Teaching as Design

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Traditional Western Formal Education

- Plato's Academy 385 B.C.

- Univ. of Bologna 1088 A.D.

- Student books rare

- Teacher lectures to deliver information

Printing Press ~1440 A.D.

- **Radical change in teaching possible:**

  Reading assignment

- **But still we lecture!**
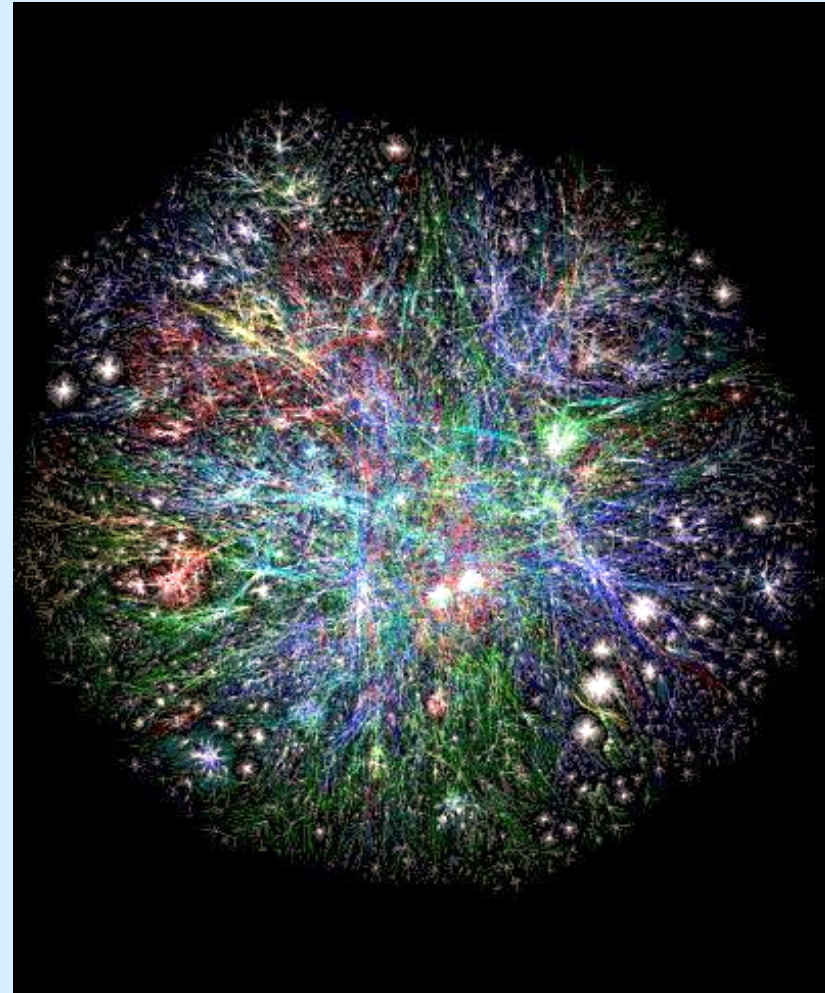
More Media for Info Delivery >1800

- Photos

- Recordings

- Movies

- Videos

- But still we lecture!

The World-Wide Web 1990

- **Interactive teleprocesing**
- **Incredible connectivity**
- **Fast search**
- **Wikipedia**
- **Totally new means of information delivery**
- **But still we lecture!**

Assertion (after Dewey)

- Most of us learned most that we know well by

- What we *did*,

-      not by

- What we *read or heard explained*.
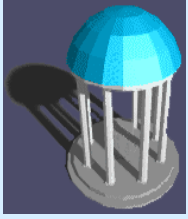
- But still we lecture!

Paradox

- We learn chiefly by Induction

But

- We teach chiefly by Deduction!

Including this dictum!

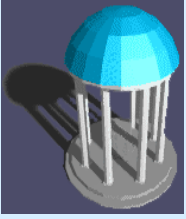Including this whole talk!

The Teacher's Job
is to

Design Learning Experiences

not principally to Deliver Information

So, Focus is on

- LEARNING, not TEACHING

  STUDENT, not TEACHER

  EXPERIENCE, not TEXT

  SKILLS, not INFORMATION

  DESIGN, not PREPARE

Teaching is a Design Task

and

Computer Scientists are

Designers!

The Scarcest Commodity

- In education, the scarcest commodity, whose allocation causes the most heated debate, is not money, it is:

- **Student Time**

CS Education Content

- Background: e.g., number systems
- Theory: e.g. big O concept
- Description of practice: e.g. computer architecture
- Skills for practice: e.g. programming

- CS information obsolesces fast
- CS skills stay

Donald Schön's Insight

- All professional education teaches the *skills* of the profession by *critiqued practice.*

- E.g., law, medicine, architecture, the ministry, art, music, social work, and indeed engineering.
  - *Educating the Reflective Practioner* [1984]

How Does This Play Out?

- Assignments
- Flipped classroom
- Quizzes & Tests
- Student-designed lessons
- Project-based learning
- Learning new skills, resources
- Yes, some old-fashioned lectures

Flipped Classroom for Critiqued Practice

- Information uptake at home

  - On-line and/or book

- Homework at school

  - In pairs, often

- Teacher walking around, giving dynamic critique

A Quiz for Learning Illumination Models

- **You are flying at high altitude over a (really) flat river delta.   The terrain below consists of**

- meandering streams networking the delta:
  kd=0.0 ks=0.9 n=100

- dry sand islands among the streams:
  0.5   0.0   1

- damp sand islands among the streams
  0.2   0.5   8

- ocean, with small waves   0.1   0.8   4

Quiz Assumptions

- Assume the earth's surface is planar and all terrain is at the elevation 0.

- Assume the ambient+Lambertian+ Phong illumination model accurately describes this real-world situation.
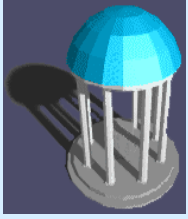
Quiz Question 1.

- 30 min. You are over the delta, near the ocean. Describe qualitatively what you see as you look down and out towards the horizon, moonward.   Be as complete and precise as you can.

- 15 min. Give an equation for *f,* the fraction of the incident moonlight reflected to you, as a function of ß, the angle between your line-of-sight and the vertical. (Here, assume the moon is a point source.)

Projects

- Costly in time

- Deep vs. broad?
  - Make the curriculum broad, the courses deep

- Collaborative?
  - 2 is magical, so is 1

Architecture Course Project

- Special-purpose machine
- Milestones with early deliverables:
    - Application description—Precise
    - Programming manual—End first month
- Intensive critique
- Early turn-in of complete project
- Intensive critique
- Do it over!

Software Engineering Lab

- 22x since Spring, 1966

- Real projects for real clients

- Teams of 3, 4, 5

  - Self-formed or prescribed

- Menu of project choices, 2x teams

- Mandatory role separation: boss, chief designer

Software Engineering Lab (cont)

- Eliciting client requirements (!)

- Weekly coaching

- Early deliverable to client, meeting

- Something running early!

- Public presentation

- Team grade+individual grade

  - Point budget for teammates

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