US ARMY RDECOM

US Army Research, Development and Engineering Command

Understanding the Impact of Intelligent Tutoring Agents on Real-Time Training Simulations

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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Presentation Roadmap

- General Notes on Intelligent Tutoring
- Reactive techniques of automated instruction
  - Strategies and successes
  - Limitations
- Active techniques
  - Strategies and successes
  - Limitations
  - Promise
- Direction of the field (Future work)
  - Military
  - Civilian

Words on Intelligent Tutoring System Design

- Typically approach well defined domains
- Adapt content to skill level
- Have turn-based, or event-based approach
- Built within a tightly coupled environment

Reactive (Computer-based) Strategies and Successes

- Scale the content to the user's ability
  - User takes in more content in a shorter time
- In specific domains, more effective than traditional instruction
- "Is Adaptive Learning Effective" Literature review
  - 15 systems, average effect size .95
  - Includes math, programming, physics, natural sciences

Reactive Limitations

- Domains are not always well defined
- Cannot expand to social tasks, or team training
- People are more than performance ability
  - Human tutors ask questions
  - Respond to stalls
  - Account for motivation
- Fundamentally, these tutors do not know “how to teach”
- Result? Observation of ½ of the human tutor effect size

Active Strategies and Successes

- 50% of (human) tutor interactions are based on affective elements
  - D'Mello, Taylor, Davidson, & Graesser, 2008
- Tutor-Learner relationship is social/trusting, which aids in cognitive development
  - Kim & Baylor, 2006
  - Woolf et. al., 2009
- Proactive human tutors have been observed to improve performance
  - Two standard deviations

Active Strategies and Successes

- Carnegie Learning's Cognitive Tutor
  - Realtime feedback based on continuous assessment
- Autotutor
  - NLP responses based on content and cognition
- Conati educational game
  - Tracks user emotional state

Active Limitations

- Everything must be realtime
- Requires a step beyond the content creation
  - Time consuming, expensive
- Feedback for a specific state is a relatively novel problem
  - Learning in a stressed state
- Incorrect decisions have negative impact
  - Razzaq & Heffernan, 2009
- Lessons Learned:
  - Do not break flow
  - Do not distract the user

Active Promise

- Team Training
- Ill-defined Domain Training
- Leadership Training
- Emotional or Stress Training

Field Direction - Civilian

- Computer-based Intelligent Tutors work: (Woolf, 2011)
  - Effectively reduce the time required for learning by 1/3 to 1/2.
  - Networked versions reduce the need for training support personnel by about 70% and operating costs by about 92%

Woolf, B.P. (2011). Intelligent Tutors: Past, Present and Future. Keynote address at the Advanced Distributed Learning ImplementationFest, August 2011, Orlando, Florida.

Field Direction - Military

- TRADOC FY 12 Warfighter outcomes
  - T-3. Adaptive Training System
  - T-5. Tailored / Adaptable Learning and Training (includes Intelligent Tutor)
- TRADOC S&T White Paper themes
  - Intelligent Tutoring Systems
- TRADOC Force Operating Capabilities
  - FOC-10-01 Leadership Training & Education
  - FOC-10-03 Realistic Training