

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



**Center for
*LifeLong
Learning
& Design***

University of Colorado at Boulder

**Lifelong Learning and Innovative Media:
Foundations for Graduate Education**

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L3D Presentation, June 30, 2004

NSF – Dear Colleague Letter

- On behalf of the Division of Graduate Education (DGE) and the Division of Research, Evaluation, and Communication (REC) of the Directorate for Education and Human Resources (EHR) we call your attention to an opportunity within the Research on Learning and Education (ROLE) program to request **support for research projects on graduate education**.

- We encourage proposals for research that can serve as a basis for strengthening
 - graduate education in science, technology, engineering, and mathematics (STEM) disciplines as well as
 - graduate education in STEM education

- Successful proposals will demonstrate expertise in
 - education research (**Sharon Derry, Uni of Wisconsin**) and/or social science research methods (**Lecia Barker, ATLAS, Bonnie Nardi, UC Irvine**) as well as
 - knowledge about STEM graduate education

NSF – Dear Colleague Letter

- While proposals on graduate education have always been welcome in ROLE, there have been few proposals submitted on this topic. The objective of this activity is to build a research community that can more effectively address current trends in STEM graduate education such as:
 - emerging STEM research fields, particularly cross-disciplinary ones (→ cognitive science, ATLAS/creative practices, ...)
 - changing expectations for STEM professionals; (→ outsourcing, digital fluency, becoming a member of a reflective community)
 - the need to broaden the sectors of the nation's population that aspire to and participate in STEM graduate education; (→ this should be a result of our URA program)
 - opportunities offered by emerging international cooperation (→ we have numerous of those: Malmö, Lübeck,)
 - opportunities offered by emerging technologies. (→ should be a major focus of the proposal)

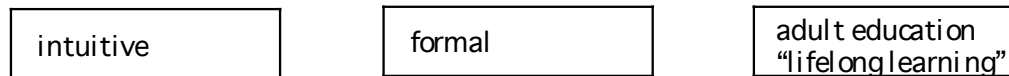
NSF – Dear Colleague Letter

- We anticipate proposals that will address these topics, as well as the examples below, but recognize the field may have additional excellent topics for research:
 - mechanisms to **redesign graduate education** in response to changes in traditional disciplines, efforts to enhance curricula and learning, and the development of new approaches within STEM research fields;
 - broad outcomes from the graduate experience including **interdisciplinary education**; partnerships with industry, K-12 schools, and informal education settings; and the communication of the societal benefits of STEM research;
 - **identification of successful graduate education models** in various STEM fields, **definitions of what constitute successful outcomes**, and the **factors** associated with these outcomes;
 - factors contributing to enhanced retention of students, completion of their degrees, and successful placement in STEM careers (**→ track records of our PhD students**), particularly for students from groups underrepresented in STEM fields. (**→ ATLAS Center for Women, Collaboration with Dillard**)

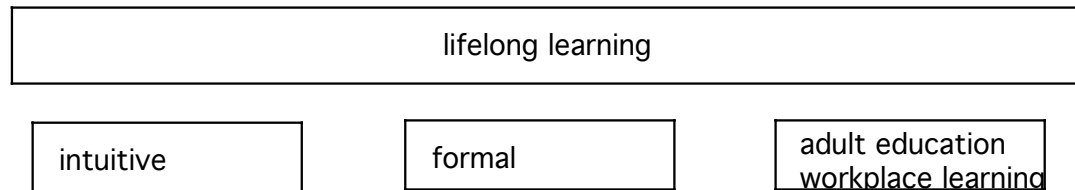
L3D's Approach to Lifelong Learning

- **objective:** rethinking and reinventing learning from a lifelong learning perspective

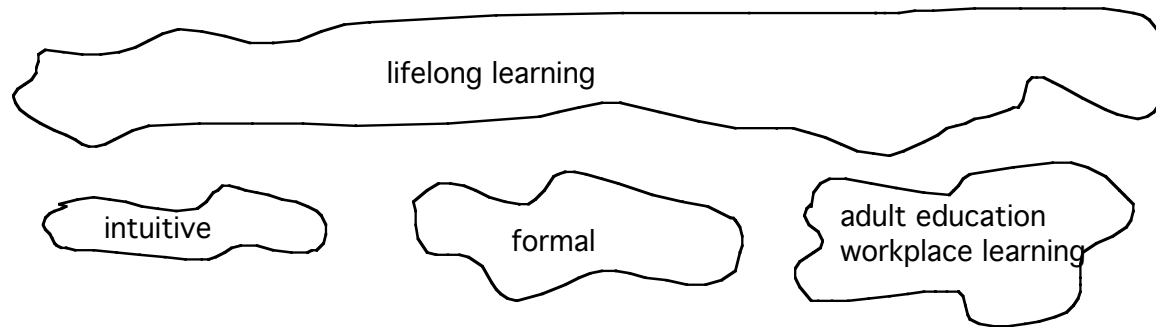
Standard View



L3D's View

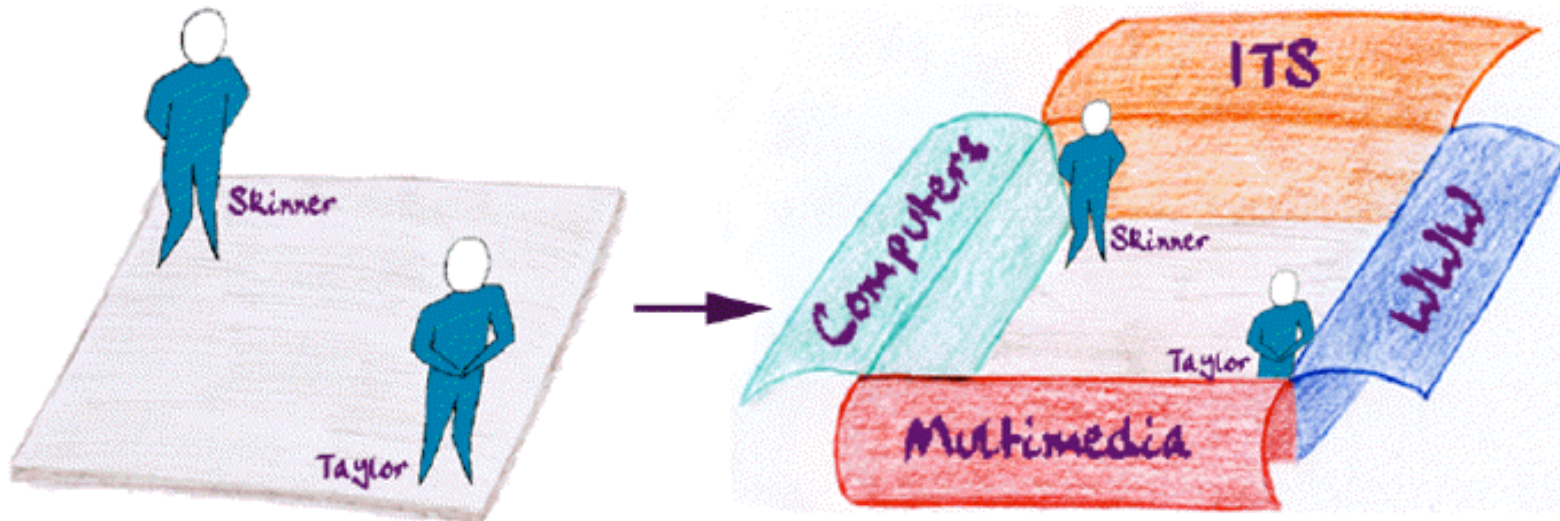


L3D's View including changes under the influence of new media



Gift-Wrapping

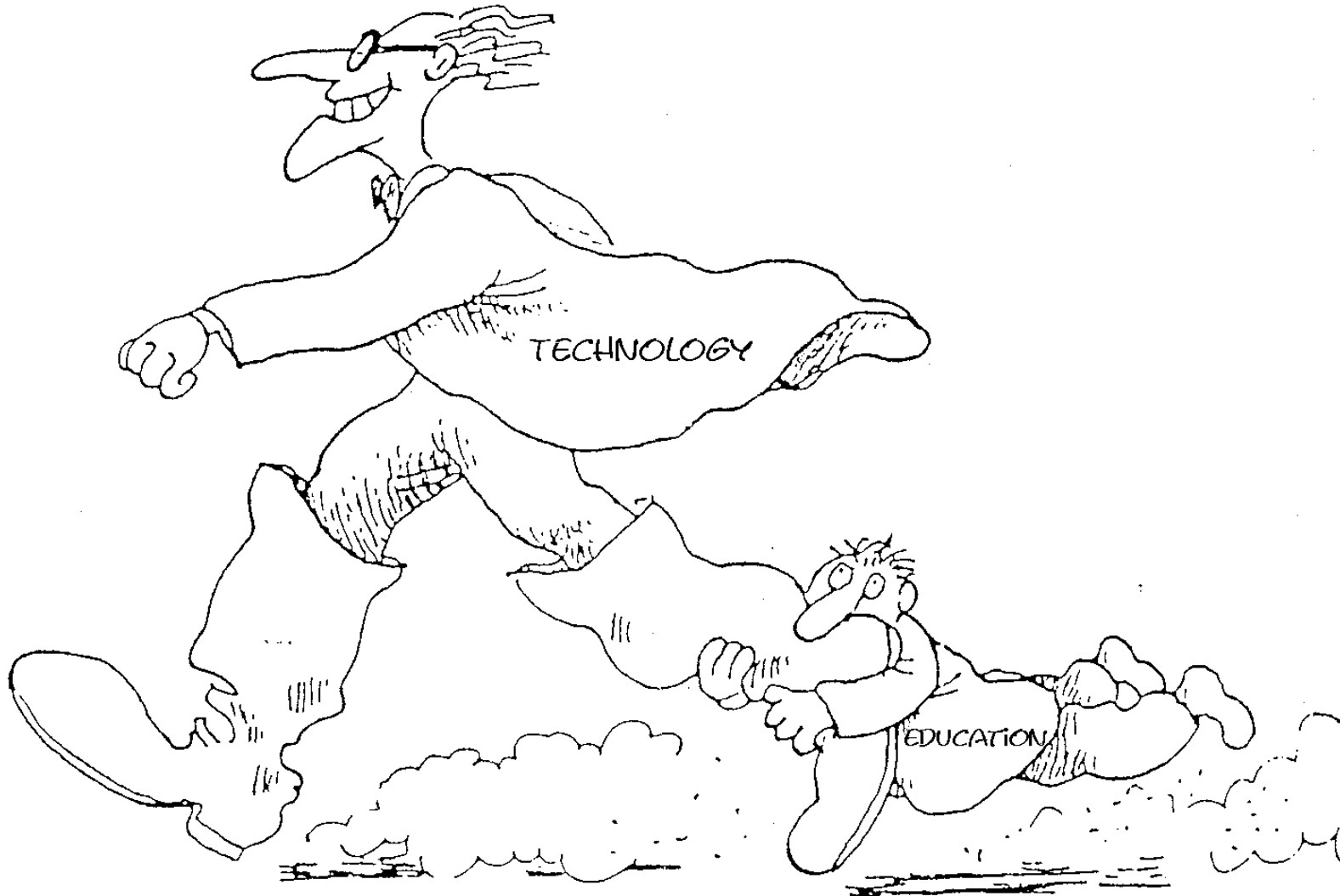
Adding Technology to Existing Educational Practice



Current Education

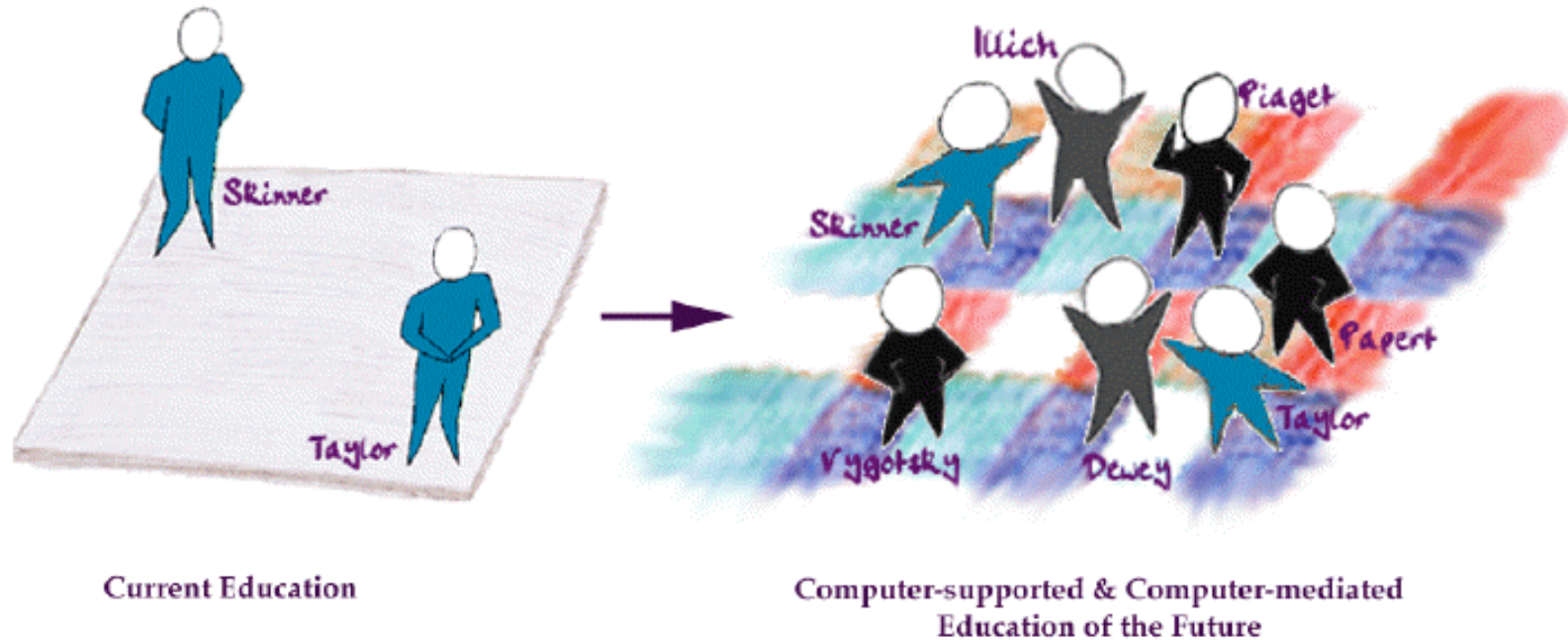
Current Education
wrapped in Technology

Techno-Determinism

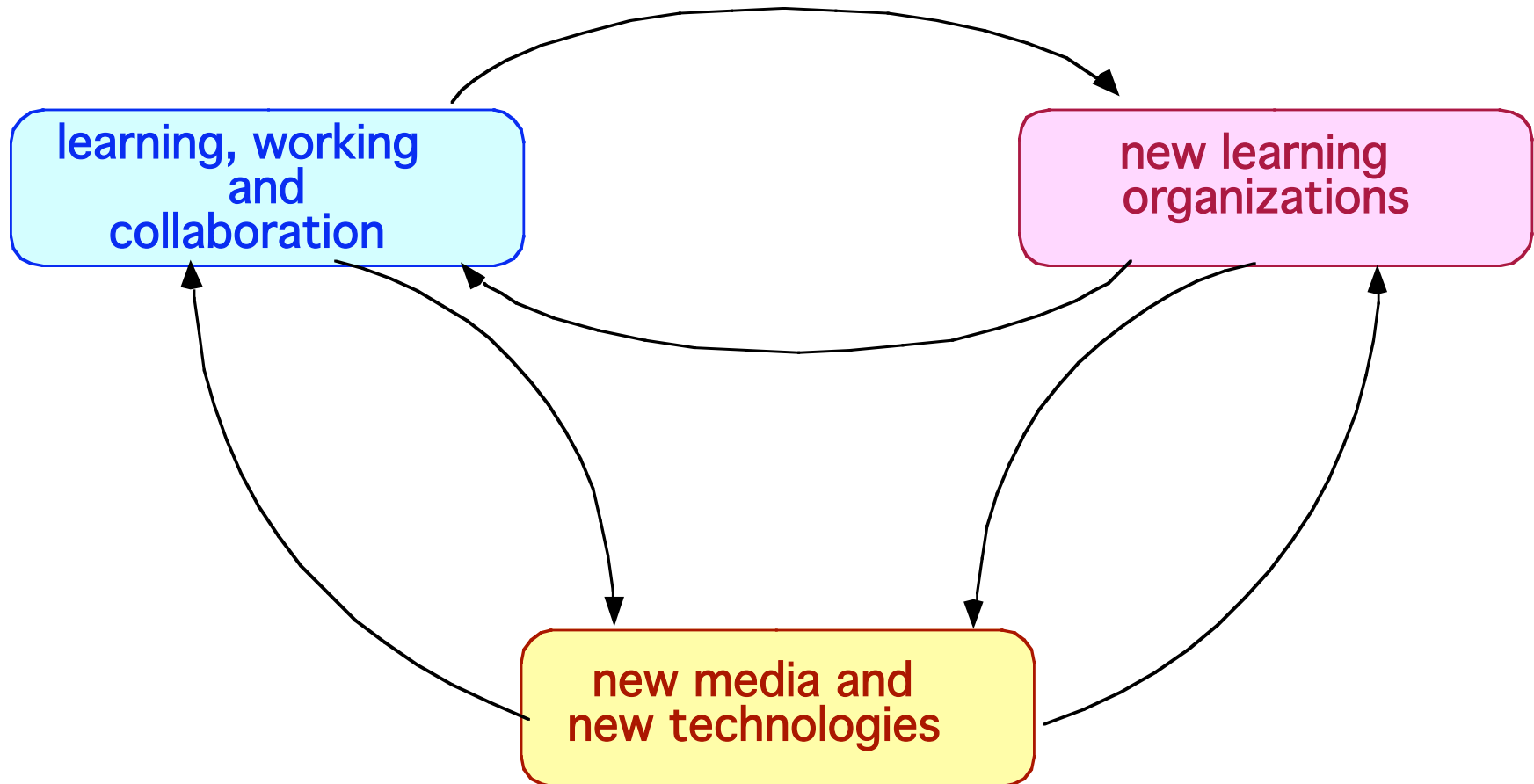


Learning and Media

Rethinking, Reinventing and Reengineering Educational Theory and Educational Practice



Co-Evolution: Beyond “Technology-Driven Developments” and “Gift-Wrapping”



Lifelong Learning and “School-to-Work” transition

- **claim:** if the world of working and living relies on collaboration, creativity, definition and framing of problems, dealing with uncertainty, change, and distributed cognition → then: *schools and universities need to prepare students for having meaningful and productive lives in such a world*
- **some objectives derived from this claim:**
 - new civic discourses are required, because one of the major roles for new media and new technologies is not to deliver predigested information to individuals, but to provide the *opportunity and resources for social debate and discussion*
 - Societies and countries of the future will be successful not “because their people work harder, but because they *work smarter*”. Creativity and innovation are considered essential capabilities for working smarter in knowledge societies creating the important challenge how these capabilities can be learned and practiced.

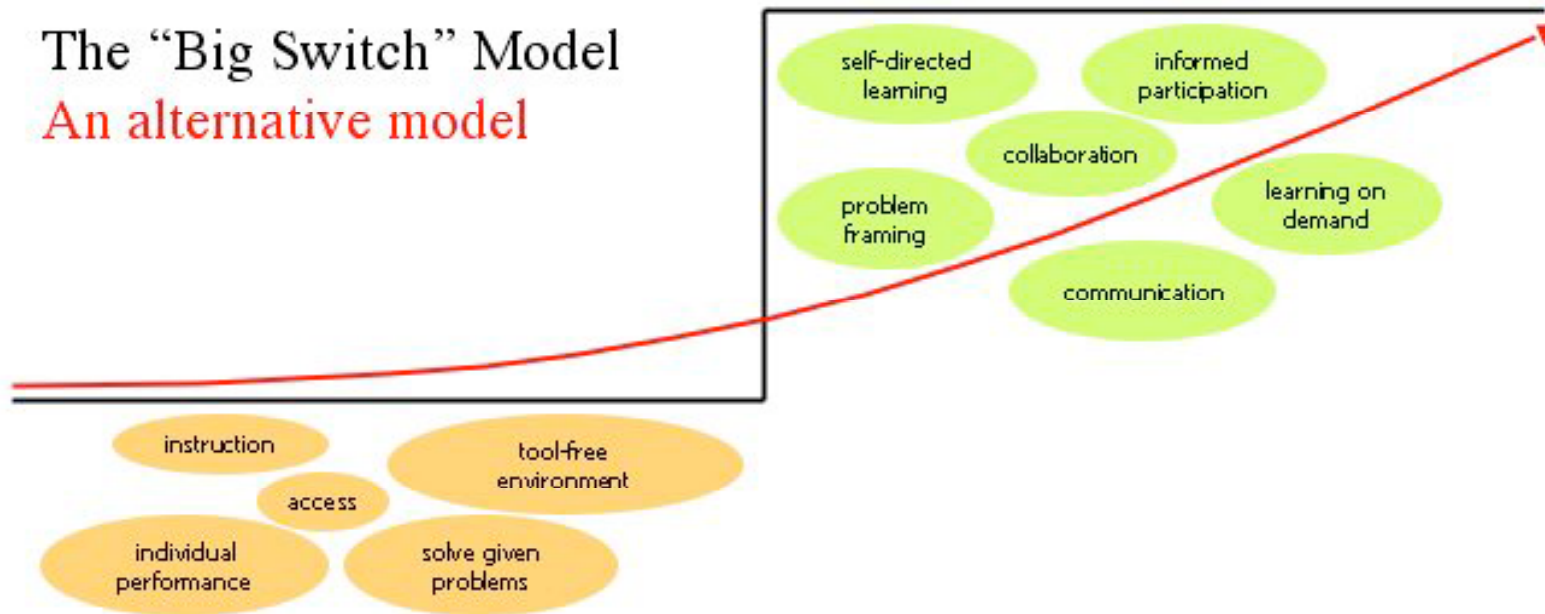
Beyond a Divided Lifetime — Beyond the “Big Switch” Approach

▪ **Claim:**

- Educational institutions need to prepare learners and workers for a world that relies on interdependent, distributed, non-hierarchical information flow and rapidly shifting authority based on complementary knowledge.
- 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).
- It is a misleading assumption that humans at a certain age will be able to throw the “big switch” and become self-directed learners after they have not experienced and practiced this during their the first 30 or forty years of their lives.

- **Recommendation:** Close the gap between school and workplace learning by allowing learners to engage in activities requiring collaboration, creativity, problem framing, and distributed cognition. Integrate learning into working and playing instead of conceptualizing it as a separate activity.

The “Big Switch” Model An alternative model



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)

Informal ↔ Formal Learning

	Informal Learning	Formal Learning
Informal Setting	<p>the standard understanding:</p> <ul style="list-style-type: none"> - museums, excursions - study abroad 	<p>exciting new possibilities:</p> <ul style="list-style-type: none"> - “mathland” - augmenting action with reflection
Formal Setting	<p>exciting new possibilities:</p> <ul style="list-style-type: none"> - classrooms as design studios: Design, Learning, and Collaboration course - learning to be: Undergraduate Research Apprentices 	<p>the standard understanding:</p> <ul style="list-style-type: none"> - schools and universities as we know them

Distributed Cognition

- **what are basic skills in the 21st century?**

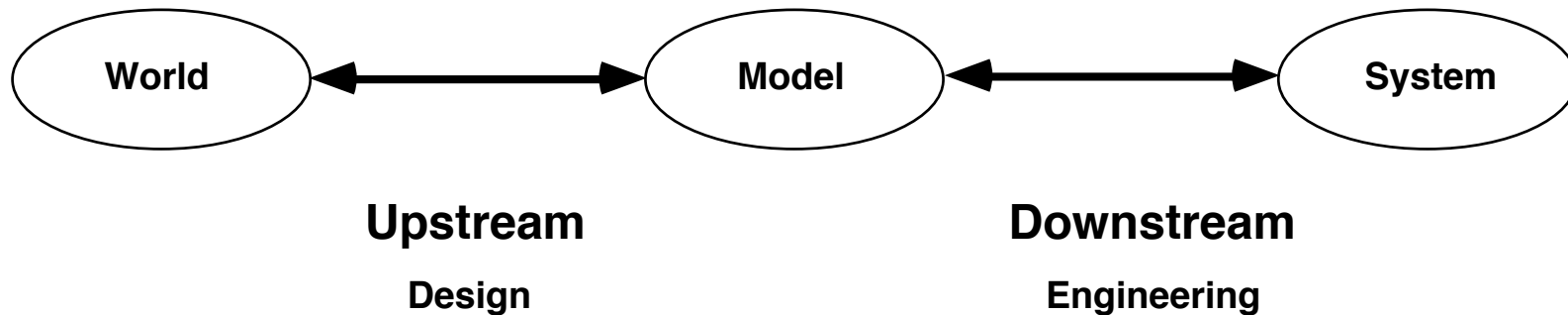
- question: if most job-relevant knowledge must be learned on demand what is the role of “basic” education?
- what is the critical background knowledge which makes learning on demand feasible?
- question: do “basic skills” change their meaning under the influence of technology?

- **tools for learning ↔ tools for living**

- **beyond having access to new media → personal empowerment**

- access / availability (e.g., “each school on the Internet”) is necessary but not sufficient
- the discourse needs to shift: from a concern about who has access to new information technologies → 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

Outsourcing



- **Denning: “The Field of Programmers Myth”, CACM, July 2004**

- prospective computer science student asks: “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, knowledge that will never migrate offshore → related to upstream activities: communication, collaboration (in communities of practice and communities of interest), design, context, integration of problem framing and problem solving, deal with fuzzy and shifting requirements, satisfy customers,

Outsourcing

- **Catherine L. Mann: What Global Sourcing Means for U.S. IT Workers and for the U.S. Economy, CACM, July 2004**
 - what are the gains to the U.S. economy and to its IT workers from global sourcing? What are its costs? What is the quality of products and services?
 - by 2002, over 67% of the people employed in IT jobs in the U.S. did not work in the IT sector, but rather designed, modified, and integrated IT for companies outside the IT sector (→see our proposal ‘Putting Owners of Problems in Charge’)
 - this argument is a starting point to be further elaborated and refined:
“technological changes in software programming modularizes and decomposes the functions into design, coding, maintenance, and user interface”
 - design and interface must be done together with the customer
 - coding and maintenance do not require close proximity with customers and can be done by less costly programmers abroad
 - US IT jobs continue to move up the IT skills ladder → lifelong learning, improve the skills of US workers

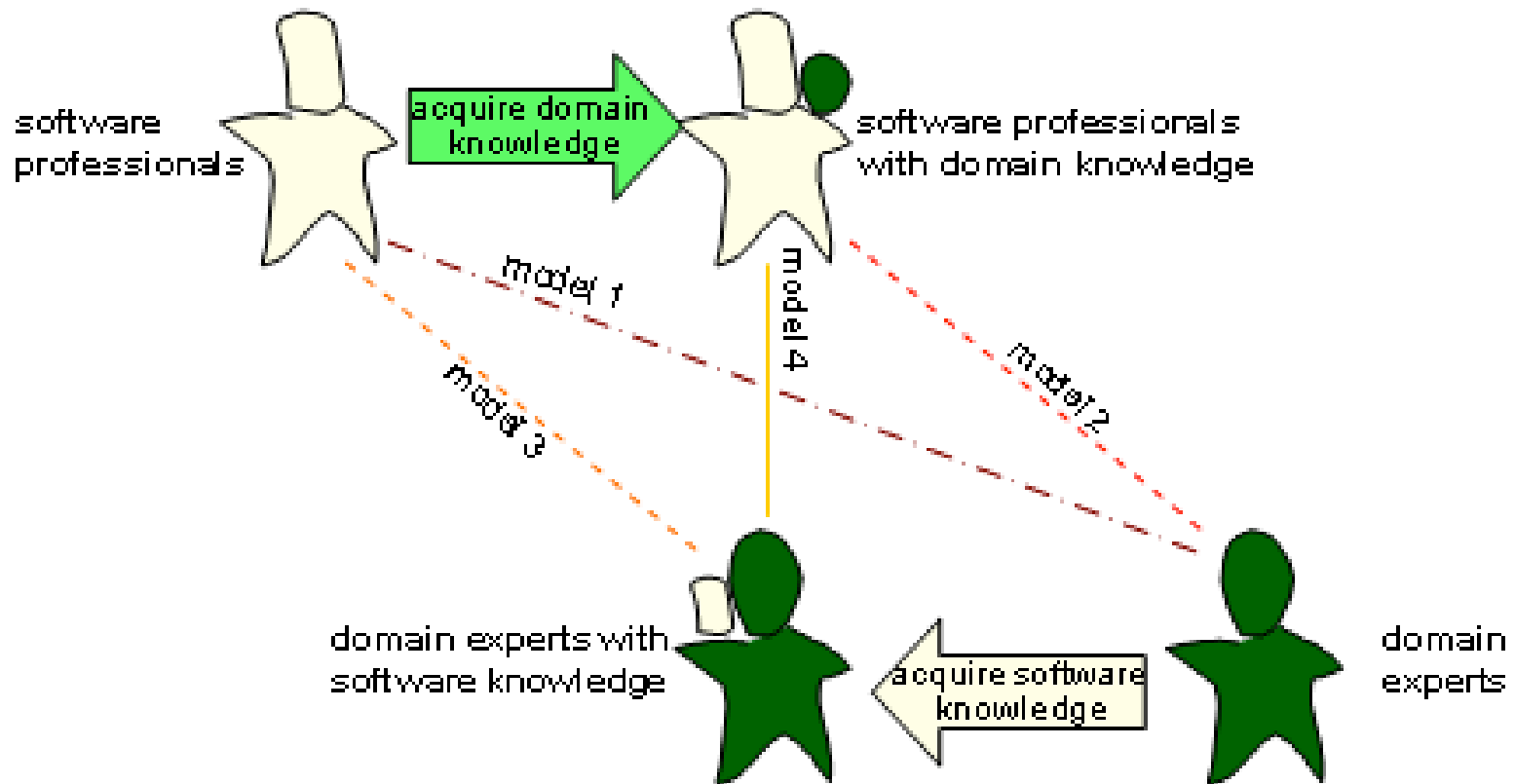
Outsourcing

- **Levy, F., & Murnane, R. J. (2004) The New Division of Labor: How Computers are Creating the Next Job Market, Princeton University Press, Princeton.**
 - beyond directly replacing humans, computers have become the infrastructure of the global economy, helping jobs move quickly to sources of cheap labor
 - Adam Smith “division of labor” → there is a new division of labor between people and computers → distributed cognition
 - computerized work
 - has increased the value of identifying and solving uncharted problems (requiring learning when the answer is not known) → called “expert thinking” by Levy (solving new problems for which there are no routine solutions) → can not be outsourced, because ill-defined problems cannot be delegated
 - has increased the importance of “complex communication”, conveying not just information but a particular interpretation of information
 - the ability to apply well-understood routines to solve problems is not valued as it used to be → candidates for outsourcing

E-learning and OpenCourseWare

- **fact:** the MIT plan to make all of its 2000 courses available for free on the Internet over the next 10 years - an initiative called OpenCourseWare for which MIT is willing to spend \$100 million.
- **research issue:** it creates a challenge which we have been discussing for some time, namely what is the core competency of a residential, research based university in the future. It must be obviously different from disseminating lecture material (otherwise MIT would move itself and other universities out of existence).

Renaissance Community – the Renaissance Scholar of the 21st Century



A Research Project — What Would We Actually DO?

- develop new **innovative conceptual frameworks** for distributed cognition, reflective communities, communication (meta-design) and collaboration skills (social creativity)

- develop **new media**
 - beyond gift-wrapping
 - support the conceptual frameworks

- engage in new practices
 - National Center for Women in IT
 - Dillard
 - courses-as-seeds

A Research Project — What Would We Actually DO?

- **descriptive**

- understanding “how things are”

- **prescriptive**

- **digital fluency** (whose meaning still needs to be defined; should not be equated with programming) should be considered as important as reading and writing, numeracy/ calculus
- **what** do we teach?
- **how** do we teach? (courses-as-seeds, communication, collaboration, distributed cognition)

Theme: Understand The Magnitude Of The Change

Claim: Our current thinking does not address the potential magnitude of the change. One can argue that we have arrived at a point where the change is of a similar magnitude to the time when our society moved from an oral to a literary society or when the printing press eliminated the scribes and gave everyone the opportunity to become literate.

Recommendation: Understand the long-term societal impacts of self-directed and lifelong learning. Self-directed and lifelong learning need to be more than a label or the adoption of surface practices. Reinvent our educational institutions and our work environments to make learning a part of life.

Theme: Distributed Cognition

Claim: The individual human mind is limited — therefore in real life (i.e., outside of schools) people rely heavily on information and knowledge distributed among groups of people and various artifacts.

Recommendation: Deemphasize rote learning and closed-book exams. Support social environments enriched by embedded computational media that emphasize collaborative learning and communication skills. Do not equate collaboration with cheating.

Theme: Reality is not user friendly

Claim: In lifelong and self-directed learning, people encounter the need for learning coming from a large variety of backgrounds and being engaged in a great variety of different tasks.

Recommendation: Provide multiple educational forms and opportunities rather than try to design the “one best” educational and computational environment. Teacher-driven approaches (such as intelligent tutoring systems) will be inadequate to support people in self-directed learning.

Theme: Changing Roles

Claim: In the past, the role of a teacher or a learner was associated with in person. In the learning environments of the future (characterized by a “symmetry of ignorance” among the participating stakeholders) these roles are changing dynamically dependent on the issues and questions under investigation. Questions arising from self-directed learning activities (as opposed to presentations by the teacher) will indicate the limitations of the teachers’ knowledge.

Recommendation: Change the role of the teacher from an oracle to a coach, mentor, and facilitator and support peer-to-peer learning. Teachers need to be comfortable interacting with learners in situations in which they do not know everything.

Theme: New Interdisciplinary, Cross-Cultural Collaborations

Claim: Realistic problems are framed and solved by groups , communities and organizations rather than individuals. The participants come from different “cultures” (different profession, different countries, different objectives) and must have the willingness, the experience, the environments and the tools to be able to learn from each other.

Recommendation: The role of a community of learners with different backgrounds needs to be explored and explicitly incorporated into our conceptual frameworks and computational media. Develop environments supporting mutual learning and mutual understanding.

Theme: Economics and the Quality of Education

Claim: Education needs to be cost-effective. While new media offer the possibility to reduce the cost of education, an equally important goal is to improve the quality of education (“If you think education is expensive, try ignorance!”).

Recommendation: Explore the scalability of educationally desirable innovations (for example, the Nobel prize winner as a private coach does not scale). Design and develop computational media to support learners in their own doing. Create new role distributions between human teachers and computational media. While there is no evidence that all the tasks of a teacher can be ‘handed over’ to a computer, new media allow us to rethink the role of the teacher.

Theme: Avoid To Reinvent The Wheel

Claim: Self-directed learning should not underestimate the knowledge of the past. Let Learners stand on the shoulders of the giants who proceeded them!

Recommendation: Self-directed learning (as any other approach towards learning and teaching) should complement other approaches. Instructionist approaches are suited to make the knowledge of the past available under the guidance of an experienced teacher.

Theme: Support Collaborative Knowledge Construction

Claim: While we face too much information in the abstract, in most specific problem situations we do not have enough knowledge.

Recommendation: Learning can not be restricted to finding knowledge which is “out there”. If nobody in a group knows the answer, we have to create new knowledge. Create environments which stimulate innovation and creativity by exploiting breakdowns, symmetry of ignorance, experimentation, and external objects serving as objects-to-think-with and objects-to-talk-about.

Theme: “Basic” Skills — Core Knowledge

Claim: A lifelong learner cannot learn any arbitrary skill on demand—prerequisites normally limit what a person can and cannot learn. This raises the important question: what “basic skills” are required in a world in which occupational knowledge and skills become obsolete in years rather than decades?

Recommendation: The “old” basic skills (such as reading, writing, and arithmetic) once acquired, were relevant for the rest of a human life; modern “basic skills” (tied to rapidly changing technologies and media) change over time. Education cannot be reduced to mere skill acquisition and information processing, but needs to prepare students to become self-directed and lifelong learners by creating passion and deep understanding about their existence as human beings in the future knowledge society.

Theme: New Assessment Strategies

Claim: Self-directed learning makes assessment strategies infeasible in which everyone is measured with the same yardstick and in which human capabilities are reduced to a number. New approaches should not avoid the assessment challenge —it is legitimate to ask for evidence that the “new” approaches are working.

Recommendation: Assessment strategies developed for instructionist learning are not suited to assess for self-directed learning. The development of new assessment strategies addressing the needs of self-directed learning is an important research problem.

Theme: Take Motivation Seriously

Claim: If we want people to be lifelong learners, we must make sure they enjoy it. *Motivation* is central to learning.

Recommendation: The beginnings of a motivational theory urgently need to be developed further. One of the benefits of integrating working and learning is the potential increase in motivation. Motivation to learn new things is critically influenced by optimal flow, a continual feeling of challenge, the right tools for the job, and a focus on the task.

Theme: Develop Innovative Media in Support of Lifelong, Self-Directed Learning

Claim: Non-computational media (such as books, films, etc.) in principle cannot analyze and critique the work of learners and contextualize new information, advice and help to their work.

Recommendation: The interpretive power of computational media is needed to support people in their own doing. To make self-directed learning economically feasible, new kinds of media are needed which are able to analyze and critique a students work. Develop requirements and create prototypes of computational environments in support of self-directed learning; examples of such requirements are: they must be user-directed and simultaneously supportive; provide information in context; exploit breakdowns as opportunities for learning, allow end-user modification and programmability; support a range of expertise, and promote collaboration.

Theme: Educate New Kinds Of Professionals

Claim: Education must prepare humans for a world where learning is an integral part of their lives. Industrial-age models of education are inadequate to prepare students to compete in the knowledge-based workplace.

Recommendation: Create educational settings for young researchers and students (at a formative stage in their careers) in which they can learn how to learn, are able to engage in personally meaningful activities, exploit the power of media, and collaborate with others in interdisciplinary and cross-cultural settings.

Theme: Beyond Technology: Change Mindsets and Organizations

Claim: There is no evidence from the past that technology by itself has changed education, learning and teaching in any fundamental way, especially technologies used in the “gift wrapping” mode.

Recommendation: Develop new mindsets and attitudes among (1) individuals (e.g.: learners, teachers, researchers, policy makers, etc.) and (2) organizations (e.g.:, nurturing a collaborative work environment, being willing to undergo culture changes).