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**FCTL**



## “Active Learning and other High Impact Strategies for a Large Gateway Engineering Course”



Karen L. Smith Faculty Center for Teaching and Learning

**Ricardo Zaurin, PhD, PE**

*Civil, Environmental, and Construction Engineering Department.  
University of Central Florida*



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**THE LECTURE IS DEAD,  
LONG LIVE THE LECTURE!**



The phrase "The king is dead, long live the king!" was first declared upon the accession to the French throne of Charles VII of France.



Is It  
Really  
Dead?



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One solution?

**Active Learning**

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2019 ASEE Southeastern Section Conference

Investigating the Impact on Students' Engagement, Perception, and Success of Several Active Learning Strategies for a Large Gateway Engineering Course: Statics.

Ricardo Zaurin

## Active Learning Incorporated to Statics

### How?

- Class Discussions/Socratic Lecturing
- Open ended questions/Brainstorming
- Class Activities (group quizzes)
- Humor-Video Games
- Class Demonstrations
- Project Based Homework (PBH)
- Experiential Learning (IDEAS)

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## Socratic Lecturing and Class Discussions (Clickers)

Which one of the following is a scalar

- 1) Force
- 2) Weight
- 3) Velocity
- 4) Position
- 5) IHNI



Turn to your side and debate with your partner about the possible answers and select 1



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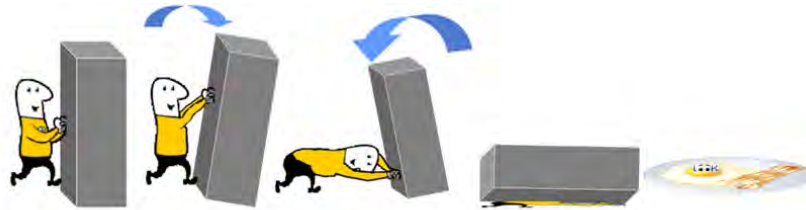
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### Interactive Animated Presentations



What do you remember about **MOMENT**?



MOMENT OF A FORCE - SCALAR FORMULATION



"Give me a lever long enough, and a place to stand, and I can move the earth."  
Archimedes, 287 to 212 BC.

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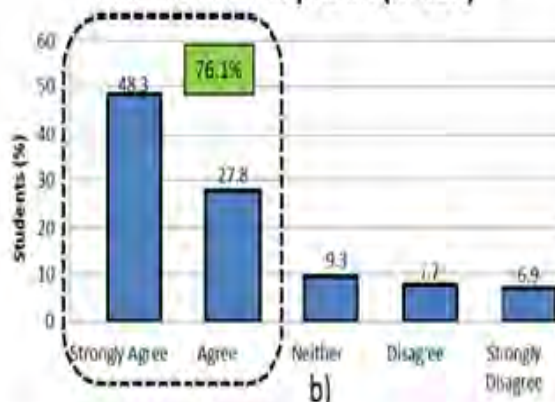
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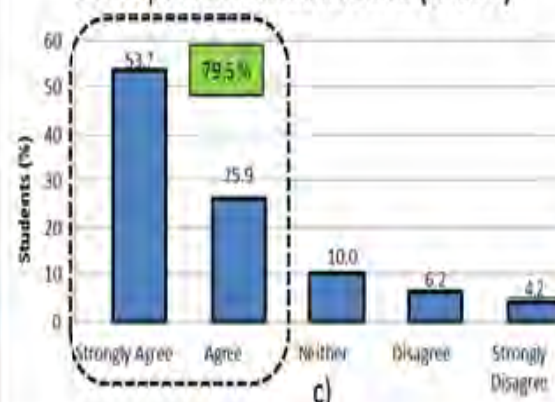


### Socratic Lecturing and Class Discussions (Clickers)

Increased my Interest, Engagement, and Class Participation (n=259)



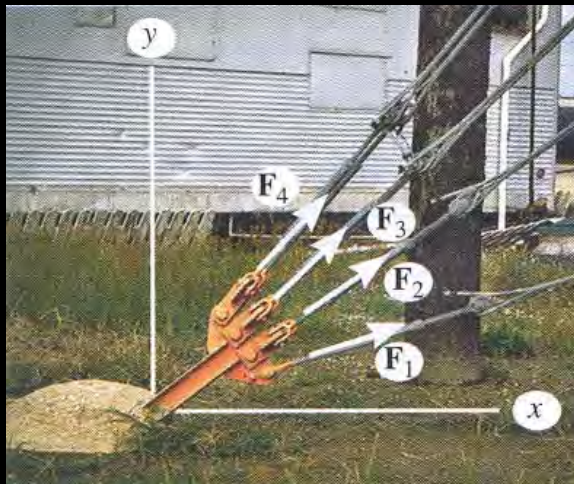
Helped me to Better Understand the Concepts Presented in Class (n=259)



# BRAINSTORMING



## APPLICATION OF VECTOR ADDITION



There are four concurrent cable forces acting on the bracket.

How do you determine the resultant force acting on the bracket ?

In your opinion... Which one is the most important of all the components?

## EGN-3310 Grading Policy



- Class Activities:
  - UNANNOUNCED
  - IN-CLASS
  - AT ANY TIME (Beginning/End)
  - 5 min-8 min

.....A tool used to measure attention and acquired knowledge...



# What is a Class Activity?



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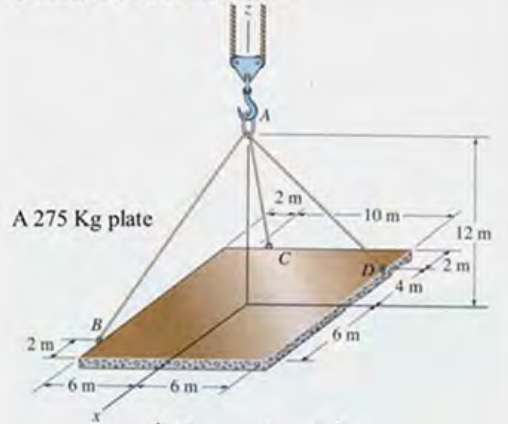
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## Graded unannounced group class activities (group quizzes)

Tension in each of the cables?

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## Graded unannounced group class activities (group quizzes)

Converted in Hands-on HW



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# Hand-Clickers and In-Class Activities

- **Class Attendance**
- **Focus:** Students must keep focus during the lecture; otherwise they might not be successful in completing the activity.
- **Ask Questions:** Students must ask questions if they don't understand the material to be sure they can do the class activity.
- **Group work and brainstorming:** Students must brainstorm, discuss, reach consensus, and solve the assigned activity.

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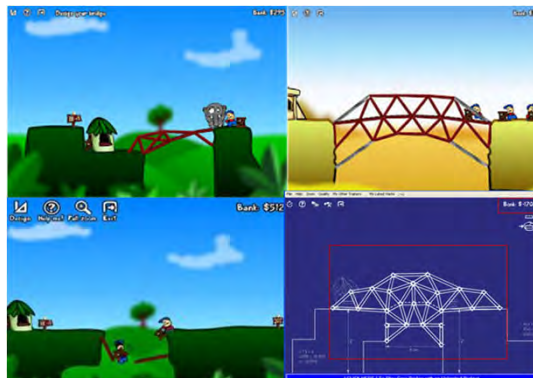
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# Humor and Games



- Introduce Principles and Implement Professional Tools to solve Real-Life Scenarios

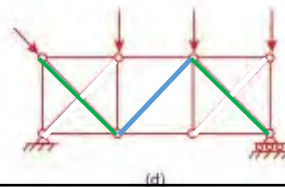
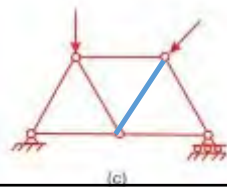
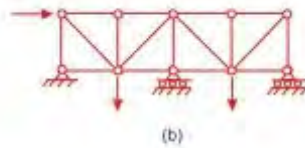
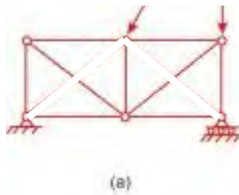


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# Humor and Games



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Materia Widget Catalog



Statics and Vectors Review Questions First Exam

24 remaining

GENERAL	1	2	3	4	5	6
VECTORS	1	2	3	4	5	6
PARTICLE EQUILIBRIUM	1	2	3	4	5	6
RIGID BODY EQUILIBRIUM	1	2	3	4	5	6

QUESTION IN "GENERAL"

Engineering Analysis Statics, among other, studies

- ☐ Any object with CONSTANT (positive or negative) acceleration
- ☐ All of the options are correct
- ☐ Objects moving at a constant speed
- ☐ Deformation in bodies
- ☐ Only bodies at rest

RETURN

SUBMIT FINAL ANSWER



Week Oct 02	...	0s
Week Oct 02	...	1s
Week Oct 02	...	0s
Week Oct 02	...	0s
Week Oct 02	...	1m 51s
Week Oct 02	...	4m 24s
Week Oct 02	...	20s
Week Oct 02	...	1s
Week Oct 02	...	10s
Week Oct 02	...	1s
Week Oct 02	...	4m 1s
Week Oct 02	...	7m 23s
Week Oct 02	...	0s
Week Oct 02	...	3m 2s
Week Oct 02	...	4m 8s
Week Oct 02	...	23s
Week Oct 02	...	0s
Week Oct 02	...	27m 1s
Week Oct 02	...	11s
Week Oct 02	...	20s
Week Oct 02	...	12m
Week Oct 02	...	4m
Week Oct 02	...	10m
Week Oct 02	...	10m
Week Oct 02	...	20m



## Find the Error(s)

Intentional mistakes mimicking  
most common students' errors  
in exams

Diagram illustrating a 3D coordinate system (x, y, z) with a force vector  $\vec{F}_A$  acting at point A. The position vector  $\vec{r}_{OA}$  is shown. The force vector  $\vec{F}_A$  is defined as:

$$\vec{F}_A = 7.77i - 5.83j - 17.5k$$

The position vector  $\vec{r}_{OA}$  is defined as:

$$\vec{r}_{OA} = 0i + 0j + 10.5k$$

The moment vector  $\vec{M}_O$  is calculated using the cross product:

$$\vec{M}_O = \begin{vmatrix} i & j & k \\ 7.77 & -5.83 & -17.5 \\ 0 & 0 & 10.5 \end{vmatrix}$$

The resulting moment vector is:

$$\vec{M}_O = (-61.2i - 81.6j) \text{ N.m}$$

The calculation is also shown as:

$$\vec{M}_O = i(-5.83 * 10.5) - j(7.77 * 10.5)$$

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- Collaborative Project Based Homework (PBH)



Paper ID #25095

### Learning by Doing: Collaborative Active Learning Hands-On Project-Based Homework for a Large Gateway Engineering Class

Dr. Ricardo Zaurin P.E., University of Central Florida



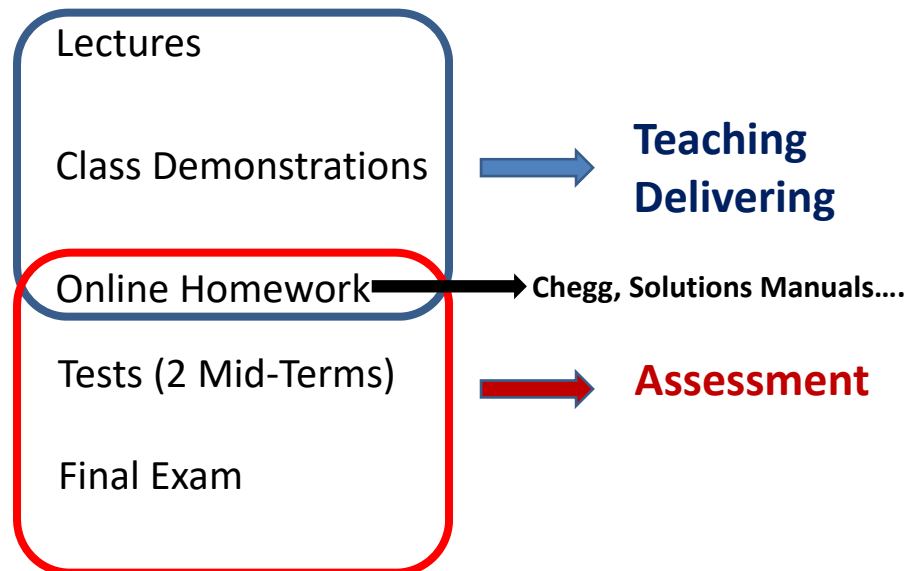
Learning by Doing: Collaborative Active Learning Hands-On Project-Based Homework for a Large Gateway Engineering Class

*"Tell me and I will forget,  
teach me and I will remember,  
involve me and I will learn"*

Attributed to Benjamin Franklin and...

Aristotle; Confucius; Native American proverb; Chinese proverb; Voltaire; Association For Experiential Education

## How is the typical the Teaching & Assessment for this class?



## Extra Credit Mini-Projects

- One Problem is Assigned as regular Homework to all the Students
- Same Problem is also offered as Additional Extra-Credit where the students Model it, compare results with hand-calculations and
- Make a Video of themselves explaining the problem and conclusions.



# Modeling

**Announcements**

EXTRA CREDIT(1) for HW2

EXTRA CREDIT(1) for HW2

Hello All,

You have the opportunity of one extra-credit mini-project for the Homework grade. This is what is asked for your extra credit:

- 1) Create a physical model of the problem 3.14 of your HW 2 (Check Mastering engineering)
- 2) Read the values from your physical measurements.
- 3) Solve theoretically (with your experimental measurements)
- 4) Compare the results
- 5) Make a small video clip of you explaining your model and results and submit it via wecourses on or before Thursday 21st (11:59 pm).
- 6) Also submit the problem solved showing also the measurements from your model (a small report including pictures)

This is a group activity (2 students per group or you can do it by yourself)

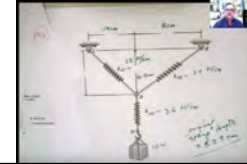
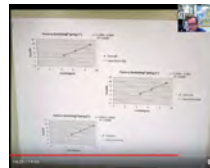
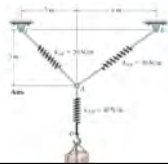
You will get up to 30 points added to your HW 2 (Depending on your work)

I just posted a video of me explaining my model. you can see it in Youtube (STATICS THE EASY WAY)

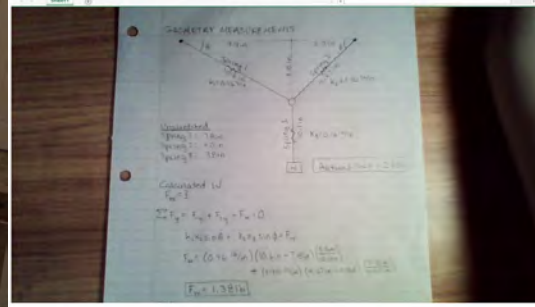
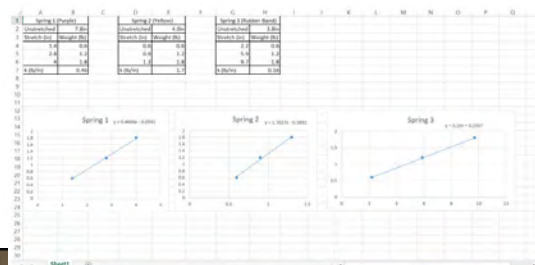
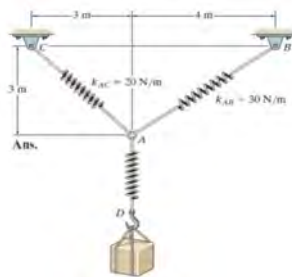
Good Luck,

Dr. Zaurin

<https://www.youtube.com/watch?v=gD8b4Omy8B8>



## Mini Projects Equilibrium and Springs



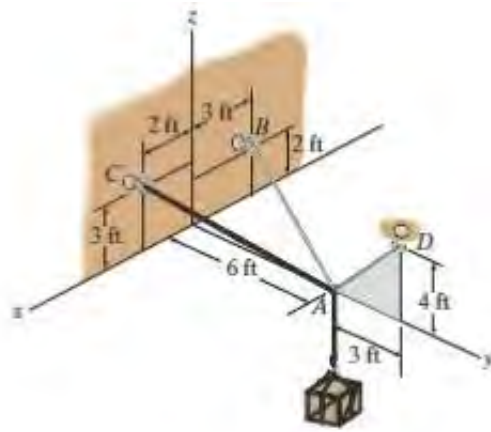
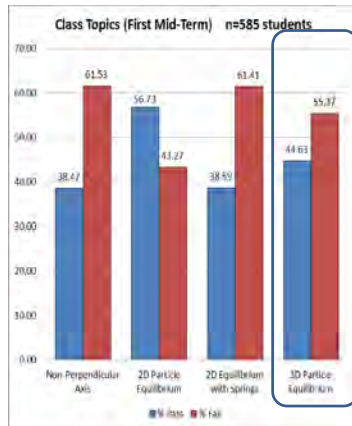


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### 3D Particle Equilibrium

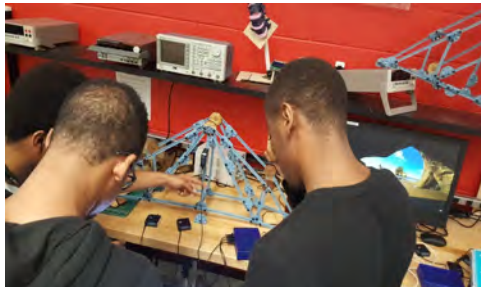


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### Trusses



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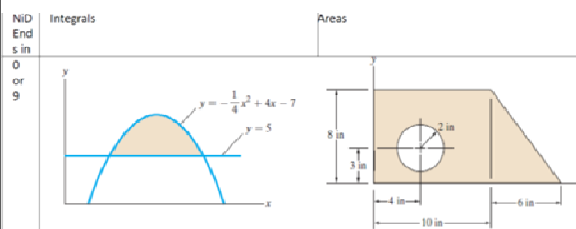


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## Centroid



Handwritten calculations for the centroid of a composite shape.

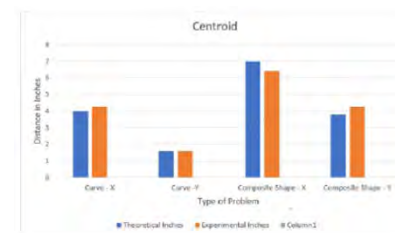
$$\bar{x} = \frac{\sum x_i A_i}{\sum A_i}$$

$$\bar{y} = \frac{\sum y_i A_i}{\sum A_i}$$


Figure	$x$ (in)	$y$ (in)	$A$ (in <sup>2</sup> )	$x A$ (in <sup>3</sup> )	$y A$ (in <sup>3</sup> )
1	4	3	12	48	36
2	12	3	3.14	37.68	9.42
3	10	8	24	240	192
<b>Total</b>			<b>39.14</b>	<b>325.68</b>	<b>237.62</b>


Centroid:

$$\bar{x} = \frac{325.68}{39.14} = 8.32 \text{ in}$$

$$\bar{y} = \frac{237.62}{39.14} = 6.07 \text{ in}$$



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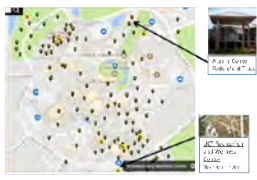


## Scavenger Hunt

### Trussemon



EXAMPLE (You can add a second page)




Look Around Campus and Catch All Trusses you Can... Snap a Picture, Put the Location on Campus Map, and Describe and Name the type of Truss if Possible. Submit a Pdf Document Showing the Truss, Description and Location on the Map. Also, Some students suggested adding a video (adding).

**YOU CAN NOT DO IT FROM YOUR VEHICLE!!!!!! STRICTLY PROHIBITED!!!!!!**

The first 10 Students with the biggest amount of trusses will earn 3 extra-credit points in the second mid-term...

**Gotta catch 'em all!**

### Supports Hunt







Look Around Engr1 and 2 Buildings and Hunt All Supports you Can... Snap a Picture, Make a list and indicate the type of reactions and How Many?


Submit a Pdf Document Showing the list of supports with the pictures, where it is, and number/type of reactions.


The 10 students with the most amount of supports/descriptions will get 3 points in their second mid-term exam.

Do not repeat the same exact one if there are several of the same (You can have several hinges, but only one door hinge)


1		Fixed Support Fx, Fy, Fz, Mx, My, Mz	Engr2 Atrium
2		Roller Support Fy, Fz, Mx, My, Mz	Engr2 Atrium
3		Pin Support Fx, Fy, Fz, Mx, My, Mz	Engr2 Atrium
4		Roller Support Fy, Fz, Mx, My, Mz	Engr2 Atrium

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- Semester Long Experiential Learning Project (IDEAS Showcase)*

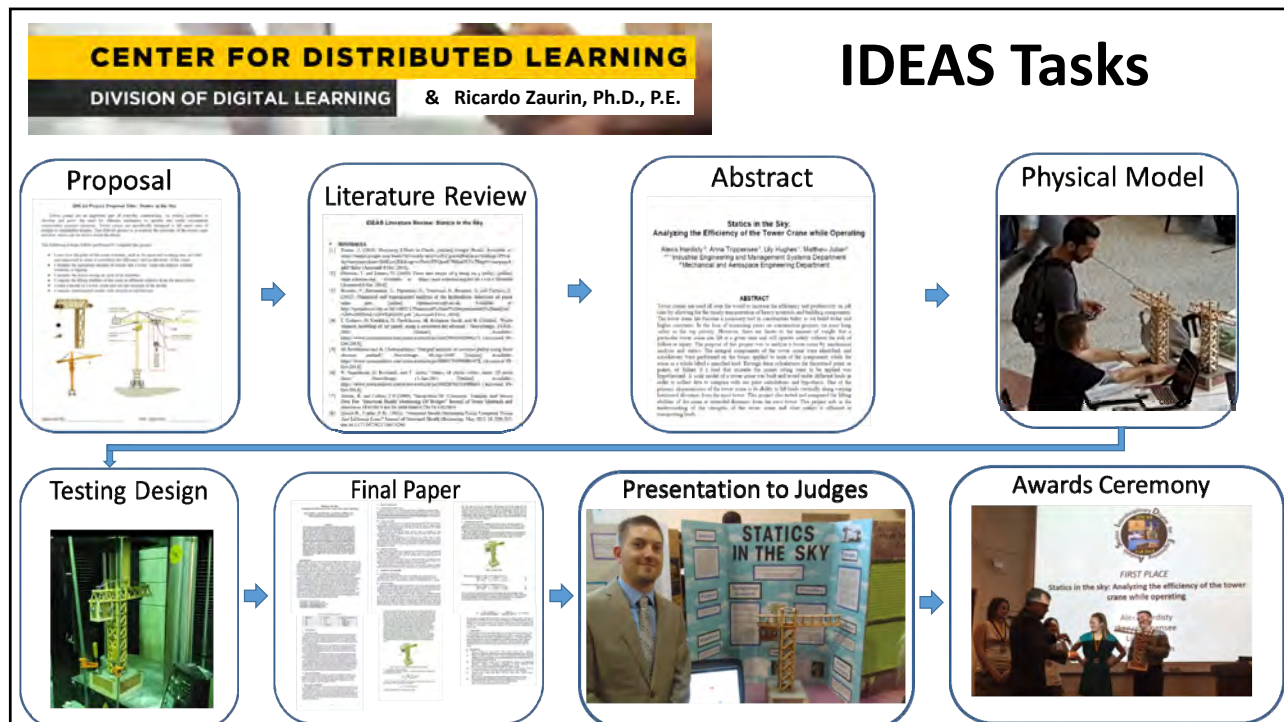


2018 ASEE ANNUAL CONFERENCE & EXPOSITION

Paper ID #21771

## Preparing the Engineering Student for Success with IDEAS: A Second Year Experiential Learning Activity for Large-size Classes

Dr. Ricardo Zaurin P.E., University of Central Florida



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## IDEAS Showcase

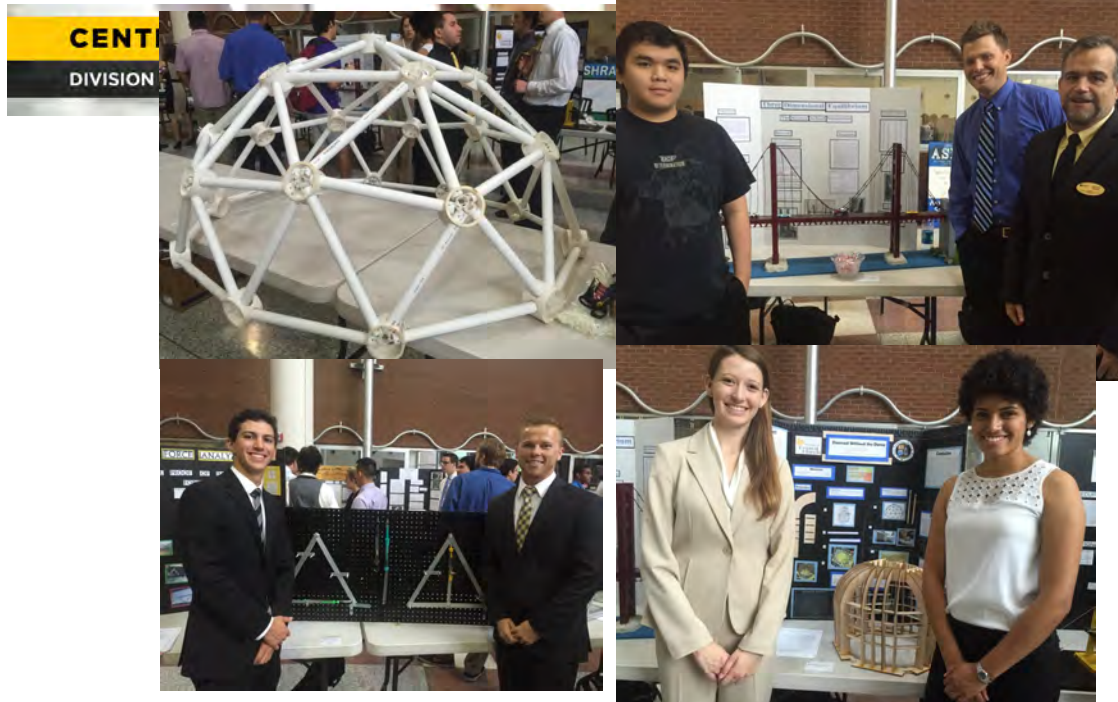
The IDEAS Showcase collage features a central image of a large crowd at an event, surrounded by smaller photos of students and faculty members. To the left of the collage is a circular logo for the "Interdisciplinary Display for Engineering Analysis Statics IDEAS Fall-2013". Below the collage is a list of tasks:

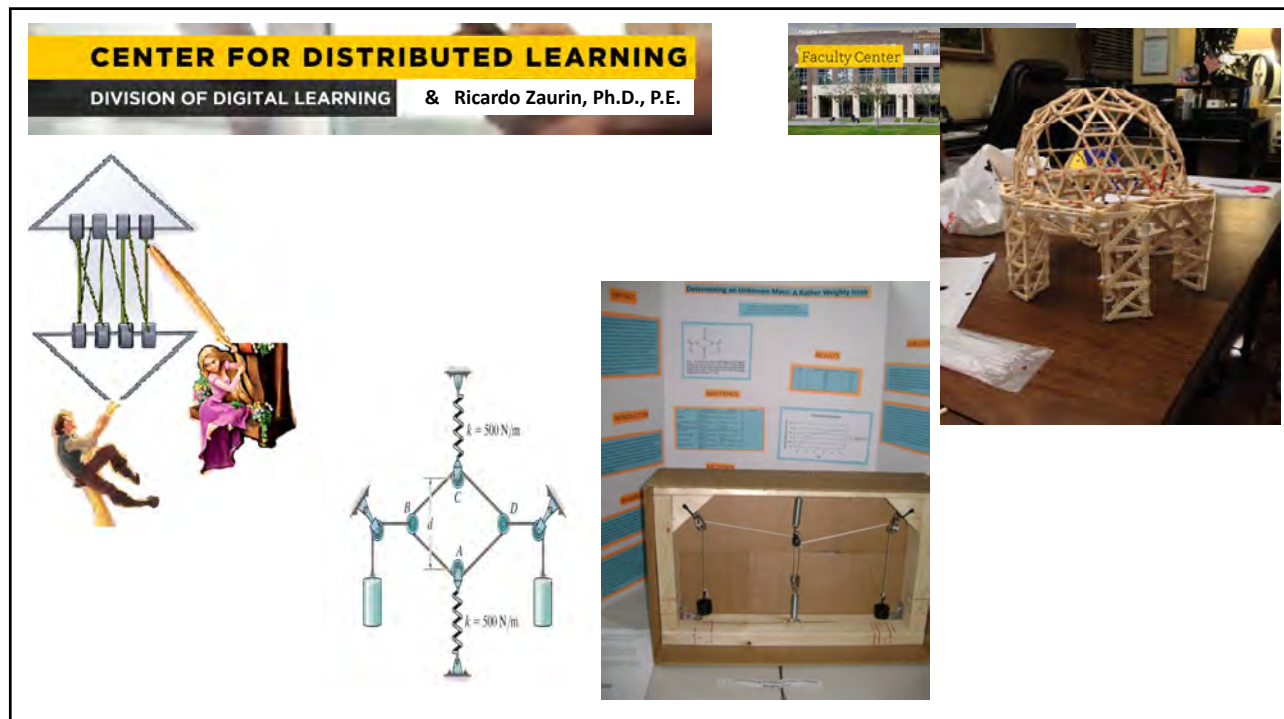
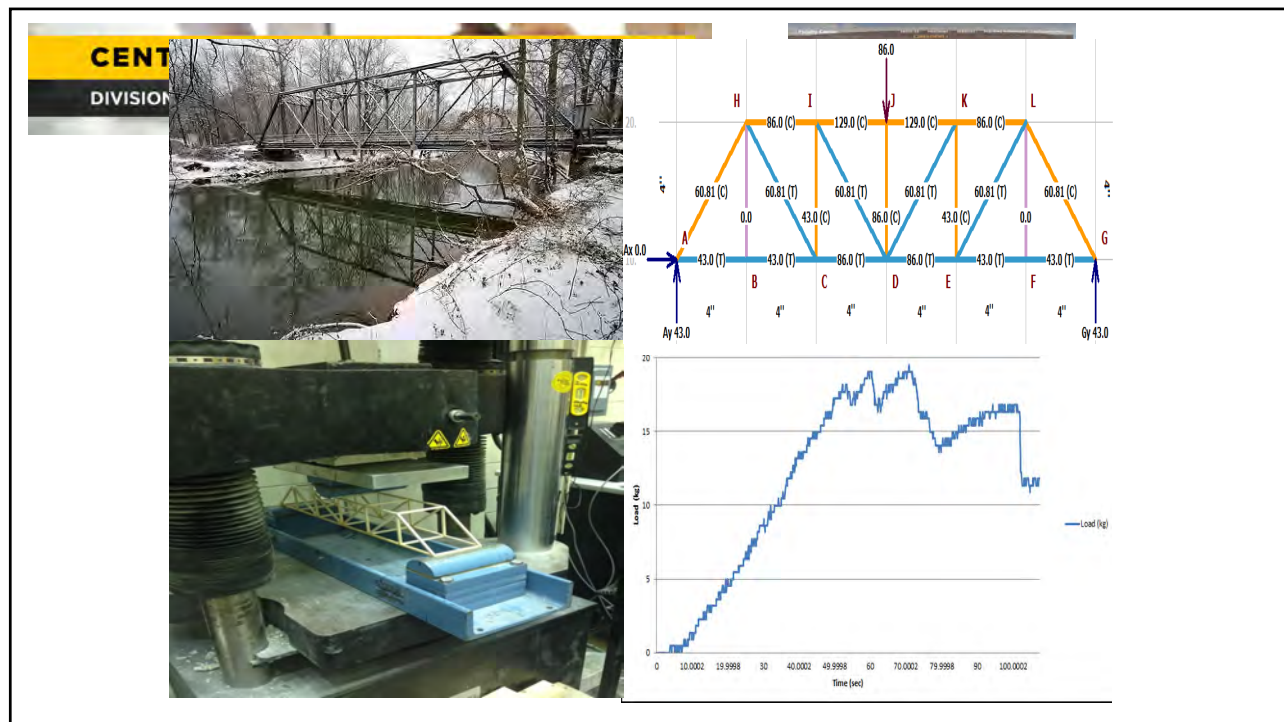
- 1) Paper
- 2) Real-life model
- 3) Physical simplified model
- 4) Numerical calculations
- 5) Lab results
- 6) Comparison/conclusions
- 7) Poster
- 8) Presentation

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## IDEAS Showcase Fall 2015





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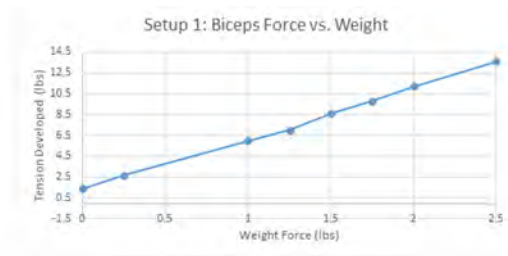
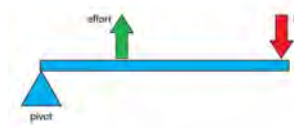
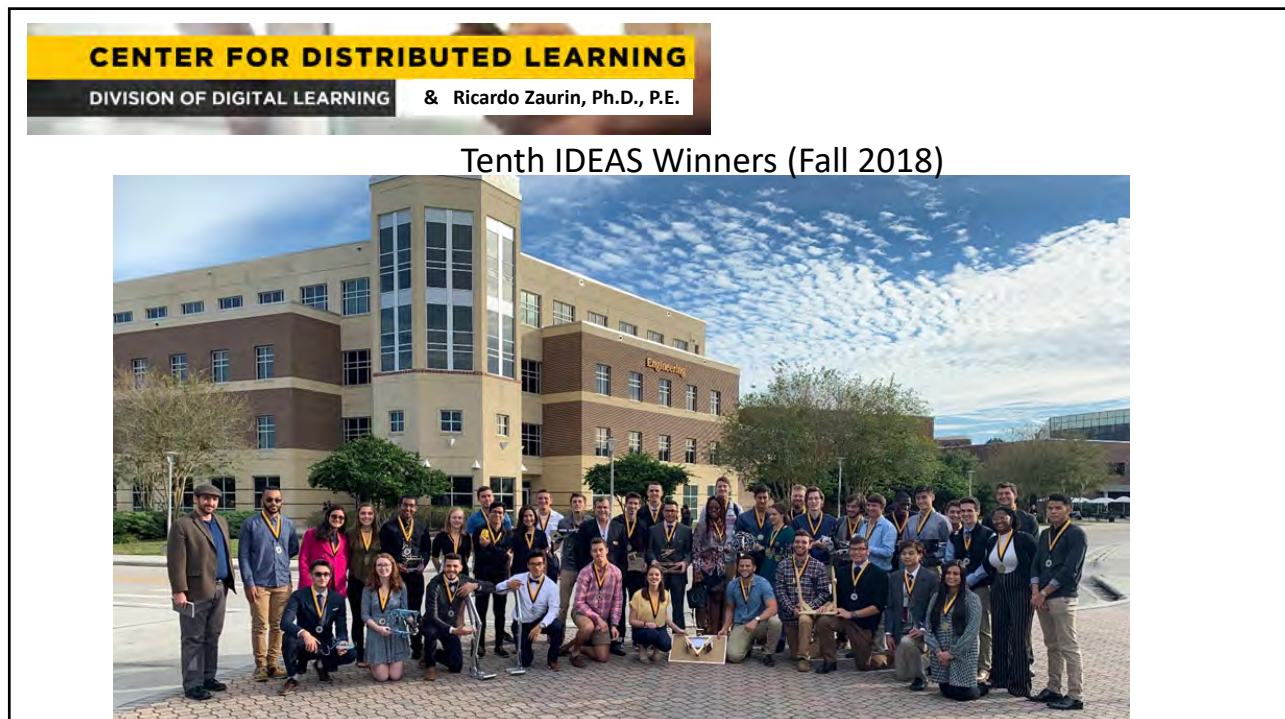
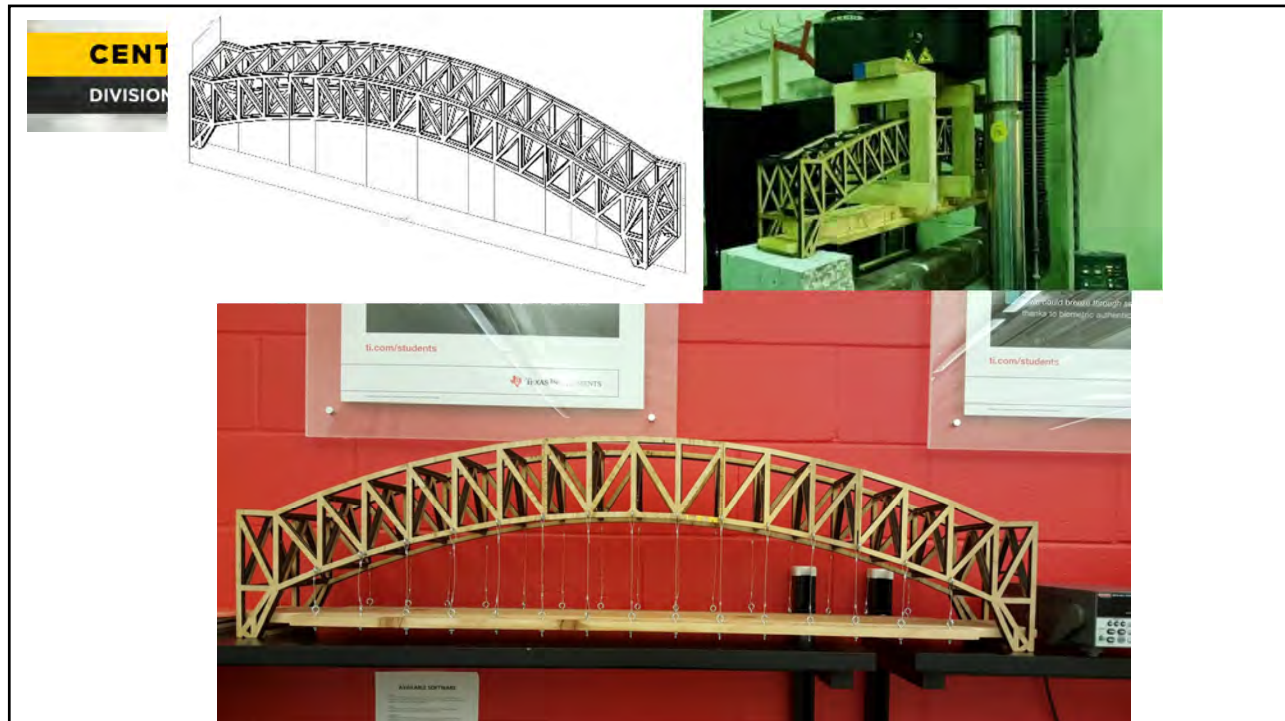


Figure 4: Graph of Setup 1 data (biceps force vs weight)

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**Discussion of the results.**


Several active learning strategies and their effect regarding students' success, class engagement, and students' perception of instruction(n=259)

- **Socratic Lectures and Class Discussions:**

- 76.1% of the sample said these activities increased their interest, engagement, and class participation;
- 79.6% expressed that this type of discussions helped them to better understand the concepts.

- **Open ended questions and Brainstorming:**

- 85.3% of the same sample agreed in the benefits regarding engagement and class participation.
- 84.6% expressed they were able to make better connections with previous courses' knowledge and with real life engineering situations.

- **Graded unannounced group class activities (group quizzes):**

- 74.9% of the students expressed that because the activities were "unannounced" they had to come to class and be prepared.
- 78.8% said their engagement and participation increased.
- 80.3% agreed on their understanding of the concepts was better because of it


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## Discussion of the results.

- **Collaborative Project Based Homework (n=558, 129 participated)**

- Results showed that PBH participants performed between 60% and 84% better than the non-participants.
- In addition, 96.8% said this activity helped them to better understand the concepts and
- 79.1% thought their class engagement increased.

- **Semester Long Experiential Learning Project (IDEAS Showcase)**

- The percentage of success was between 44% and 81% higher for IDEAS students.
- Retention within the college (~11 and 13 percent points higher)
- Higher graduation rate (around 13 points higher for the participants).

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 Products, Grants, Publications,  
Sustainability


- Around 3,000 students have participated producing ~900+ papers/projects
- Several Presentations (SSTL, NSSC, Stetson, Active Learning Expo, CDL, FCTL, ASEE)
- 8 ASEE Papers
- 4 QEP Awards- 3 Course Redesign Award
- 2 Technology Fee Grants

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**Selected Peer Reviewed Publications**

1. S. Pal, R. Zaurin, "Project-Based Homework: an Ongoing Study on Engineering Analysis-Dynamics" in Proceedings of the 128th American Society for Engineering Education National Conference (128th ASEE-2021), Long Beach, California, July 26 - 29, 2021.
2. R. Zaurin, S. Dey Tirtha, N. Eluru, "A Comparison between Mixed-Mode and Face-to-Face Instructional Delivery Approaches for Engineering Analysis: Statics,," in Proceedings of the 127th American Society for Engineering Education National Conference (127th ASEE-2020), Montreal, Quebec, Canada, June 21 - 24, 2020. 16 pages.
3. R. Zaurin, S. Dey Tirtha, N. Eluru, "A Comparative Analysis of the Students' Performance in Two Statics Courses Due to the Inclusion of an Adaptive Learning Module (ALM) to Review the Mathematics Prerequisite Knowledge," in Proceedings of the 127th American Society for Engineering Education National Conference (127th ASEE-2020), Montreal, Quebec, Canada, June 21 - 24, 2020. 14 pages.
4. R. Zaurin, "Quantitative Analysis on Students Success and Class Satisfaction by Comparing Three Different Modalities of Assessments for a Large Engineering Gateway Course," in Proceedings of the American Society for Engineering Education Southeastern Section Conference (ASEE-SE 2019), Auburn, AL, USA, March 10-12, 2019. 9 pages. Paper ID: 51. [https://papers.asee-se.org/openconf/modules/request.php?module=oc\\_program&action=view.php&id=51&type=4&a=](https://papers.asee-se.org/openconf/modules/request.php?module=oc_program&action=view.php&id=51&type=4&a=)
5. R. Zaurin, "Blended Instructional Delivery for a Large Engineering Course: A Step by Step Case Study Description," in Proceedings of the American Society for Engineering Education Southeastern Section Conference (ASEE-SE 2019), Auburn, AL, USA, March 10-12, 2019. 9 pages. Paper ID: 52. <http://www.asee-se.org/proceedings/ASEE2020/papers2020/52.pdf>
6. R. Zaurin, "Learning by Doing: Collaborative Active Learning Hands-On Project-Based Homework for a Large Gateway Engineering Class," in Proceedings of the 126th American Society for Engineering Education National Conference (126th ASEE-2019), Tampa, FL, USA, June 15 - 19, 2019. 16 pages.
7. R. Zaurin, "Investigating the Impact on Students' Engagement, Perception, and Success of Several Active Learning Strategies for a Large Gateway Engineering Course: Statics," in Proceedings of the American Society for Engineering Education Southeastern Section Conference (ASEE-SE 2019), Raleigh, NC, USA, March 10-12, 2019. 7 pages.
8. R. Zaurin, "Preparing the Engineering Student for Success with IDEAS: A Second Year Experiential Learning Activity for Large-size Classes," in Proceedings of the 125th American Society for Engineering Education National Conference (125th ASEE-2018), Paper ID #21771, Salt Lake City, UT, USA, June 24-27, 2018. 21 pages.

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## My Learning...

- Be early
- Before entering in the room take a deep breath and smile
- Start small talk with the students
- Hello Guys! How are you doing?
- I am also doing good... Thanks for asking?
- Start with a short story (Halloween) before class
- Move out of the Podium (presenters)
- Walk the classroom
- Talk with students in the back
- Cold Calls? They work for me
- Ask questions?
- Ask explanations of the answers
- DESIGN your activities
- Check the real results of your activities
- Collect Data
- Revise
- Ask students for suggestions on activities
- Try to be familiar with the trends (difficult)
- Relate your activities (If possible) with news
- Baby Steps
- Be prepared to discard the most amazing activity (in your opinion) if it doesn't work
- Introduce new activities as extra-credit until you prove they work
- Do not do it ALL at once
- Have a transparent syllabus and rubrics
- Be prepared to accept criticism (even from your colleagues)
- Disseminate your results
- Attend to conferences (even if you don't present)
- Stay after the lecture for few minutes with the students that wants to talk to you
- You don't have to be their friend but definitely not their enemy
- It is a lot of work... but IT IS WORTH IT!

## CENTER FOR DISTRIBUTED LEARNING

DIVISION OF DIGITAL LEARNING & Ricardo Zaurin, Ph.D., P.E.



Questions? Comments? Collaborations?  
Your Turn!!!



[Ricardo.zaurin@ucf.edu](mailto:Ricardo.zaurin@ucf.edu)

(407)823-5653

Ricardo Zaurin, PhD, PE

Associate lecturer

Civil, Environmental, and Construction Engineering Department  
University of Central Florida