The Effectiveness of Tutorial Dialog in an Automated Conversational Tutor

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Overview

• Human-to-human tutoring
• Introduction to AutoTutor
• Test of AutoTutor’s effectiveness
• Conclusions
• For the future
Human-to-Human Tutoring

• Pedagogically effective despite the fact that they are typically untrained (Graesser Wiemer-Hastings, Wiemer-Hastings, Kreuz, & TRG, 1999)
  – Questions/problems that promote deep reasoning
  – Collaborative, interactive discourse results in collaborative building of explanations
AutoTutor 1.0

• Simulates human tutor conversational strategies
• Synthesized speech with intonation
• Talking head with facial expressions
• Computer literacy
  - Hardware
  - Operating systems
  - The Internet
How does the operating system interact with the word processing program when you create a document?

The operating system loads the document for the application.
Modules

- **Word, punctuation segmenter**
- **Part of speech classifier** (Olde, Hoeffner, Chipman, Graesser, & TRG, 1999)
- **Speech act classifier**
- **Latent Semantic Analysis** (LSA; Landauer, Foltz, & Laham, 1998)
  - Measures quality of student contributions (e.g., match to good answers, bad answers)
- **Curriculum script**
  - Questions/problems, figures/diagrams, good answers, bad answers, dialog moves
Dialog Moves

• Pump (requests more information)
• Prompt (elicits specific word or phrase)
• Splice (inserts correct answer)
• Hint (presents fact or leading question)
• Elaboration (contributes important, overlooked information)
• Feedback (positive, negative, or neutral)
• Summary
Dialog Move Generator

• Type of dialog move chosen is determined by fuzzy production rules
  – Quality of student contribution (LSA)
  – Global parameters (e.g., ability, verbosity)
  – Topic coverage (each aspect of the answer)

• Examples:
  – IF good answer is high & completeness is low THEN Pump
  – IF subtopic ability is high & good answer is low THEN Hint
Evaluation of AutoTutor

- 48 undergraduates enrolled in computer literacy interacted with AT
- 3 within-subjects conditions
  - Re-read chapter(s) for one topic (e.g., computer hardware)
  - Interact with AT for a second topic (e.g., operating systems)
  - Re-read and AT for third topic (e.g., the Internet)
- 16 additional control subjects (test first)
- Survey of computer literacy
The Test

• 18 shallow multiple choice
  – The physical parts of the computer system are called:

• 12 deep multiple choice
  – How can you best find information on the World Wide Web?

• 18 Cloze passages (72 total)
Example Cloze Passage

The CPU, or __________, performs three main functions for the computer. The CPU runs the computer __________ by executing each program's instructions. The CPU performs the computer's mathematics. The CPU __________ with the different components of the computer, including input peripheral devices such as the keyboard and mouse, output peripheral devices such as the monitor and printer, and the computer's __________ devices such as RAM, ROM, and the hard disk.
Example Dialog

Tutor: Why is it important to consider the characteristics of the CPU [when planning to buy a computer]?
Student: speed
Tutor: And can you add to that?
Student: applications
Tutor: Okay. Well, if a program is designed for one kind of CPU, it may not run on another kind of CPU because the program and CPU are not [pause]
Student: accessible to one another
Tutor: Right, are not compatible. Okay, ...
Correlation Analyses

- Time spent on AutoTutor and LSA measure of curriculum script knowledge: \( r(64) = .31 \) (\( p < .05 \))
- Computer literacy score and test score: \( r(58) = .32 \) (\( p < .05 \))
- Test score and grade in class: \( r(64) = .33 \) (\( p < .01 \))
Experimental vs. Control: Performance on Test

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<th>Condition</th>
<th>Mean</th>
<th>SD</th>
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<tr>
<td>Experimental*</td>
<td>46.5%</td>
<td>14</td>
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<tr>
<td>Control</td>
<td>39.9%</td>
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*Subset of test questions which tested knowledge of subtopics on which participants were tutored
Mean Test Score by Condition and Question Type

- Text Only
- Tutor Only
- Tutor & Text

- Shallow
- Deep
- Cloze

Percent Correct

Text Only | Tutor Only | Tutor & Text
---|---|---
Shallow | Deep | Cloze
# Effect Size Estimates

Cohen’s $d$ (Compared to control group)

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<th>$d$</th>
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Conclusions

• AutoTutor proved to be pedagogically effective
  – Effect sizes of .46 to .5
• Results not just due to practice effects
  – Tutoring helped more than re-reading
• Collaborative, conversational nature of AutoTutor the key
For the Future

• Re-read condition better controlled
  – Time spent reading
  – Read in the session

• Similar test of newer versions of AutoTutor (1.1. and 2.0)