Lessons Learned in Embodying Tutoring for Interactive Skills
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Big Picture

§ 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.

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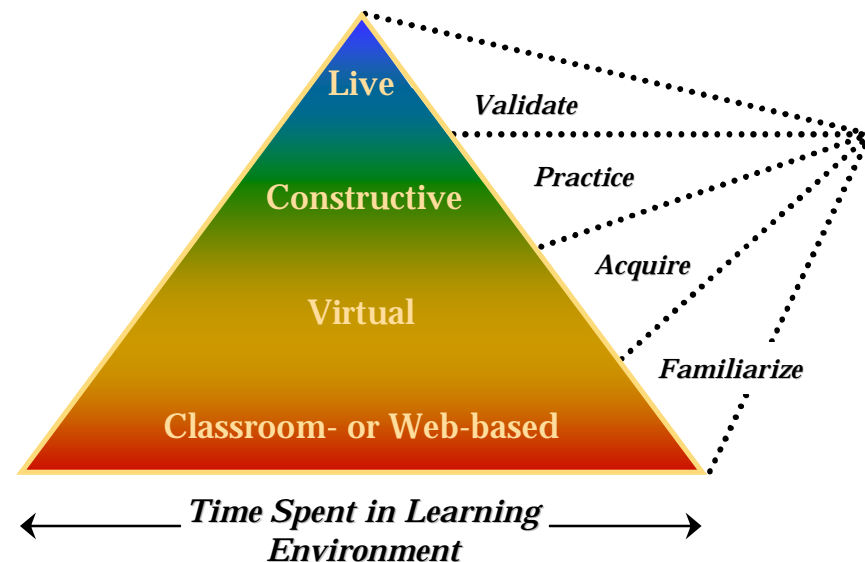
Tutoring Approach

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

Assess with typical testing.

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

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

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

React to differences between student actions and performance criteria.

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

Provide guidance or feedback but refrain from interjecting unless an obvious error.

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Performance Criteria

§ *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.**

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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.

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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.

Tutoring Roles

§ A continuum of "intrusiveness".

  § Role changes based on analyses of student performance.

§ *Demonstration* – Demonstrate best practices and step-by-step techniques.

§ *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.

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Tutoring Approach

Demonstration

Coaching

Training

Mentoring

Observation

Live
Validate

Constructive
Practice

Virtual
Acquire

Classroom- or Web-based
Familiarize

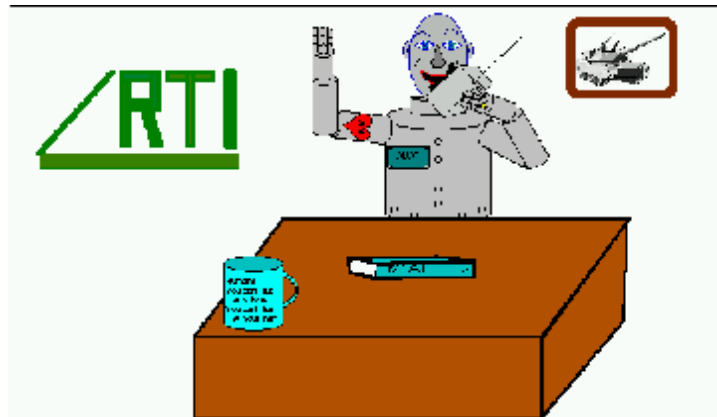*Time Spent in Learning Environment*
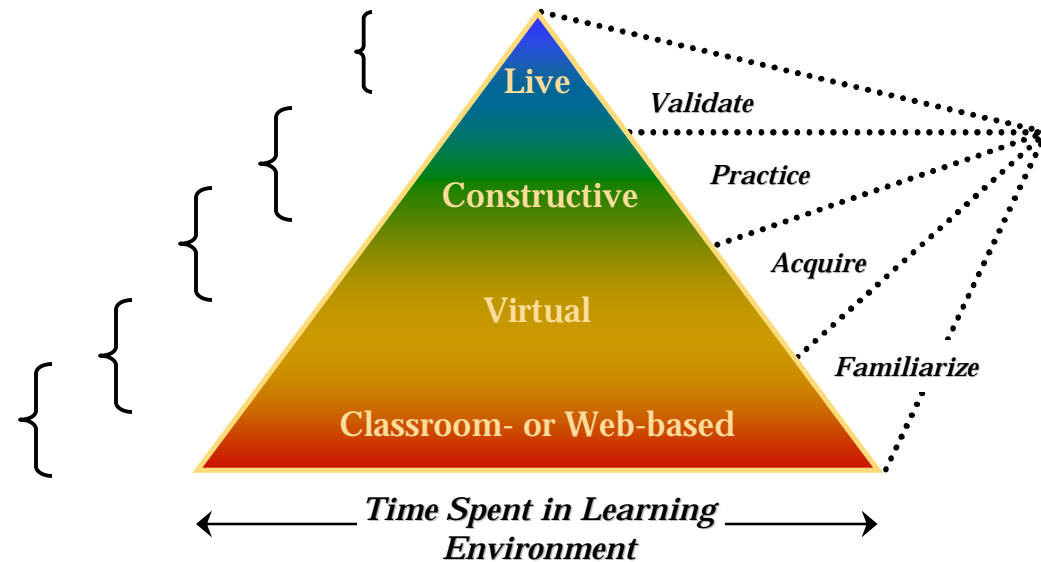
Our First Virtual Tutor

§ **Integrated into maintenance training simulation.**

§ **Idea was to enable hands-free practice.**

§ **Soldiers loved it.**

Where We've Since Gone: Interaction Skills Training

§ 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.
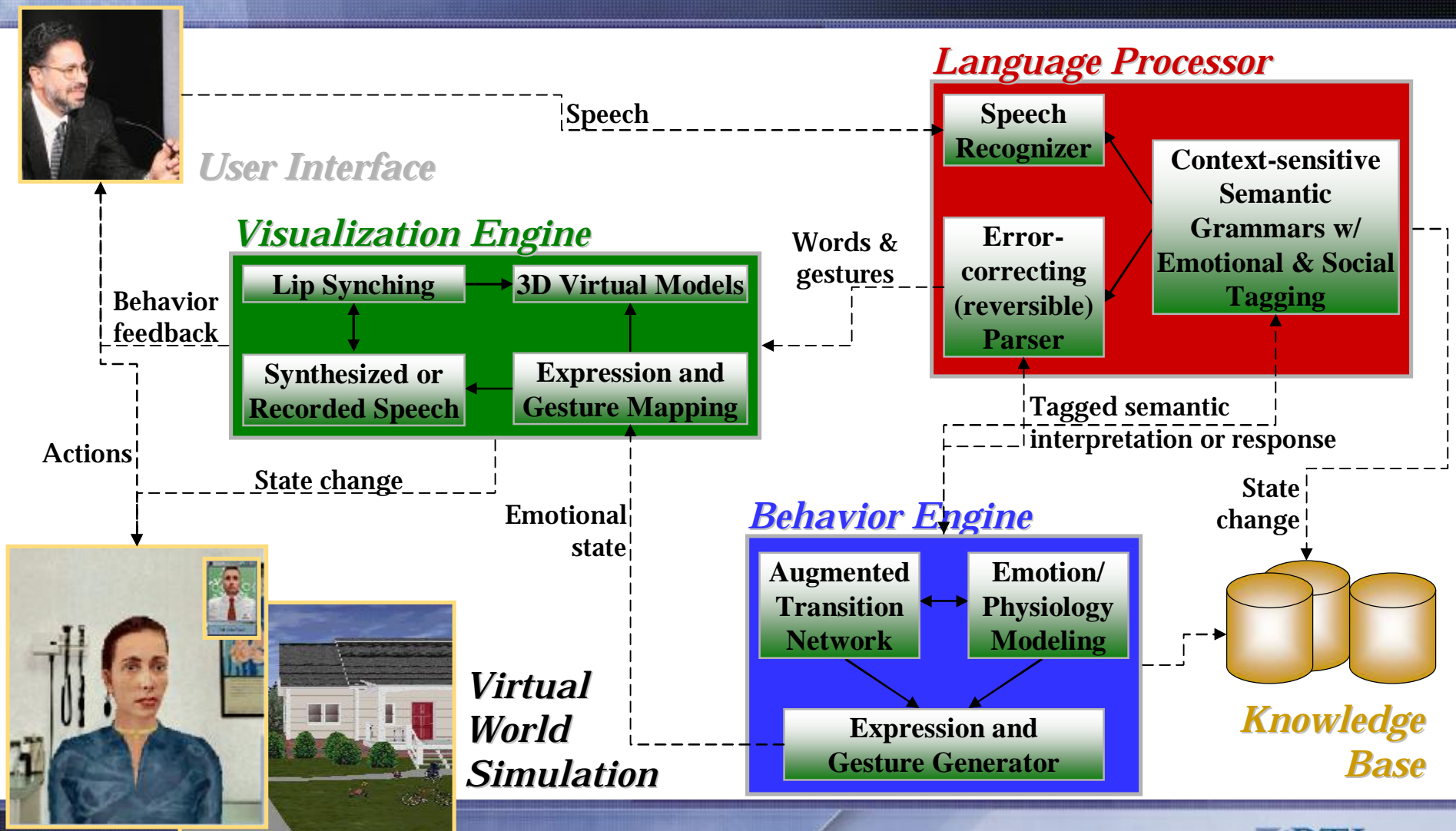
§ Military:

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

§ Civilian:

- § Conducting surveys.
- § Customer service.
- § Informed consent.

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Architecture: Simulation

User Interface

Language Processor

Visualization Engine

Speech

Speech Recognizer

Lip Synching → 3D Virtual Models

Context-sensitive Semantic Grammars w/ Emotional & Social Tagging

Words & gestures

Error-correcting (reversible) Parser

Behavior feedback

Synthesized or Recorded Speech ← Expression and Gesture Mapping

Actions

State change

Emotional state

Tagged semantic interpretation or response

State change

Behavior Engine

Augmented Transition Network ↔ Emotion/ Physiology Modeling

Expression and Gesture Generator

Knowledge Base

Virtual World Simulation

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Architecture: Tutoring

Standards Development Participation

- § 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
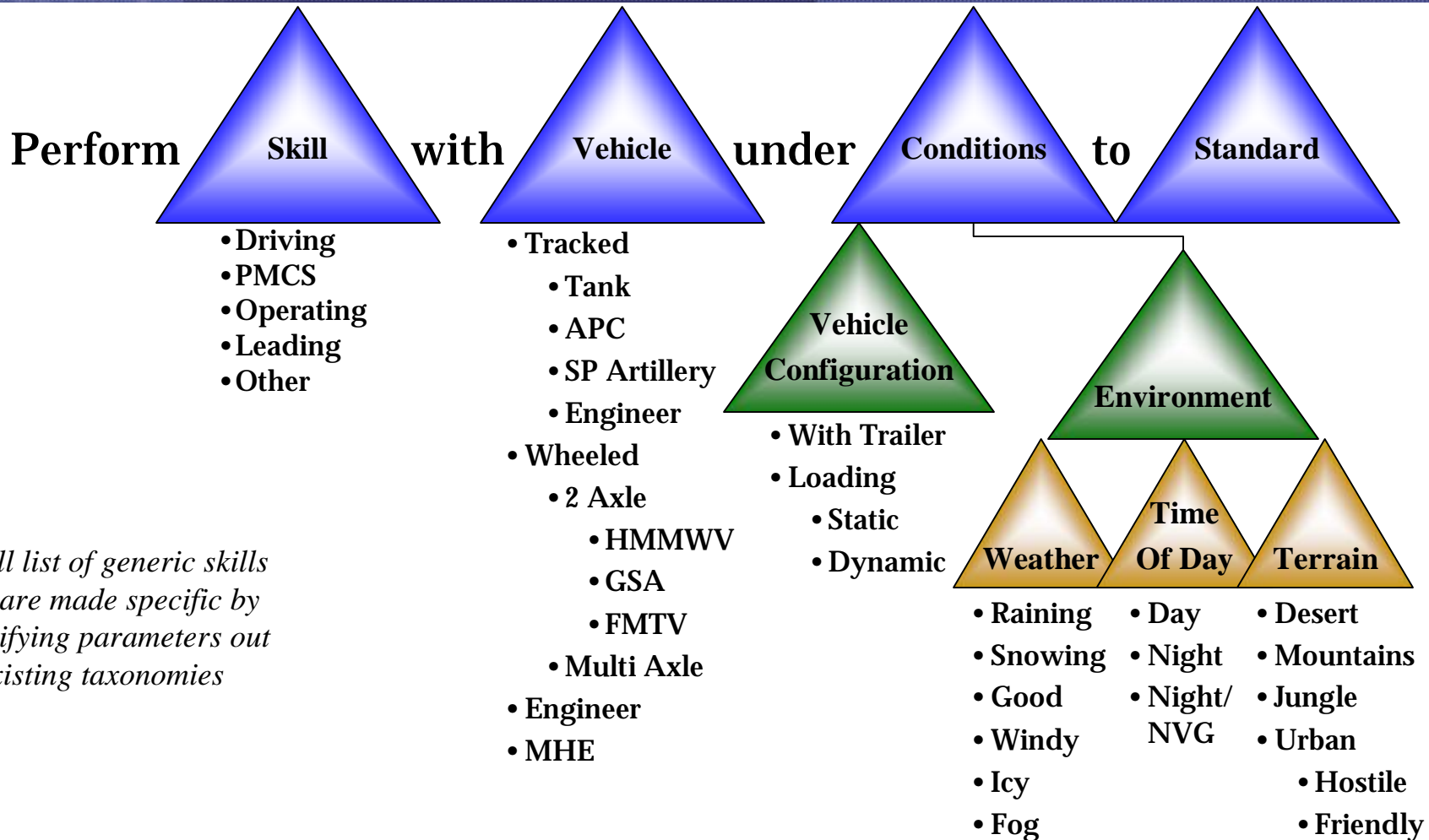 - § IEEE Learning Technology Standards Committee (LTSC)
    - § Co-Chair of joint IEEE LTSC and SISO SAC study group on standards for interfacing simulations and distributed training
    - § Serving on IEEE LTSC WG20's Project on Reusable Competency Definitions
  - § Serving as liaison between ISO/IEC JTC1 SC36 WG3 and IEEE LTSC WG20 on Competency Standards development

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Example Analysis:
Using Taxonomies to Define Tasks

Perform [Skill] **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

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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.

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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.

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