Knowledge, Desire & Three Outcomes

Observations

Want To Learn

Don’t Know How To Learn

Rote Learning

Transfer Learning

Know How To Learn

Three learning outcomes:
- No learning
- Rote learning
- Meaningful or constructivist learning

Mayer, 2001, pp. 16 -17; 1999, p. 147

Example

Rote learning versus transfer learning

What are the 3 features of object-oriented model?
- Encapsulation
- Inheritance
- Polymorphism

Which function (defined in class foo or in class bar) is called by P->func( )?
- bar

What Is Knowledge?

Epistemology – the study of knowledge

Information is not knowledge
- information is a self-contained entity that may be picked up, passed around, stored, etc.
- Knowledge is less easily detached from a person, the knower.
- Knowledge “is hard to pick up and hard to transfer. . . . Knowledge is something we digest rather than merely hold”
  - Brown & Duguid, 2000, p. 120 (emphasis added)

"Understanding is gained by an active process of construction rather than by passive assimilation of information or rote memorization”
  - Greeno, Collins, & Resnick, 1996, p. 22

Knowledge As Mental Models

A view consistent with computer science and other technical disciplines

"Researchers have also investigated reasoning and understanding that depends on mental representations called mental models, that provide a kind of simulation of events rather than descriptions of events”
  - Greeno, Collins, & Resnick, 1996, p. 19

A model “represents a complete and self-consistent simplification of reality”
  - Booch, Rumbaugh, & Jacobson, 1999, p. 93

Mental Models

Continued

Mental models contain
- Cause-effect sequences
- Time-space relations
  - Gibbons, 1998; Mayer, 1999
- They organize information into knowledge

Complete and consistent mental models
- Help people to understand how a system operates
- Facilitates their ability to solve problems related to that system

Incomplete or incorrectly formed mental models can interfere with understanding and impede problem solving
  - Kuhn, Black, Keselman, & Kaplan, 2000, p. 497
The Roles of Learner and Instructor

Both have responsibilities

- "Learning implies the existence of at least one intention, will or agency – the learner's.
- Instruction implies the interaction of at least two – the learner's and at least one other.
- But learning is still principally within the control of the individual [i.e., the learner].
- Instruction, therefore, does not cause learning but supports those learning intentions to which the learner commits."

The Instructor’s Role

Organize subject matter to facilitate building mental models

- "A major concern of instructional design is the representation and organization of subject matter content to facilitate learning.
- The thesis of this paper is that the careful analysis of subject matter content (knowledge)
  • can facilitate both the external representation of knowledge for purposes of instruction (knowledge objects) and
  • the internal representation and use of knowledge by learners (mental-models)."
  – Merrill, 2000, p. 1

Learner’s Role

Learners build mental models

- "Learning can be viewed as a process of model building”
  – Mayer, 1999, p. 144
- "Understanding is gained by an active process of construction rather than by passive assimilation of information or rote memorization”
- Three major prerequisites for problem-solving transfer
  • Skill: skills necessary to select and organize relevant information
  • Metaskill: self-monitoring skills that learners employ to understand and regulate their own learning processes
  • Will: the motivational and attitudinal aspects of learning
    – Mayer, 1999, p. 148

Learning Skill

Constructing knowledge

- Richard E. Mayer’s (1999) SOI model for learning
  • Select relevant information
    – Highlight
    – Take notes
  • Organize the information
    – Cause and effect
    – Compare/contrast
    – Lists, outlines (hierarchies), classifications (kinds of or parts of), steps, etc.
  • Integrate with previous knowledge
    – How is the new information similar to previous knowledge
    – How is it different from previous knowledge

Learning Metaskill

Metaskill: the skill of managing skills

- Effective learners exhibit a reflective, self-monitoring capacity
  • “The most successful learners elaborate what they read and construct explanations for themselves”
  • From examples, they construct explanations of solutions in terms of problem goals and principles rather than simply attending to the sequence of steps in the solutions
    – Greeno, Collins, & Resnick, 1996, p. 10
- Knowing: performance goals vs learning goals
  • Performance: ability to solve problems correctly
  • Learning: conceptual understanding
  • Adoption of performance goals versus learning goals does not correlate with intelligence
    – Greeno, Collins, & Resnick, 1996, p. 20

Learning Will

What do you want?