rigorous evaluations with nearly 100 Soldiers using an experimental/control group design that showed that the training improves team coordination and situation awareness. Users have been very positive in their assessment of the training giving it high scores for overall effectiveness.

The final DBCTT prototype courseware was provided to the 2nd Heavy Brigade Combat Team (HBCT), 1st Infantry Division, at Fort Riley, Kansas to be used to prepare for deployment to Iraq. The Brigade used the courseware with outstanding results. In the October/November 2008 issue of the *Training & Simulation Journal* (Hodges, 2008), LTC Christopher Beckert, Deputy Brigade Commander, 2nd HBCT, 1st Infantry Div, said "We've got 30 majors in this brigade. Eighteen of those majors are on the brigade staff. Digital Battle Command Team Training gave our young officers an opportunity to run exercises against our standard operating procedures. That made us a better battle staff at the brigade level. We've become more efficient and effective. The battle staff was better prepared to deploy to Iraq."

The Combined Arms Center (CAC) Training Division has directed the CAC Collective Training Division examine the integration of DBCTT into current operational and institutional training. The final TSPs have been delivered to the U. S. Army Research Institute at Fort Leavenworth, Kansas. Those interested in the training should contact the ARI Ft. Leavenworth office.

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