Stottler Henke Helps Train Navy on Land and at Sea

By Jennifer Reisch

Research shows that students learn concepts and skills more quickly when they receive one-on-one instruction. Research also shows that while traditional instructional methods of presenting learners with facts and concepts followed by test questions are effective in exposing people to large amounts of information and testing their recall, they often instill "inert knowledge" that learners can recall but may not apply correctly when needed.

Stottler Henke Associates, Inc. (Stottler Henke) develops intelligent tutoring systems (ITSs) that automatically and cost-effectively provide the benefits of one-on-one training. These systems encode the subject matter and teaching expertise of experienced instructors using artificial intelligence (AI) software technologies and cognitive psychology models. ITS systems use simulations and other highly interactive learning environments that require people to apply their knowledge and skills. These active situated learning environments help them retain and apply knowledge and skills more effectively in operational settings, explained Dick Stottler, president of Stottler Henke.

"ITSs use artificial intelligence to encode

U.S. Navy Photo

Stottler Henke develops intelligent tutoring systems (ITSs) that automatically and cost-effectively provide the benefits of one-on-one training.

expert instructor knowledge to monitor students during training exercises and simulations, identify knowledge and skill gaps, and provide pinpoint coaching and feedback, like a one-on-one tutor," he said.

"ITSs enable participants to practice their skills by carrying out tasks within highly interactive learning environments. However, ITSs go beyond training simulations by answering user questions, providing individualized hints and feedback, and adapting the simulation events." Specifically, ITSs assess each learner's actions within

these interactive environments and develop a model of their knowledge and skills. Based on this model, ITSs tailor both content and style of instructional strategies, and provide explanations, hints, examples, demonstrations, and practice problems as needed. Studies have shown that ITSs help students learn faster and translate the learning into improved performance more effectively than traditional classroom instruction.

Stottler Henke employs advanced technologies, including intelligent simulation control, authoring tools for tutoring systems, and authoring tools for simulation control, to enhance the efficacy and cost-effectiveness of training systems.

Intelligent Simulation Control

Intelligent simulations, which enable students to interact with realistic and capable computer-generated forces and automated role players, let organizations automate friendly, neutral, and opposing forces and teammates to run realistic training scenarios without the cost and complexity of having human operators control those positions manually. In free play simulations, these simulated entities need to embed goals and priorities, maintain situation awareness, and select and execute appropriate actions or communications.

Authoring Tools for Simulated Entities

Authoring tools for simulation control simplify the encoding of automated behaviors of simulated entities—such as computer-generated forces and automated role players—by non-programmers. Traditional development methods require programmers to code simulation behaviors within software; subject matter experts must describe the desired behaviors to programmers who then translate these descriptions into software. This multistep approach is cumbersome, time-consuming, and error prone.

Stottler Henke's authoring tools and run-time systems allow instructors and subject matter experts to define intelligent behaviors for free-play training simulations quickly and easily, without programming, using a visual user interface. Authoring tools make it possible to create smarter behaviors to create systems that are more realistic, challenging, and engaging without using traditional programming methods.

Authoring Tools for Intelligent Tutoring

Authoring tools for tutoring systems simplify the encoding of expert tutoring knowledge by non-programmers, so they can be executed automatically by the intelligent tutor during training scenarios. It is challenging to assess student performance during dynamic free-play simulations. Many of Stottler Henke's simulation-based tutoring systems for tactical training employ augmented finite state machines (FSMs) to look for significant temporal patterns of simulated events, states, and student actions, within the continuously changing tactical situation. By associating tactical

STP

principles with each pattern, the tutoring system can infer areas where the student's knowledge and skills are weak or strong during the training simulation.

Several of Stottler Henke's intelligent training systems have been developed with SBIR funding and have transitioned to the U.S. Navy. The four projects profiled below "have made a significant impact on the Navy's readiness, and they have brought in $32.5M in follow-on sales and DoD and private investment," said Stottler.

Tactical Action Officer Intelligent Tutoring System (TAO ITS)

The Tactical Action Officer Intelligent Tutoring System (TAO ITS) enables students to act as TAOs in tactical simulations under SBIR contract N00178-97-C-3070. To improve the tactical proficiency of TAOs in a cost-effective manner, Stottler Henke developed a simulation based ITS that immerses TAO students in simulated tactical scenarios in which they employ sensors and weapons and communicate with automated teammates. An automated software tutor monitors and evaluates what students say and do in order to identify knowledge and skill gaps and provide highly specific hints and instructional feedback.

In the U.S. Navy, the TAO controls the ship's weapons and sensors and directs the movements of the ship, other support vessels, and aircraft. The TAO also monitors the movements and actions of friendly and enemy ships, planes, missiles, and

U.S. Navy Photo

A tactical action officer keeps watch in the Combat Direction Center (CDC).

submarines in the region. The ITS teaches tactical rules of engagement to officers who direct the sensors and weapons aboard cruisers. Using this system, learners receive 10 times more hands-on experience than before. This ITS is used as part of classroom instruction and as a stand-alone system aboard Navy ships, where learners use it for self-study.

The simulation's graphical user interface displays an interactive geographical map of the region and provides rapid access to the ship's sensor, weapon, and communication functions. The system is highly configurable, and authoring tools enable the instructor to define new patterns and associated inferences; new types of ships and aircraft, scenarios, and principles; and complex behaviors for each friendly and enemy ship and aircraft to create realistic, multi-agent simulations.

After Phase II, Stottler Henke teamed with Northrop Grumman to create PORTS TAO ITS, a second-generation TAO ITS

that works with Northrop Grumman's WatchStation simulator. This version incorporates speech recognition, speech synthesis, and intelligent agents, so students can train realistically by talking to simulated teammates.

The U.S. Navy Surface Warfare Officer's School received an Excellence in Practice Award from the American Society for Training and Development (ASTD) for their use of the TAO ITS and other intelligent tutoring systems.

Helicopter Cockpit Training Simulation

The Operator Machine Interface Assistant (OMIA) scenario-based training simulation lets helicopter crew members practice the use of new instrumentation in simulated missions such as anti-submarine warfare and search and rescue. The system has saved millions of dollars for the Navy, Stottler said.

In conjunction with Navy PMA-205, Stottler Henke has developed, deployed, and updated a flexible low-cost PC-hosted and web-hosted part-task trainer (PTT) crew trainer for the Navy's MH-60S Sierra and MH-60R Romeo helicopters called OMIA under SBIR contract N00421-98-C-1252. This flexible training system functions as a part-task trainer for general functionality and is expandable to support in-depth training in particular subsystems, such as forward-looking infrared (FLIR) and active acoustics. OMIA supports integration with

U.S. Navy Photo

Multi-Mission Helicopter Common Cockpit used in the MH-60 Sierra and Romeo

physical hand control units via USB, and flight simulator software to provide an optional "out the window" view. OMIA is also used to familiarize maintenance crews with the MH-60S/R cockpit. OMIA is available to all crewmembers at land and at sea.

Acoustic Analysis Intelligent Tutoring System (AAITS)

Stottler Henke's Acoustic Analysis Intelligent Tutoring System (AAITS) lets Navy sonar technicians practice the analysis of undersea acoustic datasets to detect and classify submarines. The authoring tool lets experts create scenarios intuitively by annotating datasets using a graphical user interface.

AAITS enables students to practice the detection and classification of sources of underwater acoustic signals under SBIR contract N00039-98-C-3005. Traditional classroom instruction and computer-based training (CBT) are effective methods of presenting and testing undersea acoustic

data analysis facts and concepts. However, carrying out acoustic analysis at expert levels of proficiency requires extensive practice analyzing many acoustic datasets, or LOFARGRAMs, under the guidance of experienced analysts. The system is composed of a scenario authoring tool and a tutoring system. Acoustic analysis subject matter experts create scenarios intuitively, using the scenario authoring tool, by annotating LOFARGRAMs with significant features and links among related features and assigning a final classification. Students use the tutoring system to request LOFARGRAMs, annotate them with features and links, propose final

U.S. DoD Photo

Sonar technicians analyze underwater acoustic data

classifications, and request comparison of each student's annotations and classification with those of the expert. Through this comparison, the tutoring system can identify the acoustic analysis principles understood and correctly applied by each student in order to provide specific and individualized feedback. By storing LOFARGRAMs annotated by experts, the AAITS also serves as a knowledge repository to disseminate the most current acoustic analysis expertise to sonar technicians on land or at sea.

AAITS was deployed at 10 sites within the Navy to provide practice-based acoustic analysis training with fine-grained automated evaluation.

ReadInsight Reading Comprehension Tutor

Working with adult reading skills instructors, under SBIR contract N00014-98-C-0492 Stottler Henke developed an intelligent tutoring system that automatically assesses and diagnoses each student's specific reading skill deficiencies and tailors its instruction accordingly.

The U.S. Navy requires reading skills that exceed those of some of their personnel, Stottler explained. The resources of reading instructors, who are unavailable aboard ships at sea, are already stressed and are unable to keep up with the large number of students. The Navy needed computer-based systems that enable each instructor to teach more students. Existing reading software systems did not satisfy this need because they taught only low-level reading skills instead of higher-level comprehension skills, or they contained reading materials for young students that were inappropriate for adult learners.

Stottler Henke's system employs innovative probabilistic techniques to estimate proficiency levels of interrelated, high-level,

and low-level reading skills. A scaffolding mechanism helps students learn difficult skills by presenting exercises that build upon skills already mastered. In addition, the system helps students understand the relationship between various aspects of reading and how they can be applied in combination to achieve a high level of comprehension. By encouraging reflection, the software helps students to understand the text in more depth.

Studies show that adult reading instruction is significantly more effective when the reading material is related to each student's personal interests and career goals. Thus, the reading tutor includes an authoring tool that enables course designers to create relevant reading material without programming. For example, a manufacturing company could include reading material related to manufacturing process guidelines and instructions, so employees can acquire reading skills and learn work-related material at the same time.

In a study, the Navy compared the learning gains achieved by students using the tutors against those achieved by those given classroom training. They found that the group working with the tutors achieved skill improvements comparable to the classroom group but in half as much time. A follow-up assessment six weeks after the training showed that the group working with the tutors also had significantly lower levels of skill decay compared to the classroom group.

Stottler Henke participated in Navy's SBIR/STTR Transition Program (Navy STP) to find users and applications for the company's Aurora intelligent planning and scheduling, BEACON experiential knowledge management, and BOSS program tracking technologies.

"Navy STP's structured process and coaching helped us refine our transition approach and improve how we communicate the unique benefits of our offerings," Stottler said. "While attending the Sea Air Space conference, we met Navy decision makers, technology vendors, and potential customers. These contacts helped us identify sales prospects and teaming possibilities and learn about complementary technologies."

Stottler Henke delivers software systems to help customers solve problems that defy traditional approaches. The company has developed systems that provide practice-based learning for K-12 education, corporate training and professional development, and military training. Stottler Henke specializes in AI products and solutions for:

- Education and training
- Planning and scheduling
- Machine learning and data analytics
- Knowledge management and retrieval
- Autonomous systems

For more information, visit the company's website at https://www.stottlerhenke.com.