A STRUCTURED APPROACH FOR SCENARIO-BASED TRAINING

Randall L. Oser (Chair)
Naval Air Warfare Center Training Systems Division
Orlando, Florida

Increasingly, organizations are using simulations to provide opportunities for individuals to practice skills learned in the classroom in realistic and dynamic synthetic environments. Unfortunately, while much is known about how to construct classroom-based instructional materials to support learning, few methods, strategies, and tools exist to support the development of simulation for pedagogical purposes. This panel will describe a methodology that has demonstrated considerable potential for supporting practice and feedback in simulated environments. The panel will also examine limitations of the methodology and challenges for implementation of the methodology.

Panel Overview

The continuous increases in complexity in today's work environment require operators to engage in more cognitive processes and to continuously adapt their operational strategies to cope with emergent demands. More specifically, operators need to identify cues and patterns in the environment, assess and make inferences about their status, make judgments about their next course of action, implement actions, and evaluate the impact of these actions. Success in these environments does not happen by chance, it instead depends on the extent to which operators possess the competencies necessary to perform the job (i.e., knowledge, skills, and attitudes).

The development of training to support the competencies necessary to perform in complex environments is often a challenging effort for instructional designers. Effective training requires a systematic approach that merges a number of instructional strategies (e.g., providing information about the facts to be learned, demonstrating behaviors to be modeled, providing opportunities for practice, implementing feedback) and instructional settings (e.g., classroom, simulation, on-the-job). While much is known about how to develop classroom-based instructional materials, far less is known about how to design and implement exercises that are simulations of real-world settings. These simulations are critical because they permit the trainees to practice and receive feedback within a task-specific context. In many training environments (e.g., aircrew training, nuclear power plant team training, military team training), simulations are often the instructional strategy of choice. In some cases, simulations are the only choice. However, the introduction of these simulations alone does not guarantee the occurrence of learning. Careful design and planning of how the simulations are to be used are two essential characteristics that are necessary to maximize the effectiveness of training.

Recently, a number of researchers have demonstrated that Scenario-Based Training (SBT) is a viable approach for training the competencies necessary for performing in complex environments. SBT is organized around a systematic framework for linking all aspects of scenario design, development, implementation, and analysis. The SBT approach builds upon more traditional approaches to instructional systems design. However, SBT differs in a number of important ways. First, it focuses on the development of practice and feedback whereas many other approaches focus on all aspects of training. Second, it emphasizes the acquisition of complex (i.e., often non-proceduralized or novel) tasks versus all potential types of tasks. Third, it was originally developed to support team training as opposed to individual training. Finally, it emphasizes training in simulation environments whereas other approaches describe training using all types of media.

In this panel, we will describe the processes of SBT and discuss issues related to SBT. More specifically, four panelists, who have been active researchers in SBT and/or have been applying this knowledge to recent training programs, will address questions related to SBT, such as: "Why SBT?", "What is the SBT process?", "How can SBT be supported with technology?", and "Where has SBT worked?" These questions will provide a context in which panelists can discuss the challenges and considerations that need to be addressed before SBT is widely implemented. A set of representative references related to SBT research is provided at the end of the panel overview.

Why SBT?

Janis Cannon-Bowers, Ph.D.
Naval Air Warfare Center
Training Systems Division
Orlando, Florida

The philosophy of training systems has experienced a series of evolutions. It has transitioned from being technology driven to recognizing the importance of considering the human component. The field of training is experiencing yet another evolution toward a learner-oriented focus on training systems design. While the learner oriented design philosophy considers technology and human components, it primarily focuses on attending to features that will create an effective learning environment.

The design of an effective learning environment must be based on cognitive theories and principles of learning which explain the dynamic processes that facilitate the acquisition of critical competencies. Important questions include: "how should the facts and procedures learned in traditional classroom settings be practiced to support their effective selection and implementation in training and actual settings?"; "how should practice opportunities be developed to support transfer to situations that were not specifically presented during training?"; and "what kind of feedback needs to be provided to support learning in these environments?"

In this portion of the panel, a number of theories and principles from a cognitive learning perspective will be considered to explain how training should be developed to support the development of complex competencies. The SBT methodology is one technique that explicitly and implicitly applies many theories and principles of learning into practical applications for training. Challenges and considerations in the translation of cognitive learning theory and principles for training are also described and discussed.

What Is the SBT Process?

Jennifer Fowlkes, Ph.D.
University of Central Florida
Orlando, Florida

A framework describing the SBT methodology will be offered as a practical application for training skills required to be performed in complex settings. More specifically, an overview of the components of this approach will be provided to answer the question: What is the SBT process? In general, SBT is a systematic method for ensuring that critical competencies are practiced instead of being left to chance.

For purposes of the panel this session will briefly describe the steps associated with SBT. The first three steps of the process are performed during the design of the scenario. First, SBT involves the identification of critical competencies that require practice and feedback. The initial step in the SBT process is identifying the skills targeted for training. This step drives all of the subsequent steps in the process, from scenario design to feedback. The ways in which these skills may be identified include examining curriculum objectives or historical performance data that indicate areas in need of improvement. Second, SBT involves generating scenario events and scripts. Once targeted competencies are identified, scenarios are developed with events tied to the competencies. This linkage ensures opportunities for practice and feedback take place. This permits the systematic introduction of learning, assessment, and feedback opportunities. Third, SBT involves the development of performance measures and standards. Just as the scenario is driven by the

skills identified for training, the performance measures and standards are developed to assess trainee responses to events included in the scenario.

The next SBT step occurs during the conduct of the scenario and involves the assessment and diagnosis of performance. Performance assessment and diagnosis centers on trainee responses to the scenario events, which in turn are related to the learning objectives. Performance assessment in SBT often uses a multi-faceted approach that includes process and outcome measures at both the individual and team level. The final two steps occur following the scenario. The fifth SBT step emphasizes the provision of feedback. Diagnostic feedback is provided on the targeted learning objectives using a facilitated approach that focuses on trainee responses to events. Finally, SBT entails the maintenance of historical performance data. This allows trends to be identified regarding performance strengths and weaknesses on the targeted learning objectives. These data, in turn, can be used to generate future SBT requirements.

In addition to describing the steps outlined above, during the description of the SBT approach, a series of guidelines derived from observations of SBT exercises and literature from training and human performance will be discussed.

How can SBT be Supported with Technology?

Milton Stretton
Sonalysts, Inc
Dahlgren, VA

In many organizations, an important element for training is the tools available for generating and implementing instructional materials. While considerable advancements have been made in technology to support many aspects of instructional material development for classroom-based training (e.g., authoring tools for interactive courseware and computer-based training, digital recording and editing systems for video and audio production), far fewer efforts have focused on tools to support the design of scenarios for practice. As a result, the potential exists for knowledge learned in the classroom not to be transferred into specific operational contexts.

Past experiences suggest that SBT design and delivery can be a complex, expensive, and time consuming task. Scenario developers must often manually write and script each scenario. Scenarios to support training of large teams (e.g., comprised of 100's or 1000's of participants) can require considerable resources. Additionally, manually designed scenarios are difficult to modify in response to the performance of the participants. As a result, the use of manual SBT methods have been of limited use to many organizations.

In an effort to overcome these challenges, researchers have investigated the use of technological advances to develop tools that can facilitate the development and application of SBT. In this session, we will discuss the results of various efforts that focus on developing tools in support of scenario management, data collection, assessment, diagnosis, feedback, and debriefing strategies for SBT

Where Has SBT Worked?

Dan Dwyer, Ph.D.
Naval Air Warfare Center
Training Systems Division
Orlando, Florida

The SBT approach has been applied successfully in a number of team training environments, ranging from small two-person crews, to large distributed teams where members (who were dispersed across the U.S.) simultaneously trained together within a single scenario. Such applications of the SBT methodology have resulted in powerful training sessions in which the learning objectives, scenario design, performance measures, and feedback were tightly linked.

These systematically developed scenario-based training sessions allowed instructors to assess both the team's mission outcomes (measures of effectiveness, or MOEs), as well as the team's processes (measures of performance, or MOPs). The SBT approach facilitated the collection of

training performance data that allowed instructors to quickly and accurately pinpoint performance shortfalls and allowed an examination of performance trends across multiple scenarios.

Although SBT has been applied in a wide variety of training environments, three specific examples will be presented in which SBT has been successfully used—combat information center teams; command and control teams; and distributed, multi-service teams. Specifically, for each example, we will describe the training context in which SBT was applied, discuss the scenario development process, provide an overview of the scenario, describe how performance measures were developed, present some of the results of the performance measures that were used to support feedback, and discuss the challenges with implementation. The results of the systematic utilization of SBT suggests that team performance can be enhanced for complex tasks.

Panel Discussion

While SBT has considerable potential for training complex competencies, it is not a panacea for all training problems or situations. The panelists will be challenged to critically review their own theoretical perspectives, methods, strategies, and tools in an effort to provide a broader understanding of SBT. The goal of the critical review is not to reduce the success of SBT; instead the goal is to identify important limitations and areas for future research.

In an effort to focus the panel discussion of SBT, the panelists will be presented with the following questions:

(a) What are the biggest challenges to implementing SBT methods, strategies, and tools?

(b) What are the biggest limitations of SBT methods, strategies, and tools?

(c) What other methods, strategies, and tools for SBT should be considered?

(d) Under what conditions might SBT methods, strategies, and tools not work?

(e) What emerging methods, strategies, and tools are on the horizon to support SBT?

(f) What is the impact of SBT on existing training strategies, methods, and tools?

(g) To what extent can SBT methods, strategies, and tools be used to support training in other settings?

Summary

While the focus of the panel is on SBT, it is not to suggest that the use of scenarios is sufficient in and of itself. Instead SBT should be viewed as part of a total training continuum. That is, effective training requires a systematic approach that merges a number of instructional strategies (e.g., providing information about the facts to be learned, demonstrating behaviors to be modeled, providing opportunities for practice, implementing feedback) and instructional settings (e.g., classroom, simulation, on-the-job). As a result, research is still required to determine how best to integrate SBT into training curriculum.

While the methods, strategies, and tools associated with SBT appear to have considerable promise, additional research is required. The discussion following the panel will provide insight into those areas that must be investigated in greater detail. Answers to those questions will be increasingly more important as the environment in which operators must perform becomes more complex.

Representative SBT References

Cannon-Bowers, J. A., Burns, J. J., Salas, E, & Pruitt, J. S., (1998). Advanced technology in decision-making training. In J. A. Cannon-Bowers & E. Salas (Eds.), *Making decisions under stress: Implications for individual and team training*. (pp. 365-374). Washington, DC: APA Press.

Fowlkes, J. E., Dwyer, D., Oser, R. L., & Salas, E. (1998) Event based approach to training (EBAT). *The International Journal of Aviation Psychology, 8* (3), 209-221.

Dwyer, D. J., Oser, R. L., Salas, E., & Fowlkes, J. E. (1999). Performance measurement in distributed environments: Initial results and implications for training. *Military Psychology, 11*(2), 189-215.

Johnston, J. H., Cannon-Bowers, J. A., & Smith-Jentsch, K. A. (1995). Event-based performance measurement system for shipboard command teams. *Proceedings of the 1st International Symposium on Command and Control Research and Technology, Washington, DC,* 274-276.

Oser, R. L., Gualtieri, J. W., Cannon-Bowers, J. A., & Salas, E. (1999). Training team problem solving skills: An event-based approach. *Computers in Human Behavior, 15,* 441-462.

Oser, R. L., Gualtieri, J. W., & Cannon-Bowers, J. A. (1998) Enhancing training systems design: Implementing an event-based approach. *Proceedings of the Human Factors and Ergonomics Society 42nd Annual Meeting, Santa Monica, CA, 1309-1313.*

Stretton, M. L., & Johnston, J. H. (1997). Scenario based training: An architecture for intelligent event selection [CD-ROM]. *Proceedings of the 19th annual Interservice/Industry Training, Simulation and Education Conference, Orlando, FL,* 108-117.