RICE
Unconventional Wisdom

Active Learning in a Virtual Environment

Renata Ramos, Ph.D.

Associate Dean of Academic Affairs, Engineering
Associate Teaching Professor, Bioengineering

Rice University

RICE
Unconventional Wisdom

Outline

1. Rice Engineering Education
2. Fall 2020 Challenges
   a. Student engagement
   b. Active learning
   c. Virtual laboratory classes
3. Tools & Tips (embedded)

Rice University

Leading research university with a
strong commitment to education

~4,000
undergraduate students

~3,200
graduate students

Residential College System

Rice Engineering

- Approximately 400 students per class
- 37% of Rice UGs are in engineering

1,456 total

475 female
981 male

Diverse

12% Foreign National

88% US. Citizens Permanent Residents

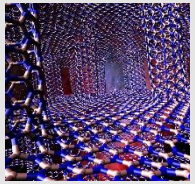
Rice Engineering

- Approximately 400 student per class
- 9 departments (6 ABET accredited programs)

Bioengineering

Chemical and Biomolecular Eng.

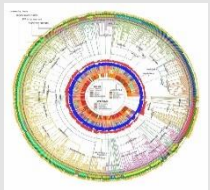
Materials Science and NanoEngineering



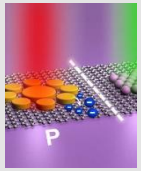
Civil and Environmental Engineering

Computational and Applied Math

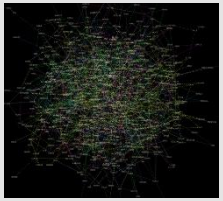
Mechanical Engineering



Computer Science



Electrical and Computer Engineering



Statistics

RICE
Unconventional Wisdom

Rice Engineering

- Approximately 400 student per class
- 9 departments
- 18 credit max (~6 courses) per semester
- General Education + Science Foundation + Engineering Core + Technical Specialization

1st Year	2nd Year	3rd and 4th Years
Science Courses	*Foundational Courses*	*Specialized Courses* *Elective Courses*

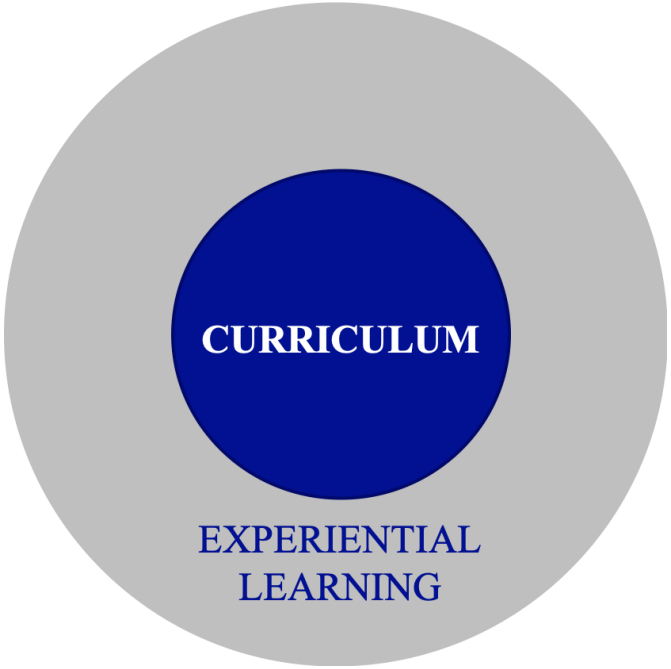
RICE
Unconventional Wisdom

Rice Engineering

18 credit max
(~6 courses)
per semester

Hands-on,
project-based
curriculum

Engineering Education



- ~550 courses per semester
- Curricular offerings include:
  - UG teaching labs
  - Independent research opportunities
- Engineering design and data science projects
- Project-based student clubs

RICE
Unconventional Wisdom

Fall 2020 Challenges

Student engagement

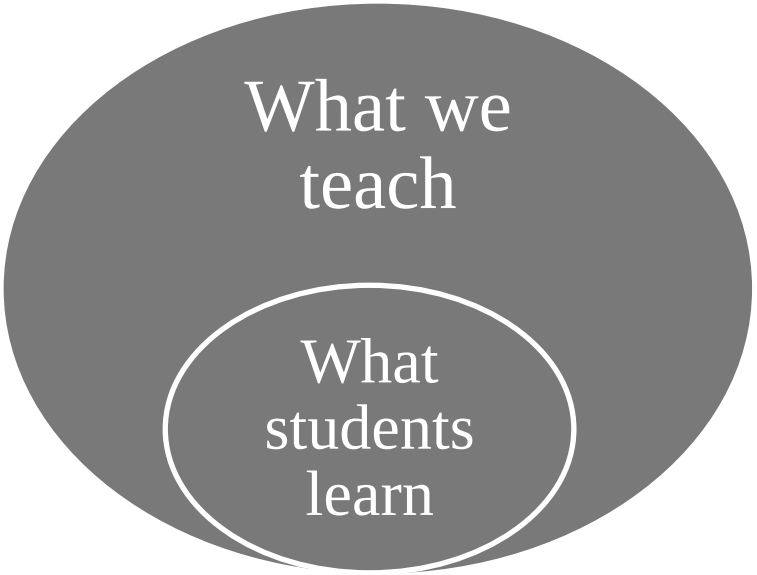
Active learning

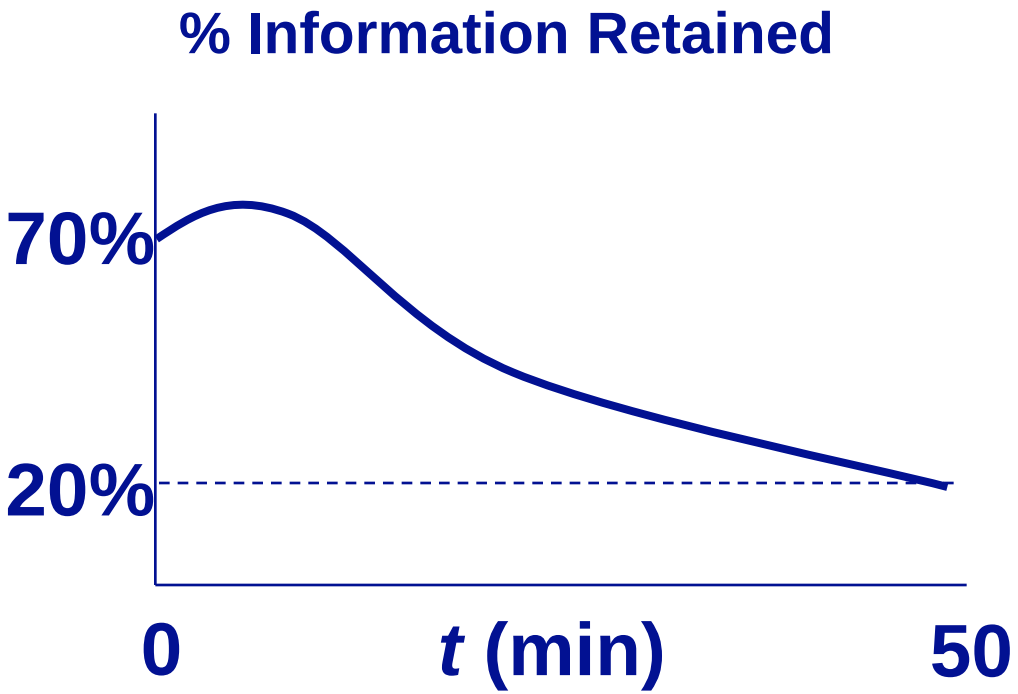
Laboratory courses

… in a ***virtual*** environment

RICE
Unconventional Wisdom

Teaching ≠ Learning





t **=time in lecture when information was presented**

RICE
Unconventional Wisdom

Student Engagement

We know how to teach face to face…

RICE
Unconventional Wisdom

Student Engagement

…but what does this look like online?

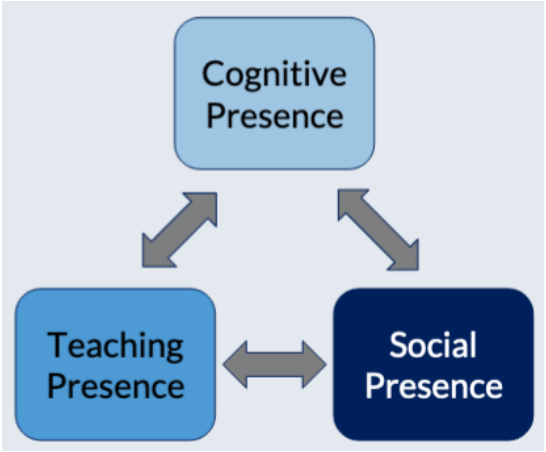
RICE
Unconventional Wisdom

Student Engagement

Engaging Student Remotely

Community of Inquiry Framework

- **Social**: communication and group cohesion
  - Interactions with peers
  - Interactions with faculty
- **Teaching**: design and facilitation of learning
  - Communication and expectations plan
  - Material presentation/organization → modular
  - Delivery format
  - Feedback
- **Cognitive**: engaging with material
  - Critical thinking
  - Apply knowledge



D. Flower and J. Lang. 2019. Small Teaching Online Applying Learning Science in Online Classes. John Wiley & Sons.

Engaging Student Remotely

What can we do as instructors to engage our students?

Build a solid foundation of social and teaching presence to stimulate cognitive presence

- Create community
- Be clear, flexible and present
- Prepare: know available technology and tools
- Rethink your course in terms of design and delivery

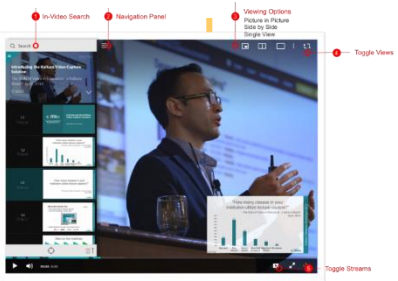
Technology Tools (Delivery)

Lecture Management

Lecture Capture

Annotations & Whiteboards

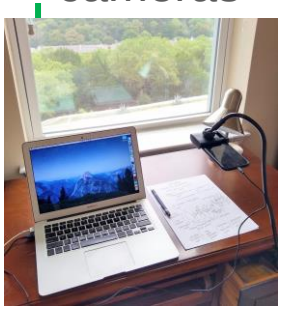
Kaltura



Narrated PPT

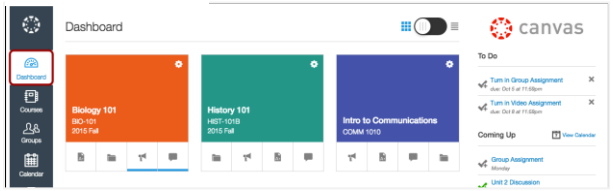
Blue jeans

Document cameras

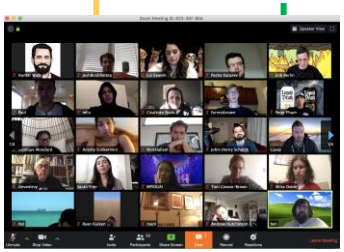


Slide annotations

Canvas



Zoom



Jamboards & Whiteboards

RICE
Unconventional Wisdom

Fall 2020 Challenges

Student engagement

Active learning

Laboratory courses

… in a ***virtual*** environment

RICE
Unconventional Wisdom

Active Learning

Instructional activities that

engage students in

their own learning process

provide students with "opportunities to meaningfully talk, listen, write, read and reflect on the content, ideas, issue, and concerns of an academic subject"

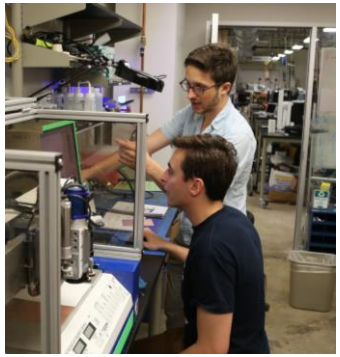
RICE
Unconventional Wisdom

Active Learning

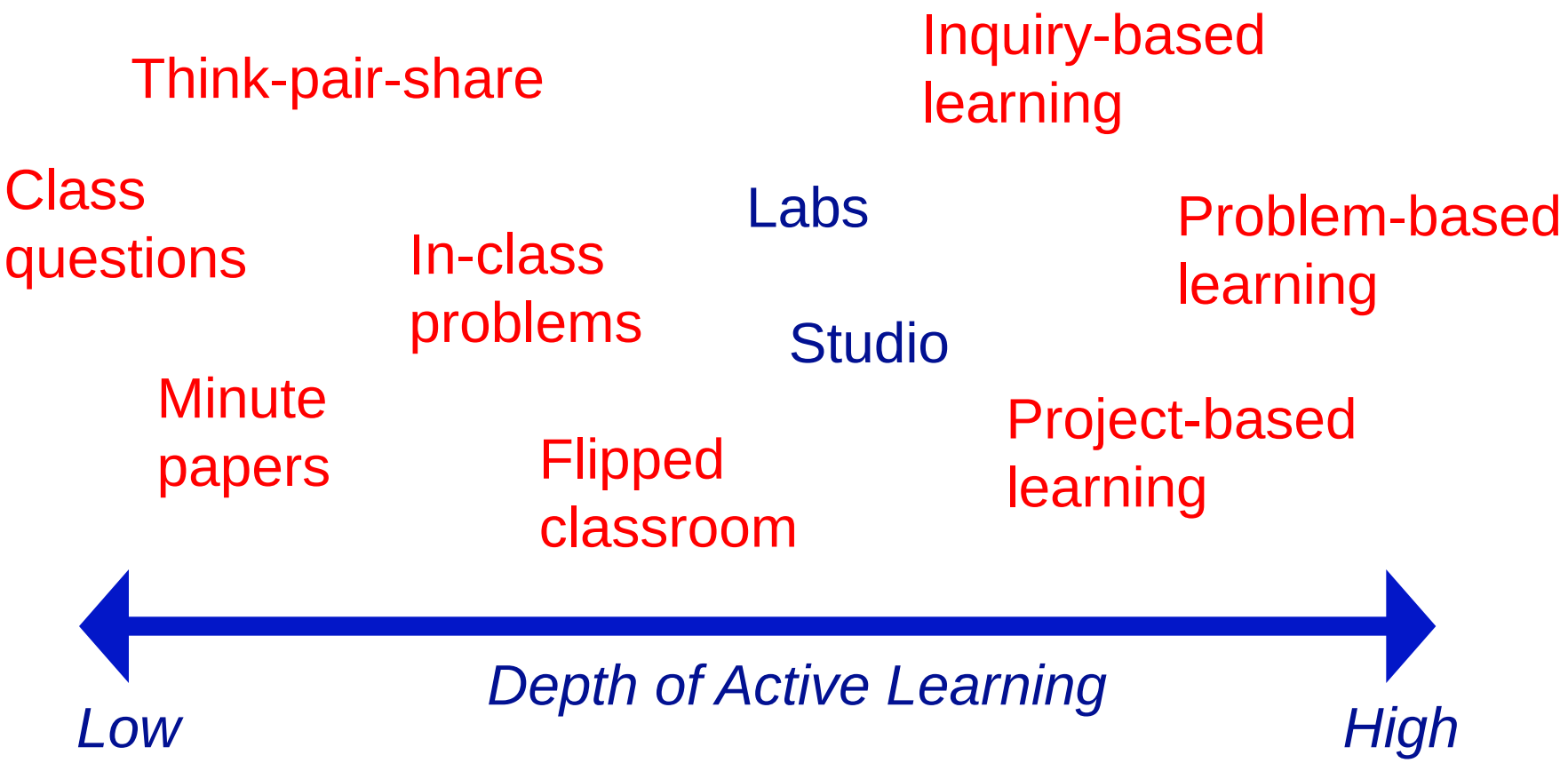
~~Why~~ How to do active learning?







Types of Active Learning



Technology Tools (Active)

Collaboration

Google Suite

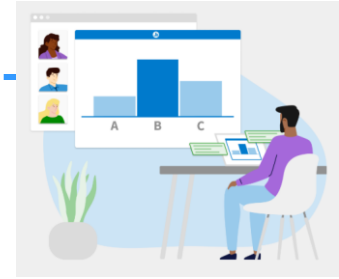
Break Out Rooms

Piazza

Discussions (LMS)

Polling

Poll Everywhere



Kahoot

RICE
Unconventional Wisdom

Fall 2020 Challenges

Student engagement

Active learning

Laboratory courses

… in a ***virtual*** environment

Laboratory Courses

Objectives of Labs

1. Selection of instrumentation
2. Comparison of theory and practice
3. Experimental design and implementation
4. Data analysis
5. Design and assemble a part or system
6. Learn from failure
7. Creativity
8. Psychomotor skills
9. Practice hazard identification and mitigation
10. Communication
11. Teamwork
12. Practice scientific ethics
13. Develop sensory awareness

The role of the laboratory in undergraduate engineering education. 2005 JE, 94

Laboratory Courses

Virtual Labs Can Still Accomplish…

1. Selection of instrumentation
2. Comparison of theory and practice
3. Experimental design ~~and implementation~~
4. Data analysis
5. Design ~~and assemble~~ a part or system
6. Learn from failure
7. Creativity
8. ~~Psychomotor skills~~
9. Practice hazard identification and mitigation
10. Communication
11. Teamwork
12. Practice scientific ethics
13. ~~Develop sensory awareness~~

The role of the laboratory in undergraduate engineering education. 2005 JE, 94

Rice Lab Instruction

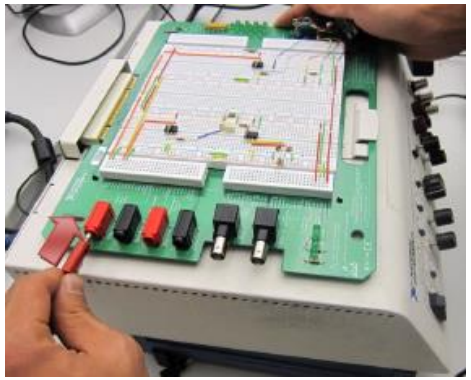
Freshman → **Sophomore** → Junior → Senior

Systems Physiology

Electronic Circuits

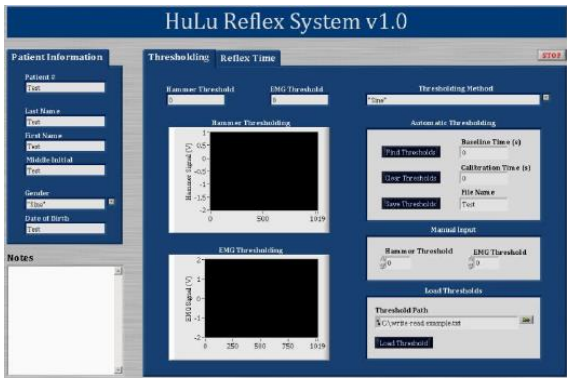
Rice Lab Instruction

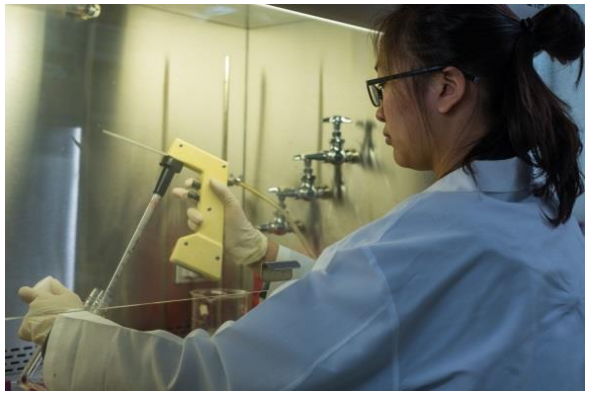
Freshman → Sophomore → **Junior** → Senior



Bioinstrumentation

Tissue Culture





Rice Lab Instruction

Freshman → Sophomore → Junior → **Senior**

Mechanical Testing

Bioprocessing

Digital Design

Medical Device troubleshooting

Rice Lab Instruction

Freshman → Sophomore → Junior → **Senior**

Mechanical Testing

Bioprocessing

Digital Design

Medical Device troubleshooting

Virtual Labs Course

How do we teach virtual labs?

- Rethink your course by identifying and preserving *critical* learning objectives – what do my students need to learn?

- Reconfigure your lab to match objectives:
  - Provide data for analysis
  - Equipment selection/experimental design
  - Teamwork via zoom (current industry)
  - Communication – video, reports
  - Emphasize concepts (teachable moments or misconceptions) /critical thinking/theoretical design

Virtual Laboratories

PREDICTION

REFLECTION

faculty
demonstration

thought
experiment

ACTIVITY

student or faculty
simulation

student
experiment
(most effective)

no
experiment
(least effective)

Nootis, Prince, Vigeant, Golightly. ASEE 2015, 2018, 2019.

Emphasizing Concepts

- Create/facilitate demonstrations & simulations
  - Heat transfer misconceptions (melting ice)
  - Mechanical testing pre-recorded experiment
- Use available media or supplies
  - Medical troubleshooting lab → break apart lab with common household items
  - Existing online videos (common for physics and chemistry principles)

    Pressure in fluids
- Learning by teaching (peer-teaching)
- Consider virtual labs and simulations

Technology Tools (Labs)

- Brainstorming/Collaboration
  - Padlet
  - Mural, Miro, IdeaBoardz
- Virtual Labs/Demos
  - LabXchange – biological science simulations
  - Journal of Visualized Experiments experiments demonstration, mapped to key concepts and student protocols.
  - MERLOT repository housing virtual labs.
  - ChemCollective chemistry lab simulations
  - Phet – interactive simulations that allow students to vary parameters
  - ThinkerCAD - virtual circuit design program
  - PhysioNet - physiological data from different experimental setups (ECG, gait and balance, EEG, images, etc.) which can be provided for data analysis
  - Labview - tutorials and online labs, demos of data acquisition protocols
  - Protolabs – Design for manufacturing resources

Thanks for your time!

- Social Presence:
  - Be clear, flexible and present
  - Provide collaboration opportunities
- Teaching Presence
  - Course design – rethink your course
- Cognitive Presence
  - Real-world applications