Tools to Help Prepare Soldiers for the Contemporary Operating Environment

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ABSTRACT

The contemporary operational environment (COE) is rapidly evolving – what worked recently may not work now and probably will not work next week. As the Army operates increasingly as an expeditionary force, it will become even more important to share lessons learned quickly and to promulgate best practices widely. Training requirements are therefore also becoming increasingly dynamic and complex. Instructors must develop timely teaching points that rest on solid doctrinal foundations while addressing current issues. Accordingly, through the sponsorship of the Army Research Institute and the Office of the Secretary of Defense, we are exploring educational strategies and technologies that can close the gap between the classroom and the operational environment. The goal is to provide capabilities that support interactions between students and outside experts in the Contemporary Operational Environment under the control of a Small Group Instructor. The central idea is to enable students to relate classroom concepts to current issues through the guidance of outside experts. In this manuscript we describe the problem, the theoretical background for our approach, and results from our efforts to identify requirements.

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BACKGROUND

Joint and Expeditionary Mindset

When considering a Joint and Expeditionary Mindset, it is clear that the future force will not have the luxury to provide the Soldier with extensive training for particular regional assignments and cultures. Instead, soldiers must be ready to be assigned anywhere in the world on short notice. They must be able to adapt rapidly to situations in which factors of mission, enemy, terrain, troops, time, and civilians are unfamiliar or changing. They must learn to learn.

The reflections of Lieutenant General Petraeus on Iraq are instructive. They point to some of the issues and the level of analysis required in the development of training systems for cognitive skills needed in ill-defined cross-cultural situations (Petraeus, 2006):

- Understand local organizations and coordinate with specific individuals well enough to enable locals to take control of their own destiny.
- Make as many of the locals as possible feel that they have a stake in stability and reconstruction operations in which the U.S. military personnel are significantly involved.
- Understand the costs and benefits of every tactical decision in terms of its possible unintended consequences on the attitudes and actions of the local population.
- Develop networks for human intelligence at the level of neighborhoods because this is the scale on which terrorists' tactics of intimidation and disruption are most effective.
- Anyone and everyone can become involved in civil affairs during stability and reconstruction operations irrespective of training in this area prior to deployment.
- Understand the interconnections among local institutions which provide the services on which a local population depends.
- Understand the values and associated cultural practices which give the local population its sense of identity and self worth.
- Understand the cultural ecology including political, economic, social, and physical conditions of people's daily lives.

Petraeus emphasizes that one of the major obligations of Commanders to junior leaders is "to do everything possible to train them before deployment for the various situations they will face, particularly for the most challenging and ambiguous ones" (Petraeus, 2006, p. 7).

Such exigencies of the Contemporary Operating Environment (COE) also have been noted recently by other military scholars who are mindful of lessons learned throughout the history of counterinsurgency (e.g., Kilcullen, 2006; Scales, 2006; Yates, 2006). The most important implication is to understand the vulnerability of systems and infrastructure on which social stability depends. The other is the importance of human intelligence that is a robust means for our adversaries to identify and exploit vulnerability as well as a means for U.S. forces to detect or defeat insurgents who employ idiosyncratic means of attack (Meigs, 2003).

As implied by the observations of Petraeus (2006), Kilcullen (2006, p. 1) aptly describes the most beneficial activities as those reminiscent of beat cop behaviors. He emphasizes that individuals should develop "a framework in which to fit every new piece of knowledge you acquire. Study handover notes from predecessors" (Kilcullen, 2006, p 2).

Military Training and Education

The objective of the ongoing research and development (R&D) reported here is to determine the constructs associated with a Joint and Expeditionary Mindset and to develop a computer-mediated training environment to foster that mindset in ground combat personnel (Riccio, Lerario, Cornell d'Echert, Pound, Brunyé, & Diedrich, 2006).

We believe that a developmental perspective must be at the heart of any approach that purports to address or change mindset. From a developmental perspective, early to mid-career Army officers appear to be the students who would most benefit from an educational innovation directed at a Joint and Expeditionary mindset. More specifically, the Maneuver Captains Career Course (MC3) at Ft. Benning, Georgia, is an appropriate curriculum for JEM given that it focuses on Combined Arms Warfighting at the tactical level across the full spectrum of combat.

The MC3 divides the program of instruction into two phases: the Company Phase and the Brigade-Battalion Phase. We are working with the Company Phase in which all officers receive the same training on company level full spectrum operations. There are several modules in the Company Phase, each approximately one week in duration. Our focus is on the module that addresses Stability Operations.

The end states of the module which addresses Stability Operations and Counterinsurgency include: (a) quickly analyze, develop, and brief a tactically sound course of action; (b) understand the enemy (asymmetrical threat in a counterinsurgency environment); (c) understand where to defeat the enemy (terrain: urban environment); (d) understand how to defeat the enemy in the course of limited offensive operations; and (e) understand the capabilities of the assets in the Stryker Brigade Combat Teams Task Organization.

Pedagogical Approach

The MC3 program of instruction has been strongly influenced by guidance from the U.S. Army Training & Doctrine Command and Combined Arms Center to emphasize challenges of counterinsurgency, and to balance offensive, defensive, and stability operations. The classroom environment focuses on small groups of up to 16 Captains led by a Small Group Instructor. Each module generally utilizes (a) doctrinal lectures, (b) historical vignettes, (c) readings and videos, (d) tactical decision exercises in which students participate, and (e) instructor-led discussions. Instructor-led exercises and discussions provide opportunities for guided experiential learning. Instructors can guide experiential learning by introducing new situations, rich in detail, to a class along with general principles and methods for making meaning of the details. They can thus reveal to students the ways in which knowledge is situated. Understanding the influence of local or momentary ecology (e.g., physical and cultural surroundings) on an unfolding event has the potential to help students generalize from their own experiences and classroom experiences to new situations (Brown, Collins & Duguid, 1989; Gibson, 1991; Lave & Wenger, 1991).

The common details and scenarios of a classroom experience also foster collaborative learning among the students. One learner can make personal connections between sets of concrete details that initially may seem bewildering to others. In a collaborative environment, the idiosyncratic connections and meanings that individual students make of the classroom experiences provide opportunities for all students to be exposed to the perspectives of others (Bandura, 1997; Lewin, 1948). This provides each student with a foundation for comprehending and potentially adopting multiple perspectives. Accordingly, a key objective of our R&D is to help implement a methodology that promotes experiential, participatory, and collaborative learning.

The Army Guided Experiential Learning model (e.g., Clark, 2004; Markley, 2007) holds the promise of meeting many educational needs. Nevertheless, it is prudent to consider a variety of alternative methods, including problem-based ones, which may be more effective for certain kinds of learning (e.g., see Bransford, Brown, & Cocking, 2000). Problem-based methods hold the promise of challenging trainees to think, and to discover what they know and need to know, thereby facilitating deeper understanding.

The argument for a multifaceted approach underscores the general need for educational systems to be learner-centered, knowledge-centered, assessment-centered, and community-centered (Bransford et al., 2000). To be learner-centered, an educational system must address what learners bring to the table – what they know, what they don't know, what they need to learn, and what they are motivated to learn. To be knowledge-centered, effective educational systems must encourage sense-making rather than mere memorization. To be assessment-centered, learning systems must provide formative feedback and not only summative evaluation. To be community-centered, the learning environment must encourage exploration in an open environment and must be relevant to, and reflect, the community in which it is embedded (Figure 1). Similarly, Wallace (2006) has argued that the

Generative Force must be closely coupled to the Operational Force. The challenge is to use a variety of technologies and techniques that find the "sweet spot" at the intersection of these objectives (see also, Scales, 2006).

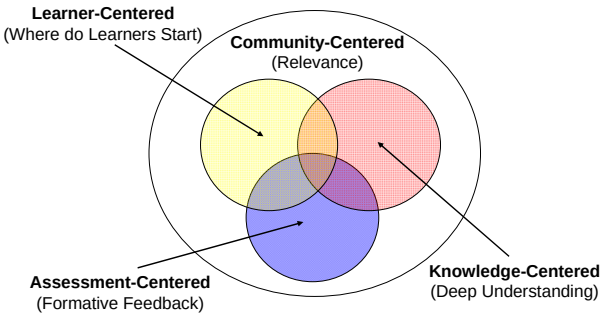

Figure 1. Requirements for effective learning systems, adapted from Bransford et al. (2000).

In the following sections, we describe methods and progress from our efforts to identify requirements for technological support and educational approaches to close the gap between the classroom and the operational environment.

METHOD

Qualitative Inquiry

A key aspect of our methodology was to assemble a group of technical, operational, and programmatic experts to examine assumptions, methodology, and conclusions in a collaborative working group over an extended period of time (Riccio et al., 2006; Riccio, Sullivan, Klein, Salter, & Kinnison, 2004). Participants in the working group consisted of the investigators, including behavioral scientists, and four recently retired Army officers whose primary responsibility at the time of the investigation was identifying and promulgating lessons learned from Iraq and Afghanistan about asymmetrical warfare with active duty military units.

The activities of the standing working group occurred over a six month period and included participant observation, interviews, document analysis, memo writing, constant comparison, cross checking, achieving a balance and tension of multiple perspectives, and development of grounded theory (see Camic et al., 2003; Denzin & Lincoln, 2003). The initial responsibility of the working group was to identify capabilities of high priority in Joint and expeditionary operations, priorities for which there is a convergence of evidence from different sources. The *Joint Capabilities Integration and Development System* (JCIDS) provided a structured methodology for identification of capability gaps and solutions (Chairman of the Joint Chiefs of Staff, 2004). Key elements of the JCIDS methodology include Functional Area Analysis, Functional Needs Analysis, Functional Solution Analysis, and Post Independent Analysis.

Three focus group events were conducted with the participants of our standing JCIDS-based working group. They occurred during the first two months of the project and were separated by at least two weeks. Each focus group event occurred over a two-day period. Sessions on consecutive days were between two and four hours in duration. The first focus group identified facets of the problem, participants, and stakeholders. The second focus group event addressed the Functional Area Analysis and Functional Needs Analysis, and the third addressed the Functional Needs Analysis and the Functional Solution Analysis. Considerations, recommendations, and opinions of the working group were documented to avoid a narrow focus from a dominant perspective.

In the spirit of the Post-Independent Analysis step in the JCIDS process, conclusions from the analysis of needs and solutions were vetted through frequent coordination with potential users and stakeholders. The intent was to facilitate development of capabilities that can be transitioned almost immediately. The primary source of stakeholders and users was the MC3 at Ft. Benning.

After the Functional Solution Analysis, work was initiated on a prototype web-based tool that can be used in environments such as the MC3 to help Small Group Instructors prepare ground component forces with the necessary cognitive skills for the emerging challenges of a Joint and Expeditionary force. Development of the tool generated additional, more refined, questions that required a second round of collaborative inquiry with subject matter experts. This iterative cross-fertilization between software development and interactions with users about the resulting capabilities ("spiral development") will continue throughout the project.

Surveys and Associated Interviews

Following the initial qualitative inquiry, a two-page survey was distributed to 52 current and retired Army personnel representing a variety of ranks (COL to 2LT) and years of military service (1 to 31 years, M = 10 years) to reveal additional facets of the problem that had not been addressed in the JCIDS process. More specifically, the survey was divided into two categories of questions. The first set of questions addressed knowledge of the COE such as how important this

knowledge is to a Soldier's survivability, how long does it take to gather information, and what are the key sources of information gathered. The second set of questions addressed electronic collaborative tools such as whether such tools can be an effective way to share information about the COE, whether people are willing to use them, whether people are able to use them.

There were two types of survey responses. First, a 5-point Likert-type scale was used to assess participants' level of agreement with certain statements, such as "Information about the COE is important to a Soldier's survivability." Second, participants ranked a given list of items, such as ranking sources of this information.

Broader Interviews

To facilitate analysis, follow-up interviews with two military education experts were then conducted to help interpret the survey results and to stimulate broader discussion with the two experts (Tashakkori & Teddlie, 1998). In the second part of the each interview, the two experts were asked for their opinions on issues related to learner-centered, knowledge-centered, assessment-centered, and community-centered aspects of military training and education that were most important in the context of the findings from the JCIDS process.

RESULTS AND DISCUSSION

Functional Area Analysis

In the JCIDS-based Functional Area Analysis, the working group identified the implications of Joint Operations Concepts, Joint Operating Concepts, and Joint Functional Concepts for training a Joint and expeditionary mindset. The relevant Operations Concepts are fully integrated, expeditionary, networked, decentralized, adaptable, and decision superior (DoD, 2003). An important implication of these attributes is that individuals and units must be rapidly deployable, employable and sustainable in areas of operation that may have a minimum of existing infrastructure.

The Joint Operations Concepts are fostered by timely and accurate communication about relevant situations and lessons learned. Relevance, timeliness, and accuracy are fostered by two-way communication that helps individuals understand the contexts within which information is presented and received, elaborate on actual or potential misunderstandings, and establish the credibility of the source. There is rapid growth in capabilities that help link individuals who have a need to know with appropriate experts.

The JOC span full spectrum operations (DoD, 2004b). The biggest challenges for Joint and expeditionary operations are rapid transitions between offensive, defensive, and stability operations. There are profound issues in these transitions for individuals and for units over short and long time scales. Rapid transitions that are especially difficult involve in-stride changes between lethal and nonlethal actions. With respect to longer term issues, the working group identified the following question as a powerful guideline for training: "What would Soldiers do differently if they knew they had to stay and fight for the duration of the operation?" This mindset helps a Soldier take ownership of the job of the person to be replaced rather than merely taking the place of that person.

In the context of decentralized, and especially in the context of the stability operations, the Joint Functional Concept of Joint Command & Control emphasizes the importance of a subordinate leader's ability to act on the basis of broad statements of commander's intent (DoD, 2004a). Similarly, it is important for commanders to be able to provide subordinates with clear direction without presumptive detail about implementation. In essence, commanders and subordinates must learn to strike a balance in the natural tension between command and control.

Functional Needs Analysis

In the JCIDS-based Functional Needs Analysis, the working group focused on two major components of expeditionary mindset: Getting there and being there. "Getting there" skills and issues include: (a) no-notice or short-notice deployment sequence; (b) area studies to gain general knowledge of potential threats and environments; and (c) basic soldier skills such as move, shoot, communicate, and first aide.

"Being there" skills and issues include (a) coordination and interaction with other government agencies and non-government organizations; (b) population engagement, both the leadership and masses; (c) offensive action to destroy insurgent elements; and (d) intelligence collection and analysis. No matter where "there" is, the problem sets and resources will be similar: tribal and political, interactions with other government organizations and non-government organizations, offensive and defensive operations.

The intent of the working group was to identify urgent needs related to Joint and Expeditionary mindset in the COE. Given this, and in retrospect, it is not surprising that we identified some nascent solutions in the activities of networked, decentralized, and adaptable forces (both the Generative and Operational Forces).

Two kinds of emerging solutions are represented by the Battle Command Knowledge System and an internet-based capability for peer-to- peer communication ("CAVNET").

The Battle Command Knowledge System is an online knowledge management system for the generation, storage and rapid retrieval of information (Kerr, 2006). It includes a forum for interaction between individuals as well as a database of documents (Warrior Knowledge Base). The database includes many thousands of knowledge objects. There are capability gaps in Battle Command Knowledge System, however, that derive from the quantity of relevant material and number of individuals to which it provides access.

One capability gap is the difficulty in finding the right information in the right amount and in the time the user has available. This is a common problem with knowledge databases that provide a plethora of information that is apparently or actually relevant to a user's needs. To address this gap, methods of training are being considered that could help achieve a virtual "right seat ride" for novice users (Kerr, 2006). We believe that this is a promising approach to making a database both usable and useful.

Another capability gap is in measures of effects. The common approach to such measures in a knowledge database or other web-based capabilities is to count number of objects on the site or how many times the site is accessed ("hits"). This is very limiting, and it sheds little or no light on the value of a web site to users. Measures are needed that provide insight into the nature and extent of the impact of a web site on users, whether any learning has taken place, or whether the meaning or use made of the information is valid. The expert guidance implied by the virtual right seat ride could provide a path to more meaningful measures. In principle, experts could provide subjective assessments of individuals they are guiding.

CAVNET is a method of sharing information, peer to peer, which conceptually builds on predecessors such as Platoonleader.com and Companycommander.com. CAVNET has demonstrated the concept for providing peer-to-peer information sharing on a secure network in theater. It was first established for the 1st Cavalry Division in Iraq in April 2004 (PBS Frontline, 2005). Since then, 3rd Infantry Division ("Marnenet") and the 4th Infantry Division ("Ironhorsenet") have, in turn, adopted the system and are using it in Iraq.

The Internet allows many people to communicate instantly about topics of mutual interest. There is demand for any such resource because of the need to share emerging enemy and friendly tactics, techniques and procedures. There is a need to achieve competitive advantage against a networked, adaptable, and cellular enemy force. In essence, CAVNET demonstrates one method to provide a trusted source of knowledge for junior leaders on a time scale that allows these users to establish credibility, validity, and relevance of the information and to act on it, that is, to expedite the sharing of actionable intelligence.

As Figure 2 illustrates, the next logical step is to utilize such a capability in closing the gap between the institutional Army and the operational Army—to reduce the "…lag between what is being taught in the classrooms and evaluated at the training centers and what is being executed on the ground in combat" (PBS Frontline, 2005). Like the Battle Command Knowledge System, however, the success of CAVNET brings capability gaps that derive from potential access to vast people networks and amounts of information.

Figure 2. Closing the gap between the operational and institutional Army (Photos courtesy of U.S. Army).

Functional Solution Analysis

The key finding from our JCIDS-based working group was that there is a need for a tighter coupling between educational institutions and the current operations in theater. Given that MC3 arguably is on the cutting edge in closing this gap, the question becomes how best to establish even closer integration of the educational and operational environments.

The JCIDS-based Functional Solution Analysis converged on computer-based tools that allow outside experts to communicate directly with students and become a resource to instructors in the MC3. Accordingly, we are developing a web-based community of practice toolset that ties the classroom to the operational community through such simple functions as individual chat, group chat, and postings

in forums involving threaded discussions. In this case, the toolset will allow instructors, students, and outside experts to interact online regarding key issues, topics, or documents of interest (Figure 3).

By enabling such interaction, students can explore how concepts learned in the classroom relate to current issues. They can actively pull relevant information from experts in theater or who are otherwise closer to the roles in which students will find themselves after deployment. The key insight is that a dialogue must develop that allows exploration through questions and answers in which the student can be guided to make non-trivial links between doctrine, classroom exercises, and current practice.

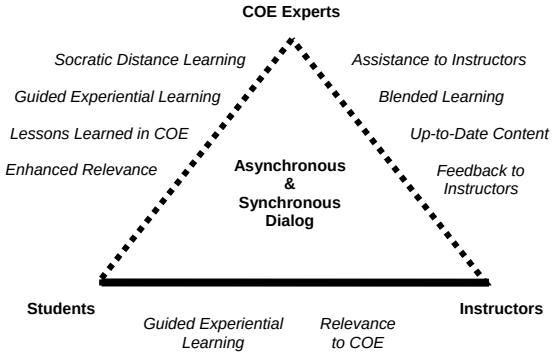

Figure 3. Opportunities for COE experts to assist instructors in closing the gap between classroom and COE.

The notion is that, by guiding student dialogue with outside experts, instructors can facilitate early rudimentary "Right Seat Rides" (a metaphor for one type of guided learning) that begin familiarization and make abstract lessons more concrete and actionable. The outcome should be Soldiers who have learned to learn, and who are ready to learn once deployed into a changing or ill-defined situation.

Post Independent Analysis

The primary thrust of work is not the software tool to support dialog – indeed, simple functions like chat and virtual whiteboards already exist. Our focus is in how to structure such an environment to achieve a significant improvement in learning, and in particular, its ultimate impact on cognition and action in the COE.

Our interactions with users and stakeholders were critical in the development and integration of the materiel and nonmaterial components of the capability. Concepts about the tool, the needs for it, and the use of it were examined collaboratively as the concepts developed and as they were instantiated in early builds. Interactions with users and stakeholders utilized a multifaceted methodology including interviews, document analysis, and naturalistic observations (Camic et al., 2003; Denzin & Lincoln, 2003; Tashakkori & Teddlie, 1998). The concurrent development of a grounded theory builds on the framework of Bransford et al. (2000).

Survey and Associated Interview Results

Knowledge Relevance and Currency

Respondents believed that information about the COE is very important (M = 4.65/5, SD = 0.59) to a Soldier's survivability. When asked to estimate how long it takes a Soldier to acquire critical information about the COE, 50% of participants responded 1-2 months, while another 20% indicated 2-4 months. Surprisingly, approximately 20% indicated that it takes only 1-2 weeks to acquire information on the COE. Results from follow-up interviews revealed that these respondents may fall into two very different categories: members of rapid deployment teams and novices. The former are trained to gather and share operationally current information in a rapid manner, while the latter may simply be unaware of all the information they need to know. The remaining 10% of the participants chose either 1-2 days or 4-6 months.

Soldiers indicated that they most commonly use first hand experience and "right seat rides" as sources of critical information about the COE, followed in decreasing order by verbal word-of-mouth (from lateral ranks), verbal word-of-mouth (from superiors), verbal word-of-mouth (from subordinates), unofficial written or electronic documents, and official written or electronic documents. Right seat rides can be particularly valuable in learning the geography of the COE. However, several respondents noted that the quality of such guided learning can vary drastically. Interviewees indicated that the attitude of the incoming or outgoing units can greatly impact the quality of a guided learning experience. For example, if a particular outgoing unit is focused on going home after a lengthy deployment, then they may not be motivated to conduct a thorough right seat ride. Similarly, if the incoming unit believes that it knows everything already, they may not attend to the information in the right seat ride as closely as perhaps they should.

Soldiers ranked both official and unofficial written or electronic documents as being the two least commonly used sources of information about the operational environment. Interviewees indicated a variety of reasons why these potentially valuable sources of information are not commonly used. For instance, soldiers may be required to read through voluminous

amounts of data. While units often do make storyboards and other materials available to other units, it would be time consuming to review it all. In addition, Soldiers may be unable to review materials because of limited secure internet access (SIPRNET).

Not surprisingly, the majority of respondents (55%) stated that some sources of information about the COE are underutilized. However, 45% of respondents believed that there are no underutilized sources. Interviewees were surprised by the number of respondents who answered this way. They suggested that less experienced Soldiers might not be aware of what other types of information could help them to learn about the COE. Indeed, 'yes' responses were positively associated with years of military service.

Electronic Collaborative Tools

Respondents believed that electronic collaborative tools are useful for sharing relevant and current information about the COE (M = 4.11/5, SD = 0.81) and that they would be likely to use tools for distance learning (M = 3.98/5, SD = 0.77). When they ranked communication modalities according to their likelihood of use, they demonstrated a strong preference for asynchronous and one-to-one communications. More specifically, they ranked the following communication modalities according to their likelihood of use in decreasing order: Asynchronous one-to-one (such as an electronic mail service)*;* Synchronous one-to-one (such as a text-based real-time messaging service between two individuals)*;* Asynchronous one-to-many (such as posting on an electronic bulletin board)*;* Synchronous one-to-many (such as a text-based real-time messaging service between multiple individuals).

Respondents also indicated they would be both willing and able (M = 3.86/5, SD = 0.89) to participate in teaching about the COE using electronic collaborative tools. Furthermore, Soldiers believed that electronic collaborative tools for distance or local learning can contribute to Soldier survivability by bridging the gap between a learning environment and the COE (M = 4.06/5, SD = 0.75).

Interviewees were somewhat skeptical of the respondents' actual ability to participate in teaching. Once deployed, Soldiers have many demands on their time. Even the most well-intentioned Soldiers may find that they either do not have the time to teach or that they have unreliable computer access. However, the key to promoting usage among deployed Soldiers is to make it as easy as possible for them to use the tool. Interviewees recommended strategies such as having the tool be compatible with Microsoft Outlook so that scheduled sessions could be imported into Outlook. Interviewees also recommended including an email functionality through which users can send links to other users. That way Soldiers would not be required to log in to the tool every day, but rather the information would be pushed to them.

Broader Interview Results

Community-Centered Learning Environments

Bransford et al. (2000) note that community-centered learning environments focus on two key elements: (a) an environment in the classroom that encourages open discussion, including discussion of misconceptions, in a non-judgmental manner; and (b) creating an environment that is tied in tangible ways to the community it serves such that the learning is seen as relevant. From this perspective, the following key insights emerged from working group discussions, surveys, interviews, and associated document reviews.

The first key element of community-centered learning environments is consistent with the Army's approach to After-Action Reviews. These interactions are common in the MC3 and in other venues of Army training, and are typically conducted in an open and non-judgmental manner. A computer-based tool can facilitate After Action Reviews by prompting participants to conduct them appropriately.

The second key element of community-centered learning is actually the central focus of the current work—helping to close the gap between the classroom and the COE. Our vision is for students and instructors to have the capability for web-based interaction with outside experts almost anywhere at anytime. Any progress toward achieving this vision would be welcome at the MC3 and presumably many other sites of military training and education.

Bransford et al. (2000) describe community-centered learning as the proper backdrop for learner-centered, knowledge-centered, and assessment-centered aspects of effective educational system. Accordingly, additional issues deriving from a community-centered approach are described below in the context of the implications for learner-centered, knowledge-centered, and assessment-centered environments.

Learner-Centered Learning Environments

Following Bransford et al. (2000), we assume that the key element of being learner-centered is to ensure that the learning environment adequately addresses what students know, do not know, and how they are motivated to learn. Learners start at different places, with different strengths and weaknesses, and different

gaps in their understanding. From this perspective, the following key points emerged during our investigation.

Dialog has the potential to help reveal what students know, don't know, and how they come to know. These dialogs can be observed and tracked. The small group environment of the MC3 provides opportunities for instructors to dialog with students and for students to dialog with each other. It would be beneficial to increase opportunities such as these and to make them more effective. Two ways to increase effectiveness are (a) to make opportunities for dialog available when students are most highly motivated to receive and pull information, and (b) to identify and promulgate lessons learned about practices in instructional dialog that students and instructors find to be useful.

Computer-mediated methods of dialog, in principle, can facilitate the capture and archiving of best practices as well as collaborative insights that emerge in dialog between novices and experts. In the application at hand, we assume that best practices will have the characteristics of Socratic dialog. Instructors or other experts should lead students to discover connections or implications for themselves rather than simply telling them "the answer." That is, students should be guided in how to think, not told what to think.

Computer-mediated activities also allow for personal structuring of information that emerges in the activities. This presents tradeoffs for design and use of the tool, however, because student-driven structure can undermine pedagogically-driven structure for course materials and methodology. Nevertheless, a capability for student-driven structure should be explored given the motivational value and carry-over effects of anything that promotes active learning.

Web-based dialog, in principle, increases access to a wide variety of experts. In the present application, the most valuable experts are active duty personnel in theater, those from other specialties or organizations, and/or those who are otherwise close to the roles in which students will find themselves after deployment. The role of such outside experts in web-based dialog is important to the extent that students will be more likely to be influenced by the behavior of others if it results in outcomes they value, if the other person is similar to the student and has admired status, and if the behavior has functional value (Bandura, 1997).

Knowledge-Centered Learning Environments

To be knowledge-centered, a learning environment must go beyond simple memorization of facts and disconnected elements. Rather, learning environments should foster sense-making, which involves deep understandings with rich, causal connections (Bransford et al., 2000). While this may seem obvious, even the best curricula can benefit from continual vigilance about the coherence and relevance of the big picture. The world changes, thus the key integrating themes for a curriculum may need to be updated from time to time. From this perspective, the following key insights emerged form our investigation.

Socratic dialog with outside experts can reveal to students the ways in which knowledge about the operational environment is situated in contemporary nuances of political, military, economic, and social factors as well as infrastructure, information, physical environment and time. Understanding the influence of local or momentary ecology on an unfolding event helps students generalize from their own experiences and "classroom" experiences to new situations (E. Gibson, 1991; J. Gibson, 1977; Lave & Wenger, 1991).

While dialog with outside experts can help to develop integrated sense-making—in light of connections to real problems in the COE—facts and issues may still be somewhat difficult to comprehend in absence of direct experience with the particular roles (e.g., of Company Commanders) in the COE. Stories by outside experts and instructors can help provide ways to integrate knowledge into meaningful wholes. Dialog and sharing of stories, however, must be grounded in curriculum objectives and associated course materials.

One important element of curriculum, as a whole, is the developmental perspective. Students must be prepared for learning at the level required in any particular course. Course content and methodology must stake into account such prerequisites. This is difficult to ensure in a rapidly changing curriculum. Such situations demand extra vigilance by instructors in attending to the meaning that students make of course material and experiences in the learning environment. In this respect, web-based dialog with outside experts is not likely to be pedagogically effective unless outside experts can be resources that can be harnessed by the instructors.

An enabling objective of our approach is to combine the best of knowledge databases with the best of on-line help from an expert by providing a way in which each can leverage the strengths of the other. An expert can help a novice navigate quickly and efficiently through an otherwise potentially overwhelming amount of information (e.g., course materials). At the same time, the need to know about something specific, something which is potentially available in a database, grounds and contains a dialog that otherwise could become tangential, divergent, or inefficient.

Guidance through an overwhelming and unfamiliar body of information is no different from what a skilled small-group instructor or mentor does in introductory phases of any curriculum. Similar benefits can accrue from a capability that would enable experts to guide novices "on-line" as a mechanism of distance learning.

Grounding dialog between a student and an instructor in specific learning objectives is also no different from what occurs in any educational situation. The implication in the present case is to provide a capability for on-line dialog between a third-party expert and a student to be harnessed by learning objectives of the instructor. In essence, the strategy is to blend classroom education with distance learning in a way that each facilitates and gives meaning to the other.

Assessment-Centered Learning Environments

Following Bransford et al. (2000), learning environments should be go beyond summative assessments; that is, identifying what students can produce on a test or a paper at the end of the course. While meeting standards is critical, Bransford et al argue that assessment-centered environments must focus on formative assessment; that is, uncovering misconceptions and providing feedback in an open atmosphere. From this perspective, the following points emerged from working group discussions, surveys, interviews, and associated document reviews.

Many current methods of assessment are not sufficient in that they do not peel back the layers of the learning process. In this sense, it is critical to develop and utilize measures of process as well as outcomes or measures of effects. Computer-mediated activities can provide a window into the thinking of the student. In principle, one can trace the dialog that leads to an insight or to a dead end. The selection, use and storage of information can be traced. Such sources of potential measures of process should be explored in the development of the tool.

Measures of process will be valuable for continual improvement of the utilization of outside experts as well as in the improvement of learning by students. The contributions of outside experts can be assessed with respect to the ideals of Socratic dialog. Instructors can provide such feedback to outside experts to make them more useful resources to the instructors. Over time, lessons learned and best practices can be captured in "train the trainer" packages for outside experts and instructors.

Measures of effects typically are difficult to obtain if the intent is to identify the impact of training or education on subsequent behavior or performance (e.g., in a job, assignment or duty position). There are two ways that web-based utilization of outside experts could help identify the efficacy or utility of learning. First, outside experts are more likely to able to appreciate the implications of a student's knowledge or thinking for performance in theater, that is, to assess the potential impact of learning. Second, former students who have experienced the web-based dialog with outside experts in a blended learning environment may, themselves, become outside experts. This would provide valuable direct feedback on the actual impact of learning.

CONCLUSIONS

In summary, our work to date on tools and methods to close the gap between the classroom and the COE provides opportunities to address community-centered, learner-centered, knowledge-centered, and assessment-centered needs of an effective education system. These preliminary conclusions are supported by early feedback from potential users. Our next step will be to develop a set of computer-based tools to realize direct connections between outside experts, students, and instructors. This work will involve further specification of detailed requirements, tool implementation, and iterative testing to explore effectiveness and to guide redesign. We expect that this work will help realize a strong community-centered synthesis of Generative and Operational Forces. In so doing, this work promises to address the training of a Joint and Expeditionary mindset by contributing to the ability of Soldiers to readily adapt to a variety of dynamic missions throughout world.

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