CyberLab: Internet Assisted Experimentation

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Content

- Statement of the Problem
- Current status
- Cyberlab solution
- Comparison and Benefits
- Summary

Education/Problem Statement

- Primary objective of education:
  - Teach students to Learn to Think, to Gain Knowledge
- Constraints:
  - I/O bandwidth into the brain, brain processing power, limited resources, assets, time, existing infrastructure
- In past one-on-one education has been most effective
- Problem Statement:
  - Optimize a student's learning process under the constraints.

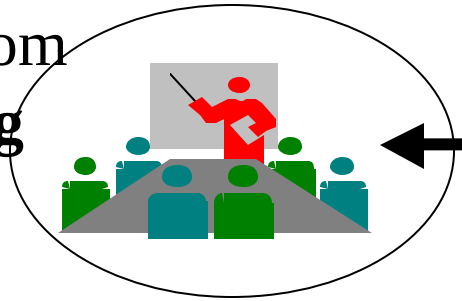
Conventional Approach

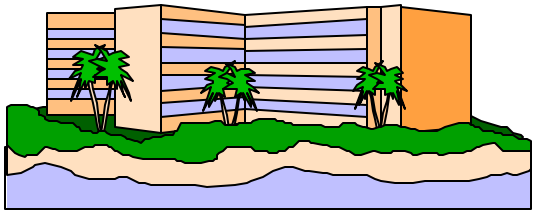
Traditional learning: 3-Body Problem

Administration

$$, employment

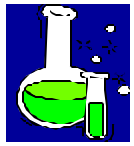
Classroom **teaching**





Universities

Laboratory



Time, effort, learning rate

$$, Degrees

High Inertia System

Students

Learning Process: My Observation!

Information

I/O limited

Creation of new knowledge, understanding, innovation

Very low I/O

Richard Feynman

- Storage: repetitive reading
- Processing: difficult, takes time and effort
- Feedback loop system

What role can the Internet play in this process?

The Role of the Internet

- Efficient Reading Machine
  - **“Live Book”**
  - **Internet make teacher/student tasks easier, more efficient**
- Benefits:
  - Efficient information provider: Students, labs and teachers can be at separate locations and times
  - Frees the teacher and student from cumbersome tasks
  - Provides more time for learning through more personal contact with the teacher, and others
- Build on top of the current educational infrastructure

CyberLab Value Proposition

- Provide:
  - Reliable, well thought-out laboratory system
  - Access to scarce resources to a wider population of students through time sharing
- Benefits:
  - Reduce cost of education through efficiency
  - Reduce the barrier to entry to laboratory work
  - Promote discovery through experimentation
  - Improve classroom teaching and distance learning through demonstrations
  - Allow more time for personalized education

Virtual Versus Remote Lab

- Virtual (computational) Lab:
  - Computations and simulations often cannot capture full range of experimental phenomena
  - Real-life effects hard to model
- CyberLab:
  - Real live experience with physical laboratory
  - Physical effects can be explored
  - Remote access brings real-world learning experience
- Combine Virtual and CyberLab

The Vision

CyberLab™ Building Blocks

Analysis tools

Message board

Professor

Student notebook

Experiment

Reference materials

Scheduler

Lab information

Student friendly Web site

Lab Notebook

Contains all information about the experiment:

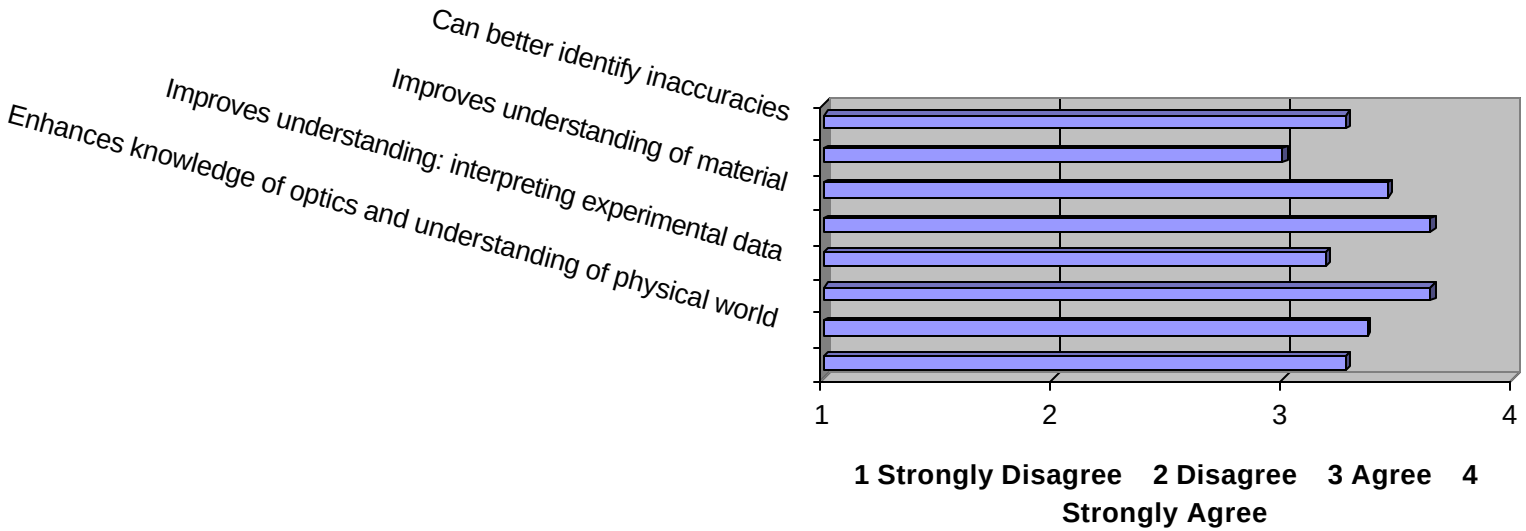
Handouts
Correspondence
Data
Reports
To do list

CyberLab Proto Demonstration

- Notebook manages collected information
- Schedule allows sharing of resources
- Real-time laboratory
- Information on lab equipment
- Data Analysis
- Instructor Correspondence
- Main Navigation Tool

Student Evaluation EE366

Key Questions - Educational Value of CyberLab



Benefits

- CYBERLAB

- Instill good laboratory practices
- Student excitement stimulates learning
- Provide access to laboratory, computational, and reference facilities worldwide
- Cost effective learning tool
- Sharing of resources
- Convenient and fun
- Remote hands-on experience

- WET LAB

- Instill good laboratory practices
- Student frustration often impedes learning
- Does not provide efficient access to laboratory, computational, and reference facilities worldwide
- Expensive learning tool
- Difficult to share resources
- Often frustrating and tedious
- Hands-on experience

Summary

- CyberLab:
  - *More efficient education delivery, at lower cost and with more user flexibility*
  - *The Internet makes low-value student/teacher tasks easier*
- Pilot program in 1998 was very successful
- Students seem to like it:
  - It is *convenient* and *fun*
- The Internet:
  - "Live Book" education tool
  - Allows more teacher/student time for truly important tasks