

Technology for On/ Off Campus Learning

An Overview

Eric Klopfer

David Karger, Rob Miller,
Haynes Miller, Karen Wilcox,
Jeff Merriman, Brandon
Muramatsu, Peter Donaldson,
Dave Pritchard

Technologies

- Themes

- We have many technologies already in R&D and use across campus (well beyond those presented today)
- We also face issues in scaling and transfer across classes/domains

The image shows a research paper titled "Successful Classroom Deployment of a Social Document Annotation System" by Sacha Zyto, David R. Karger, Mark S. Ackerman, and Sanjay Mahajan. The paper discusses the use of a social document annotation system (NB) in a classroom setting. It includes an abstract, a discussion of the system's design, and a VUE Concept Map. The VUE Concept Map is a diagram showing the relationship between the course description, the activity description, and the concept map. The activity description is titled "Measuring Poverty and Inequality: experimental data: political and measurement." The VUE Concept Map is a diagram showing the relationship between the course description, the activity description, and the concept map. The interface also shows a discussion section.

The image shows two educational modules. The top module is "MIT Global Shakespeare Learning Modules" titled "The Play: Lear's Solo Dance in Costume". It features a video of a performer in a costume. The bottom module is a chemistry simulation titled "Introduction" showing a character in a lab coat interacting with a digital interface. The interface includes a "Quest Log" with a task "The Source of the Burns" and a chat window with characters billybob, ladyjane, and hedwick. The simulation also shows a periodic table and a flask with red liquid.

Technologies

- Nb – Collaborative PDF Annotation
 - David Karger
- Caesar - Crowdsourced Code Review
 - Rob Miller
- Crosslinks – With and Across Course Concept Links
 - Haynes Miller + Karen Wilcox
- MC3 – MIT Core Concept Catalog
 - Jeff Merriman + OEIT
- Video Capture
 - Brandon Muramatsu + OEIT
- Video Editing/Mixing
 - Pete Donaldson
- Online Course Data Mining
 - Dave Pritchard
- Games
 - Eric Klopfer

Nb

- Threaded discussions like a forum
 - But in document margin
- Standard web site
- Faculty initiates
 - signs up
 - invites students
 - uploads PDFs
- Students discuss
 - Highlight text, enter comment
 - Reply to existing comment

4/5 126%

1.

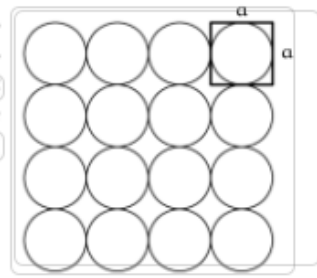
2.

3.

5.3.2 Atomic sizes and substance densities

Hydrogen has a diameter of 1\AA . A useful consequence is the rule of thumb is that a typical interatomic spacing is 3\AA . This approximation gives a reasonable approximation for the densities of substances, as this section explains.

Let A be the atomic mass of the atom; it is (roughly) the number of protons and neutrons in the nucleus. Although A is called a mass, it is dimensionless. Each atom occupies a cube of side length $a \sim 3\text{\AA}$, and has mass $A m_{\text{proton}}$. The density of the substance is



m_{proton} if you multiply this by N_A is Avogadro's number:

What's that ?

group. ent in-

Class ? Reply Requested

Staff Sign

Myself

Discard Save

a is defined. The denomina-

to remember N_A . However, N_A arises in chemistry and reaction between microscopic calculations:

6 note(s) 2?

Anonymous Class How did we get 3 from 1?

Anonymous Class The 1 was the diameter of hydrogen. The interatomic spacing.

Anonymous Class The 3 and 1 represent 2 different values space between all atoms while $1A$ is the specifically.

Anonymous Class 2? So hydrogen atoms are spaced by only atoms are typically spaced between $3A$? correctly?

Anonymous Class Why doesn't this vary significantly base atom? Or is three just the overall average

Instructor Class As you say, it is based on the size of th the very small end, and uranium is at the Angstroms is a good average size to use atoms in ordinary substances. As a *ver approximation, think of the diameter as : (The number of shells is the row number

1 note(s) Too many 'is's in this sentence.

1 note(s) This paragraph's wording is a little bit c

1 note(s) I feel like I have seen this drawing bef what is the area of wholes in betwe

2 note(s) 1✓ If it's not a mass, don't call it a mass.

Successful Classroom Deployment of a Social Document Annotation System

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ABSTRACT

NB is an in-place collaborative document annotation website targeting students reading lecture notes and draft textbooks. Serving as a discussion forum in the document margins, NB lets users ask and answer questions about their reading material *as they are reading*. We describe the NB system and its evaluation in a real class environment, where students used it to submit their reading assignments, ask questions and get or provide feedback. We show that this tool has been successfully incorporated into numerous classes at several institutions. To understand how and why, we focus on a particularly successful class deployment where the instructor adapted his teaching style to take students' comment into account. We analyze the annotation practices that were observed—including the way geographic locality was exploited in ways unavailable in traditional forums—and discuss general design implications for online annotation tools in academia.

Author Keywords

Hypertext; annotation; collaboration; forum; e-learning;

ACM Classification Keywords

H.5.2 Information Interfaces and Presentation (e.g. HCI): User Interfaces. - Graphical user interfaces.

General Terms

Design; Experimentation; Human Factors;

INTRODUCTION

Early hypertext research offered the promise of annotating texts for educational purposes with the detailed discussion necessary to understand complex material. The Web amplified that promise. But it has not been fulfilled.

There is at present no collaborative annotation tool in widespread use in education. Past work revealed significant barriers to their adoption. For example, Brush's [3] study of an online annotation system reported that because students printed and read documents and comments offline, faculty had to force discussion by requiring replies to comments. It

has been unclear whether the annotation systems were too limited, the technical ecology around them was too rudimentary, or the educational system was not adequately prepared. Perhaps in consequence, research on the topic has lain relatively fallow for the past decade.

In this paper, we offer evidence that the time may be ripe for a renewal of research and development on collaborative annotation systems. We report on NB, an annotation forum that has been successfully deployed and used in 55 classes at 10 universities. Students use NB to hold threaded discussions in the margins of online class material.

Our contribution is twofold. First, we provide evidence that the socio-technical environment of the classroom has evolved to the point where the barriers that were encountered by earlier annotation tools have lowered enough to be overcome by motivated teachers and students. While these changed circumstances do not yet hold in *all* circumstances, we will argue that they are common enough to be worth designing for.

Our second contribution is to assess specific features of NB that we believe contributed to its being adopted and valued by its users. Our design of NB's "situated discussions," contrasting with the traditional "linked hypertext" model, was motivated by the following design hypotheses:

- That the ability to comment in the margins, without leaving the document, would enable students to comment "in the flow" while reading, reducing the deterrent loss of context involved in commenting elsewhere;
- That the in-place display of comments in the margins would draw students' attention to relevant comments while reading, and encourage them to respond;
- That the physical location of comments with their subject matter would provide a valuable organizational structure distinct from the chronological organization typical of discussion forums, helping students aggregate related threads and consider them together;

Taken together, we believed these characteristics would drive a virtuous cycle, encouraging more students to participate more heavily, thus providing more helpful material for other students, yielding additional incentive to participate.

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2 threads on page 1

2  This is pretty meta.

2  How well do their findings generalize beyond that pa

2 threads on page 3

2  I wonder how well NB would scale beyond the traditional clas

2  The first two courses are taught by the paper's author

1 thread on page 5

9  Interesting - this surfaces what appears to be lots of stud

1 thread on page 6

1  Interesting! ;)

1 thread on page 9

2  Students tend to use re-reading the text most frequently a

This is pretty meta. Michael Bernstein - 03 May, 08:30AM

[Reply](#) [Actions](#)

You mean annotating a paper on annotation? Wait till we write the paper analyzing these annotations!

[Reply](#) [Actions](#)

David Karger  - 04 May, 12:54PM

Problem: Feedback in 6.005

- Foundation-level course (250-300 students)
- Students write lots of code
- Automatic grading is necessary but not sufficient

```
// compute n! requires n >= 0
int factorial(int n) {
    if (n == 0) return 1;
    else return n * factorial(n-1);
}
```

correct and understandable

```
int factorial(int n) {
    int i, result=1;
    if (n == 0) result = 1;
    else {
        for (i = 1; i < n; ++i) result = result * i;
        result = result * n;
        return result;
    }
    return 1;
}
```

correct but confusing

- Solution chop up the code into chunks and farm it out to students, staff and alumni

65 float grade = Math.round((.2 * q...
8 weeks ago by [@Luke Plummer \(5\)](#)
grade method is unnecessary, could just return (int) Math.round...
1 0

7 weeks ago by [Mason Tang \(103\)](#)
I think it's not altogether a bad idea to encapsulate the weights for the final grade computation in a method, but I do agree that this implementation is not nearly the best way of doing that.
0 0

66 + (.1 * participation)); return ...
automatically generated by checkstyle
'1' is a magic number.
0 0

```
50 /**  
51  * Takes in the quiz, pset, project, and participation grades as values out  
52  * of a hundred and returns the grade based on the course information also  
53  * as a value out of a hundred, rounded to the nearest integer.  
54  *  
55  * Behavior is unspecified if the values are out of range.  
56  *  
57  * @param quiz  
58  * @param pset  
59  * @param project  
60  * @param participation  
61  * @return the resulting grade out of a hundred  
62  */  
63 public static int computeGrade(int quiz, int pset, int project,  
64     int participation) {  
65     float grade = Math.round((.2 * quiz) + (.4 * pset) + (.3 * project)  
66         + (.1 * participation));  
67     return (int) grade;  
68 }
```



Caesar: Divide & Conquer

programs chopped into chunks and sent to many reviewers

```
1 package factors.server;
2
3 import java.io.BufferedReader;
4 import java.io.IOException;
5 import java.io.InputStreamReader;
6 import java.io.PrintWriter;
7 import java.math.BigInteger;
8 import java.net.ServerSocket;
9 import java.net.Socket;
10 import java.net.SocketException;
11 import java.util.ArrayList;
12 import java.util.Collections;
13
14 import util.BigMath;
15
16
17
18 /**
19  * PrimeFactorsServer performs
20  * for counting prime factors.
21  *
22  * Your PrimeFactorsServer should take
23  * indicating which port you
24  *
25  * ex. arg of "4444" will make
26  *
27  * Your server will only need to handle
28  * connected client disconnects, you
29  * future clients to connect
30  *
31  * The client messages that come in
32  * factored and the range of values
33  *
34  * Your server will take this in and
35  */
36 public class PrimeFactorsServer {
37     /** Certainty variable for BigInteger
38     private final static int CERTAINTY = 100;
39
40     /**
41     * @param args String array containing Program arguments. It should only
```

code to review

PrimeFactorsServer	package factors.server; import java.io.BufferedReader; import java.io.IOException;...	5	1
PrimeFactorsServer	package factors.server; import java.io.BufferedReader; import java.io.IOException;...	5	1
EchoClient	package echo.client; import java.io.BufferedReader; import java.io.IOException; im...	1	1
EchoClient	package echo.client; import java.io.BufferedReader; import java.io.IOException; im...	5	1
EchoClient	package echo.client; import java.io.BufferedReader; import java.io.IOException; im...	3	1
EchoServer	package echo.server; import java.io.BufferedReader; import java.io.IOException; im...	3	1
PrimeFactorsClient	package factors.client; import java.io.BufferedReader; import java.io.IOException;...	6	1
PrimeFactorsServer	package factors.server; import java.io.BufferedReader; import java.io.IOException;...	6	1
EchoClient	package echo.client; import java.io.BufferedReader; import java.io.IOException; im...	2	1
EchoClient	package echo.client; import java.io.BufferedReader; import java.io.IOException; im...	2	1

code recently reviewed

RulesOf6005.extendDeadline(..)	/** * Based on the slack day policy, returns a date of when the assignment would ...	18	2
RulesOf6005.extendDeadline(..)	/** * Based on the slack day policy, returns a date of when the assignment would b...	4	3
RulesOf6005.computeGrade(..)	/** * Takes in the quiz, pset, project, and participation grades as values out of ...	9	3
RulesOf6005.extendDeadline(..)	/** * Based on the slack day policy, returns a date of when the assignment would b...	6	2
RulesOf6005.computeGrade(..)	/** * Takes in the quiz, pset, project, and participation grades as values out * o...	6	3
RulesOf6005.hasFeature(..)	/** * Tests if the string is one of the items in the Course Elements section. * * ...	3	2
RulesOf6005.hasFeature(..)	/** * Tests if the string is one of the items in the Course Elements section. * * ...	6	2
RulesOf6005.hasFeature(..)	/** * Tests if the string is one of the items in the Course Elements section. * * ...	4	2
RulesOf6005.hasFeature(..)	/** * Tests if the string is one of the items in the Course Elements section. * * ...	5	2
RulesOf6005.hasFeature(..)	/** * Tests if the string is one of the items in the Course Elements section. * * ...	4	2

Social Reviewing

seeded by automatic style checker

```
12 /** * @param expression * a Stri...  
automatically generated by checkstyle  
File contains tab characters (this is the first instance).
```

👍 1 👎 0

upvote & downvote

```
13 * @param expression * a String r...  
5 weeks ago by Jason Juang \(104\)  
Specify here that expression must not be null. You're throwing an unchecked exception when that happens, so you owe it to whoever is calling your method to explain that you're going to crash their program if they do that.
```

👍 1 👎 1

write new comments

4 weeks ago by [T] [Robert C Miller \(107\)](#)

But a NullPointerException is the typical result when passing null anyway, and that's unchecked too.

reply & discuss

[view all code](#)

```
12 /**  
13 * @param expression  
14 *     a String rep  
15 *     the problem  
16 * @return the value of th  
17 *     units, e.g. "72pt",  
18 */  
19 public String evaluate(String  
20     if (expression == null) {  
21  
22     Lexer lexer = new Lexer(ex  
23     Parser p = new Parser(lexe  
24     return p.evaluate().toStri  
25 }
```

go beyond the chunk, if needed

Crosslinks

Definite integral - Crosslink: x

crosslinks.mit.edu/Crosslinks/index.php/Definite_integral

login via mit touchstone

crosslinks

page discussion view source history

Definite integral

The **definite integral**

$$\int_a^b f(x) dx$$

is the net signed area between the graph of $f(x)$ and the x -axis over the interval $[a, b]$.

Wikipedia: Integral

Wolfram MathWorld: Definite Integral

Prepare

- Riemann sum [\[learn\]](#)
- Function [\[learn\]](#)
- Derivative [\[learn\]](#)
- Antiderivative [\[learn\]](#)
- Mean value theorem [\[learn\]](#)
- [Add Crosslink](#)

Learn

- 18.01 Single Variable Calculus: Lecture Notes
- 18.01 Single Variable Calculus: Video Lecture
- 18.01SC Single Variable Calculus: Definite Integrals
- Riemann Sums: Mathlet
- [Add External Link](#)

Relate

- Antiderivative [\[learn\]](#)
- [Add Crosslink](#)

Advance

- Convolution [\[learn\]](#)
- Divergence theorem [\[learn\]](#)
- Expected value [\[learn\]](#)
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- 16.Unified: Momentum of a rocket
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Courses: 16 | 18

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Lecture 18: Definite Integrals

Integrals are used to calculate cumulative totals, averages, areas.

Area under a curve: (See Figure 1.)

1. Divide region into rectangles
2. Add up area of rectangles
3. Take limit as rectangles become thin

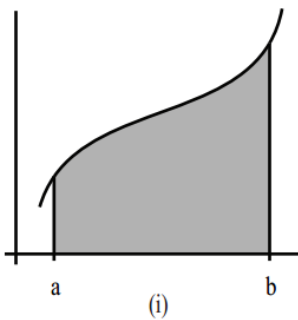


Figure 1: (i) Area under a curve; (ii) sum

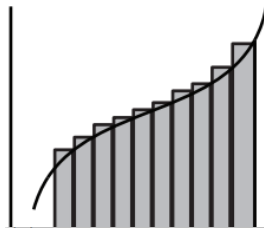
Example 1. $f(x) = x^2$, $a = 0$, b arbitrary

1. Divide into n intervals
Length b/n = base of rectangle
2. Heights:

- 1st: $x = \frac{b}{n}$, height = $\left(\frac{b}{n}\right)^2$
- 2nd: $x = \frac{2b}{n}$, height = $\left(\frac{2b}{n}\right)^2$

Sum of areas of rectangles:

$$\left(\frac{b}{n}\right)\left(\frac{b}{n}\right)^2 + \left(\frac{b}{n}\right)\left(\frac{2b}{n}\right)^2 + \left(\frac{b}{n}\right)\left(\frac{3b}{n}\right)^2 + \dots + \left(\frac{b}{n}\right)$$



d'Arbeloff Interactive Math Project [Help](#)

Riemann Sums

$\Delta x = (b-a)/n$
Estimate = 0.87500
 $a = -1.00$ $b = 2.00$

endpoint \leftarrow 0.0 0.5 1.0 0.0

Estimates

Riemann sum - Crosslinks

crosslinks.mit.edu/Crosslinks/index.php/Riemann_sum

page discussion view source history

Riemann sum

A Riemann sum adds the signed areas of rectangles whose heights are determined by a function. Its limit, as the width of the rectangles tends to zero, is the Riemann integral of the function.

Wikipedia: Riemann sum [W](#)

Wolfram MathWorld: Riemann Sum [M](#)

Prepare

Summation [\[learn\]](#)
Add Crosslink [⚡](#)

Learn

Riemann sums: Mathlet [M](#)
Add External Link [⚡](#)

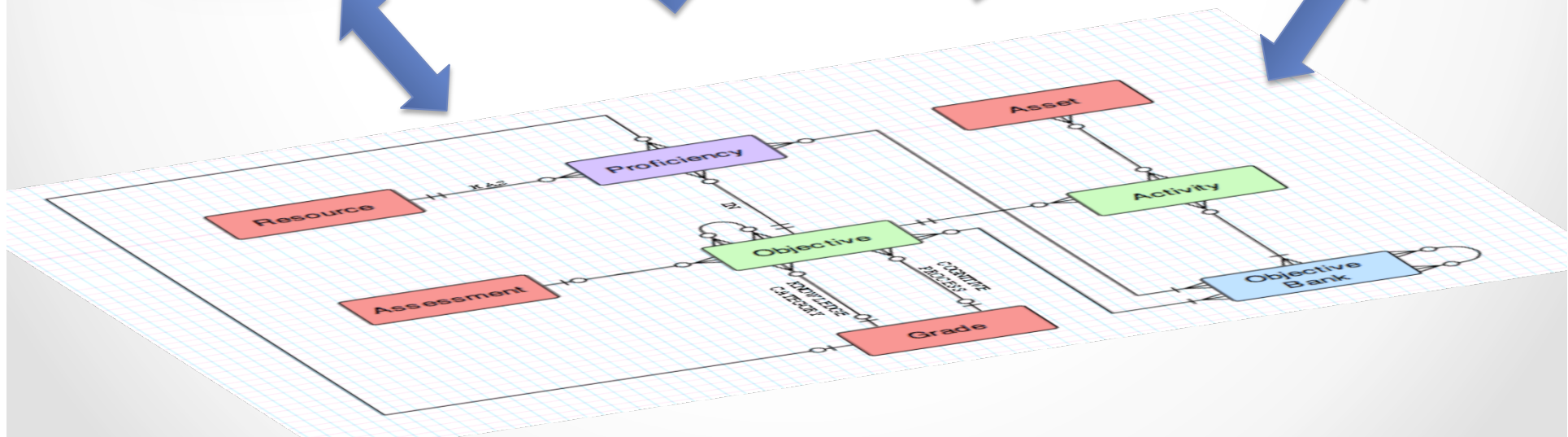
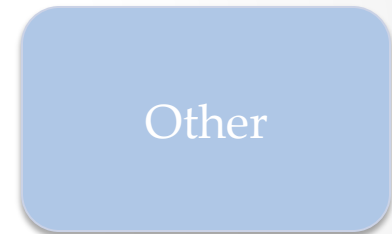
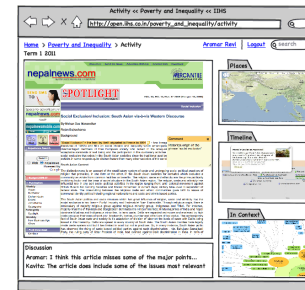
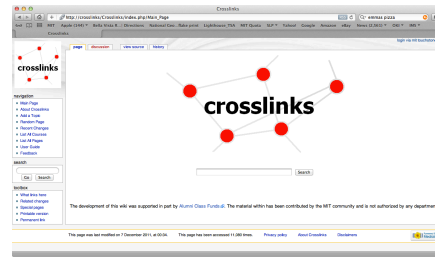
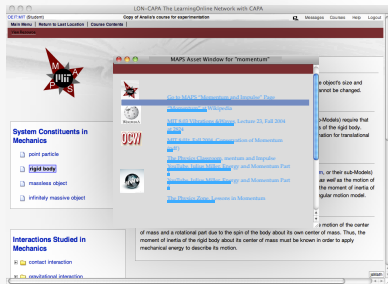
Advance

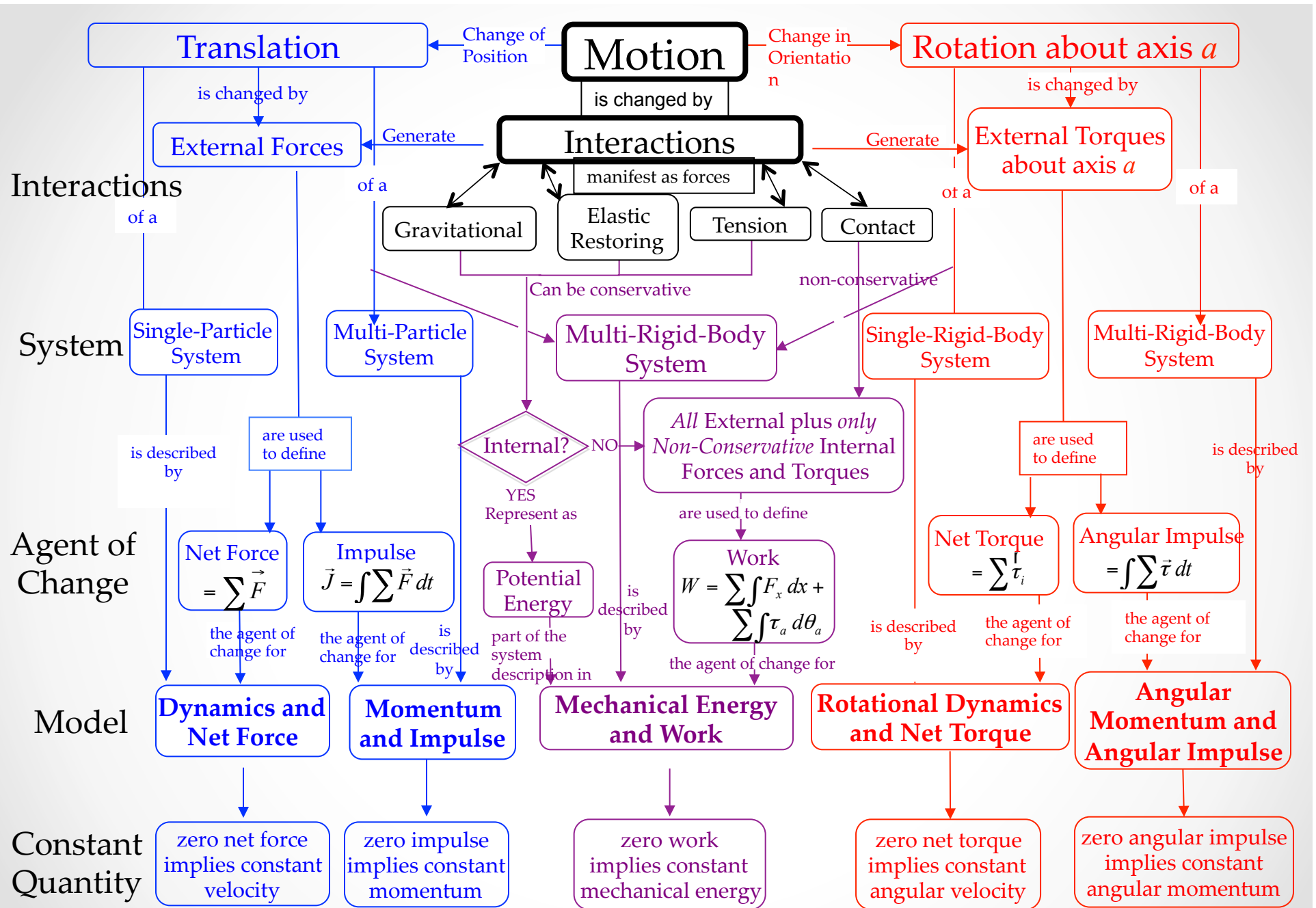
Definite integral [\[learn\]](#)
Add Crosslink [⚡](#)

Course: 18

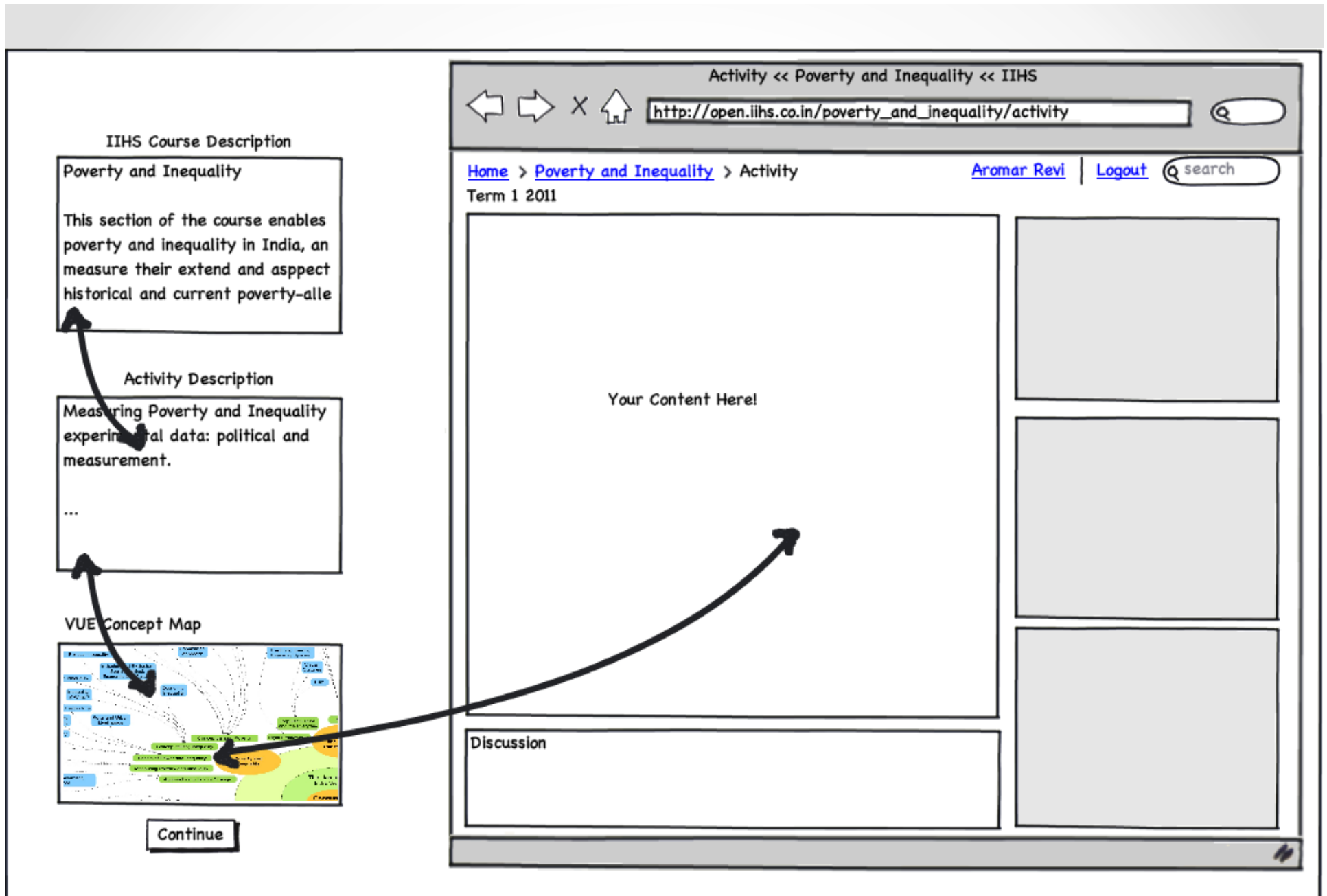
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The MC3 Service





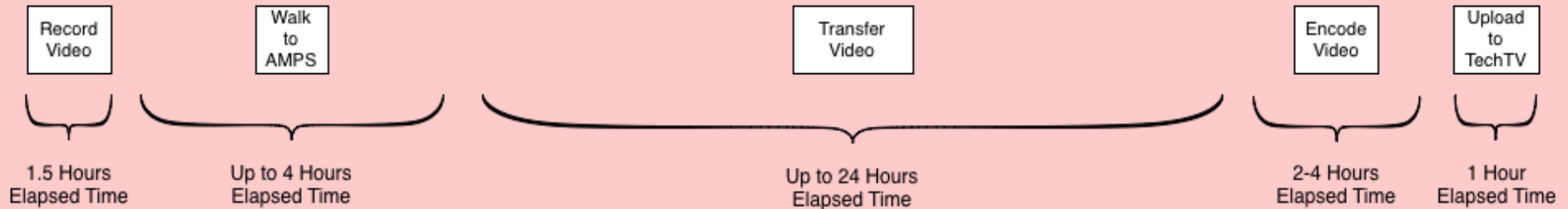
Example #1 –Modeling Applied to Problem Solving (MAPS) Physics concept model – Professor David E. Pritchard MIT



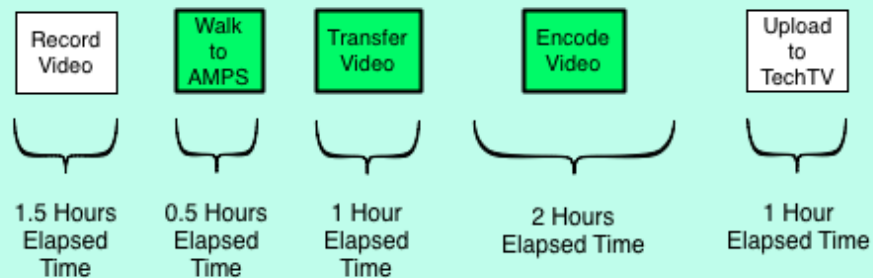
The goal of MC3 is to enable various kinds of educational applications to re-use concept-content relations. In this case we can imagine a student guided learning application that shared the same concept model with the map that the faculty used to develop the curriculum ¹⁴

Video

Typical Lecture Capture Workflow and Best Case Elapsed Time at MIT



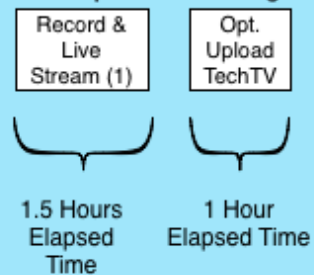
2.002 Lecture Capture Workflow and Elapsed Time with Special Handling*



Special Handling
 Best Case: 1.5:4.5 = 0.33
 Worst Case: 1.5:20 = 0.075

Typical
 Typical Case: 1.5:30 = 0.05

2.003 Lecture Capture Workflow and Elapsed Time using Wirecast



WireCast
 Best Case: 1.5:1 = 1.5

Record Video

- AMPS Camera Operator
- Student Camera Operator
- Automated (No Camera Operator)

Record and Live Stream

- Wirecast (h.264 in Flash/mp4, Media IS Separatable)
- Echo360 (Proprietary format in Flash, Media NOT Separatable, Playback via separate server)
- Matterhorn (h.264 in Flash/mp4, Open Source, Media IS Separatable)



The Play: Lear's Solo Dance in Costume

[← Previous Chapter](#) [Next Chapter →](#)

Lear Is Here dir. Wu Hsing-kuo, Taiwan, 2001

Notes:

Paragraph Font Family Font Size **B** *I* U ~~x~~ ~~x'~~ A ab

email to: email these notes

Introduction

Wu begins with a 27-minute solo performance as King Lear dressed in a version of the traditional costume for the *lao sheng* role, as an old man of high authority, in beautiful

- Script
English
Chinese
- Interviews

Lon Capa Course Management



? [horizontal_problem](#) (metadata)

Browsing resource, all submissions are temporary.

Show All Foils

A mass of 0.16 kilogram can glide freely on an airtrack. It is attached to a spring ($k=64 \text{ N/m}$) and oscillates back and forth with an amplitude of 0.3 meters. What is the kinetic energy at a distance of 0.1 meters from the equilibrium?

Tries 0/99

At $t=0$, the mass is found in the equilibrium position $x=0$ with a velocity of 6 m/s to the right. Which is the correct equation of motion?

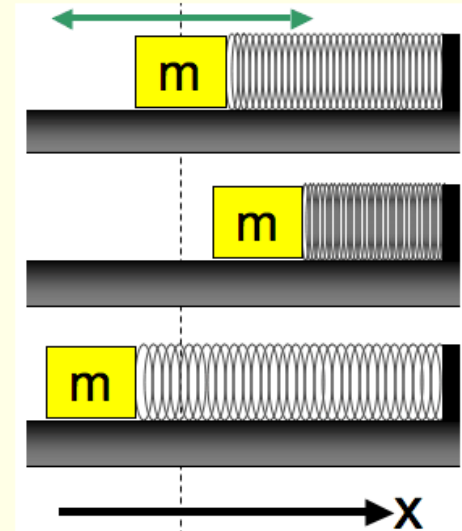
- $x(t)=0.3\text{m}\cdot\cos(20\text{rad/s}\cdot t)$
- $x(t)=0.3\text{m}\cdot\sin(20\text{rad/s}\cdot t)$
- $x(t)=0.3\text{m}\cdot\sin(6\text{rad/s}\cdot t)$
- $x(t)=6\text{m}\cdot\cos(20\text{rad/s}\cdot t)$
- $x(t)=0.3\text{m}\cdot\cos(0.16\text{rad/s}\cdot t)$

Tries 0/2

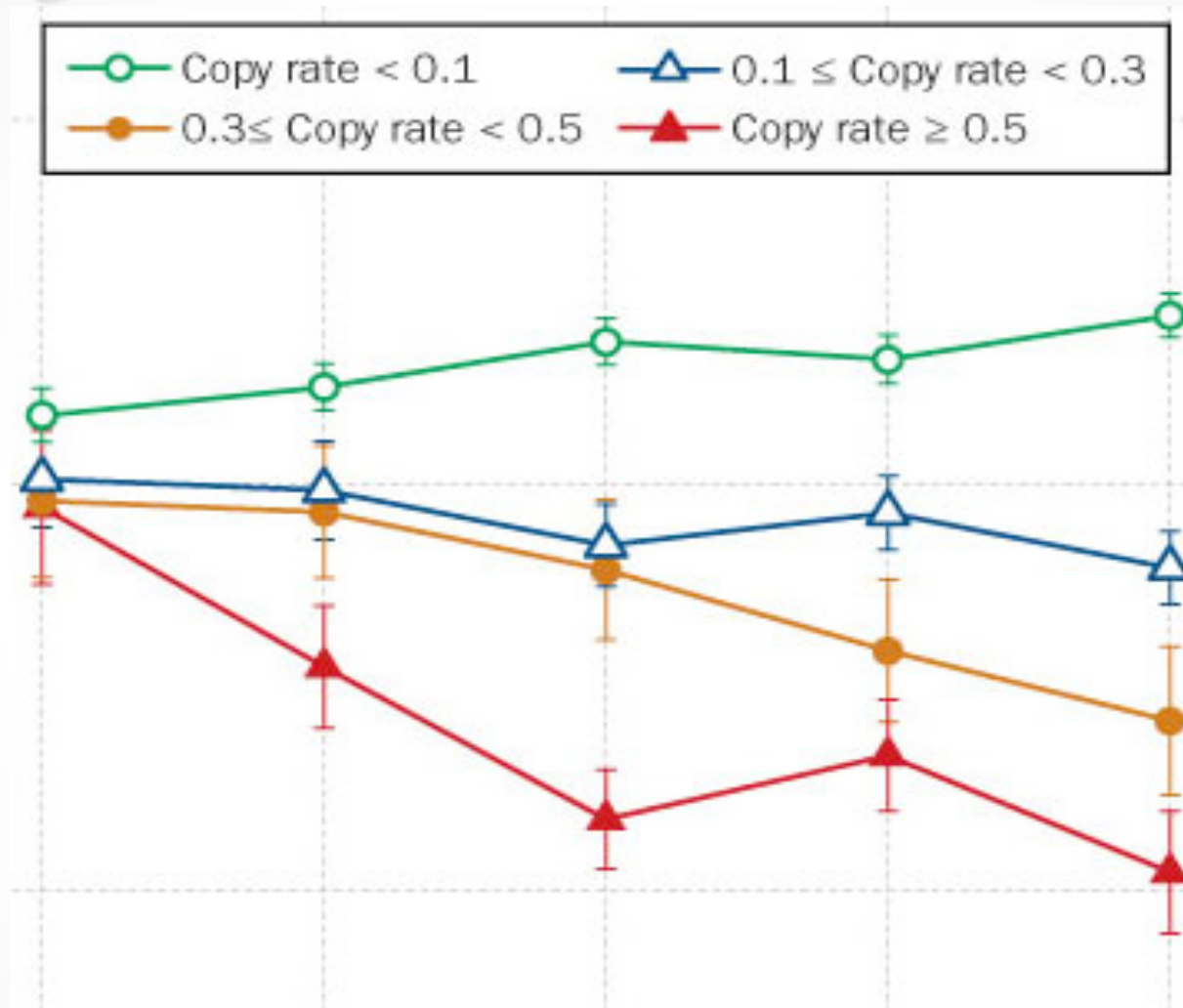
When does the oscillator have maximum acceleration?

- When its velocity is maximal
- When it is at the equilibrium position
- When its elongation is maximal

Tries 0/2

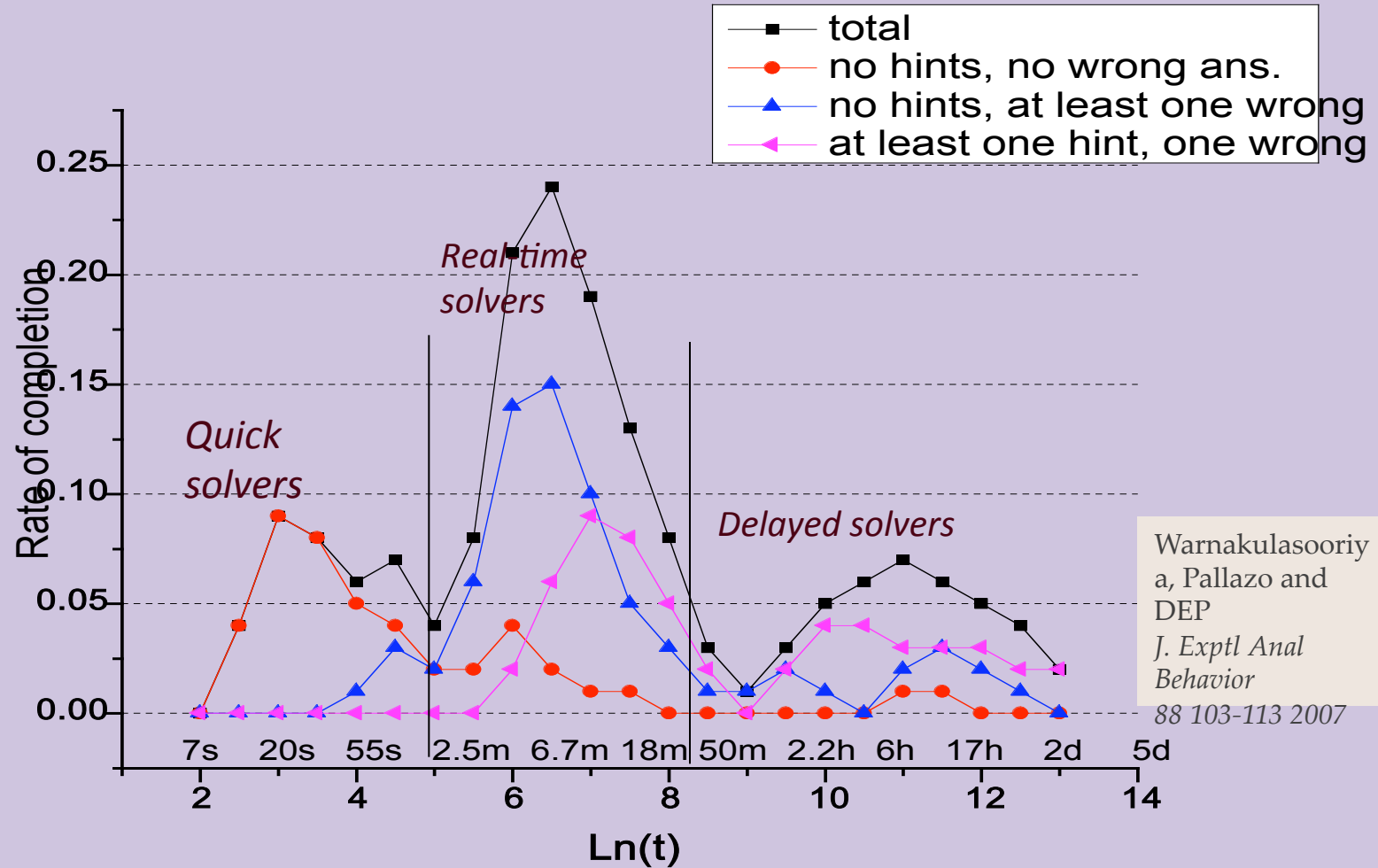


Copying Online Homework → Worse Grades



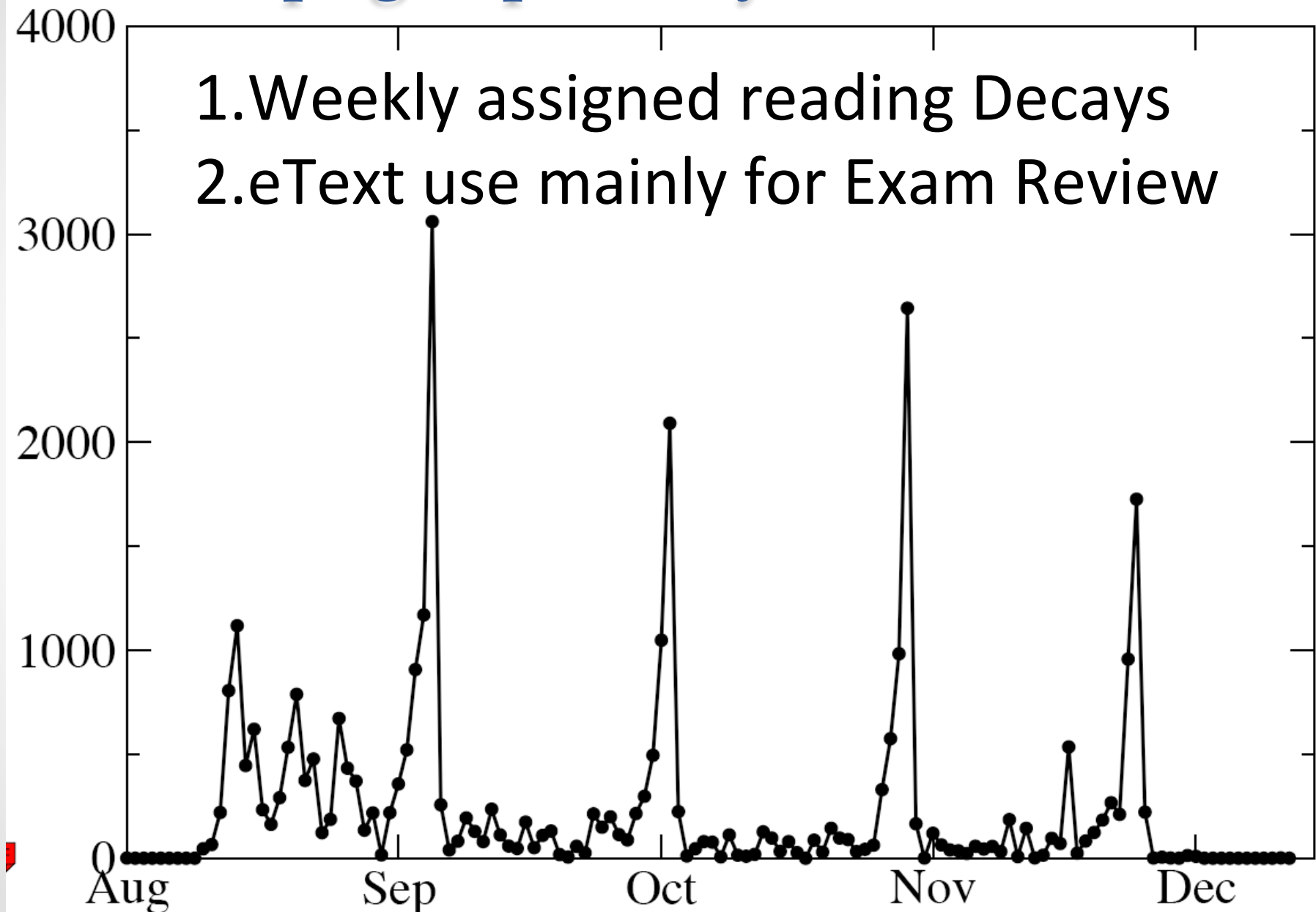
Net of 1.1 std dev for about 60% copying implies ~ 2.0 std. dev. effect size for *no copying vs. all copying*

TIME Copying ← Quick, Correct Answer



1. Respond in <1 min – insufficient to read and answer
2. Correct on first try vs. 90% of remaining students

e-text pages per Day over semester



Games

The Beasties

Level: 1 Win-Loss Record: 1 - 0

Twisty Muffy

Fuse Bo

The Lab

Hands Tail Horns Mouth

A A U A U U U G A

Orzine Elphine Torkanine

Serrated Tail

Twisty You

LEVELS
1 2 3

VOICE LOG

Yes Walker,

I remember that some PATHS are special:

x click to close x

STEMMMMO



Technologies

- Themes

- We have many technologies already in R&D and use across campus (well beyond those presented today)
- We also face issues in scaling and transfer across classes/domains

The image shows a research paper titled "Successful Classroom Deployment of a Social Document Annotation System" by Sacha Zyto, David R. Karger, Mark S. Ackerman, and Sanjay Mahajan. The paper discusses the use of a social document annotation system (NB) in a classroom setting. It includes an abstract, a list of authors with affiliations, and a detailed description of the system's design and implementation. The system is designed to facilitate collaborative learning by allowing students to annotate documents and discuss their findings in real-time.

Below the paper is a screenshot of a software interface for "Activity << Poverty and Inequality << IHS". The interface includes a navigation bar, a search bar, and a main content area with sections for "IHS Course Description", "Activity Description", "VUE Concept Map", and "Discussion". The "Activity Description" section is highlighted, showing the text: "Measuring Poverty and Inequality experimental data: political and measurement." The interface also features a "Continue" button and a "Your Content Here" placeholder.

The image shows two screenshots related to educational technologies. The top screenshot is from the "MIT Global Shakespeare Learning Modules" website, specifically the "The Play: Lear's Solo Dance in Costume" module. The page features a video player showing a person in a costume performing a solo dance. The page also includes navigation links for "Home", "About", "Learn is Here", "Global Shakespeares Archive (external site)", and "Contact".

The bottom screenshot is from a chemistry simulation. It shows a character in a yellow shirt interacting with a virtual laboratory. The character is pointing at a board that displays a chemical structure and a pH scale. The simulation includes various laboratory equipment like flasks, beakers, and a test tube. A "Quest Log" is visible in the bottom right corner, showing the current quest: "The Source of the Burns". The quest log also includes a list of characters and their dialogue: billybob: "Anybody figured out the hydronium puzzle yet?", ladyjane: "nope, but im working on it. come over and we can team up", hedwick: "i can help too!", and SAY: "Great! Where are you located?".