WMD Incident Management Simulation and Tutor

NIEHS

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Project Team

**Stottler Henke** - Artificial intelligence software
  intelligent training simulations
  intelligent tutoring
  scenario authoring tools

**Hank Christen** - expert: disaster preparedness
  *EMS Incident Management System*
  *NIMS Principles and Practice*
  *Understanding Terrorism & Managing Consequences*
  *Terrorism Response: Field Guide for Fire & EMS Organizations*
  *Mass Casualty and High Impact Incidents*

**Nathaniel Hupert, MD** – Cornell Medical School
  Public Health and Hospital System Preparedness for
  Bioterrorism and Epidemic Outbreaks
## Stottler Henke ITS Applications

<table>
<thead>
<tr>
<th>Military &amp; Space</th>
<th>Tactical decision-making</th>
<th>Helo cockpit operations</th>
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<tbody>
<tr>
<td></td>
<td>Command and control</td>
<td>Helo piloting</td>
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<td></td>
<td>Sonar data analysis</td>
<td>Information warfare</td>
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<td></td>
<td>Satellite operations</td>
<td>Air Operations Center</td>
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<td></td>
<td>Counter-terrorism data analysis</td>
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<td>Joint staff officer inter-Service/agency teamwork</td>
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<td>System diagnosis and recovery</td>
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<td>Air Planning – cultural reasoning</td>
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<tr>
<th>Professional</th>
<th>Emergency medicine</th>
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<tr>
<td></td>
<td>Equipment and software operations</td>
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<td></td>
<td>Leadership, project management</td>
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<thead>
<tr>
<th>K-12 &amp; College</th>
<th>Earth science / satellite imagery (HS, college)</th>
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<tbody>
<tr>
<td></td>
<td>Reading comprehension (adult)</td>
</tr>
<tr>
<td></td>
<td>Math (Grades 3-6, algebra)</td>
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<td></td>
<td>Nutrition (Jr. HS)</td>
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Intelligent Tutoring Systems (ITSs)

ITSs emulate the practices of an organization’s best instructors to provide the benefits of one-on-one tutoring automatically and cost-effectively

- Evaluates student actions and/or utterances
- Assesses student’s knowledge and skills
- Interventions = hints, feedback, questions, remediation, guided reflection -- adapted to each student
- Complements classroom instruction and/or CBT
Simulation Complements Field Exercises

**Advantages**

“any time, anywhere” learning at low incremental cost per student-experience

High learning density (learning vs. time) (focused student learning experiences)

Higher conceptual fidelity – less scripting of student actions students assess situations and decide

**Disadvantages**

Lower physical/social/visual fidelity
Sim + Tutoring = Improved Training

- Realistic Simulations
  - Traditional CBT Q&A
  - Precise, Accurate Assessment Pinpoint Instruction
- Simulation-based intelligent tutoring systems
Sim-Based Tutors are Effective

- Dr. Wes Regian (Air Force Labs) reports average improvement of $1\sigma$, vs. classroom instruction
- John Anderson of CMU reports that ITSs:
  - Required 1/3 less instruction time
  - Yields 1 standard deviation performance improvement
- Air Force avionics tutor evaluation
  - 20 hours with tutor = 4 years OJT
- US Navy reports 10x increase in tactical experience using Stottler Henke’s Tactical Action Officer ITS
Navy Tactical Action Officer
TAO ITS v1 - Assessment Example

One of dozens

Wait for Attack

incoming missile?

Under Attack

proper defensive action taken?

Principle Failed

Principle Untested

Principle Passed

timeout?

missile destroyed?

timeout?
TAO ITS – Version 2
## Tactical Action Officer (TAO) ITS

<table>
<thead>
<tr>
<th><strong>Students</strong></th>
<th>U.S. Navy Tactical Action Officer students</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Problem</strong></td>
<td>Improve the tactical proficiency of Tactical Action Officers (TAOs) cost-effectively.</td>
</tr>
<tr>
<td><strong>Solution</strong></td>
<td>Free-play tactical simulation with intelligent friendly and enemy forces and speech-enabled teammates (v2)</td>
</tr>
<tr>
<td></td>
<td>Automated evaluation of student performance</td>
</tr>
<tr>
<td></td>
<td>Principles passed/failed reported at end of scenario</td>
</tr>
<tr>
<td><strong>Assessment Approach</strong></td>
<td>Many finite state machines, running in parallel, track sequences of actions and states that show presence/absence of specific knowledge and skills.</td>
</tr>
<tr>
<td><strong>Status</strong></td>
<td>Version 1 – U.S. Navy SBIR Success Story.</td>
</tr>
<tr>
<td></td>
<td>Version 2 in acceptance testing.</td>
</tr>
</tbody>
</table>
Combined Arms
Team Training
Combined Arms Ops = Close Teamwork

- Artillery gun target lines
- Mortar gun target lines & surface danger zone
- Helicopter routes
- Helicopter battle positions
- Aircraft routes
- Ground maneuver
- Ordnance danger areas
- Enemy threat rings

Combined Arms Operations rely on close teamwork among different military units to achieve strategic advantages. This diagram illustrates various elements and routes that are crucial for effective combined arms operations.
Playback via 2D, 3D, Timeline Displays
**After-Action Intelligent Review System**

<table>
<thead>
<tr>
<th>Students</th>
<th>Fire Support Coordination teams for Marine Corps Combined Arms Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem</td>
<td>Help instructors assess the performance of 100+ students during team training simulations</td>
</tr>
<tr>
<td>Solution</td>
<td>AAIRS automatically detects and reports errors and conflicts to instructors and provides incident playback using 2D, 3D, and timeline displays.</td>
</tr>
<tr>
<td>Assessment Approach</td>
<td>Speech recognition extracts key words, phrases AAIRS analyzes decisions, voice communications, and simulation events to detect and explains errors</td>
</tr>
<tr>
<td>Status</td>
<td>Key part of system that received Florida Governor’s Award</td>
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WMD Incident Management Project Vision

Enable widely deployable, easily customized experiential application-level learning of incident management knowledge and skills for diverse student roles, organizations, and WMD scenarios.

Situation assessment
Tactical decision-making
Command, control, communication (NIMS)

Employ simulation and intelligent tutoring to improve performance via active learning (vs. factual recall and passive learning).
Phase 1 Scope

Develop and demo an initial prototype scenario to illustrate the instructional approach and elicit estimates of instructional effectiveness and market demand.

Scenario:
- Chemical incident
- Medical Branch Director

Simulation:
- Radio communications
- Reference documents
- Maps
- Command charts
NIMS Command Hierarchy

- Command
  - Section Chiefs
    - Admin-Finance
    - Logistics
    - Operations
    - Planning
    - Intelligence
  - Branch Directors
    - Other
    - Law Enforcement
    - Medical
    - Fire-Rescue
    - Public Works

Student role in prototype scenario
Phase 1 Prototype

Note: Graphic is not to scale. Smith Memorial Hospital is on N 5th Ave and is not depicted.
Simulation-Based Tutoring Scenarios

**Briefing**  
Student role  
Background  
Recent events

**Simulation**  
Carries storyline  
Presents decision cues  
Accepts and responds to actions  
Provides hints

**Debriefing (intelligent tutor)**  
Provides performance feedback  
Guides reflection (phase 2)
# Training System Design Goals

**Effective and Efficient**
- Challenging, engaging situations
- Automated performance feedback
- Many learning objectives / hour

**Conceptual realism**
- Realistic types of situations, info cues, actions, sim responses

**Diverse students**
- Adaptive hinting

**High volume distance learning**
- Web/SCORM friendly
- Avoid costly 3rd party software

**Rapid scenario development and customization**
- Scenario authoring tools w/ domain-specific extensions and easy-to-create media
Performance Model Guides Scenario Design

Student Mental Actions and States

Assess situation → Decide & execute → Situation awareness → Knowledge & Skills → Goals

Observable Events & States

Cues → Assess student → Actions

World State → Assess student → Information

Process Information

[Image]

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Smarter Software Solutions

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Planned Phase 2 Scope

Increase usability and sophistication of scenarios

- Presentation of information cues
- Entry of student actions and notes
- Simulation models and responses
- Student performance assessment
- Instructional feedback and dialogs
- Scale and type of incidents
- Student role and organizations (first responders, hospitals, communities)

Expand breadth of scenarios