Conceptual and Architectural Design Process of an SBT-AID Training System

Sae Schatz, Clint Bowers, Denise Nicholson
University of Central Florida, Institute for Simulation and Training
Partnership II Building, 3100 Technology Parkway, Orlando, FL 32826 USA
sschatz@ist.ucf.edu, bowers@mail.ucf.edu, dnnichols@ist.ucf.edu

Keywords:
Scenario-Based Training (SBT), Simulation, Adaptive Instruction, Intelligent Tutor

In this poster session, we discuss our approach to designing and building an advanced training system that combines intelligent tutoring components, scenario-based instructional simulations, dynamic scenario generation capabilities, content authoring support, and self-validating machine learning techniques. We call the conceptual design Scenario-Based Training: Adaptive, Intelligent, Dynamic (SBT-AID).

1. Rationale for SBT-AID

On the one hand, Scenario-Based Training (SBT) is the optimum instructional strategy for training complex real-world tasks, such as those characterized by multiple information sources, conflicting information, rapidly evolving scenarios, and so on (Cannon-Bowers & Salas, 1998). However, SBT is expensive and time-consuming, and it is not practical in its current form, which relies so heavily on highly-trained instructors being in-the-loop.

On the other hand, adaptive training technologies are highly effective and efficient. Intelligent tutors routinely show training performance gains of 0.4–1.0 standard deviations over traditional classroom instruction (e.g., Dede, 2008; Lane, 2006), and they may enhance training efficiency by 100% (e.g., Romero et al., 2006) or even 1000% percent (e.g., Stottler & Vinkavich, 2000). However, most intelligent tutors are not well suited to train the higher-level skills required for complex task domains. The exception to this is a special class of intelligent tutors, called situated tutors, that combine the intelligent and adaptive capabilities of intelligent tutors with simulated environments (Woolf, 2009). As we have previously reported (Schatz et al., under review), the most sophisticated situated tutors are able to effectively support higher-order skills training while also demonstrating enhanced effectiveness and efficiency.

However, advanced situated tutors still suffer from some limitations. For instance, one major problem is that their training scenarios are still difficult and expensive to create. Few systems have an adequate scenario base, and the provided authoring tools are general insufficient (Bowers & Jentsch, 2001). Thus, scenarios are often developed in a haphazard manner that does not facilitate effective training (Chipman, 2006).

To address the limitations of scenario-based training, intelligent tutors, and situated tutors we have developed a conceptual paradigm called Scenario-Based Training: Adaptive, Intelligent, Dynamic (SBT-AID).

2. SBT-AID Overview

SBT-AID is an extension of the well-accepted scenario-based approach to training proposed by Cannon-Bowers et al. (1998) and Oser et al. (1999). The standard SBT paradigm specifies eight steps: (1) Conduct task analysis, (2) Select training objectives, (3) Develop event sets and scenarios, (4) Select then utilize a training environment, (5) Select and apply an instructional strategy, (6) Conduct performance assessment, (7) Deliver feedback, and (8) Record trainees’ performance history. These steps are carried out almost entirely by the instructional staff with little-to-no support from the training system. This places a heavy workload on instructors and necessitates that instructional staffs include not only subject-matter experts but also instructional design and technology experts.

The SBT-AID approach extends the standard SBT paradigm by automating instructor tasks, broadening support for content generation, and integrating lessons-learned from intelligent tutoring research. More specifically, the “AID” acronym refers to the embedded Adaptive training technology, Intelligent system and trainee assessment approaches, and Dynamic generation of scenario content. The fourteen steps of the SBT-AID model are as follows: (1) Conduct task analysis, (2) Build or access trainee profiles, (3) Select training objectives, (4) Select and apply an instructional strategy, (5) Deliver pre-task instruction, (6) Generate a relevant training scenario, (7) Deliver the scenario via a virtual simulation, (8) Assess and diagnose process performance, (9) Adapt the training scenario, (9) Deliver during-execution extrinsic feedback, (10) Assess and diagnose outcome performance, (10) Deliver post-task instruction (e.g., after-action review), (11) Record meta-data on training session, and (12) Record trainees’ performance history.

3. Architecture Design Process

Our team is currently developing an SBT-AID prototype system. We are integrating our prototype with an existing laptop-based, multi-user military training simulation. To develop the prototype architecture, we referenced and integrated many
litteratures, including SBT theories, intelligent tutoring designs, and novel modeling and machine learning approaches. Our goal is to develop an effective SBT-AID system that delivers high return-on-investment. Thus, throughout the design process we have made choices that minimize development costs while still supporting effective training. Figure 1 shows a high-level diagram of the architecture.

![Figure 1. High-level design of the SBT-AID prototype](image)

During this poster session, we will discuss the architectural design choices in much more detail. We will also present our research-based hypotheses regarding how the SBT-AID system will enhance training efficiency and effectiveness, while reducing the burden on human instructors.

4. References


Acknowledgements

This work is supported by the Office of Naval Research Grant N0001408C0186. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the official policies, either expressed or implied, of the ONR or the US Government. The US Government is authorized to reproduce and distribute reprints for Government purposes notwithstanding any copyright notation hereon.

Author Biographies

SAE SCHATZ, Ph.D. is a research associate with the UCF-IST Applied Cognition and Training in Immersive Virtual Environments (ACTIVE) lab; she conducts applied research in scenario-based training, adaptive instruction, and training architectures in support of the lab’s military training efforts.

CLINT BOWERS, Ph.D. is a Professor of Psychology and Chief Scientist of the ACTIVE laboratory. His recent research is in the areas of augmented cognition and training, and he has a long history of research in technology and training.

DENISE NICHOLSON, Ph.D. is director of the ACTIVE laboratory. Her research focus on human systems modeling, simulation and training includes virtual reality, human–agent collaboration, and adaptive human systems technologies for Department of Defense applications. She joined the university in 2005 with over 18 years of government service.