Computer-Supported Scrum-Based Agile Pedagogy (CSAP)

Dissertation Presentation

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July 22nd, 2016
Outline

1. Summary
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3. Research Questions
5. Scrum & Pedagogy Design
6. Computer-Supported Scrum-Based Agile Pedagogy (CSAP)
7. TeachBack
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   8. Computers in the Classroom
   9. Early Detection of At-Risk Students
   10. Peer-Assisted Learning
   11. CSAP in hybrid online/physical classrooms
12. Future Opportunities
13. Contributions of the Research
CSAP: Summary

- Agile methods have revolutionized software development through
  - Continuous transparency, inspection, adaptation, customer collaboration, and incremental delivery

- In this research, we’re proposing an analogous framework for pedagogy
  - **Computer-Supported Scrum-Based Agile Pedagogy (CSAP)**
  - Founded on agile teaching, active learning, and technology
  - Computer use provides efficiency, enables new approaches and opportunities
  - Students & teaching staff work as a cross-functional and self-organizing team
  - ... with iterative cycles of transparency, inspection, and adaptation
  - ... with dynamic interaction between content, instruction, and assessment in service of discovering optimal learning and teaching outcomes
Background: Issues We See

- Prevalence of traditional and inferior teaching/learning practices, in light of better ones
  - “One size does not fit all” - different teacher’s philosophy, demographic, subject area, school’s mission statements
    ■ Each responds to particular teaching/learning methods differently
- Poor adoption of effective teaching and learning practices from research
- Challenges of the 21st century classroom
  - Unmet student expectations for interactions, autonomy, flexibility, etc
  - Learning objectives often not fully achieved
  - Classroom technology not appropriately designed or used to its potential
Opportunities for developing CSAP

- Effective learning and teaching methods are widely available
  
  Eg. Constructivism
  
  - Eg. Flipped Learning
Opportunities for developing CSAP

- It is the right time for this approach in the 21st century classroom
  - Digital native / millennial students
  - Diversity in students and modes of learning/teaching
  - Abundance of technology and internet
  - Abundance of anytime/anywhere information
Opportunities for developing CSAP

- Educators and researchers are shifting to more learner-centered pedagogy
  - Focusing on the learning process and the particular students
  - Some more interactive and flexible classrooms
    - Virtual and online classrooms
    - MOOCs
    - Technologies: Learning Catalytics, EdX, Edmodo, Apple Classroom apps, etc

- We saw a feasible analogy from Scrum that could be exploited to combine these opportunities to effectively address the issues we saw
Research Questions

How can we use CSAP to improve learning and teaching outcomes?

● How does the use of computers in the CSAP classroom affect learning outcomes?

● How can we monitor and predict learning outcomes in a CSAP classroom?
  ○ Moreover, can we proactively detect and support at-risk students?

● How can CSAP be effectively implemented in synchronous mixed online/physical classrooms?

● How can various learning/teaching approaches be effectively supported in CSAP?
  ○ We formally experimented with an implementation of collaborative learning
Agile Software Development

Agile Alliance: XP, Scrum, Adaptive Software Dev., Agile Organizing Framework, Pragmatic Programming., etc

Philosophy - self-organizing and self-managing teams working towards a goal are more effective than tightly controlled and directed approaches

Agile Manifesto - outlines the principles and values of Agile Soft. Dev:

- Individuals and interactions over processes and tools
- Working software over comprehensive documentation
- Customer collaboration over contract negotiation
- Responding to change over following a plan
Scrum

● The most popular and widely adopted of the agile methods
● An iterative design framework, uses self-managing and cross-functional teams, open collaboration, and well-managed chunks of time to achieve goals and deliverables towards a product.
● Scrum consists of: a team + roles + events + artifacts + rules
● At its core - Empiricism - “knowledge comes from experience and making decisions based on what is known”
● Scrum implementations are upheld by 3 pillars:
  ● Transparency
  ● Inspection
  ● Adaptation
Scrum Team

- Product Owner - Owns ‘what’ is desired and ‘why’ it’s desired
- Scrum Master - Keeper of the Scrum Process, facilitator
- Development Team - Owns ‘how’ and ‘how quickly’ work is delivered

Diagram Adapted From: http://danielcoding.net/scrum-part-3-the-team/
Scrum Events

Diagram Adapted From: http://cloudtips.net/scrum-06-events/
The Analogy: Scrum/Agile & Pedagogy Design

**Agile Software Dev.**

**Agile Manifesto:**
1. Individuals and interactions over processes and tools
2. Working software over comprehensive documentation
3. Customer collaboration over contract negotiation
4. Responding to change over following a plan

**Scrum:**
1. Transparency
2. Inspection
3. Adaptation

**Agile Pedagogy**

1. Students/teachers and their interactions over specific teaching/learning approaches
2. Working mastery over rote learning or memorization for grades
3. Student-centered instruction over syllabus-driven schedules
4. Receptive and responsive to student learning needs over following a fixed lecture/syllabus plan

1. Transparency, collaboration
2. Continuous testing, feedback
3. Fitting pedagogy to observed needs
How it looks in the classroom

- **Spontaneity**: each class is a sequence of contingent activities, selected by the instructor in real-time to best meet the needs of the students.
- **Explicit Learning Goals**: each activity has explicit learning objectives shared with the students and evaluated by in-class formative assessments.
- **Active Learning**: most activities involve students interacting directly with the content: collaborative, cooperative, problem-based, projects, etc.
- **Agency**: students choose their own projects (with faculty approval) rather than having all students work on the same homework assignment.
- **Belonging**: students work together as a class and in groups that change daily.
The Analogy

Team:
1. Product Owner
2. Scrum Master
3. Development Team
4. Stakeholders

Events:
1. Sprint
2. Daily Scrum
3. Sprint Review
4. Sprint Retrospective

Artifacts:
1. Software Product
2. Product Backlog
3. Sprint BackLog
4. Increment or “Done”

1. Instructor
2. Instructor, TA, Staff
3. Instructor, TAs, Staff, + Students
4. Students, parents, institution, etc

1. Unit in a semester course
2. Pre/Post-class feedback review
3. Unit/Midterm summative or formative exams
4. Instructor, TAs, Staff, + Students collectively review: feedback, results, resources, methods, enjoyment

1. Optimal students’ mastery of learning objectives
2. Syllabus
3. Unit learning objectives
4. Students’ satisfactory mastery of unit objectives
CSAP Inside Class

**Pre-Class**

- **Content** covering Learning Objectives
  - reading, videos, slides

- **Content Reflection**
  - free comments, quiz

**In-Class**

- **Instructional Activities** *(goal-based)*
- **Formative Assessments & Feedback**
- **Recap & Class Discussion**

If Objectives NOT met.

Repeat for the next set of learning goals
CSAP Inside Class

Pre-Class

Content covering Learning Objectives
-reading, videos, slides

Content Reflection
- free comments, quiz

In-Class

Instructional Activities (goal-based)

Formative Assessments & Feedback

Recap & Class Discussion

If Objectives NOT met.

Repeat for the next set of learning goals

Daily Scrum

Developing 1 User-Story

Day Backlog

Story Scrum

Repeat for the next set
Identify and Intervene with struggling students
- assessing personal and pedagogy issues

Evaluate instructional activities used
-on effectiveness and efficiency

Teach several classes
- Set learning objectives
- Monitor instructional activities & assessment data

Adjust Pedagogy & Implement Interventions

CSAP Outside Class
1. **Sprint Review**
   - Assessing personal and pedagogy issues

2. **Identify and Intervene with struggling students**

3. **Evaluate instructional activities used**
   - On effectiveness and efficiency

4. **Teach several classes**
   - Set learning objectives
   - Monitor instructional activities & assessment data

5. **Adjust Pedagogy & Implement Interventions**

**Sprint Planning**

**Sprint Retrospective**

**Sprint Review**

**1 Sprint**

CSAP Outside Class
Benefits of Scrum-Based Agile Pedagogy

⭐ Teaching will be more agile and informed
  ○ More student-centric
  ○ More goal-oriented - towards optimal mastery of learning objectives
  ○ More effective

⭐ Teacher gains deep and practical insights on pedagogy with respect to teaching methods and learning by assessing her own teaching & students

⭐ Enforces more transparency on students’ and teacher's expectations
Benefits of being Computer-Supported

★ Automatic collection of data from students and teaching/learning activities
  ○ Automatic analysis of data for student learning & teaching insights
  ○ Automatic analysis of data for understanding of each student’s learning characteristics

★ Extends seamlessly to hybrid classrooms
★ Extends to large classes. Eg 300+
★ Supports back-channel communication to help small group of students catch up in real-time
★ Formative assessment is faster with real-time grading
★ Provides online resources for students to review
TeachBack
TeachBack

an in-classroom web application designed to support the CSAP methodology

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
… 1st, Some History
Your anonymous ID for this session/class!

We'll use the ID to anonymously group and track your session response!

How do you feel? *

- Engaged
- Bored
- Confused

Why?

Submit

Never submit passwords through Google Forms.
### Affective Tutor

<table>
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<tr>
<th>Timestamp</th>
<th>How do you feel?</th>
<th>Why?</th>
<th>Your anonymous ID for this session/class!</th>
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<tr>
<td>4/29/2013 9:56:49</td>
<td>Engaged</td>
<td>today is the last class</td>
<td>tjh724</td>
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<td>user2</td>
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... spring 2013 ...
summer 2013 ...
summer 2013 ...
summer 2013 ...
summer 2013 ...
summer 2014 ...

teachback.herokuapp.com
User Account

My Current Courses

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

- MKYP 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
  Geranenfang 123: Mon,Wed,Thu 08:00-08:50
  Instructor: Maria Miara

TeachBack Announcements

NO CURRENT ANNOUNCEMENTS. Create new in a Course page.
Lecture

Class Discussion & Formative Assessment
We'll discuss various types of computer peripherals (hardware). We'll do exercises involving categorizing various devices we use all the time.

Rating: ★★★★★

Lecture Presentation: Introduction to CS
We'll cover basics about computer software and hardware.

Rating: ★★★★★
Activity - Instructor View

Lecture Presentation: Introduction to CS

We'll cover basics about computer software and hardware.

Version 0.8 · About TeachBack · Contact Us · Report Technical Suggestions/I Issues · © TeachBack 2015
Activity - Student View

Mary Intro to Computer Science! Welcome: Intro Lecture Presentation: Introduction to CS

Activity Page: Lecture Presentation: Introduction to CS Rating: ⭐⭐⭐⭐⭐ 0

We'll cover basics about computer software and hardware.

My Activity Notes

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

We'll cover basics about computer software and hardware.

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!

Engaged - Confused - Bored

Class Feedback Timeline

Student Count


Engaged - Confused - Bored

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

FPS
The bullet shoots in the same direction regardless of the avatars’ orientation. Pls help.

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

invisible plane
How did you make the plane invisible?

collision with plane
Questions - Instructor View

rot
find the rotation matrix for the angle 0.5 radians around the x axis \( \cos = 0.878 \quad \sin = 0.479 \)
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
\[
\begin{bmatrix} 1 & 4 & 6; 0 & 3 & 2 \end{bmatrix} \times \begin{bmatrix} 1 & 2; 3 & 5 & 10 \end{bmatrix}
\]
Correct Answer:
\[
\begin{bmatrix} 39 & 74; 16 & 29 \end{bmatrix}
\]

Responses: 40, 29/40: 72%

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

Responses: 40, 30/40: 75%

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

Responses: 41, 27/41: 65%

Can you multiply two 4x4 matrices together?

Responses: 40
**Question Summary**

Question: What is the intersection "time" \( t \) for the ray through the origin in direction \((1,1,1)\) and the plane through \((2,3,4)\) with normal \((3,2,1)\).

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<th>Points</th>
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<td>?</td>
<td>2.0</td>
</tr>
<tr>
<td>5.38</td>
<td></td>
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### Group Tasks

**Spin the objects in the scene**
Write the code that goes in the render method which will make all of the objects (except the plane and lights) continually spin.

- **InGroup:** 16, 12/16: 75%
- **Individual:** 31, 12/31: 38%

**Operations on a scene**
Write a javascript expression which, when you run it in the developer console moves every object up 1 unit.

- **InGroup:** 24, 16/24: 66%
- **Individual:** 34, 13/34: 38%

**Point3D**
Create a Point3D class with
a constructor, and add, dot, toString methods

- **InGroup:** 25, 20/25: 80%
- **Individual:** 35, 22/35: 62%

**Multiplication**
Add a multiply method to the Complex class and you should cut/paste in the Complex.prototype code here...

- **InGroup:** 30, 20/30: 66%
- **Individual:** 35, 16/35: 45%
GroupWork - Student View

Group #1

Info: You're required to submit your FINAL PERSONAL response from any of the group responses; it doesn't have to be one of your answers!

---

**Group Responses**

**Question:** Evolution
Did humans evolve from monkeys?

**No**
- jsmith | at 09:24, 5 months ago
  Points: 2.0 | Good!

**Yes**
- mjane | at 11:07, 5 months ago

**No**
- mjane | at 11:18, 5 months ago
  Points: 2.0

---

**Group Chat**

I agree, that's why we still have both humans and monkeys today.
- jsmith | at 17:04, 6 minutes ago

I think both humans and monkeys evolved from the same common ancestor. So the answer is no.
- mjane | at 17:00, 10 minutes ago

yeah
- jsmith | at 00:51, 5 months ago

New Comment
Participation & Performance Stats

Course Page: 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.
Start Date 01/14/2014  •  End Date 12/31/2015

<table>
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<th>E-mail</th>
<th>%C</th>
<th>Pts.</th>
<th>Correct</th>
<th>InCorrect</th>
<th>Ungraded</th>
<th>%Answered</th>
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<td><a href="mailto:mjane@email.com">mjane@email.com</a></td>
<td>100.0%</td>
<td>6.0</td>
<td>3.0</td>
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<td>John Smith</td>
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<td>0.0</td>
<td>0/0</td>
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## 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

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<th>Absent</th>
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<td>0</td>
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<td>18</td>
<td>1</td>
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<td>3</td>
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At-Risk Assessment

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<th>%QnsAnswdC</th>
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<td>72.7%</td>
<td>58.3%</td>
<td>67/67</td>
<td>100.0%</td>
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<td></td>
<td></td>
<td>28/33</td>
<td>84.8%</td>
<td>28.6%</td>
<td>60/67</td>
<td>89.6%</td>
<td>1.7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>33/33</td>
<td>100.0%</td>
<td>51.5%</td>
<td>61/67</td>
<td>91.0%</td>
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<td></td>
<td>33/33</td>
<td>100.0%</td>
<td>51.5%</td>
<td>58/67</td>
<td>86.6%</td>
<td>19.0%</td>
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</table>

Based on less than 25.0% attempts or performance on graded Questions and GroupWork (individual answers) problems.
Recent Ways TeachBack has Been Used

1. Pre-class posting of activities and assignments
   ○ Reflection posts/comments or quiz
2. In traditional lecture classes as an interactive and assessment companion
3. Full deployment in active and flipped classes
4. Facilitation of in and out of class assignments, quizzes and exams
5. A repository of notes, class content for self-study and revision
6. Collection and analysis of students participation and assessment records. Including various types of attendance
CSAP Experiments Using TeachBack
Research Question #1

How does the use of computers in the CSAP classroom affect learning outcomes?

Computers in the CS1 Classroom
William T. Tarimo, Fatima Abu Deeb, Timothy J. Hickey.
The 7th International Conference on Computer Supported Education. May 2015

A Flipped Classroom With and Without Computers
William T. Tarimo, Fatima Abu Deeb, Timothy J. Hickey
The Experiment

Compare two approaches to similarly flipping a CS1 class

I. **Computer-supported**
   For all interactions, formative assessments, feedback, coding using TeachBack and Spinoza & other tools

II. **Without students’ computers**
   Use pen & paper, in-person discussions, traditional interactions

**Constants**: Instructor, pedagogy, materials, lectures, questions and coding challenges
Flipped CS11a during Fall 2014

**Course:** Introduction to Programming in Java and C

I. 2 sections, each ~145 students

II. Pre-class: Assigned readings + mandatory reflection or short assignment

III. 50-minute class (M,W,F): 3-5 interactive activities

IV. Four 3-week units with summative exams in the end

V. Section 1 no computers during unit 3, section 2 no computers during unit 4.
Data Collected

- End-of-unit surveys
  - various self learning assessments
  - assessments of teaching styles and tools
- Frequency of visits to TAs hours
- Hours spent on the course outside of class
- Participation in TeachBack and Spinoza
- End of unit quiz grades
- Final course grades
Results

1. (TeachBack & Spinoza) computer use didn’t harm learning outcomes
2. Most students prefer the computer-supported pedagogy option.
Results

3. Lack of distraction from computer use in class

Most students didn’t report being distracted

- Largely due to the engaging and segmented class meetings
  - Short interactive activities => students engaged with material, peers and instructor

- Students are more likely to be distracted by computers in traditional lecture classrooms
Results

4. A few students were distracted by computers in class

- A few students indicated learning and concentrating better without computers
- Also reported being easily distracted in general (ADHD)
- Some Comments:
  - “Not using a computer, it lead me to better concentrate.”
  - “Not being allowed to use our computers helped for concentration and focus.”
Results

5. Students generally approved of the active learning approach

- With or without computers
- Some comments:
  - “The class was very lenient towards our learning ... Learning is the number one goal.”
  - “I was forced to try to learn the material to the best of my ability beforehand to be as prepared as possible whether or not I was using my computer or notebook.”
Research Question #2

➢ How can we monitor and predict learning outcomes in a CSAP classroom?
  ○ Moreover, can we proactively detect and support at-risk students?

Early Detection of At-Risk Students in CS1 Using TeachBack/Spinoza
William T. Tarimo, Fatima Abu Deeb, Timothy J. Hickey.
Consortium for Computing Sciences in Colleges — Northeastern Region. April, 2016
The Experiment

**Class:** Flipped CS11A class in fall 2014

**Analysis:** How data from students interactions, feedback and performance in formative assessments correlated with performance in the course

**Measures we looked at:** engagement, learning speed, confidence, drive, and persistence
Results

● Positive correlations to course grade
  ○ **Engagement**: f.a. questions answered, Feedback records, Forum posts & comments
  ○ **Learning Speed**: Total points earned in formative assessment activities

● Suggestive correlations
  ○ **Drive**: Mandatory and optional programming challenges attempted in Spinoza
  ○ **Persistence**: Average compilation attempts on programming challenges in Spinoza

● Poor correlation
  ○ **Confidence**: student self-assessed level of confusion when first encountering new topics
    ■ Overall feedback from being Engaged, Bored and Confused
Results

- Positive correlations to course grade: Engagement and Learning Speed

  - Engagement: Course Grade vs Total TeachBack Participation
    \[ y = 0.1539x + 71.296 \]
    \[ R^2 = 0.1235 \]

  - Learning Speed: Course Grade vs Total iResponder Points
    \[ y = 0.2447x + 66.029 \]
    \[ R^2 = 0.2907 \]
Results

- Poor correlations to course grade: Persistence and Drive

**Persistence: CourseGrade vs Average Number of Compilations per Homework Problem**

**Drive: CourseGrade vs Number of Exercises Attempted**
Results

- Poor Predictor: Confidence
Detecting & Supporting At-Risk Students

● Detection:
  ○ currently using participation and performance in formative assessment

● Example Interventions:
  ○ Struggling students are emailed, asked to visit TAs or the instructor’s office hours
  ○ Group TA visits for students with common misunderstanding
  ○ + Others

<table>
<thead>
<tr>
<th>Questions Stats</th>
<th>Forum Stats</th>
<th>Feedback Stats</th>
<th>GroupWork Stats</th>
<th>Attendance Stats</th>
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Based on less than 25.0% attempts or performance on graded Questions and GroupWork(individual answers) problems.

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<th>Full Name</th>
<th>E-mail</th>
<th>QnsAnswd</th>
<th>%QnsAnswd</th>
<th>%QnsAnswdC</th>
<th>GrWkAnswd</th>
<th>%GrWkAnswd</th>
<th>%GrWkAnswdC</th>
</tr>
</thead>
</table>

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Research Question #4

➢ How can CSAP be effectively implemented in synchronous mixed online/physical classrooms?

Fully Integrating Remote Students into a Traditional Classroom using Live-Streaming and TeachBack
William T. Tarimo, Timothy J. Hickey
Frontiers in Education (FIE). October 2016
The Experiment

**Class:** Flipped Computer Graphics class, Fall 2015

**Analysis:** The effects of allowing optional remote attendance by using live lecture-streaming and required TeachBack use. From half-way in the semester

**Data:** TeachBack attendance, engagement and performance. Echo360 data. Final exam and course grades.

**Results:** A feasible and pedagogically justifiable alternative/supplement to regular class attendance
Results: Effects on Absenteeism

- Overall class attendance remained the same, counting remote attendance.
- On average per day: 75% physically in class, 18% remote, and 7% absent.

**Absenteeism, Grouped by Number of Classes Missed by Students during Parts 1 and 2 of the Course.**

<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>
Results: Student Use of Live-streaming

- Students embraced the option

**Remote Attendance, Grouped by Number of Classes Live-streamed by Specific Students.**

<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>
Results: Student Use of Live-streaming

- Students were committed to streaming-lectures while remote
Results: Effects on Learning Outcomes

- Has insignificant effect 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>
Results: Effects on Learning Outcomes

- Has insignificant effect on participation grade compared to absenteeism

**Linear Regression Analysis: Class Participation 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>0.0156</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>
Results: Use of Lecture Recordings

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

1. 51.5% - All or most courses should have the option
2. 30.6% - Just affective 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. Amid poor video quality complaints
5. Comments: Convenience, Anywhere attendance, Valuable Alternative
   a. Also: Risk of poor concentration, depended on good connection
   b. Better as an option, Separate TeachBack groupings, Good when not abused
Research Question #4

➢ How can collaborative learning be effectively supported in CSAP classrooms?
The Experiment

**Class**: Flipped Computer Graphics, Fall 2015

**Analysis**: Investigated learning during collaborative assessment activities using GroupWork.

**Data**: GroupWork grades, Final written exam, Course grades, Student survey
Results: Learning during GroupWork

- Student’s average performance: On average, most students performed better when working in groups
- Class average: From 0.995 to 1.223, statistically significant with p = 0.0001. An Effect Size of 0.618
Results: Learning during GroupWork

- Struggling students benefit the most from collaboration
Results: Learning during Group Work

- Per problem average performance: On average, across all problems, students performed better when working in groups.
- Class average: From 1.003 to 1.236, statistically significant with $p = 0.0001$. An Effect Size of 0.609.
Results: Effects on course outcomes

Individual performance is a better predictor - since course grades are individual measures
Results: Student Opinions

1. GroupWork activities were useful towards learning:
   i. 80.5% rated 3-5. 55.5% rated 4-5. On a scale of [1,5]

2. On satisfaction with GroupWork use: On a scale of [1,5]
   i. 75% rated 3-5, with 44.4% rating 4-5.

3. Students liked the integration of the Think-Pair-Share methodology in GroupWork

4. GroupWork introduced collaboration and cooperation learning opportunities

5. Students liked the ever-changing GroupWork groups

6. Even balance on preference between GroupWork forum and F2F discussions while in class
Limitations & Future Opportunities

● Most reported quantitative analysis was based on CS courses taught by a single instructor at the university level.
  ○ CSAP can also be used in other disciplines and at the junior and senior high school levels.
  ○ >> Conduct studies across more disciplines, instructors and education levels

● >> Add more features to TeachBack to support additional learning/teaching activities and methods
  ○ Better streamlining of the CSAP practice with additional features and advanced analytics

● >> Work on a plan for the future of TeachBack after the research
Contributions of the Work - CSAP

We proposed and evaluated the feasibility and effectiveness of the CSAP methodology in improving college learning and teaching

a. Showed that computers can be effectively used in the classroom to support learning and teaching

b. Data from computer-mediated classrooms can be used to many benefits as shown in CSAP

c. We implemented and reproduced the benefits of various teaching/learning methods using CSAP and TeachBack. Eg. Collaborative, Cooperative, Problem-Based, Think/Pair/Share etc

d. Showed that CSAP and TeachBack can be used for discovery and experiments on teaching and learning (as a SOTL platform)

e. We showed how (and that) CSAP can be supported in mixed remote/physical classrooms
Contributions of the Work - TeachBack

Designed and developed TeachBack to support CSAP and flipped classrooms.

a. Used in several classes and disciplines at Brandeis and beyond to practice flipped and CSAP based classrooms.
   i. Computer Science - Timothy Hickey - 12+ Courses - 100s of students
   ii. Mathematics - Rebecca Torrey - 2 Courses - 69+43 Students
   iii. Biology - Maria Miara & Elaine Lai - 3 Courses - 232+128+80 Students
   iv. Anthropology - Travis Parno - 1 Course - 77 Students
   v. Economics - Carol Osler - 1 Course - 59 Students
   vi. + Others outside Brandeis University
and as of last night ...

… that’s in 2 years
Excludes The Affective Tutor data

1,579 Users
60 Courses
1,042 Questions
37,134 Answers
103 GroupWork
3,711 Responses
2,073 Course-Enrollment
1,052 Posts
194 Notes
340 Lectures
377 Activities
4,855 Comments
10,094 Feedback
The End.

Thank You!

Time For Questions
Appendix
Scrum Components

Roles
- Product Owner
- Development Team
- Scrum Master

Artifacts
- Increment
- Product Backlog
- Sprint Backlog

Events
- Sprint
- Sprint Planning
- Daily Scrum
- Sprint Review
- Retrospective

Diagram Adapted From: http://www.slideshare.net/agilevietnam/you-thought-you-understood-product-backlog
Scrum Methodology

Input from End-Users, Customers, Team and Other Stakeholders

Product Owner

Team

Sprint Planning Meeting (Parts One and Two)

Sprint Backlog

Product Backlog

Team Selects How Much To Commit To Do By Sprint’s End

ScrumMaster

Product Backlog Refinement

Sprint 1-4 Weeks

No Changes in Duration or Goal

Review

Daily Scrum Meeting and Artifacts Update

Potentially Shippable Product Increment

Retrospective

Diagram Adapted From: http://www.andreasphotiou.net/tag/scrum/
Flipped Classroom

TRADITIONAL MODEL

Knowledge Acquisition

Knowledge Construction

FLIPPED MODEL

Knowledge Acquisition

Knowledge Construction