Wisdom is not the product of schooling but the lifelong attempt to acquire it.
- Albert Einstein

Learning: From Speculation to Science

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source: Learning: From Speculation to Science → Introduction to Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.) (2001) *How People Learn — Brain, Mind, Experience, and School,* National Academy Press, Washington, D.C., pp 3-27

Learning: Current Theories

- learning is a process of **knowledge construction**, not of knowledge recording or absorption
- learning is **knowledge-dependent**; people use their existing knowledge to construct new knowledge
- learning is highly **tuned to the situation** in which it takes place
- learning needs to account for **distributed cognition** requiring to combine knowledge in the head with knowledge in the world
- learning is affected as much by **motivational issues** as by cognitive issues
- **learning and teaching are not inherently linked** ("much learning takes place without teaching" — but: "much teaching takes place without learning")

Research Approaches to Understand Learning More Deeply

- cognitive psychology
- developmental researchers
- **transfer** (source: Detterman, D. K., & Sternberg, R. J. (1993) *Transfer on Trial: Intelligence, Cognition, and Instruction,* Ablex Publishing Corporation, Norwood, NJ.)
  - "American business have a major stake in fostering transfer of training, since they spend up to a $ 100 billion each year to train workers. Yet the estimate is that no more than 10% of training transfers to the job. So business wastes $90 billion each year because of lack of transfer."
  - "One reason why the notion of general transfer keeps rising from the grave is that it is such an attractive proposition for psychologists and educators alike. It is the one effect that, if discovered and engineered, could liberate students and teachers from the shackles of narrow, disciplinary education. Sustaining these longings is the fact that it is very difficult to prove that something does not exist. There is always another manipulation in the psychologist's tool box to try."

Understand Learning More Deeply — Continued

- **social and cognitive psychology** and **anthropology**

- **neuroscience** → Bruer, J. T. (1997) "Education and the Brain: A Bridge Too Far," *Educational Researcher, 2*6(8), pp. 4-16.
  - The neuroscience and education argument attempts to link learning, particularly early childhood learning, with what neuroscience has discovered about neural development and synaptic change.
  - Neuroscience has discovered a great deal about neurons and synapses, but not nearly enough to guide educational practice in any meaningful way.
  - Currently, it is just too much of a leap from what we know about changes in synapses to what goes on in a classroom.
  - Educators, like all well-informed citizens, should be aware of what basic science can contribute to our self-understanding and professional practice.
  - Educators should consider more carefully what neuroscientists are saying before leaping on the brain and education bandwagon.

Understand Learning More Deeply — Continued

- **school learning ←→ lifelong learning** → Scribner, S., & Sachs, P. (1990) "On The Job Training: A Case Study." In *National Center on Education and Employment*, pp. 1-4.
  - a decade of interdisciplinary research on everyday cognition demonstrates that school-based learning, and learning in practical settings, have significant discontinuities. We can no longer assume that what we discover about learning in schools is sufficient for a theory of human learning.

- **Lifelong learning → Integration**
  - intuitive **five-year-old learners**, featuring their conceptions and constraints
  - the **traditional student working** in an institution with its agenda and customary mode of operations
  - the **disciplinary expert** who can extend skills and understanding in new ways

Learning = f{Media}

- design and evaluation of learning environments
- emerging technologies

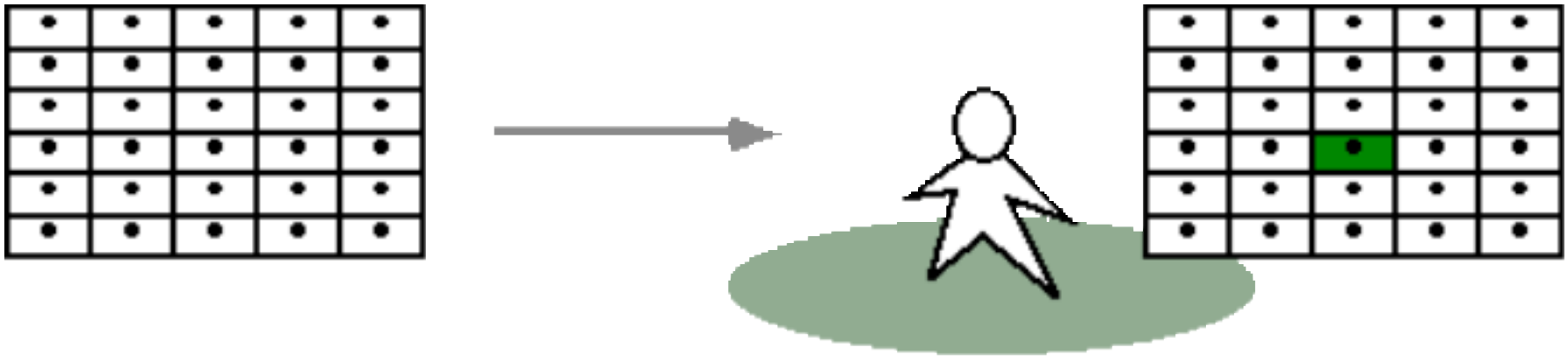
Information and Knowledge

- **Herbert Simon**: the meaning of “knowing” has shifted from being able to remember and repeat information to being able to find and use it

- Challenges
  - **coverage**: sheer magnitude of human knowledge renders its coverage by education an impossibility
  - **obsolescence**: a fast changing world makes knowledge obsolete

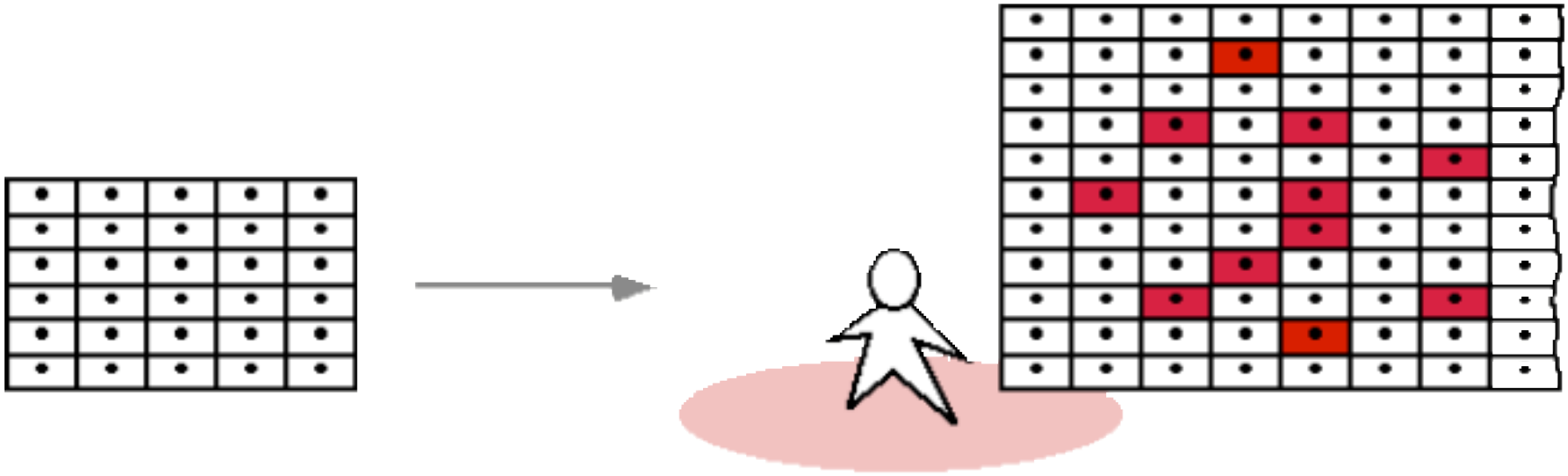
Old Model: Learn in School what is Needed in Life

school **life**



Problem with the Old Model in Today's World
—
Coverage and Obsolescence

school **life**



Focus of the Book "How People Learn"

- **human learning**
  - not: animal learning
  - not: machine learning

- **objectives:**
  - research with implication for: formal instructional environments (K-16)
  - research helping all individuals achieve their fullest potential

- **missing:**
  - lifelong learning
  - collaborative learning
  - distributed cognition perspective
  - learning and tools

The Big Historical Picture

- first there was: **philosophy** and **theology**

- **behaviorism**
  - Behaviorism is an approach to the study of behavior that assumes it must be possible, in principle, to secure a full, lawful explanation of behavior, including verbal behavior in humans, in terms of present and past behavioral, physiological, and environmental variables, in ways that do not require mention of the mental.

- **programmed instruction**
  - method of presenting new subject matter to students in a graded sequence of controlled steps
  - Students work through the programmed material by themselves at their own speed and after each step test their comprehension by answering an examination question or filling in a diagram. They are then immediately shown the correct answer or given additional information.
  - Computers and other types of teaching machines are often used to present the material, although books may also be used. **Computer-assisted instruction**, which both tests students' abilities and marks their progress, may supplement classroom activity or help students to develop ideas and skills independently.

The Big Historical Picture — Continued

- **cognitive science**
  - "the study of intelligence and intelligent systems, with particular reference to intelligent behavior as computation"
  - Cognitive science refers to the interdisciplinary study of the acquisition and use of knowledge. It includes as contributing disciplines: artificial intelligence, psychology, linguistics, philosophy, anthropology, neuroscience, and education.

- **cognitive science grew out of the following developments:**
  - the invention of computers and the attempts to design programs that could do the kinds of tasks that humans do;
  - the development of information processing psychology where the goal was to specify the internal processing involved in perception, language, memory, and thought;
  - the development of the theory of generative grammar and related offshoots in linguistics;
  - Cognitive science is a synthesis concerned with the kinds of knowledge that underlie human cognition, the details of human cognitive processing, and the computational modeling of those processes;

The Big Historical Picture — Continued

- **social and cultural context of learning**
  - the socio-cultural perspective has profound implications for teaching, schooling, and education;
  - A key feature of this emergent view of human development is that higher order functions develop out of social interaction;
  - Vygotsky argues that a child's development cannot be understood by a study of the individual. We must also examine the external social world in which that individual life has developed;
  - Vygotsky described learning as being embedded within social events and occurring as a child interacts with people, objects, and events in the environment" → Vygotsky, L. (1986). Thought and language. Cambridge, MA: The MIT Press

- **new experimental tools**
  - computers
  - looking inside the brain
  - video analysis

Key Findings

- Students come to the classroom with preconceptions about how the world works. If their initial understanding is not engaged, they may fail to grasp the new concepts and information that are taught, or they may learn them for purposes of a test but revert to their preconceptions outside the classroom.

- To develop competence in an area of inquiry, students must:
  - have a deep foundation of factual knowledge,
  - understand facts and ideas in the context of a conceptual framework,
  - organize knowledge in ways that facilitate retrieval and application.

- A "meta-cognitive" approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them.

Implications for Teaching

- Teachers must draw out and work with the **preexisting understandings** that their students bring with them.

- Teachers must teach **some subject matter in depth**, providing many examples in which the same concept is at work and providing a firm foundation of factual knowledge.

- The teaching of **meta-cognitive skills** should be integrated into the curriculum in a variety of subject areas.

The Meta-cognitive Process

- **meta-cognitive process**
  - enhances learning by guiding students' thinking
  - in this rapidly changing world, the challenge of teaching is to help students develop skills that will not become obsolete
  - meta-cognitive strategies are essential for the twenty-first century because they enable students to cope successfully with **new situations**

- **Learners who are well developed meta-cognitively:**
  - Are confident that they can learn.
  - Make accurate assessments of why they succeed in learning.
  - Think clearly about inaccuracies when failure occurs during tasks.
  - Actively seek to expand their repertoire of strategies for learning.
  - Match strategies to the learning task, making adjustments when necessary.
  - Ask for guidance from peers or the teacher.
  - Take time to think about their own thinking.
  - View themselves as continual learners and thinkers.

Designing Classroom Environments

- Schools and classrooms must be **learner centered**

- To provide a **knowledge-centered classroom** environment, attention must be given to:
  - what is taught (information, subject matter)
  - why it is taught (understanding)
  - what competence or mastery looks like

- **Formative assessments** — ongoing assessments designed to make students' thinking visible to both teachers and students — are essential. They permit the teacher to grasp the students' preconceptions, understand where the students are in the "developmental corridor" from informal to formal thinking, and design instruction accordingly. In the assessment-centered classroom environment, formative assessments help both teachers and students monitor progress.

- Learning is influenced in fundamental ways by the **context** in which it takes place. A community-centered approach requires the development of norms for the classroom and school, as well as connections to the outside world, that support core learning values.

Designing Technological Support

- who is the teacher or the learner — computer or student?
- **the computer as teacher**
  - Programmed instruction (founded on Behaviorism)
  - Computer-assisted instruction
  - Intelligent Tutoring Systems
  - Intelligent Agents
- **interactive learning environments**
  - simulation, visualization, critiquing, intelligent summarizing
- **computer-mediated communication and collaboration**
  - Swikis
- **the students as teacher** → Interactive **programming** environments
  - LOGO
  - Squeak

Learning: Current Theories → Specific System Developments

- learning is a process of **knowledge construction**, not of knowledge recording or absorption → ***reflection-in-action, argumentation***

- learning is **knowledge-dependent**; people use their existing knowledge to construct new knowledge → ***differential descriptions, user models, personalization***

- learning is highly **tuned to the situation** in which it takes place → ***human problem-domain communication, domain-oriented design environments***

- learning needs to account for **distributed cognition** requiring to combine knowledge in the head with knowledge in the world → ***learning on demand, using on demand, Envisionment and Discovery Collaboratory***

- learning is affected as much by **motivational issues** as by cognitive issues → ***gift cultures, an interest is a terrible thing to waste***

- **learning and teaching are not inherently linked** → **learning when the answer is not known, informed participation**

What Can Designers of Learning Environments Learn from Skiing

- **Source:**

Burton, R. R., Brown, J. S., & Fischer, G. (1984) "Analysis of Skiing as a Success Model of Instruction: Manipulating the Learning Environment to Enhance Skill Acquisition." In B. Rogoff, & J. Lave (Eds.), *Everyday Cognition: Its Development in Social Context,* Harvard University Press, Cambridge, MA - London, pp. 139-150.

http://l3d.cs.colorado.edu/~gerhard/papers/skiing-paper-1984.pdf

- **questions:**
  - role of ski-lifts
  - role of safety bindings
  - role of graduated length model
  - role of environment

Answers

- role of ski-lifts → **time on tasks**
- role of safety bindings → **create a safe environment in which people can make mistakes**
- role of graduated length model → **increasing complex microworlds**
- role of environment → **decouple skills** (e.g., gliding and stopping)

Decoupling Gliding and Stopping