



STUDENT LEARNING AND ANALYTICS AT MICHIGAN

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January 25, 2013:

**High Return on Faculty Investment: Addressing Diverse Student Needs  
in Large Lectures Through Screencasting**

**Joanna Mirecki Millunchick**, Professor of Materials Science and Engineering  
U-M College of Engineering

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STUDENT LEARNING AND ANALYTICS AT MICHIGAN

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[www.crlt.umich.edu/slam](http://www.crlt.umich.edu/slam)

# Impact of Screencast Technology: Connecting the Perception of Value and the Reality of Performance

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University of Michigan

CENTER FOR  
RESEARCH ON  
LEARNING AND  
TEACHING IN  
ENGINEERING  
**CRLT**  
ENGIN

Tershia Pinder-Grover, Katie Green, Joanna Mirecki Millunchick

Supported by CRLT ISL and Whitaker grants

# The efficacy of screencasts

- A screencast is...
  - A movie that captures voice, video, and presentation materials
    - Lecture capture
    - Supplemental lectures
    - Homework/exam solutions

**Table of Contents:**

- Introduction
- 5.7
- Solution
- 5.13
- Solution
- Interpolation of ERF
- 5.21
- Solution for Qd
- Solution for Do
- Solution for T=1300C
- 6.3
- 6.22
- First Criterion: No plastic def
- First Criterion solution
- Second Criterion: diameter n
- Second Criterion solution

**Problem Statement:** 5.13 Nitrogen from a gaseous phase is to be diffused into pure iron at 675°C. If the surface concentration is maintained at 0.2 wt% N, what will be the concentration 2 mm from the surface after 25 hr? The diffusion coefficient for nitrogen in iron at 675°C is  $1.9 \times 10^{-11} \text{ m}^2/\text{s}$ .

**Handwritten Solution:**

$$T = 675 + 273 = 948 \text{ K}$$

$$C_s = 0.2 \text{ wt}\% \quad C_0 = 0$$

$$D = 1.9 \times 10^{-11} \text{ m}^2/\text{s}$$

$$t = 25 \text{ hr} (3600 \text{ s/hr}) = 9 \times 10^4 \text{ s}$$

$$x = 2 \times 10^{-3} \text{ m}$$

**Diagram:** A rectangular block representing a semi-infinite solid. Three arrows labeled 'N' point towards the left face of the block.

**Graph:** A plot of concentration  $C$  versus distance  $x$ . The y-axis is labeled  $C_s = 0.2$  and  $C_0 = 0$ . The x-axis is labeled  $x$  with a tick mark at  $2 \text{ mm}$ . A red curve shows the concentration profile, starting at  $C_s$  at  $x=0$  and decaying towards  $C_0$  as  $x$  increases.

**Fick's 2nd Law for const. surface conc. on semi ∞ solid:**

$$\frac{C_x - C_0}{C_s - C_0} = 1 - \text{erf}\left(\frac{x}{2\sqrt{Dt}}\right)$$

$$C_x = 0.056 \text{ wt}\%$$

**Equation Solving:**

$$0.056 - 0 = (0.2 - 0) \left[ 1 - \text{erf}\left(\frac{2 \times 10^{-3}}{2\sqrt{1.9 \times 10^{-11} \times 9 \times 10^4}}\right) \right]$$

$$\text{erf}\left(\frac{x}{2\sqrt{Dt}}\right) = 1 - \frac{0.056}{0.2} = 0.52$$

$$\frac{x}{2\sqrt{Dt}} = \text{erf}^{-1}(0.52) = 0.5189711$$

**Video Player Interface:** The video player shows a progress bar at 02:54 / 13:50. Below the player is a 'File Downloads' bar with an entry for 'iPod Video, 22.44 MB'.

# Lecture capture

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- Direct recording of what went on in class
  - [resolved shear stress lecture](#)

# Supplementary Lecture

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## ■ Additional resource

- [Kahn academy](#)

# Homework/exam solution

Introduction

5.7

Solution

**5.13**

Solution

Interpolation of ERF

5.21

Solution for Qd

Solution for Do

Solution for T=1300C

6.3

6.22

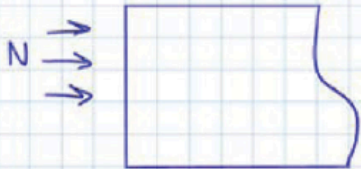
First Criterion: No plastic def

First Criterion solution

Second Criterion: diameter n

Second Criterion solution

**5.13** Nitrogen from a gaseous phase is to be diffused into pure iron at 675°C. If the surface concentration is maintained at 0.2 wt% N, what will be the concentration 2 mm from the surface after 25 h? The diffusion coefficient for nitrogen in iron at 675°C is  $1.9 \times 10^{-11} \text{ m}^2/\text{s}$ .



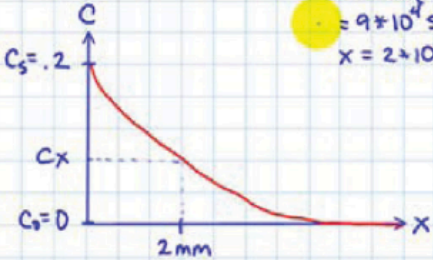
Handwritten solution:

$$T = 675 + 273 = 948 \text{ K}$$

$$c_s = .2 \text{ wt\%} \quad c_0 = 0$$

$$D = 1.9 \times 10^{-11} \text{ m}^2/\text{s}$$

$$t = 25 \text{ hr} (3600 \text{ s/hr}) = 9 \times 10^4 \text{ s}$$

$$x = 2 \times 10^{-3} \text{ m}$$


Fick's 2nd Law  
for const. surface  
conc. on semi  $\infty$   
solid

$$\frac{C_x - c_0}{c_s - c_0} = 1 - \exp\left(-\frac{x^2}{2Dt}\right)$$

$$C_x = .056 \text{ wt\%}$$

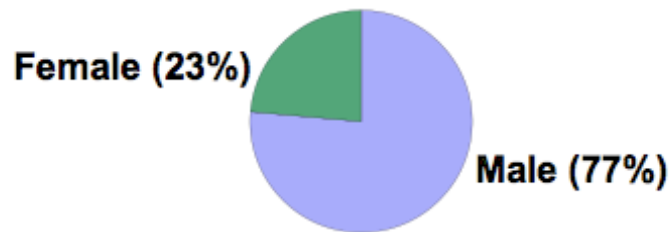
Calculator output:  
 solve((Cx - 0) / (.2 - 0) ==  
 1 - exp((2 \* 10^-3)^2 / (2 \* ((1.9 \* 10^-11) \* (9 \* 10^4))))), Cx)  
 (Cx = 0.0558971)

File Downloads IPod Video, 22.44 MB

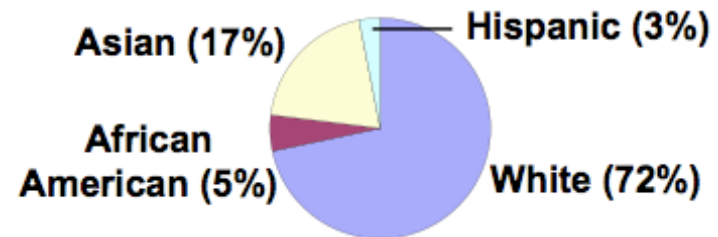
# Project Goals

This study documents the strategic use of screencasts in a large introductory Materials Science and Engineering (MSE) course, and examines their impact on student usage and course performance.

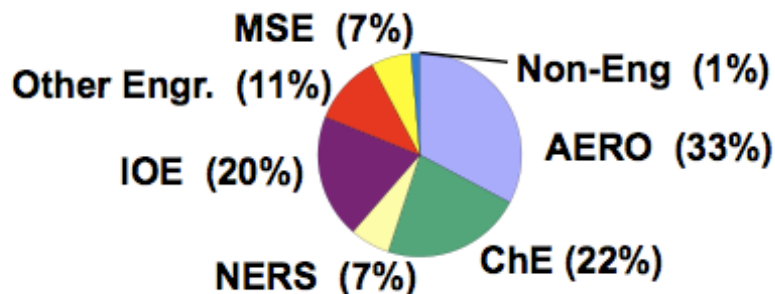
**Gender**



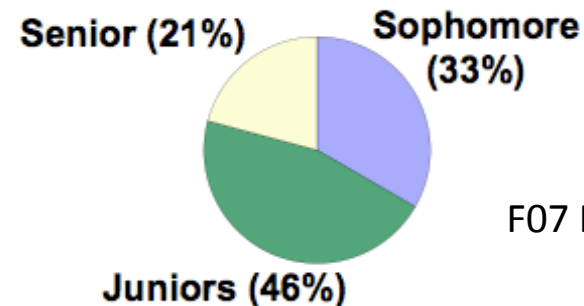
**Race**



**Department**



**Class Year**



F07 N=154 (this data)  
 F08 N=219  
 W09 N=181



# Research Questions

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- Do students perceive screencasts to be valuable
- Does the use of screencasts promote student self-efficacy and increase performance
- What are the motivations for using or not using the screencasts

# Theoretical Framework

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- **Self Efficacy**, students' beliefs about their academic capabilities, has been shown to be strongly linked to their motivation to achieve
  - Intrinsic Motivation- based on an inherent interest
  - Extrinsic Motivation- based on a achieving a desired result
- **Expectancy-Value Theory** states that a person's choice, persistence, and performance on a specific activity is strongly linked to her expectation that she will do well and how much she values the activity
  - Activities that are initially extrinsically motivated can be shifted towards the intrinsic given enough autonomy and success

*Zimmerman, Contemp. Ed. Psych. 25, 62 (2000)*

*Wigfield and Eccles, Comtemp. Ed. Psych 25 68 (2000)*

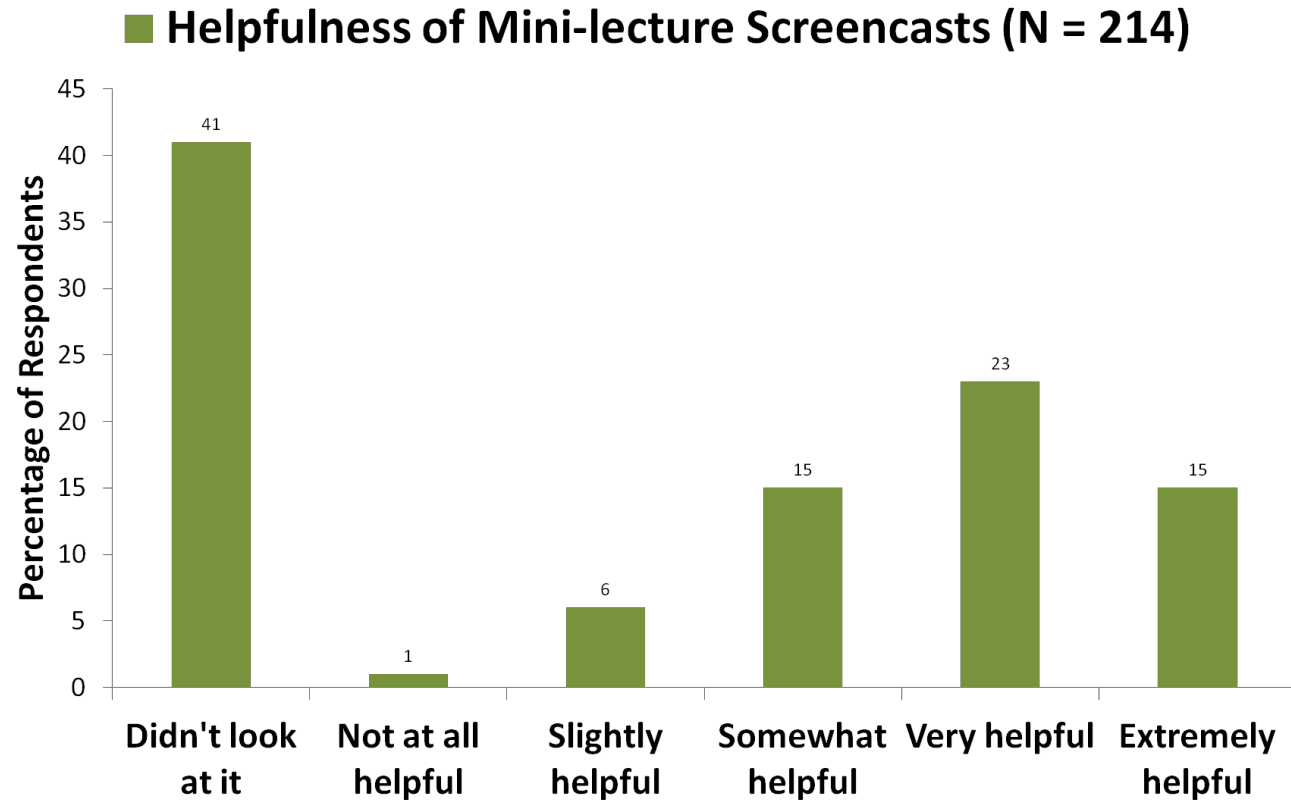
*Ryan and Deci, Contemp. Ed Psych 25 54 (2000)*

# Methodology

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- Student Perceptions
  - Midterm evaluations conducted by CRLT
  - End of term survey administered by CRLT
- What really happened
  - Analysis of usage was tested for significance to student data
    - Academic background (Major, Year, Cumulative GPA)
    - Demographics (Gender, Race)
    - Student performance (homework, exams, final grade)
- No analysis on usage was performed until after the final scores in the course we posted.

# Value



- A majority of students who view the screencasts believe that they are helpful.
- 90% of students agree that mini-lecture screencasts in particular promote a deeper understanding of the course material

# Value

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## ■ What the students said

- *... I felt they were extremely helpful, and much more extensive study tools ...screencasts can be downloaded and played on iPods make them very convenient. ... and I hope that more professors begin using this technology.*
- *Screencasts both showed solutions and problem strategies. The verbal explanation makes it more understandable than a simple [homework] solution handout.*
- *I really liked listening to the solution explanation to the homeworks even if I got the problem right. Just listening to the way the problem was reasoned out in words helped me to remember processes and procedures better.*

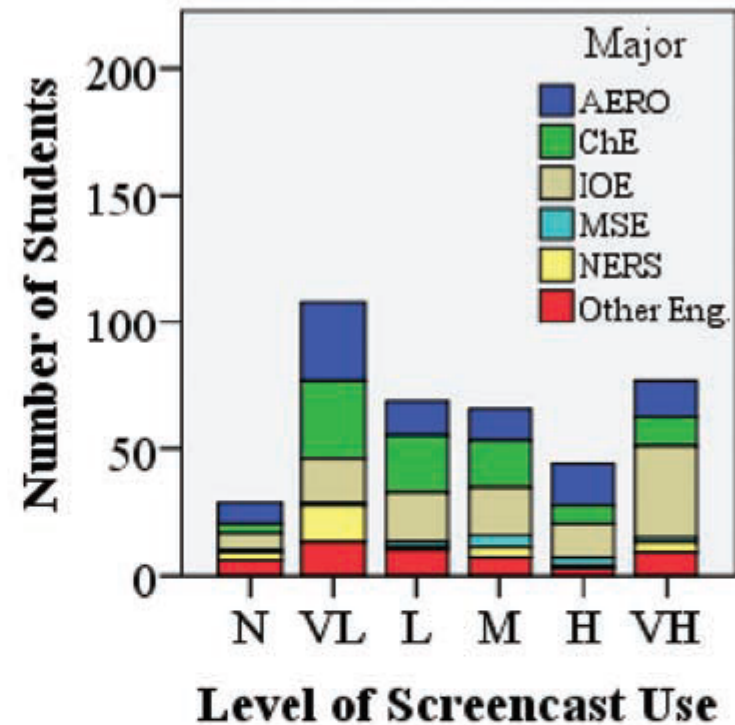
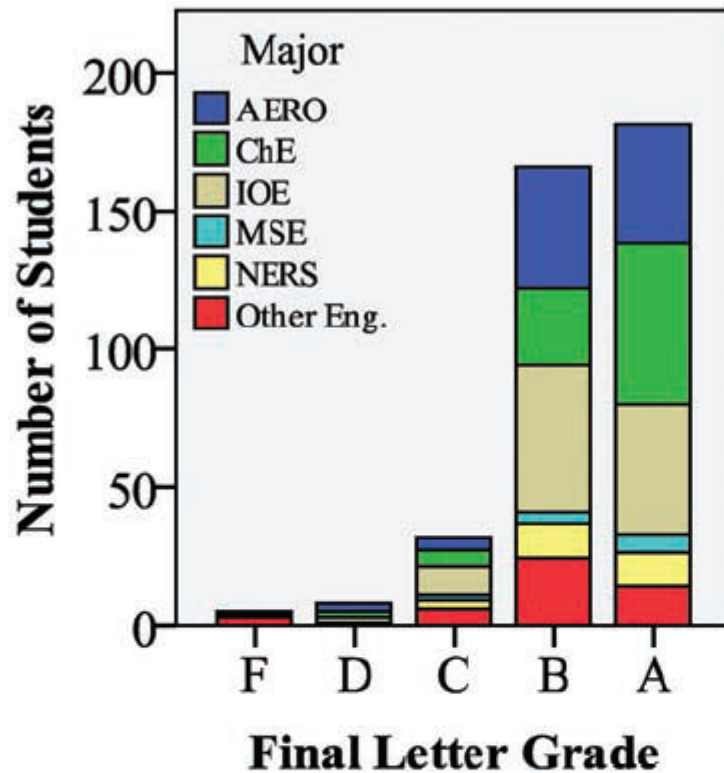
# Value

- Students tend to watch screencasts from start to finish
  - The highest watchers were more likely to watch the entire homework solution screencasts
  - Those who watched the entire hw screencast were more likely to have lower homework grades

Strategies for	I got things wrong and wanted to fix them		Lecture	
	Number	Percentage	Number	Percentage
Watched entire video from start to finish	68	33	129	66
Re-watched certain segments based on my homework responses	54	26	10	5
Went to specific points to review	40	19	24	12
Watched large chunks looking for information	29	14	18	9
Browsed around	18	9	15	8

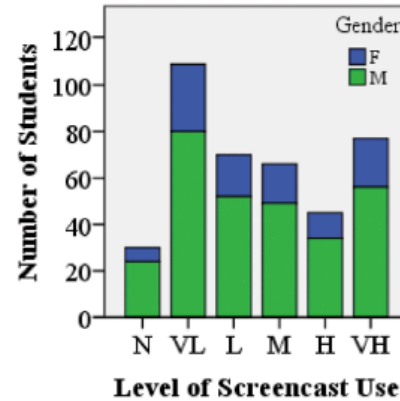
# Performance

- Screencast usage was positively and significantly correlated to overall performance in the course

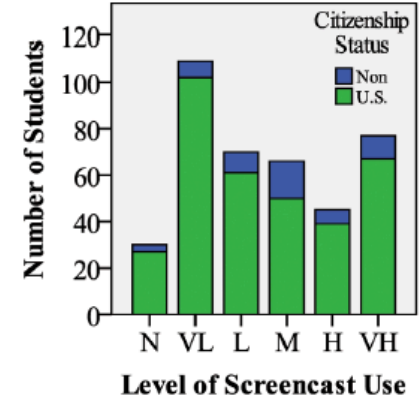


# Performance

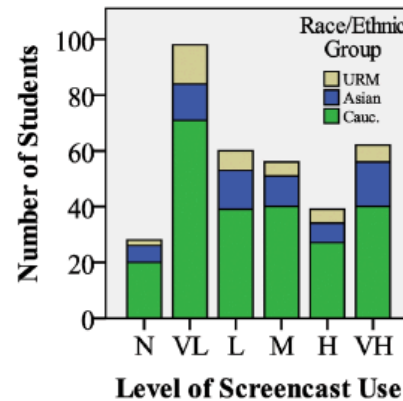
- Examined different groups of students to see if there were differences
  - No significance across gender, citizenship, ethnicity, academic level



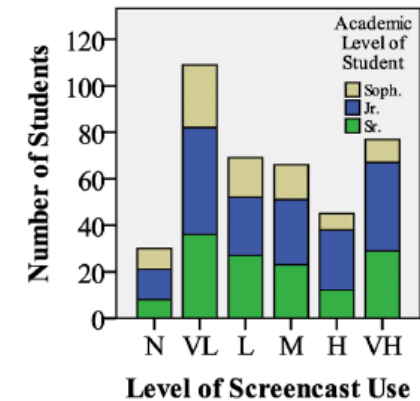
(a)



(b)



(c)



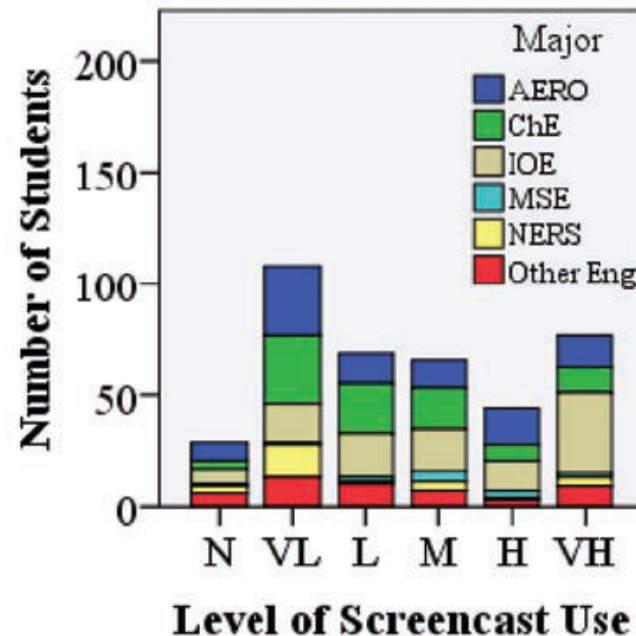
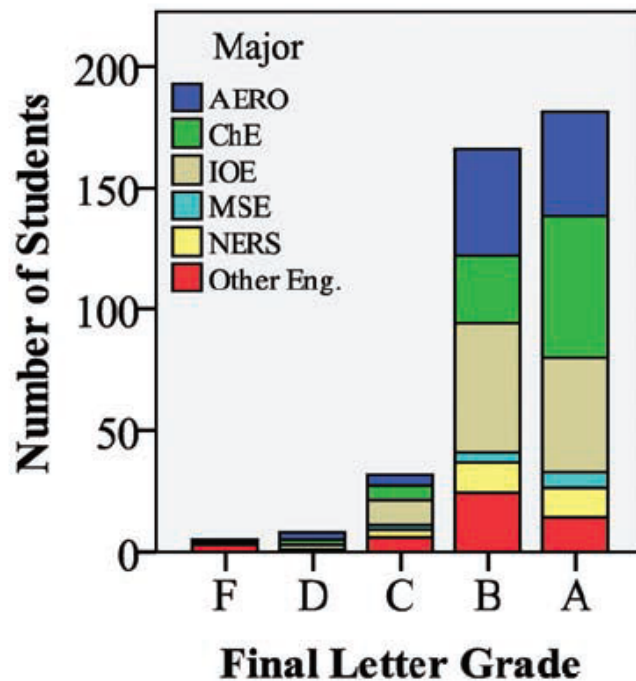
(d)



# Performance

## Significance across major

- ChE use screencasts at lowest levels, while receiving the highest grades
- IOE use the screencasts the most, and receive average grades. Prior to the introduction of screencasts; IOEs received the lowest grades.



# Performance

- The ChE Curriculum contains many MSE topics covered
- The IOE curriculum contains no MSE topics covered

Materials Science & Eng.	Chemical Engineering	Aerospace Engineering	Industrial & Operations Eng.
<ul style="list-style-type: none"> <li>• Principles of Engineering</li> </ul>	<ul style="list-style-type: none"> <li>• Materials and Energy Balances</li> </ul>	<ul style="list-style-type: none"> <li>• Intro to Aerospace</li> </ul>	<ul style="list-style-type: none"> <li>• Economic Decision Making</li> </ul>
<ul style="list-style-type: none"> <li>• Mechanical Behavior</li> </ul>	<ul style="list-style-type: none"> <li>Engineering and Design</li> </ul>	<ul style="list-style-type: none"> <li><b>Structures</b></li> <li>• Aerodynamics</li> <li>• Aircraft and spacecraft Propulsion</li> <li>• Space Flight Mechanics</li> <li>• Aircraft Dynamics</li> </ul>	<ul style="list-style-type: none"> <li>• Ergonomics</li> <li>• Linear Statistical Models</li> <li>• Data Processing</li> </ul>

Screencasts have a positive impact as a supplementary resource to aid student learning, especially for students with less familiarity with course content, all other things being equal.

# Performance

- Case study: Examined the impact of screencast usage on ability to answer exam questions.
  - If IOE students watched ANY screencasts, they performed better on a PARTICULAR question
  - If IOE students watched a PARTICULAR screencast, the significance was even stronger for the performance on that PARTICULAR question
  - Also somewhat true for AEROs

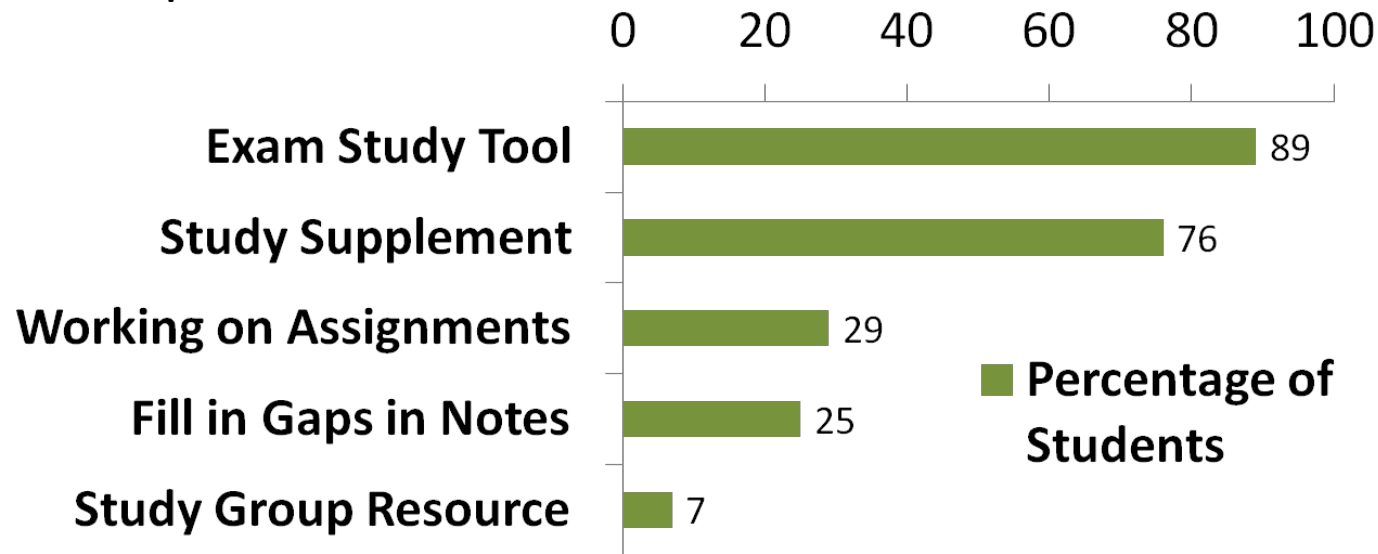
Screencast Use and Performance on Final Exam Question One  
 by Students' Major (Pearson Correlations)

Major	<i>n</i>	Number of Web site hits & polymer structure final exam question		Number of views of polymer structure screencast (range = 0 to 5) & polymer structure final exam question	
		Correlation	Sig.	Correlation	Sig.
AERO	34	$r = 0.350^*$	$p = 0.042$	$r = 0.345^*$	$p = 0.046$
ChE	45	$r = 0.123$	$p = 0.421$	$r = 0.177$	$p = 0.243$
IOE	60	$r = 0.425^{**}$	$p = 0.001$	$r = 0.375^{**}$	$p = 0.003$

\* $p < 0.05$ ; \*\* $p < 0.01$ .

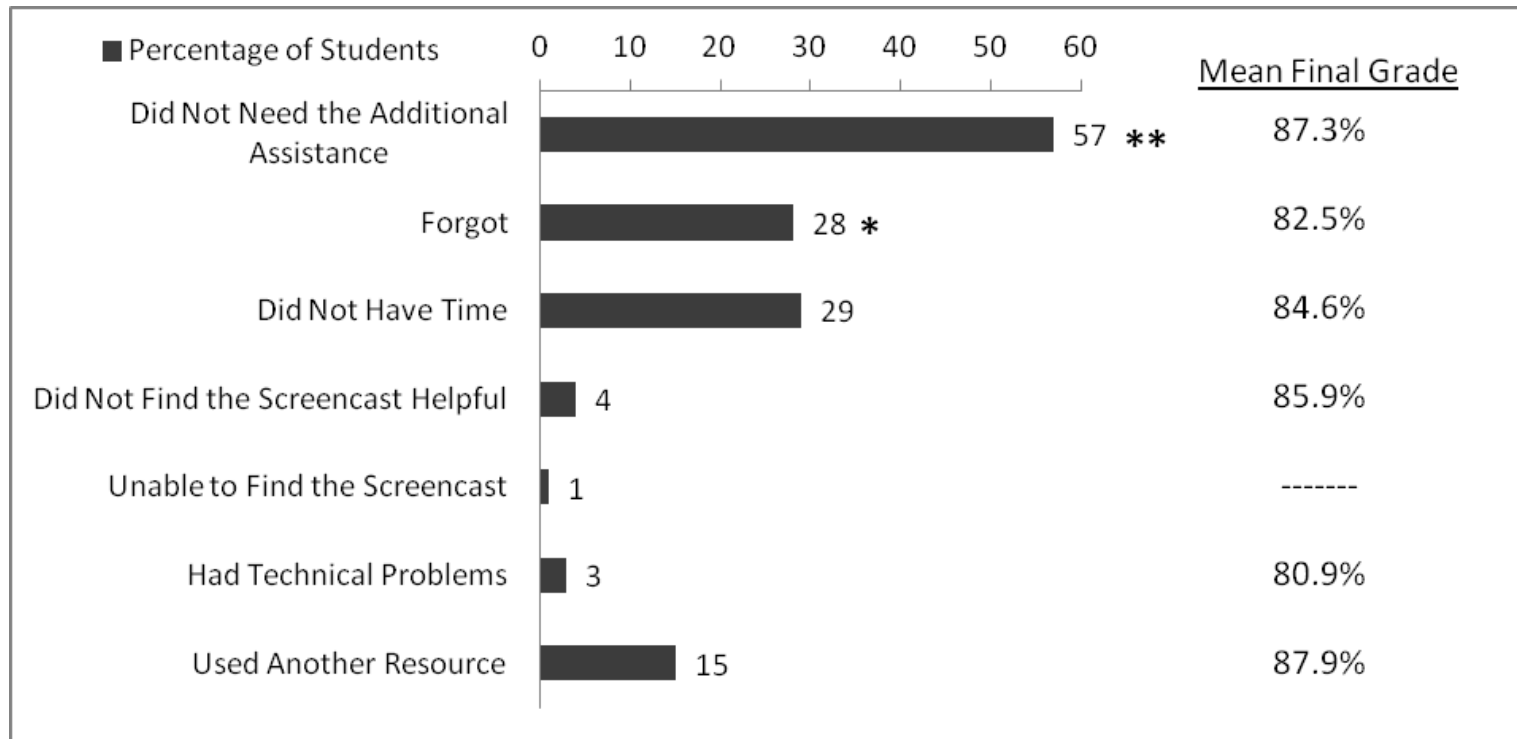
# Motivation

- Students are motivated to use the screencasts because they are perceived to be helpful and they are shown to improve course performance



# Motivation

## ■ Why do only 58% of the students use the screencasts?



# What we've learned

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- Screencasts are useful for explaining concepts and procedures.
  - Shift first exposure of a concept
  - Level the playing field
  - Allow for more active learning during class
  
- They appear to enhance student self-efficacy
  
- How to publish in the Ed literature
  - K. Green, T. Pinder-Grover, J. M. Millunchick, *Journal of Engineering Education* **101** 717 (2012)
  - T. Pinder-Grover, K. R. Green, J. M. Millunchick, *Advances in Engineering Education* **2** 9 (2011).

# Screencasting Best Practises

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# Technical Requirements

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- On your own computer
  - Software
    - Camtasia            \$\$\$
    - Screenflow        \$\$
    - Jing                free
  - Microphone
- Course management system



# Challenges

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- Not a substitute for good teaching
- Can be a time sink if you let it
- Uploading large files to CMS can be a pain

# Best Practices

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- Content Preparation
- Recording
- Editing and Production
- Publish

# Content Preparation

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- WHY are you doing it?
  
- Decide on your production quality
  - [YouTube](#) vs [Hollywood](#)
  
- Start Small

# Recording

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- Have your materials ready
- Speak normally
- “Take two”
- Use your cursor to point
- Record in short segments

# Editing and Production

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- Watch the tutorials if they exist
- Cutting
- Zoom and pan
- Chapters
- Make it web friendly

# Publish

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- Upload to Ctools
  - Native upload tool
  - Third party upload tool (cyberduck)

Joanna Mirecki Millunchick  
Materials Science and Engineering  
joannamm@umich.edu