Human Learning

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CS 260: SPRING 09
Today’s Class

- ~40 minutes of student presentation - today’s topic
- Discussion and further details
- Group discussions
- Group presentations
Last Class

- Pragmatism
- Learning theory
  - Piaget, Vygotsky, and Constructivism
  - Activity theory
Today’s Topic

- Coming up
  - 1/28/2009: Constructivism and Piaget
  - 2/2/2009: Designing for Unschooled Users
  - 2/9/2009: Vygotsky and Learning
How People Learn

- National Research Council published How People Learn in 1999
  - Updated edition in 2004
  - How Children Learn is chapter 4 of the report
• Why study human learning in HCI?
Why Children’s Learning

- Why study learning in children specifically?
Infants’ Capabilities

- **Infants as Tabula Rasa**
  - Jean Piaget in 1920s
- **Studies of how infants “integrate sight and sound and explore their perceptual worlds.”**
- **Children as active participants in learning**
  - Vygotsky – social construction of learning
Vygotsky and Piaget were leading educational theorists of 20th century

- Piaget – world explored is “natural”
- Vygotsky – world explored is social construct
Piaget’s stages

- Piaget observed stages in child development
  - Sensori-motor (acting, observing, remembering)
  - Semiotic or symbolic (naming things)
  - Concrete operations (relationships, transformations)
  - Propositional or formal thought
• Transfer

Area = h \times b
Building new knowledge from existing
- Real-world experience
- Existing understanding
- Generality of earlier knowledge
- Abstraction
- Motivation

People learn best by doing
Transfer and Zone of Proximal Development

Tasks performed alone

ZPD

Tasks doable with assistance

Tasks that cannot be done at all
Infant Learning

- What is the ZPD for infants?

- Methodology from NRC reading
  - Non-nutritive sucking and habituation
  - Visual fixation
Infant Learning

There are clear stages of learning

- 5-7 month-olds: need point of contact
- 10 month-olds: envision usage of tools
- 24 month-olds: choose the best unattached tool
Privileged Domains

- Physical Concepts
- Biological Causality
- Early Number Concepts
- Language
Privileged Domains

- Physical Concepts
• Biological Causality
Privileged Domains

- **Early Number Concepts**
  - 6-8 month olds with 2-item or 3-item photographic slides
  - Infants tracking 2 or 4 rabbit hops
  - 5 month olds surprised when addition does not yield more

- Note: this does not mean they understand number systems
Privileged Domains

- **Language**
  - 4 month olds prefer speech over other sounds
  - By 2 months, American infants react to English faster than French
  - 8-10 months recognize linguistically relevant contrasts
  - Understand language contextually
    - “Eat the apple” in the high-chair, “throw the apple” in playpen
Intelligence

- Gardner’s seven types
  - Linguistic
  - Logical
  - Musical
  - Spatial
  - Bodily
  - Kinesthetic
  - Interpersonal and intrapersonal
Intelligence

- Entity theory
- Incremental theory
  - Supported by formative evaluations
How Do People Improve

- Strategies
- Meta-cognition
Strategies

- Rehearsal
- Elaboration
- Summarization
- Clustering
• **Clustering**
  - Categorization where appropriate
  - Miller suggests that people generally can remember 7 +/- 2 items
  - This may be phonemes, symbols, numbers...
• BNBISRBCMCAC
Clustering

- IBM-CBSN-BCRCA
Strategies develop and evolve

1. Discoveries are made via success, not impasse or failure
2. Transition strategies are short-lived but useful
3. Generalization occurs slowly
Metacognition

• Self-regulation may appear early
• Self-reflection is later developing

• Metacognition is the learner’s conscious awareness of their learning process
  ○ Limitations, strengths, strategies, connections
  ○ Determines how learning is managed, and leads to better transfer
Metacognition example

- Strong learners reading a textbook will pause regularly, check understanding, and go back to difficult passages

- Weak learners may read through the entire text, then realize they don’t understand and start again
Metacognition

- Inquiry-based learning uses an explicit meta-cognitive strategy
Metacognition

- **Question:** a new problem for the learner

- **Hypothesis:** Learner proposes a solution or a way to understand the problem better

- **Investigate:** Learner figures a way to try out the hypothesis (often an experiment)
Metacognition

- **Analyze**: understand the results of the investigation.

- **Model**: Construct a model or principle for what’s going on.

- **Evaluate**: Evaluate the model, the hypothesis, everything that came before
Scaffolding

- Creating a “scaffold” to build the structure of learning on
  - Scaffold is gradually removed
  - Teacher -> teacher + learner -> learner

- Helps expand the ZPD gradually
Scaffolding for young children (from NRC reading)

- Interesting the child in the task
- Reducing the number of steps or otherwise simplifying task
- Motivating and maintaining the pursuit of the goal
- Marking critical features of discrepancies
- Controlling frustration and risk
- Demonstrating an idealized version
Scaffolding
Piaget and Vygotsky led to studies of child learning
Privileged domains
Transfer and ZPD
Metacognition
Strategies
Scaffolding
Discussion Questions

• All people learn - not many are Berkeley-graduate-student-level formal learners.
  ○ Why are we Berkeley grad students good learners? What subjects are easy to learn and why?
  ○ How should human learning influence the design of non-educational software?

• Pick a “concept” that many of you share (e.g. understanding code compilation or proving NP-completeness)
  ○ List some important steps that occur during microgenesis (understanding the concept)
  ○ Give the time frame for those steps