Uncommon Thinking for the Common Good

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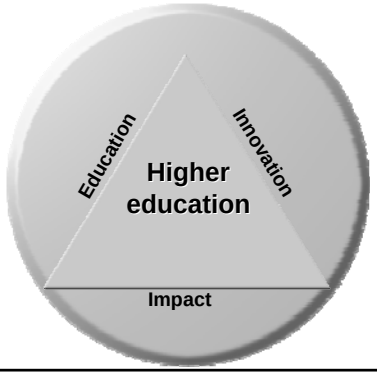
Global challenges

- Education
- Environment
- Health
- Economy

Social compact



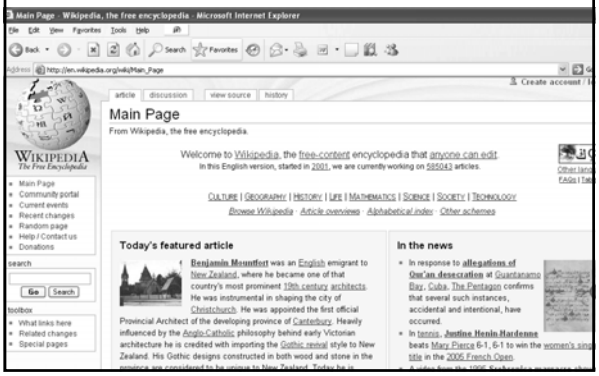
"How do you take the best of intentions and turn it into positive change?"

—Clinton, 2009

Emerging culture

Anything, anywhere, anytime

Expertise redefined



Collective intelligence

- Collective intelligence: everyone has something to contribute
- Knowledge is created not possessed
- Shift in emphasis, e.g., wikipedia is a process not a product
- Social connections are important
- Need "skills for participation" (e.g., social skills; cultural competencies) not just individual skills
- Age doesn't matter; a "newbie" can be 60 and the expert 16

—Jenkins, 2008

Enabling architecture

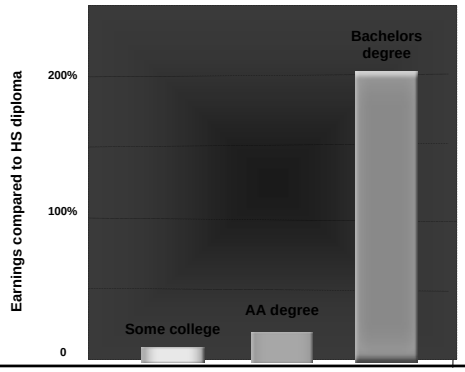
- Internet provides an architecture for participation and collaborative creation
- Accessible work can be modified
- Society benefits from small, cumulative contributions of millions of people
- Use by everyone does not exclude use by anyone

—Digital Connections Council, 2006

The Internet is not just a technology….it is a mindset

Educational imperative

Impact of a degree



Inadequate preparation for college

- Only 22% of high school students are prepared to earn a C or above in first year college courses
- 6 of 10 high school students took the recommended core curriculum
- Of that 60%, only 27% achieved level of attainment needed to succeed in 4 core college courses
- 4 in 10 take remedial courses
- 4 or 5 students in college remedial courses earned good grades in high school —a B or better
- 75% of US high school graduates are not proficient in math

—Ferguson, 2008

College readiness and work crisis

- Students need the same level of preparation in reading and mathematics for work or college
- Most American high school students are not ready for either work or college
  - —Half of students are capable of succeeding but are not prepared to do so
  - —3 in 10 students aren't yet, but could be, prepared to succeed

—ACT, 2004

Inadequate preparation costs $16B

- Graduating from high school without adequate preparation for college or work will cost **$16 billion** per year in remediation, lost productivity, and increased demands on criminal justice and welfare systems
- Students who require remediation courses are less likely to graduate
  - —70% who took 1 or more remedial reading courses did not graduate or receive a certificate
  - —58% who took 1-2 remedial math courses did not graduate or receive a certificate

—ACT, 2005

High school may be too late

- 8th grade academic achievement has a greater impact on college and career success than high school achievement or family background
- **80%** of 8th graders do not have the knowledge and skills they need to enter high school and succeed
- Students not prepared for high school are less likely than others to be prepared for college or work

—ACT, 2008

College completion challenge

- 100 students in 9th grade
- 70 graduate high school in 4 years
- 37 of the 70 enter college within 1 year
- 22 of the 37 don't need remediation before earning college credit
- 19 of the 37 graduate college (BA) within 6 years

—Sampson, 2008

Access and affordability

- Tuition increasing 2x faster than inflation
- Tuition increasing faster than state funds
- All 50 states face long-term budget deficits; budgets squeezed by mandated spending increases
- State funding not keeping pace with enrollment growth or inflation

—Wellman et al., 2008

Global demand

- 120 million students by 2010
- Enrollment growth accelerating; governments see education as a way to move from developing to developed nation
- Education needed by the 4 billion people at the bottom of the economic pyramid

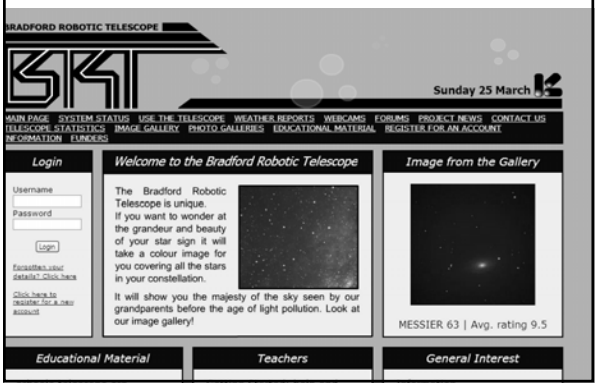
—Daniel, et al., 2006

Access to scholarly information

- Open educational resources
  - —Open Courseware Initiative
  - —Connexions
- Self-publishing
- Open books
- Campus archives

Instant information; context

Virtual observatory

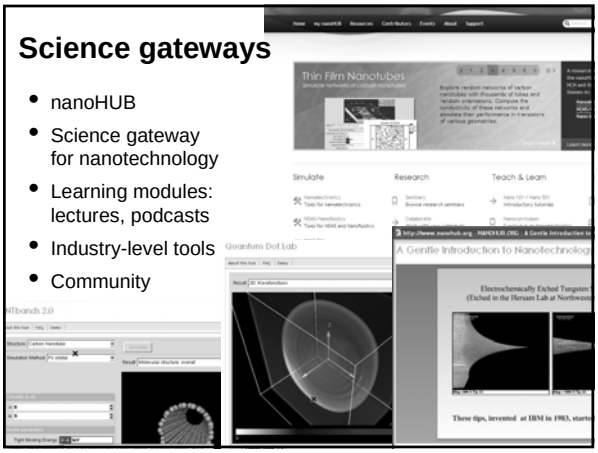


Student-created resources

Ancient Spaces: Developed by the Faculty of the Arts, University of British Columbia

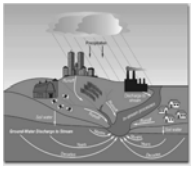
Science gateways

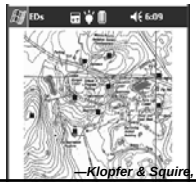
- nanoHUB
- Science gateway for nanotechnology
- Learning modules: lectures, podcasts
- Industry-level tools
- Community



Augmented reality

- Environmental detectives
- Players briefed about rash of local health problems linked to the environment
- Need to determine source of pollution by drilling sampling wells and ultimately remediate with pumping wells
- Work in teams representing different interests (EPA, industry, etc.)





—Klopfer & Squire, 2003

Image courtesy of Phil Long, MIT

Environment

The Internet is not carbon neutral

- The Internet requires 14 power stations for power, turning out the same amount of CO_2 emissions as the airline industry
- One small server generates as much CO_2 as a SUV with a fuel efficiency of 15 mpg
- Data center servers, AC and networking equipment used 1.2% of US power in 2005
- PCs and monitors account for 1/3rd of IT power consumption and CO_2 emissions
- At current growth rates the Internet will consume as much energy in 25 years as all of humanity does today

—ASTA, 2008; St. Arnaud, 2008

E-Waste

- Estimated 133,000 PCs are discarded by US homes and businesses each day
- Less than 10% of electronics are recycled
- In 2005 EPA estimated that unused/unwanted electronics amounted to 1.9 to 2.2 million tons of waste
  - —1.5 to 1.8 million tons discarded in landfills
  - —345,00 – 379,000 tons were recycled
- Estimated 50 million tons of e-waste is generated globally each year

Hanselman & Pegah, 2007

International challenge

- All countries have their own version of the "American dream"—house, car, microwave, refrigerator
- Billions of people are moving from "low impact" to "high impact" lifestyles
- By 2020 80% of the growth in energy demand will be from developing countries
  - —China will represent 32%
  - —Middle East will represent 10%

—Friedman, 2008

The Internet may be part of the solution

- Dematerialization, or creating goods and services using fewer natural resources (e.g., online news) may be part of the solution
  - —PDA vs newspaper: 32-140 times less CO_2; several orders less NO_2 and SO_2
- Virtualization one of most effective tools for cost-effective, greener computing
  - —Example: Princeton's plasma physics lab
  - —Cut 75% of annual power and cooling costs
  - —Improved processing power 3x
  - —Emitted 28 fewer tons of CO_2
- More efficient PCs (thin clients, notebooks) can reduce the amount of CO_2 produced by 75%

—Intel, 2007; American Consumer Institute, 2008; McGee, 2007

"Widespread adoption of broadband in the US alone would cut energy use by the equivalent of 11% of annual oil imports."

—American Consumer Institute, 2008

Economic development

Broadband

- The critical infrastructure of the future
- Universal broadband would contribute 300,000 jobs for each 1% increase in penetration
- Broadband enables
  - —Innovation
  - —Cost-savings
  - —Addressing problems in education and health care

—Brookings Institute; Criterion Economics, 2008

Universities as economic engines

- Over 50% of basic research is conducted at universities; foundation for new industries
- Universities account for 15% of applied research and development
- Campus innovations diffused through patents, start-ups and consulting
- Economic impact of universities, for example:
  - — NC State graduates infuse $2.9 billion into North Carolina's economy each year
  - — Every dollar of state funding generates $8 in total income for North Carolina

—Bernanke, 2007

Spin off companies

- SAS (software)
- Sicel Technologies (biomedical)
- Biolex (neutracueticals)
- Lipomed (biome
- Cree (electronics)

Re-creating yourself

- Today's learners will have 10-14 jobs by age 38
- The top 10 in-demand jobs in 2010 didn't exist in 2004
- 1 out of 4 workers has been employed by their company for less than one year
- 1 out of 2 workers has been employed by their company for less than 5 years

—US Department of Labor; Fisch, 2007

Virtual organizations

- Distributed across space: participants span locales and institutions (can include 'citizen scientists')
- Distributed across time: synchronous and asynchronous
- Computationally enabled: collaboration support systems
- Computationally enhanced: simulations, databases, analytic services

—NSF, 2008

Earthquake collaboratory

- Network for Earthquake Engineering Simulation (NEES)
- National collaboratory: a distributed research center
- Advances understanding of how earthquakes and tsunamis affect man-made infrastructure
  - —Roads
  - —Buildings
  - —Port facilities
  - —Public utility systems
- Shared, community-wide data system
- Open system for community contributions

"Being connected is not sufficient—we must be smarter, infusing intelligence into the way the world works."

—Pamisano, 2008

"We are now all connected—economically, technically, socially."

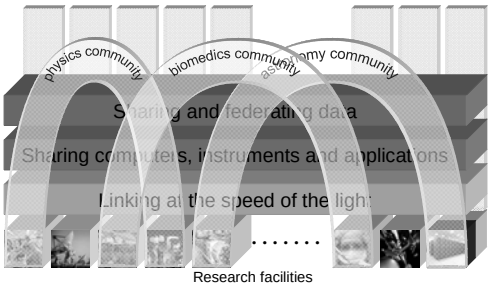
Common and uncommon

Collaboration

- Community's ability to interact, collaborate and explore
- Harness distributed computing resources that cannot be supported by individual campuses
- Create international network of resources
- Enable new forms of scholarly inquiry and education

—Bottum et al., 2008

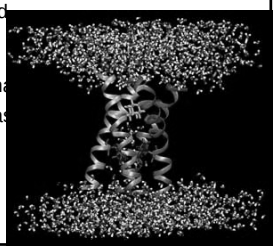
Infrastructure for discovery



—Campolargo, 2008

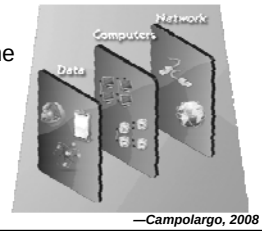
Distributed

- TeraGrid: Open, distributed scientific discovery infrastructure—brings campus resources together in grid
- Low-threshold access to more resources than a campus could afford individually
- Distributed facility; resources independently owned and mana
- 100+ discipline-specific databas
- Enables communities to use resources through a common interface



Data as an infrastructure

- The amount of data is doubling every year
- Large collaborations are emerging to collect and aggregate data
- E-research is emerging; computational techniques are essential
- Scientists need to be at home with their discipline, but also data management and computational skills



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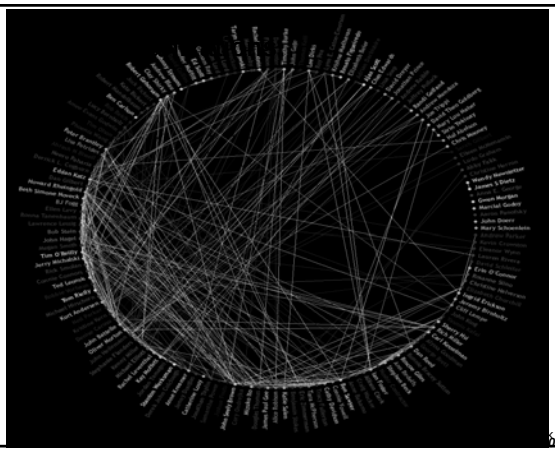
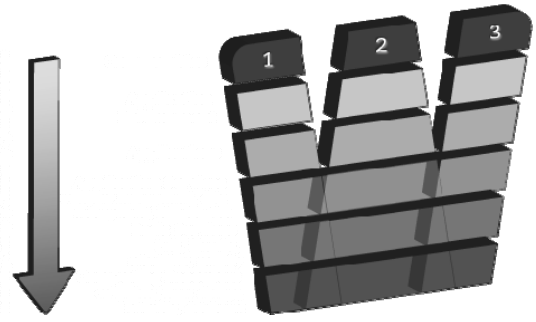


Leveraging investments



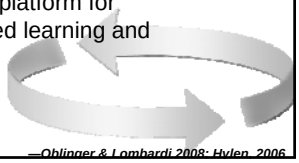
—McCartney, 2008

Creating a collaborative culture

- IT has a role in creating social connections
- It facilitates the work of virtual organizations
- Enhances the power of discovery through human + machine computation
- IT contributes interfaces for
  - —Interaction
  - —Workflow
  - —Visualization
  - —Collaboration
- Mechanisms for sharing resources and services

Leverage all contributions

- Adopt principles of connections, co-creation and collective intelligence
- Networked community that pools resources
  - —Distributed across the globe
  - —Sampled, mashed up, remixed and re-contextualized for effective local use
- University becomes a platform for collaborative, supported learning and discovery



—Oblinger & Lombardi 2008; Hylen, 2006

A common purpose

uncommon thinking for the common good

It's not about information.
Or technology.
It's what we do with IT that counts.

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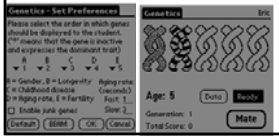
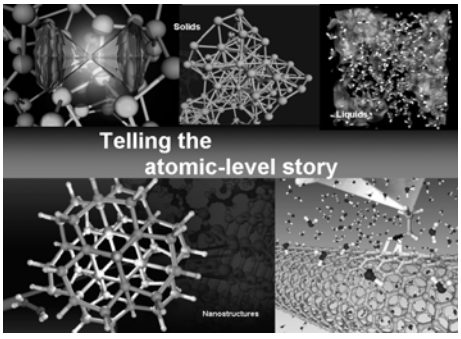
EDUCAUSE
Transforming Education Through Information Technologies

Virtual university

Active

- Goal is to live as long as possible and reproduce
- Ability to survive is linked to the genome; must figure out the genetics involved
- Mating is by "beaming" between hand-helds





Reduction in greenhouse gases

	Annual savings	Forecast 10-year savings
Telecommuting	134.7	568.2
E-commerce	37.5	206.3
Teleconferencing	36.3	199.8
Replacement of mail, CDs, publications with online equivalents	9.8	67.2

(millions of tons)

—American Consumer Institute, 2008