

Our Approach

While traditional training approaches focus on memorizing facts and procedures, the Pacific Northwest National Laboratory engages interdisciplinary teams to develop interactive, scenario-based e-Learning courses where learners solve realistic problems. Our approach promotes understanding concepts—not just memorizing facts and steps—and thus allows students to apply the knowledge gained to problems encountered in the real world.

Interactive, Scenario-based Learning

Our team applies principles of cognitive psychology, human information processing, and learning to create interactive, student-centered courses for the U.S. Army, control systems professionals, national laboratory security inquiry officials, to name a few.

“Thank you for providing this type of training. It is cost effective and provides a source of reference material which can be used over and over.”

—electrical utility company

“Excellent computer based course. OPSEC training should be a part of any corporation’s CBT program.”

—IT professional

Logistics Communications Operations and Maintenance. PNNL developed an interactive, web-based training application for the U.S. Army to teach soldiers how to deploy and maintain a wireless logistics communications system. The training first conveys simpler concepts and then builds up to more complex problems. Frequent checks on learning, exercises, and optional quizzes reinforce the concepts using real-life examples and scenarios. The final exam provides a scenario-based environment where students must discover and solve a collection of problems they are apt to encounter in the field.

Control Systems Training. Our team has developed two novel and engaging e-Learning applications to help control system employees address the unique security challenges they face and to help raise employee awareness.

Cyber Security for Control Systems uses a variety of animations and interactive, “hands-on” exercises to portray real-world cyber security situations and reinforce key concepts. OPSEC (Operations Security) for Control Systems helps students deepen their understanding of concepts with interactive exercises in which they explore different environments to discover problems. They even have the opportunity to play the “bad

guy” and try to disrupt a competitor’s manufacturing process. This course won the 2007 Interagency OPSEC Support Staff (IOSS) National Award for Multimedia Achievement.

Cyber Security Awareness. We developed two e-Learning courses for the U.S. Department of Energy: Computer Forensics Awareness and Computer Sanitization Awareness. Both courses dynamically customize the content to meet the learning objectives corresponding to different students’ roles. The dynamic content delivery features and the use of interactive multimedia elements make these courses much more engaging and educationally sound than the lengthy classroom versions they replace.

Guided Discovery

As with our scenario-based e-Learning applications, our guided discovery approach facilitates learning by providing practice on problems adapted from actual work settings. But the guided discovery approach takes this one step further by providing coaching and support early in the instruction and then reducing the level of coaching as the learner’s knowledge and skills grow. This approach is particularly effective because learners gain knowledge through doing rather than being told.

ESTHER. In this e-Learning application for security inquiry officials, learners work on problems adapted from real-world security incident situations. Because security threats continually change, inquiry officials need to employ high-level cognitive skills and problem-solving. The traditional training approach of memorizing facts and steps is of little use here. Once the learner demonstrates a certain level of expertise, ESTHER reduces the amount of coaching but also allows learners to return to a previous level if they feel they need more help. The guided-discovery approach is ideal for training in any area that requires complex problem-solving.

Pachelbel®

Pachelbel® is a PNNL-developed learning management and delivery system used for most of our e-Learning applications. Pachelbel provides instructors the ability to develop

courses that are tailored to the needs of individual students while simplifying course content development and providing the flexibility needed to support instructional approaches suited to both the teachers and the students. These courses can then be delivered as web-based or stand-alone, CD-based training.

Student-Centered Learning. When a student registers for a class managed by Pachelbel, key information about that student is collected. Students may provide information about their roles, experience level, location, etc. Pachelbel then tracks the student through every page visited, monitoring how the student is navigating the system, what pages, lessons, and courses have been visited and completed, and where the student currently is within the training. At every step, Pachelbel uses everything it knows about the student to determine not only which content it should display but also how that content should be displayed. The entire page design and individual elements of each page can be altered on the fly to better accommodate the student’s current needs and learning approach.

For example, if a student is progressing through a lesson in a strict sequential manner, Pachelbel will provide content and navigation elements that best support this sequential approach. If that student decides to navigate through the material non-sequentially (e.g., jumping from page to page via search results of desired topics), Pachelbel can restructure the material to provide additional, contextual information, helping the student more fully understand the content at that particular point.

Note: PNNL’s Pachelbel Learning Management System is SCORM conformant.



In this scenario, learners use techniques they’ve just read about, such as Phishing and Social Engineering, to steal a competitor’s secrets. By learning how to think like the “bad guy,” they also learn how to prevent such attacks.



With the “hands-on” experience gained through PNNL’s e-Learning applications, learners confidently apply that knowledge in the field.

Potential Training Applications

In addition to training described in this brochure, our e-Learning approach can be applied to numerous domains with very different instructional goals. Possibilities include:

- » Facility inspection: We can build virtual environments where learners zoom in on items, pick up and rotate objects, move to different rooms, and more. This is especially useful when real-life facility inspection is impractical, expensive, or dangerous.
- » Equipment assembly: We can create life-like 3D models and provide simulated assembly to use as demonstrations or allow learners to assemble, connect, and/or operate the equipment themselves.
- » Employee skills: We can develop scenarios where learners play a specific role and interact with other characters. This could be used for staff members training for a new position or for managers to understand their staff members’ duties.

Training topics are limited only by your needs and imagination!



Left: Learners can rotate and examine equipment to become more familiar with it.

Center: Learners troubleshoot problems they will likely encounter in the field.

Right: The Rehabilitation Learning Center, a Pachelbel® learning environment for spinal cord patients, provides graphics and videos, such as one illustrating a fracture dislocation, and information on various types of spinal injuries.

Our Interdisciplinary Teams

A PNNL e-Learning team typically includes the following:

- » Multimedia designer
- » Graphic artist
- » Computer scientist/system administrator
- » Instructional designer
- » Content developer/editor
- » Cognitive psychologist
- » Subject matter expert

Frequently, several team members also have a background in classroom instruction and share a passion for effective teaching and learning. Because PNNL is a national laboratory, we are able to find onsite subject matter experts in a wide and diverse number of disciplines.

More information, including example applications, can be found at the Cognitive Informatics Learning and Skill Development web page:

www.pnl.gov/cogInformatics/learning_applications.stm

Frank L. Greitzer, PhD

Instructional Design, Human-Computer Interaction Design

Pacific Northwest National Laboratory
P.O. Box 999, K7-28
Richland, WA 99352
Phone: (509) 372-4251
frank.greitzer@pnl.gov

Doug Rice

e-Learning Application Design and Development, Pachelbel, Instructional Design

Pacific Northwest National Laboratory
P.O. Box 999, K7-28
Richland, WA 99352
Phone: (509) 372-4965
doug.rice@pnl.gov

Lori Ross O’Neil

Security Training Development and Instruction

Pacific Northwest National Laboratory
P.O. Box 999, K8-83
Richland, WA 99352
Phone: (509) 375-6702
lro@pnl.gov

Student-Centered e-Learning for Solving Real-World Problems

