Talking Heads: Learning Environments with Animated Conversational Agents

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Psychology, Computer Science, & the Institute for Intelligent Systems
Exploring a Sea of Animated Conversational Agents

AutoTutor  Adele  STEVE  Carmen  SI Agent  Laura

BEAT  PKD Android  Leonardo  iMAP  Casey

iSTART  TLTS  Spark  MRE
Tactical Language Training System (Johnson)
Memphis Systems

AutoTutor

HURA Advisor

iSTART

How is the packet switching model of message transmission like the postal system?
Other systems with agents developed at University of Memphis

<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARIES</td>
<td><strong>Critical thinking</strong> about science experiments</td>
<td>Millis, Halpern, Graesser</td>
</tr>
<tr>
<td>SEEK Web Tutor</td>
<td><strong>Critical stance</strong> while exploring web on plate tectonics</td>
<td>Wiley, Goldman Graesser</td>
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<tr>
<td>MetaTutor</td>
<td><strong>Self-regulated learning</strong> of circulatory system on the web</td>
<td>Azevedo, Graesser, McNamara</td>
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<tr>
<td>iDRIVE</td>
<td><strong>Question asking and answering</strong> in physics, biology, and computers</td>
<td>Gholson, Graesser</td>
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What is AutoTutor?

• Learn by conversation in natural language


The sun exerts a gravitational force on the earth as the earth moves in its orbit around the sun. Does the earth pull equally on the sun? Explain why.

- Talking head
  - Gestures
  - Synthesized speech

- Presentation of the question/problem

- Dialog history with
  - tutor turns
  - student turns

- Student input (answers, comments, questions)
When a car without headrests on the seats is struck from behind, the passengers often suffer neck injuries. Why do passengers get neck injuries in this situation?
How is the packet switching model of message transmission like the postal system?

Packets are sent to intermediate destinations before being routed to their final destination.
Dual agents on critical thinking
(Memphis, Northern Illinois, Claremont)

- **Experiment** with flaws is read.
- **Critique** the study on scientific method.
- **Trialogue:**
  1) Participant
  2) Tutor agent
  3) Ignorant agent

![Image of agents]
What about learning gains?
<table>
<thead>
<tr>
<th>Effect Size</th>
<th>Tutor Type</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>.42</td>
<td>Unskilled human tutors</td>
<td>(Cohen, Kulik, &amp; Kulik, 1982)</td>
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<tr>
<td>.80</td>
<td>AutoTutor</td>
<td>(14 experiments) (Graesser and colleagues)</td>
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<tr>
<td>1.00</td>
<td>Intelligent tutoring systems</td>
<td>PACT (Anderson, Corbett, Aleven, Koedinger) Andes, Atlas (VanLehn) Diagnoser (Hunt, Minstrell) Sherlock (Lesgold)</td>
</tr>
<tr>
<td>(?)</td>
<td>Skilled human tutors</td>
<td>(Bloom, 1987)</td>
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</table>
Conceptual Physics
(Graesser, Jackson, et al., 2003)

Three conditions:
• AutoTutor
• Read textbook
• Read nothing
Multiple Choice Test on Physics

- AutoTutor
- Read Textbook
- Read nothing

- Pretest
- Posttest
- Adjusted posttest

Multiple Choice Test Score

- Bar chart showing test scores for different conditions.
Conceptual Physics
(VanLehn, Graesser, et al., 2007)

Three conditions:
1. Human tutors
2. Why/Atlas
3. Why/AutoTutor
Multiple Choice Test on Physics

Bar chart showing proportions of correct answers for three groups: Human Tutor, Why Atlas, and Why AutoTutor. The chart compares pretest, posttest, and adjusted posttest results.
What about learner emotions?


Emotions while learning with AutoTutor

**BOREDOM**
Being weary or restless through lack of interest

**CONFUSION**
A noticeable lack of understanding

**DELIGHT**
A high degree of satisfaction

**FLOW**
A state of interest that results from involvement in an activity

**FRUSTRATION**
Dissatisfaction or annoyance

**SURPRISE**
Wonder or amazement, especially from the unexpected
Bayesian Diagnosticity

Facial Expressions = 2.935

Posture Features = 1.260

Dialogue Features = 1.572

Diagnosticy
How might AutoTutor be Responsive to the Learner’s Affect States

1) If learner is **frustrated**, then AutoTutor gives a hint.

2) If **bored**, then some engaging razzle dazzle

3) If **flow/absorbed**, then lay low

4) If **confused**, then intelligently manage optimal confusion
Look like PKD: Robotic Muscles

Serial cable → Controller Card → Servos