A TRAINING SOLUTION FOR ADAPTIVE BATTLEFIELD PERFORMANCE

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ABSTRACT

To meet evolving operational challenges, we must leverage new strategies to train officers "how to think," as well as "what to think," preparing them to succeed in the face of unexpected events. This paper describes a model used for training adaptive battlefield thinking and the experimental program of instruction to implement and test that model with officers at the US Army Command and General Staff College (CGSC). In a recent project--Army Experiment 6 (AE6)--the challenge to provide a training strategy for adaptive thinking was met by a cooperative effort between the US Army Research Laboratory (ARL) and the US Army Research Institute (ARI). Each organization initially responded to the requirement with proposed approaches that at first glance seemed to be diametrically opposed. The operational question became whether we could integrate the approaches to define, train and measure adaptive performance. The two approaches proposed were a Constructivist Advanced Learning model and the Deliberate Practice model. The Constructivist model, an ecological approach to training, and Deliberate Practice, based on a Behaviorist orientation, were surprisingly complementary. A synthesized approach was developed and implemented as the "Adaptive Thinking Program of Instruction" (AT POI) to train brigade staff decisionmaking during execution. Eleven Majors from the Advanced Tactics elective, A308, at the CGSC Officer's Course participated in the experimental course in the spring of 1999. The students participated in exercises with a team of highly experienced military experts acting as mentors. The first part of the instruction concentrated on creating a multi-dimensional understanding of the battlefield and actually used a more tradition instructional approach. The second portion of the instruction was in the form of a capstone exercise. It centered on intense deliberate practice of cognitive skills in an environment designed in accordance with the Constructivist model and the Deliberate Practice model. The process to guide the practice was based on the Constructivist model, and it was also congruent with the Deliberate Practice model. Student insight into battlefield situations was supported in both parts of the instruction by use of a consistent set of themes that have been shown to represent expert perception of battlefield situations, and by simulations to enact and display developing situations under discussion. Performance was compared with that of similar students in a control group who did not receive the special training, but who completed the existing advanced tactics elective course during the first half of the AT POI and participated in a traditionally structured capstone exercise during the second half. Performance measurement, consisting of a structured method for eliciting situation assessments, was conducted pre- and post-training for the first half of the course and pre- and post-training for the second half of the course. The performance instrument was adapted from an ARI experimental assessment instrument. Subject matter expert and student assessments of the training were also gathered by means of surveys and interviews. Students who completed the AT POI were found to perform significantly better at adaptive tactical thinking. Better performance was found after the second half of the course only--the intense practice portion. The first half of the course, more traditional in nature, did not produce measurable gains in adaptive thinking. We conclude the paper with recommendations for maintenance of model integrity as this approach is disseminated and with reference to further research and development needed for assessment of adaptive thinking skills.

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In the 21st century, the US will face challenges of unprecedented complexity, diversity, and scope.
--TRADOC Pamphlet 525-5, 1994

To meet the challenges of the 21st century battlefield—all of which cannot be anticipated--we must leverage new strategies to train officers "how to think," as well as "what to think," preparing them to succeed in the face of unexpected events. This paper describes a model used for training adaptive battlefield thinking and the experimental program of instruction to implement and test that model with officers at the US Army Command and General Staff College (CGSC).

DEFINING ADAPTIVE THINKING

Concern over the increasing pace of battle and unexpected battlefield circumstances have led senior leaders to conclude that there is an increased need for adaptive battlefield thinking. Senior leaders have characterized (but not definitively operationalized) adaptive thinking as

- the ability to react to unexpected changes during operations,
- knowing "how" to think and not just "what" to think
- the ability to attain a "multi-dimensional" conceptualization of battlefield events and use this understanding to decide and act.

CANDIDATE TRAINING APPROACHES

In the US Army's Training and Doctrine Command's (TRADOC) Army Experiment 6 (AE6) the challenge to provide a training strategy for adaptive thinking was met by a cooperative effort between the US Army Research Laboratory (ARL) and the US Army Research Institute (ARI). Each organization responded with proposed approaches that at first glance seemed to be diametrically opposed—one derived from an ecological or naturalistic perspective and the other being from a Behaviorist orientation. The two approaches proposed were the Constructivist Advanced Learning model and Deliberate Practice. The operational question became whether we could integrate the approaches to define, train and measure adaptive thinking. The two approaches are described below.

Constructivist Advanced Learning Model

The Constructivist Advanced Learning model advocated by ARL is based on the constructivist research and theoretical literature. The goal of constructivist instruction is to help the learner identify and frame a problem, and then experience how information can function as a tool to solve that problem. The approach consists of creating multiple, complex, problem-solving iterations. Use of a rich context allows the student to see situations from numerous perspectives and to struggle with making sense of situations by defining problems and arriving at workable solutions. The approach is student-centered and places the instructor in a facilitation role.

Three elements form the basis of the learning model: Situated Cognition/Situated Instruction; Cognitive Flexibility Theory; and, the Student-Centered Sustained Exploration Learning Process.

Situated Cognition Theory/Situated Instruction. Situated Cognition Theory asserts that people must "conditionalize" their knowledge through experience. Knowledge is not stored in rigid schema for retrieval during problem solving per an information-processing model that involves matching a situation with a pre-designated template. Knowledge is assembled--constructed---for use in the context of problem solving according to the meaning a person attributes to the situation, rather than being re-constructed from static representations in memory (Young, & McNeese, 1995). Meaning is "created on the fly, rather than being translated from something (representational or schematic) in the head" as problems are solved (p. 360). Meaning is always interactive--a result of interaction between people and an environment. One does not teach meaning, but provides experiences in which the student can practice creating meaning and comparing it with that created by others, i.e., practice how to think in context and in collaboration.

A simple example of conditionalized knowledge is found in the proper understanding and use of proverbs. (These kinds of proverbs are often seen on children's intelligence tests.) Proverbs actually contradict each other at times. For example, "Haste makes waste" and "A stitch in time saves nine" may seem to offer opposing views. To use knowledge well, people must have experiences in constructing knowledge as they interact with various environments. Conditionalized knowledge (i.e., use in context) provides the individual with the ability to understand and more importantly use the proverbs appropriately. In general, it is only through multiple experiences that people acquire the ability to create meaning and assemble knowledge appropriately across a variety of situations--all of which cannot be anticipated. In addition, multiple experiences help attune a person's perception of the environment across a variety of problems, increasing their proficiency at constructing effective meaning and applying knowledge appropriately.

"Brown, Collins and Duguid (1989) were the first to...produce a proposal for a model of [situated] instruction that has implications for classroom practice," (Herrington & Oliver, 1997, p. 2). Brown et al. (1989) argued that many training transfer problems can be characterized as a case of "inert knowledge." Inert knowledge is information that has been learned, but is not readily available for application in the appropriate setting due to a lack of recognition of the match between the information and the performance context. Inert knowledge is avoided only when learning is embedded in a social and physical context affording the same types of cognitive cues as the environment within which resulting knowledge is to be used.

"One of the greatest challenges…for teachers [in implementing situated instruction] derives from the need to change their role from a provider of information to a coach and often a fellow learner," (Cognition and Technology Group at Vanderbilt [CTGV], 1993, p. 53). The CTVG (1992) encourages teachers not to introduce concepts through direct teaching, but to use scaffolding and coaching at critical times in the problem solving process to help the students move forward. For example, if a student has a good approach to a problem, but lacks the math skill to implement it, the teacher may facilitate by teaching a particular procedure when it is needed for problem solving. The teacher's job is "to hold the learners in their 'zone of proximal development' by providing just enough help and guidance, but not too much....[T]his happens in many naturalistic situations such as mother-child relationships and apprenticeship settings," (Perkins, 1992, p.163).

The distinction between scaffolding (coaching) and more traditional feedback is critical to the Constructivist Advanced Learning model. Scaffolding refers to the instructor or mentor observing the students as they perform the task(s), and intervening only when the students reach a point of no progress. This intervention can take the form of questions, demonstrations, discussion, or instructions. The mentor should only intervene to the point where the student can begin making progress again.

In comparison, the feedback process--also used in the learning model--is instructor led. An after action review (AAR) may be a formal briefing of a plan by the students, an AAR after execution of a plan, or a more informal review during the learning process. The key to good feedback is having the students generalize the process that they used to solve the problem, while the mentor guides the feedback and offers or even demonstrates other possible solutions.

Cognitive Flexibility Theory. Cognitive Flexibility Theory is particularly appropriate to high-level cognitive training of staff officers because the area of expertise can be described as an "ill-structured domain." Spiro, Feltovich, Jacobson, and Coulson (1992a) defined ill-structured domains as those in which each case of knowledge application involves multiple concept structures, both concepts and cases are complex, and the pattern of concept application can vary substantially across cases that may seem to be similar on the surface.

Cognitive Flexibility Theory also emphasizes the nature of advanced learning and asserts that the uniqueness and importance of this stage of learning has been largely overlooked in much of training development. The advanced learner is neither a novice nor an expert. The advanced student in an ill-structured domain requires a period of sustained exploration (guided experience) to move through this stage. Problem solving in this stage is composed of successive iterations of problem definition, sub-problem definition and discovery, and the construction of goals and solutions. Equilibrium points are created by the student and are annihilated in the problem space as new perceptions are gained. Periods of disequilibrium lead to new discoveries and the creation of new equilibrium points in the problem space (Young, 1995). It is only through sustained involvement in this iterative process that a student learns to attune perception in ill-structured domains and to tolerate the ambiguity of disequilibrium that is part of practice and performance at the expert level.

Student-Centered Sustained Exploration Learning Process. To apply the Constructivist approach, ARL developed a student-centered learning process (Ross, Halterman, Pierce, & Ross, 1998). Figure 1 depicts the learning process and the nature of the facilitation actions needed to support the process. Our conceptualization of the process supports the instructor in making the distinction between scaffolding (coaching and support during problem solving) and feedback (reflection on performance; demonstration of expert performance; and generalization of performance). The process also provides instructors insight into what kind of scaffolding is needed when.

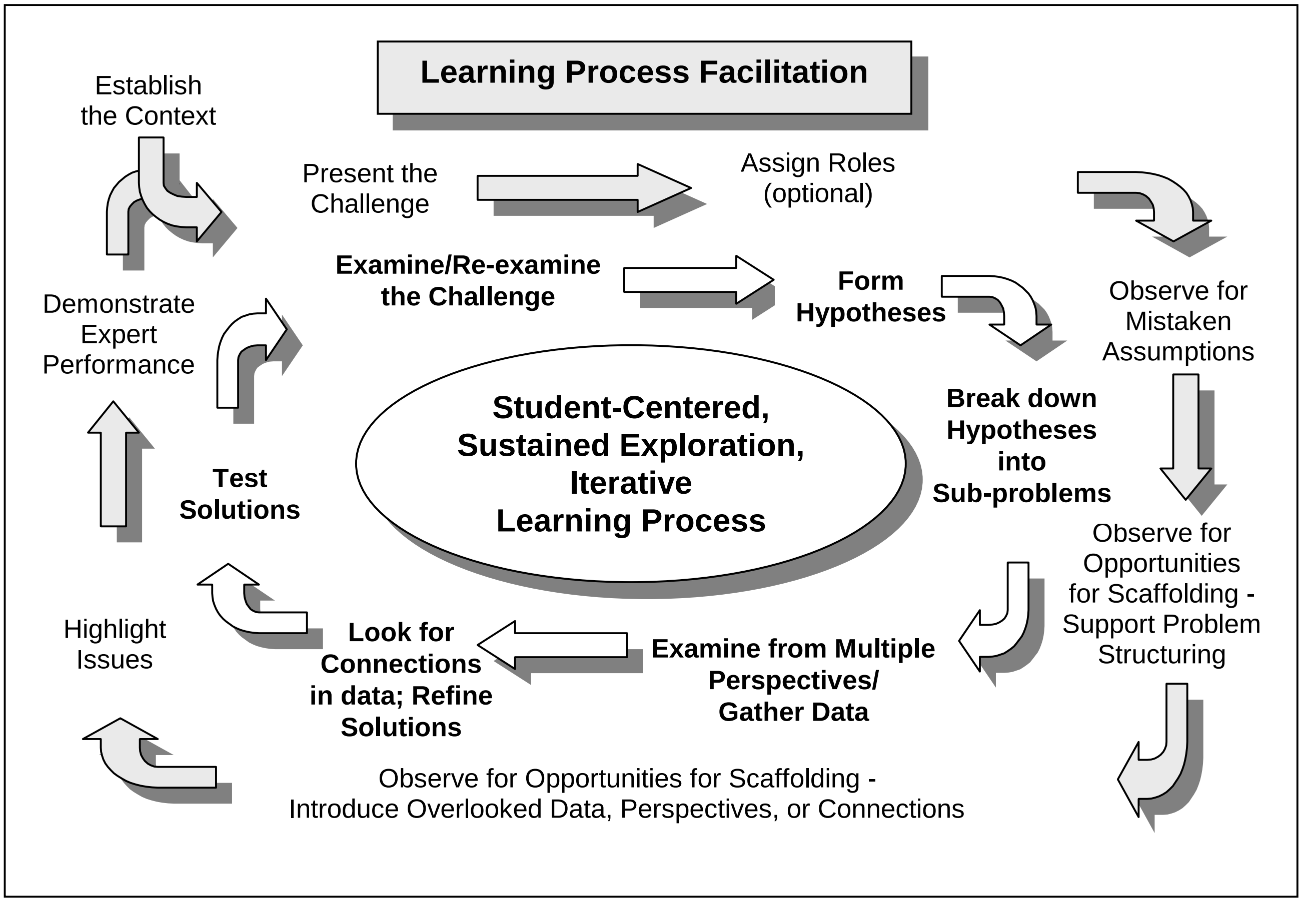

Figure 1. The Student-Centered Learning Process
Ross, Halterman, Pierce, & Ross (1998)

Deliberate Practice

Deliberate practice is a mode of training common in sports. Based on classic Behaviorist learning theory, deliberate practice involves performing while focusing on selected elements of form. The elements are compared against an expert standard, and consciously controlled so that they conform to the standard. The behavior is repeated until it is performed automatically with improved form.

Thus, in deliberate practice there is an isolation of a component behavior, performance, measurement, feedback, and a shaping of correct performance. Typically there is a focus on weaknesses as opposed to strengths. The final performance of the response in a correct form is vital because it is only through performance that the behavior becomes automatic and can be performed without conscious effort. Making a mistake, and later realizing that mistake, for example, during an AAR discussion, does not go far enough.

Deliberate practice requires a repetition in which the correct behavior is performed.

Automaticity and Complex Performance. For the most part, deliberate practice concepts have developed in fields involving training skilled sensorimotor behavior, such as music, sports, gunnery, and piloting. In this instance, we applied the same training concepts to thinking behaviors, i.e., battlefield understanding and decision making during execution. This may seem unusual at first. Thinking behaviors are, however, largely automatic and based on habits. Further, in times of stress, fatigue, or competing demands on performance, habits predominate.

One area where deliberate practice concepts may have been successfully applied to cognitive behavior is in the Soviet chess training academies. The rest of the world studied the game of chess, its strategies and tactics, and tried to understand why one move was better than another. The Soviets did this as well, but also studied the human processes of finding good moves and avoiding errors, of searching and evaluating chess positions, and of controlling emotion and fighting the psychological battle with one's opponent. The Soviets described principles of expert play which reflected the thought patterns of grandmasters. While many of these expert principles were familiar to the rest of the world, the Soviet trainers went one critical step further. They created exercises that trained these principles, ingraining them in their students. The Soviet students employed the expert thought patterns not simply because they understood the principles nor because they were following a remembered checklist. The behaviors had become automatic. As a result of the exercises, the students followed the principles without thinking about them, freeing their limited conscious resources to focus on the novel aspects of the contest and to think more deeply and creatively at the board.

Themes Associated with Expert Perceptions of Battlefield Events. Developing expertise can be viewed as a three-tiered process. In the bottom tier the officers learn to understand military concepts and their relationships. This is a knowledge acquisition process. In the second, deliberate practice tier, they develop skill in manipulating the concepts, that is, thinking with them. Under the action of directive feedback they correct weakness and strengthen component thinking skills. In the third tier they exercise what are now hopefully strengths and reinforce existing skills. All three tiers are important elements in the development of expertise.

Reading the Soviet chess training manuals it is clear that they had identified chess-specific thought habits - completely analogous to elements of form in sport or music. In order to emulate their methods it is necessary to do the same for battle command. Several ARI studies have addressed this goal. In one study (Deckert, Entin, Entin, MacMillan, & Serfaty, 1994), renowned tactical experts evaluated the planning and reasoning of a variety of military participants. The protocols of the planning sessions were analyzed to see what behaviors led to high ratings. Our initial cut is a list of seven habits that we have identified as characteristic of expert military practitioners and by the same token as not characteristic of beginners or those evaluated as less skilled. That initial set is:

- Model a **thinking** enemy.
- Keep a focus on **mission accomplishment** and **higher commander's intent.**
- Exhibit visualizations that are **dynamic, proactive, and flexible.**
- Show rich **contingency** thinking.
- Consider where your fight fits into **the bigger picture** of what is happening/should happen both from friendly and enemy perspectives.
- Consider **all elements/systems** available to you and your enemy and their interactions.
- Include considerations of **timing**.

These behaviors are familiar to most soldiers who have studied the art of battle command. Despite the familiarity of the ideas, the behaviors are commonly performed poorly or not at all in realistic situations, especially in times of stress, fatigue, and distracting demands. The commander encounters a minefield and does not consider the enemy's purpose in emplacing the minefield. (Where does he want me to go?) He changes his axis of advance and does not consider how this will affect adjacent friendly units. He reacts to an unexpected enemy threat and does not assess the affect of his reaction on mission accomplishment. He forecasts the actions of the enemy regiment he is facing without considering what role that regiment plays in the concept of the enemy division commander. He visualizes the movements of one of his companies through the attack without assessing the progressive effects of combat on the company's capabilities. It is not enough just to understand the concepts; it is necessary to perform the behaviors with enough repetition that they become habitual. Thinking itself should never become automatic and effortless but the structure of how to think on the battlefield, once it has become habitual, supports clear and accurate thinking under conditions of pressure.

SYNTHESIS OF THE APPROACHES

The lack of an agreed upon definition of adaptive thinking left open to interpretation how best to achieve the skill. Drawing on the ongoing work described above, we constructed a definition of adaptive thinking as being

- domain-specific rather than general critical thinking skills;
- based on effective learning experiences;
- based on a concept of automaticity that includes not just procedural tasks, but cognitive tasks as well, to ensure performance under stress and to free the mind to work at higher cognitive levels;
- supported by a kind of perceptual attunement (that can be understood as "themes" used by experts to assess a battlefield situation) which facilitates the cognitive management of complex and rich information;
- based on the ability to assess a situation in more depth through access to multiple perspectives;
- tolerant of the disequilibrium associated with the assessment of complex issues;
- the ability to collaborate with others and "feed" off each other's ideas until a workable solution is reached.

As a result of our operational definition of adaptive thinking skills, we were able to structure an interlocking approach from ARL and ARI to guide the development of an experimental training program. An ideal application of the model would have the following characteristics.

1. Rich cases and examples in a narrative (story) format.
2. Multiple iteration of cases within a larger scenario to increase the depth of exploration across cases.
3. Pictures not text to the extent possible to provide more and richer context cues.
4. Students provide "story" resolutions before they are exposed to expert solutions.
5. Data needed to solve problems are embedded in the learning context.
6. Multiple links between concepts across cases stress the web-like structure of knowledge across the domain.
7. Knowledge is presented from multiple perspectives.
8. Stimulating collaborative process using problems so complex that students must work together to solve them, i.e., students must socially negotiate problem solving.
9. Use of active learning techniques. Students must do something; they must construct knowledge in interaction with a problem.
10. Support for continual self-assessment, i.e., self-reflection and articulation by the students of what is being learned.
11. Support at critical junctures to push the student past current limitations, such as introducing information to correct persistent biases or introducing techniques at critical points when they will be used.
12. Demonstrations of expert performance.
13. Pairs of related cases to establish learning transfer outside of only one scenario context.

In addition, the use of themes to guide the development of cognitive skills is also desired as is seen in the work of Spiro, et al. (1992b). The themes must be domain specific such as those cited above (Deckert et al., 1994). To create change in performance with this model, as many practice iterations as possible must be used with careful coaching throughout practice in the form of scaffolding. To create adaptive thinking specifically, the practice sessions must be centered around the insertion of increasingly difficult "probes." These probes must be carefully designed changes in a tactical situation meant to stimulate a collaborative thought process in response to change.

APPLICATION

We implemented the synthesized learning model in the "Adaptive Thinking Program of Instruction" (AT POI) to train brigade staff operations. Eleven majors from the Advanced Tactics elective at the CGSC Officer's Course received training in the spring of 1999. A total of 177 students who had already completed the first portion of the advanced tactics elective, A308, provided the pool from which participants were drawn. An experimental group of 11 majors and a control group of 11 majors were selected from volunteers. Selection was made from the pool of volunteers for control and experimental groups based on the need to assemble the mix of branch specialties found in the brigade staff for the two groups.

Prior to the first part of the instruction, all students completed an assessment (Form A) as a pre-test of their tactical situation assessment skills. The pre-test required the student to submit a time limited written response to six questions. The first three questions required the student to analyze a tactical situation and make recommendations. The situation was portrayed to the students through a one-page graphic of the situation and a one-page description of the situation. It was referred to as the General Situation. Each student was then presented with a new graphic and text description of a change that had occurred in the situation. This change was referred to as the Special Situation. The second three questions required the student to provide the same type of time limited written input to analyze the situation and make recommendations in an attempt to measure the ability to think adaptively in response to change. Only the responses to the second set of questions were used in the analysis presented here.

All of the AT POI occurred in the CGSC WarLab containing an immersive classroom, a virtual tactical operations center, and simulation support. The first part of the instruction concentrated on creating a multi-dimensional understanding of the battlefield and actually used a more tradition instructional approach. Challenges to implementation of the model had arisen when resources did not permit careful crafting of vignettes and probes for the first part of the course, and when the CGSC desire for student presentations used too much time in the first part of the course in these researchers' opinion. We predicted that the first part of the course would likely not produce gains in adaptive thinking.

The instruction in part one sought to provide a multi-dimensional viewpoint to the students' tactical assessments by highlighting key variables and tactical products by the five Battlefield Functional Areas (BFAs)--intelligence, fire support, maneuver, logistics, and air defense. A typical class consisted of a student led presentation, and a discussion of a tactical situation led by a Subject Matter Expert (SME) in the BFA following each student presentation. Fifteen hours were devoted to the BFA portion of the course, and nine hours were devoted to deliberate practice oriented to specific BFAs. The practice sessions used a low overhead simulation called Decisive Action, which was developed by LTC James Lunsford at CGSC. The control group had been given the task of analyzing and planning for the scenario that would be used for the annual CGSC Prairie Warrior capstone exercise while the experimental group completed the first half of the BFA training and the Decisive Action practice sessions. A typical day for the experimental group from the first part of the course is shown in Figure 2 below. The course layout is shown in Figure 3 below.

Figure 2. The WarLab Immersive Classroom at CGSC - First Part of the Course

Following the BFA instruction and Decisive Action practice, the experimental students received approximately 12 hours of introductory and refresher training on the five BFA tactical computer systems known as the Army Battle Command System (ABCS). The control group used Decisive Action to practice during this 12 hours, but they did not receive scaffolding from the SME team. The Form A assessment was then re-administered as a post-test for the first portion of training, followed immediately by Spring Break.

Prior to the second part of the course both groups were given a second assessment (Form B) as a pre-test to this portion of training. The assessment was judged as equivalent to Form A by a team of SMEs. The assessment method was the same for Forms A and B. The second portion of the experimental instruction centered on intense deliberate practice of cognitive skills in an environment designed in accordance with the Constructivist model and the Deliberate Practice model. To start this portion of the training, the students in each group were given a scenario to study that was new to both groups, and the experimental group was formed into a staff group. (In contrast, the control group had been formed into a brigade staff at the beginning of the AT POI.)

Control Group	Experimental Group
Form A Assessment Administered (Pre-test)	
Formed into Staff Group	No Staff Group Formed
Analyze Prairie Warrior Scenario/Plan as a Staff Group per Usual A308 Procedure 24 hours	15 hours of Cross-Training on BFAs Staff Group Formed 9 hours of Practice Using Decisive Action Simulation with Mentors Providing Scaffolding
12 hours of Practice Using Decisive Action With No Mentoring	12 hours ABCS Refresher Training
Form A Assessment Administered (Post-test)	
Spring Break	
Form B Assessment Administered (Pre-test)	
New scenario to both groups (Eagle-ModSAF driven/NTC terrain)	
9 hours learning to use the simulation; testing simulation configuration; 6 hours planning (both groups)	
Senior Mentor Introduced as Commander	
20 hours of Execution with the Simulation with Senior Mentor	20 hours of Deliberate Practice with the Simulation with Senior Mentor and Mentor Team Providing Scaffolding
Form B Assessment Administered (Post-test)	

Figure 3. Diagram of Control Group versus Experimental Group Course

In the second portion of the course, nine hours of class time for both groups were devoted to insuring the Eagle-ModSAF simulation, linked to the various ABCS components, was properly configured and the students knew how to use it for deliberate practice. The experimental group and the control group were then each given six hours of class time to plan in response to the new scenario.

Twenty hours were then devoted to practice by both groups in the form of a capstone exercise. A senior mentor entered the experiment at this time to play the part of the Commander and work with each group equally. The experimental group participated in exercises with the same team of SMEs providing scaffolding and feedback as they done in the first part of the course. The control group participated in the same exercises without the mentor team. This portion of the course is illustrated in Figure 4 below.

At the end of the second portion of the training, both groups completed Form B again as a post-test. SME and student perceptions of the training were also gathered by means of surveys and interviews during and after the training.

Figure 4. Capstone exercise in the experimental classroom using Eagle-ModSAF and ABCS

RESULTS

Interrater reliability was not up to the generally desired level of at least .85 across raters. To compensate, an average of the five raters' scores were used to calculate each student's score. Table 1 below shows the interrater correlation matrix for the five SMEs (r = .47 to .74.)

	SME 1	SME 2	SME 3	SME 4	SME 5
SME 1	1.00				
SME 2	0.55	1.00			
SME 3	0.59	0.47	1.00		
SME 4	0.54	0.52	0.59	1.00	
SME 5	0.73	0.74	0.72	0.73	1.00

Table 1. Interrater Reliability Correlation Matrix

The control group and the experimental group performed differently on the Special Situation items that were designed to measure adaptability. Table 2 below summarizes the results of a 2 (control or experimental group) x 2 (Form A or Form B) analysis of variance using the difference between the pre- and post-test scores of the Specials Situation items. Table 2 shows a significant main effect found between the control and experimental groups (F (1,20) = 5.79, p < .03). The experimental group improved more than the control group.

Source	Sum of Squares	df	Mean Square	F
Between				
Groups	5.55	1	5.55	5.79*
Error	19.19	20	0.96	
Within				
Forms A and B	13.72	1	13.72	13.69**
Groups x Forms	11.92	1	11.92	11.90**
Error	20.04	20	1.00	

* p < .05   ** p < .01

Table 2. Summary Table of Analysis of Variance

In addition, there was a main effect for Form (F (1,20) = 13.69, p < .01). Students improved more on Form B than on Form A. However, the main effects need to be interpreted in terms of the significant interaction between Form and group (F (1,20) = 11.90, p < .01). In the control group, there was no difference in improvement between Form A and Form B (M Form A = .16 and M Form B = .24). However, in the experimental group the improvement was much greater on Form B than on Form A (M Form A = -.17 and M Form B = 1.99). Figure 5 below presents the mean differences for groups and forms.

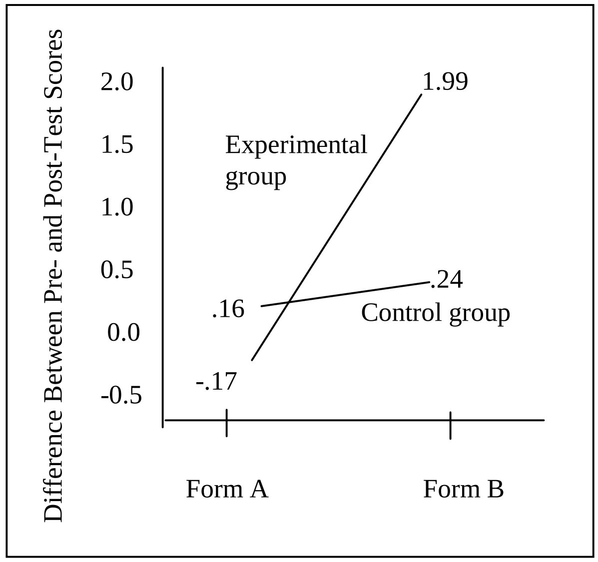

Figure 5. Mean Differences by Group Between Pre- and Post-Tests of Form A and Form B

Qualitative findings indicated that students did not find the BFA training worthwhile. Although they felt the idea might have merit, they perceived that the application never developed multiple battlefield perspectives in sufficient detail. The scaffolding technique was refined over the nine hours devoted to use of the Decisive Action simulation in part one of the course. The students were satisfied with the scaffolding technique that emerged, i.e., frequent, brief "huddles" with SMEs. This method was judged by students to be more valuable than extended exercise periods followed by an AAR.

Students in the experimental group were dissatisfied with the ABCS training due to the lack of context and the lack of hands on practice. This seemed to reflect a general problem with available ABCS training, and not something particular to the AT POI.

The number of practice iterations in tactical planning and execution were still below what the students desired as part of a CGSC experience.

The SMEs and other observers of the exercise shared the opinion that the level of performance, understanding the effects of changing variables, the information required, and the ability to comprehend at a higher level of thought process was observed in the experimental group. Observers also noted that the control group initially "out-performed" the experimental group, because the control group was more adept at group process. The control group had formed into a staff group and started a planning exercise well before the experimental group was formed into a staff group. This observation of the control group points to the fact that practice in a staff group (or for individuals, in their appropriate staff role) should be part of the learning model.

DISCUSSION

The learning model as applied in the AT POI did produce superior adaptive thinking in the experimental group as measured by both written assessments and expert observation. Lack of measurable progress from the first part of the course can be attributed to the traditional learning model used and the lack of focused practice in the portion where practice was used. The Decisive Action portion of the practice, in the first part of the course, did not constitute a true implementation of the learning model. The lack of implementation was due to the lack of refinement in the scaffolding technique at that time, the lack of carefully crafted probes and cases, and the lack of multiple iterations.

Alternately, the lack of progress in the first part of the experimental course could also be explained in terms of Situated Cognition Theory. That is, any additional knowledge gained in the first part of the course constituted inert knowledge as described above. It was not retrievable for appropriate use in performance on the assessment. Direct instruction and even classroom discussion should be severely limited outside the context of the practice process.

Both Deliberate Practice and the Constructivist Advanced Learning model advocate multiple iterations. While students would have liked even more iterations in the second half of the course, the number of iterations used did provide an improvement in adaptive thinking. Iterations alone are not sufficient. If multiple iterations were sufficient, then the control group would also have shown improvement on assessment Form B. Scaffolding, use of the themes to guide cognitive development, and probes developed to stimulate particular thought processes are all key to success of the learning model when it is applied to achieve adaptive, tactical thinking.

SMEs commented that the use of written assessments might interfere with the thought processes we are attempting to capture. The SMEs proposed an oral presentation of the student's analysis to avoid disturbing his cognitive flow while thinking about a situation. This observation is in line with discussions of assessment in the Constructivist literature, which cite the problem of observing a cognitive process without interfering with it. Though even a verbal report may interfere with conceptualization. Assessment constitutes a key area for further research whether it is in terms of greater reliability of the instrument used here or development of an alternate method.

Next steps being considered are an extension of the methodology to the emerging US Army Strike Force and development of an elective at CGSC based on this learning model. A key area of consideration is the ability to codify this approach in training support packages with appropriate vignettes, probes and measures. The question for the future is how the highly adaptive thinker interacts with the digitized battlefield systems. Do adaptive tacticians use digitized systems better? Do digitized systems have to be refined to properly support the adaptive staff? Neither aspect, the digitized system or the users, can be studied in isolation. Clearly, the interaction between the adaptive staff and system will provide the variables of interest for supporting improved tactical performance on the 21st century battlefield.

ACKNOWLDGEMENTS

This work was supported by the U.S. Army Training and Doctrine Command, the U.S. Army Command and General Staff College, the US Army Research Institute for the Behavioral Sciences, Fort Leavenworth, and a U.S. Army Research Laboratory "Top 5" research initiative. The authors gratefully acknowledge the statistical consultation and review provided by Dr. Mary Dzindolet, Cameron University, Lawton, Oklahoma, and the review provided by Mr. Wes Hamm, Mitre Corporation and AE6 Consultant.

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Key terms: Adaptive Thinking, Constructivism, Deliberate Practice, Training Design, Student-centered Learning