Learning Spaces Collaboratory Webinar

Flipped/Blended 21st Century Learning Environments

April 15, 2015
The central LSC strategies are to take a *kaleidoscopic perspective* on transforming the environment for undergraduate learning and provide a *feedback loop* through which the broader community is informed about best practices and lessons learned.
Learning Outcomes

❖ About what spaces say about how learning happens

❖ About research findings on how learning happens

❖ About the evolution of active learning environments
Facilitator

• Nancy Lape
  *Harvey Mudd College*

Moderator

• Jeanne L. Narum
  *Learning Spaces Collaboratory*
Nancy Lape

Associate Professor of Engineering
Harvey Mudd College
Learning happens when learners are:

- actively engaged in constructing their own knowledge
- situated in a social and supportive community
- able to reflect and build on prior knowledge
- involved with addressing meaningful problems

What if …

...we grounded our planning on research on how learning happens?

How People Learn

[Image of book cover]
Lessons from the field: Learning by doing works

<table>
<thead>
<tr>
<th>Method</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use or Teach</td>
<td>90%</td>
</tr>
<tr>
<td>Practice</td>
<td>75%</td>
</tr>
<tr>
<td>Discussion</td>
<td>50%</td>
</tr>
<tr>
<td>Demonstration</td>
<td>30%</td>
</tr>
<tr>
<td>Audio Visual</td>
<td>20%</td>
</tr>
<tr>
<td>Reading</td>
<td>10%</td>
</tr>
<tr>
<td>Lecture</td>
<td>5%</td>
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One must learn by doing the thing, for though you think you know it, you have no certainty until you try.

—Sophocles, 400 B.C.

Engaging students as practitioners in the field facilitates interest, persistence, and success.

—Carl Wieman, 2011 A.D.
"Mr. Osborne, may I be excused?  
My brain is full."
What if …

…we grounded our planning on calls to action from the broader community?

Calls to action:

❖ preparing learners for leadership in an complex world
❖ ensuring the success of all students in an increasingly diverse society
❖ connecting to institutional and societal expectations of our graduates
❖ embracing an uncertain future.
Example: Level 1 Research Project: Planetary Exploration: Mars analogue component

**Plan a mission to Mars**
Outline scientific goals and mission objectives; design an undergraduate experiment

**Mathematics**
Use of mathematical software to simulate planetary motion

**Physics**
Kepler’s laws, angular momentum, Newtonian gravity

**Life Science**
Extremophiles, biogeochemical cycles

**Earth Science**
Earth as an analogue: fluvial processes, tectonic activity, glacial movement

**Chemistry**
Combustion of rocket propellants

**Psychology**
Manned vs. unmanned missions, group dynamics
SOURCE: U.S. Census Bureau.
Employers give college graduates low scores for preparedness across learning outcomes; students think they are better prepared.

Proportions saying they/recent college graduates are well prepared in each area:

<table>
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<th>Students</th>
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<tbody>
<tr>
<td>Working with others in teams</td>
<td>37%</td>
<td>64%</td>
</tr>
<tr>
<td>Staying current on technologies</td>
<td>37%</td>
<td>46%</td>
</tr>
<tr>
<td>Ethical judgment and decisionmaking</td>
<td>30%</td>
<td>62%</td>
</tr>
<tr>
<td>Locating, organizing, evaluating information</td>
<td>29%</td>
<td>64%</td>
</tr>
<tr>
<td>Oral communication</td>
<td>28%</td>
<td>62%</td>
</tr>
<tr>
<td>Working with numbers/statistics</td>
<td>28%</td>
<td>55%</td>
</tr>
<tr>
<td>Written communication</td>
<td>27%</td>
<td>65%</td>
</tr>
<tr>
<td>Critical/analytical thinking</td>
<td>26%</td>
<td>66%</td>
</tr>
<tr>
<td>Being innovative/creative</td>
<td>25%</td>
<td>57%</td>
</tr>
<tr>
<td>Analyzing/solving complex problems</td>
<td>24%</td>
<td>59%</td>
</tr>
<tr>
<td>Applying knowledge/skills to real world</td>
<td>23%</td>
<td>60%</td>
</tr>
<tr>
<td>Awareness/experience of diverse cultures in US</td>
<td>21%</td>
<td>48%</td>
</tr>
<tr>
<td>Staying current on developments in science</td>
<td>21%</td>
<td>44%</td>
</tr>
<tr>
<td>Working with people from different backgrounds</td>
<td>18%</td>
<td>55%</td>
</tr>
<tr>
<td>Staying current on global developments</td>
<td>18%</td>
<td>43%</td>
</tr>
<tr>
<td>Proficient in other language</td>
<td>16%</td>
<td>34%</td>
</tr>
<tr>
<td>Awareness/experience of diverse cultures outside US</td>
<td>15%</td>
<td>42%</td>
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*8-10 ratings on zero-to-ten scale
Bloom's Taxonomy of Learning (New Version)

- Creating
- Evaluating
- Analyzing
- Applying
- Understanding
- Remembering

Increasing difficulty
INNOVATION
STUDIO
RULES

• Speak up, fail big
• Expect the unexpected
• There are no bad ideas
• No experts, share often
• Collaborate always
• Stumbling is important
• Try everything twice
• Be inspired by adversity
• Tell a story, change hats
• Color outside the lines
• Make metaphors
• Question everything
What if …

...we grounded our planning on the insights of our students about how learning happens?
How I learn best is trying to figure out answers, working in groups to learn with and from my friends... when I don’t know something I can usually find someone who can explain it to me.
I think we all learn better when we can see what others are doing…in a place where there are ‘things’ around that make it a good place for learning.
I like to work in teams to solve a problem.
I am a big-picture learner, so I have to understand from the beginning how what I am trying to learn fits into the larger picture of what I am learning.
What works for me is when I can go back and forth between learning by myself and learning with my group.
The Harvey Mudd Story

Nancy Lape
Associate Professor of Engineering
Harvey Mudd College
Why Flip?

❖ More active learning during course meeting time

INVERTED/FLIPPED

Direct content delivery occurs outside course meeting time.
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❖ More engagement with content within and beyond course meeting time

❖ More content

INVERTED/FLIPPED

Direct content delivery occurs outside course meeting time.
Why flip?

Increase in peer instruction

Increase in student interaction in classroom

Increase in instructor-mediated time in classroom

Stronger peer network

Immediate feedback during learning process

Greater focus during class time

Early ID and clarification of misconceptions

Increase in retention of material

Affective gains

Immediate feedback during learning process

Increase in retention of material

Affective gains
We are NOT studying . . .

Traditional Lecture

Flipped Classroom
We ARE studying:

Active Learning Classroom

Flipped Classroom
- 4 years
- 3 Instructors
- 2 Courses
  - Engineering 82: Chemical and Thermal Processes (SO/JR)
  - Math 45: Differential Equations (FR)
- Each instructor teaches control and inverted sections

A Quasi-Experimental Study
Research Questions

❖ More time actively working with instructors on meaningful tasks?

Probing the Inverted Classroom

A Controlled Study of Teaching and Learning Outcomes in Undergraduate Engineering and Mathematics

Funded by NSF Grant #1244786
Research Questions

❖ More time actively working with instructors on meaningful tasks?
❖ Higher learning gains?

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❖ Increased metacognitive gains?
Research Questions

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❖ Increased interest in and positive attitudes towards STEM (affected gains)?
❖ Increased metacognitive gains?
❖ Increased student and faculty satisfaction?
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Typical E82 Control Class
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10-minute lecture on isentropic efficiency
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Concept question on isentropic efficiency
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Short problem involving isentropic efficiency
Typical E82 Control Class

10-minute lecture on isentropic efficiency

Concept question on isentropic efficiency

Short problem involving isentropic efficiency

Repeat with new topic
Typical E82 Inverted Class
Typical E82 Inverted Class

Brief review of isentropic efficiency
Typical E82 Inverted Class

Brief review of isentropic efficiency

Answer questions on isentropic efficiency
Typical E82 Inverted Class

Brief review of isentropic efficiency

Answer questions on isentropic efficiency

1-2 Concept questions on isentropic efficiency
Typical E82 Inverted Class

- Brief review of isentropic efficiency
- Answer questions on isentropic efficiency
- 1-2 Concept questions on isentropic efficiency
- Long problem involving isentropic efficiency
Higher Learning Gains? *E82*

1. Thermal Concept Inventory (concepts) and
2. Chemical and Thermal Process Assessment (applying material)
Higher Learning Gains?  

1. Thermal Concept Inventory (concepts) and  
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everyone learned, but . . .
Higher Learning Gains? E82

1. Thermal Concept Inventory (concepts) and
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everyone learned, but . . .

learning gains were the same

for control and flipped sections.
Why no difference?
## Why no difference?

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How can we take advantage of the flipped format?

❖ Activities that could not be carried out as part of homework

A Quasi-Experimental Study

Relaxed study design
How can we take advantage of the flipped format?

- Activities that could not be carried out as part of homework
- “Jigsaw” problem presentations
- More ill-formed problems

A Quasi-Experimental Study

Relaxed study design
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Some students "didn't feel connected to material". Watching videos was perceived as "less stressful" in terms of homework/coursework load by students in the inverted classroom. Students in the traditional section reported that the inverted section students were unfairly benefitting from more examples and explanations in class as well as a lighter work load.
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## Strengths of the Inverted Classroom
- "Lively and interactive"
- "Individual responsibility on student"
- "Ability to interact with students while they build understanding of course material via problem solving"

## Challenges of the Inverted Classroom
- "Balancing discussion time with work time"
- "Students who needed more time to grapple with material being swept along by students who understood the material more quickly"

## Strengths of the Traditional Classroom
- "Fun all-class dynamic"
- "Lively and interactive"
- "Ability for students to ask questions as the course material is being introduced"

## Challenges of the Traditional Classroom
- "Not knowing how well they were really understanding the material until I saw HW scores and test performance"
- "Addressing individual needs of all students"
HMC Faculty Satisfaction

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What if we were designing spaces in 2020, what questions would we be asking then?
AUDACIOUS QUESTIONS

How do we create sustainable spaces?
- renewable spaces?
- spaces for whatever comes next?

Univative Spaces Look "Messy"
⇒ doesn't look good in a brochure, in the architect's portfolio.
AUDACIOUS QUESTIONS

Is the concentration to be on improving the student learning environment or the propagation of the institutions/college/department/faculty structures?

Collaboration: Do we trust each other enough to change?
AUDACIOUS QUESTIONS

Do your classrooms need walls?

How do we transform learning spaces, formal & informal, to enable the practice and mastery of creative problem solving? How do we entice and motivate and inspire our clients? Why does this matter to us and our world?
AUDACIOUS QUESTIONS

DISTINCTION OR EXTINCTION... OURS TO CHOOSE?
WHAT EXPERIENCES MAKE THAT BECOMING HAPPEN?

WHAT SPACES ENABLE THOSE EXPERIENCES?

HOW DO WE KNOW?
Alma College ♦ Auraria Library ♦ Bentz/Thompson/Rietow ♦ Calvert Wright Architecture PC ♦ Calvin College ♦ Celli-Flynn Brennan ♦ Claremont Colleges Library ♦ Colby College ♦ Cuyahoga Community College, Westshore Campus ♦ Emory University ♦ Fairfield University ♦ HOK ♦ Iowa State University ♦ Izzy Plus ♦ Kansas State University Libraries ♦ Lawrence University ♦ Linfield College ♦ Lord Aeck Sargent ♦ McCarty Architects ♦ McGill University ♦ McMaster University Library ♦ Middlebury College ♦ Muhlenberg college ♦ NELSON ♦ Payette Associates Inc. ♦ SERA Architects ♦ Shepley Bulfinch ♦ Steelcase Education ♦ Stonehill College ♦ SWBR Architects ♦ Syracuse University ♦ UC Berkeley - ETS ♦ Union College ♦ University at Albany ♦ University of Arizona ♦ University of California, Merced ♦ University of Illinois at Urbana-Champaign ♦ University of Minnesota ♦ University of North Carolina Charlotte ♦ University of Richmond ♦ University of Wisconsin-Madison ♦ Washington and Lee University ♦
Learning Spaces Collaboratory

Join the conversation – send us your ideas about questions to ask in shaping learning spaces
pkallsc@pkallsc.org

Upcoming Spring LSC Webinars

• Implementing an AAU STEM Initiative: Integrating Renewal of How and Where Learning Happens
  May 5, 2015

• Reframing the Concept of Maker Spaces: Maker Spaces Reinvented
  June 10, 2015