Science Foundations Training for Bomb Technicians: A Practical Application of Interactive Learning

by Benjamin D. Hamilton, MS, Ed.D (ABD)
Senior Program Analyst
SETA Support Contractor to the Technical Support Working Group (TSWG)

Background

State and local bomb technicians are confronted with (and will increasingly be confronted with) a variety of improvised explosive devices (IEDs) that are diverse in their design, construction, function and lethality. As terrorist and criminal capabilities increase, it is crucial that the bomb squad community stays ahead of the rapidly evolving threat. As a result, a training needs analysis was conducted to identify how instructional technology could be leveraged to supplement the bomb squad community's knowledge of electronics, physics and chemistry.

Instructional technology is the theory and practice of design, development, utilization, management and evaluation of processes and resources for learning (Seels and Richey, 1994). In other words, the goal of instructional technology is to positively affect learning through the use of technology. Unfortunately, all too often the electronic revolution has simply provided a way for paper-based materials to be distributed electronically. Only recently has the validity of this approach been questioned. The following application provides insight into how technology may be used to enhance learning instead of merely supporting it.

Solution

The Science Foundations project was financially supported by the Technical Support Working Group (TSWG) with technical expertise provided by the Hazardous Devices School (HDS), the National Bomb Squad Commanders Advisory Board (NBSCAB) and TSWG. Applied Research Associates (ARA) was contracted to develop the training. The effort began with a Cognitive Task Analysis to capture exemplar characteristics from experienced bomb technicians. Once captured, these characteristics were combined with science foundations specifically targeted to the bomb squad community. The outcome was three interactive, computer-based training modules focused on electronics, physics and chemistry. This science-based instruction focuses on IEDs, how they work, their effects, and their impact on render safe procedures (RSPs).

Benefits

There is a Chinese Proverb that states, "Tell me, I will forget. Show me, I may remember. Involve me, and I will understand." One of the goals of the Science Foundations project was to create an interactive and engaging learning experience, whereby the learner's motivations and interests are sustained throughout the training. There exists a significant amount of research highlighting some of the benefits of instructional technology (Johnson, & Howell, 2005; Lau, 2003; Plotnick, 2004; Young, Klemz, & Murphy, 2003). In addition to these commonly accepted best practices and strategies in computer-based training (i.e., practice, reinforcement/feedback, motivational design, multiple learning styles, etc.) (Dick, Carey, & Carey, 2001; Heinich, Molenda, Russell, & Smaldino, 2002; Smith & Ragan, 1999), the Science Foundations project employed three interrelated characteristics that increased the interactive nature of the training: role playing, interactions and discovery.

Role Playing. Role playing is one of the oldest forms of instructional strategies. With the proliferation of technology, users can become much more involved and see the immediate results of their decisions. In their roles, learners are free to explore the different consequences of their decisions that they may not normally do in the real world.

Interaction. Garris, Ahlers, and Driskell (2002) observed a "shift in the field of learning from a traditional, didactic model of instruction to a learner-centered model that emphasizes a more active learner role" (p. 441). This shift represents a movement away from "learning by listening" to "learning by doing" (p. 441), or what Klabbers (2000) defined as "learning as acquisition" to "learning as interaction."

Discovery. The goal of learning environments should be to facilitate learning discovery (Barab, Barnett, & Squire, 2002; Barab, Hay, Barnett, & Squire, 2001). Through an active participation in the discovery process, learners are able to test hypothesis, detect rules and uncover basic principles more efficiently and effectively than if they were simply told the information.

Application of Interactive Characteristics

The Science Foundation project incorporated interactive characteristics throughout the training. One example is a garage scene that was used to set the stage and engage the learner (Figure 1). Learners are informed to take the role of a bomb technician who has just come across a garage scene. The garage contains various "items of interest" (i.e., rocketry motors, pipes, chemicals, spare electronic parts, etc.). These items of interest are spread throughout the garage and it is the learners' job to observe the scene and identify the various items. In another portion of the training, learners can configure simple

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circuits to test and discover relationships between batteries, voltage, resistors and currents. Through their selections, learners can immediately see the impact (or lack thereof) of their decisions.

Figure 1 – Interactive Garage Scene

Conclusion

The Science Foundations project was created with the intent to provide bomb technicians with the information and resources to grasp a deeper understanding of the science foundation principles behind bombs. In this case, technology was a useful means to create interactive instruction. As Bates (1979) observed, the responsibility of an effective educational program is to create individuals capable of autonomous learning. The movement of the field needs to take learners away from "learning by listening."

Note: The Science Foundations project is scheduled to be completed in October 2007. The Hazardous Devices School will be assuming responsibility for the administration of this program. They will announce it to all bomb squads as soon as it is completed and available for online computer access.

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About the Author:

Mr. Hamilton is a Senior Program Analyst and SETA Support Contractor to the U.S. Government. His expertise includes analyzing, designing, evaluating, and managing projects involving interactive instruction, performance improvement, and simulation-based training. He received his Masters degree in Instructional Technology from Bloomsburg University and is currently completing his dissertation for a Doctorate of Education in Instructional Technology and Distance Education from Nova Southeastern University.

"Initiative is doing the right thing without being told."

~ Victor Hugo