Designing effective pedagogical agents

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What is a pedagogical agent?

Requirements

- Persona (character)
- Image, with animation
- Voice
- Assists in a computer-based learning task

*May or may not have intelligence or adaptivity*
What is the potential value of pedagogical agents?

- Empirical evidence suggests anthropomorphic agents are valuable for learning (e.g., Atkinson, 2002; Baylor, 2002, 2003; Moreno, Mayer, Spires, & Lester, 2001)

- Why?
  - Social relationship with learner (Baylor, 2001)
  - Personalize learning task (Moreno et. al., 2001)
Goals

- Present evidence regarding appropriate features for designing effective pedagogical agents (Part 1)
- Present methods for evaluating effectiveness of pedagogical agents (Part 2)
Part 1: Designing pedagogical agents

Steps:
1. Determine desirable instructional outcome(s)
2. Select agent pedagogy
3. Define agent role
4. Create a viable persona
5. Develop feedback mechanisms
6. Set media components
FIRST: What is the desired *instructional outcome*?

This is the *key* consideration for pedagogical agent (or any other type of) design!
Instructional outcomes..

- Define **globally**:  
  - e.g., recall, transfer, application, motivation

- Define **specifically**, in learner-centered terms:  
  - For students to be able to solve quadratic equations  
  - ..to be able to list dangers of smoking  
  - ..to compare different philosophical views on human nature
Select pedagogy

- **Constructivist**
  - Agent as a scaffold or guide
  - Best for complex or ill-defined tasks

- **Instructivist**
  - Agent directly teaching information
  - Best for well-structured domains

- *How much “intelligence” is desirable?* (Solomon & Perkins, 1991)
Define agent role (see Baylor & Kim, 2003)

- Agent as motivator
  - Provides support

- Agent as expert
  - Provides information

- Agent as mentor (see Baylor, 2000 for overview)
  - Provides expertise and motivational support

- Agent as learning companion or collaborator (e.g., Hietala, 1998; Kim, 2003)

- Determine need for multiple roles (and perhaps multiple agents...)}
Create viable agent persona, (based on role)

- Personality
- Level of emotional expression
- Degree of human-likeness
- Credibility
Develop agent feedback mechanisms

- Determine desirable amount of agent-learner interaction
  - *System-initiated or learner-initiated

- Set feedback triggers
  - Behavior-initiated interventions vs. timed interventions

- Write scripts (if appropriate)
Set media components

- **Voice**
  - Importance of voice as primary medium to convey agent persona
  - Human voice versus computer-generated

- **Image**
  - Gender and ethnicity
  - Realistic versus cartoon

- **Animation** (see Johnson, Rickel, & Lester, 2000)
  - Deictic gestures versus affective animations
  - Minimize extraneous animations
Strategies for multiple agents

- Using agents to represent multiple perspectives on a topic (e.g., Baylor, 2002)
  - To promote cognitive conflict and cognitive flexibility

- Allow for selection of agent-instructors (e.g., SCI-WISE)
Other design considerations…

- Consider cognitive load issues
  - multiple agents
  - animation

- Assess issues of learner versus system control
  (see Baylor, 2001)
Development tools

- Microsoft Agent
- Poser (by Curious Labs)
- PeoplePutty (by Haptek)
Part Two: Evaluating pedagogical agents

Steps:
1. Revisit instructional goal of agent
2. Consider other outcomes to evaluate
3. Select appropriate research method(s)
4. Review existing instrumentation
5. Design items or instrument as necessary
Revisit instructional goal of agent

- Refine as necessary
- Be as specific as possible regarding learning performance
  - e.g., recall, application, transfer
Consider other outcomes to evaluate

- Attitudes
  - e.g. disposition, self-efficacy, motivation
- Agent’s efficacy at promoting reflection and metacognition
- Learner’s perception of value of agent
- Learner engagement with agent (and/or task)
- Nature of agent-learner interactions
Select appropriate research method(s)

- Consider whether you want rich data or quantitative-oriented data, for each outcome
  - Which best gives you the answers you desire?

- Choose appropriate research method(s):
  - Experimental and pseudo-experimental
  - Case studies
  - Usability studies
  - Interaction analysis
Review existing agent instruments and/or relevant items

**Interest/motivation**
- Moreno, Mayer, Spires, & Lester (2001)

**Attitude (self-efficacy, disposition)**
- Baylor, 2002

**Agent persona and facilitating learning by agent:**
- ATAS (Attitude Toward Agent Scale) : vanEck & Adcock, 2003)
- API (Agent Persona Instrument) : Baylor & Ryu, 2003
Design items and/or instrument

- Likert scales
- System-collected data
  - Microgenetic data
- Open ended questions
- Interviews
- Video
Summary of process

Design
- Determine desirable instructional outcome(s)
- Select agent pedagogy
- Define agent role
- Create a viable persona
- Develop feedback mechanisms
- Set media components

(Development & Testing – not covered here)

Evaluation
- Revisit instructional goal of agent
- Consider other outcomes to evaluate
- Select appropriate research method(s)
- Review existing instrumentation
- Design items or instrument as necessary
Selected Reading list

Conceptual articles

Selected Reading List

**Empirical studies**


*Also see [http://pals.fsu.edu](http://pals.fsu.edu) for our current empirical proceedings papers*
Selected Reading List (3)

Edited Books