Learning Spaces Collaboratory Webinar

Flipped/Blended 21st Century Learning Environments

April 15, 2015

http://www.pkallsc.org/

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

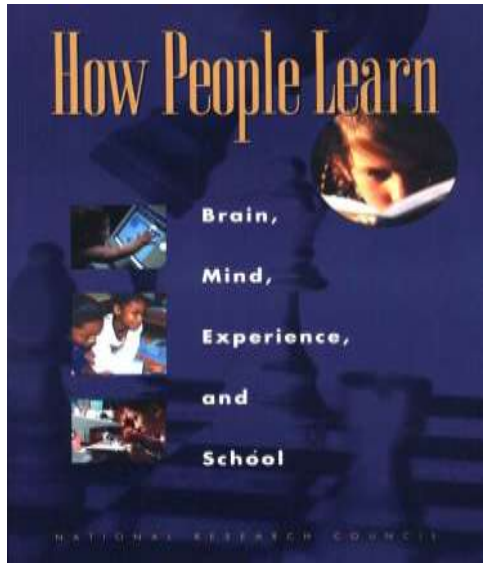
Harvey Mudd College

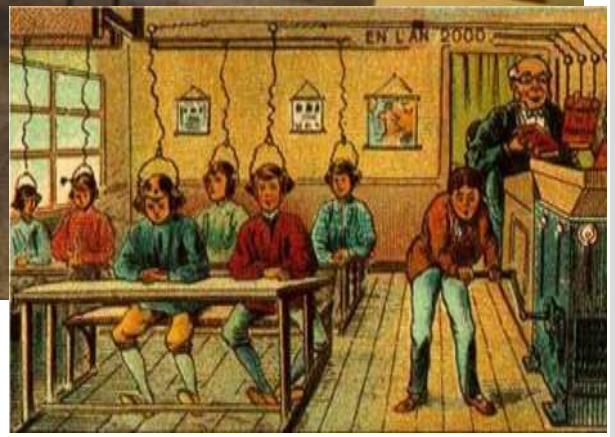
Learning happens when learners are:

- 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

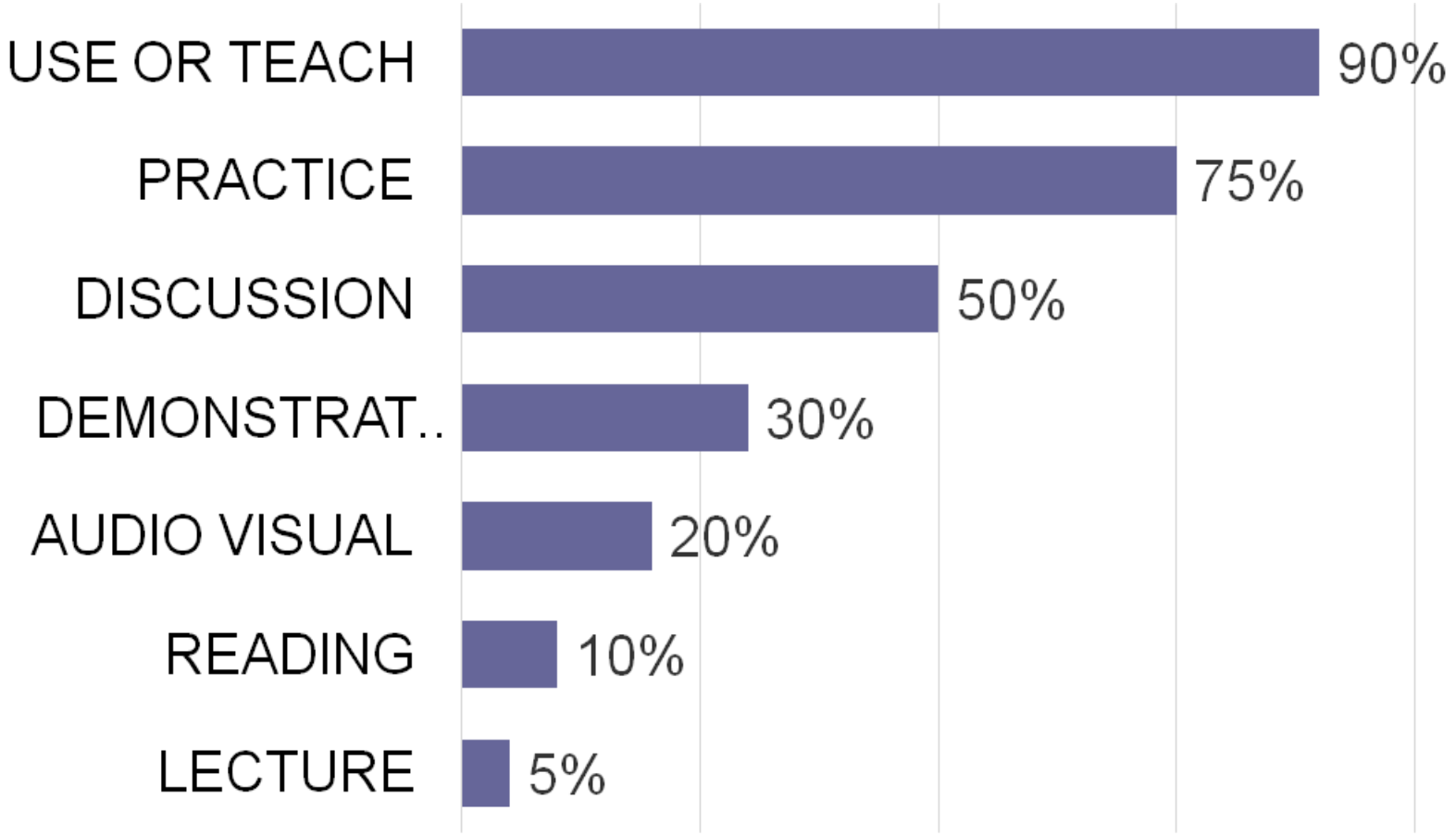
What if …

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




EN L'AN 2000

Lessons from the field: Learning by doing works



National Training Labs, 2000.

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."

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.

What if …

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

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

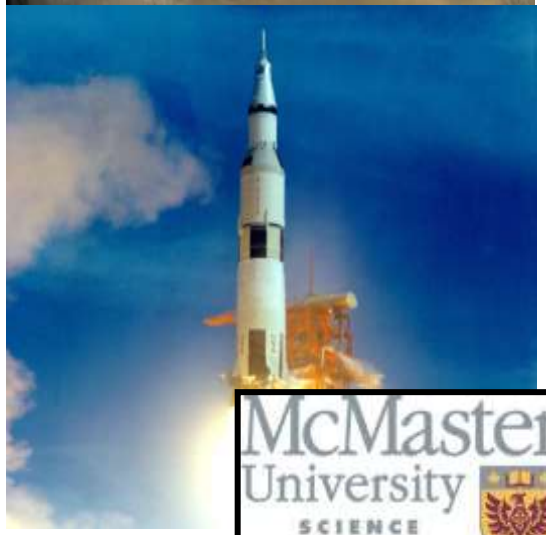
Physics
Kepler's laws, angular momentum, Newtonian gravity

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



McMaster University SCIENCE

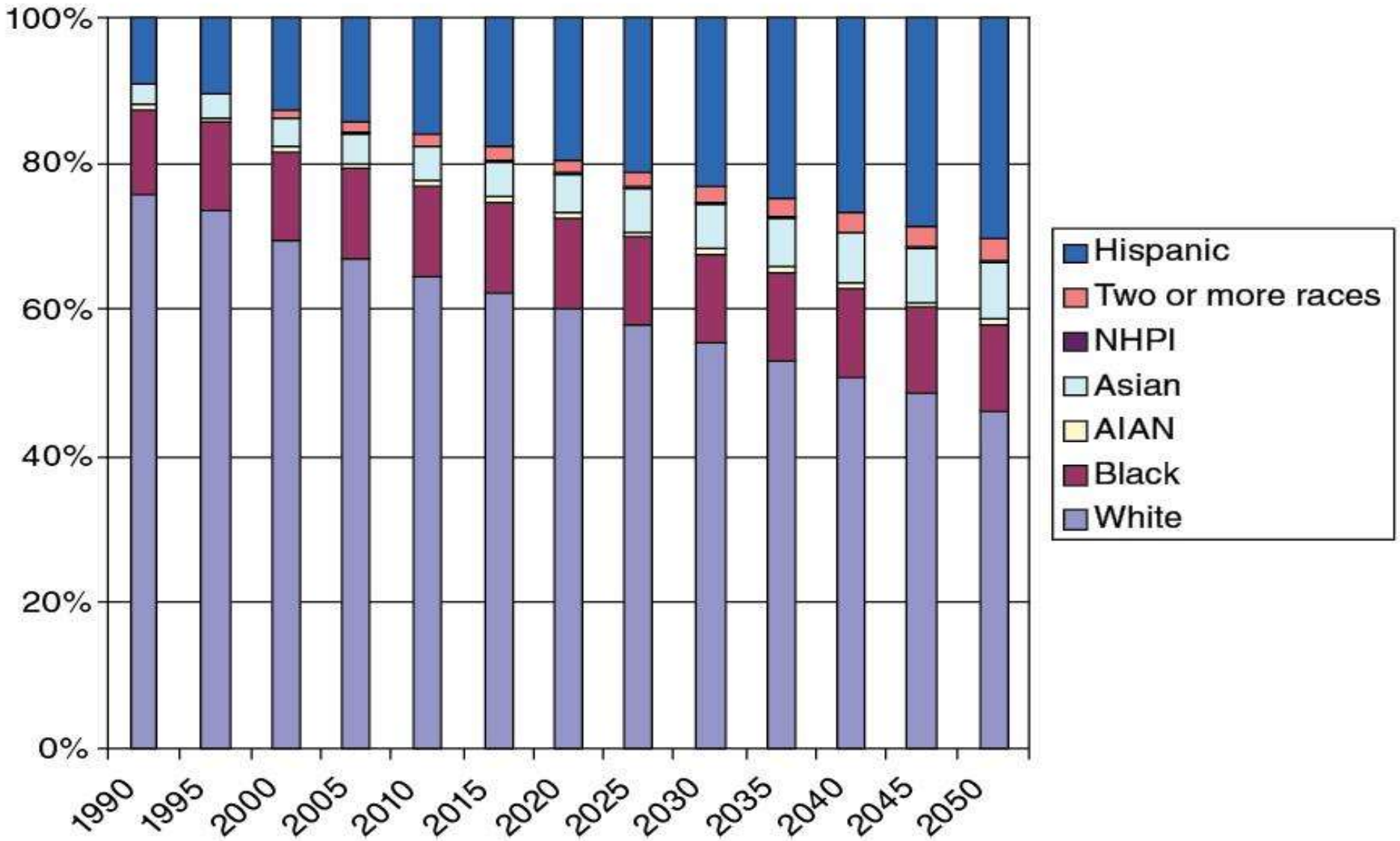
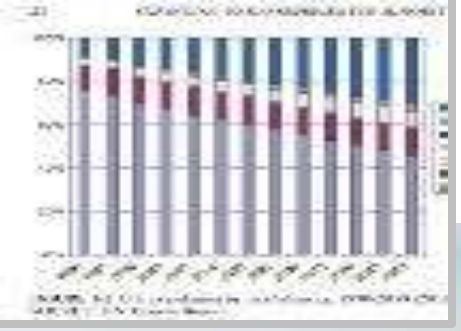


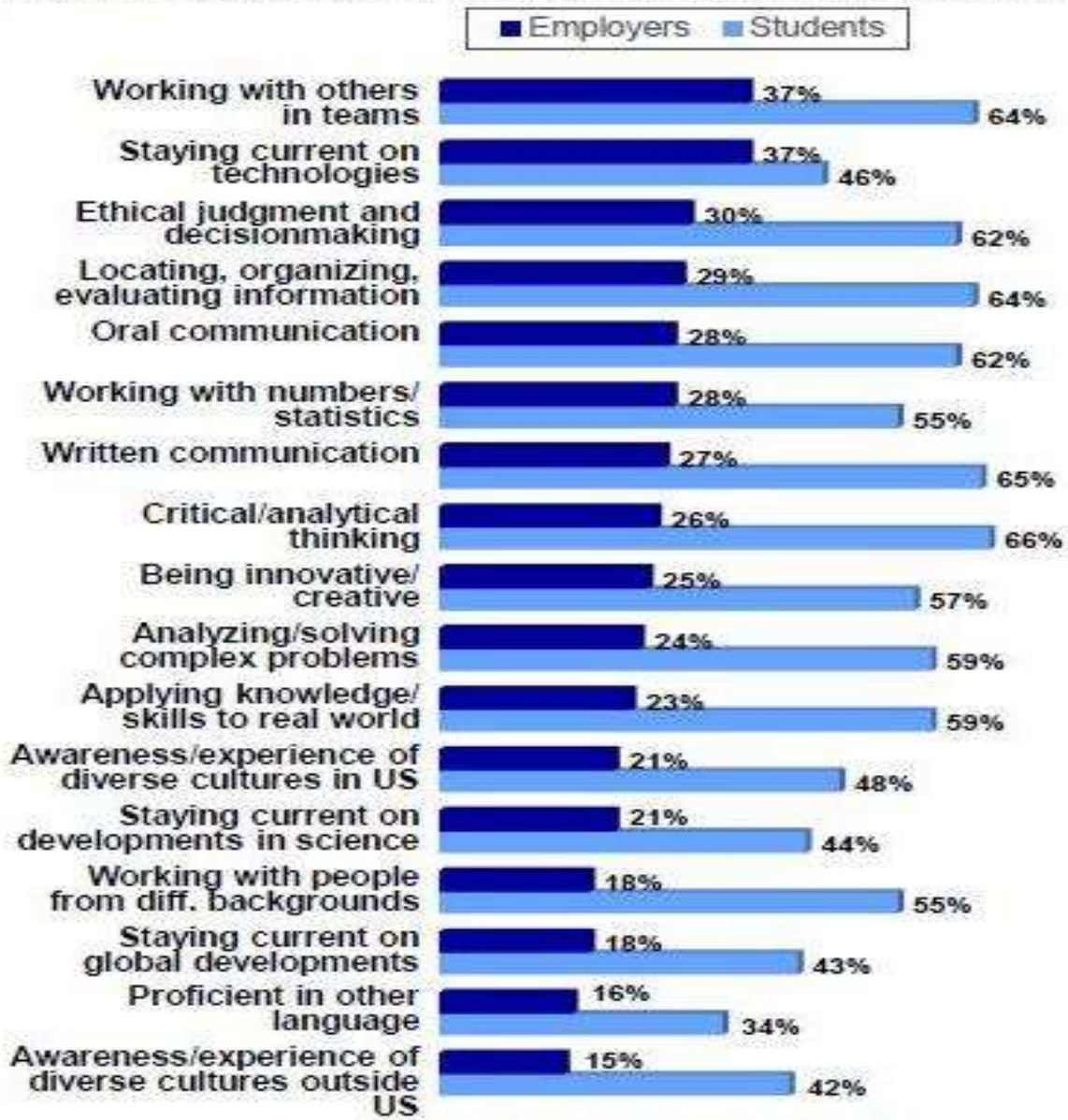
FIGURE 1-2 U.S. population by race/ethnicity, 1990-2050 (2010-2050 projected).
SOURCE: U.S. Census Bureau.



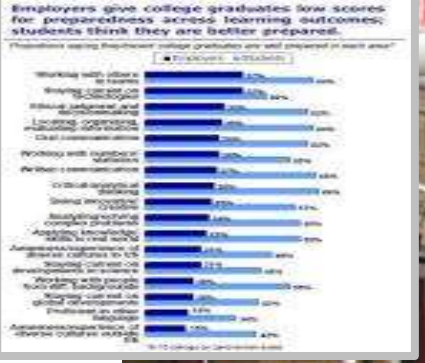
MORGAN STATE UNIVERSITY
GATEWAY TO OPPORTUNITY
STAIRWAY TO EXCELLENCE

Employers give college graduates low scores for preparedness across learning outcomes; students think they are better prepared.

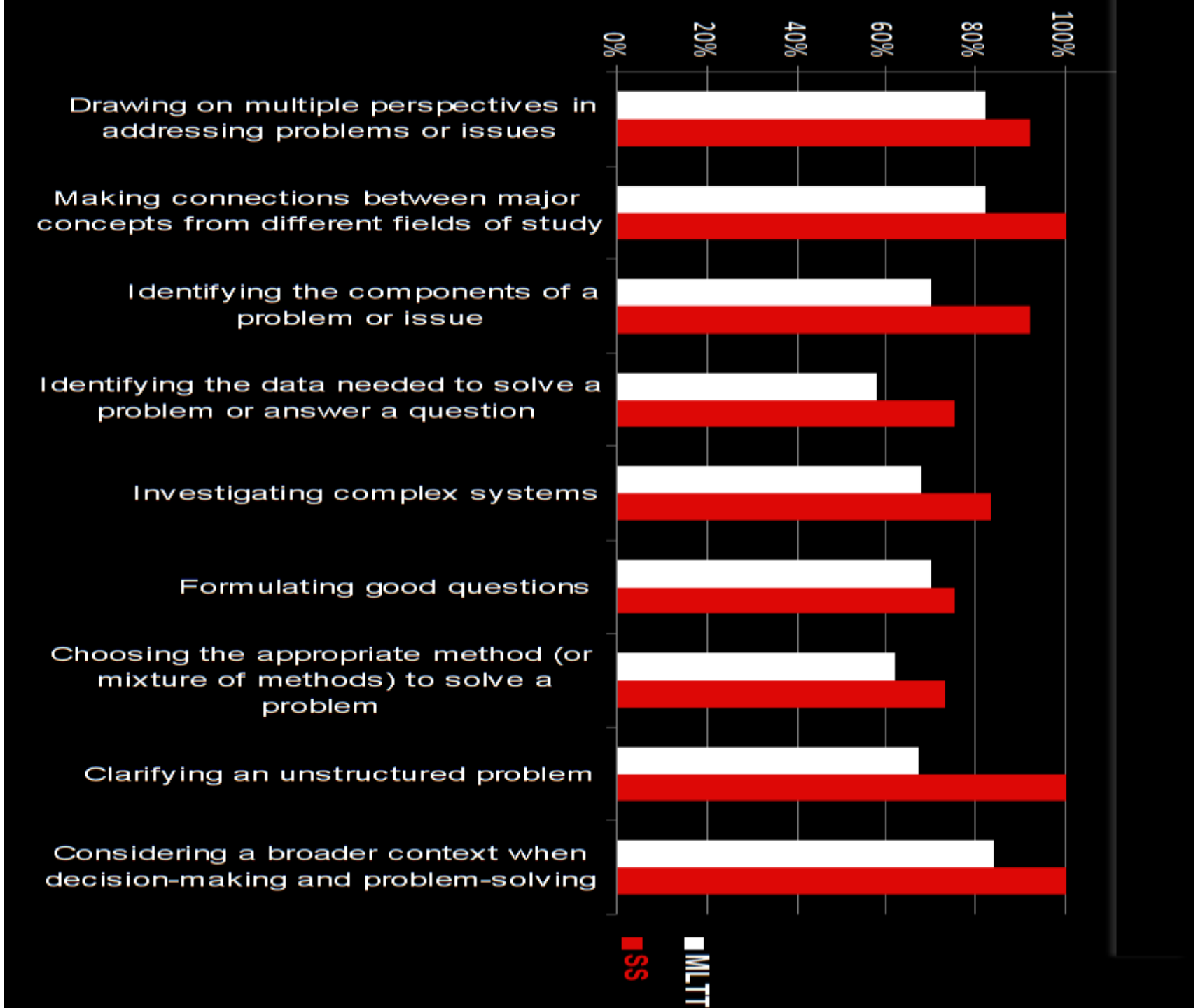
*Proportions saying they/recent college graduates are well prepared in each area**

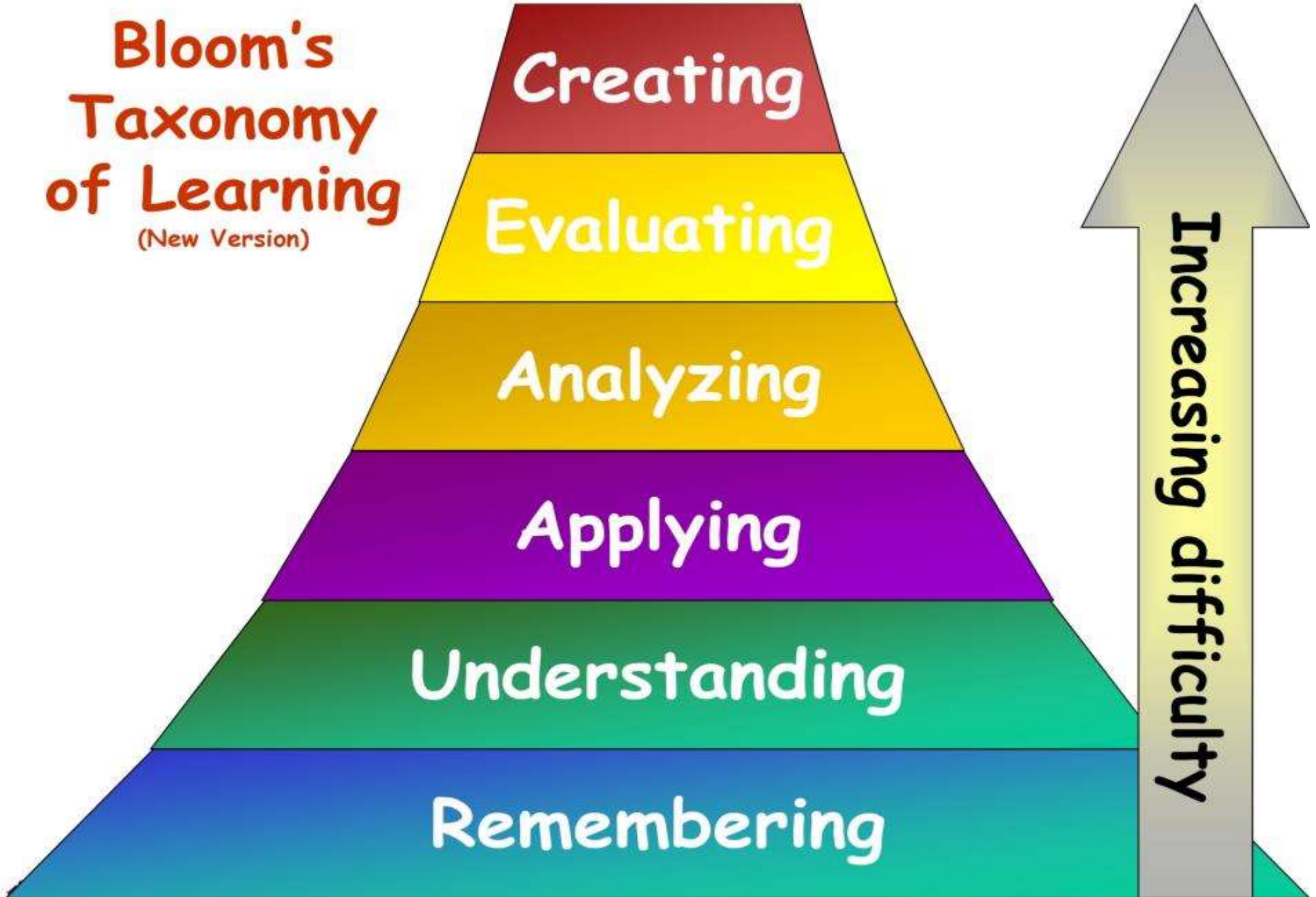


*8-10 ratings on zero-to-ten scale



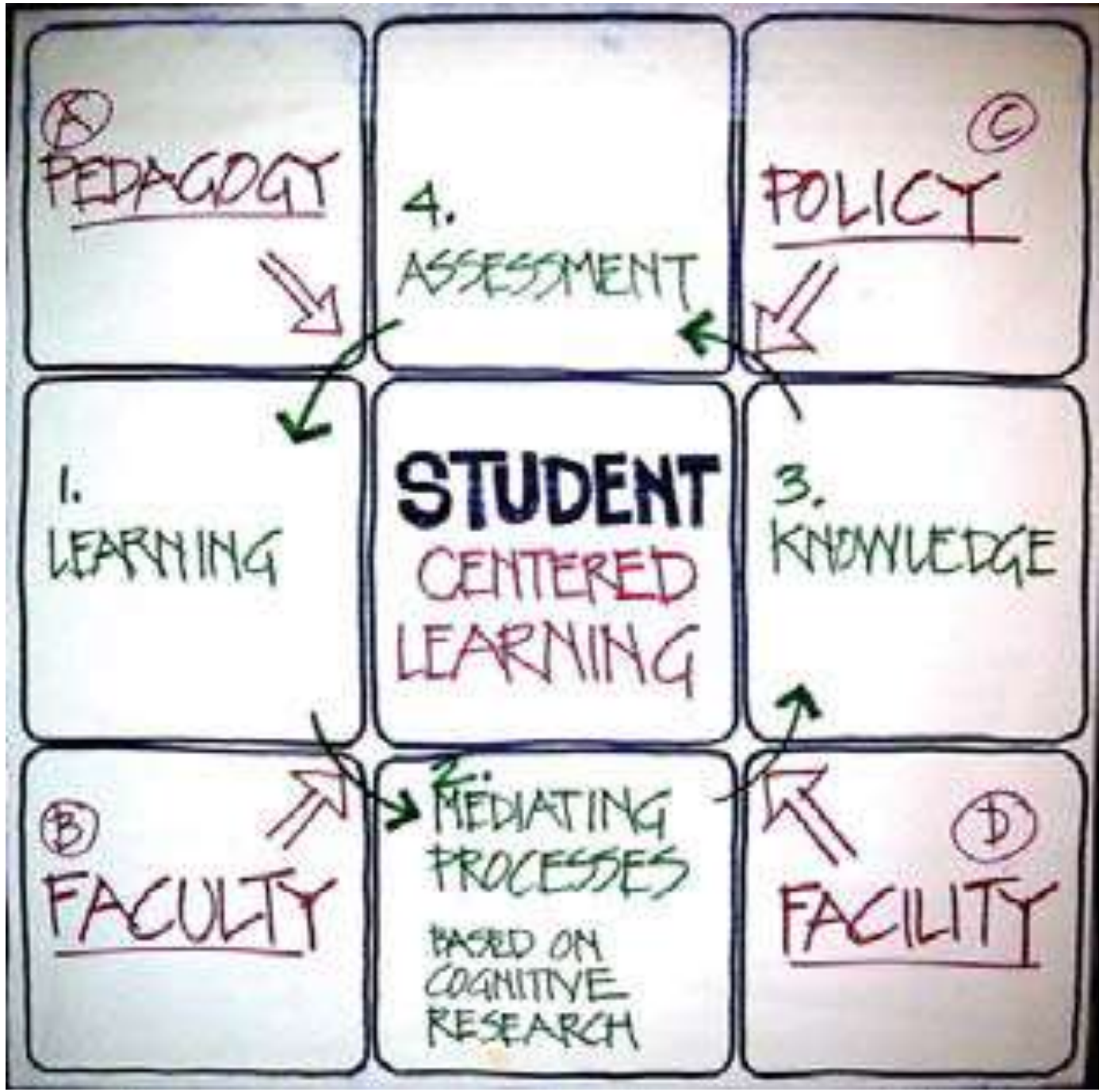
UNIVERSITY OF MICHIGAN


0%
20%
40%
60%
80%
100%
Drawing on multiple perspectives in addressing problems or issues
Making connections between major concepts from different fields of study
Identifying the components of a problem or issue
Identifying the data needed to solve a problem or answer a question
Investigating complex systems
Formulating good questions
Choosing the appropriate method (or mixture of methods) to solve a problem
Clarifying an unstructured problem
Considering a broader context when decision-making and problem-solving
SS
MLT


Bloom's Taxonomy of Learning
(New Version)
Creating
Evaluating
Analyzing
Applying
Understanding
Remembering
Increasing difficulty


Bloom's Taxonomy of Learning
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.

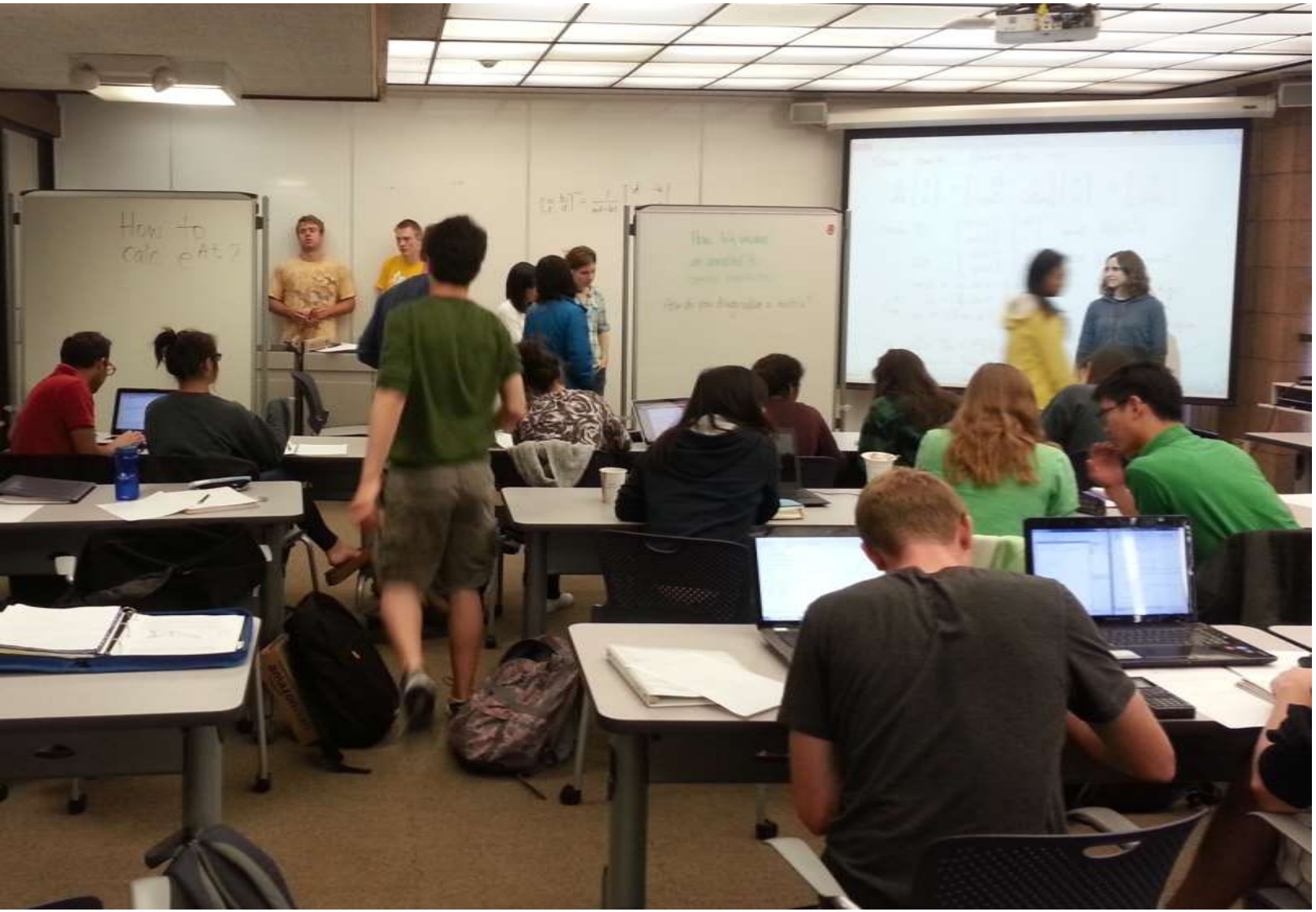
I think we all learn better when we can see what others are doing…in a place where there are ‘things’ around that make it a good place for learning.

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.

Why Flip?

- More active learning during course meeting time
- More peer-to-peer interaction during course meeting time

INVERTED/FLIPPED

Direct content delivery occurs outside course meeting time.

Why Flip?

- More active learning during course meeting time
- More peer-to-peer interaction during course meeting time
- More engagement with ill-defined problems during course meeting time

INVERTED/FLIPPED

Direct content delivery occurs outside course meeting time.

Why Flip?

- More active learning during course meeting time
- More peer-to-peer interaction during course meeting time
- More engagement with ill-defined problems during course meeting time
- More engagement with content within and beyond course meeting time

INVERTED/FLIPPED

Direct content delivery occurs outside course meeting time.

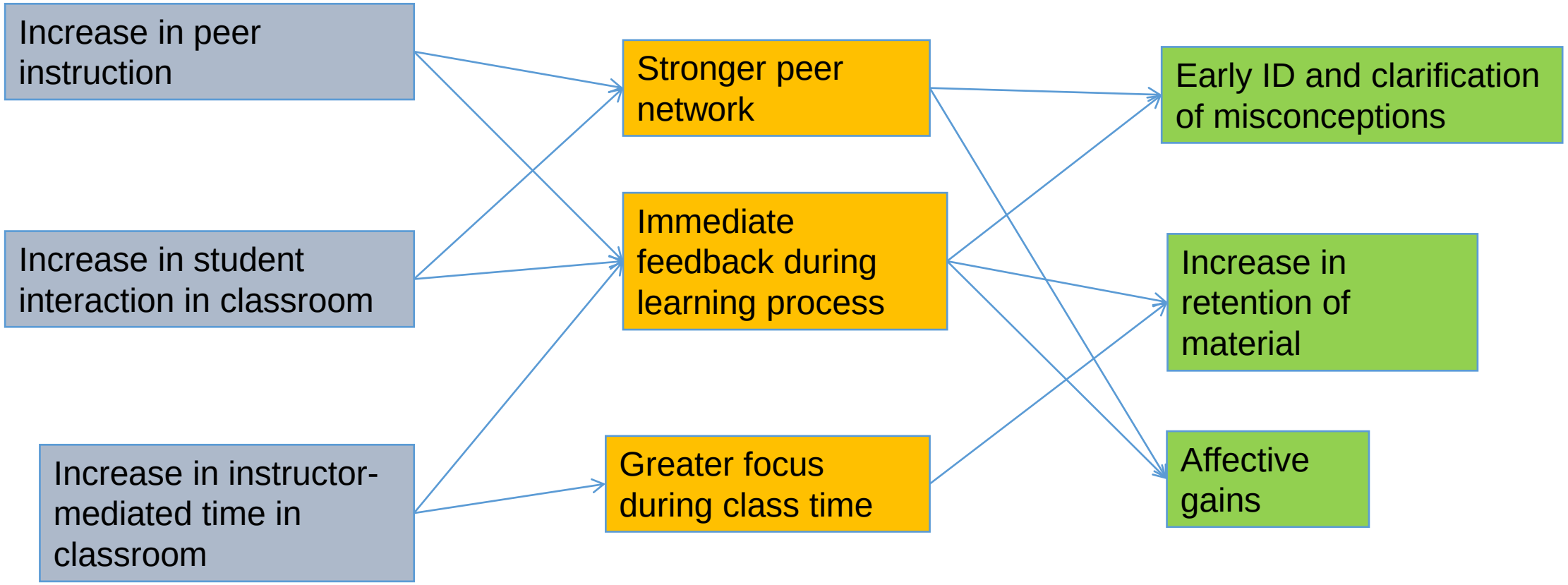
Why Flip?

- More active learning during course meeting time
- More peer-to-peer interaction during course meeting time
- More engagement with ill-defined problems during course meeting time
- More engagement with content within and beyond course meeting time
- More content

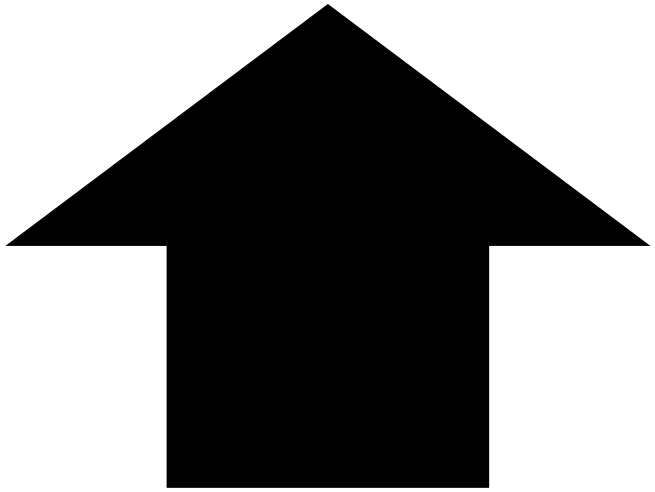
INVERTED/FLIPPED

Direct content delivery occurs outside course meeting time.

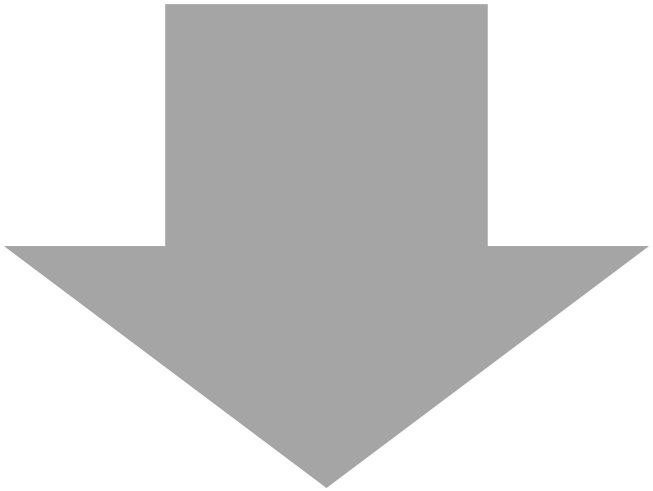
Why flip?


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

We are NOT studying . . .

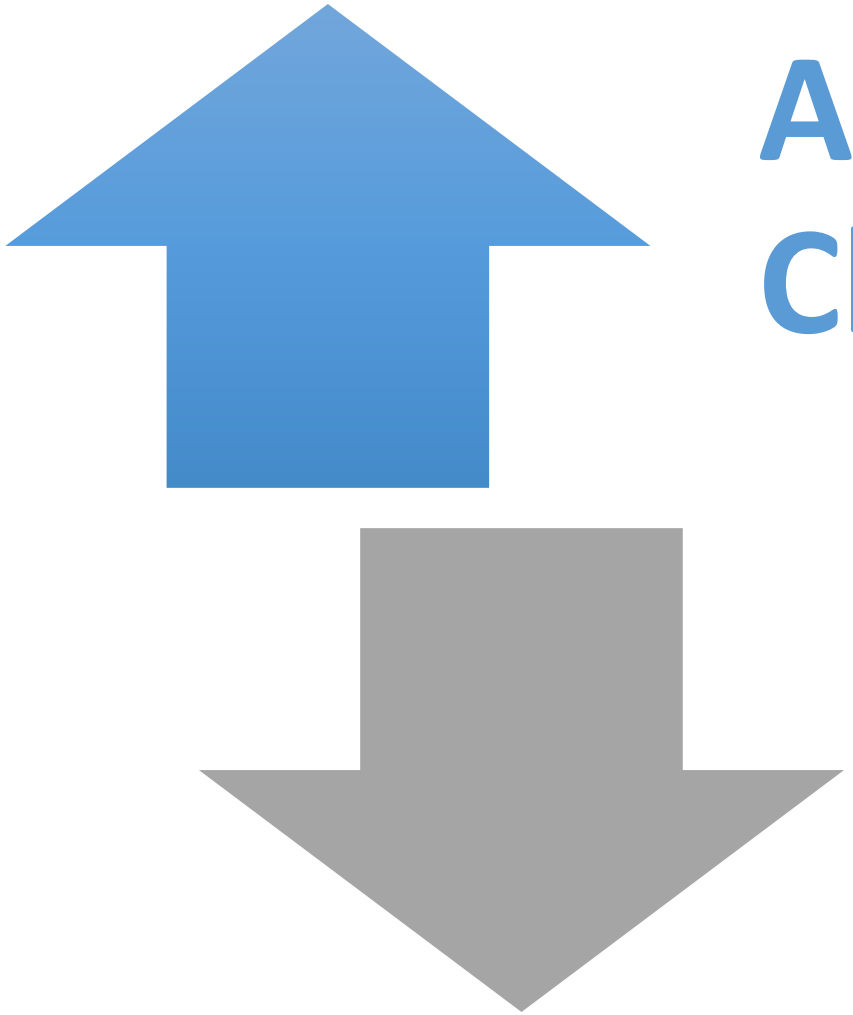


Traditional Lecture



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?

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?
- Increased ability to apply material in new situations (transfer)?

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?
- Increased ability to apply material in new situations (transfer)?
- Increased interest in and positive attitudes towards STEM (affected gains)?

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?
- Increased ability to apply material in new situations (transfer)?
- Increased interest in and positive attitudes towards STEM (affected gains)?
- Increased metacognitive gains?

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?
- Increased ability to apply material in new situations (transfer)?
- Increased interest in and positive attitudes towards STEM (affected gains)?
- Increased metacognitive gains?
- Increased student and faculty satisfaction?

Probing the Inverted Classroom

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

Funded by NSF Grant #1244786

	In Class	Outside of Class
Control	• Mini-lectures • Short problems	• Homework problems • Ill-formed problems
Inverted	• Homework problems • Ill-formed problems	• Mini-lectures • Short problems

Typical E82 **Control** Class

Typical E82 **Control** Class

10-minute lecture on isentropic efficiency

Typical E82 Control Class

10-minute lecture on isentropic efficiency

Concept question on isentropic efficiency

Typical E82 Control Class

10-minute lecture on isentropic efficiency

Concept question on isentropic efficiency

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


E82 Announcements: Day 26

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? *E82*

1. **Thermal Concept Inventory** (concepts) and
2. **Chemical and Thermal Process Assessment** (applying material)

everyone learned, but . . .

Higher Learning Gains? *E82*

1. **Thermal Concept Inventory** (concepts) and
2. **Chemical and Thermal Process Assessment** (applying material)

everyone learned, but . . .

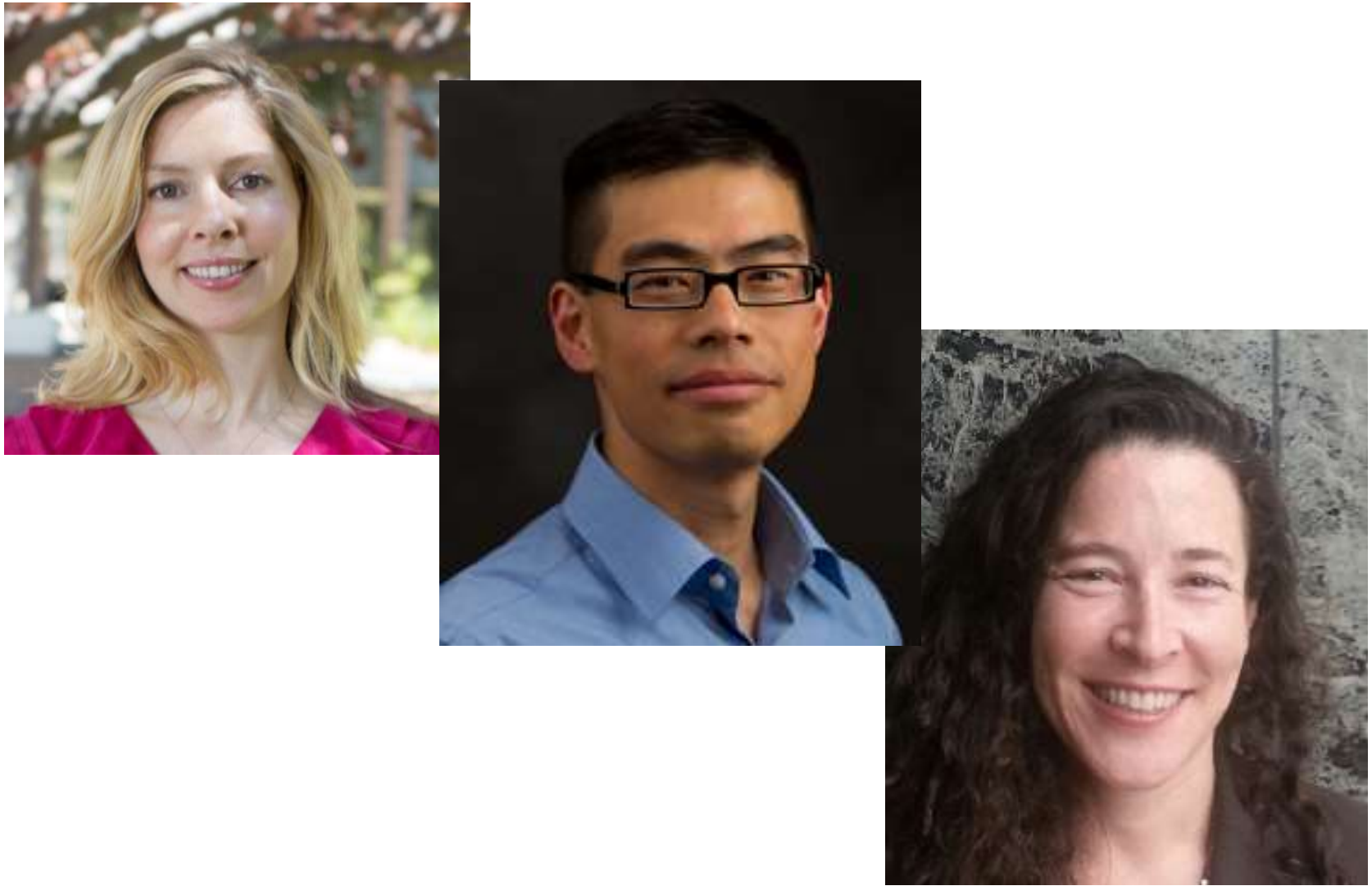
learning gains were the same

for control and flipped sections.

About HMC

HARVEY MUDD COLLEGE

Why no difference?



Why no difference?

	In Class	Outside of Class
Control	• Mini-lectures • Short problems	• Homework problems • Ill-formed problems
Inverted	• Homework problems • Ill-formed problems	• Mini-lectures • Short problems

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

HMC Student Satisfaction

Key Benefits	Key Drawbacks	Perceived Differences Between Course Formats

HMC Student Satisfaction

Key Benefits	Key Drawbacks	Perceived Differences Between Course Formats
• **Access to professor** during class time while working through problems • Ability to **pause and re-watch video** lectures for review and study for exams		

HMC Student Satisfaction

Key Benefits	Key Drawbacks	Perceived Differences Between Course Formats
• **Access to professor** during class time while working through problems • Ability to **pause and re-watch video** lectures for review and study for exams	• **Inability to ask questions**/ have class discussions in real time during lectures • **Pacing of video** lectures is not responsive to student needs • Some students ***"didn't feel connected to material"***	

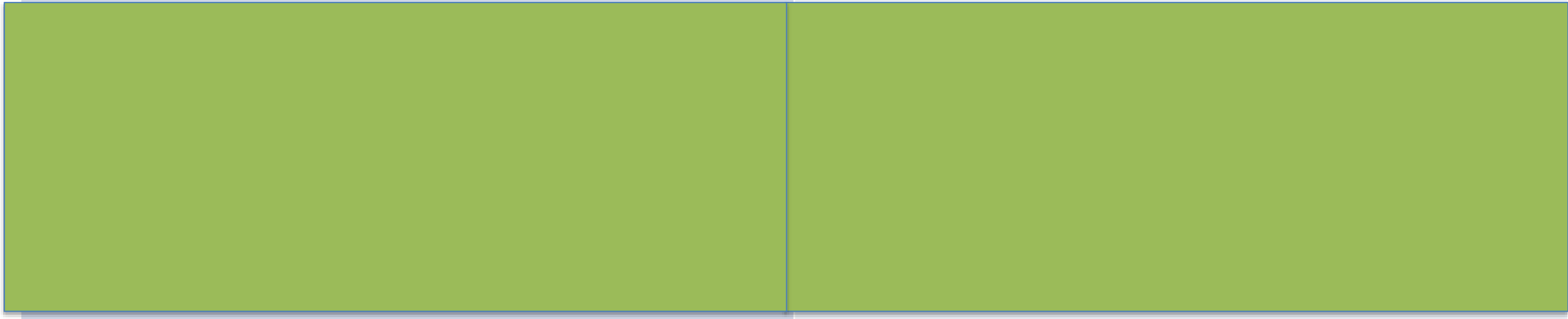
HMC Student Satisfaction

Key Benefits	Key Drawbacks	Perceived Differences Between Course Formats
• **Access to professor** during class time while working through problems • Ability to **pause and re-watch video** lectures for review and study for exams	• **Inability to ask questions**/ have class discussions in real time during lectures • **Pacing of video** lectures is not responsive to student needs • 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

HMC Faculty Satisfaction

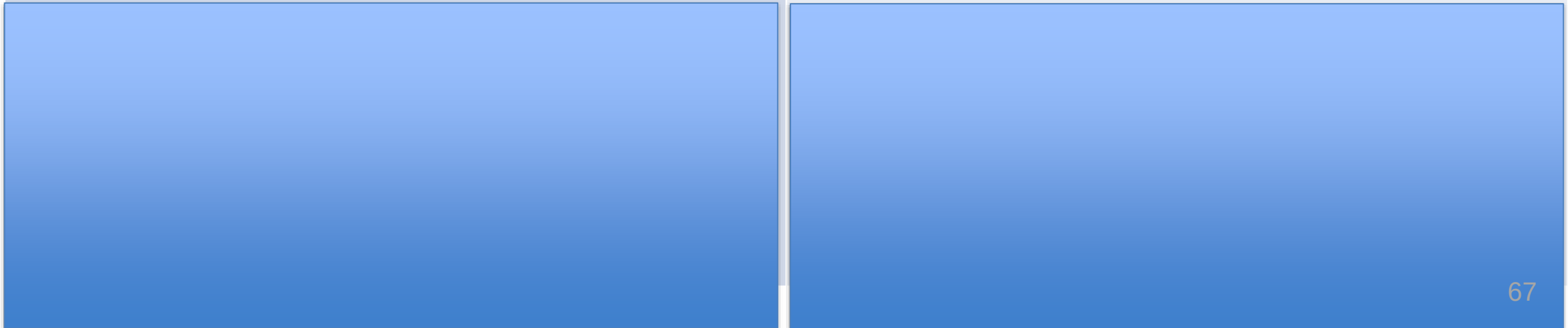
Strengths of the Inverted Classroom

Challenges of the Inverted Classroom



Strengths of the Traditional Classroom

Challenges of the Traditional Classroom

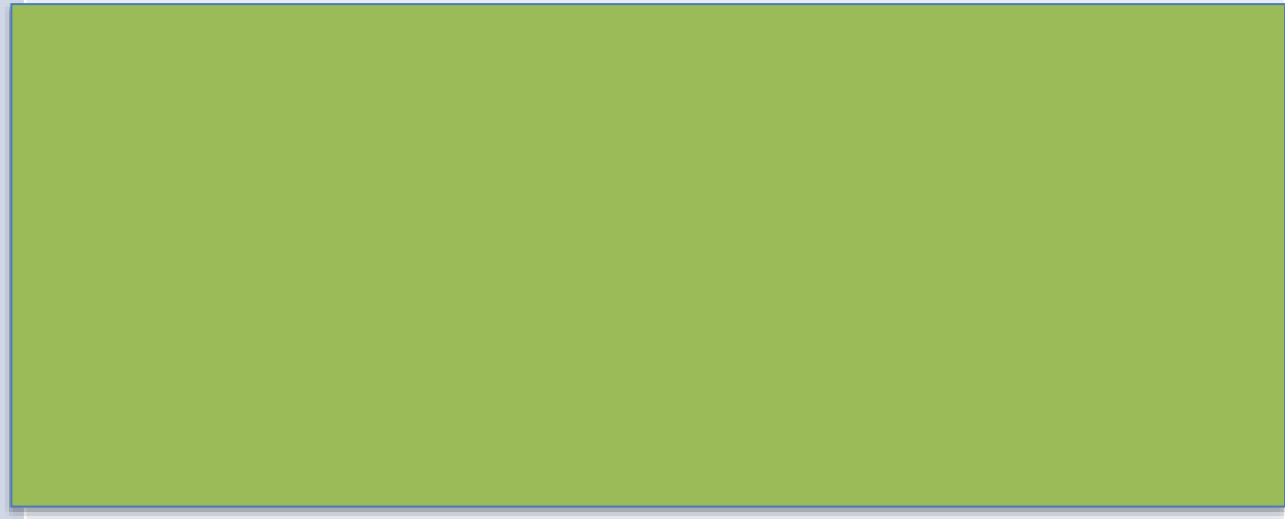


HMC Faculty Satisfaction

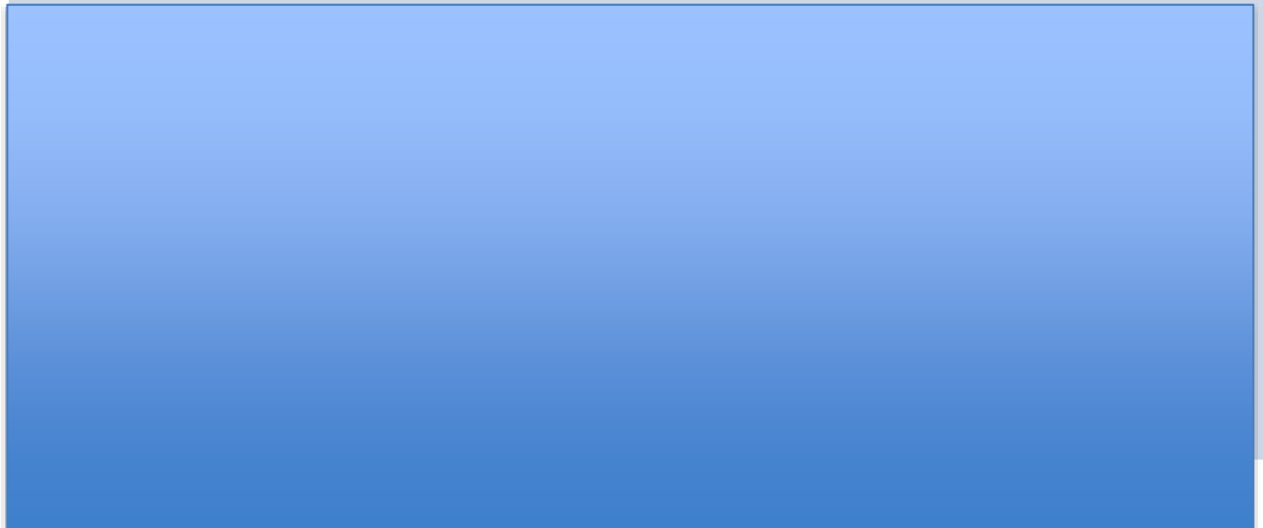
Strengths of the Inverted Classroom

- "Lively and interactive"
- "Individual responsibility on student"
- "Ability to interact with students while they built understanding of course material via problem solving"

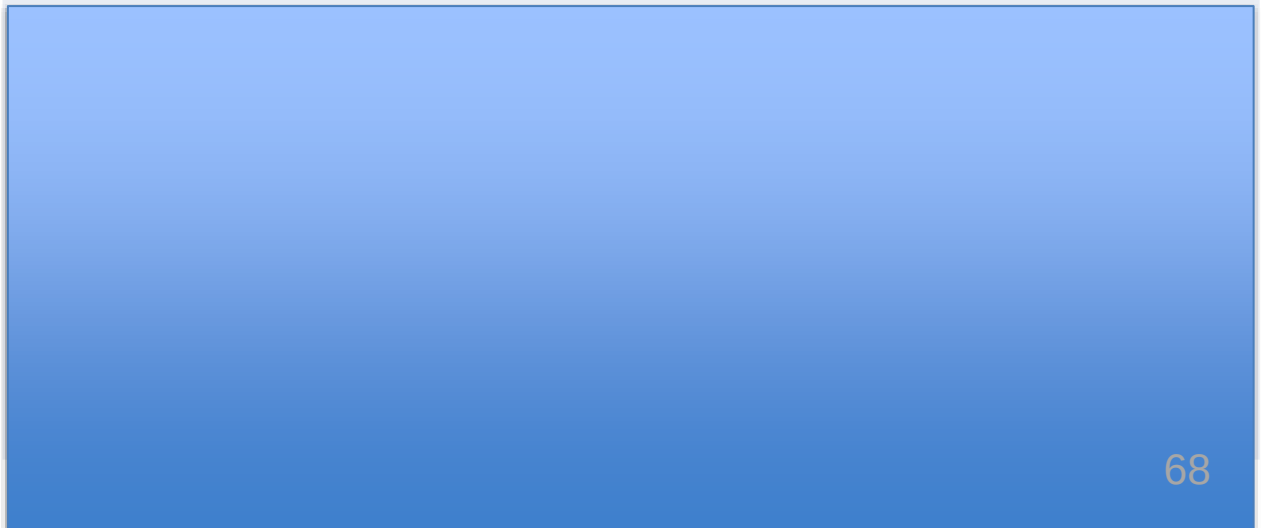
Challenges of the Inverted Classroom



Strengths of the Traditional Classroom



Challenges of the Traditional Classroom

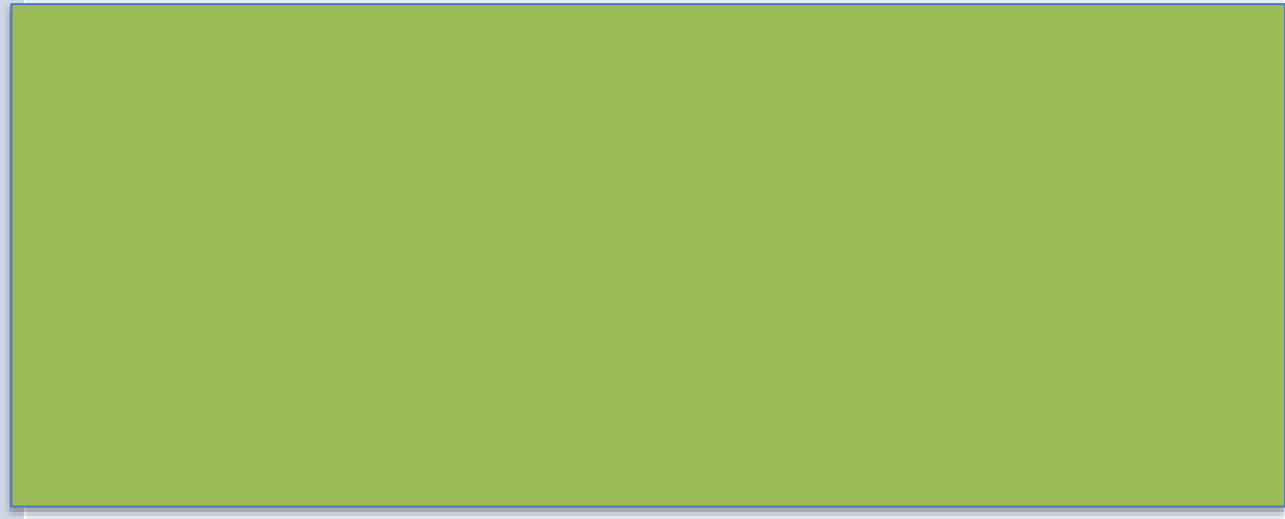


HMC Faculty Satisfaction

Strengths of the Inverted Classroom

- "Lively and interactive"
- "Individual responsibility on student"
- "Ability to interact with students while they built understanding of course material via problem solving"

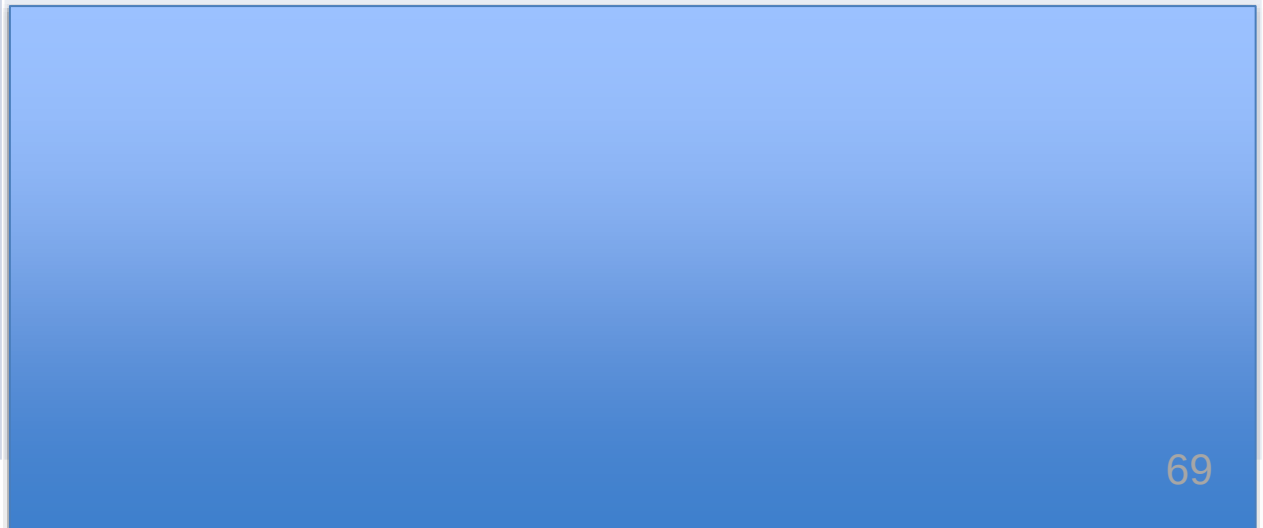
Challenges of the Inverted Classroom



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



HMC Faculty Satisfaction

Strengths of the Inverted Classroom

- "Lively and interactive"
- "Individual responsibility on student"
- "Ability to interact with students while they built 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

HMC Faculty Satisfaction

Strengths of the Inverted Classroom

- "Lively and interactive"
- "Individual responsibility on student"
- "Ability to interact with students while they built 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"

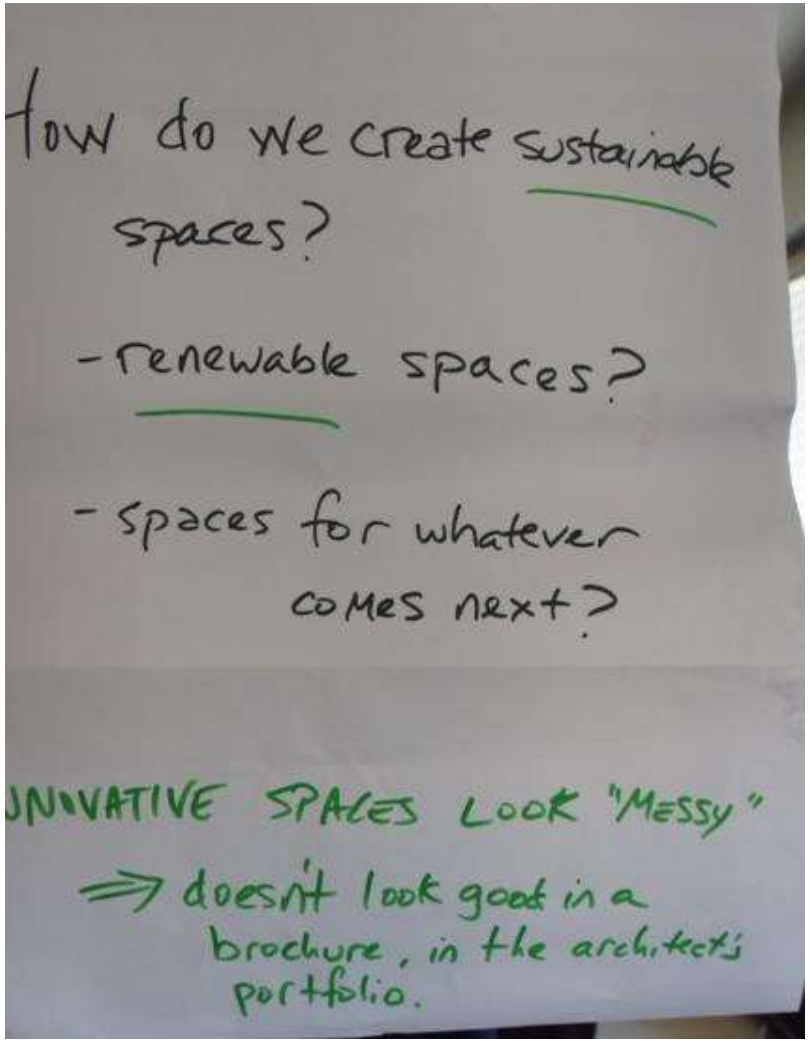
Challenges of the Traditional Classroom

- "Not knowing how well they were really understanding the material until I saw HW scores and test performance"
- "Addressing individual needs of all students"

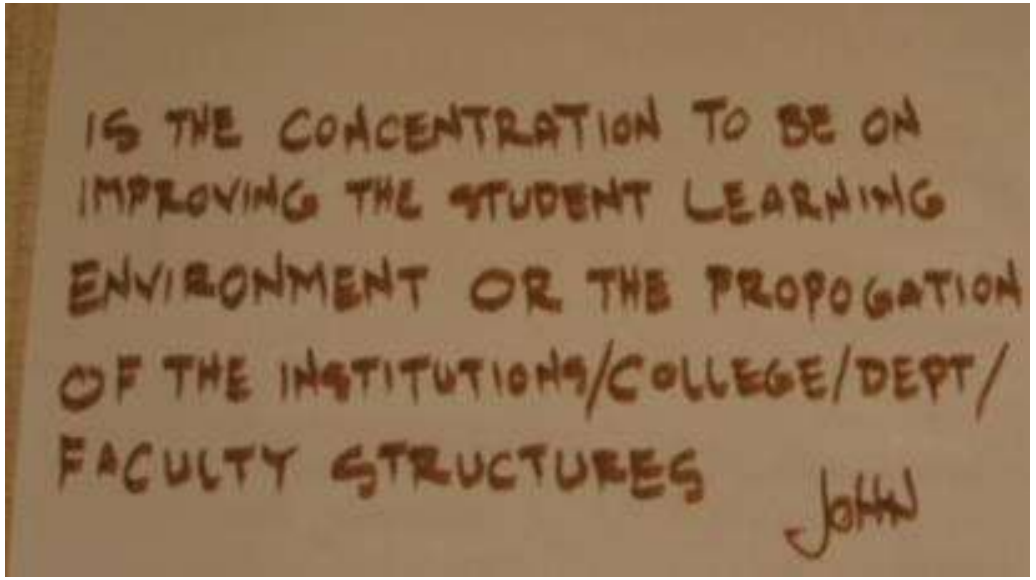
AUDACIOUS QUESTIONS

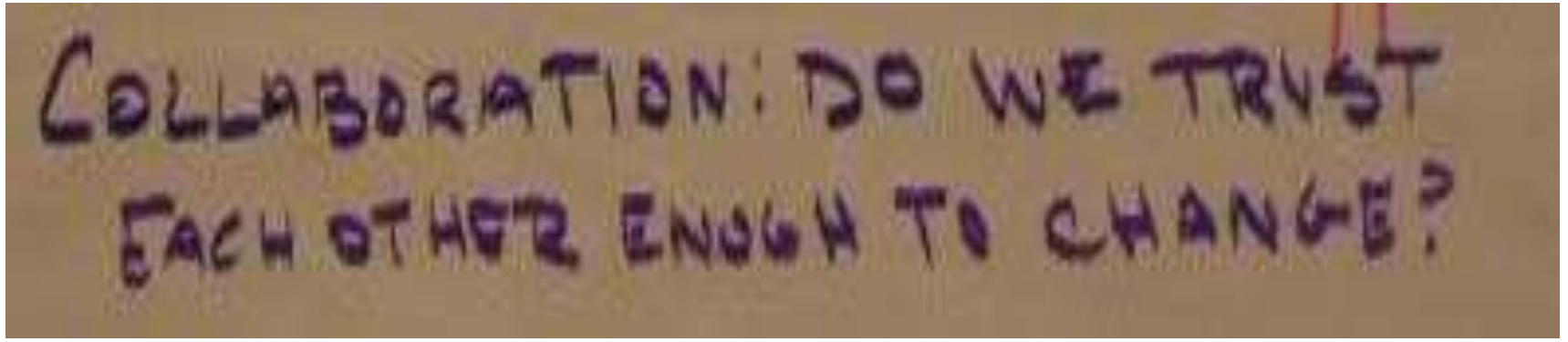
- What if we were designing spaces in 2020, what questions would we be asking then?

AUDACIOUS QUESTIONS

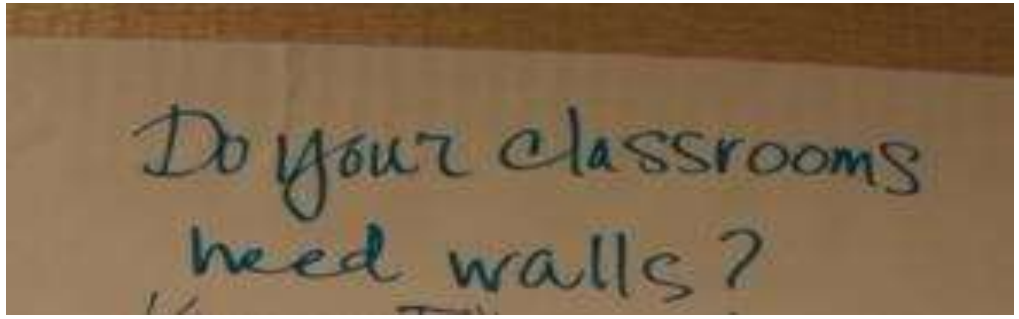


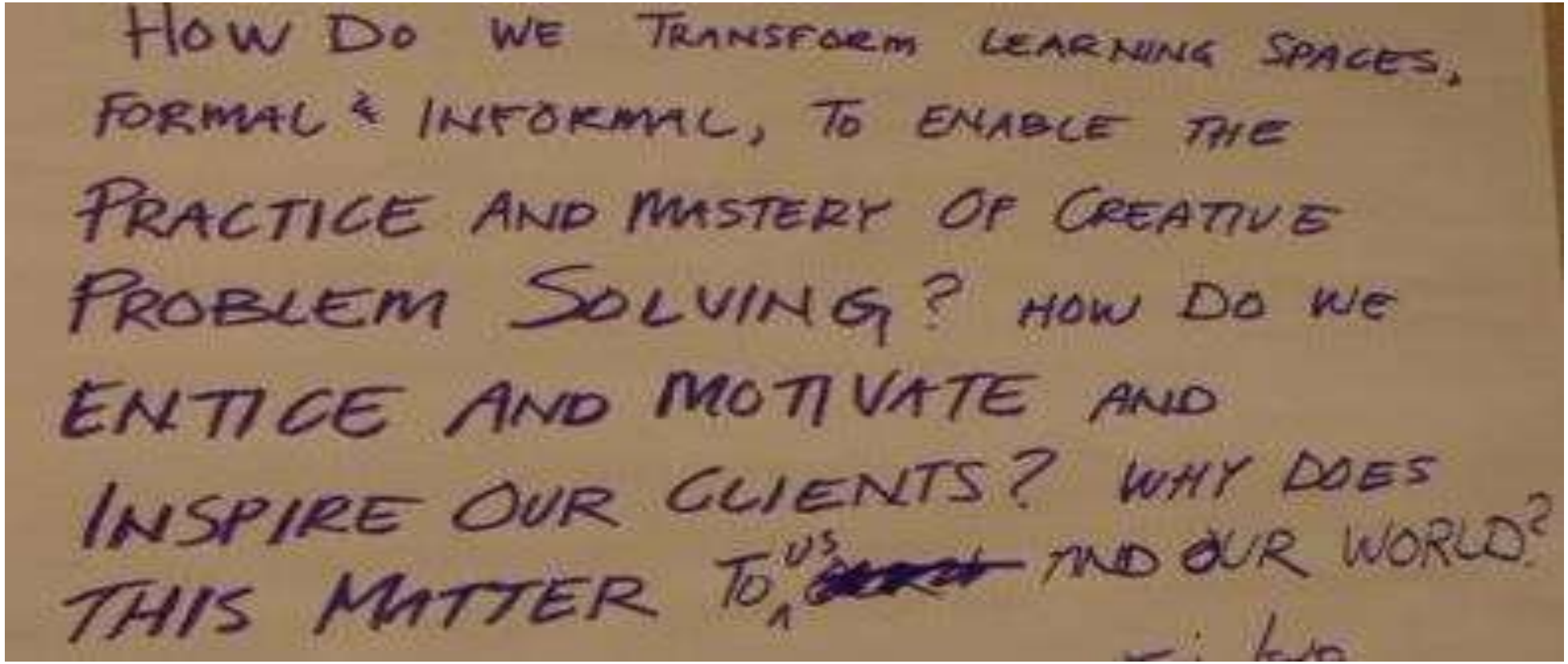
AUDACIOUS QUESTIONS



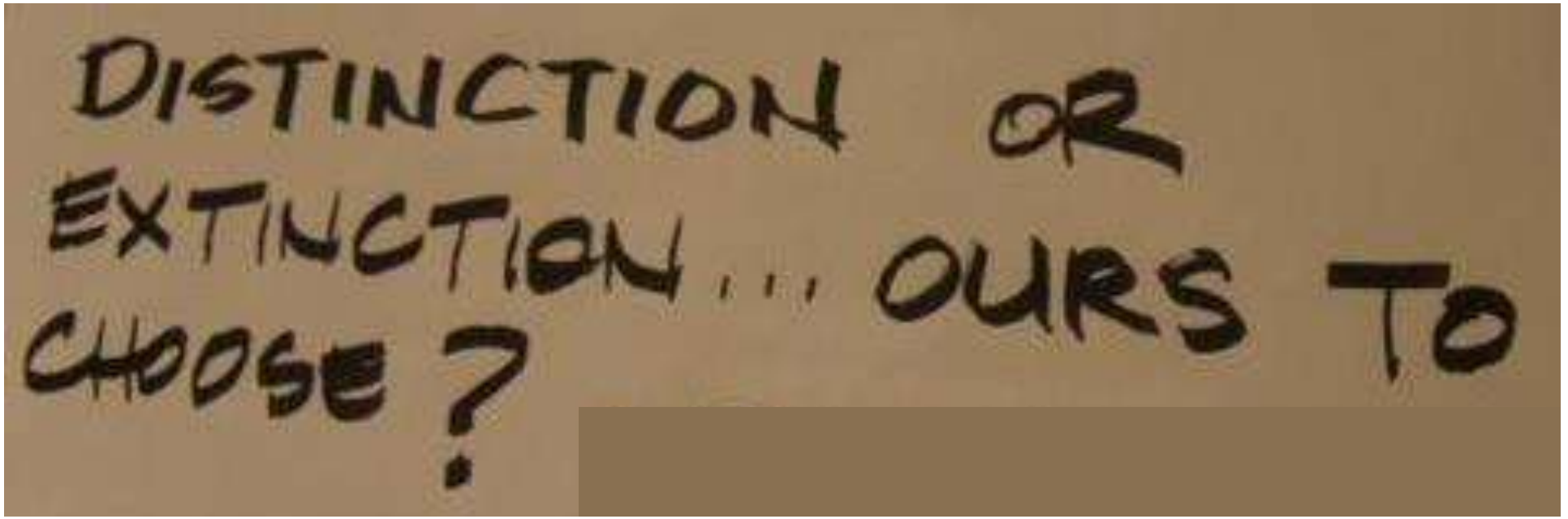


AUDACIOUS QUESTIONS





AUDACIOUS QUESTIONS

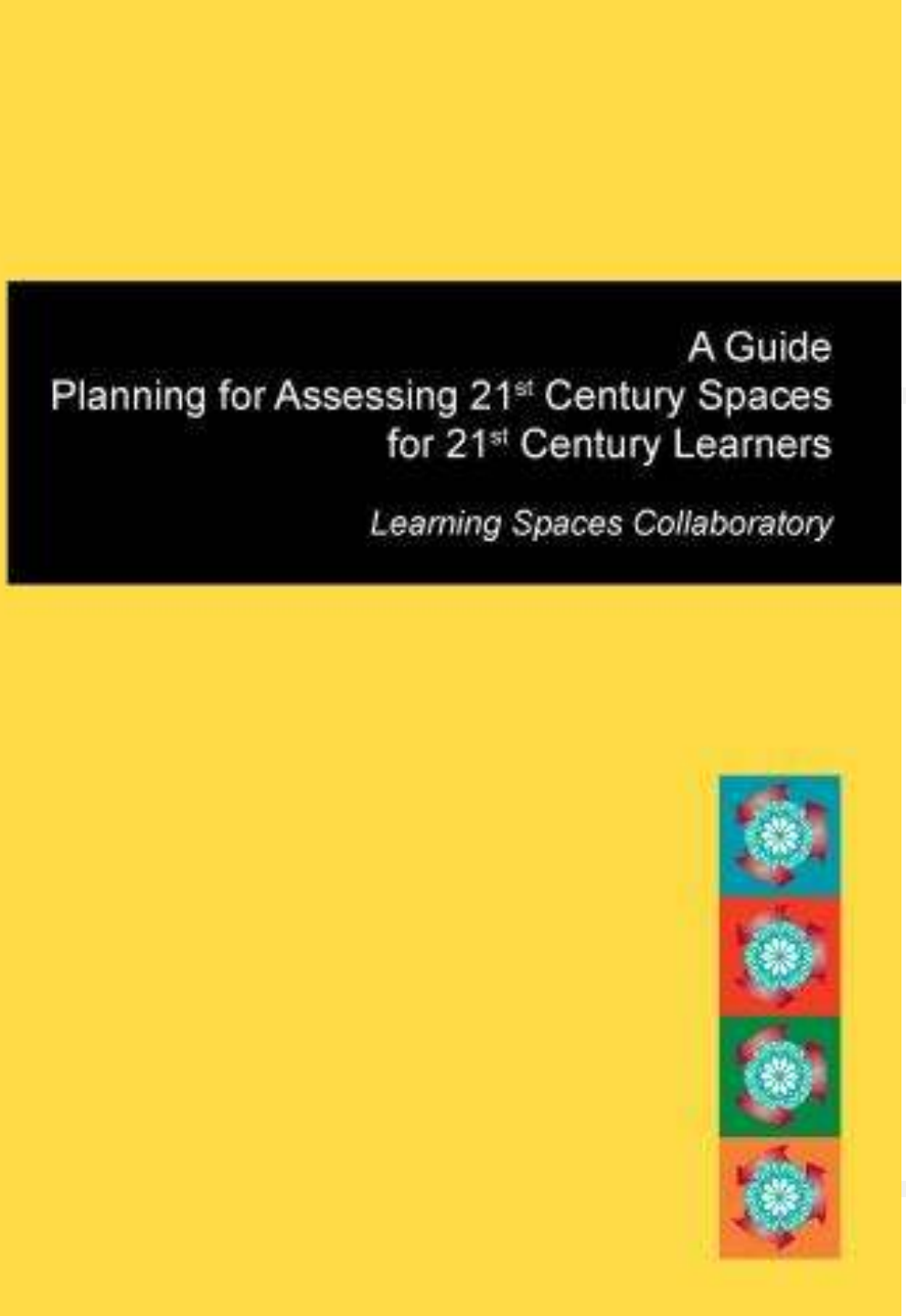


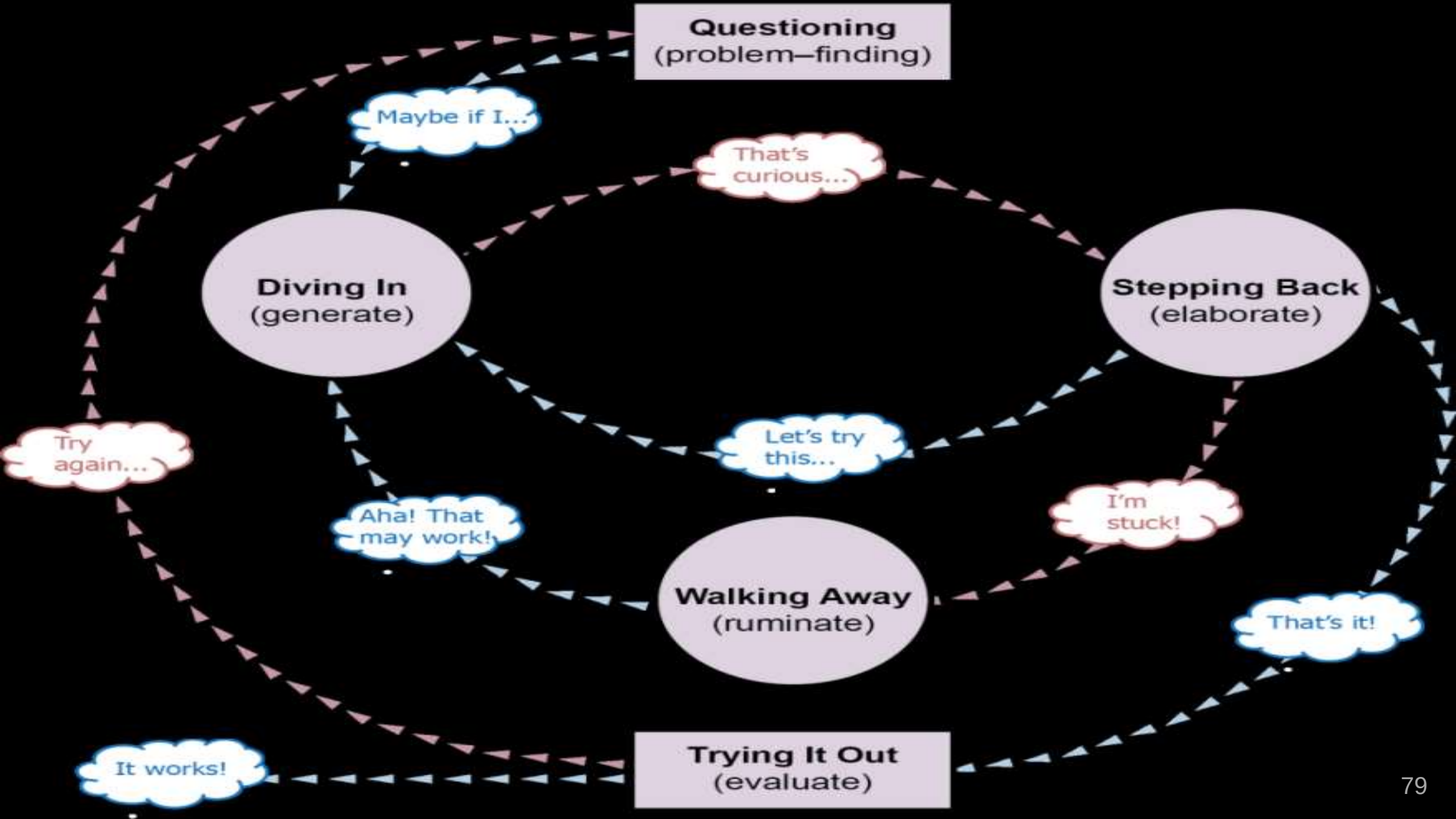
WHAT DO WE WANT OUR LEARNERS TO *BECOME*?

WHAT EXPERIENCES MAKE THAT *BECOMING* HAPPEN?

WHAT SPACES ENABLE THOSE EXPERIENCES?

HOW DO WE KNOW?




Questioning
(problem–finding)
Maybe if I...
That's curious...
Diving In
(generate)
Stepping Back
(elaborate)
Try again...
Let's try this...
Aha! That may work!
I'm stuck!
Walking Away
(ruminate)
That's it!
It works!
Trying It Out
(evaluate)

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