



# *One Way the Pandemic Improved My Teaching*

Spring 2021 Lightning Symposium

*Hosted by the Academy for Excellence in Engineering Education (AE3)*

March 30, 2021  
10:00am

- All participants will be automatically muted upon entry to the Main Room.
- The symposium will consist of:
  - Nine (9) unique presentations of **4 minutes or less**
    - An audible signal will alert presenters when they have 30 seconds remaining and again when time has expired.
- A general Q+A session following all presentations, coordinated by Chris Schmitz (ECE)
- The chat space will remain open during the lightning presentations
- You are encouraged to post questions, share ideas, and offer comments during the presentations; the presenters will not be responding to chat during their 4-minute presentations but rather during the Q+A session following all presentations.
- AE3 staff will monitor for the chat for questions that may be addressed during the open Q+A sessions following all presentations.
- Please raise your hands to ask open-mic questions during the Q+A session.
- The symposium will be recorded and available on the AE3 website (<http://ae3.engineering.illinois.edu>) later this week.



**Abigail R. Wooldridge**  
**Industrial and Enterprise Systems**  
**Engineering**  
***Designing Usable Classes for***  
***Connectedness***

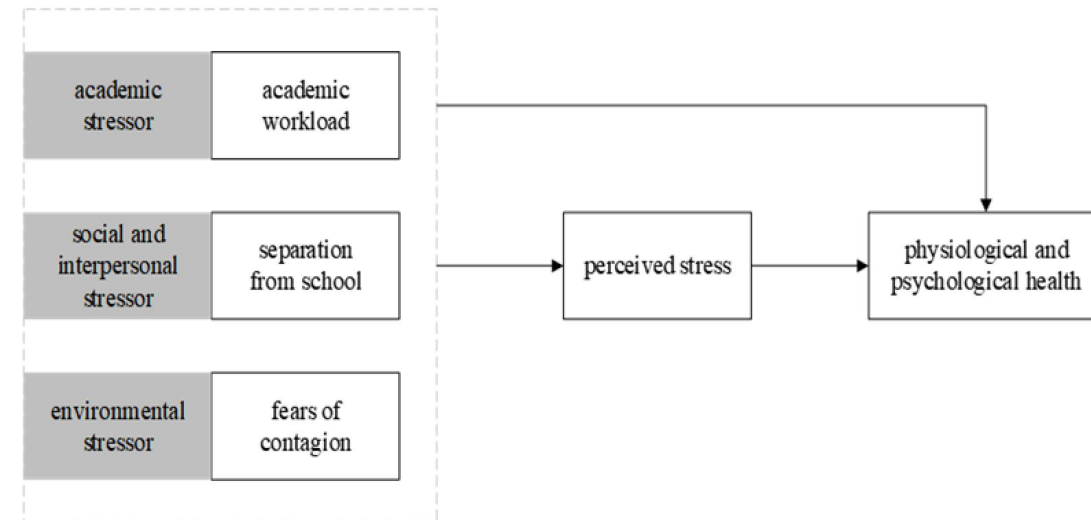
## Students report higher levels of stress during the COVID-19 pandemic

(Son et al., 2020; Wang et al., 2020; Yang et al., 2021)

### From human factors/ergonomics perspective, stress:

- Is linked with errors and decreased performance.
- Leads to negative health outcomes over time (e.g., increased blood pressure, chronic conditions and burnout) .
- Results from **misfit** between demands (i.e., stressors) and resources.

### Redesign for fit to improve student outcomes!



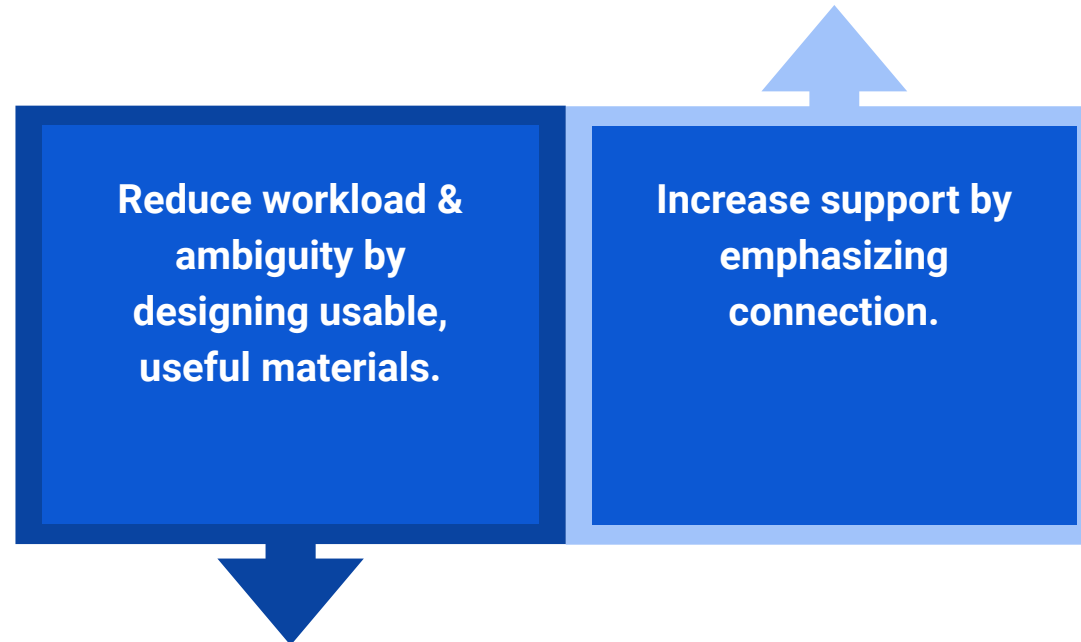
From Yang et al. (2021)

## Reduce Stressors

- Workload
- Role ambiguity
- Role conflict
- Interpersonal conflicts
- Supervisory style
- “Job” insecurity

## Increase Resources

- Job control
- Social support
- Compatible schedules
- Educational resources





## Consider usability heuristics in design of course materials

### Special attention to usable calendar:

*Consistent* due date (everything always due Friday at midnight).

*Minimalist* with only needed information

*Mapping and recognition*: organized by week, same format

## 10 Usability Heuristics



### Visibility

Show system status, tell what's happening



### Mapping

Use familiar metaphors & language



### Freedom

Provide good defaults & undo



### Consistency

Use same interface and language throughout



### Error Prevention

Help users avoid making mistakes



### Recognition

Make information easy to discover



### Flexibility

Make advanced tasks fluid and efficient



### Minimalism

Provide only necessary information in an elegant way



### Error Recovery

Help users recognize, diagnose and recover from errors



### Help

Use proactive and in-place hints to guide users

Based on Nielsen's ten heuristics. Updated by Scott Klemmer and Janaki Kumar.



## Make it easy for students to connect with instructor

### Required office hours visit (for points)

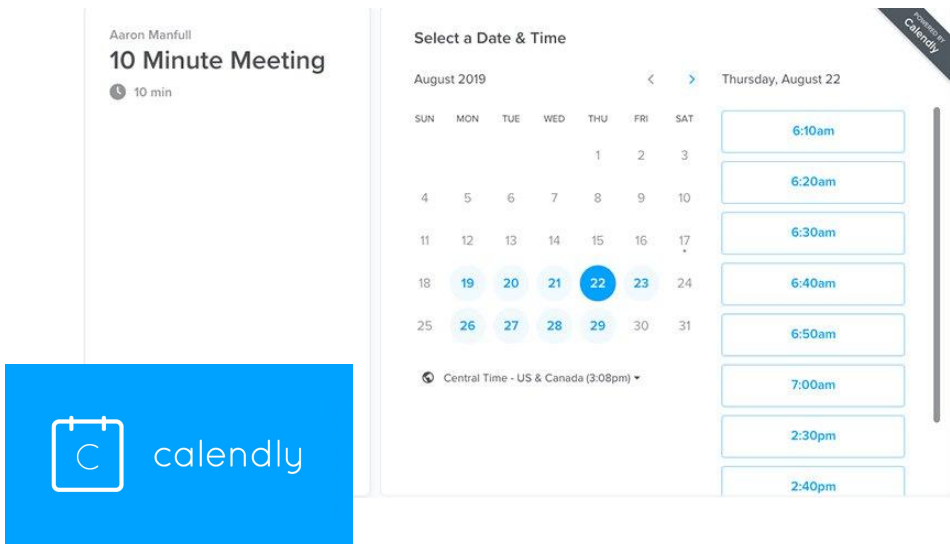
Breaks down barriers for some student groups.  
Ensures able to join (find room, zoom link).  
Supports tailoring materials to student interests

### Optional office hours visits (for extra credit)

Incentivizes ongoing dialog.  
Reduces stress related to grade.  
**Small** but appreciated.

### New: use Calendly for scheduling due to conflicts

Increase access (in controlled way).  
Reduces my workload!



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# Holly Golecki

## Bioengineering

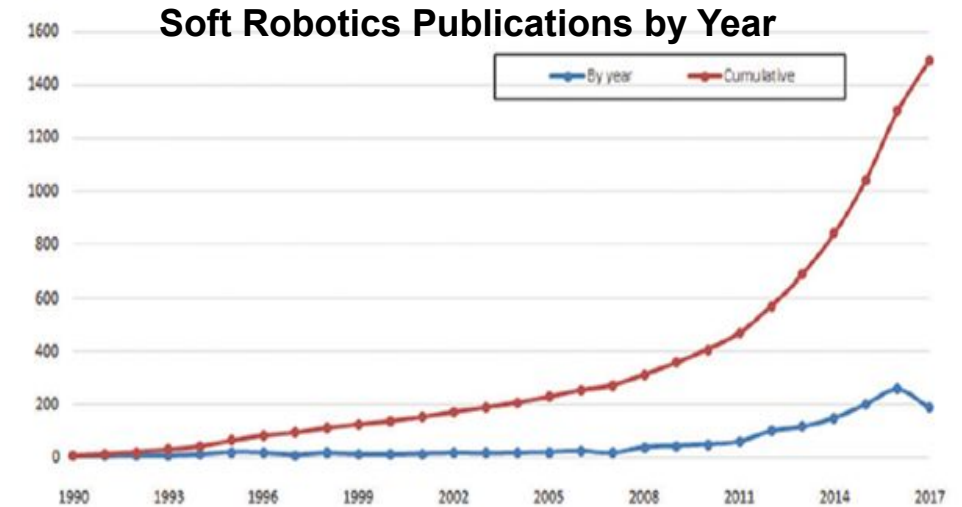
### *Leveraging Virtual Open Access Science*





## Course Resources:

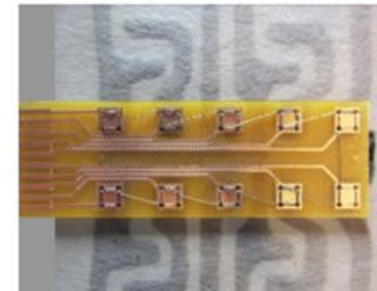
- Relatively new field
- Utilizes journal articles as course text
- Soft Robotics Toolkit: a collection of resources from practitioners across the world



[Home](#) [About](#) [Components](#) [Showcase](#) [Forum](#) [Contribute](#) [Resources for Educators](#) [Outreach](#) [K-12 Program](#)

HOME /

### Contribute to the Soft Robotics Toolkit



Contributions to the Soft Robotics Toolkit allow us to continue our work to create a comprehensive and accessible resource around soft robotics. By hosting this open-source library, researchers and students alike can use the opportunity to promote and share their work within the growing community. Submissions to the site are accepted year-round through contributions from researchers and professionals in the field.

Contribute to the Soft Robotics Toolkit by submitting your work for review. Please review all requirements for submission on the following page.

[Share your Research](#)

**The pandemic changed two things:**

- 1. “Zoom” became second nature**
- 2. More of science became “open access”**

# Many Conferences were *Virtual* and *Free*



→ This allowed my students to interact with the most cutting-edge information in bioinspired robots and healthcare applications

2020 IEEE/RSJ  
International Conference on  
Intelligent Robots and Systems(IROS)

October 25 – November 25, 2020 On-Demand Conference

Theme: Consumer Robotics and Our Future


Click [IROS On-Demand](#) - Went Live 10/24/20 23:45 Pacific

(09/07/20): Announced that IROS 2020 will **not** be held in-person. The safety and well-being of our participants is our priority. With the continued resurgence of COVID-19 within the Nevada, in particular Las Vegas, along with the city's prohibiting large or even moderately-sized public gatherings, it makes it an impossibility to hold the in-person event as originally planned.


(09/23/20): Announced that IROS 2020 is **free** with access to every Technical Talk, Plenary and Keynote, over 60 Workshops and Tutorials, the Competitions, and includes publishing of papers in the IROS Proceedings and IEEE Xplore.

This unprecedented offering is made possible thanks to the support and leadership of the Sponsoring Societies: the [Robotics Society of Japan \(RSJ\)](#); the [IEEE Robotics and Automation Society \(RAS\)](#); the [IEEE Industrial Electronics Society \(IES\)](#); the [Society of Instrument and Control Engineers \(SICE\)](#); and the [New Technology Foundation \(NTF\)](#) in light of COV-19, to share the advances in robotics, and to broaden attendance globally.


**IROS 2020 Distinguished Plenary Speakers**



Danica Kragic  
KTH, Sweden



Cynthia Breazeal  
MIT, USA



Yukie Nagai  
Univ of Tokyo, Japan

## Medical, Cellular, Micro and Nano Robots - With support from IROS Platinum Partner "KUKA"



## Design, Mechanisms, Actuators, Soft and Bio-Inspired Robots



## Grasping, Haptics and End-effectors - With support from IROS Gold Partner "Rainbow Robotics"



## Human-Robot Interaction, Teleoperation, and VR





# This applied in BIOE435 Senior Design, too



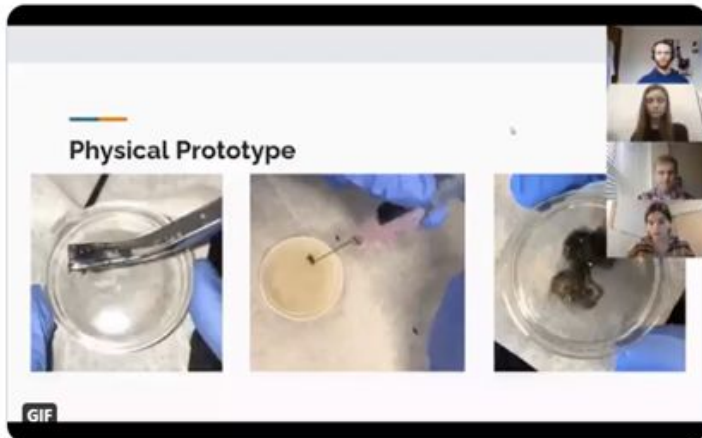
→ Any barriers to contacting experts in the field were completely removed and opportunities to present at conferences were free and accessible.

## AIChE Regen Eng Society Symposium

## FRESH Bioprinter




 Illinois BIOE  
@BIOENGatIL

#Bioengineering #seniordesign students, Maddie Blaauw, Brendan Brasch, Caroline Fatina & Jarron Roy, will be presenting their improved 3D #Bioprinter project at the @ChEnected Regenerative Engineering Society Symposium today. This project is sponsored by prof. @Underhill\_UIUC



RESEARCH ARTICLE | BIOMEDICAL ENGINEERING

## Three-dimensional printing of complex biological structures by freeform reversible embedding of suspended hydrogels

Thomas J. Hinton<sup>1</sup>,  Quentin Jallerat<sup>1</sup>, Rachelle N. Palchesko<sup>1</sup>,  Joon Hyung Park<sup>1</sup>, Martin S. Grodzicki<sup>1</sup>, Hao-Jan Shue<sup>1</sup>, Mohamed H. Ramadan<sup>2</sup>, Andrew R. Hudson<sup>1</sup> and  Adam W. Feinberg<sup>1,3,\*</sup>

<sup>1</sup>Department of Biomedical Engineering, Carnegie Mellon University, Pittsburgh, PA 15213, USA.

<sup>2</sup>Department of Chemistry, Carnegie Mellon University, Pittsburgh, PA 15213, USA.

<sup>3</sup>Department of Materials Science and Engineering, Carnegie Mellon University, Pittsburgh, PA 15213, USA.

\*Corresponding author. E-mail: feinberg@andrew.cmu.edu

– Hide authors and affiliations

Science Advances 23 Oct 2015:  
Vol. 1, no. 9, e1500758  
DOI: 10.1126/sciadv.1500758

# Looking Ahead..

Conferences won't always be free, or even online, but we will have this new agility with connecting online that we can leverage to enhance our students' engagement with practitioners, cutting-edge results, and opportunities in our fields.







**Michael R. Nowak**  
**Computer Science**  
***Interactive daily lessons***  
***in CS-128***

## Motivation

Not only "***how can I teach better during the pandemic***", but "***how can I use this as an opportunity enhance my student's experience for once we are back to normal***"

Acknowledge Student  
Outside Responsibilities

Maintain Student  
Attention

Enhance Student  
Engagement

## Interactive daily lessons in CS-128

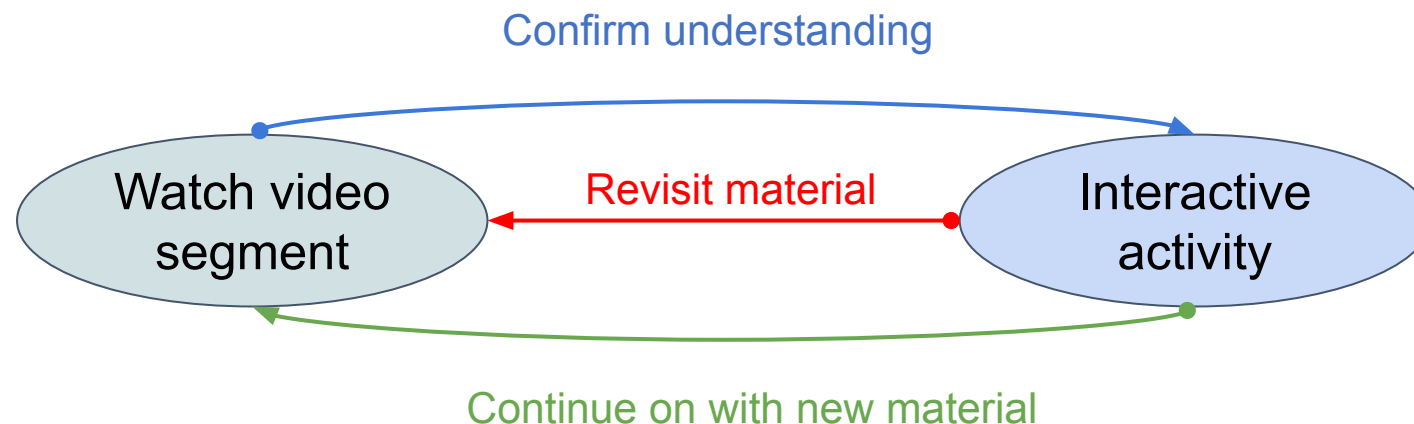
Students are exposed to **new material each day** through video and have an **opportunity to practice what they've learned** through our **interactive coding exercises**

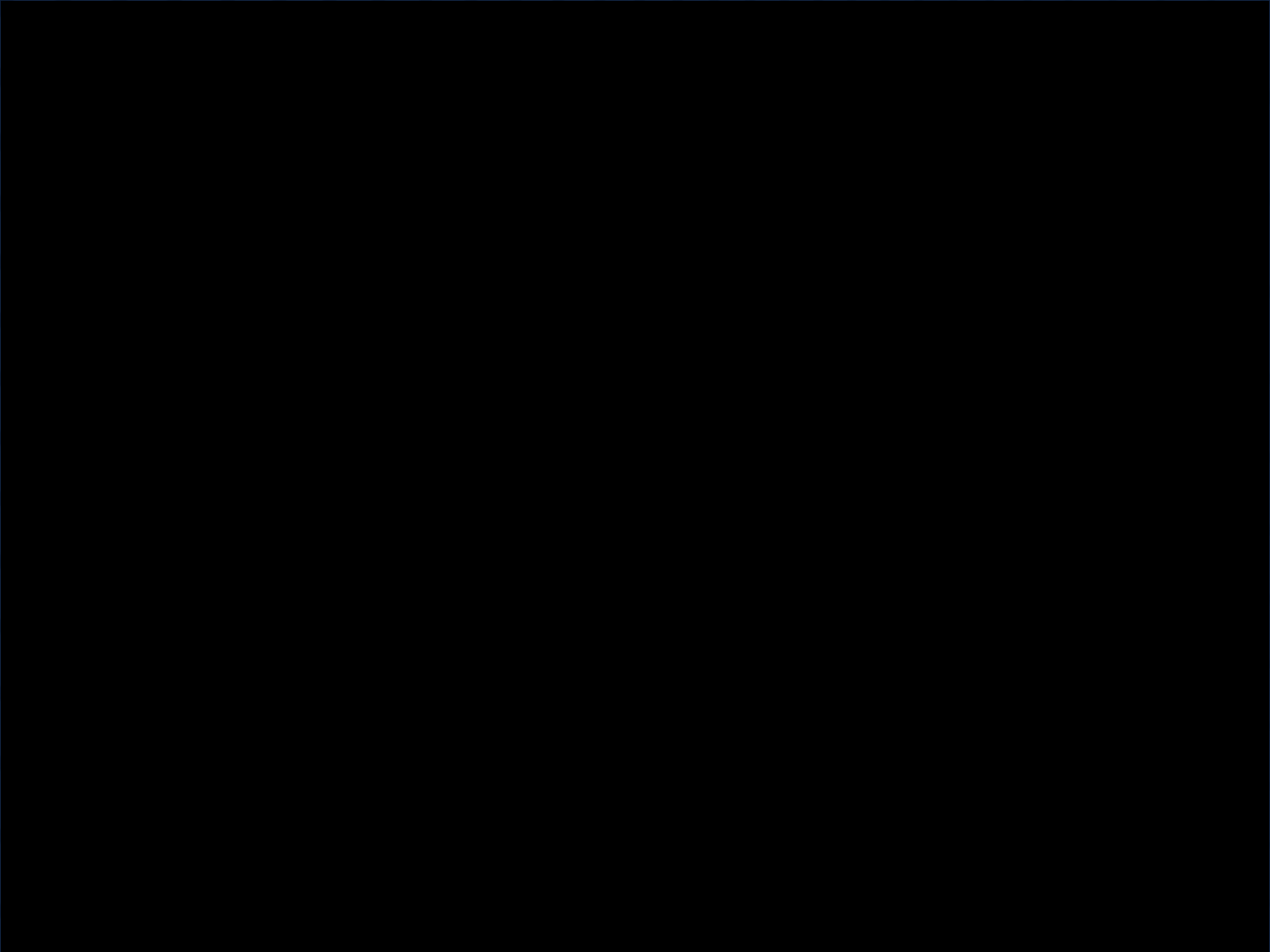
On-demand

20-30 minutes of  
video content

Divided into short  
video segments

Side-by-side with  
interactive coding  
exercises





## Parting thoughts

**Interactive daily lessons** are **more focused than traditional lectures**, while providing an **engaging mix of content and assessment** each day!

They provide **enhanced accessibility**, especially to nontraditional students

Their production takes dedication and careful planning

It's difficult to get the time-boxing correct and sometimes lessons run longer than expected

Likewise for the video segments

Interactive activities take additional time to develop too

**I do not plan to return to the lecture model post pandemic**





**Wayne Chang**  
**Mechanical Science and Engineering**  
***Standardizing computing platform***  
***across engineering courses***

## “Less is More”

- How does one keep up with ever growing and evolving variety of numeric computing platforms?
- Will commercial software always be available?
- Jack of all trades?



## “Connectedness is the Essence of Everything”

- How do we optimize the role of prerequisites?
- Do students see the benefits of fulfilling prerequisites?
- Are students overwhelmed by the variety of tools and platforms used between classes?



Mohd Azri Suratmin / EyeEm / Getty Images





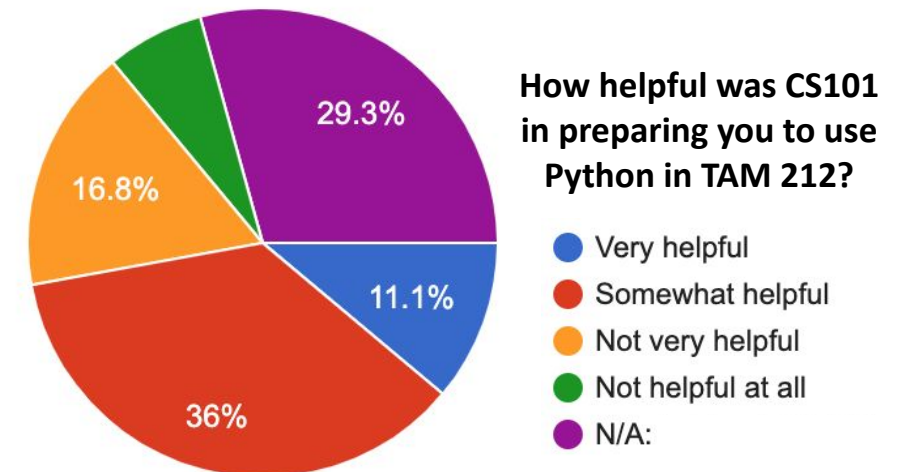
## Dilemma: Defining Standards in Engineering Curriculum

- TAM 2xx (210/211, 212, and 251) courses has been functioning as a community of teaching, and students benefited greatly from standardized course policies for all TAM 2xx courses
- The necessity of numeric computation has been a point of contention for both faculties and students
- Commercial software (e.g. MATLAB) availability has been inconsistent in recent years
- What are other classes doing?

## Collaboration with CS101 to Incorporate Python into TAM 2xx

- Python is the primary programming language in CS101
- Computation labs in Math 257 uses Python
- PrairieLearn has integrated Python workspace
- CS101 course resources are made available to TAM 2xx students as Python refreshers
- TAM 2xx will be involved in CS101 course redesign

**Invitation: how can TAM 2xx better serve your course?**







**Chrysafis Vogiatzis**  
**Industrial and Enterprise Systems**  
**Engineering**  
***Diverse delivery modes for flipped***  
***classrooms***



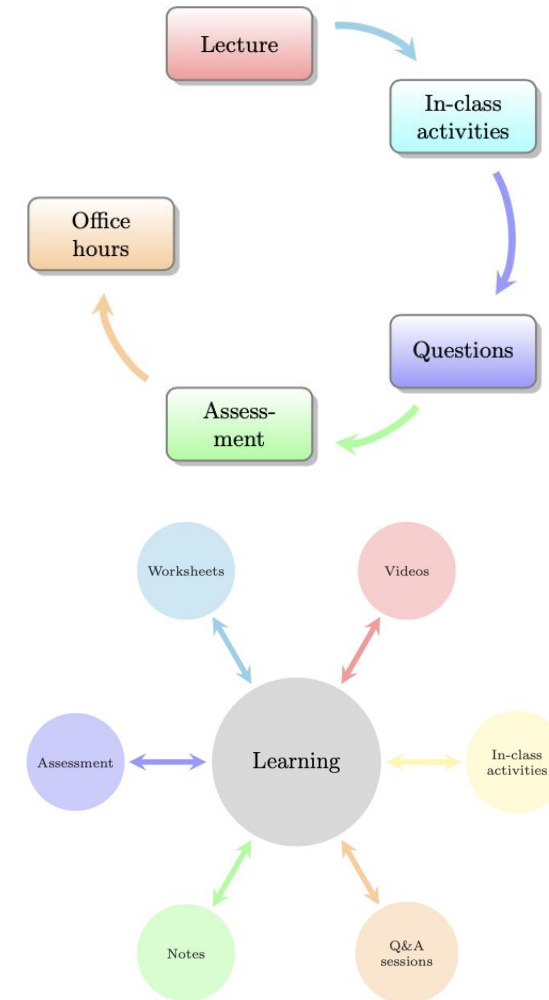
## Spring 2020 → Fall 2020

### Before the pandemic:

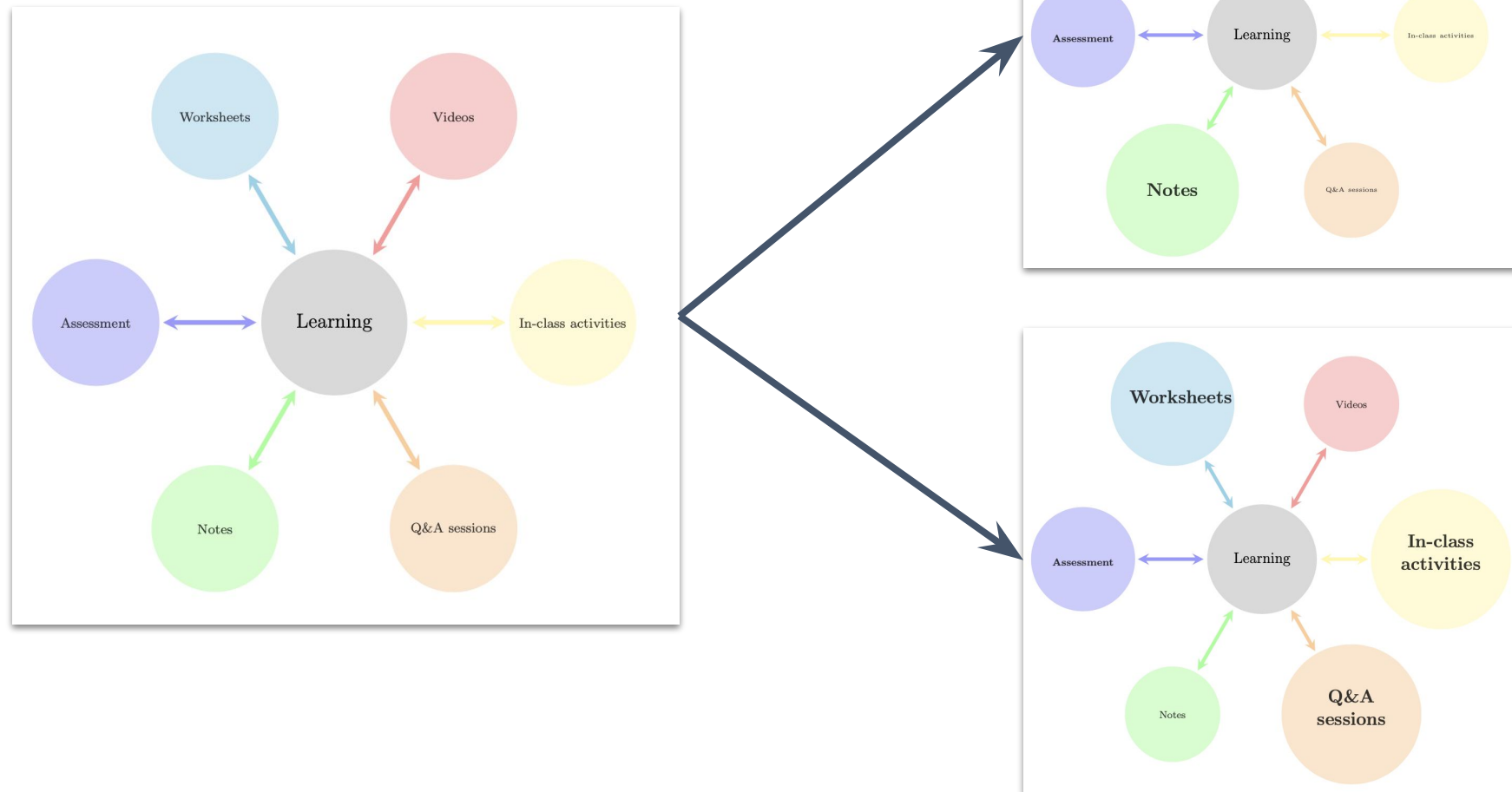
- almost sequential order of activities per topic.
- had bought into active learning; still the majority of time was spent *lecturing*.

### After the pandemic:

- total redesign of IE 300.
- flipped classroom; multiple “low-stake” assessments; group work during class; small duration pre- and post-lecture videos; extra Q&A sessions.
- **multiple modes of content delivery.**



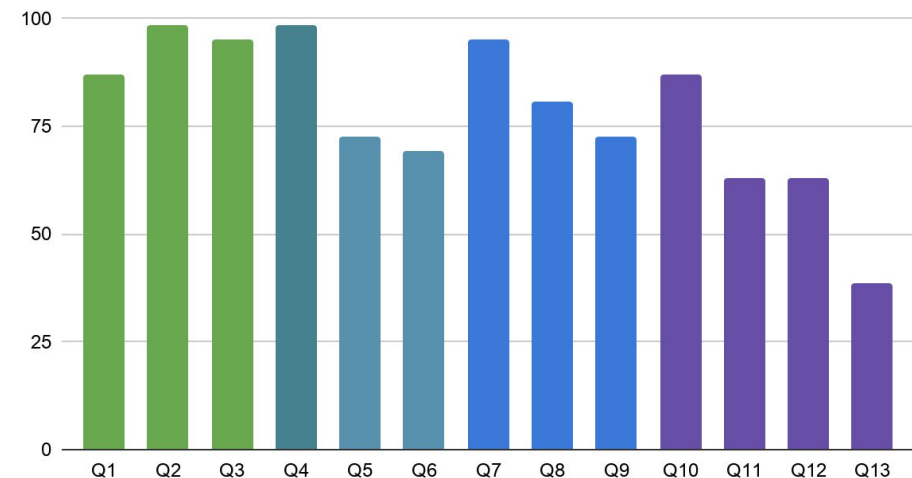
## Diverse modes

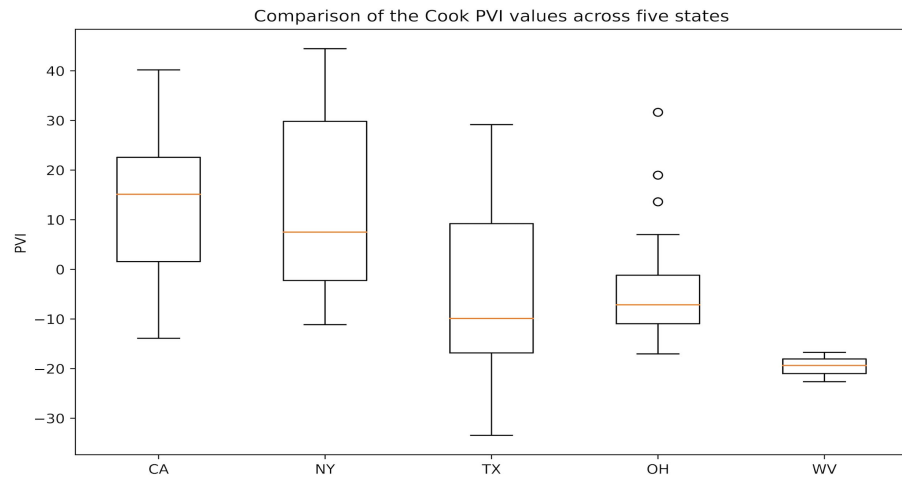


## Worksheets: process and feedback

- Students receive the worksheet an hour before class, and have to submit it after class.
  - Completed or not! Submission is worth points; correctness is not (at this point).
- The teaching assistants and myself correct the worksheets and collect information on “problem areas”.
- Allows for *personalized student feedback* (through gradescope).
- Also provides me with feedback!
  - For Q&A sessions; for office hours discussions; for Piazza posts; for extra activities.

Worksheet 9 percentage of correct answers



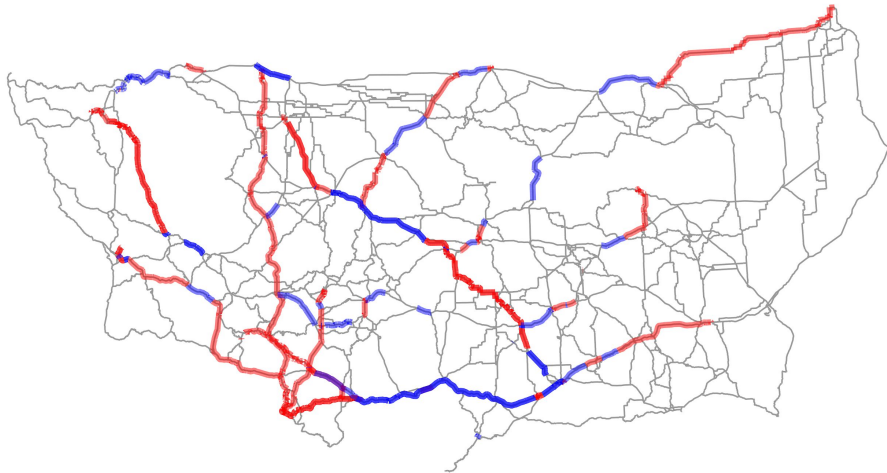


## Feedback + Questions

Based on the feedback provided to students, and based on the questions received by students (in office hours and on Piazza):

- We schedule more or fewer synchronous activities.
- We provide extra exercises/notes/post-lecture videos.
- We “synchronize” by doing extra Q&A sessions.

**We also assign just-in-time assignments!**





## Tools used

- Gradescope
- ClassTranscribe
- Piazza
- Compass
- gather.town

The screenshot displays a Zoom meeting interface. A chat window is open in the foreground, showing a conversation about a question. The chat messages are:

- From Eric Plante to Everyone: 11:31 AM  
I had a question on problem 11
- From Vollen Mathew Mammen to Everyone: 11:39 AM  
just did  
Sir, Q10  
yeah  
0.5  
simpler than we expected
- From Vollen Mathew Mammen to Everyone: 11:45 AM  
sure sir

The chat window also shows a "To: Everyone" dropdown and a "Type message here..." input field. In the background, a video grid shows several participants. A large red circle highlights a handwritten equation on a worksheet:

$$+ \frac{9}{6} = \frac{9}{3} \Rightarrow \frac{0.5}{3} = \frac{1}{6}$$

The worksheet is titled "LECTURE 9 WORKSHEET 5". The bottom of the screen shows a navigation bar with a "GRAINGER ENGINEERING" logo and a "78" page number.



**Abdu Alawini**  
**Computer Science**  
***Synchronous Group activities***  
***on Prairielearn***



# CS411 structure before the pandemic

- **Class meeting time:**
  - 80% lecture
  - 20% iClicker activities
- **Semester-long Group project**
- **Homework assignments**



- **Hard to lecture to a laptop monitor**
- **Students couldn't connect with their classmates**
- **A significant increase in the number of team communications issues reported**

**How can we build the support communities students had before the pandemic?**







Summer of 2020: Prof. Silva et al. led the development of collaborative assessments on Prairielearn

## Group work features:

- Students can create/join/leave teams
- Instructors can assign students to teams
- Students work collaboratively on assignments
- All team members receive the same grade

|          |   |
|----------|---|
| SQL-PRE1 | Introduction to the Relational Model                                |
| SQL-PRE2 | Basics of SQL   |
| SQL-PRE3 | Advanced SQL: Multi-Relation (JOIN) Queries                         |
| SQL-PRE4 | Advanced SQL: Subqueries and Set Operations                         |
| SQL-PRE5 | Advanced SQL: Grouping, Aggregation and Views                       |
| SQL-PRE6 | Advanced SQL: Database Updates and Stored Procedures                |
| SQL-PRE7 | Advanced SQL: Constraints and Triggers                              |
| SQL:GA1  | Group Activity 1: Basics of SQL 👤                                   |
| SQL:GA2  | Group Activity 2: Multi-Relation (JOIN) Queries 👤                   |
| SQL:GA3  | Group Activity 3: Subqueries and Set Operations 👤                   |
| SQL:GA4  | Group Activity 4: Advanced SQL Queries (Aggregation and Grouping) 👤 |
| SQL:GA5  | Group Activity 5: Updates and Stored Procedures 👤                   |
| SQL:GA6  | Group Activity 6: Constraints and Triggers 👤                        |

Access

Downloads

Files

Groups

Questions

Question stats

Regrading

Settings

Statistics

Students

Uploads

CLDBD :GA14: Groups

+ Add a group

X Delete all groups

Upload

Upload a CSV file with group assignments.

Auto

Automatically assign students to groups.

Copy

Copy the group assignments from another assessment.

| Name      | Size | Group Members (UIDs) |          |
|-----------|------|----------------------|----------|
| sqlphobia | 4    | <div></div>          | Action ▾ |
| T50       | 4    |                      | Action ▾ |
| Sanctuary | 4    |                      | Action ▾ |
| one       | 4    |                      | Action ▾ |
| team103   | 3    |                      | Action ▾ |
| fish411   | 4    |                      | Action ▾ |
| team87    | 3    |                      | Action ▾ |

# Synchronous Group Activities on Prairielearn



## Before Class

- Students watch a pre-lecture video (20-30 minutes)
- Take a 5-minute quiz
- Can ask questions on Campuswire



## During Class

- *First 45 minutes*
  - Work with a team of 4 on exercises related to the pre-lecture
- *Last 30 minutes*
  - Instructor solve problems related to the group activity, and
  - Answer students' questions

## Synchronous Sessions

- Attendance required
- Two Zoom meeting to have enough breakout rooms for 400+ students
- Queue@illinois for managing help requests
- CAs + TAs help with managing the session and answering questions

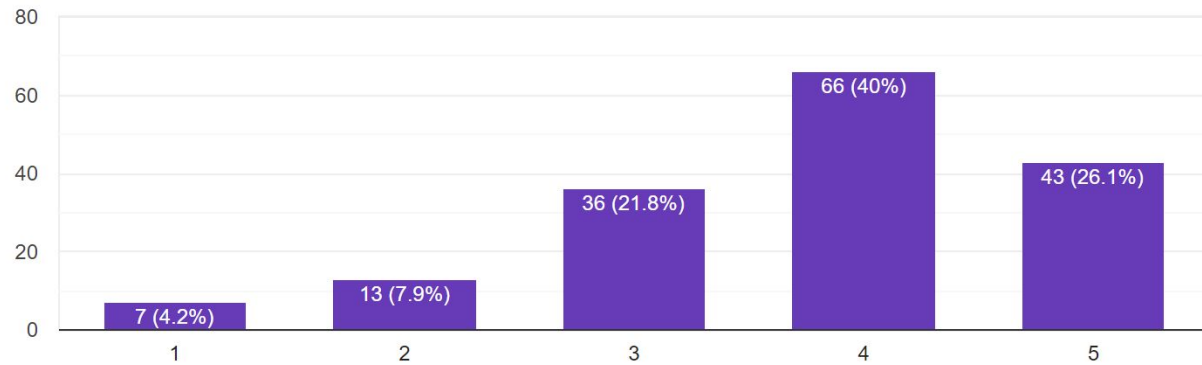
# Promising Early Feedback



## Spring 2019

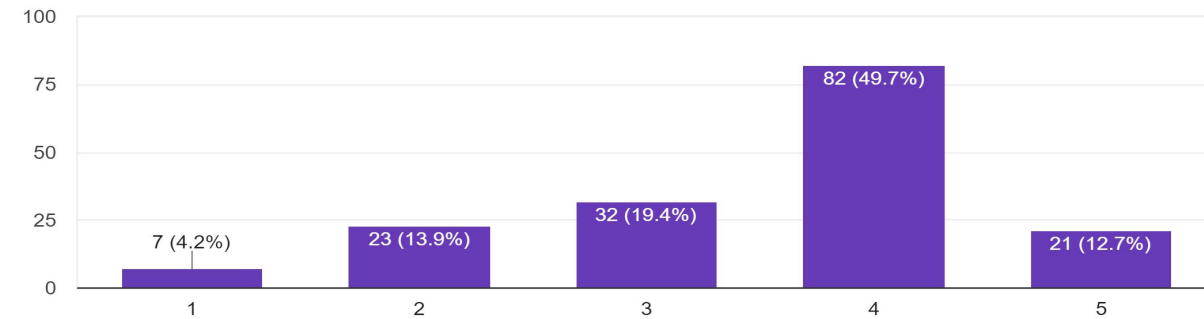
In-class iClicker questions and discussion have helped me learn?

165 responses



How well do you understand advanced SQL queries (i.e., JOINS, Subqueries, Grouping and Aggregation) ?

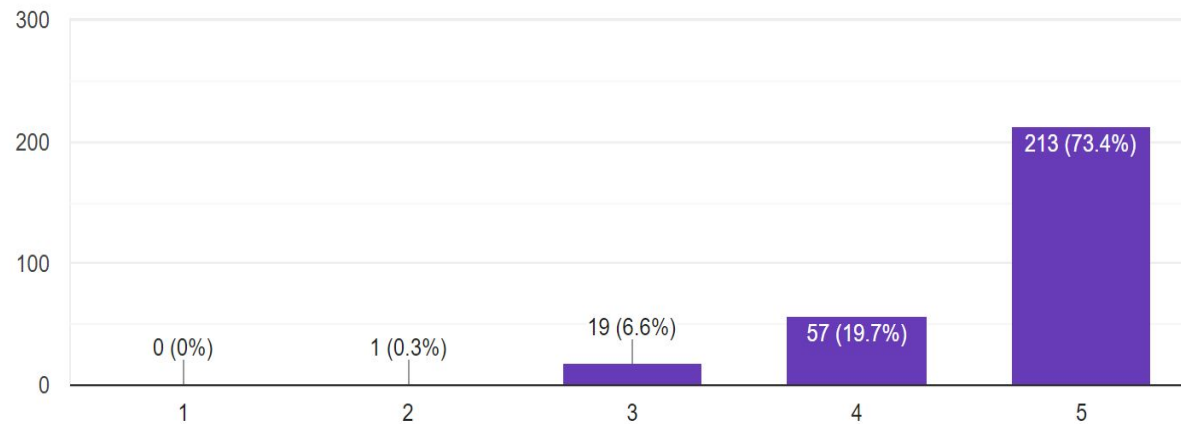
165 responses



## Spring 2021

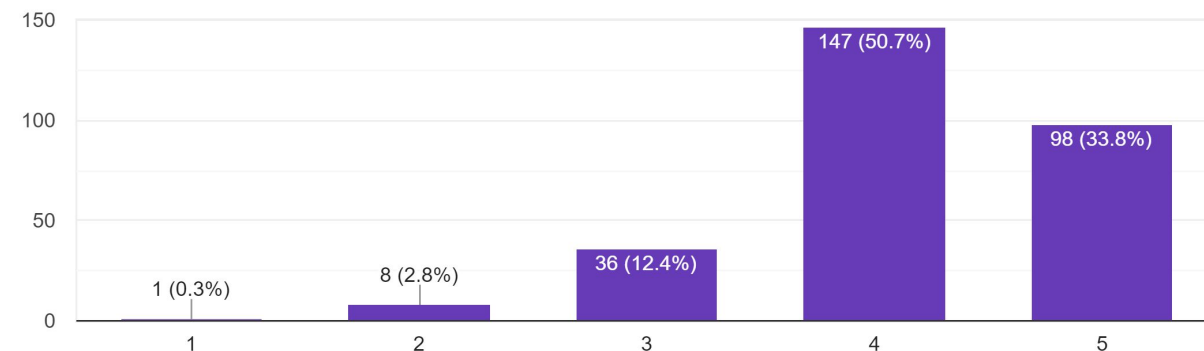
Group Activities have increased my understanding of course concepts.

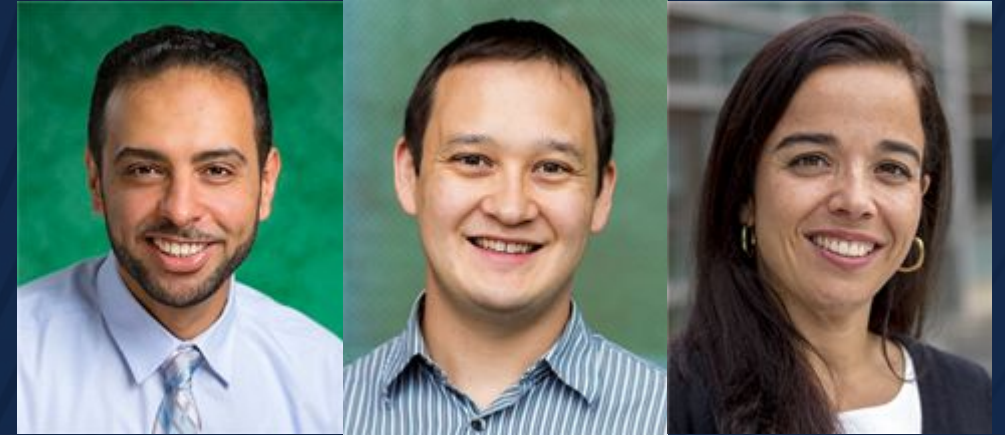
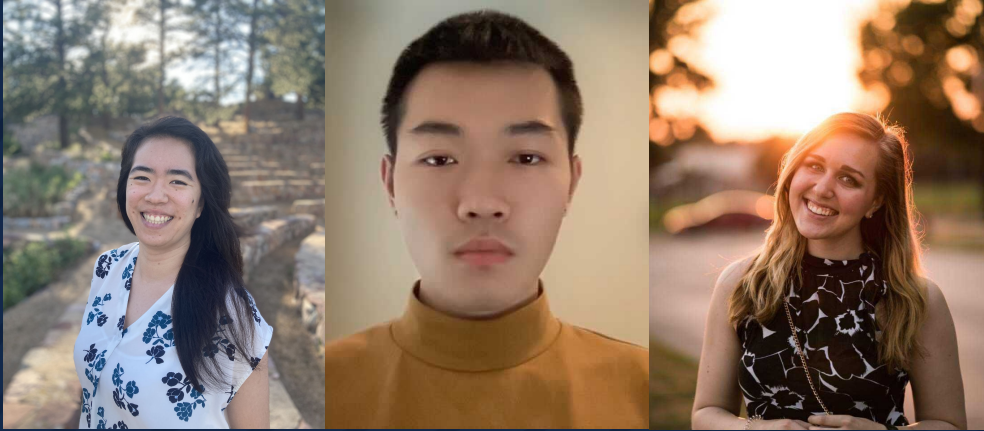
290 responses



How well do you understand advanced SQL queries (i.e., JOINS, Subqueries, Grouping and Aggregation) ?

290 responses



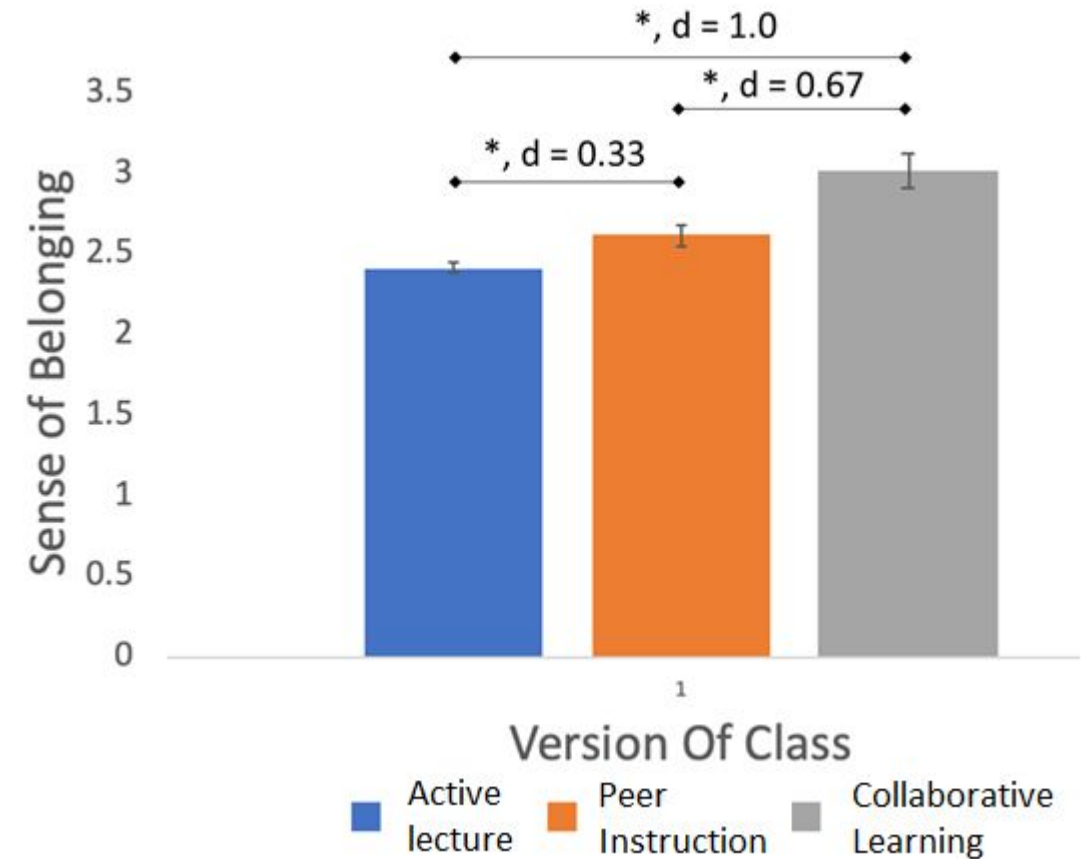
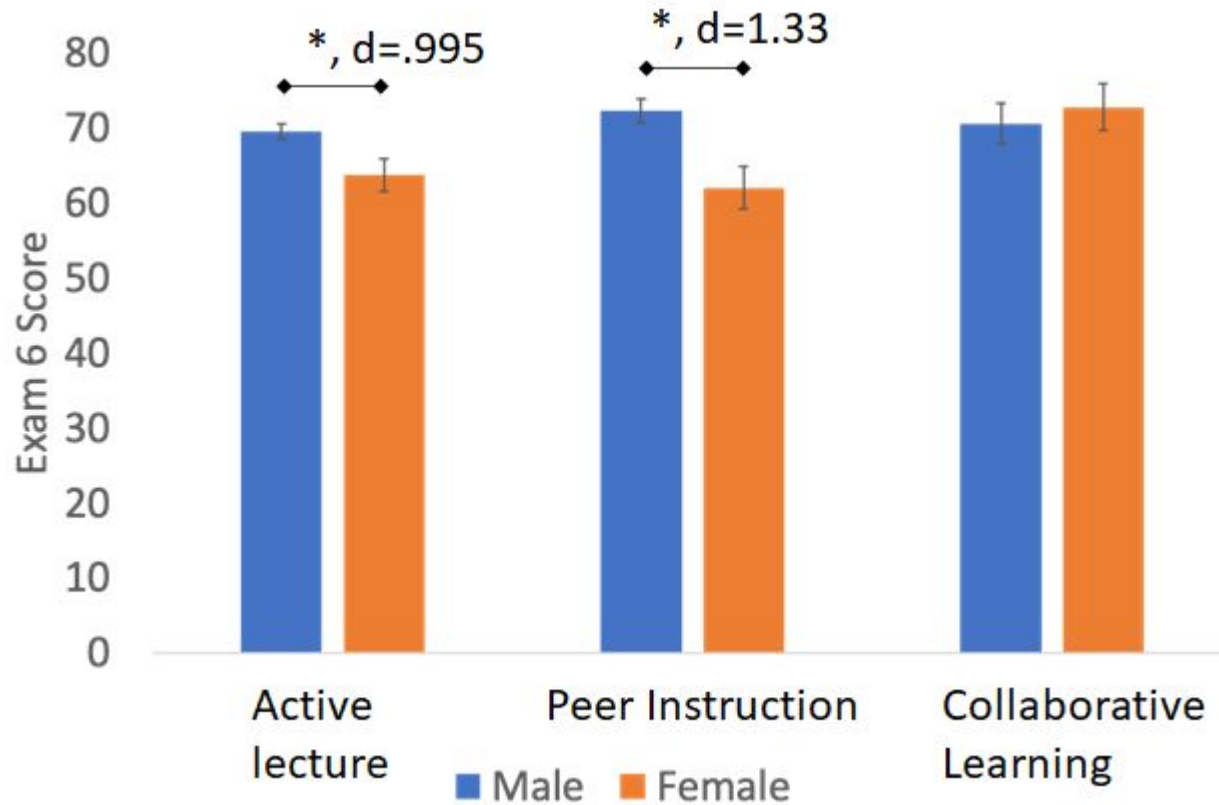


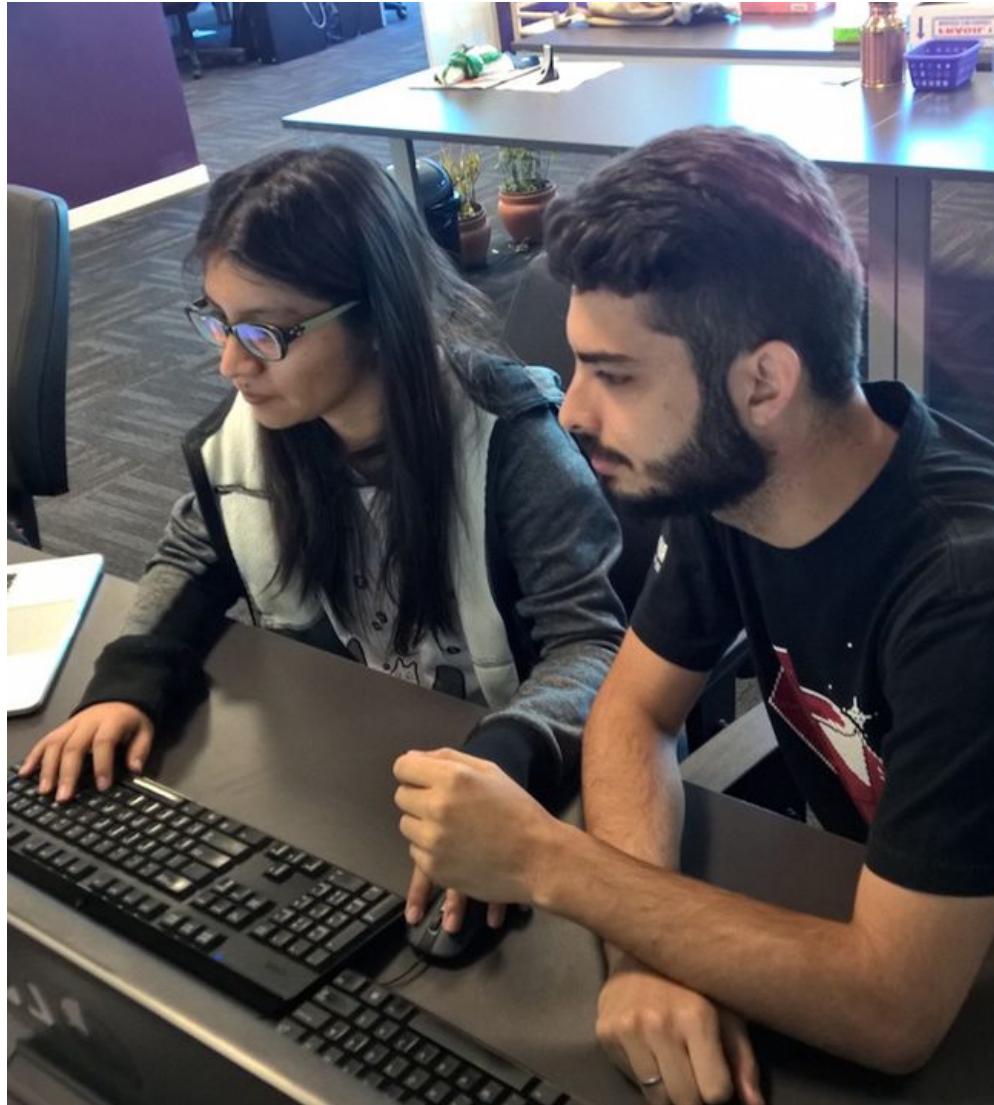
# Geoffrey Herman

## Computer Science

### *Group activities with assigned roles*





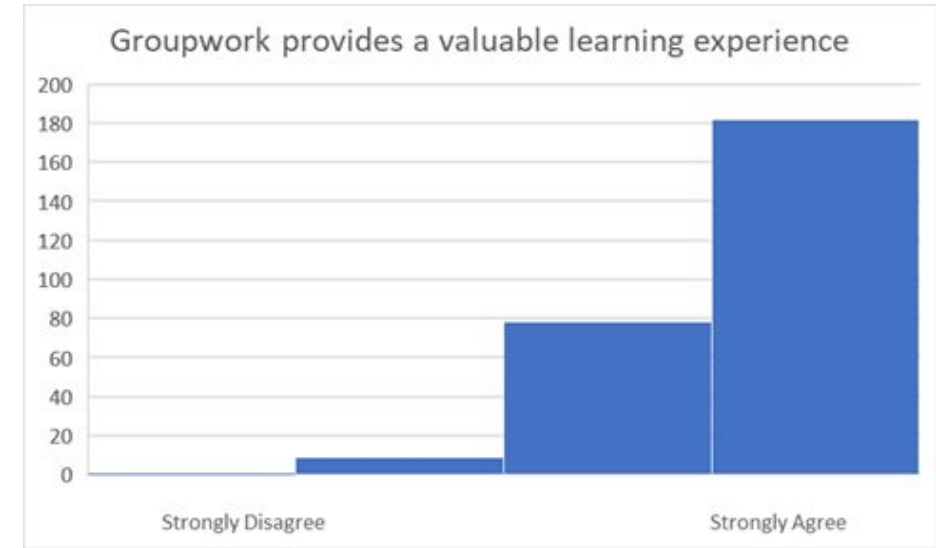
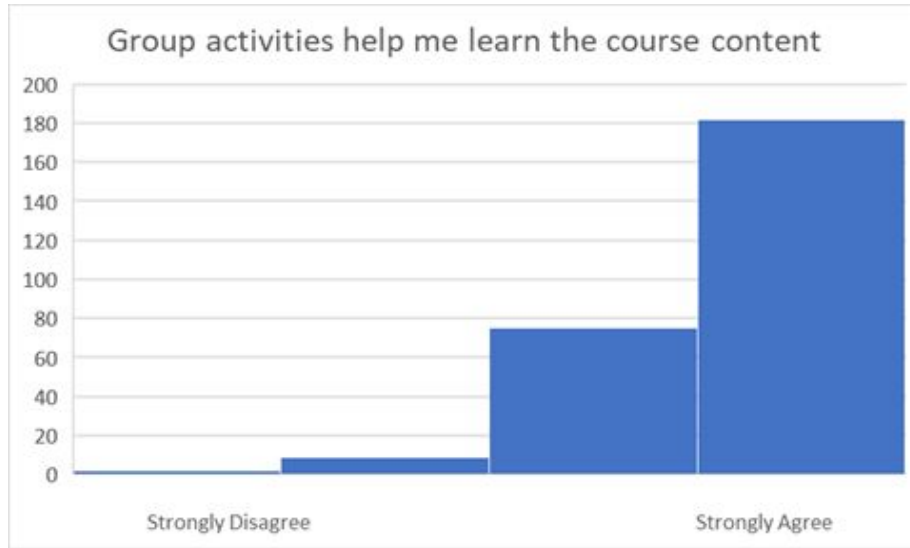


**Manager:** Keep team on task

**Recorder:** Enter answers, share screen

**Reflector:** Make sure everyone is keeping up

# Positive reception so far



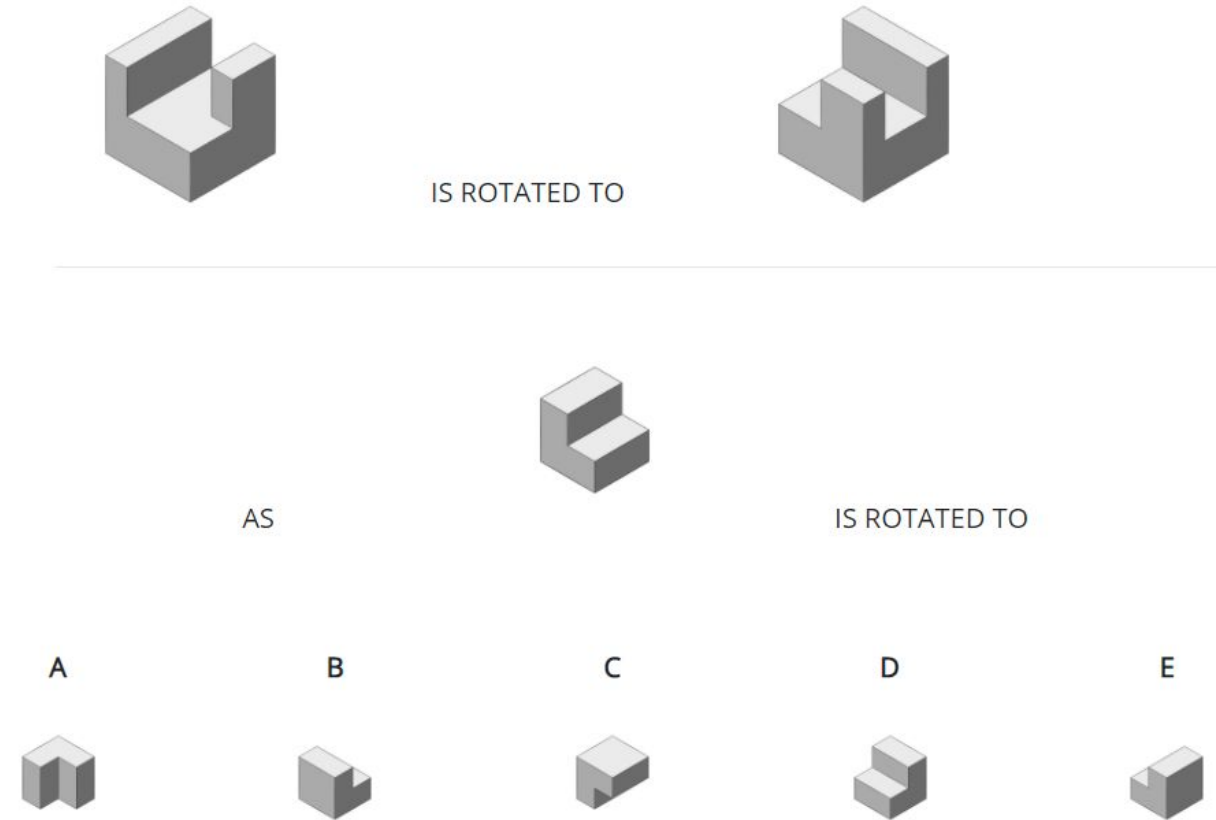
Groups are taking 15-30 minutes less on each assessment than last semester



**Brian Woodard**  
**Aerospace Engineering**  
***Virtual Visualization Training***



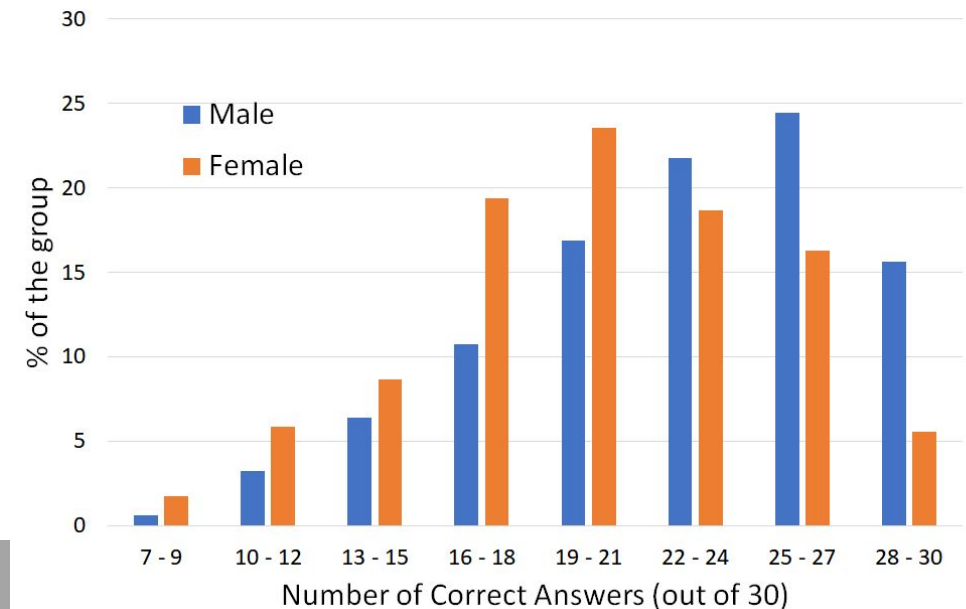
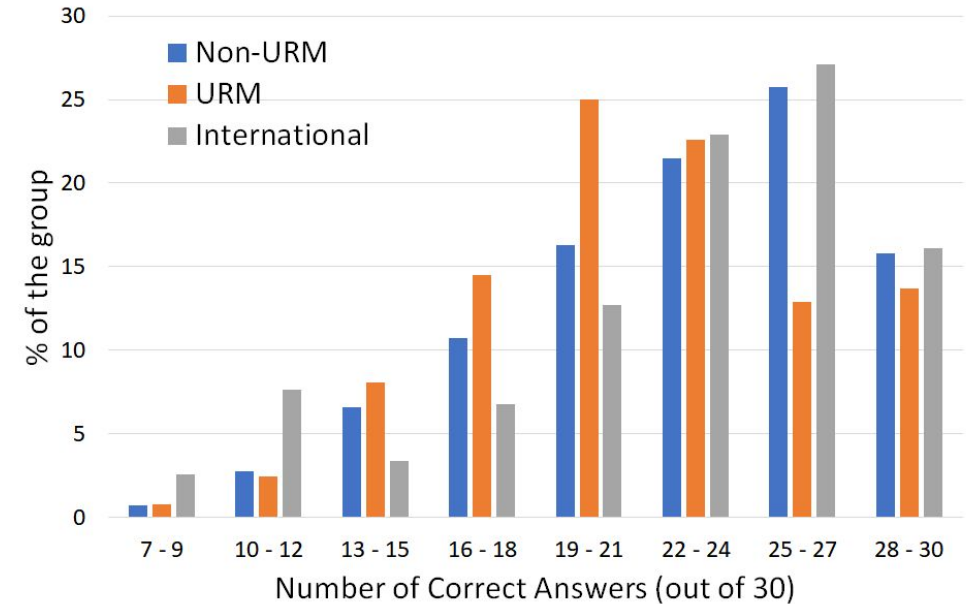
- Spatial skills are one of the strongest predictors of future success in STEM coursework and STEM careers (Shea et al. & Wai et al.)
- Visuospatial skills are malleable, and individuals may need different methods to practice and improve their skills (Sorby et al.)



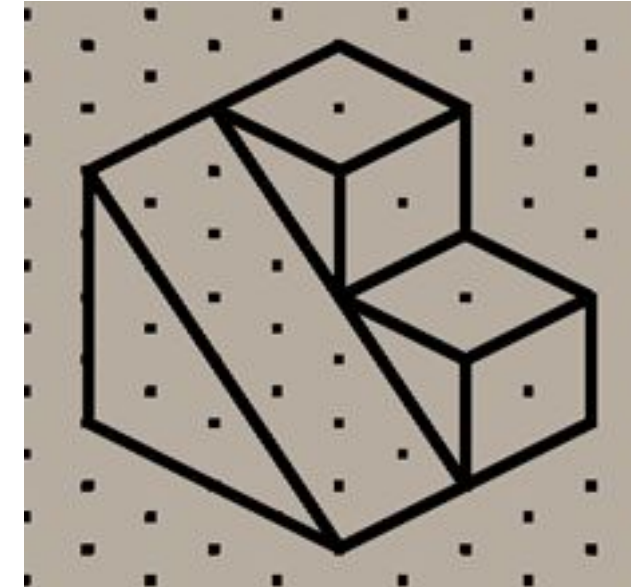
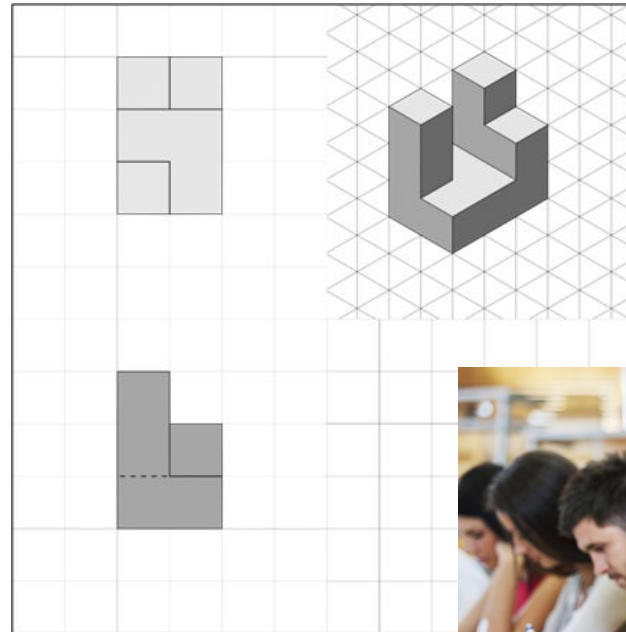
# Spatial Skills Among Students



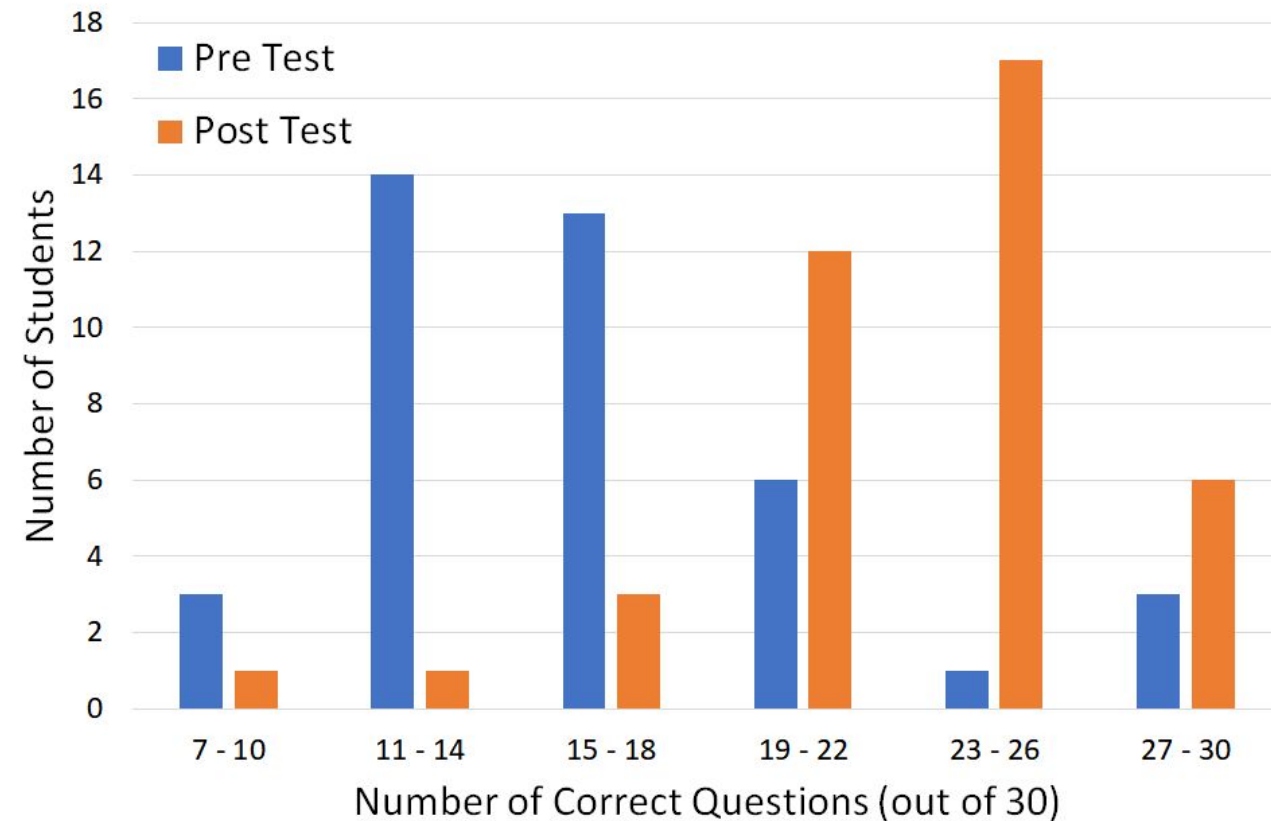
- Visualization skills, especially mental rotation skills, of female students are well documented to lag behind those of their male counterparts (Linn et al. & Voyer et al.)
- A standard test of mental rotation skills was given to ~1000 of our Grainger freshmen in spring/summer 2020
- Timed test scored out of a maximum of 30



- SIIP Team has been working to develop training for spatial skills
- Training traditionally includes:
  - Multiple choice questions
  - Online sketching
  - **Hand sketching**
- SIIP Team
  - Molly Goldstein, Mike Philpott
  - Tiffany Li, Ziang Xiao
  - Kirk Leck, Krishna Modi



- SIIP team taught an Eng. 177 course in Fall 2020 to teach spatial visualization skills . . .  
**virtually**
- Students with lower visualization skills were recommended to take our class
- **No hand sketching was utilized**
- **Alternative, Zoom-based activities were developed for the course**
- Students given assessment again at the end of the semester
- **The training can still work!!!**







# Katie Ansell

## Physics

*Proximity, proxies, praxis in labs*



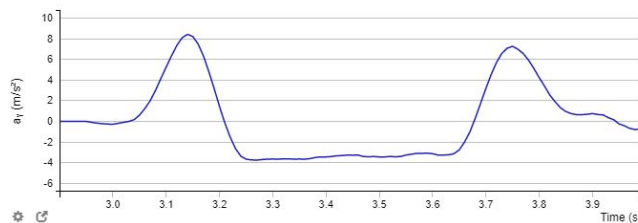


Our model for collaboration in introductory Physics labs relies on physical proximity

**I** ILLINOIS  
Physics



Wheel - Acceleration (100 Hz)



## Remote collaboration challenges:

- Integrating many pieces of technology
- Limited visual channels
- Varied levels of technology familiarity and access
- Increased potential for toxic group situations

**For success in remote instruction, we needed to be deliberate about training and group dynamics**

## Train everyone before lab starts.

Instructor team:  
Synchronous

Students:  
Asynchronous



## Name and address group dynamics

**Group roles**  
(PI/Skeptic/Analyst)

**Group contracts**  
Ground rules,  
remediation



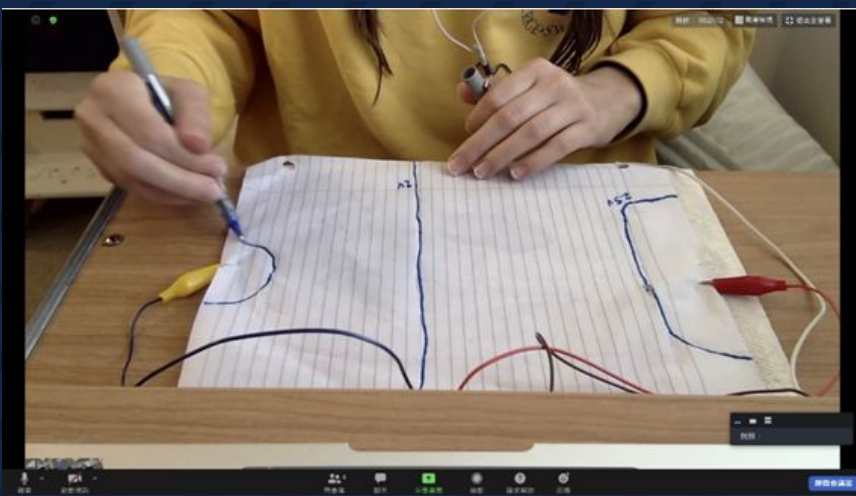
## Use first lab meeting to put it together

Lab 0: No experiment

Practice being on Zoom, Teams

Assignment: Write a group contract





## These structures establish and communicate our values:

Training:

**It takes time to learn how to do new things, and we want our instructors and students to be prepared to succeed in the lab**

Group dynamics:

**All group members should feel agency, investment, and responsibility for the group as a whole**

Because we hold these values for in-person instruction too, we will be keeping these structures in the post-pandemic future

## Question & Answer Session

**Chris Schmitz**, *discussant*  
Teaching Associate Professor, ECE  
Chief Advisor  
Education Innovation Fellow (EIF)





**Thank you for attending today's lightning symposium.**

**If you have any questions, we encourage you to reach out to individual presenters directly, or you can contact:**

**Jay Mann, Director**

**AE3**

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Thank you for all you do for your students and for Grainger Engineering!



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