chemistry education as the ‘binding energy’ for active learning

real learning not just the myth

Lennie Scott-Webber, PhD
Director Education Environments Globally
"Empowering chemical educators to generate deep learning reactions"
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From Passive to Active Learning – Chemistry Teaching is its DNA
SE is a dedicated group within Steelcase focused on developing evidence-based researched solutions for education environments.

- focus on understanding behaviors in physical spaces
- Innovation in design, furniture, tools, and technologies for learning environments
OUR MISSION

...help colleges and schools create the most effective, rewarding, and inspiring learning environments...
research
“When I pronounce the word *future*, the first syllable already belongs to the past.”

-- Wislawa Szymborska
HUMAN-CENTERED / DESIGN THINKING RESEARCH PROCESS

1. UNDERSTAND: SECONDARY RESEARCH; EARLY OBSERVATIONS
2. OBSERVE: SOCIAL ANTHROPOLOGY; ON-SITE ETHNOGRAPHY
3. SYNTHESIZE: PATTERN ANALYSIS; PATTERN CODING; RESEARCH INSIGHTS; DESIGN PRINCIPLES
4. REALIZE: IDEATION PHASE
5. PROTOTYPE: HALF – TO FULL-SCALE; TRIAL AND ERROR
6. MEASURE: ACTIVE LEARNING POST-OCCUPANCY EVALUATION AL-POE™
ACTIVE LEARNING ECOSYSTEM
ACTIVE LEARNING ECOSYSTEM
ACTIVE LEARNING ECOSYSTEM

PEDAGOGY

ACTIVE LEARNING

SPACE

TECHNOLOGY

‘TOOLS’
content = just data
engagement = high student success predictor
engagement in context
=
deep learning
Is space relevant?
YES! When Evidence-based design practices are employed.

AND when face-to-face experiences embrace engagement.
The difference between the mean composite standard and the mean composite current scores is highly statistically significant for both sections using a paired t-test, $p<0.001$. 

**PARTICIPANTS**

$n=278^*$
Student Survey Results

Percentage of students who attributed moderate to exceptional increase in factors in new classroom (rating of 3, 4 or 5 on Likert scale)
ACTIVE LEARNING INCREASES STUDENT PERFORMANCE IN SCIENCE, ENGINEERING, AND MATHEMATICS
Scott Freemana,1, Sarah L. Eddy, Miles McDonougha, Michelle K. Smithb, Nnadozie Okoroafora, Hannah Jordta, and Mary Pat Wenderotha

BUILT ENVIRONMENTS IMPACT BEHAVIORS
RESULTS OF AN ACTIVE LEARNING POST-OCCUPANCY EVALUATION
by Lennie Scott-Webber, Aileen Strickland, and Laura Ring Kapitula

T.H.E. Journal
META-ANALYSIS: IS BLENDED LEARNING MOST EFFECTIVE?
By David Nagel 07/01/09
blended learning

- students learn in a supervised brick-and-mortar location away from home at least some of the time
- students experience online delivery with some control over the time, place, path, and/or pace

a variety of blended learning models are emerging…

- face-to-face driver
- rotation
- flex
- online lab
- self-blend
- online driver

Source: Adapted from Classifying K-12 Blended Learning, Innosight Institute, 2011 © 2014 Steelcase
blended learning

• students learn in a supervised brick-and-mortar location away from home at least some of the time

• students experience online delivery with some control over the time, place, path, and/or pace

Source: Adapted from Classifying K-12 Blended Learning, Innosight Institute, 2011
blended learning

traditional model

- remembering
- understanding
- applying
- analyzing
- evaluating
- creating

Face to Face

blended model

- remembering
- understanding
- applying
- analyzing
- evaluating
- creating

Online

adaption of revised New Bloom’s Taxonomy®

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From Passive to Active Learning - analogue & digital
learning preferences | learning research

V  A  K

visual  auditory  kinesthetic
By ZOE TIMOTHY DOWNING on October 20, 2008

http://www.personal.psu.edu/ztd102/blogs/science_teaching_and_learning/2008/10/blog-8-learning-theories-venn-diagram.html; retrieved june 10, 2011; science teaching and learning; a discussion of readings for SCIED 552
chemistry education w/lab-base = active learning
major factors
Digital Revolution
App “quilt”
transitions (1950-today)
transistors
mainframe computers
personal computers
smart phones
iPad

2,3, retina, mini, lite—thanks Steve
Social Revolution
Who is teaching who?
sharing is the cornerstone

communicate continually

not worried about security

blur public + private
changing needs

spaces to work as teams
technology to support
co-authoring of presentations
classrooms that support teams
fluid lecture
quick breakout
multiple screens
Environmental Revolution
Environmental Shift

Student Demand
Part of Decision Making
Staff Recruitment + Retention
Visible and Real
Better Learning Environments
Air
Quality of Light
Acoustics
Deep learning???
Source: The 2014 Gallup-Purdue Index Report

“…answers lie in what student are doing in college and how they are experiencing it.. have a profound relationship to a person’s life and career. Yet they are being achieved by too few.”
“Slightly more graduates who majored in the arts, humanities and social sciences (41%) are engaged at work than either science (38%) or business (37%).” p. 11
WANTED!!

T-shaped students
With 21st century skills

21st Century Skills
21st Century Skills

Trilling + Fadel
21st Century Skills

Daniel Pink
Whole New Mind

Richard Florida
Rise of Creative Class

From: Information Age
To: Conceptual Age
Conceptual Economy

21st Century Skills Required

- Design
- Storytelling
- Symphony
- Empathy
- Play
- Meaning
Design
Conceptualize
Think Creatively
(Not Only Function)
Storytelling
Coherence
Poise
Skill
(Not Only Argument)
Symphony
Ability to Work Together
Co-Author
Collaboration
(Not Only Focus)
Empathy
Immerse Oneself
In Another Culture
(Not Only Logic)
Play
Game Playing
Be Humorous
Think Creatively in
Everyday Problem Solving
(Not Only Seriousness)
Meaning
Not 1:1 Literal
Appreciate Symbolic
(Not Only Data)
if
fostering interaction, connection + engagement

student
- peer instruction
- group work

educator
- student response systems
- online and in-class discussions
- tutoring and coaching

learner
- co-creation
- online assessments
- online exercises

content
the results

Face to Face
• complex, higher level interactions
• impromptu interactions
• spatial context

Online
• self-reflection and review
• more problem solving and doing
• focus on weak areas
• increase in student data
• more frequent student feedback
• parent involvement

Outcomes
• access to courses and experts
• faster and higher completion rates
• higher engagement
• higher grades
• increased attendance

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blended learning gives rise to a wider range of classroom activities, both face-to-face and digital
Empower the mind
testing is for computers
creating is for humans
Empower the mind
opportunities
Give Them ‘Tools’ to Manage Their Own Learning

Contemplative Spaces
Comfortable Seating - Long Sessions
Noise system to Reduce Sound
Give Them ‘Tools’ to Manage Their Own Learning

Noisy | Collaborative spaces
Portable tables, technology, whiteboards
Noise system to encourage conversation
Give Them ‘Tools’ to Manage Their Own Learning

Whiteboard ‘Rooms’
‘Maker spaces’
Give Them ‘Tools’ to Manage Their Own Learning
Transition Zones Between Quiet + Noisy Spaces
Give Them ‘Tools’ to Manage Their Own Learning

Fully equipped group study rooms
Efficiencies—room scheduling from any portable device or at the door
Print Management system
Engage
Learning Alcove
On the fly learning
Curated content
short, artful, educational
Created content
student produced
Engage
Technology Showcase
Maker Space
Google Glass
Emerging Technologies
Engage

Multipurpose Room

Lectures
Event Space
Banquet Facilities
challenges
what challenges have we discovered?

- ALIGNMENT
  - Design SPACE
  - Professional Development/Management BEHAVIOR
  - Technology TOOLS
what challenges have we discovered?
active learning journey

- ideal
- an easy, straight shift

- reality
- a complex shift involving many variables
ALIGNMENT of WHY
What is the institution’s ‘why’ around active learning? How is the institution internally aligned around this ‘why’?

DIMENSIONS of HOW
How is institution working towards their why?
- professional development & curriculum?
- technology?
- space?

DIMENSIONS of WHAT
What plans or programs does the institution have in place, or is looking to develop, as they relate to how they are working towards their why?
design – business paradigm shift

- desired active behaviors
  - misalignment
    - DENSITY ISSUES
      - inhibits
        - MOVEMENT
          - inhibits
            - ACTIVE LEARNING
## Large Classroom Taxonomy

<table>
<thead>
<tr>
<th>PEDAGOGY</th>
<th>TECHNOLOGY</th>
<th>SPACE</th>
</tr>
</thead>
<tbody>
<tr>
<td>700+</td>
<td>individual engagement</td>
<td>auditorium</td>
</tr>
<tr>
<td></td>
<td>individual student tools</td>
<td>10-15 s.f./student</td>
</tr>
<tr>
<td></td>
<td>shared tools</td>
<td></td>
</tr>
<tr>
<td></td>
<td>classroom</td>
<td></td>
</tr>
<tr>
<td>500+</td>
<td>individual engagement</td>
<td>auditorium</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>classroom</td>
<td></td>
</tr>
<tr>
<td>250+</td>
<td>individual engagement</td>
<td>auditorium</td>
</tr>
<tr>
<td></td>
<td>group engagement</td>
<td>lecture hall</td>
</tr>
<tr>
<td></td>
<td>instructor tools</td>
<td>tiered classroom</td>
</tr>
<tr>
<td></td>
<td>shared tools</td>
<td>15-20 s.f./student</td>
</tr>
<tr>
<td></td>
<td>classroom</td>
<td></td>
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<tr>
<td></td>
<td>student-student</td>
<td></td>
</tr>
<tr>
<td></td>
<td>student - instructor</td>
<td></td>
</tr>
<tr>
<td>120+</td>
<td>individual engagement</td>
<td>lecture hall</td>
</tr>
<tr>
<td></td>
<td>group engagement</td>
<td>tiered classroom</td>
</tr>
<tr>
<td></td>
<td>instructor tools</td>
<td>flat floor classroom</td>
</tr>
<tr>
<td></td>
<td>shared tools</td>
<td>20-25 s.f./student</td>
</tr>
<tr>
<td></td>
<td>classroom</td>
<td></td>
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<tr>
<td></td>
<td>student-student</td>
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<td>flat floor classroom</td>
</tr>
<tr>
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<td>shared tools</td>
<td>25-30 s.f./student</td>
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<td>classroom</td>
<td></td>
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<td>student-student</td>
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</tbody>
</table>

**Research:**

- The higher the number the less opportunity for engagement [use of clickers, or diadic connections limit deep learning]
- The lower the number the higher the opportunity for engagement [a range of techniques can be employed addressing deep learning]
a tsunami is building...
Education leaders are struggling with how to...

- attract and retain top faculty
- attract and retain top students
- improve student success
- incorporate new, more effective pedagogies
- help students develop 21st century skills and meet their expectations
- integrate technology and future-proof their investments
- improve space utilization and keep up with demand
- fund needed change
- make face-to-face relevant in the climate of disruptive online delivery models
solutions in application
technology intent

- Analogue
  - Incorporate vertical writing surfaces for group work
  - Provide individual, moveable writing surface
  - Add easels/carts for transporting and having information persistence of student work

- Digital
  - Triangulate 3 interactive white boards for educator and student use
  - Use ultra short throw projection to reduce glare
  - Support student co-creation using interactive technologies

products

- Node 5-star base
- Verb team tables
- Verb instructor station
- Verb personal whiteboard with easel and rail
- eno flex interactive whiteboard with ultra short throw projector
- groupwork round table

3D RENDERING

Double LearnLab™ | Whole/Multi-Group

Swivel chairs provide students with immediate viewing of content and their peers, from every seat in the room.

Triangulation of digital content gives all groups equal visual access and ability to share what they’ve created.
Wall track allows the perimeter of the room to take advantage of vertical space, enriching the learning environment by displaying the process of student thinking.

Multiple aisles allow instructor to connect, coach, and assess student work during class.

technology intent

- Analogue
  - Incorporate vertical writing surfaces for group work
  - Provide individual, moveable writing surfaces
  - Add easels/carts for transporting and having information persistence of student work
- Digital
  - Provide multiple large screens and projectors

products

- Node 5-star base
- Verb chevron tables
- Verb personal whiteboard
- Verb easel
- Verb wall track
- Pocket adjustable height stand

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technology intent

- Analogue
  - Provide moveable writing surfaces for individual/team work and sharing
  - Add easels/carts for transporting and having information persistence of student work
  - Add wall track for mounting whiteboards supporting information persistence

- Digital
  - Provide multiple large screens and projectors
  - Include perimeter access for digital media work with wall mounted LCD screens
  - Include mobile media:scapes

products

- Convene
- Node
- Verb instructor station
- Huddleboard whiteboard with easel and rail
- media:scape mobile

Open aisles allows instructor to seamlessly move through space to connect with every team
technology intent

- Analogue
  - Provide moveable writing surfaces for individual/team work and sharing
  - Add easels/carts for transporting and having information persistence of student work
  - Add wall track for mounting whiteboards supporting information persistence

- Digital
  - Provide multiple large screens and projectors
  - Include perimeter and interior power access for digital media work

products

- media:scape
- Node
- Verb instructor station
- groupwork mobile whiteboard
- edge series whiteboards
products

- Node
- campfire big and half lounge
- alight
- sw1
- Huddleboard whiteboard and easel
- paper table
- personal table
- exponents podium
- media:scape and media:scape kiosk
- last minute stool

technology intent

- Analogue
  - Provide moveable writing surfaces for individual/team work and sharing
  - Add easels/carts for transporting and having information persistence of student work
  - Add wall track for mounting whiteboards supporting information persistence

- Digital
  - Provide multiple large screens and projectors
  - Include perimeter and interior power access for digital media work
HIGHER-EDUCATION
SOLUTIONS IN APPLICATION

Stanford dSchool
University of Missouri Kansas City, Bloch School of Business
SOLUTIONS IN APPLICATION
SOLUTIONS IN APPLICATION

Virginia Commonwealth University
HIGHER-ED LIBRARIES & IN-BETWEEN SPACES
SOLUTIONS IN APPLICATION

Grand Valley State University, Michigan
SOLUTIONS IN APPLICATION

Grand Valley State University, Michigan
University of California, Los Angeles
Phoenix College, Arizona
Kent Innovation High School, Michigan
WORK & BUSINESS
SOLUTIONS IN APPLICATION

Steelcase University Learning Center, Michigan
SOLUTIONS IN APPLICATION

LearnLab, Steelcase University Learning Center, Michigan
SOLUTIONS IN APPLICATION

Steelcase Global Headquarters WorkCafe, Michigan
SOLUTIONS IN APPLICATION

Steelcase University Learning Center, Michigan
summary
Active Learning Ecosystem
teaching and learning are changing

passive learners
active learners

directed learning
facilitated learning

knowledge revealed
knowledge discovered

alone
alone and together

knowledge is discrete
knowledge is embedded

content focused
content and process focused
technology is changing

- MOOCs
- 1:1 and BYOD
- Blended learning
- Distance learning
- Flipped classrooms
- Collaboration
  - student groups
  - peer-to-peer
  - faculty/student interaction
  - virtual
space remains the same

history repeating itself
independent solutions
=
inconsistent fit
21st CENTURY LEARNERS
19th century learning places
chemistry education should lead the way to deep learning
EVIDENCE-BASED INTENTIONALLY DESIGNED SPACES
"Empowering chemical educators to generate deep learning reactions "
thank you

lscottwe@steelcase.com
APPENDIX
BIBLIOGRAPHY

- Steelcase Threesixty Magazine, “Rethinking Higher Education Spaces: Issue 60” by Steelcase, Fall 2010
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