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

LifeLong Learning

• more than “adult education” — tries to cover and unify all phases: intuitive learner (home), scholastic learner (school and university), skilled domain worker (workplace)

• integration of working and learning: learning is a new form of labor

• engagement in self-directed, authentic problems: constructionism

• learning on demand: coverage is impossible and obsolescence cannot be avoided

• collaboration: the individual human mind is limited
  → organizational and collaborative learning
Some Claims about Learning

- people learn best when engrossed in the topic, motivated to seek out new knowledge and skills because they need them in order to solve the problem at hand

- real learning — the way we learn is trying something, doing it and getting stuck. In order to learn, we really have to be stuck, and when we’re stuck we are ready for the critical piece of information. The same piece of information that made no impact at a lecture makes a dramatic impact when we’re ready for it.

- "A major illusion on which the school system rests is that most learning is the result of teaching" — Ivan Illich (in "Deschooling Society")

- learning and teaching are not inherently linked:
  - much learning takes place without teaching
  - much teaching takes place without learning
A Lifelong Learning Perspective for Education

- if the world of working and living relies on collaboration, creativity, definition and framing of problems, dealing with uncertainty, change, distributed cognition — then schools and universities need to prepare students for having meaningful and productive lives in such a world.

  - 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.
## School Learning and Lifelong Learning

<table>
<thead>
<tr>
<th></th>
<th>School Learning</th>
<th>Lifelong Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>emphasis</strong></td>
<td>“basic” skills</td>
<td>education embedded in ongoing work activities</td>
</tr>
<tr>
<td><strong>potential drawbacks</strong></td>
<td>decontextualized, not situated</td>
<td>important concepts are not encountered</td>
</tr>
<tr>
<td><strong>problems</strong></td>
<td>given</td>
<td>constructed</td>
</tr>
<tr>
<td><strong>new topics</strong></td>
<td>defined by curricula</td>
<td>arise incidentally from work situations</td>
</tr>
<tr>
<td><strong>structure</strong></td>
<td>pedagogic or “logical” structure</td>
<td>work activity</td>
</tr>
<tr>
<td><strong>roles</strong></td>
<td>expert-novice model</td>
<td>reciprocal learning</td>
</tr>
<tr>
<td><strong>teachers</strong></td>
<td>expound subject matter</td>
<td>engage in work practice</td>
</tr>
<tr>
<td><strong>mode</strong></td>
<td>instructionism (knowledge absorption)</td>
<td>constructionism (knowledge construction)</td>
</tr>
</tbody>
</table>
## Emphasis on Training versus Emphasis on Lifelong Learning

<table>
<thead>
<tr>
<th></th>
<th>Emphasis on training</th>
<th>Emphasis on lifelong learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>perceived role of new media</td>
<td>economical, productivity</td>
<td>quality</td>
</tr>
<tr>
<td>epistemologies of knowledge</td>
<td>explicate and transfer existing knowledge</td>
<td>understand existing knowledge and create new knowledge</td>
</tr>
<tr>
<td>new media</td>
<td>learn about computers</td>
<td>learn with computers</td>
</tr>
<tr>
<td>impact of new media</td>
<td>make delivery method more efficient</td>
<td>allow new things to be learnt</td>
</tr>
<tr>
<td>teaching</td>
<td>add-on to current teaching methods</td>
<td>change what we teach and how we teach</td>
</tr>
<tr>
<td>assessments</td>
<td>number of facts known</td>
<td>articulating knowledge, reflective practitioner</td>
</tr>
<tr>
<td>mindset</td>
<td>passive consumer</td>
<td>active designer, co-developer</td>
</tr>
<tr>
<td>setting</td>
<td>schools, separate, formal, forced</td>
<td>workplace, families, museums; integrated, informal, discretionary</td>
</tr>
<tr>
<td>new knowledge</td>
<td>assigned-to-learn, decontextualized,</td>
<td>need-to-know, on demand, contextualized</td>
</tr>
<tr>
<td>learning</td>
<td>rote learning</td>
<td>learning with understanding</td>
</tr>
</tbody>
</table>
Designing Technological Support for Lifelong Learning

- 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

- **the students as teacher** → Interactive **programming** environments
  - LOGO, Smalltalk
  - Squeak, Scratch

- **interactive learning environments**
  - simulation, visualization, critiquing, intelligent summarizing

- **computer-mediated communication and collaboration**
  - Wikis, 3D Warehouse
Movie: Learning about Gravity

- teach about gravity ↔ letting people experience it

- use contradictions as a source for curiosity and insight

- ask interesting questions and let the students come up with answers

- use of new media (specifically Squeak = open source version of Smalltalk; used for Swikis and the Envisionment and Discovery Collaboratory)

- reinvent the classroom culture with new media (beyond clickers)
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")
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**
Practical Implications: Learning on Demand

- **challenges**: coverage and obsolescence
  - **coverage**: sheer magnitude of human knowledge renders its coverage by education an impossibility
  - **obsolescence**: a fast changing world makes knowledge obsolete
  - see diagrams in lecture 9/22

- **observation**: learning is usually treated as a supply-side matter (following teaching, training, or information delivery)

- **claims**: learning is much more demand driven
  - people learn in response to need
  - when people cannot see the need for what’s being taught, they ignore it, reject it, or fail to assimilate it in any meaningful way
Beyond a Divided Lifetime: the Fallacy of the “Big Switch” Approach

- **the problem:** the gap between school-based learning, and learning in practical settings
  - lifelong learning is more than “adult education”; it covers and unifies all phases: intuitive learner (home), scholastic learner (school and university), and skilled domain worker (workplace)

- **misleading assumption:** humans at a certain age will be able to throw the “big switch” and become self-directed learners, engage in problem framing, communication, and collaboration….. — after they have not experienced and practiced this during their the first 30 or forty years of their lives

- **goal:** close the gap between school and workplace learning
  - allow learners to engage in activities requiring collaboration, creativity, problem framing, and use of powerful tools
  - integrate learning into working and playing instead of conceptualizing it as a separate activity
formal educational environment    big switch    (working) life

the alternative model: “evolutionary path” towards a creative, engaged, self-motivated member of society (should serve as a design requirement for learning and education
A Distributed Intelligence Perspective for Education

**claim:** distributed cognition provides an effective theoretical framework for understanding what humans can achieve and how artifacts, tools, and socio-technical environments can be designed and evaluated to empower humans beings and to change tasks

- **forms of distribution:**
  - between different human beings
  - between humans and media/technologies

- **advantage of media/technologies** (the “Nobel Prize Winner” fallacy)
  “a thing is available at the bidding of the user - or could be - whereas persons formally become a skill resource only when they consent to do so, and they can also restrict time, place, and methods as they choose.” (Illich, I. (1971) Deschooling Society, Harper and Row, p 125)

- **importance of:** hand-held calculators, spelling correctors, critiquing systems, essay grader, summary street, Tools for Living and Tools for Learning
New Media: Gift-Wrapping
Adding Technology to Existing Educational Practice

“There is nothing so useless as doing efficiently that which should not be done at all.” — Peter Drucker
Techno-Determinism

Leonardo Book, p 117: “no breakthrough in instructional technology will solve the education problem”
Learning and Media

Rethinking, Reinventing and Reengineering Educational Theory and Educational Practice

Current Education

Computer-supported & Computer-mediated Education of the Future
# Transcending Skinner and Taylor

<table>
<thead>
<tr>
<th>Skinner/Taylor</th>
<th>Beyond Skinner and Taylor</th>
</tr>
</thead>
<tbody>
<tr>
<td>there is a “scientific,” best way to learn and to work (programmed instruction, computer-assisted instruction, production lines, waterfall models)</td>
<td>→ real problems are ill-defined and wicked; design is argumentative, characterized by a symmetry of ignorance among stakeholders</td>
</tr>
<tr>
<td>separation of thinking, doing, and learning</td>
<td>→ integration of thinking, doing, and learning</td>
</tr>
<tr>
<td>task domains can be completely understood</td>
<td>→ understanding is partial; coverage is impossible</td>
</tr>
<tr>
<td>objective ways to decompose problems into standardizable actions</td>
<td>→ subjective, situated personal interests; need for iterative explorations</td>
</tr>
<tr>
<td>all relevant knowledge can be explicitly articulated</td>
<td>→ much knowledge is tacit and relies on tacit skills</td>
</tr>
<tr>
<td>teacher / manager as oracle</td>
<td>→ teacher / manager as facilitator or coach</td>
</tr>
<tr>
<td>operational environment: mass markets, simple products and processes, slow change, certainty</td>
<td>→ customer orientation, complex products and processes, rapid and substantial change, uncertainty and conflicts</td>
</tr>
</tbody>
</table>
Co-Evolution: Beyond “Technology-Driven Developments” and “Gift-Wrapping”

learning, working and collaboration

new learning organizations

new media and new technologies
Impact of Media on Education

- the real digital divide is not access or ownership, but fluency supporting independence of high-tech scribes → claim: the discourse needs to shift from a concern about who has access to new information technologies to who will have the knowledge that will position them to design, create, invent, and use the technologies to enhance their personal lives and social worlds

- new innovative models of interdisciplinary and transdisciplinary collaboration

- new models and a new understanding of division of labor
  - see shift to “computers and X”: (1) computers and biology → Bioinformatics, Life Sciences; (2) computers and media → media informatics, ATLAS
  - reintegration of work: researchers have become content providers, writers, typesetters, distributors, …
Outsourcing — Will CS Students find a Job in the USA?

- **an emerging question** for prospective computer science students: “if the heart and soul of computing (programming) is being auctioned off to the lowest offshore bidder, what is the future for me?”

- **question**: what will be the computing jobs, skills, and knowledge that are less likely to migrate offshore

- **my claim**: activities related to upstream activities: communication, collaboration, design, context, integration of problem framing and problem solving, deal with fuzzy and shifting requirements, satisfy customers → these are the difficult and important problems

- **claim**: “system development is difficult not because of the complexity of technical problems, but because of the social interaction when users and system developers learn to create, develop and express their ideas and visions” (Greenbaum & Kyng, 1991)
Conclusions

- explore the **scientific foundation for human learning in the 21\textsuperscript{st} century**

- transcend the limitations of the unaided individual human mind by emphasizing **distributed intelligence**

- define, design, and assess **new media / socio-technical environments** that empower learners and workers

- keep in mind:
  
  *"If you think education is expensive, try ignorance"*