MIT's 3.091 and NSDL Materials Digital Library: Investigating the Role of Digital Libraries in Freshmen Introductory Science Courses with No Lab Component

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Outline of today's talk

- ABET colloquy, January 2002
- dilemma facing classes
- hypothesis of this study
- January 2005
- next steps

The Thirteen Objectives

1. Instrumentation
2. Models
3. Experiment
4. Data Analysis
5. Design
6. Learn from Failure
7. Creativity
8. Psychomotor
9. Safety
10. Communications
11. Teamwork
12. Ethics (in Lab)
13. Sensory Awareness

Questions Asked of Panel:

- Are all of these Objectives necessary for Engineering Laboratory programs?
- Are those Objectives that are necessary currently in existing Laboratory programs?
- Could these Objectives be met remotely?
- What would it take to meet those that might not be able to be met currently?

Importance of Objective

ESSENTIAL	Ethics Data Analysis Communication Teamwork
VERY IMPORTANT	Models Experiment Instrumentation Safety
IMPORTANT	Sensory Psychomotor Failure Design

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Snapshot of 3.091 Fall 2004

enrollment **630**

lectures MWF (chalk & talk w/ AVs)

recitations TR (30 sections)

weekly problem set and quiz

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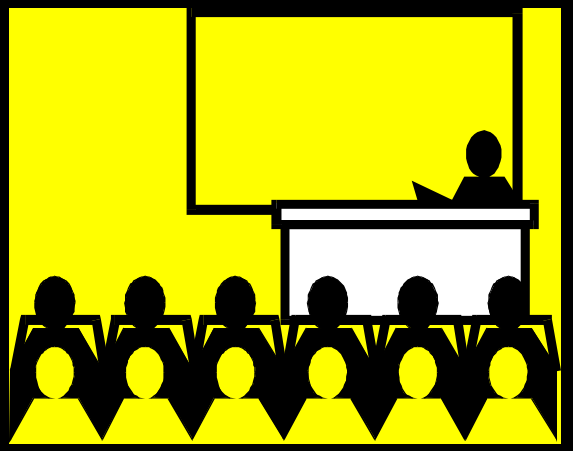
hypothesis



- the majority of objectives can be met by a virtual laboratory

- if so, 💣 💣 💣 💣 💣 💣 💣 💣

  the results are **scalable**

  - 600 students

  & **broadly applicable**

  - not restricted to chemistry

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IAP subject for credit

3.039 Solid State Chemistry Virtual Laboratory
Donald R. Sadoway, Patrick E. Trapa
Mon-Fri, Jan 10-14, 18-21, 10am-12:00m, 4-231
6 units

Part laboratory, part educational experiment, this subject will introduce laboratory practice without performing experiments. With the guidance of the professor and TA, students will plan three experiments, search for data in digital libraries, and analyze the results. Skill building will include technical writing and oral presentation including the preparation of effective slides.

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Materials Digital Library

MatDL.org

NSDL

NIST National Institute of Standards and Technology

NSDL Resources – Diverse Topics and Formats

Interactives

Documents

Maps

Data Sets

Communities of Practice

Images

Exhibits

Videos

Remotely Operated Instruments

News

Services

Teaching Resources

Professional Development

Visualization Tools

Tools

Animations

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MatDL Overview

MIT

Teaching Resources

- Solid State Chemistry
- Modeling & Simulation
- Transport Archive

University of Michigan

Teaching Resources

- Computational Nanoscience of Soft Matter

Research Resources

- Soft Matter Repository

MatDL.org Repository

MSEL/NIST

- Phase Diagrams
- MALDI
- CTCMS
- Combinatorial Methods
- Green's Functions

Kent State University

Tools

- Submission
- MatML grapher
- Course composition

University of Colorado at Boulder

- Metis Workflow Technology

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3.039 Materials Virtual Laboratory

- **8 students ☞ 2 "lab groups"**

- **two "experiments":**
  - **❶ Born-Haber cycle**
  - **❷ structure-property relationships in polymers**

3.039 Materials Virtual Laboratory

- **instruction by interactive presentation: skill building**
  - **data mining (MIT Libraries)**
  - **scientific writing (papers)**
  - **oral presentation (.ppt)**
- **intensive coaching of teams**

3.039 Materials Virtual Laboratory

- **measured effectiveness by self assessment before & after:**

1	3	5
worse	no change	better

3.039 Materials Virtual Laboratory

- **measured effectiveness by self assessment before & after:**

1 **3** → **5**

worse **no change** **better**

Self assessment of change in understanding

ABET Lab Objectives	N	Mean	Std. Deviation
Safety	8	3.00	.00000
Psychomotor	7	3.14	.37796
Sensory awareness	8	3.63	.74402
Instrumentation	8	3.63	.74402
Learn from failure	8	4.00	.75593
Design	8	4.13	.64087
Models	8	4.13	.64087
Analysis	8	4.25	.70711
Creativity	8	4.25	.46291
Experimental	8	4.50	.53452
Team work	8	4.50	.53452
Ethics in research	8	4.63	.51755
Communication	8	4.75	.46291

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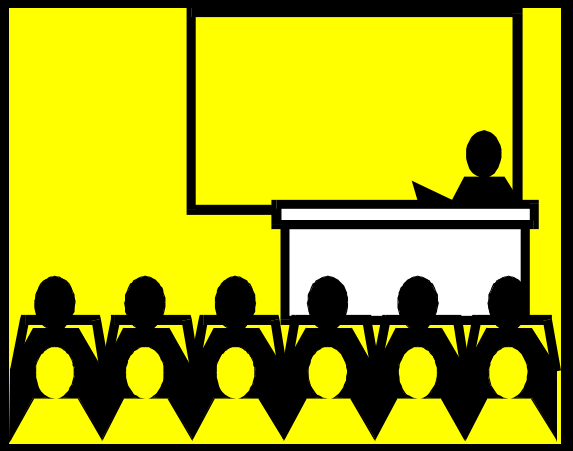
hypothesis validated



- the majority of objectives can be met by a virtual laboratory

- 

  the results are **broadly applicable**
  - not restricted to chemistry

  can we show the results to be **scalable**?
  - 600 students

next steps

- scale up to 3.091 (8 ☞ 600)
- fall 2005 begin with MIT Libraries, i.e., databases & bibliography
- plan for companion VL subject exploiting more of MatDL

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broader implications?

✏ **can the VL approach be adopted for large physics classes?**

acknowledgments

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