Center for LifeLong Learning & Design

University of Colorado at Boulder

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

Innovative Media in Support of Distributed Intelligence and Lifelong Learning

Gerhard Fischer and Shin'ichi Konomi

L3D Meeting, October 19, 2005

<< IEEE International Workshop on Wireless and Mobile Technologies in Education — WMTE 2005>>

WMTE 2005

- **IEEE Int'l Workshop Wireless and Mobile Technologies in Education**
  - Nov. 28 – 30 @ The University of Tokushima

- **Keynote**

  Gerhard Fischer

  Innovative Media in Support of Distributed Intelligence and Lifelong Learning

  Claire O'Malley *(Learning Sciences Research Institute, U of Nottingham)*

  ... application of psychological theories and methods to the design and use of CSCL environments ... EU Projects including

  Ken Sakamura *(U of Tokyo & Ubiquitous ID Center)*

  Ubiquitous Computing Technologies for Ubiquitous Learning

Ken Sakamura (some projects related to WMT)

- **TRON Project (Distributed Computing, Real-time operating system)**
  - ITRON widely used as an OS for Japanese mobile phones

- **Tokyo University Digital Museum**
  - Museum heavily armed with WMT technologies: using PDA, HMD, RFID, Barcodes, Laser pointer & photo sensor, social virtual reality, ...

- **Intelligent House of the Future (with Toyota)**

- **Ubiquitous ID Center**
  - Standardization of RFID (beyond supply-chain management)
  - Pilot tests (w/ strong government support)
  - In Kobe, Ueno, Aomori, etc.: many RFID tags/sensors embedded in the pavement, sidewalks, street furniture
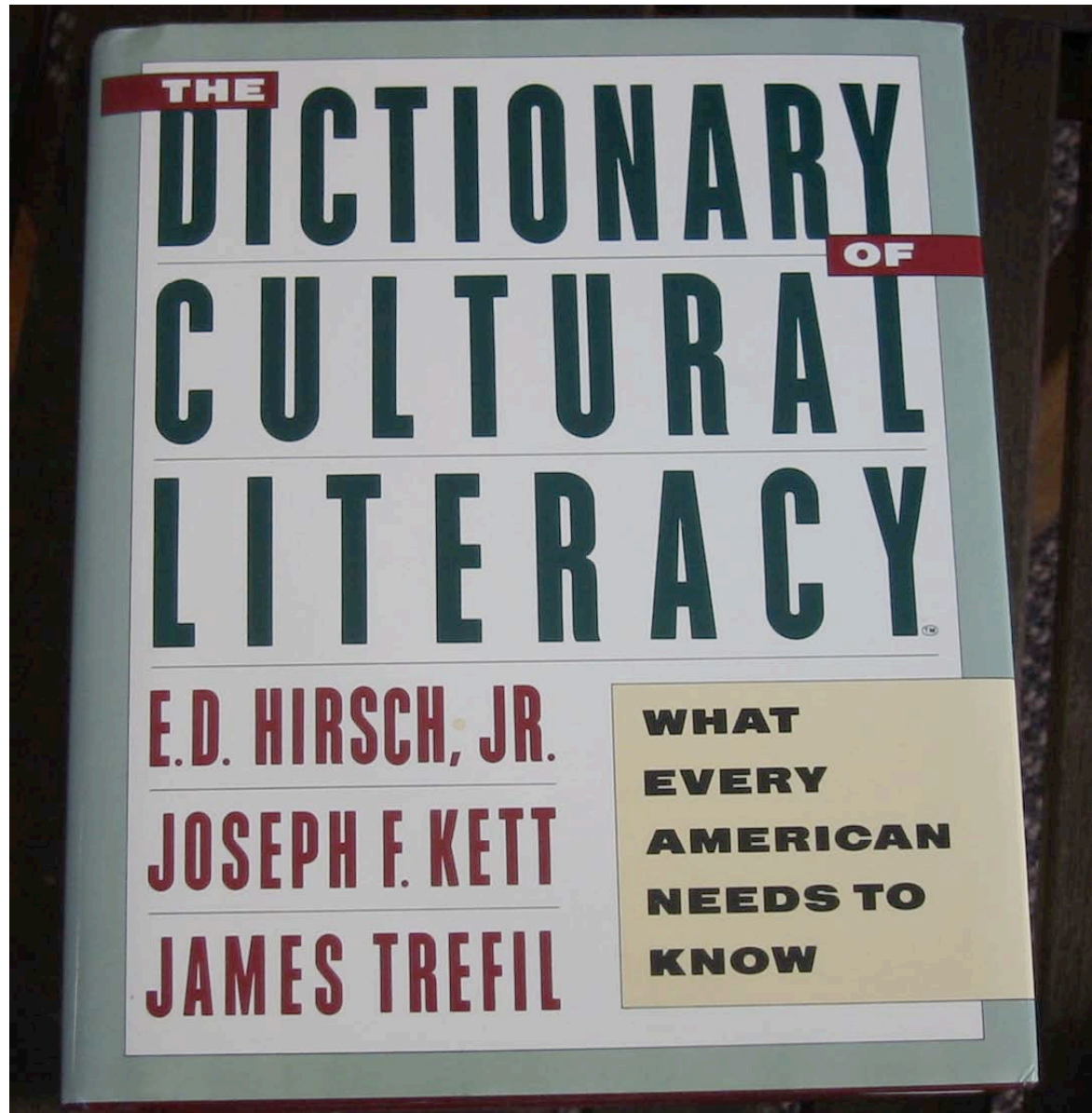
Overview

- Basic Message or Basic Question

- Education in the 21st Century

- Lifelong Learning and Distributed Intelligence

- Challenges for WMTE

- Conceptual Frameworks

- Application Systems
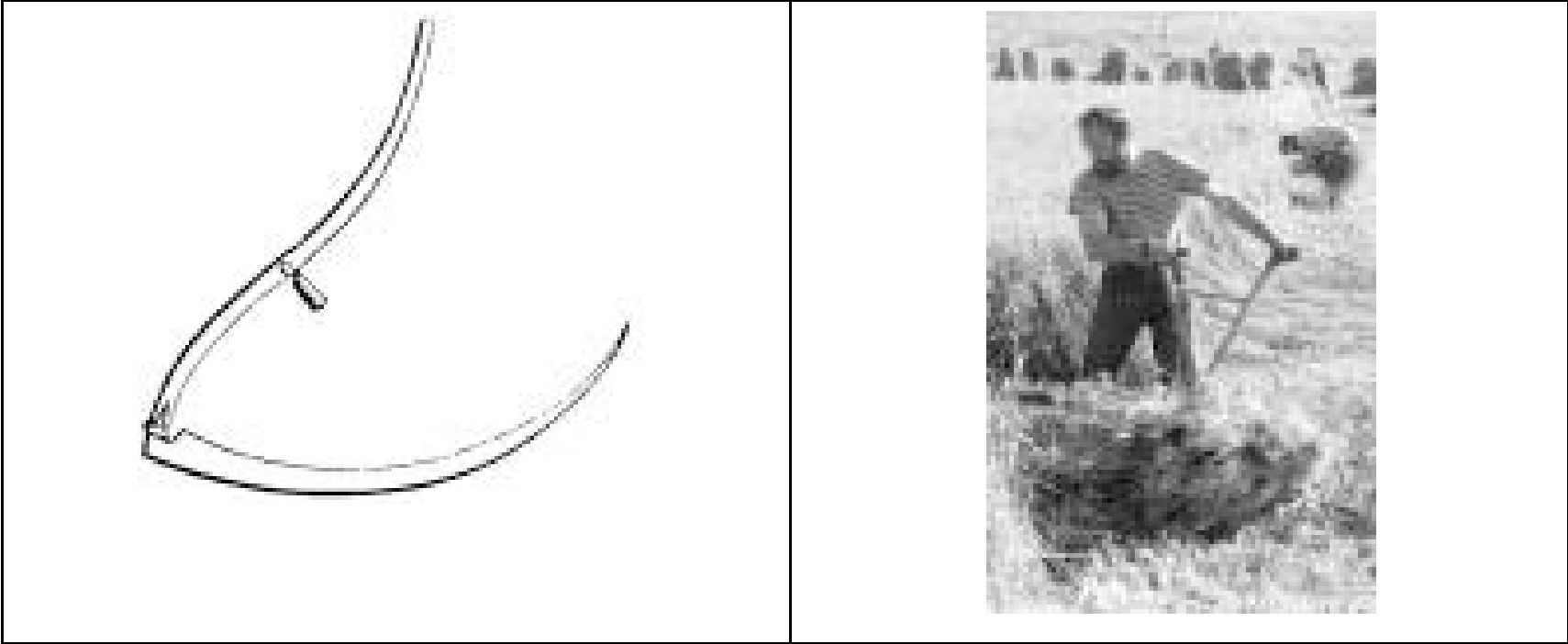
- Reflections

- Conclusions

The Basic Message or Basic Question

- Wireless and Mobile Technologies in Education: what is the **true value added**?

- **approaches:**
  - **gift-wrapping:** technology as add-on to existing practices

  - **techno-determinism:** technology dictates educational concerns

  - our approach: **co-evolution** based on
    learning / working / education = f {media} → new socio-technical environments

- **opportunities:**
  - new levels of **distributed intelligence** (tools for learning ←→ tools for living)

  - **human attention** (information → "the right information at the right time, in the right place, in the right way to the right person")

  - **basic skills** in the 21st century (knowledge in the head ←→ knowledge in the world) → what really means "learning", "knowing", "understanding" in the world of today and of the future

Being Educated?

The Dictionary of Cultural Literacy

E.D. HIRSCH, JR.
JOSEPH F. KETT
JAMES TREFIL
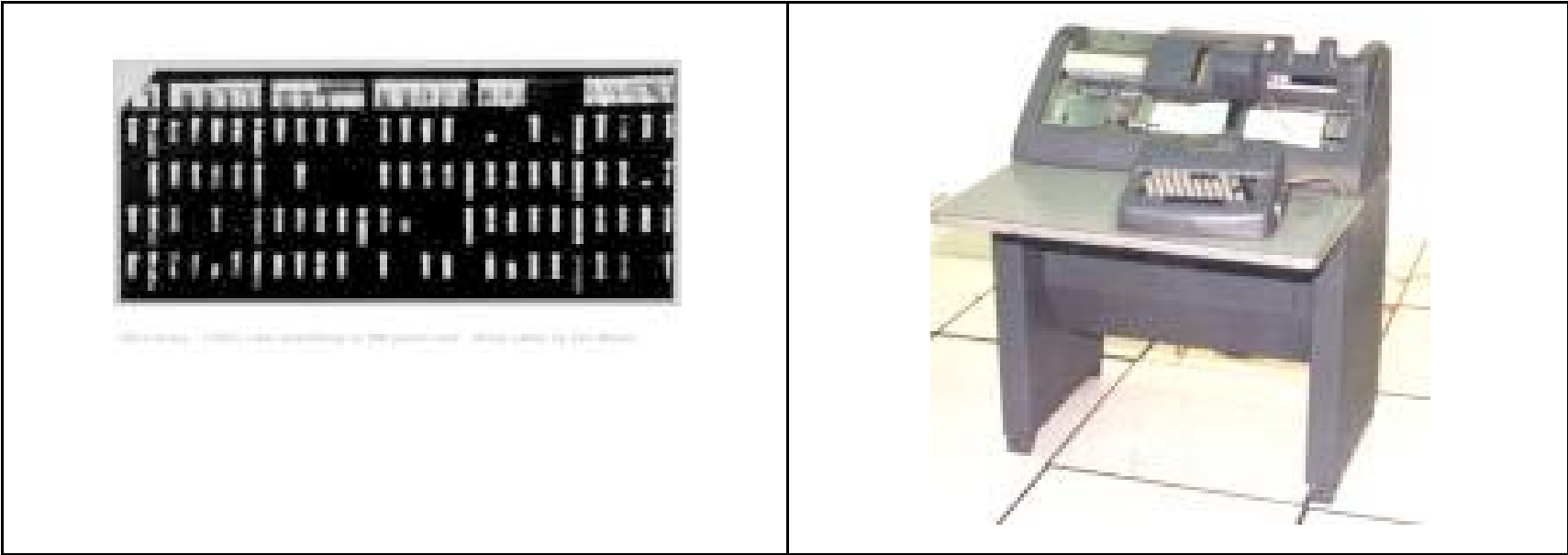
WHAT EVERY AMERICAN NEEDS TO KNOW

Learning / Working / Education = f {media} — In the Old Days

Today

Learning / Working / Education = f {media} — In the Old Days

Today

Education of the Future — A Lifelong Learning Perspective

- **basic assumption:** If the world of working and living relies on collaboration, creativity, definition and framing of problems, dealing with uncertainty, change, and distributed cognition — then education needs to prepare students for meaningful and productive lives in such a world

- **objective:** education from a lifelong learning perspective *should*
    - help learners enhance their abilities to learn
    - engage in meaningful activities
    - promote new civic discourses, since a major role for new technologies is not to deliver predigested information but to provide for social debate and discussion
    - exploit the power of media

- **goal:** wireless and mobile technologies can be valuable for lifelong learning
    - by offering learning opportunities at all times and at all locations
    - by redrawing the borderline between knowledge in the head and knowledge in the world

Education of the Future — A Distributed Intelligence Perspective

claim: *human cognition* has been seen as existing solely "inside" a person's head, and studies on cognition have often disregarded the physical and social surroundings in which cognition takes place

question: does this statue convey the "right" imagine?

("The Thinker" by Auguste Rodin)

Human-centric Perspective and Co-Evolution
—
the importance of usage and activity rather than technologies

- *Who* **is using the computer?** — learners, teachers, skilled professionals, technically sophisticated users, domain workers

- *What* **are they doing?** — moving through space, accessing information, engaging in informed participation and collaborative knowledge construction, communicating with others, participating in collaborative design activities

- *Where* **are they doing it?** — in classrooms, in their work environments

- *When* **are they are able to do it?** — at any time without major preparations or setup

- *Why* **are they doing it?** — a self-directed and self-motivated activity, an assigned task, to obtain information

- *How* **do they it?** — in a tool-rich environment, in their heads

Tools for Learning

Tools for Living

Tools for Living ←→ Tools for Learning

- **tools for living** (such as eyeglasses) are grounded in a distributed intelligence perspective, in which intelligence is mediated by tools for achieving activities that would be error prone, challenging, or impossible to achieve

- **tools for learning** (such as training wheels) are grounded in a "scaffolding with fading" perspective in which the ultimate goal is autonomous performance by people without tools

- **a possibility provided by WMT:** Tools for living rely on the presence of the tools at all times, and wireless and mobile technologies can therefore make them more relevant because we can rely on them at all times.

Planning and Situated Action

----------------- learning "ahead" ----------------------- learning in context ----------→
time

show a person in a room   out in the world with a PDA
reading a book or in front of
a computer

world-as-imagined   **world-as-experienced**
prediction   **reality**
planning   **situated action**

Context Awareness
—
Information Delivery in Large Software Reuse Repositories and High-Functionality Applications

L4: Entire Information Space

(L4 – L3): Unanticipated Information

L1: Well Known

L2: Vaguely Known

L3: Belief

Task-relevant information
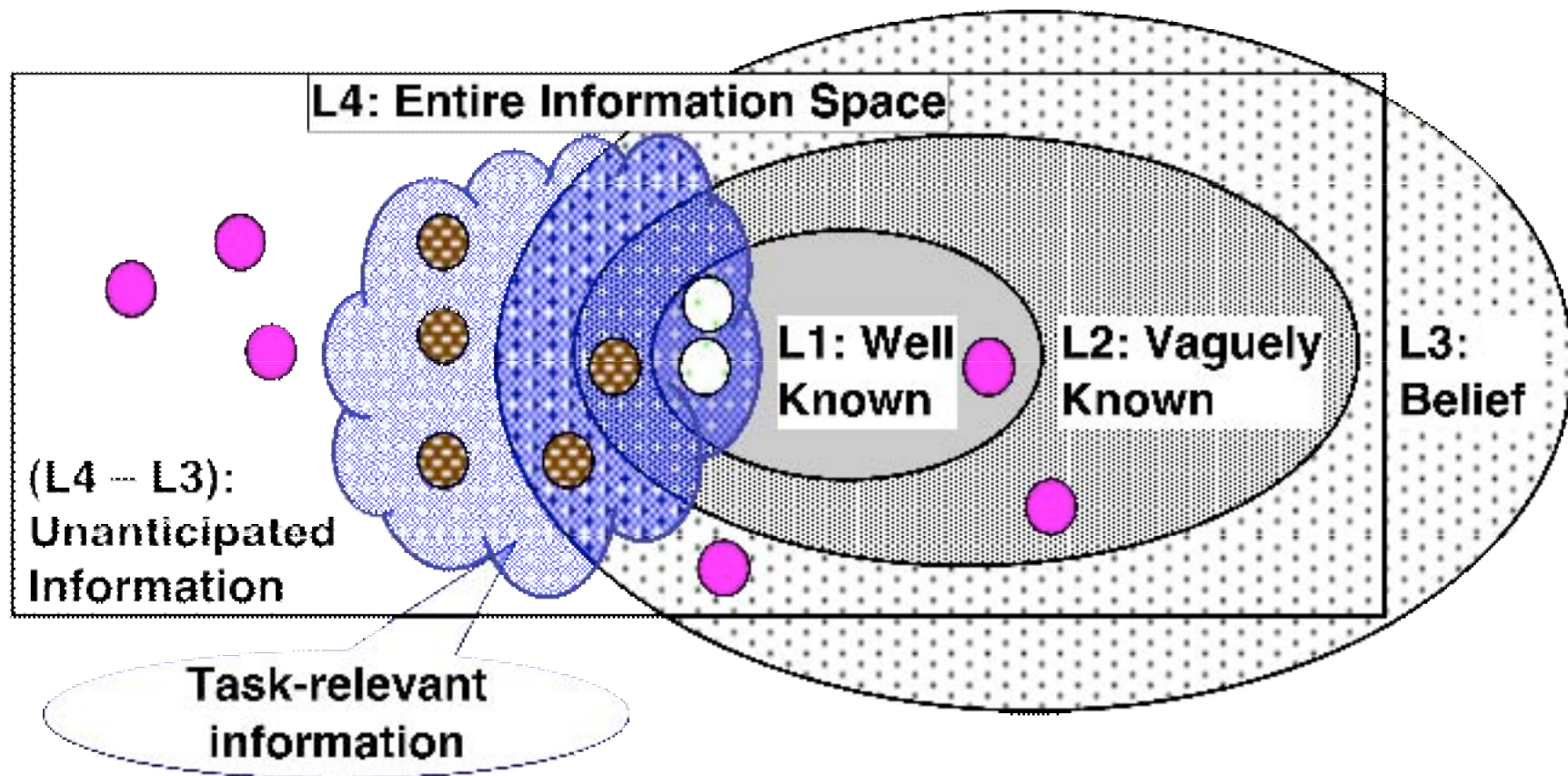
Human Attention — the Scarce Resource

Herbert Simon (Nobel Prize Winner) in "Sciences of the Artificial"

- **claims**
    - a design representation suitable to a world in which the scarce factor is information may be exactly the wrong one for a world in which the scarce factor is attention
    - the critical component in information sharing is not information per se, but ***human attention***
    - "What information consumes is rather obvious: it consumes the ***attention*** of its recipients. Hence a wealth of information creates a poverty of attention, and a need to allocate efficiently among the overabundance of information sources that might consume it."

example:
    - some crisis in the world → many messages to the State Department
    - printing capacity was identified at the limiting factor → buy high speed printers
    - the real bottleneck: time and attention of the human decision makers who had to use the incoming information → the real challenge: filters, intelligent summarizing, …

The **Right Information** at the **Right Time**, in the **Right Place**, in the **Right Way** to the **Right Person**

- right **information**: relevant to the task at hand → task modeling

- right **time**: intrusiveness (pull versus push)

- right **place:** location-aware cell phone (noisy environment versus movie theatre), smart tour guides

- right **way**: multimodal presentation (textual, visual, auditory, tactile)

- right **person**: taking background knowledge and interests of specific users into account → user modeling, "who do I ask and who do I tell"

Distributed Intelligence and Lifelong Learning
—
Conceptual Frameworks

- **Intelligence Augmentation (IA)** rather than on Artificial Intelligence (AI) by empowering human beings rather than replacing them

- providing support not only to individuals but to **groups and communities**, and thereby exploiting the power of social creativity based on informed participation

- contextualizing generic systems to person- and task-specific environments to account for a "universe of one" by supporting **meta-design, customization, and end-user development**

- **transcending "gift-wrapping" and "techno-determinism"** as isolated and one-sided design objectives for new media by pursuing **co-evolution**
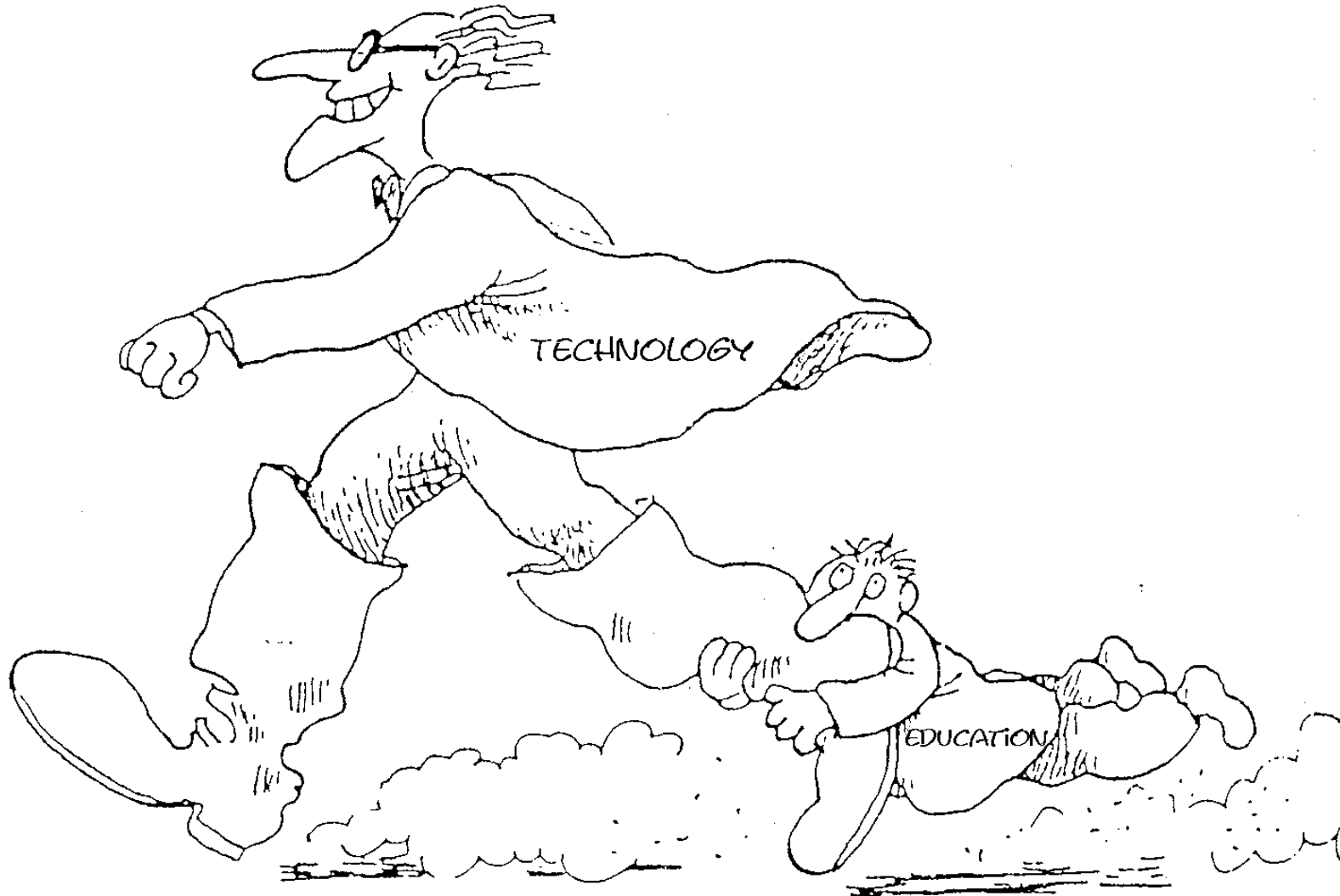
Gift-Wrapping: Adding Technology to Existing Practice

"There is nothing so useless as doing efficiently that which should not be done at all." — **Peter Drucker**
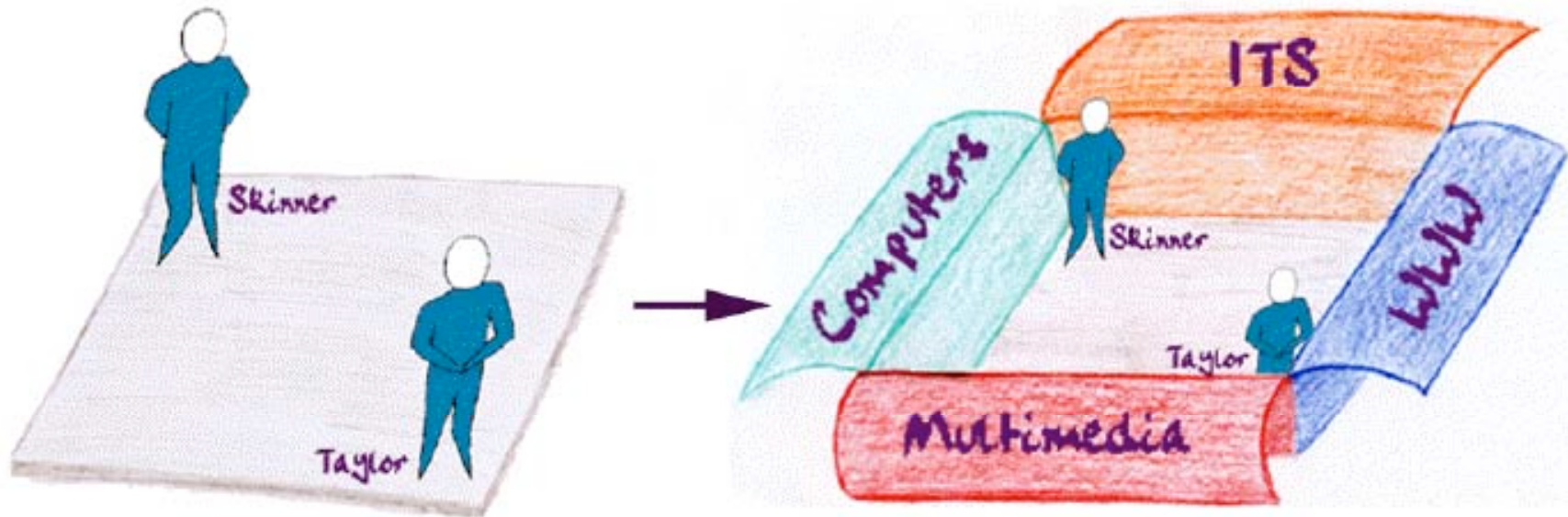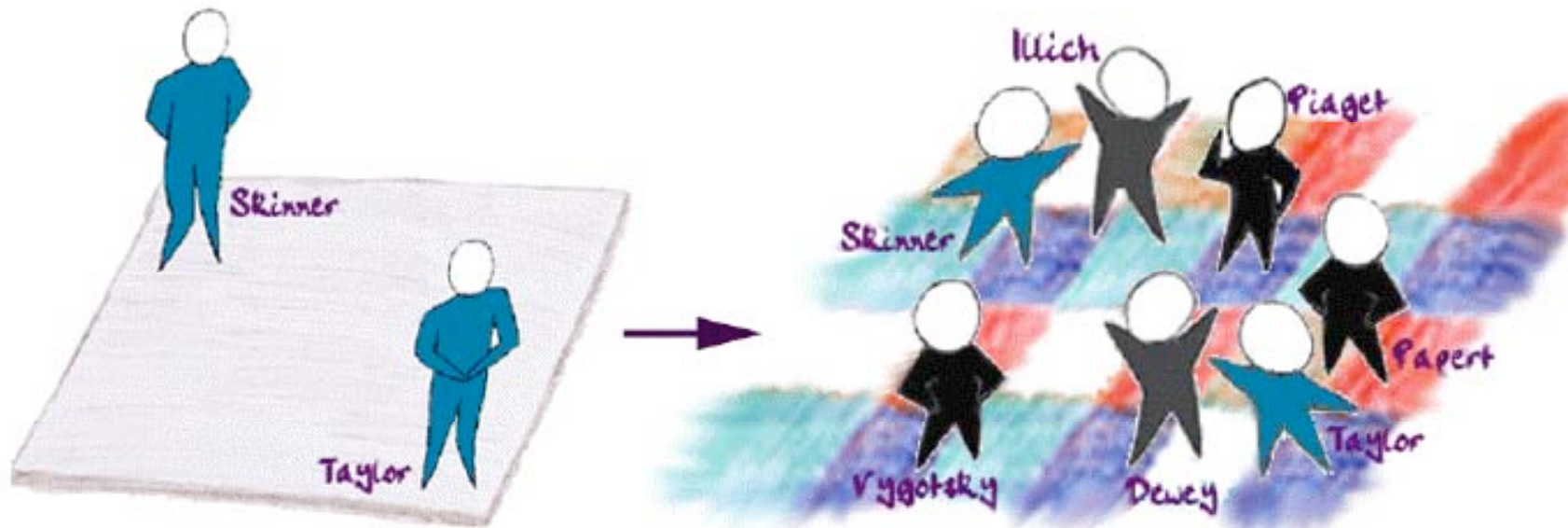

current practice (e.g., education)   current practice wrapped in technology
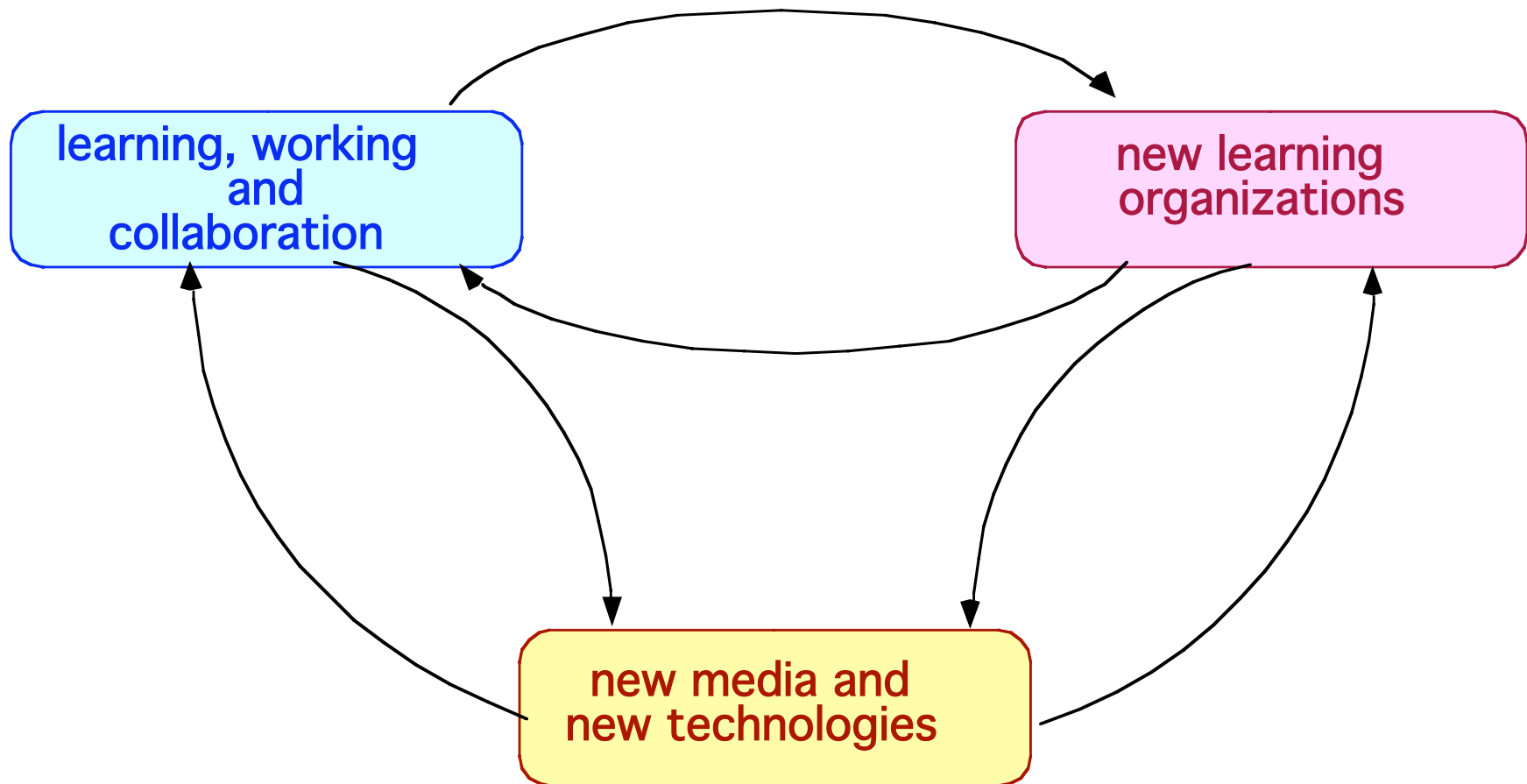
Techno-Determinism

Learning and Media: Rethinking, Reinventing, and Redesign Theory and Practice

current practice

computer-supported and computer–mediated practice of the future

Co-Evolution: Beyond "Technology-Driven Developments" and "Gift-Wrapping"

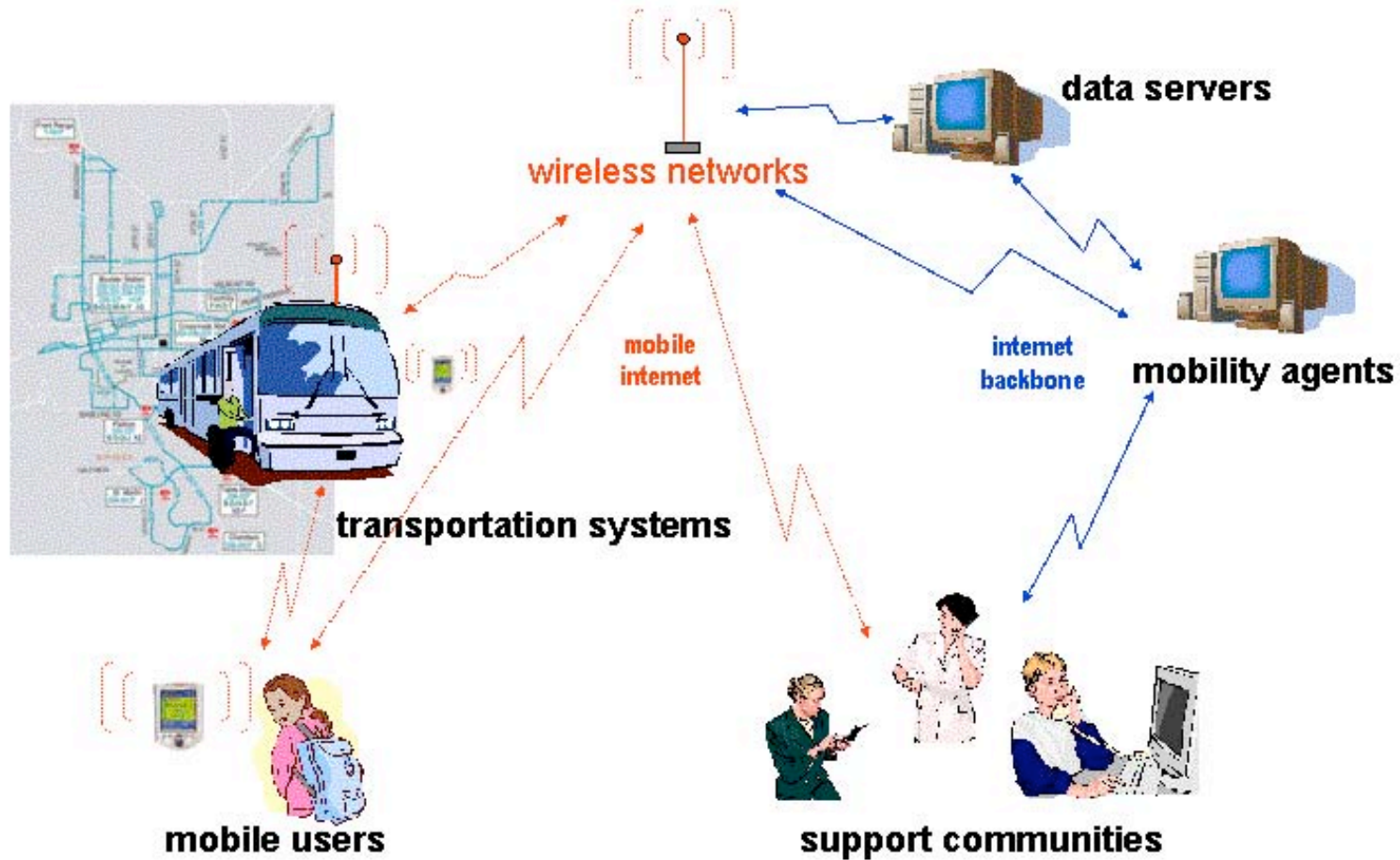# Distributed Intelligence and Lifelong Learning
—
WMT based Application Systems

- **going small:** socio-technical environments supported by personalized, portable devices and wireless communication that afford information and communication between people as they move around in the world — **Mobility-for-All / MAPS / LifeLine**

- **going large:** large computational tables that allow people from diverse backgrounds to access, contribute to, and interact with information in an inherently social manner to support collaborative work among others in shared physical locations —**Envisionment and Discovery Collaboratory**

- **going everywhere:** smart physical objects that communicate with computational environments, allow for context-aware information delivery, and create articulate environments — the **QueryLens** system

Going Small: Human-Centered Public Transportation Systems

- Mobility-for-All

- MAPS — creating scripts for WMTs

- LifeLine — socio-technical environments

Mobile architecture

data servers

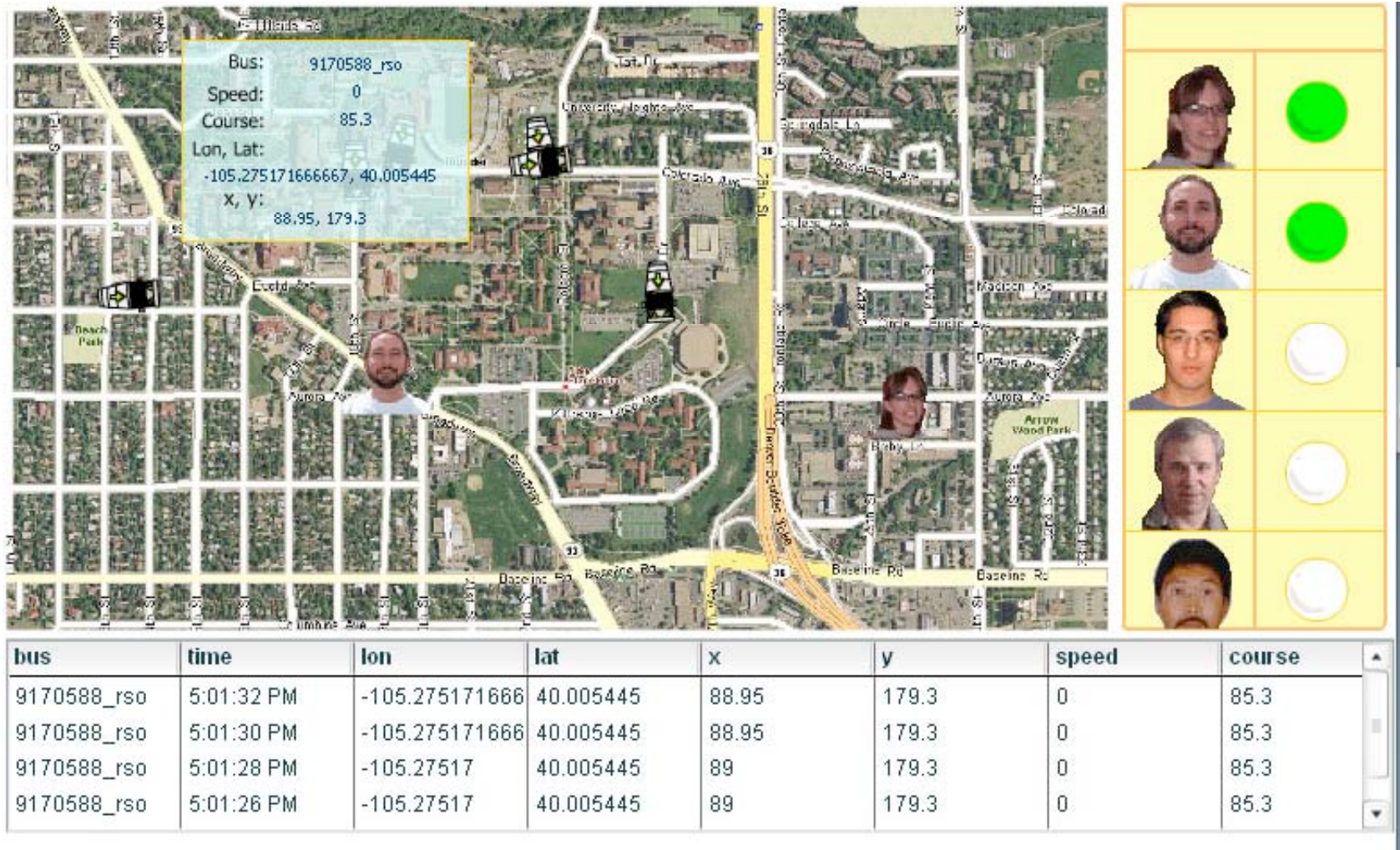wireless networks

mobility agents

mobile internet

internet backbone

transportation systems

mobile users

support communities

17

MAPS Script Editor

MAPS Handheld Prompter

LifeLine

Going Large: Envisionment and Discovery Collaboratory

Going Everywhere: Query Lens

Smart Physical Objects

**Media
Server**

RFID

**Query
Server**

Access & Contribution

Object identification

Articulation & Sharing
Information Needs

Distributed mobile databases
with bi-directional synchronization

**Context-aware
information delivery**

User identification

The '*right*' information at
the '*right*' time in the '*right*'
way to the '*right*' users
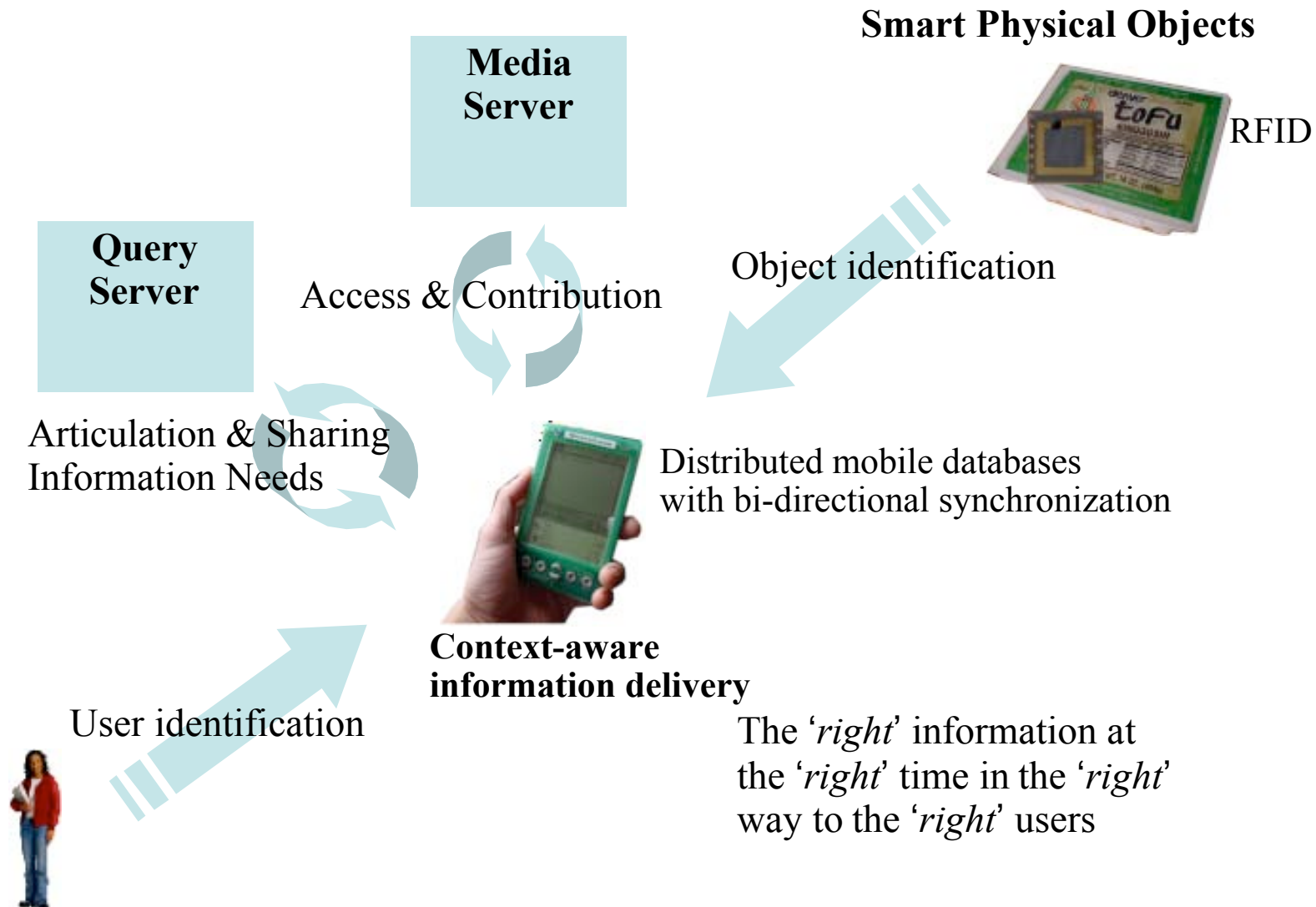
Reflections: Privacy

- **problem of isolation**
  - How can we avoid decontextualized information delivery?
  - Knowing about users' preferences and tasks

- **problem of the world without privacy**
  - at the intellectual level, individuals need to process the information that is constantly bombarding them, information that cannot be processed while they are still "on the go"

- **boundary control (rather than isolation)**
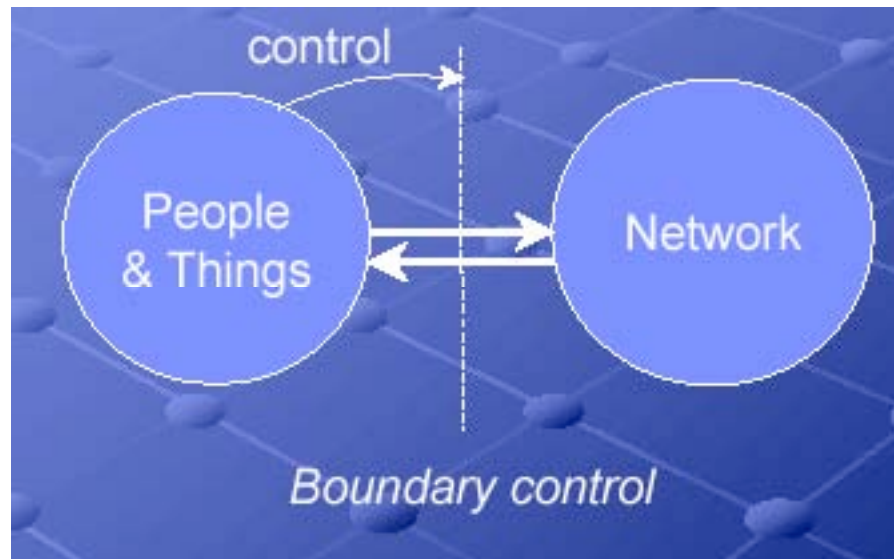
Reflections: Innovating Innovation

- **looking 10 years in the future**
  1994 ←----------------------------------→ **2004** ←--------------------------------------→ 2014
  WWW becomes   Business, Education, Collaboration
  available   have fundamentally changed

                         WMTE technologies become   **???????**
                         widely available

- **innovating innovation** (John Seely Brown)
  - our ideas of innovation have gone stale → be innovative in the area of **innovation itself**
  - will WMT be a **"disruptive innovation"** (= something that actually changes social practices: the way we live, work and learn → beyond "gift-wrapping")

- **challenges associated with disruptive innovation:**
  - it is not technology per se that matters, but **technology-in-use**
  - **shift the discourse**: from a concern about who has **access** to new information technologies → who will have the **knowledge** to design, create, invent, and use the technologies enhancing human lives

The Challenge for WMTE: Beyond Technology

- question: what is the magnitude of a change?
    - oral → literal society
    - printing press
    - digital media
    - World Wide Web (WWW)
    - **WMTE**

- new divisions of labor

- redefinition of the unique human role in socio-technical environments

Conclusions

- WMTE: it is **not simply a technology challenge**

- the biggest problem in the field of WMTE is an **imagination crisis** of exciting things to do, of understanding the trade-offs (opportunities and pitfalls

- the future is not out there to be "discovered" — it has to be **invented and designed and not only**
  - by info-enthusiasts, based on techno-determinism
  - by limiting ourselves to gift-wrapping

- looking ahead: **predicting the future**

  "This is not the end. It is not even the beginning of the end. But it is, perhaps, the end of the beginning." —Winston Churchill