

Teaching and Learning in the 21st Century

Wolfgang Bauer

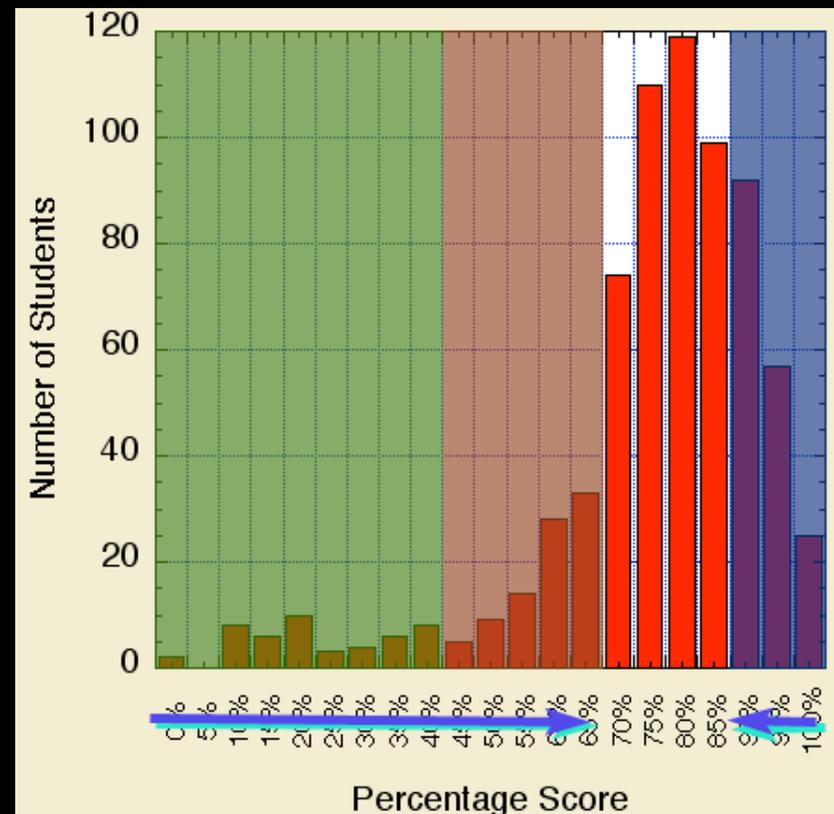
Michigan State University

“I think, however, that there isn’t any solution to this problem of education other than to realize that the best teaching can be done only when there is a direct individual relationship between a student and a good teacher [...] It is impossible to learn very much by simply sitting in a lecture [...] But in our modern times we have so many students to teach that we have to try to find some substitute for this ideal.”

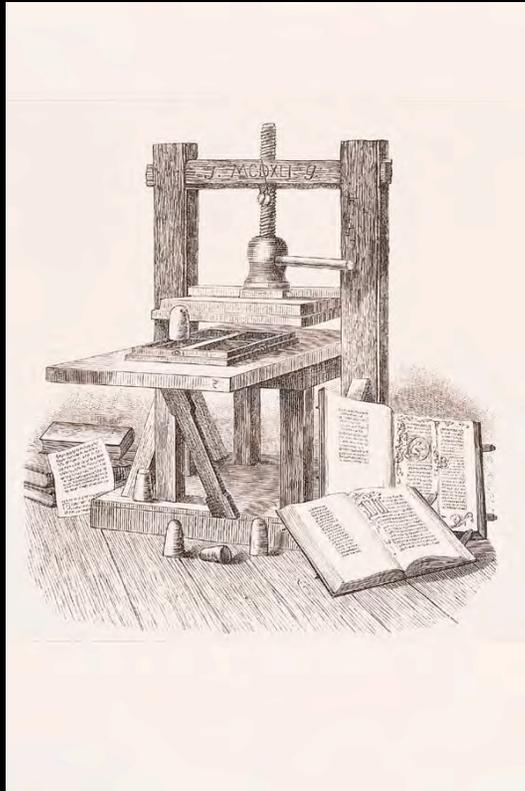
*Richard P. Feynman, June 1963
(Introduction to Feynman Lectures)*

Potential Problems in Large Lecture Classes

- Large spread in preparation of a diverse student population
- Impersonal nature of instruction / little one-on-one contact between instructor and students
- Achieving and maintaining high standards
- Large human resources required for grading
- Timely recognition of students' problems and difficulties
- Cheating on exams/Copying assignments



Technology Teaching Innovations



Gutenberg Press
~1450



Radio
~1900

Television
~1930

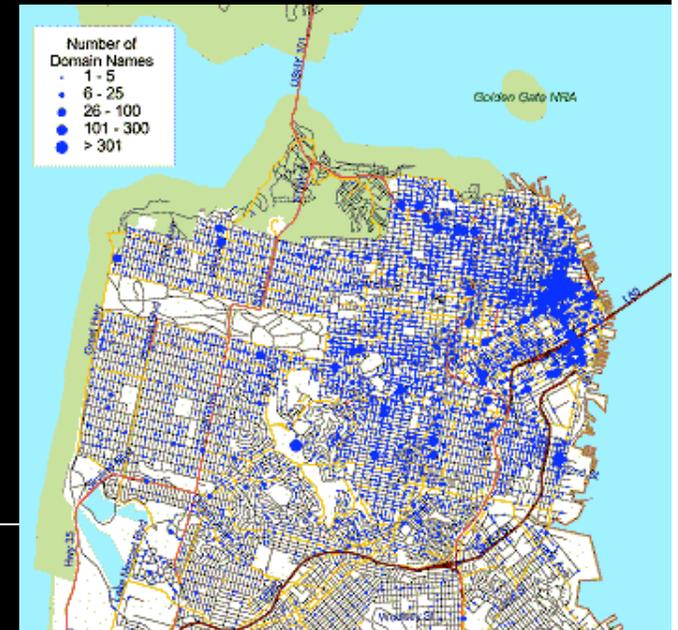


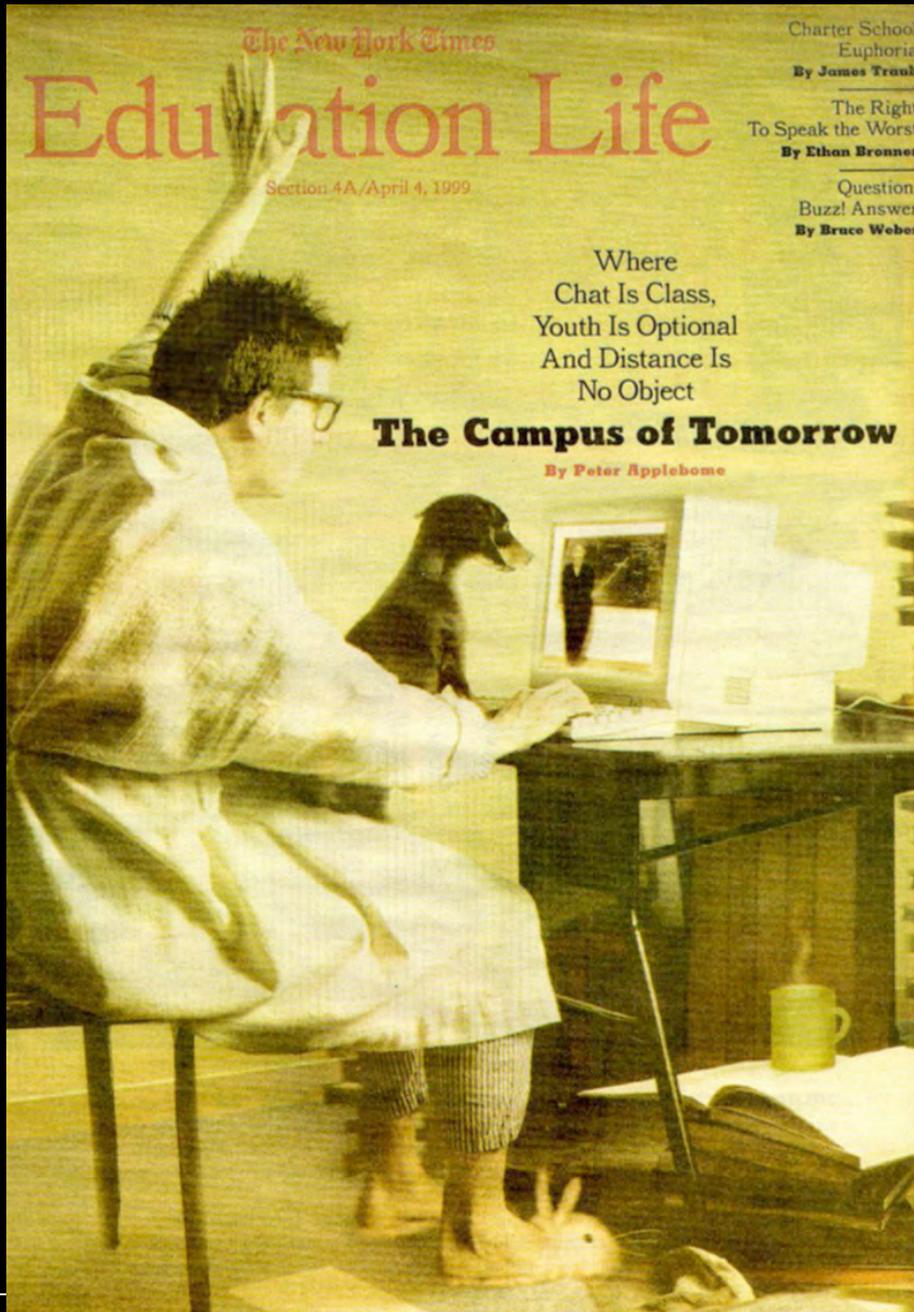
Internet

- First web-browser



Tim Berners-Lee, CERN, 1989



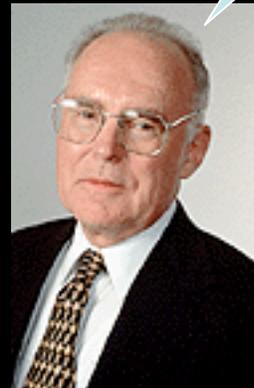
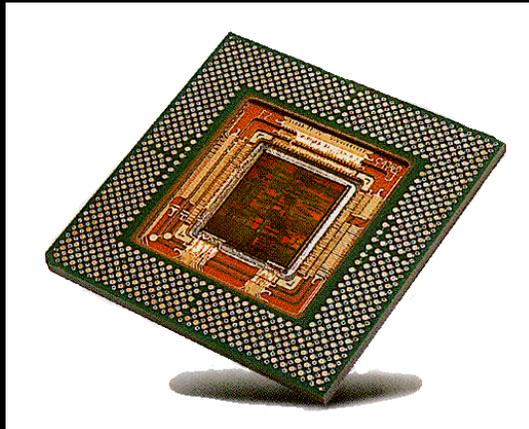


NY Times
April 1999

Moore's Law

- 1947: Transistor is invented
- 2006: Each Intel CPU chip has $\sim 10^8$ transistors
- This year, ~ 100 quadrillion transistors will be produced

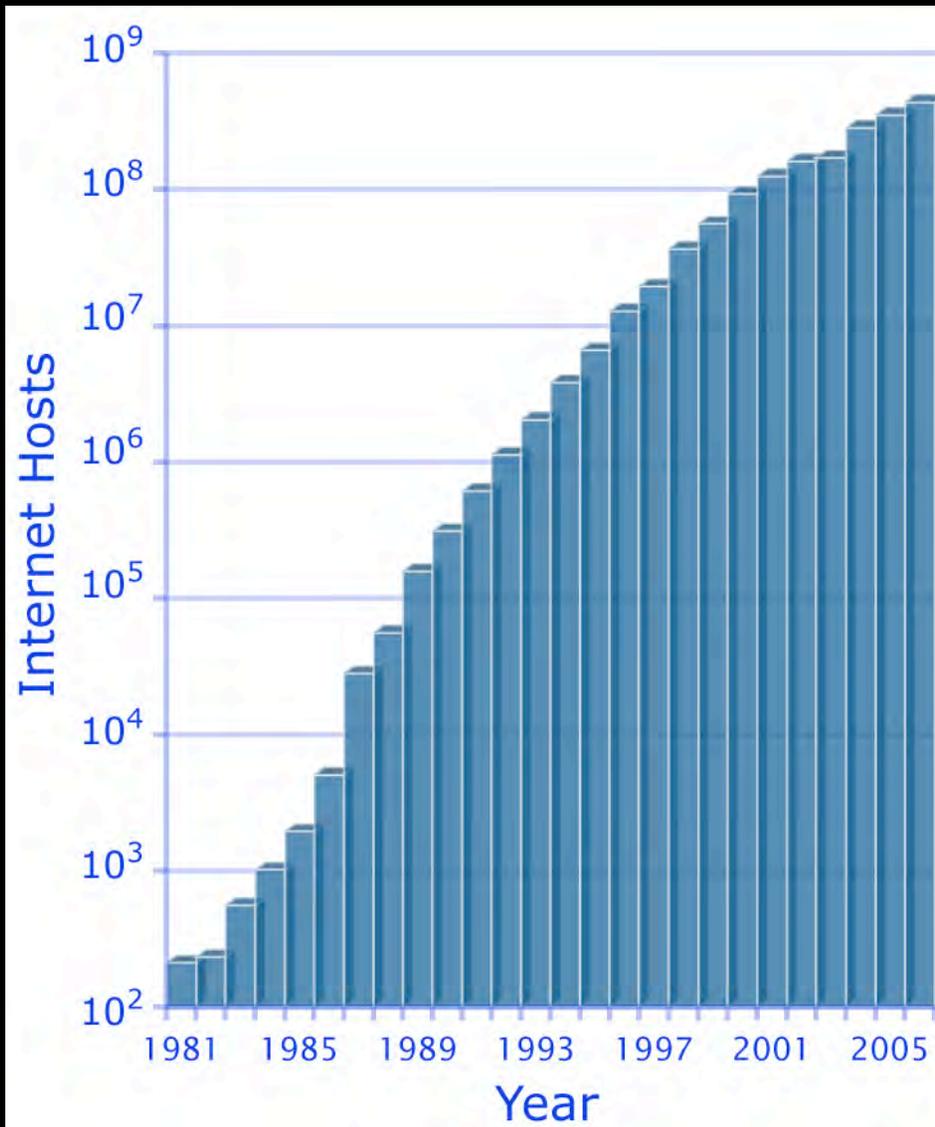
Microchips double in power and halve in price every 18 months



Gordon Moore



Growth of Internet



- Number of Internet hosts doubles every year
- Right now: 1 Internet host for every ten humans



Data:

<http://www.isc.org/>

Loading "University of Phoenix" <http://www.phoenix.edu/> Q- university

The Open University <http://www.open.ac.uk/> Q- open univ

FernUniversität in Hagen: Fernstudium | Weiterbildung | Akademiestudien <http://www.fernuni-hagen.de/> Q- fernunive

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FernUniversität in Hagen
Fernstudium – Weiterbildung – Akademiestudien

Sie haben Ziele. Sie wollen neben dem Beruf und der Familienarbeit studieren oder sich weiterbilden. Dann bietet Ihnen die FernUniversität in Hagen für Ihre Zukunft die ideale Lösung: im [Fernstudium](#) Bachelor-, Master und Diplomabschlüsse erwerben, wissenschaftliche [Weiterbildung](#) für den Karrieresprung und [Akademiestudien](#) für die Weiterbildung „on demand“ auch für Hochbegabte. Auf der Basis unserer praxisorientierten Forschung entwickelte Studienprogramme werden im modernen Medienmix des Blended Learning vermittelt. Der Umgang mit Rechner und Laptop ist für uns also neben Studienbrief und Präsenzphase selbstverständlich. [Unser Profil](#)
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Open "http://www.fernuni-hagen.de/Home/home_contentjs.html#" in a new window behind the current window

How big is the University of Phoenix?

The Chronicle: Daily news: 09/27/2006 -- 01: U. of Phoenix Buys Naming Rights to a Pro-Football Stadium

http://chronicle.com/daily/2006/09/2006092701n.htm

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THE CHRONICLE OF HIGHER EDUCATION
Today's News
Wednesday, September 27, 2006

U. of Phoenix Buys Naming Rights to a Pro-Football Stadium

By [GOLDIE BLUMENSTYK](#)

Following in the path of Gillette, FedEx, and Reliant, the University of Phoenix has bought the naming rights to a National Football League stadium, it announced on Tuesday.

Phoenix's \$154-million, 20-year deal with the Arizona Cardinals makes it the first university to

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Open "http://ad.doubleclick.net/jump/news.che/sz=120x930;num=76543?" in a new window behind the current window

W N I L T N O U T L I N E

- Learning Content Management System
- Assessment System
- Multiple Content Representations
- Research on Learning
- Open-Source

OUTLINE

- Learning Content Management System
- Assessment System
- Multiple Content Representations
- Research on Learning
- Open-Source

LON-CAPA

- Merger of three large instructional technology systems at MSU
 - CAPA - homework system since 1992
 - MultiMedia Physics - cd-based learning system since 1992
 - LectureOnline - web-based course management system
- Learning Online Network with Computer-Assisted Personalized Approach

LON = LearningOnline Network (1)

- Providing high quality learning content in an online environment is time and cost intensive
- Typical scenario today:
 - Online material is developed by only one instructor
 - Online material is used by only one instructor
 - Online material is used in only one course
 - No assessment of learning effectiveness
- Ineffective use of time and resources

LON = LearningOnline Network (2)

- Much better scenario:
 - Online material is developed and reviewed by more than one instructor
 - Online material is shared among instructors
 - Online material gets used across many courses and disciplines
 - Continual assessment of learning effectiveness

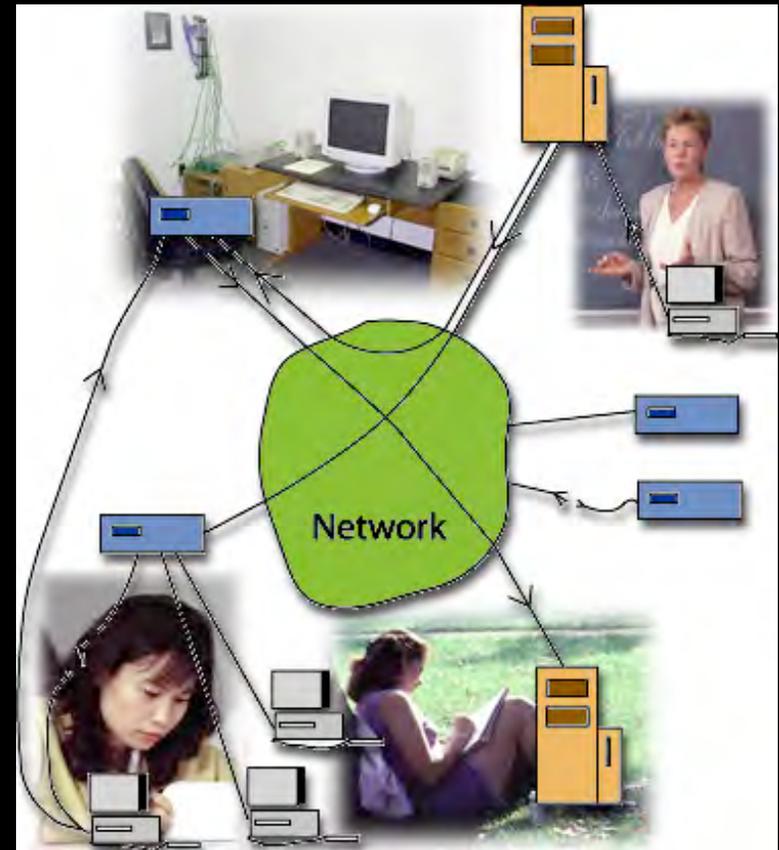
Multimedia Collaborative Content Creation (mc³)

LON = LearningOnline Network (3)

- We have built:
 - a cross-institutional cross-disciplinary content repository
 - a tool to seamlessly assemble this content
 - a course management system to readily deploy this content and courses built on it

Network

- Network of connected servers
- Any server in the network can serve sessions for any user
- Content replication in background
- Network-wide persistent URL paths
- Essentially unlimited *scalability*

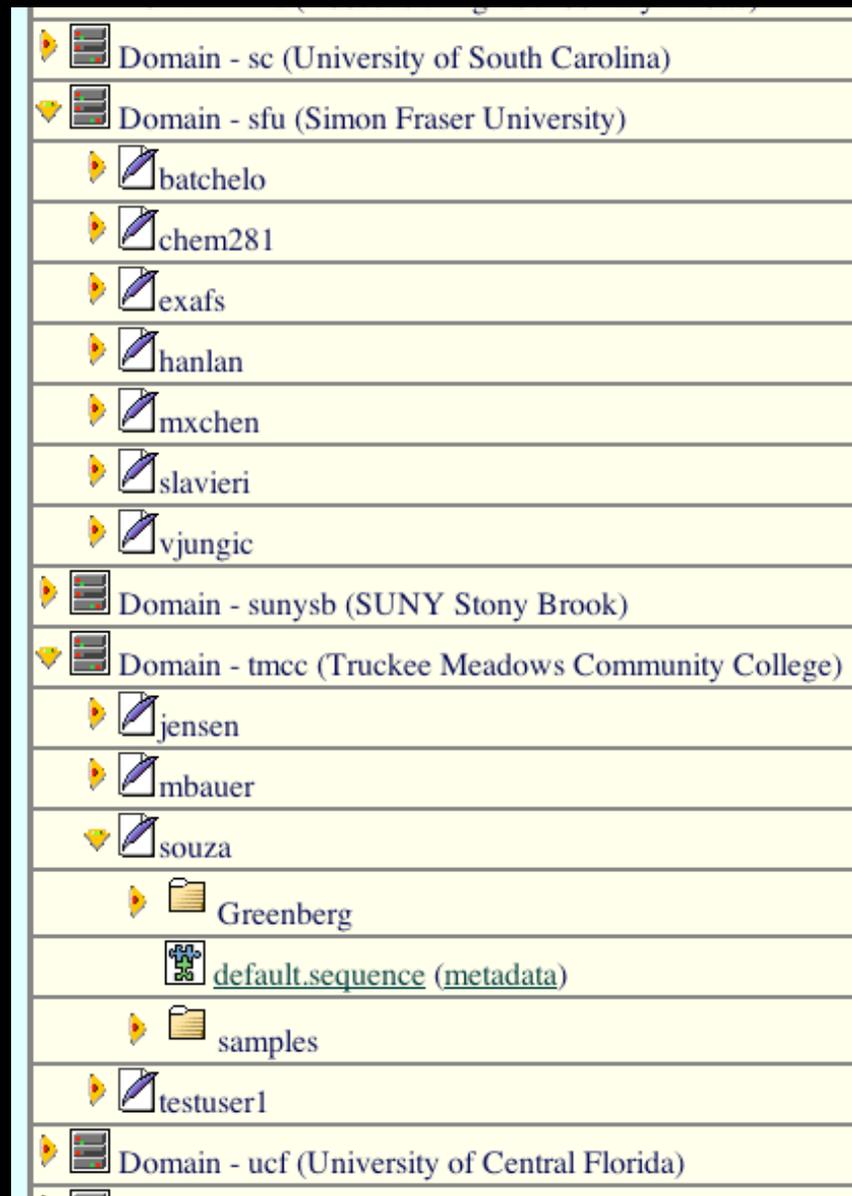


<http://neptune.physics.ndsu.nodak.edu/res/msu/mmp/kap18/problems/cd>

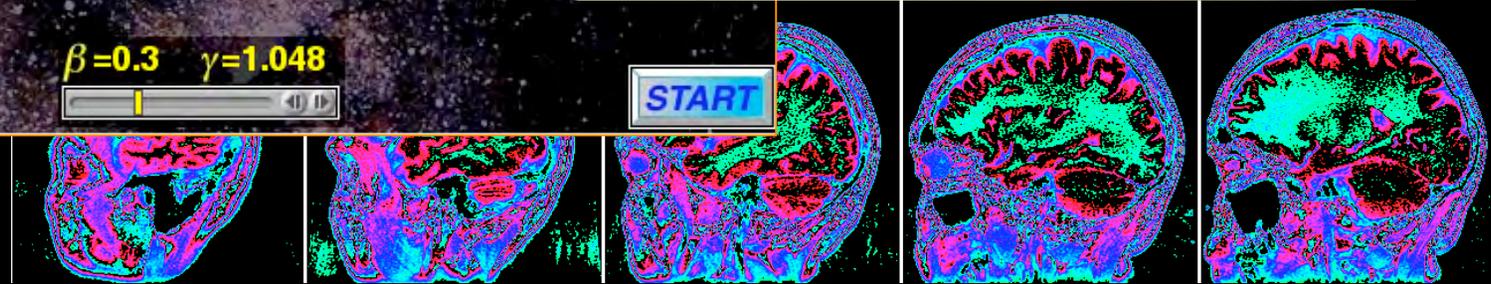
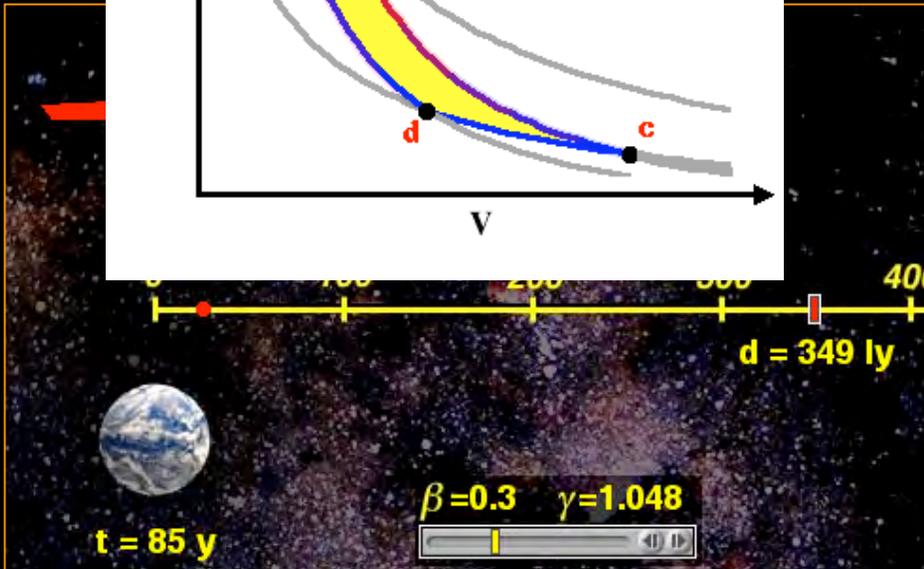
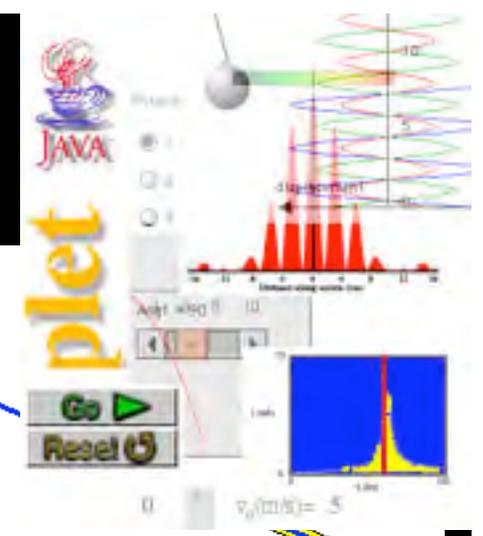
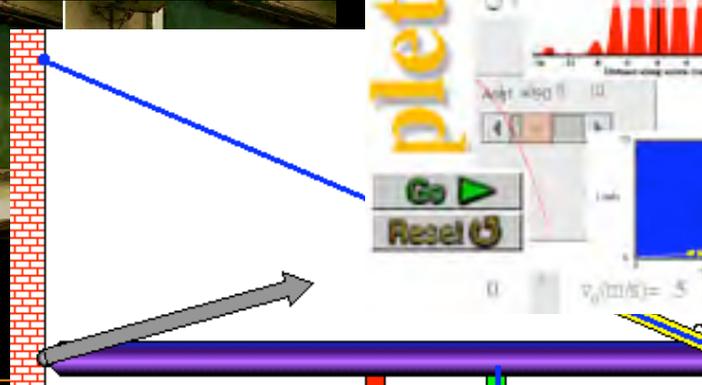
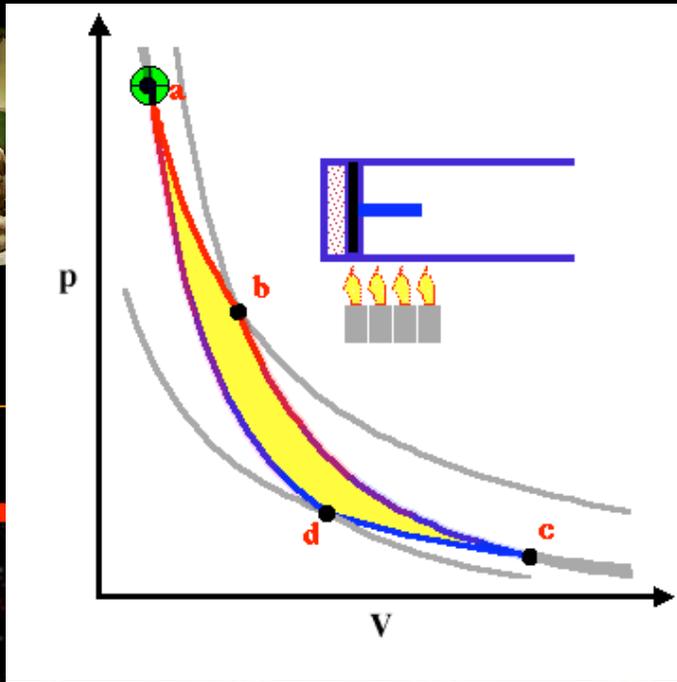
Virtual Filesystem

“The aisles of your supermarket”

Your shopping cart: The Resource Assembly Tool



Sample Resources



Search

- Statics metadata: Dublin Core, cross-walk to IMS
- Dynamic metadata: use assembly data for recommender system:

Access and Usage Statistics	
Network-wide number of accesses (hits)	890
Number of resources using or importing resource	1 <ul style="list-style-type: none"> • Eukaryotic Gene Control [msu/bio/Gene Expr/111f03GeneCntrl.sequence]
Number of resources that lead up to this resource in maps	1 <ul style="list-style-type: none"> • Back to the Original Question [msu/bio/Gene Expr/problems/originalquestion.problem]
Number of resources that follow this resource in maps	1 <ul style="list-style-type: none"> • Eukaryotic vs Prokaryotic Gene Expression II [msu/bio/Gene Expr/problems/eukvsprokII.problem]
Network-wide number of courses using resource	3 <ul style="list-style-type: none"> • LBS 145 - Spring 2004 • ZOL 711 - Fall 2003 • BS 11

Assessment Statistical Data	
Total number of students who have worked on this problem	291
Average number of tries till solved	1.37
Degree of difficulty	 (0.36)

Custom Rights

Edit action	Effect	Domain	Course	Section/Group
<input type="text"/>	deny	Default		
1. <input type="text"/>	allow	msu	<input type="text"/>	<input type="text"/>
				Select Course
2. <input type="text"/>	allow	fsu	14837df9f9b408dfsul2	<input type="text"/>
			PHY 2048C - General Physies A Summer 2004	Select Course
<input type="button" value="Store"/>				

Each author can determine for each individual resource or a group of resources which group of users has what set of usage rights under which conditions!

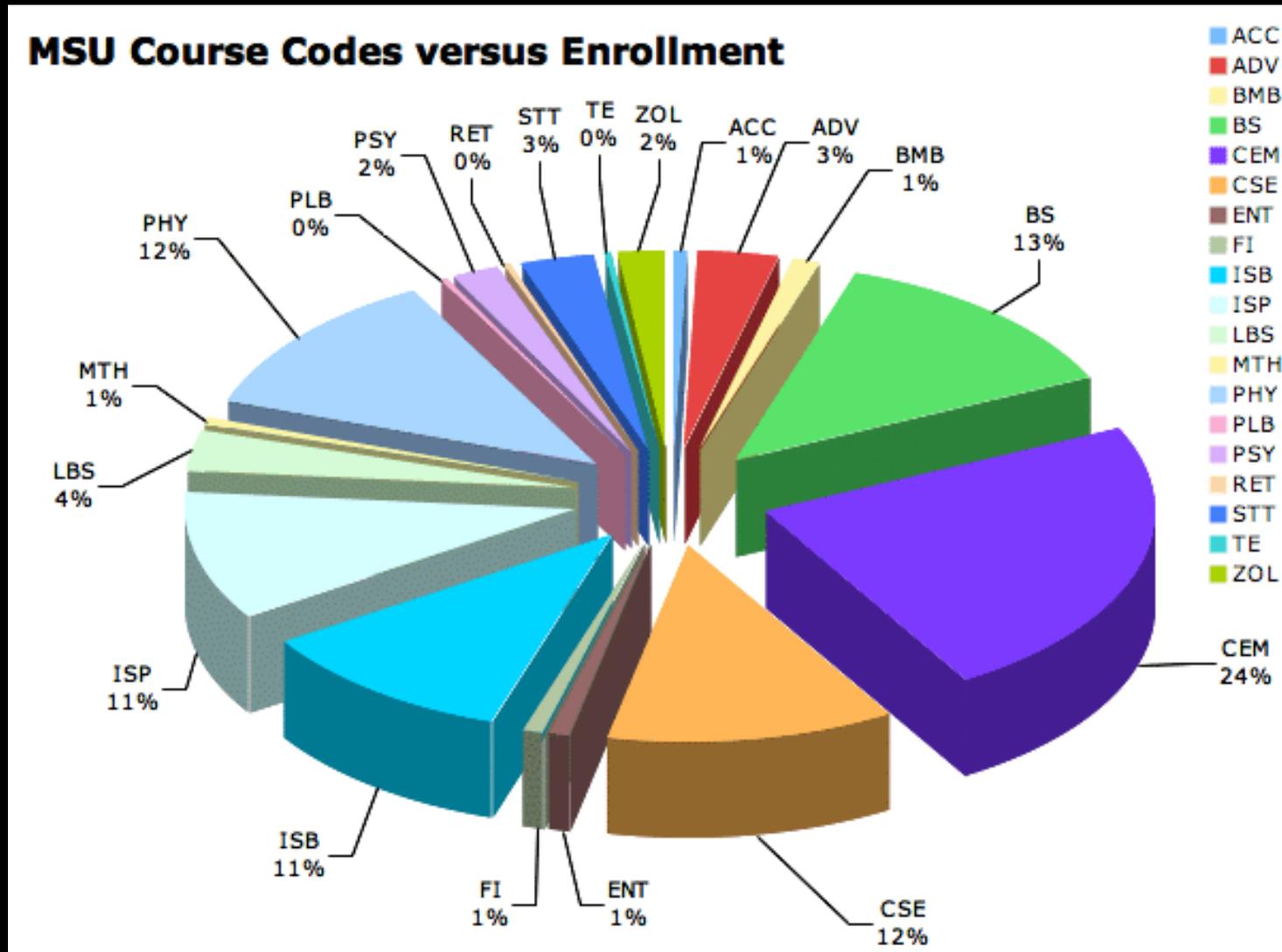
LearningOnline Network

- Oct. 2006 snapshot of resource pool

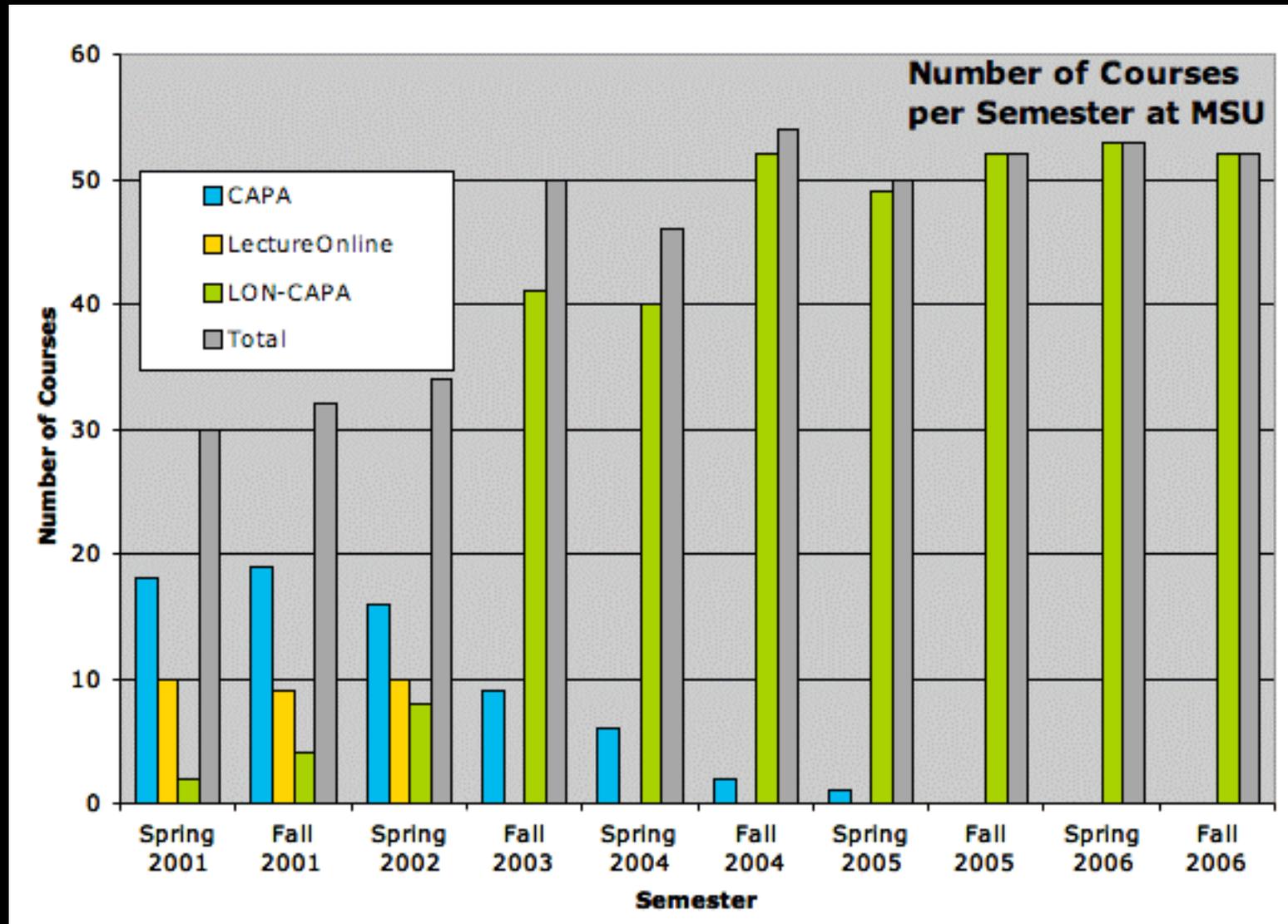
	Available	Used	Used externally	Instances of being used at institutions
Images	88079	18262	9629	43191
Problems	80009	57979	23816	111764
HTML content pages	57972	5888	2949	15877
Reusable content assemblies	7405	3184	1299	6228
Animations and simulations	1575	507	338	1728
Movie and sound files	742	326	105	587
Other (PDF, MS Office, etc)	11302	2484	674	3693
Total	247084	88630	38810	183068

- Biology, physics, chemistry, math, food science, geology, economics, ...

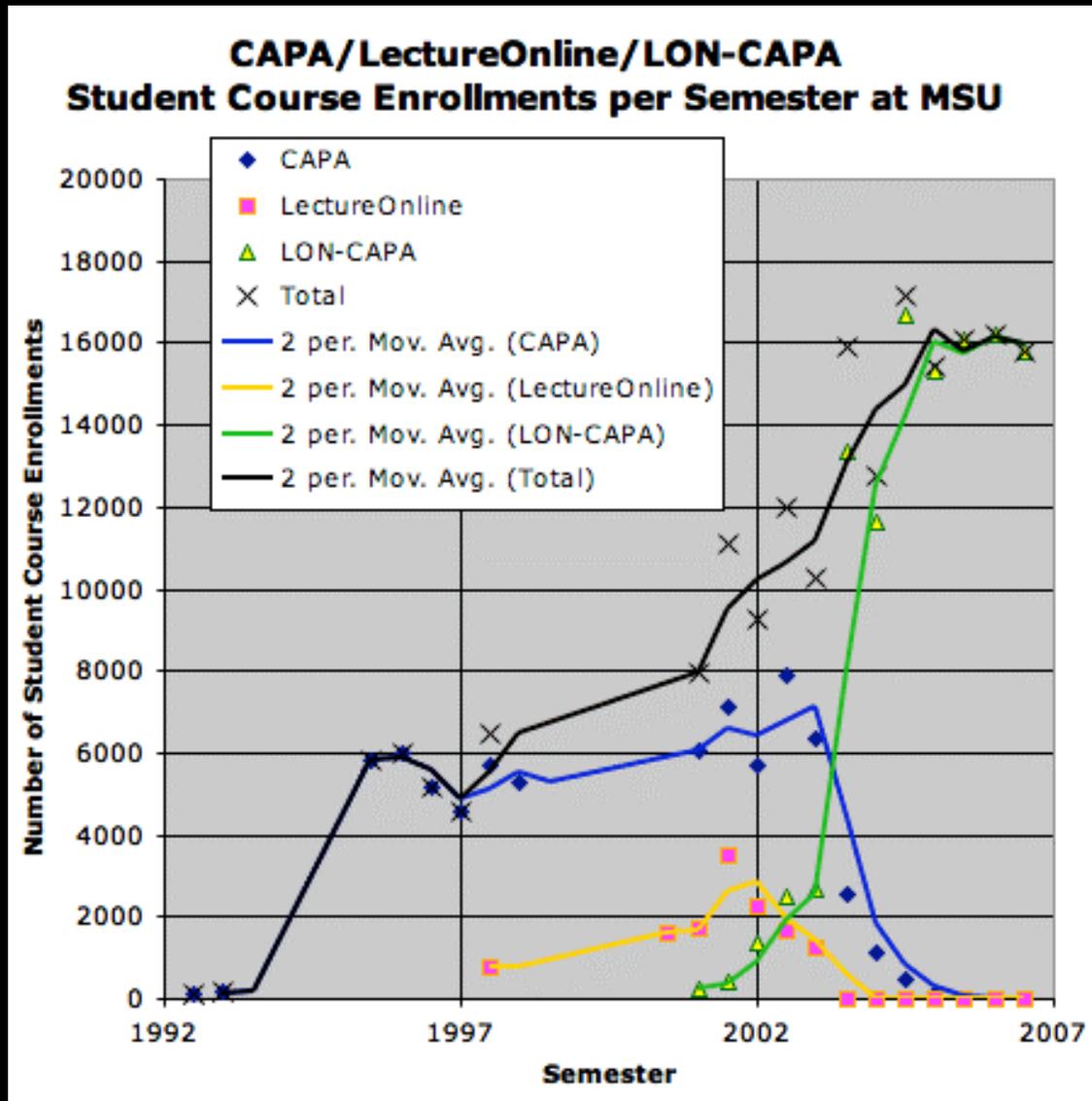
LON-CAPA use at MSU



LON-CAPA use at MSU



LON-CAPA use at MSU



- Some of the most prominent options for instructional technology (according to Freeman Publishers)

10. Are you using media in any of your classes?

- Yes
 No

11. If so, what are you using?

Please check all that apply:

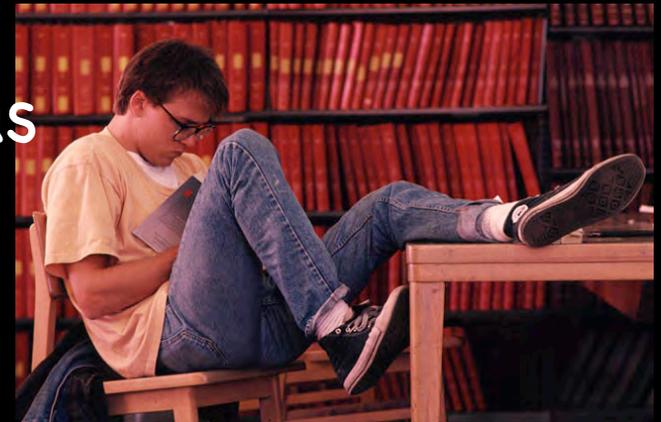
- PowerPoint presentations
 Encouraging students to research on the web
 Textbook's companion website
 E-books
 Clickers (student response systems)
 LonCapa
 MasteringPhysics
 WebAssign
 eGrade
 iSolve
 Physics Now
 Blackboard
 WebCT
 Other:

OUTLINE

- Learning Content Management System
- **Assessment System**
- Multiple Content Representations
- Research on Learning
- Open-Source

CAPA

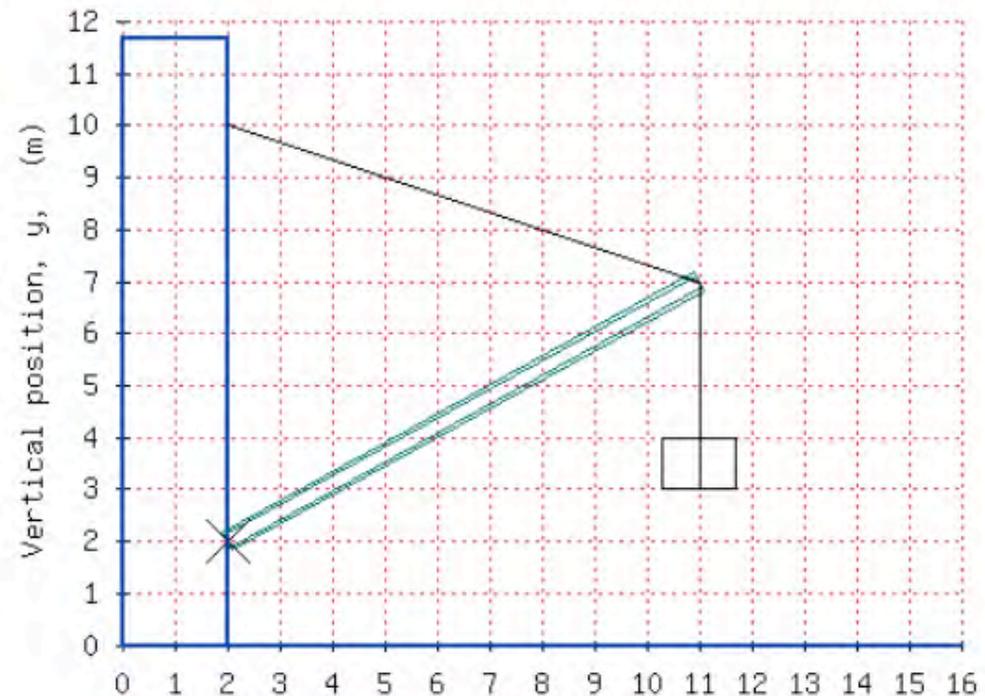
- Computer-Assisted Personalized Approach
- Online assessment with immediate feedback and multiple tries
- Different students get different versions of the same problem
 - different options
 - different graphs or images
 - different numbers or formulas



CAPA

- Same problem
- Two students

A crate with a mass of 177.5 kg is suspended from the end of a uniform boom with mass of 88.5 kg. The upper end of the boom is supported by a cable attached to the wall and the lower end by a pivot (marked X) on the same wall. Calculate the tension in the cable.



CAPA

Benefits:

- learners can work together without just exchanging the answers
- learners get immediate feedback on their learning progress
- instructors get immediate feedback on their learners' progress
- in-class audience feedback systems (IR, RF, PDAs, ...) fully integrated

Course Action Items

http://s2.lite.msu.edu/adm/whatsnew

MICHIGAN STATE UNIVERSITY

The LearningOnline Network with CAPA

Wolfgang Bauer
Course Coordinator
Fall 2005, Phy183

Course Action Items

Fall 2005, Phy183->Display Action Items

Problems requiring handgrading

No problems require handgrading

Problems with errors

No problems with errors

Problems with av. attempts ≥ 2 or deg. difficulty ≥ 0.5 and total number of students with submissions ≥ 2

Change thresholds?

Resource	Part	Num. students	Av. Attempts	Deg. Diff	Last Reset	Reset Count?
Area of a Sphere	single part	478	2.10	0.53		<input type="checkbox"/>
Volume of a box	single part	461	5.44	0.83		<input type="checkbox"/>
Trigonometry2.problem	single part	473	2.27	0.56		<input type="checkbox"/>
Traveling Car	part - 11	476	9.67	0.90		<input type="checkbox"/>
BowlingBallDrop.problem	single part	472	2.34	0.58		<input type="checkbox"/>
	single					

Unread course discussion posts

Location	Type	Number of new posts
BiggerEarth.problem	Resource	9
CylinderSurface.problem	Resource	8
Area of a Sphere	Resource	5
Denominator Calculation	Resource	5
Perimeter	Resource	3
Volume of a box	Resource	59
Trigonometry1.problem	Resource	3
Trigonometry2.problem	Resource	12
Coordinate calculation	Resource	13
UnitConversion1.problem	Resource	4
Traveling Car	Resource	22
BowlingBallDrop.problem	Resource	7
CastleDrop.problem	Resource	5
MaximumHeight.problem	Resource	3
SprintDistance.problem	Resource	16
SprintRace.problem	Resource	13
Free Fall Acceleration	Resource	9
g-force	Resource	9
Increasing Velocity	Resource	9

CAPA

Benefits, cont.:

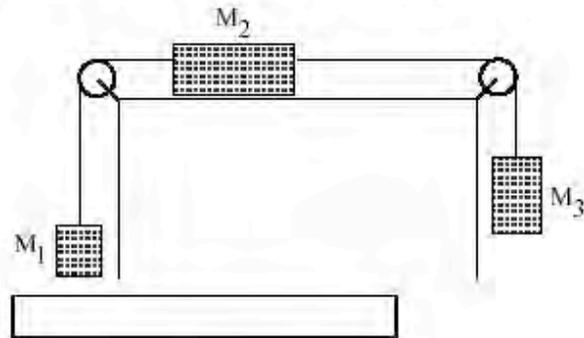
- cost-savings in routine grading
- instructor time used for instruction (possibly even one-on-one; see Feynman quote!), not grading
- LON: shared problem library, de-facto setting standards and establishing baselines
- LON: cross-course cross-institutional dynamic metadata

OUTLINE

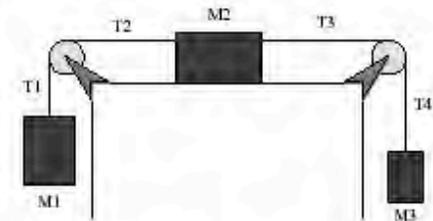
- Learning Content Management System
- Assessment System
- Multiple Content Representations
- Research on Learning
- Open-Source

Multiple Representation (1)

The three blocks shown are released at $t=0$ from the position shown in the figure. Assume that there is no friction between the table and M_2 , and that the two pulleys are massless and frictionless. The masses are: $M_1 = 1.0$ kg, $M_2 = 7.0$ kg, $M_3 = 3.0$ kg. Calculate the speed of M_2 at a time 1.55 s after the system is released from rest.



In the figure, M_2 has more mass than M_1 and M_1 has more mass than M_3 . The questions refer to the magnitudes of tensions and weights.



There is friction between the horizontal plane and M_2 ($\mu_k \neq 0$). M_2 is observed to travel at a constant speed. Assume that the pulleys are frictionless and have negligible mass. Select the appropriate statements to complete the following sentences.

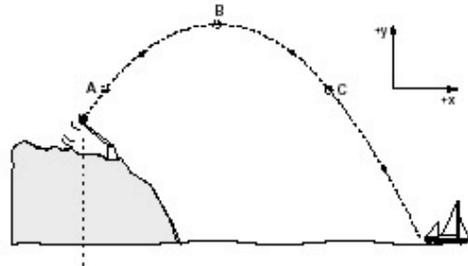
Choices: True, False, Greater than, Less than, Equal to.

1. T_3 is ... T_2 .
2. T_1 is ... M_1g .
3. T_4 is ... M_3g .
4. T_2 is ... T_1 .
5. The magnitude of the net force on M_2 is $T_2 - T_3$.
6. M_1 accelerates downwards.

Multiple Representation (2)

Catapult

A catapult on a cliff launches a large round rock towards a ship on the ocean below. The rock leaves the catapult from a height H of 32.0 m above sea level, directed at an angle θ above the horizontal with an unknown speed v_0 .



The projectile remains in flight for 6.00 seconds and travels a horizontal distance D of 142.0 m. Assuming that air friction can be neglected, calculate the value of the angle θ (in degrees).

Tries 0/99

Calculate the speed at which the rock is launched.

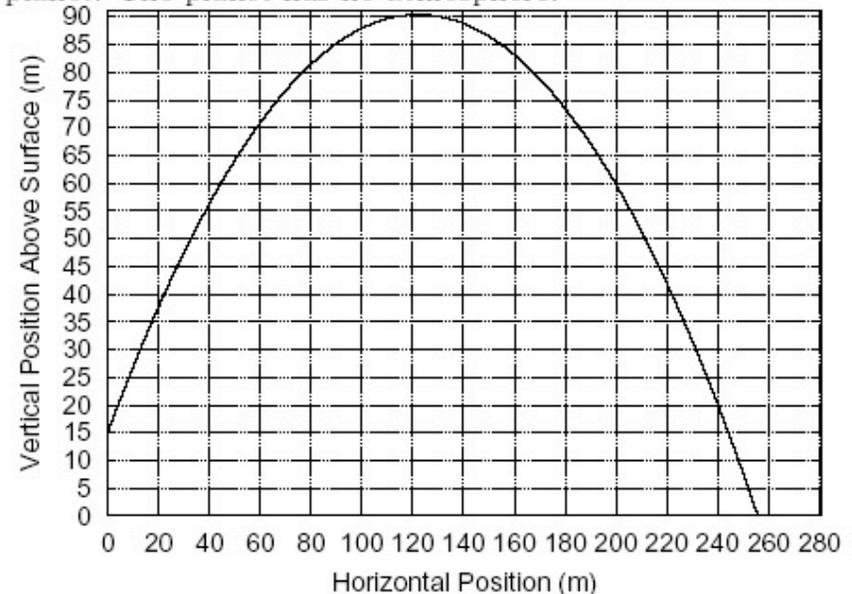
Tries 0/99

To what height above sea level does the rock rise?

Tries 0/99

Trajectory of a rock on planet-X

The trajectory of a rock thrown from a height with an initial speed of 22.9 m/s is shown in the figure below. Evaluate the magnitude of the gravitational field at the surface of the planet. The planet has no atmosphere.



Tries 0/99

Future of Multiple Representations

- Let students pick preferred representation
 - Text
 - Animation
 - Talking head
 - Powerpoint
 - Applets
 - ...
- Have computer keep track of preferences and customize selections and initial offerings
 - ... just like Amazon.com ...

Exam Support

A capacitor is completely charged with 650 nC by a voltage source that had 350 V.

1 pt What is its capacitance? (in F)

7.A 1.49×10^{-9} B 1.86×10^{-9} C 2.32×10^{-9}

D
G

Students receive automatically generated individualized multiple choice exams with their names (and photos).

1 pt
gether

8.

LON-CAPA machine-grades the bubble sheets.

part

the

same.

- C The capacitance increases.
D The voltage drop between the plates increases.
E The energy stored in the capacitor increases.

1 pt The initial air gap was 8 mm. What is the stored energy if the air gap is now 6 mm? (in J)

9.A 0.00 B 8.53×10^{-5} C 1.14×10^{-4}
D 1.30×10^{-4} E 1.52×10^{-4} F 3.41×10^{-4}
G 3.44×10^{-4} H 4.87×10^{-4}

A capacitor is completely charged with 670 nC by a voltage source that had 350 V.

1 pt What is its capacitance? (in F)

7.A 1.91×10^{-9} B 2.39×10^{-9} C 2.99×10^{-9}

same.

- C The charge on the plates increases.
D The capacitance increases.
E None of the above.

1 pt The initial air gap was 6 mm. What is the stored energy if the air gap is now 11 mm? (in J)

9.A 0.00 B 6.40×10^{-5} C 1.17×10^{-4}
D 2.15×10^{-4} E 2.91×10^{-4} F 3.63×10^{-4}
G 4.39×10^{-4} H 5.42×10^{-4}

Exam Support: Re-Takes

A capacitor is completely charged with 650 nC by a voltage source that had 350 V.

1 pt What is its capacitance? (in F)

7. **A** 1.49×10^{-9} **B** 1.86×10^{-9} **C** 2.32
D 2.90×10^{-9} **E** 3.63×10^{-9} **F** 4.53
G 5.67×10^{-9} **H** 7.08×10^{-9}

1 pt Now the plates of the charged capacitor are pulled together with the voltage source already disconnected.

8. **A** The charge on the plates increases.
B The energy stored in the capacitor remains the same.
C The capacitance increases.
D The voltage drop between the plates increases.
E The energy stored in the capacitor increases.

1 pt The initial air gap was 8 mm. What is the stored energy if the air gap is now 6 mm? (in J)

9. **A** 0.00 **B** 8.53×10^{-5} **C** 1.14×10^{-4}
D 1.30×10^{-4} **E** 1.52×10^{-4} **F** 3.41×10^{-4}
G 3.44×10^{-4} **H** 4.87×10^{-4}

A capacitor is completely charged with 670 nC by a voltage source that had 350 V.

Problem 6

Due on Tuesday, Feb 22 at 10:00 am

A capacitor is completely charged with 640 nC by a voltage source that has 375 V.

What is its capacitance? _____

Tries 0/3

Now the plates of the charged capacitor are pulled apart with the voltage source still connected.

- The capacitance increases.
 The voltage drop between the plates increases.
 The energy stored in the capacitor increases.
 The energy stored in the capacitor remains the same.
 None of the above.

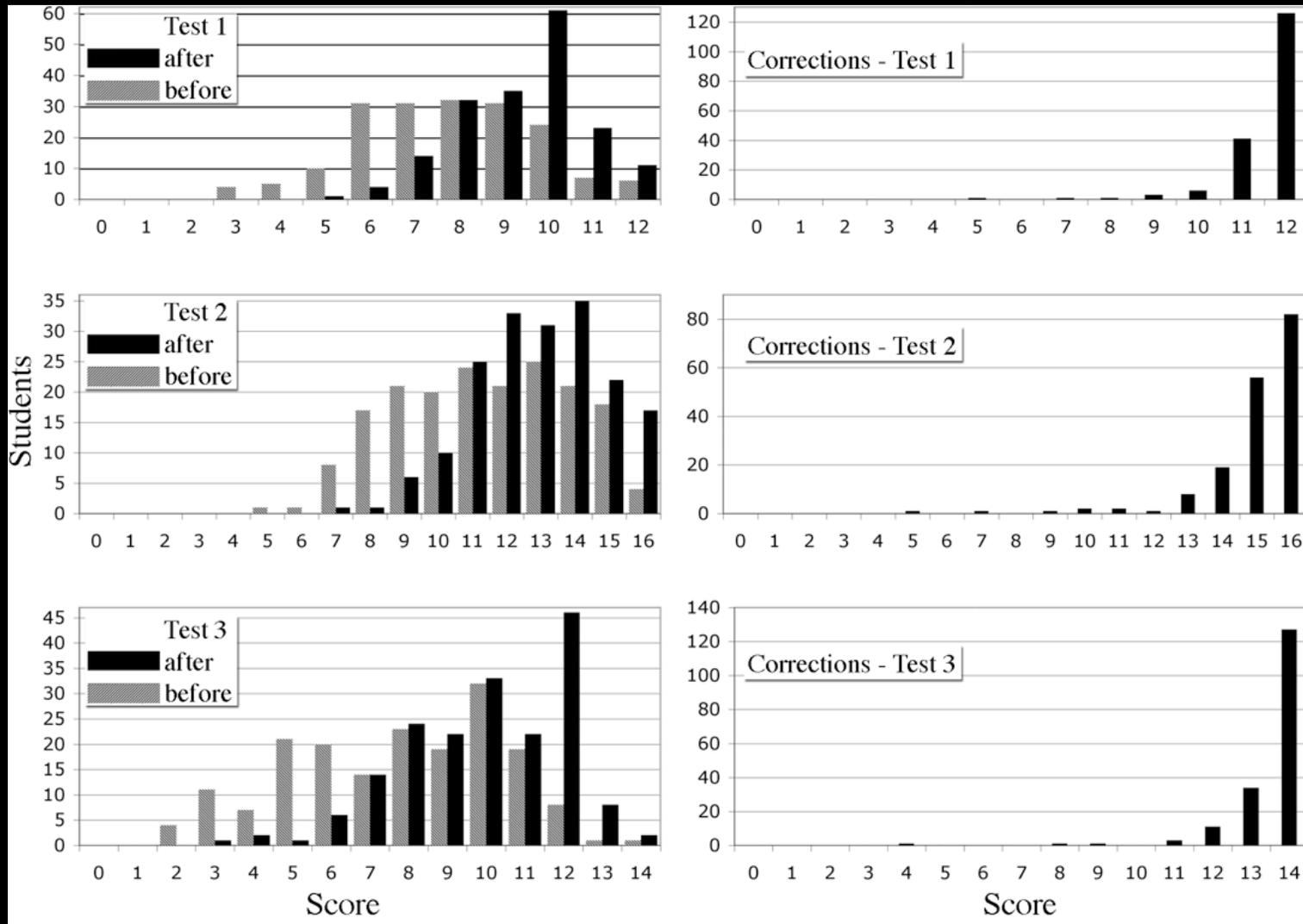
Tries 0/2

The initial air gap was 5 mm. What is the stored energy if the air gap is now 10 mm?

Tries 0/3

9. **A** 0.00 **B** 6.40×10^{-4} **C** 1.17×10^{-3}
D 2.15×10^{-4} **E** 2.91×10^{-4} **F** 3.63×10^{-4}
G 4.39×10^{-4} **H** 5.42×10^{-4}

Exam Support: Re-Takes



Kortemeyer, Bauer, Benenson, Kashy, The Physics Teacher 44, 235 (2006)

Evaluation → Test Bank

The LearningOnline Network with CAPA

The LearningOnline Network with
Evaluate Resource

CastleDrop.problem

Please rank the following criteria:
The material appears to be correct

The material is helpful

The material is covered with sufficient depth

The material is presented in a clear way

The resource is technically correct (loads fast enough, does not produce errors, links work, etc)

Any comments?

Submit Evaluation

Student input screen

Catalog Information

Overall Assessment Statistical Data

Total number of students who have worked on this problem	766
Average number of tries till solved	1.66
Degree of difficulty	(0.40)
Degree of discrimination	(0.00)

Evaluation Data

Material presented in clear way	(4.32)
Material covered with sufficient depth	(4.55)
Material is helpful	(4.45)
Material appears to be correct	(4.45)
Resource is technically correct	(4.59)

Evaluation Comments (visible to author and co-authors only)

PRIVACY: Simple, yet educational. Fairly intuitive.

PRIVACY: This was a good problem, but it made you think because you have to make 2 equations with 2 unknowns, but once you got that it was easy to solve.

PRIVACY: This was a great problem, and I really like the advice Professor Bauer gave, I understood it perfectly after that.

PRIVACY: I thought all the prob's were good in this set. I especially liked this one, though. Including something like Lord of the Rings in a problem gets us science geeks excited. In fact, I did these problems for fun.

PRIVACY: I like the theme of the problem. It was not too bad, I just had to think about how to set it up. Once I thought a little, it came along nicely.

PRIVACY: Took a while to figure out how to set it up, but afterwards, I felt like it was an easy prob.

Author / instructor output screen

OUTLINE

- Learning Content Management System
- Assessment System
- Multiple Content Representations
- Research on Learning
- Open-Source

No Significant Difference Phenomenon Website

http://www.nosignificantdifference.org/

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wcet The Cooperative advancing the effective use of technology in higher education

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The NSD research was originated and is still edited by: **Thomas L. Russell**, emeritus, North Carolina State University. [Mr. Russell's Bio](#)



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[1979](#) [1978](#) [1977](#)

No Significant Difference Phenomenon

Search for

SEARCH [Advanced Search](#)

This website has been designed to serve as a companion piece to Thomas L. Russell's book, "**The No Significant Difference Phenomenon**" (2001, IDECC, fifth edition). Mr. Russell's book is a fully indexed, comprehensive research bibliography of 355 research reports, summaries and papers that document *no significant differences* (NSD) in student outcomes between alternate modes of education delivery, with a foreword by Dr. Richard E. Clark. Previous editions of the book were provided electronically; the fifth edition is the first to be made [available in print from IDECC \(The International Distance Education Certification Center\)](#).

The primary purpose of the NSD website is to **expand on the offerings from the book** by providing access to appropriate studies published or discovered after the release of the book. In addition to studies that document *no significant difference* (NSD), the website includes studies which do document *significant differences* (SD) in student outcomes based on the mode of education delivery. Both types of entries may be **searched**:

- By **year**, through the left navigation menu;
- Through a **simple keyword search**, available at the top right of each page; or
- Through an [advanced search](#).

This site is intended to function as an **ever-growing repository** of comparative media studies in education research. Both *no significant differences* (NSD) and *significant differences* (SD) studies are constantly being solicited for inclusion in the website. Please feel free to [submit an entry](#).

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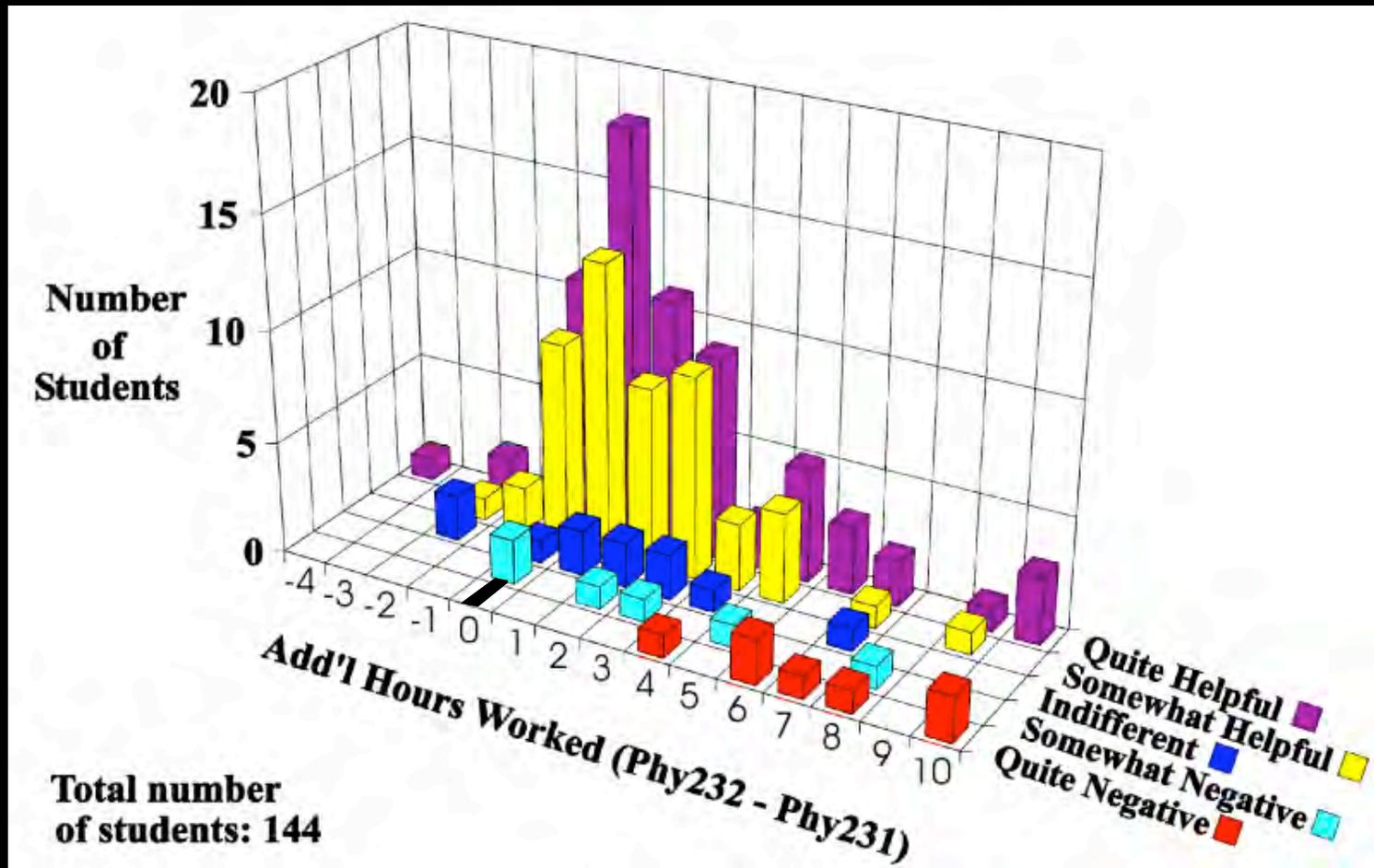




Possible Problems with Research on Learning

- If the teaching innovation and the evaluation instrument are not matched, random noise will be measured
- Humans are not machines
 - Simple input/output models do not work
 - Individuals can give themselves feedback and know when they have learned something
 - Motivated humans will learn, no matter what the tools and methods offered
- The only thing (almost) universally agreed upon:
 - Learning needs to be fun
 - More time-on-task is beneficial

Students spend more time on task AND rate LON-CAPA as very helpful!



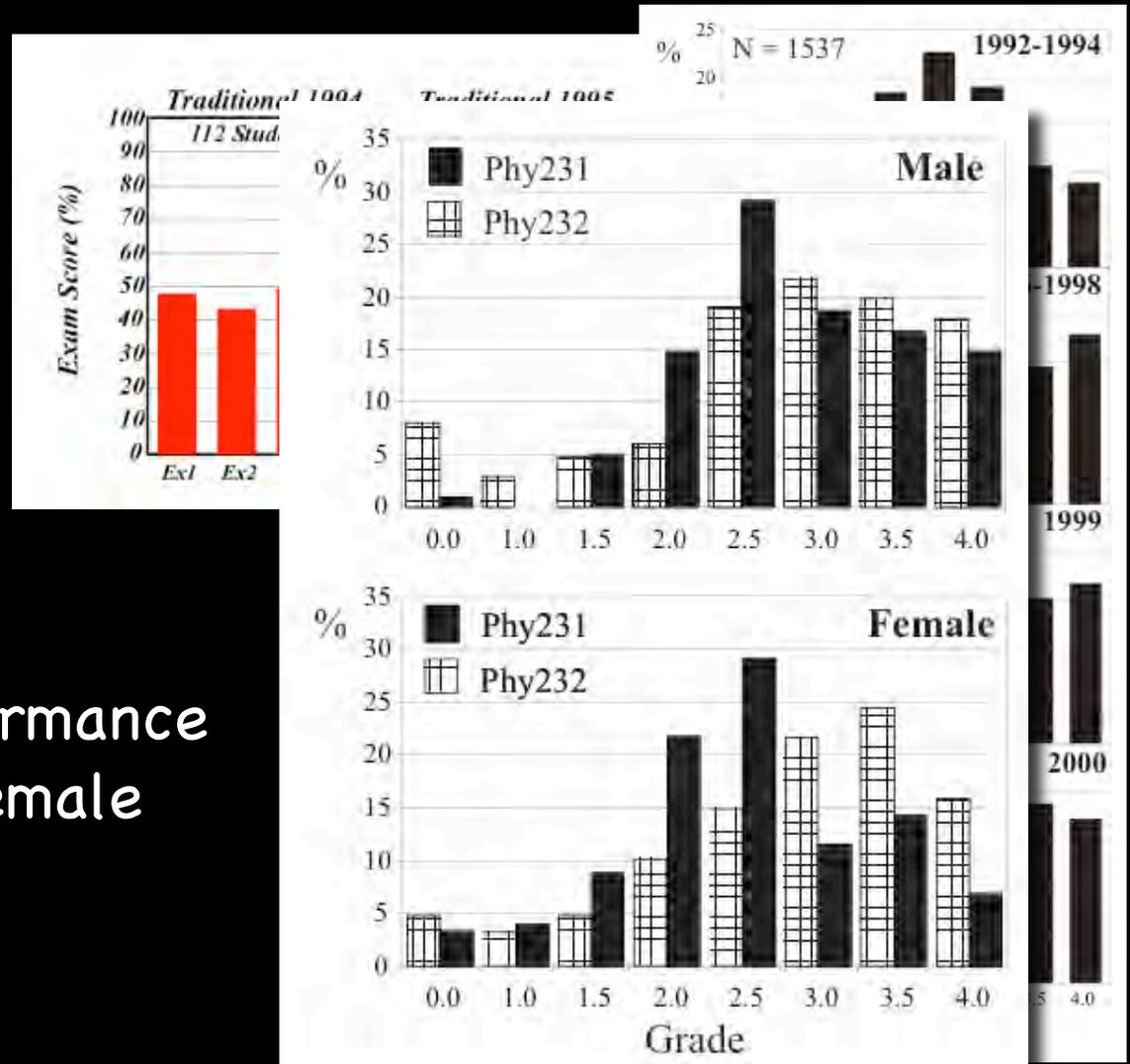
LON-CAPA - Research on Learning

Across a number of studies:

Improved exam performance

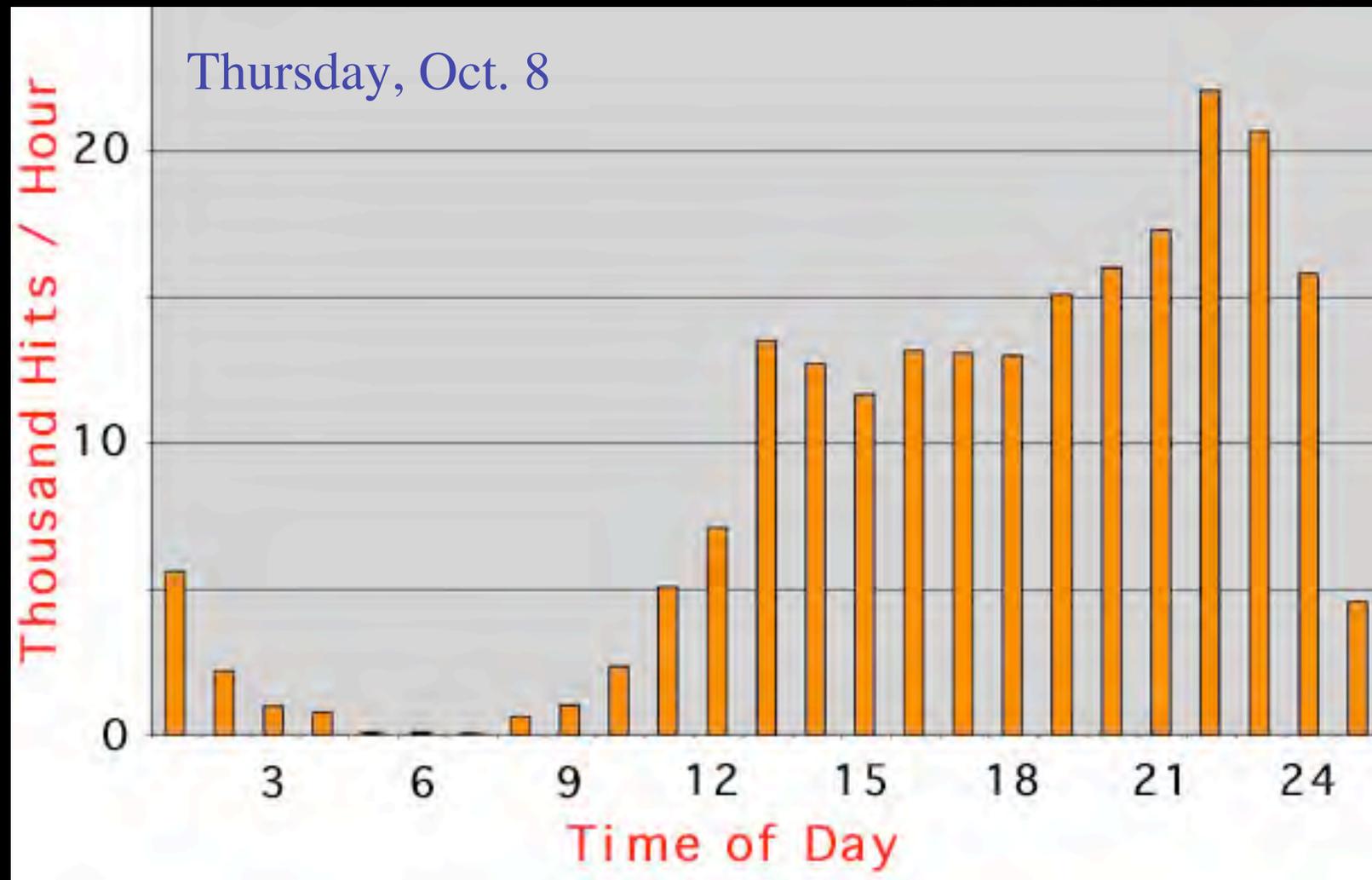
Improved course performance

Improved performance especially of female students

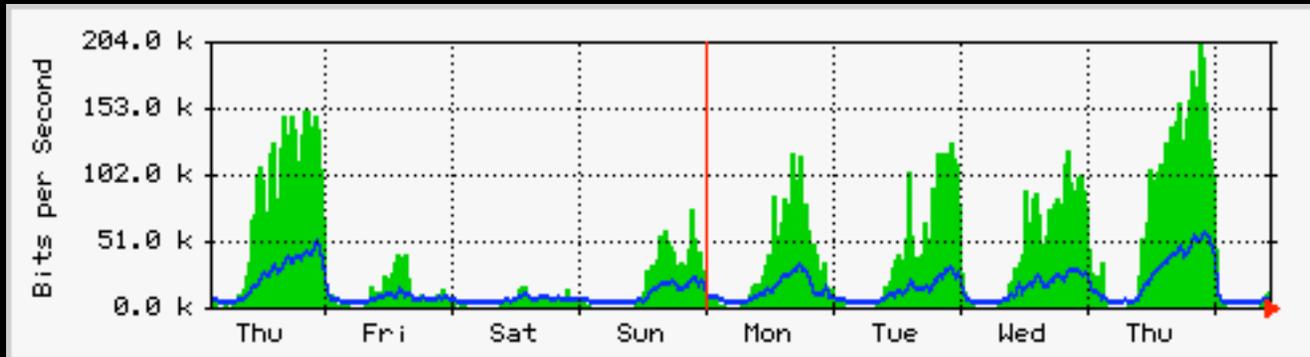


When do Students Work?

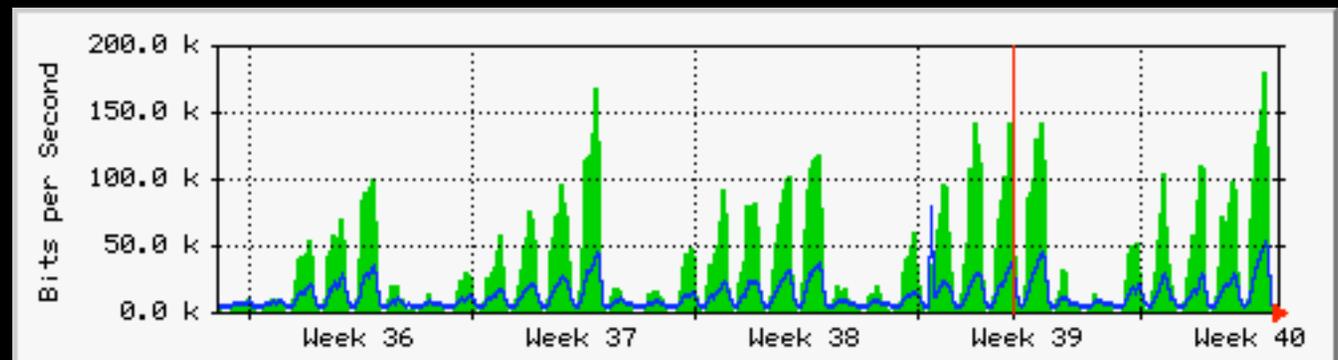
- Homework due at midnight
- 770 students in class



Network Traffic During the Week



Week from Thursday, Oct 1, to Oct 8



Homework is due on Thursdays at midnight

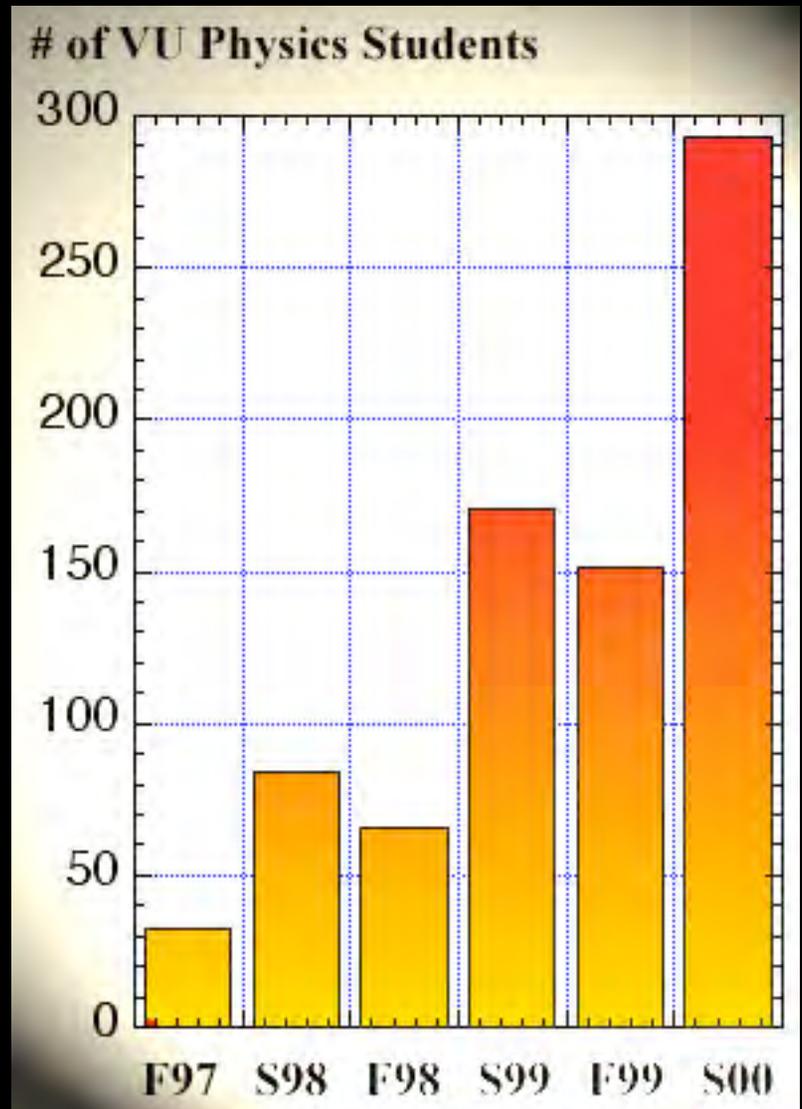
Virtual University Physics

- Phy231c and Phy232c at MSU
- No lectures, no textbook
- All materials in *lectureOnline*
- Asynchronous interaction with students via e-mail (~1000/semester)
- Synchronous interaction via chat-room and (physical) help-room
- Instructor spends **more one-on-one time** with students
 - No lecture, no homework grading, minimal grade database maintenance
 - Time savings result in more office hours and student contact



Enrollment

- Fall 97: 32
- Spring 00: 293
- Enrollment capped at 300 since then
- Since 99/00:
AP Physics
 - Contract with Apex Learning (P. Allen)
 - ~200 high school students in first class
 - Exponential growth



Do they *learn* better?

- Comparison study in Fall 1998: Taught lecture based PHY231 and compared to PHY231c
- Same homework assignments, same exams, same grading system
- Virtual university students scored **slightly higher** on all three exams and on FCI baseline test, and obtained slightly higher final grades (2.93 vs. 2.87) on average
- Statistically **significant** effect!
- One explanation: putting materials on www forces the students to engage in more active learning
- Another: VU students are self-selected group

Virtual Physics Laboratory Exercises

- What is **essential** about lab exercises?
 - Act of taking data
 - Processing of data
 - Error estimate
 - Lab report
- **Not** essential:
 - Physical touching of apparatus
 - Possibility to hurt oneself



Physics Lab

Physics Java Labs

Please complete all of these labs before the end reports (as email attachments) back to the [instru](#)

Before you start your lab report, it might be use

Lab 1: [Determination of g](#)

Lab 2: [Collisions and Conservation L](#)

Lab 3: [Pendulum](#)

Lab 4: [Phase Transitions](#)

Lab 5: [Archimedes' Experiment](#)

Lab 6: [Fluid Flow](#)

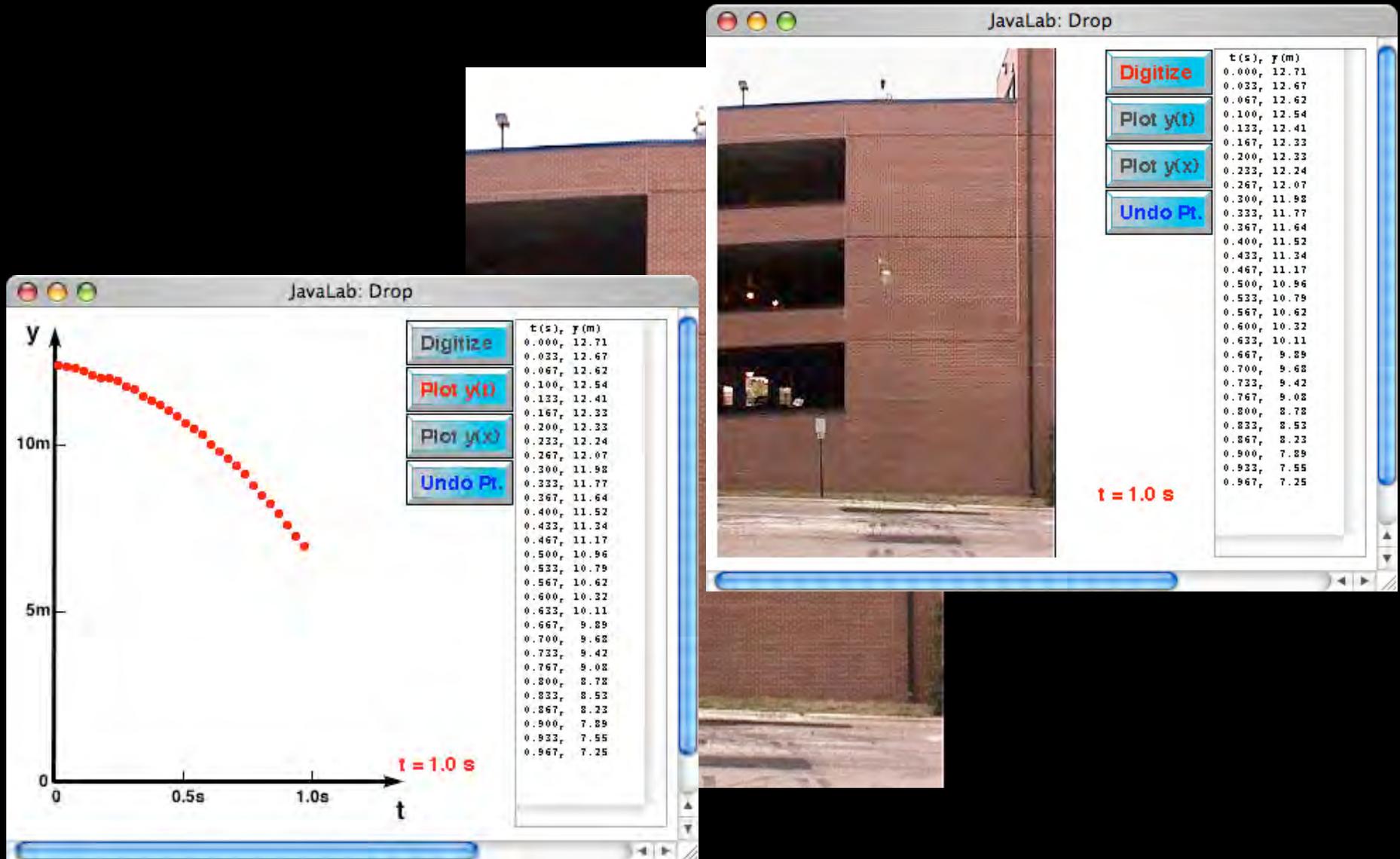
Lab 7: [Photo Effect](#)

Lab 8: [Nuclear Decay](#)

One of the premier goals of each laboratorc how to deal with measurements uncertain on how to calculate your best values and couple useful links:

- [Mean values and error estimates](#)
- [Error propagation](#)
- [Calculator for mean values and sta](#)

Virtual Lab: Determinate g

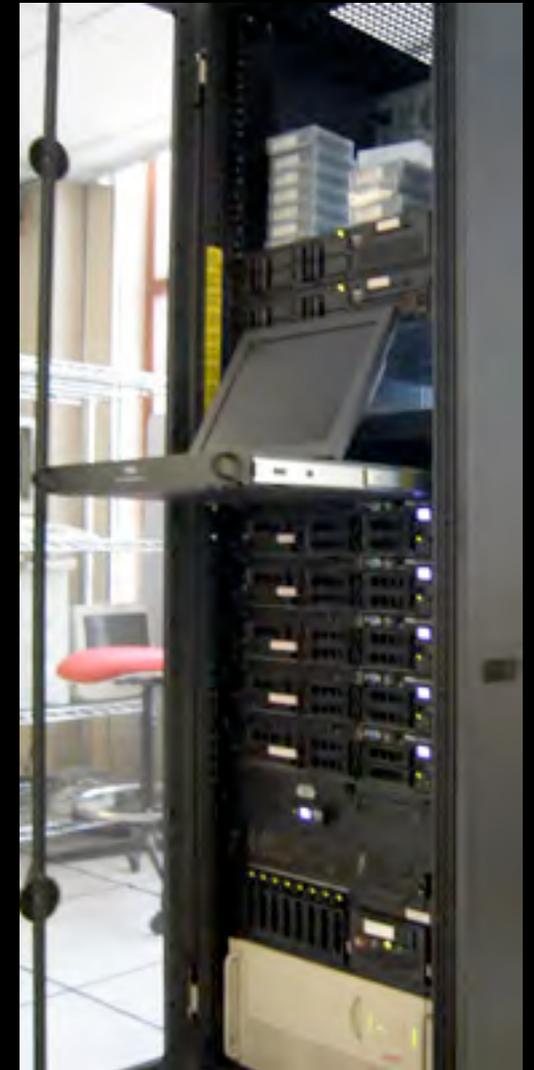


OUTLINE

- Learning Content Management System
- Assessment System
- Multiple Content Representations
- Research on Learning
- Open-Source

LON-CAPA

- Open-source free software
- No license fees
- GNU General Public License
- Can be modified, extended, improved, adapted ...
- Runs on Linux, no license fees for operating system
- Developed by educators for educators



OPEN SOURCE

- Code contributions by
 - Michigan State University
 - Florida State University
 - Ohio University
 - Simon Fraser University Vancouver
 - Hebrew University Jerusalem
 - UNICAMP São Paulo

Internationalization

- Rewrote most screen output such that it can be localized into other languages



LearningOnline Network



Currently used at 44 high schools, 3 middle schools, 4 community colleges, 6 content development projects, 6 publishing companies, and 37 universities in the USA

TheDump.loncapa.org
 http://thedump.lon-capa.org/

cliXX eduCog Google Scholar MSUeMail lon-capa Economy TEXTBOOK Energy ELA DeanSearchCNS



TheDump

- [What Is TheDump?](#)
- [Current Content](#)
- [Features](#)
- [Accessing TheDump](#)
- [Contributing to TheDump](#)
- [Officers and Coordinators](#)
- [TheDump Mailing List](#)

Submit New Resource to TheDump

What is TheDump? [Top](#)

Short for *Teachers Helping Everyone Develop User Materials and Problems*, **TheDump** is a collection of K-12 level resources on the LON-CAPA network. Easily imported into courses, these sequences make it easy to add tested and well-written problems from several sources into a course. Along with university coordinators from Michigan State University and Florida State University, TheDump is currently run and headed by K-12 teachers from around the Mid-Michigan area.

Current Content [Top](#)

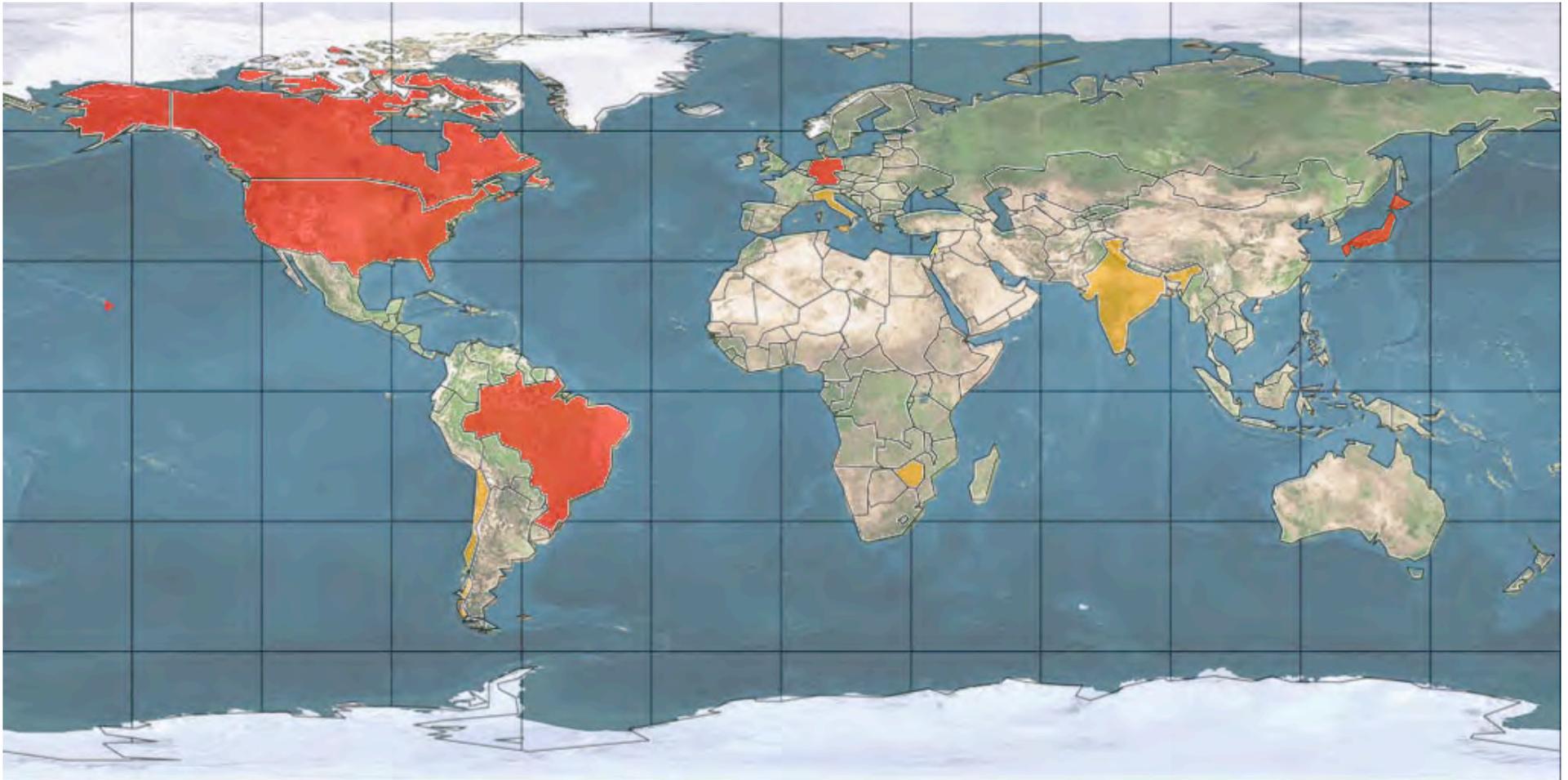
As of May 2006, TheDump contains sequences with over 500 resources, written and used around the world. While the bulk of the problems are currently in the physical sciences disciplines, efforts are underway to expand and build a library of mathematics resources.

Current subjects and disciplines included (but are not limited to):

- Physics
- Chemistry
- Biology
- Earth Sciences
- Calculus (in progress)
- Algebra I (in progress)
- *More to come...*



LON-CAPA Installations



Multiple: USA, Canada, Brazil, Japan, Germany
Single: Chile, India, Italy, Israel, Zimbabwe

Resource Sharing

		U01	U04	PR01	U06	U17	U05	U03	HS20	U12	PR06	U11	U08
Available		144418	17545	10809	8799	7635	7037	5120	4439	4066	3750	3283	2989
Used		38245	7596	340	4821	2908	4880	3411	3842	2841	1502	1231	2102
Used externally		17099	1804	339	974	276	3507	1735	1035	1997	1502	415	62
Using ↓													
U01	38855	34790	301	105	17	49	1621	294	74	102	298	137	3
U05	11668	4881	23	14	3	33	4357	866	29	500	328	5	3
U04	10343	2393	6969		10		207	374	8	128	2	18	
U06	10089	2261	64	13	4755		305	1001	8	10	2	72	2
U03	9973	4053	58	27	5	84	1213	3173	7	728	14	166	
U08	8578	2014	1078	6	2	2	720	5					2097
HS20	6465	2138	1	47			40	350	3767	21	70	4	
CC04	6356	1156	25		2	31	1586	789	197	1522		64	7
U17	6270	2689	4	7		2813	188	205	94	140	4		2
HS40	5251	3899	22	5		40	65	293	388	70	27	16	1
U14	5135	1682	213	42	12	1	665	42		3	7	114	
U09	4246	3409	7		1			15		1		1	

TABLE 2: TOP DOZEN LEARNING CONTENT PROVIDERS (COLUMNS) AND USERS (ROWS). UNIVERSITIES ARE LABELED "U," COMMUNITY COLLEGES "CC," HIGH SCHOOLS "HS," MIDDLE SCHOOLS "MS," PROJECTS "PR," AND PUBLISHING COMPANIES "PU." THE FIRST ROW SHOWS THE TOTAL NUMBER OF RESOURCES WHICH THE DOMAIN IS MAKING AVAILABLE TO THE POOL, THE SECOND ROW THE NUMBER OF RESOURCES ACTUALLY BEING USED, AND THE THIRD ROW THE NUMBER OF RESOURCES WHICH ARE USED AT A DOMAIN OTHER THAN ITS OWN. THE FIRST COLUMN SHOWS THE TOTAL NUMBER OF RESOURCES A DOMAIN IS USING FOR ITS COURSES, AND THE REMAINING CELLS HOW MANY RESOURCES THE DOMAIN IN THE ROW IS USING THAT ORIGINATED IN THE DOMAIN IN THE COLUMN. ITALICS INDICATE AN INSTITUTION USING ITS OWN RESOURCES.

The LearningOnline Network with CAPA

Home > Partner Organizations

Partner Organizations



Collection,
National Science Digital Library



Member,
SMETE.org



Partner,
Partnership in Global Learning



System,
CompusSource



Sustaining Member,
American Association of Physics Teachers

Contact Us: lon-capa@lon-capa.org




CONNECTING
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Mathematics
Engineering
Technology
Education

SMETE.ORG
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Berkeley, CA 94720-1750
TEL: +1 510 643-1818
FAX: +1 510 643-1822

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Welcome to *eduCog*, a company providing cost effective, affordable access to quality educational tools and services.

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September 26, 2006

[Michigan State University Open Source Project Fuels Bottom-up Teaching Innovation](#)

The LearningOnline Network with Computer-Assisted Personalized Approach, or LON-CAPA, is an innovative Michigan State University Web-based service allowing educators to easily create and share course material across a range of subjects. [Full story](#)

Source: Michigan State University



September 25, 2006

[Using Synthetic DNA, Cornell Researchers Fashion Low-cost, Biodegradable Hydrogels for Drug Delivery and Tissue Engineering](#)

Using synthetic DNA formed into crosses, Y's and T's, Cornell researchers have created biocompatible, biodegradable, inexpensive hydrogels that can be easily formed into any desired shape for biomedical applications. [Full story](#)

Source: Cornell



2003
COMPUTERWORLD HONORS
21ST CENTURY
ACHIEVEMENT AWARDS



COMPUTERWORLD HONORS

A Search for New Horizons
21ST CENTURY ACHIEVEMENT AWARDS



LON-CAPA



"Judged best
IT application
in the world in
Education &
Academia"



Collaboration



Closing Thoughts

- Initially developed at Michigan State University
- Funding received from
 - NSF ITR grant
 - Mellon Foundation
 - Sloan Foundation
 - Howard Hughes Medical Institute
- April 2006: LON-CAPA consortium formed
 - Founding members: MSU, Illinois, more in the process of joining
 - Open invitation to join us
- More information: <http://www.lon-capa.org/>