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Assistive Devices for Persons with Disabilities, Flipping Classrooms, & Some Potentially Useful Information



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Plan for This Morning

- My innovation from 2010
 - Assistive devices for persons with disabilities
- What's interesting to me now
 - Junior level inverted classroom
- Words of wisdom
 - Just got tenured, so I'm reflective



ME/BME 565: Senior Capstone Design Assistive Devices for Persons with Disabilities

- 3-quarter capstone series that focused on real world problems in assistive device design & evaluation.
 - Students design, build, and evaluate an assistive device
- Worked closely with Physical Therapy, and Occupational Therapy, and Physical Medicine and Rehabilitation
 - Work with patients, clinicians, companies to get project ideas
 - Graduate level DPT and MOT students on the design team



Course Evolution

- Offered to Mechanical Engineering students since 2008
 - Previously sponsored by NSF grant (2008-2012)
 - Currently sponsored by NIH grant (2012-2017)
- Biomedical Engineering undergraduates joined the teams of Mechanical Engineering undergrads and graduate students in Occupational Therapy and Physical Therapy in 2010
- 2010-11: 26 ME students, 14 BME students
- 2011-12: 14 ME students, 23 BME students
- 2012-13: 28 ME students, 47 BME students
- 11 person teaching team from 5 departments, 2 colleges



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Collaborators & Sources of Projects

TONY R. WELLS FOUNDATION



Riverside Methodist
Hospital
OhioHealth



VISION & VOCATIONAL
SERVICES



Altercare

Where camp is good medicine.



Why The Class Is Great!

- Students get to experience the entire design cycle
 - Design-prototype-test cycle
 - Co-creation model: involving end-user throughout process
- Autumn: Introduction to the Design Process
 - Design techniques, statistics, design exercises, written and oral communication
 - Smaller fun design project...chance to fail early, take mulligan
 - Need finding and defining the problem
- Winter: Design and Build
 - Concept development, construct mock-ups, concept selection, detailed design,
- Spring: Build, Test, and Report
 - Finish construction, conduct experiments, evaluate, final documentation



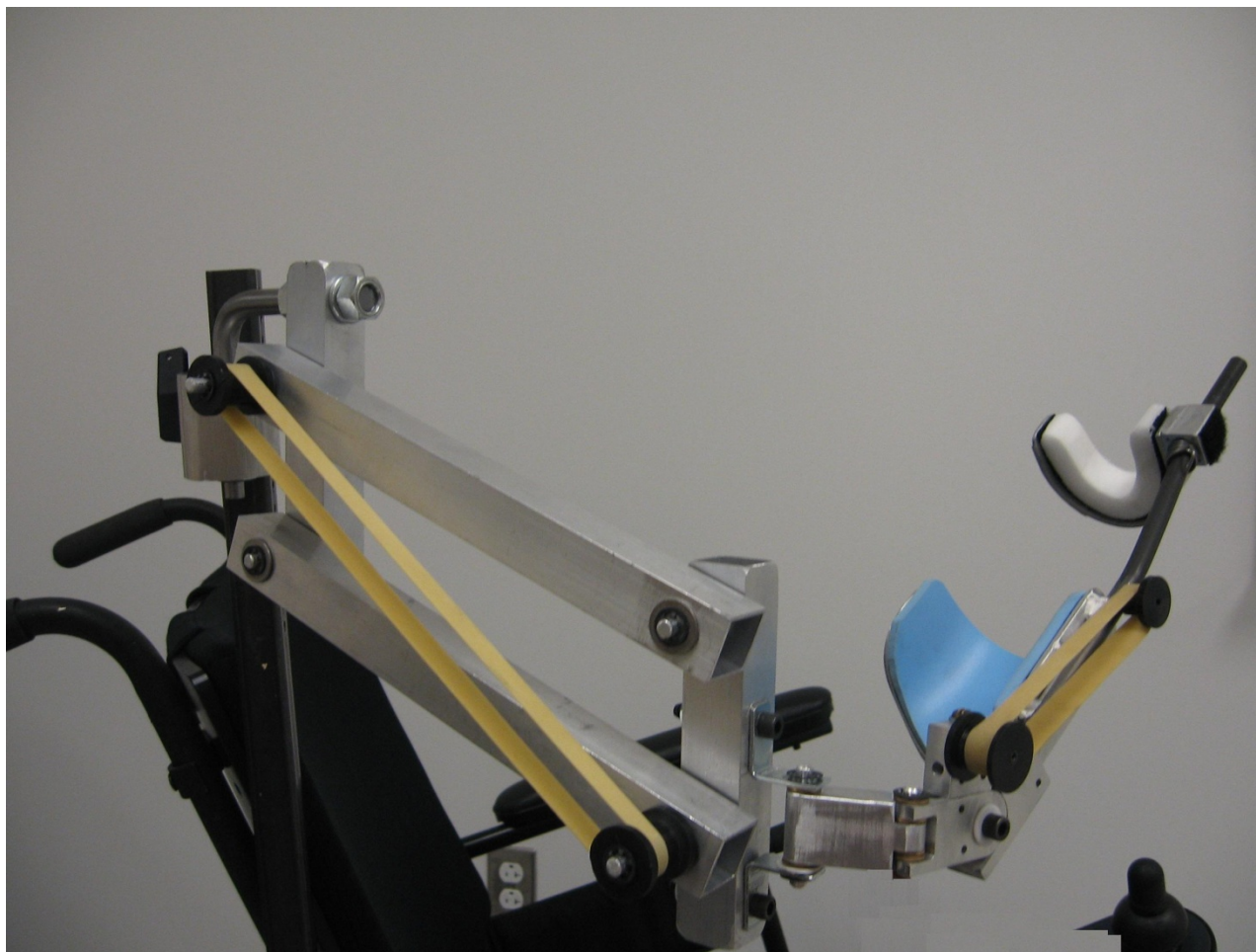
Student Peer Evaluation

- Performed twice a quarter
- Part of the feedback was a part of the grade
 - “If you have \$100,000 to give to your team as a bonus, how would you divide the money?”
 - Anything earned above \$100,000 was extra credit
- Free response, not graded
 - Strengths
 - Areas for improvement



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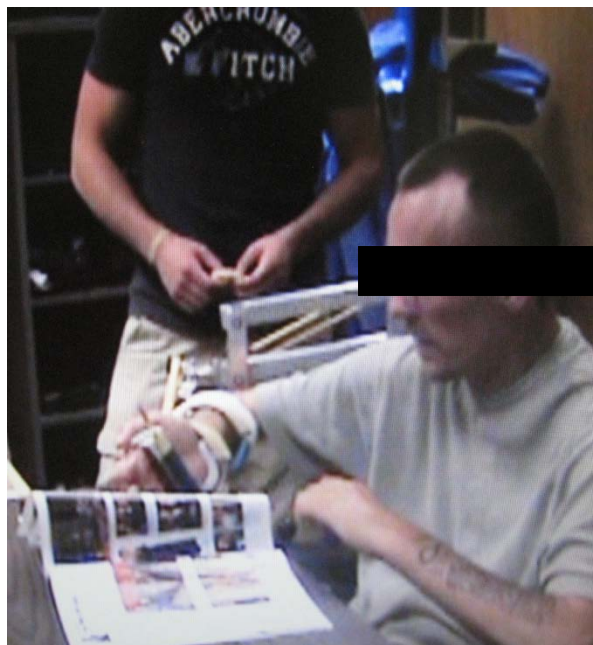
Mobile Arm Support





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Mobile Arm Support





Gait Trainer





We Had an Interesting Problem

- Random calls from across the country
- People looking to purchase our products
- As a class, and a University, not positioned for that
 - Legal ramifications
 - Production capability



“Patents and Pies”

- Intellectual property “speed dating”
 - Improve on invention disclosure quality
- Rounds with tech licensing staff in February
 - 5 minute pitch from team
 - 10 minute conversation
 - Repeat process
- Tech licensing has a kitchen
 - Served pie and ice cream



Could Someone Make Devices?

- Local non-profit tried to champion a product and see it through to development
 - Built prototype
 - Not the success or process anyone imagined
- Explored options with several companies, got close once
 - Company had extra capacity on the line
 - Legal details were being worked out
- Still thinking about ways to widely distribute products



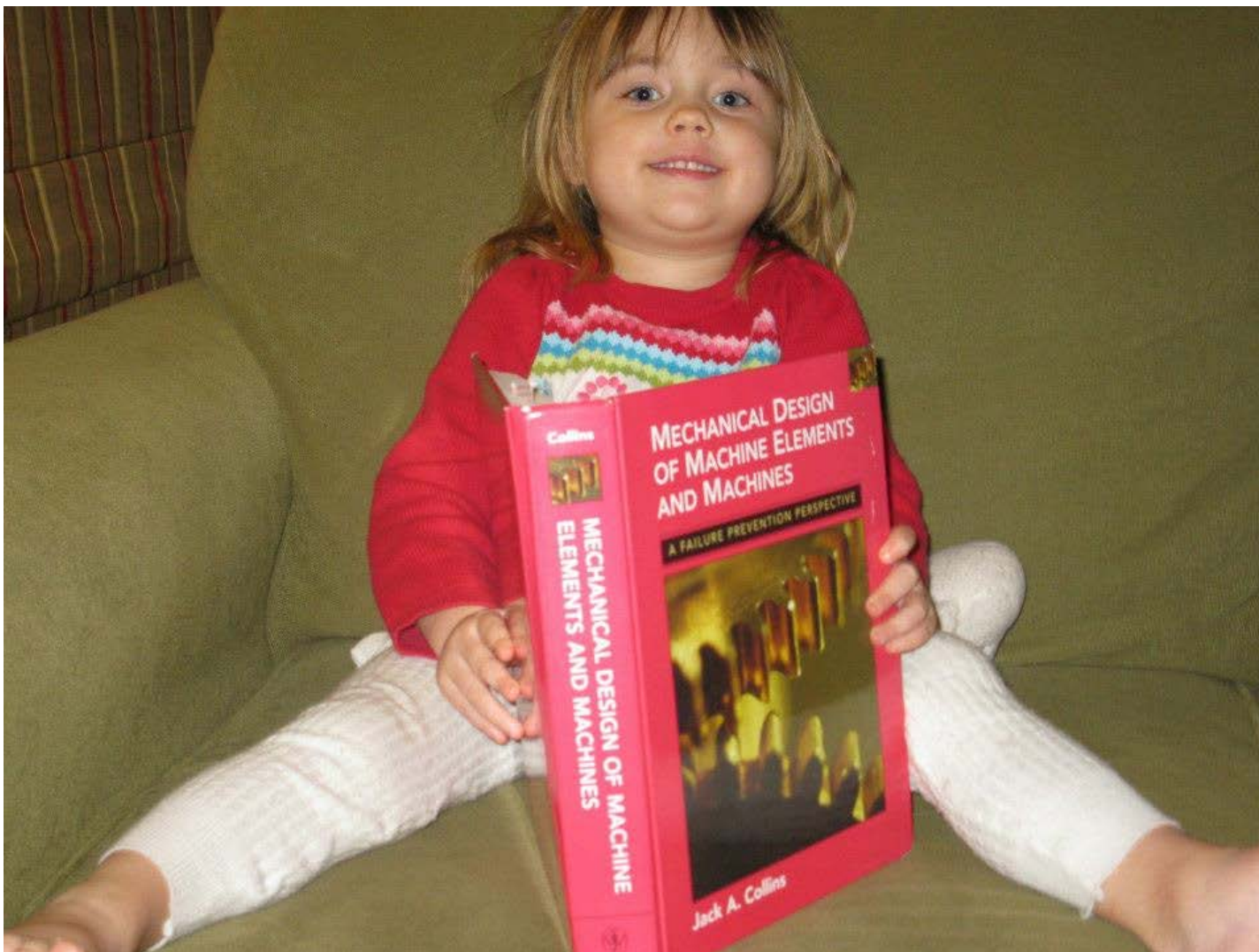
Some Lessons

- When I graduated, my PhD advisor told me to not lead a device design course until I got tenure
 - Of course, I ignored him
 - Of course, he was right
- The course could quickly consume all of my time
 - Individual teams and course as a whole
 - So I stopped coaching, then stopped directing in 2012
- Course funding (NSF, NIH, local non-profits)
 - External reviewers saw it as a unique positive
 - Internal faculty saw it as a bonus after research \$\$\$



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Switching to a Younger Group...





ME 3671 Machine Elements II

- Core junior level course, ideally second semester
- **Topics Covered:** Springs (tension, compression, torsion, leaf, miscellaneous), Brakes and clutches (external and internal short and long shoe, band, cone), Flywheels, Gears (spur, helical, bevel, worm), Belt and Chain drives, Bearings (rolling element, plain, and hydrostatic).
- **Course Goals:** This course is intended to help students develop an intuitive understanding of the design concepts for specific machine elements and kinematic relationships for various machine elements.



Unique to My Section

- Meeting 3 times a week for 55 minutes each presents some challenges
 - “drinking from a fire hose?”
- Suggested to me a possible new way to do lectures
 - Inspired by my FOEE experience
- I experimented with a new approach in spring 2013
 - It was fantastic!



Experiment of January 2013

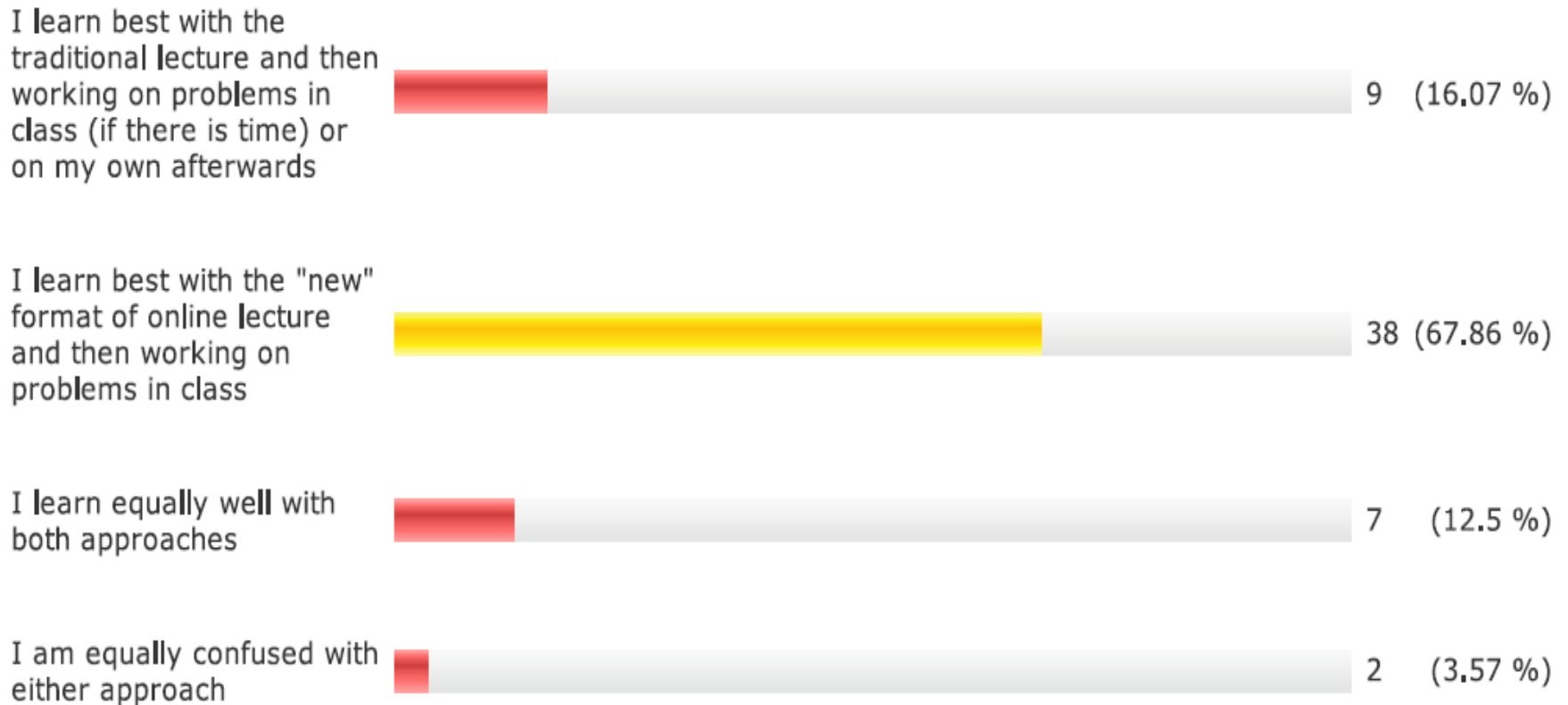
- I was going to be out of town for a conference
- I did 2 weeks of material “traditionally”
 - Lecture in class with PPT
 - Practice problems as time allowed
- I then did 2 weeks with a flipped/inverted room
- The students then voted



Results: Learning Ability

Question 1

How would you assess your ability to learn the material with the 2 different lecture styles?

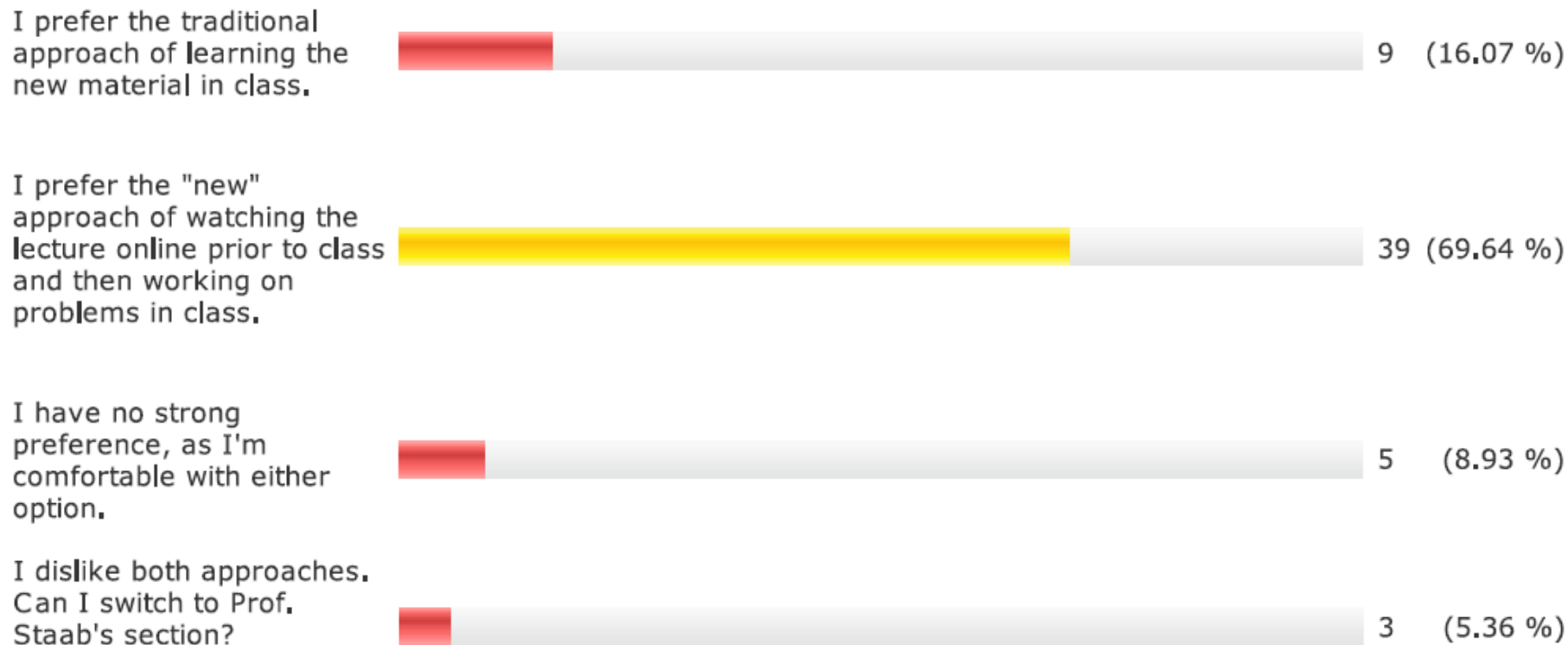




Results: Class Format

Question 3

How would you like the lectures to be presented for the rest of this semester?



Number of Responses: 56



Student Reaction About Inverted Classroom

- "I loved it!"
- "Practice problems in class were really helpful"
- "I could go back and watch things later"
- "3670 had too much material in class"

- "I stopped watching the videos and just came for the in-class problems."

- "I hated it. It is too much extra work. I don't have time to watch videos before class"



Flipping Observations & Questions

- I currently have 82 students in my section
 - Flipped classrooms can work at a large scale
 - It is easier the second time through (double prep first time)
- I get a range of participation in class
 - Fully engaged, working problems, talking with neighbor, sharing
 - Copying answers from screen (not bring anything with them)
 - Sleeping
- Little correlation with watching lecture and grade
 - How much of the theory is even important for this class?
- What topics can or cannot be flipped?



Final Thoughts from FOEE 2010

- Teaching innovations are awesome!
- Ed Crawley
 - Academia can't just be about research
 - If you're not interested in teaching, go to a lab
- Norman Fortenberry
 - Learn to play politics
 - "If they want to turn [it] into a Christmas tree, get your ornament on there"