Lessons Learned in Embodying Tutoring for Interactive Skills
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Focus of presentation is simulation training.

Implications:
- Significance of performance measurement.
- Appropriateness of use of [embodied] tutor.
Simulation Training Approach

- **Familiarize** – Gain knowledge about components or events or procedures.

- **Acquire** – Learn “school solution” or best-practice techniques and procedures, often in lock-step (i.e., vs. free-play) fashion.

- **Practice** – Practice techniques and procedures and strategies for their application.

- **Validate** – Test on performance of skills to established standards within set conditions.
**Familiarize** – Gain knowledge about components or events or procedures.

**Acquire** – Learn “school solution” or best-practice techniques and procedures, often in lock-step (i.e., vs. free-play) fashion.

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**Validate** – Test on performance of skills to established standards within set conditions.

Assess with typical testing.

Learn by doing, multiple scenarios with different ‘fault’ conditions, reach-back to supporting materials.

React to differences between student actions and performance criteria.

Provide guidance or feedback but refrain from interjecting unless an obvious error.
Lesson – Atomic unit of instruction doable in a single computer session (though bookmarking adds convenience) having terminal and enabling learning objectives.

Terminal learning objectives (TLO):
- For a familiarize lesson:
  - Learn components of and relationships [within [subsystem Y of] system Z].
  - Learn states and modes [of [subsystem Y of] system Z].
  - Learn how a mission is defined [for [subsystem Y of] system Z].
- For an acquire lesson – Acquire the skill to do task X [...].
- For a practice lesson – Practice the skill of doing task X [...].
- For a validate lesson – Demonstrate mastery of the skill of doing task X [...].

Enabling learning objectives (ELO) – Linked to specific measurable events; also termed performance measures.
Training Course

- Organized into lessons:
  - FAPV progression.
  - Lessons address specific ELO/TLO.
  - Some type of assessment (quiz, practical demonstration) determines student GO/NOGO:
  - Lessons can be skipped if student already knows material as determined by some type of initial assessment.
  - Partial ordering in lesson sequence, but students not forced to comply with ordering.
    - Recommended sequencing is based on analyses of student performance.
Analyses of Student Performance

- Ongoing and after-the-fact.

- Categorical – Actions might be correct, incorrect, don’t care.
  - Incorrect actions placed into pre-defined categories.
  - What happened – Performance measures.
  - Why it happened – Performance measure criteria.
  - How it happened – Student actions.

- Based on student actions and simulation state, decide whether and how to intervene.
  - Intervention based on error category and frequency of errors.
  - Direct support – dialog boxes, cueing, tutoring
  - Internal support – change in lesson sequencing, reduction of task complexity.

- Evaluate overall progress through training course as well as through individual lessons.
A continuum of “intrusiveness”.

Role changes based on analyses of student performance.


Coaching – Actively prompt, cue, and assist as the students perform, suggesting actions to guide students while remediating after actions.

Training – Provide content-relevant help, with students largely in control, while frequently assessing knowledge to keep learning on track.

Mentoring – Monitor actions and only offer context-sensitive help or remediation or critique when necessary or requested.

Observation – Observe and record and conduct after-action review involving playback and reflection.
Tutoring Approach

- Demonstration
- Coaching
- Training
- Mentoring
- Observation
Our First Virtual Tutor

- Integrated into maintenance training simulation.
- Idea was to enable hands-free practice.
- Soldiers loved it.
Law enforcement:
- Encounters with persons with mental illness.
- Deception detection.
- Assess behavior of at-risk populations.

Medical:
- Taking patient history.
- Interacting with children.
- Trauma patient assessment.

Military:
- Maintenance assistance.
- Chemical agent attack triage.
- Self aid / buddy aid.

Civilian:
- Conducting surveys.
- Customer service.
- Informed consent.
Architecture: Simulation

User Interface

Visualization Engine
- Lip Synching
- 3D Virtual Models
- Synthesized or Recorded Speech
- Expression and Gesture Mapping

Behavior Engine
- Augmented Transition Network
- Emotion/Physiology Modeling
- Expression and Gesture Generator

Language Processor
- Speech Recognizer
- Error-correcting (reversible) Parser
- Context-sensitive Semantic Grammars w/ Emotional & Social Tagging

Knowledge Base

Speech
Words & gestures
Tagged semantic interpretation or response
State change

Lip Synching 3D Virtual Models
Expression and Gesture Mapping

Actions
State change

Behavior feedback

Emotional state

Synthesized or Recorded Speech

Visual World Simulation
Architecture: Tutoring

Course-specific remediation

Remediation

Course Data
Lesson Startup
AAR Data

Lesson Management
Lesson Execution
After action review

Generic remediation data
RTI is active in the development of international standards for computer-based learning, education, and training

- ISO/IEC JTC1 Subcommittee 36 (SC36), Information Technology for Learning, Education, and Training
- IEEE Learning Technology Standards Committee (LTSC)
  - Co-Chair of joint IEEE LTSC and SISO SAC study group on standards for interfacing simulations and distributed training
  - Serving on IEEE LTSC WG20’s Project on Reusable Competency Definitions
- Serving as liaison between ISO/IEC JTC1 SC36 WG3 and IEEE LTSC WG20 on Competency Standards development
Example Analysis: Using Taxonomies to Define Tasks

**Perform** with **Vehicle** under **Conditions** to **Standard**

- **Skill**
  - Driving
  - PMCS
  - Operating
  - Leading
  - Other

- **Vehicle**
  - Tracked
    - Tank
    - APC
    - SP Artillery
    - Engineer
  - Wheeled
    - 2 Axle
      - HMMWV
      - GSA
      - FMTV
    - Multi Axle
  - Engineer
  - MHE

- **Vehicle Configuration**
  - With Trailer
  - Loading
    - Static
    - Dynamic

- **Environment**
  - Weather
    - Raining
    - Snowing
    - Good
    - Windy
    - Icy
    - Fog
  - Time Of Day
    - Day
    - Night
    - Night/NVG
  - Terrain
    - Desert
    - Mountains
    - Jungle
    - Urban
    - Hostile
    - Friendly

*Small list of generic skills that are made specific by specifying parameters out of existing taxonomies*
AAR Functions

- Interact with the learner to agree about:
  - What the learner did right
  - What the learner did wrong
- Define a recommended next lesson set
- Explain the recommendations based on learner experience
- Store the recommended next lesson set for use by the Lesson Manager
A Few Lessons Learned: Tutoring

Identifying student performance measures requires assessment of protocols and standards and subject-matter expert input.

Having realistic-enough simulations and tutoring requires rigorous expert or instructor input and review.

Performance must be measured against defined criteria, and tutoring should focus students on need-to-know competencies, providing links to prescriptive training.

- Simpler assessment for familiarization.
- More complex assessment for other phases.

Interaction skills often fail to have best-practice criteria, so designer and expert decisions drive assessment.

SCORM concepts of ELO/TLO extensible to conceptual performance measures

- Take into account reasoning behind student actions, and theory behind the reasoning, to drive remediation.

Results from knowledge and performance assessment link to remedial training.
A Few Lessons Learned: Virtual Tutors

- Students are engaged with virtual human tutors and understand how tutors can take on the different roles:
  - Embodying tutors increases their salience.
- Virtual human tutors are quite appropriate to lead to competency and mastery of skills:
  - Realism of interacting with an emotive, responsive virtual human engages students.
  - Querying virtual tutors allows strategic and reflective thinking.
  - Interaction skills training increasingly employs virtual humans as interactive partners.

- Appearance:
  - Gender, age, ethnicity.

- Personality:
  - Humor, politeness, volatility.

- Emotion, physiology, behavior models.

- Role:
  - Level of support, interaction playback.

- Application flow:
  - Timeout, scenario difficulty, dialog continuity.