Fully Integrating Remote Students into a Traditional Classroom using Live-Streaming and TeachBack

FIE 2016
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OUTLINE

1. Summary
2. Background & Motivation
3. Tools: TeachBack & Echo360
4. The Experiment
5. Results
6. Current Work
Summary

Studying the effects and feasibility of adding optional remote attendance to a class using
  ○ Synchronous interactive experience for both remote and F2F students
    ■ Echo360: live-streaming of class meetings
    ■ TeachBack: Web-based class-wide interactions

Research Interests:
  ● F2F class attendance/absenteeism
  ● Learning outcomes and styles
  ● Use of class resources - lecture recordings
  ● Feasibility and perspectives
Background & Motivation

- Traditional instructional model (same time and place) is still dominant
  - Unbounded avenues of F2F and real-time interactions and communications

- Growth and adoption of remote and distance education
  - Changing styles and needs of learners and teachers
  - Advancement of IT
TOOLS USED

Echo360 & TeachBack
Echo360 { echo360.com }

➔ Echo360 Lecture Capture System
➔ Fitted in select lecture halls at Brandeis University
◆ Recording Recording
◆ Live-Streaming
◆ Archiving and Later VOD
➔ There are alternative streaming/recording products
TeachBack

➔ an in-classroom web application designed to support active and interactive learning and teaching activities

Main features:
➔ Questions - a clicker-style ARS
➔ Feedback - a rapid feedback mechanism
➔ Forum - a monitored in-class help & discussion forum
➔ GroupWork - a clicker-style Think/Pair/Share assessment system
➔ Stats - students participation and assessment stats
➔ + Others
User Account

William Tarimo

My Current Courses

- **94A: EL94a**
  Brandeis: Wed 17:00-18:00
  Instructor: Timothy Hickey

- **MKTYP CS**
  Farber 101: Tue,Fri 12:30-14:00
  Instructor: Hickey

- **CS155B: Computer Graphics**
  Gzang 124: Tue,Fri 9:30-11:00
  Instructor: Hickey

- **BIOL42A: Physiology**
  Geratenzang 123: Mon,Wed,Thu 08:00-08:50
  Instructor: Maria Miara

TeachBack Announcements

- NO CURRENT ANNOUNCEMENTS. Create new in a Course page.
Feedback - Student View

Activity Page: Lecture Presentation: Introduction to CS

We'll cover basics about computer software and hardware.

My Activity Notes

YOU HAVE NOT WRITTEN ANY NOTES FOR THIS ACTIVITY!
Feedback - Instructor

Latest Feedback Summary

Engaged: (Count: 6, Percentage: 75.0%)
> I'm following!
> going well!

Class Feedback Timeline

Student Count


Engaged  Confused  Bored

Highcharts.com
I haven’t remained lost the entire class. That’s never happened before!

Note [at 10:42, 1 year ago] By [name hidden] | 1 comment | 20 views | 1 recommend

FPS
The bullet shoots in the same direction regardless of the avatars orientation pls help

Resolved [at 10:24, 1 year ago] By [name hidden] | 1 comment | 16 views

Flowers shoot downwards
When I shoot, the flowers shoot downwards not across. How do I fix this?

Resolved [at 10:24, 1 year ago] By [name hidden] | 1 comment | 7 views

invisible plane
How did you make the plane invisible?

Unresolved [at 10:17, 1 year ago] By [name hidden] | 2 comments | 8 views
rot
find the rotation matrix for the angle 0.5 radians around the x axis \( \cos = 0.878 \sin = 0.479 \)

Correct Answer:
\[
\begin{bmatrix}
1 & 0 & 0 & 0 \\
0 & 0.878 & -0.479 & 0 \\
0 & 0.479 & 0.878 & 0 \\
0 & 0 & 0 & 1
\end{bmatrix}
\]

Responses: 39, ✓ 23/39: 56%

matrix mult
\[
\begin{bmatrix}1 & 4 & 6 \\
0 & 3 & 2\end{bmatrix} \times \begin{bmatrix}1 & 2 & 3 \\
2 & 3 & 5 \\
10\end{bmatrix}
\]
Correct Answer:
\[
\begin{bmatrix}39 & 74 \\
16 & 29\end{bmatrix}
\]

Responses: 40, ✓ 29/40: 72%

apply matrix to vector
what is \(\begin{bmatrix}1 & 2 & 3 \\
5 & 5 & 0\end{bmatrix} \times \begin{bmatrix}1 & 4 & 6\end{bmatrix}\)?
Correct Answer:
\[
\begin{bmatrix}27 & 25 \\
25 & 30\end{bmatrix} \text{ or } \begin{bmatrix}27 & 25\end{bmatrix} \text{ or } \begin{bmatrix}27 \\
25\end{bmatrix}
\]

Responses: 40, ✓ 30/40: 75%

matrix mult
what is \(\begin{bmatrix}0 & 1 & -1 \\
0 & 1 & 0\end{bmatrix} \times \begin{bmatrix}3 & 5\end{bmatrix}\)?
Correct Answer:
\[
\begin{bmatrix}5 & -3 \\
5 & -3\end{bmatrix} \text{ or } \begin{bmatrix}5 \\
-3\end{bmatrix} \text{ or } \begin{bmatrix}5 & -3\end{bmatrix}
\]

Responses: 41, ✓ 27/41: 65%

Can you multiply two 4x4 matrices together?

Responses: 40
## GroupWork - Instructor View

### Group Tasks

<table>
<thead>
<tr>
<th>Task Description</th>
<th>InGroup:</th>
<th>Individual:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spin the objects in the scene</td>
<td>16, ✔ 12/16: 75%</td>
<td>31, ✔ 12/31: 38%</td>
</tr>
<tr>
<td>Write the code that goes in the render method which will make all of the objects (except the plane and lights) continually spin.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>operations on a scene</td>
<td>24, ✔ 16/24: 66%</td>
<td>34, ✔ 13/34: 38%</td>
</tr>
<tr>
<td>Write a javascript expression which, when you run it in the developer console moves every object up 1 unit.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point3D</td>
<td>25, ✔ 20/25: 80%</td>
<td></td>
</tr>
<tr>
<td>Create a Point3D class with a constructor, and add, dot, toString methods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>z = new Point3D(1,2,2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>w = newPoint3D(1,1,1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>console.log(z.dot(w))</td>
<td></td>
<td></td>
</tr>
<tr>
<td>multiplication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Add a multiply method to the Complex class and you should cut/paste in the Complex.prototype code here...</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Student Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Status</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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# Participation & Performance Stats

## Course: COSI 101: Intro to Computer Science
- **Volen 101**  
- **M, W, F 10:00 - 10:50**  
- **Instructor:** William Tarimo  
- **Spring 2014**  
- **Harvard University**

## Class Activity Stats

**Select range for lecture dates:** Default: Course start to end dates.

<table>
<thead>
<tr>
<th>Start Date</th>
<th>End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>01/14/2014</td>
<td>12/31/2015</td>
</tr>
</tbody>
</table>

### Questions Stats

<table>
<thead>
<tr>
<th>Full Name</th>
<th>E-mail</th>
<th>%C</th>
<th>Pts.</th>
<th>Correct</th>
<th>InCorrect</th>
<th>Ungraded</th>
<th>%Answered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mary Jane</td>
<td><a href="mailto:mjane@email.com">mjane@email.com</a></td>
<td>100%</td>
<td>6.0</td>
<td>3.6</td>
<td>0.0</td>
<td>0/0</td>
<td>50.0%</td>
</tr>
<tr>
<td>John Smith</td>
<td><a href="mailto:jsmith@email.com">jsmith@email.com</a></td>
<td>0%</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0/0</td>
<td>0%</td>
</tr>
</tbody>
</table>
## Attendance Stats

### Class Activity Stats

**Select range for lecture dates:** Default: Course start to end dates.

**Start Date:** 08/29/2015  
**End Date:** 12/18/2015

<table>
<thead>
<tr>
<th>Full Name</th>
<th>Email</th>
<th>Active Participation</th>
<th>Showed Up Only</th>
<th>Absent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>18</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
THE EXPERIMENT
The Experiment

Class: Fall 2015
- Flipped Computer Graphics class - 41 Students.
- 26 Class Meetings
- Offered optional remote attendance from class 11.

Data:
- TeachBack attendance, engagement and performance.
- Echo360 data.
- Final exam and course grades.
RESULTS
Effects on Absenteeism

- Overall class attendance remained the same, counting remote attendance
  - Part 1: 2.9 absentees/day & Part 2: 2.875
  - Part 2: On average /day: 75% physically in class, 18% remote, and 7% absent
  - Anecdotally, more students tend to miss classes towards end of semester

<table>
<thead>
<tr>
<th>Missed Classes</th>
<th>Students (Part 1)</th>
<th>Students (Part 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>23</td>
<td>17</td>
</tr>
<tr>
<td>1</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>
Student Use of Lecture Recordings

- 72 semester absences > 24 (33.3%) watched recordings of missed classes
  - During Part 1: 35.7%
  - During Part 2: 31.8%, only slightly lower
Student Use of Live-streaming

- Students embraced the remote option
- 75% of students tried at least once
- 18% of students tried >50% of the 16 classes

<table>
<thead>
<tr>
<th>Classes</th>
<th>Students</th>
<th>Percentage of Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
<td>25%</td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>25%</td>
</tr>
<tr>
<td>2 - 5</td>
<td>14</td>
<td>32%</td>
</tr>
<tr>
<td>7 or More</td>
<td>7</td>
<td>18%</td>
</tr>
</tbody>
</table>
Student Use of Live-streaming

- Students were committed to streaming-lectures while remote

Out of 121 live-streaming sessions:
- 84=69% streamed >= 50% of class time
- 52=43% streamed >= 90% of class time
## Effects on Learning Outcomes

- Has insignificant effect on course performance compared to absenteeism

### Linear Regression Analysis: Modified Course Grade vs. Absenteeism and Remote Attendance

<table>
<thead>
<tr>
<th>Item</th>
<th>$R^2$</th>
<th>P-Value</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Attendance</td>
<td>0.011</td>
<td>0.519</td>
<td>-0.261</td>
</tr>
<tr>
<td>Absenteeism</td>
<td>0.211</td>
<td>0.00283</td>
<td>-2.081</td>
</tr>
</tbody>
</table>
Effects on Learning Outcomes

- Has insignificant effect on participation grade compared to absenteeism

<table>
<thead>
<tr>
<th>Item</th>
<th>$R^2$</th>
<th>P-Value</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote Attendance</td>
<td>0.0156</td>
<td>0.441</td>
<td>-0.476</td>
</tr>
<tr>
<td>Absenteeism</td>
<td>0.435</td>
<td>0.0000036</td>
<td>-4.568</td>
</tr>
</tbody>
</table>
Use of Lecture Recordings

- Popular resource for both remote and face-to-face attendees
Student Opinions

1. 51.5% - All or most courses at university should have the option
2. 30.6% - Just as effective or more, 50% thought it was inferior, 19.4% Didn’t try the option
3. on scale [1, 5], 87.2% rated TeachBack as effective at 3-5
4. on scale [1, 5], 79.4% rated Echo360 as effective at 3-5.
   a. Amid poor video quality complaints
5. Comments: Convenience, Anywhere attendance, Valuable Alternative
   a. Risk of poor concentration.
   b. Depended on good connection.
   c. Better as an option.
   d. Separate TeachBack groupings.
   e. Good when not abused.
CURRENT & FUTURE WORK
Current Work

- A second run in **Introduction to 3D Animation** - Fall 2016
- 153 Students
- About $\frac{1}{3}$ of the class attending remotely
  - $\approx 45$ students/class
THE END!
Thank You!

Time For Questions

wtarimo@cs.brandeis.edu & tjhickey@brandeis.edu
teachback.herokuapp.com

From Fall 2014

1,697 Unique Users
64 Courses
1,086 Questions
41,135 Question Answers
2,260 Course Enrollments
202 Student Notes

413 Class Activities
374 Class Meetings
413 Class Activities

105 GroupWork Tasks
3,875 Task Responses
1,140 Forum Posts
6,730 Forum Comments

2,260 Course Enrollments
10,723 Feedback Records