

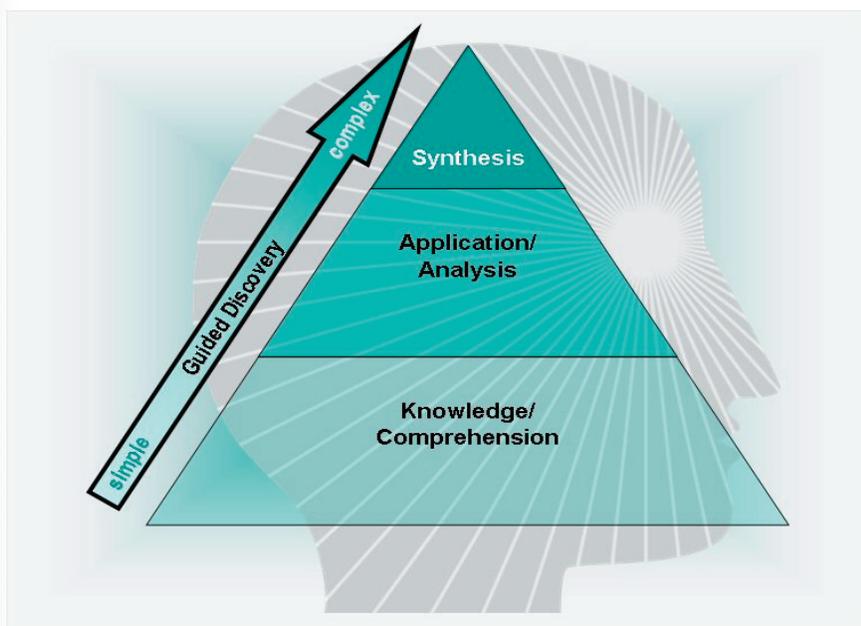
Science.

Technology.

Innovation.

Guided Discovery Based Cognitive e-Learning

PNNL's innovative e-Learning approach enriches the learning experience and actively engages students using real-world problems.



Application of Cognitive Learning and Guided-Discovery Principles in e-Learning

Traditional approaches to training concentrate on memorizing facts and procedures rather than actively solving problems. This tends to produce learners who know the right answers to questions but who do not understand the relevance of the facts or the underlying concepts required to solve new problems. In contrast, teaching by problem-solving aims to use real-world contexts that require the learner to actively apply knowledge.

PNNL's cognitive approach to Instructional System Design (ISD) is based on fundamental learning concepts and a technical approach that creates multimedia *learning objects* that have specific learning and performance objectives and enable the training application to respond effectively and adapt to the learner's performance. PNNL implements this ISD process within a guided-discovery approach that facilitates learning through coaching and support for learners working on problems (also called *scenarios*) adapted from actual work settings. As the learner gains knowledge and skill, the level of coaching diminishes. This instructional architecture offers great potential for cognitive skills training.

**Pacific Northwest
National Laboratory**

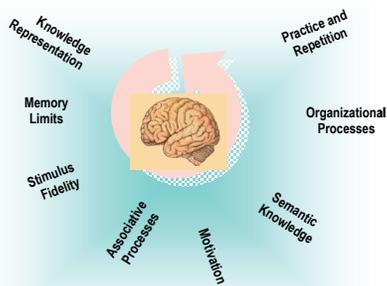
Operated by Battelle for the
U.S. Department of Energy



Cognitive Approach to Instruction

PNNL's cognitive approach:

- Engages learners to solve real-world problems, progressing from simple to complex
- Relates material to previous experience
- Demonstrates (rather than telling) what is to be learned using interactive, problem-centered activities
- Requires learners to use their new knowledge to solve problems (guiding the learner with feedback and coaching early and gradually withdrawing this support as learning progresses)
- Encourages learners to use the new knowledge in relevant applied settings.

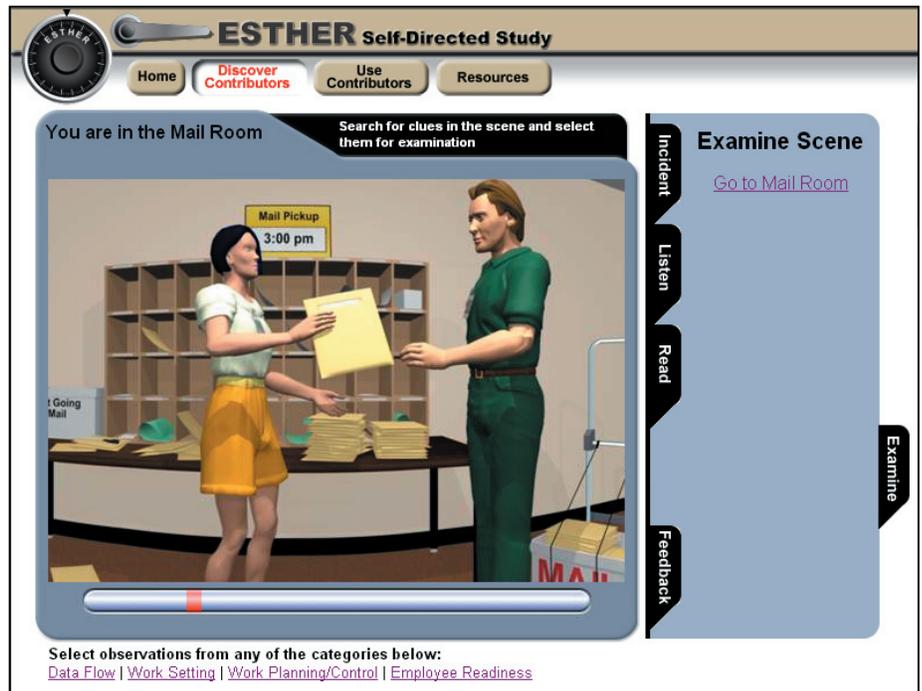


Cognitive principles guide design.

Technical Approach to Interactive Multimedia e-Learning

To employ effective multimedia content, PNNL's technical approach:

- Assesses requirements to identify effective educational styles
- Defines desired media formats and training delivery styles
- Develops prototype simulations
- Develops an interface to pass performance data back to the Learning Management System
- Develops extensions, templates, and plug-ins to facilitate integration of interactive media elements.



Sample screen from ESTHER (Enhanced Security through Human Error Reduction) guided discovery e-Learning application.

Guided Discovery Learning Application

PNNL used cognitive learning and guided-discovery concepts to design and develop an e-Learning application for training Department of Energy Security Incident Inquiry officials on human errors that contribute to security incidents. A sample ESTHER e-Learning screen is shown above. The guided discovery process takes learners from the simple to complex (both in terms of complexity of tasks and cognitive concepts) and provides multiple levels of feedback that implement varying degrees of coaching.

The learner reads a description of the incident and virtually explores the workplace where the incident occurred. This includes a re-enactment of the incident in the “Examine” tab; testimonies by co-workers (in the “Listen” tab); and available written documentation such as email (in the “Read” tab). After initially responding with basic observations, advanced learners are required to fill out a Web-based incident reporting form.

Impact of This R&D

PNNL's e-Learning research aims to create dynamic, interactive instructional environments that more closely represent real-life, “hands-on” training—achieving a level of interactive e-Learning that is absent in the market today. Through its cognitive-based guided-discovery approach to instruction, PNNL is providing innovation and leadership in computer-based cognitive skills training.

As a U.S. Department of Energy multi-program national laboratory, PNNL develops and deploys technology for national missions in energy, the environment, defense, and human health.

For more information, contact

Dr. Frank L. Greitzer
Pacific Northwest National Laboratory
P.O. Box 999, K7-28
Richland, WA 99352
509-372-4251
frank.greitzer@pnl.gov