INCORPORATION OF NI MYDAQ EXERCISES IN ELECTRIC CIRCUITS

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Outline

- Learning Styles Overview
- Characteristics of Engineering Students
- Learning Styles and Retention
- Addressing Learning Differences by Providing Different Avenues for Learning
  - Integrating hardware into the classroom
  - EE Circuits Case Study
- Student Outcomes

Learning Styles

Understanding How Students Learn

- “Learning styles” is a general term used to describe how different students learn
- A number of different ways of describing learning styles have evolved, many based on early work by Kolb and Myers-Briggs
- One popular schema for talking about learning styles in the engineering education area was developed by Felder and Soloman

Learning Styles
(Felder and Soloman)

Active

- Learning by doing

Reflective

- Learning by thinking

Learning Styles

Sensing

- Learning by facts and established methods

Intuitive

- Learning through considering abstract relationships

Learning Styles

Visual

- Learning through pictures, diagrams, demonstrations

Verbal

- Learning through verbal or written instructions

Learning Styles

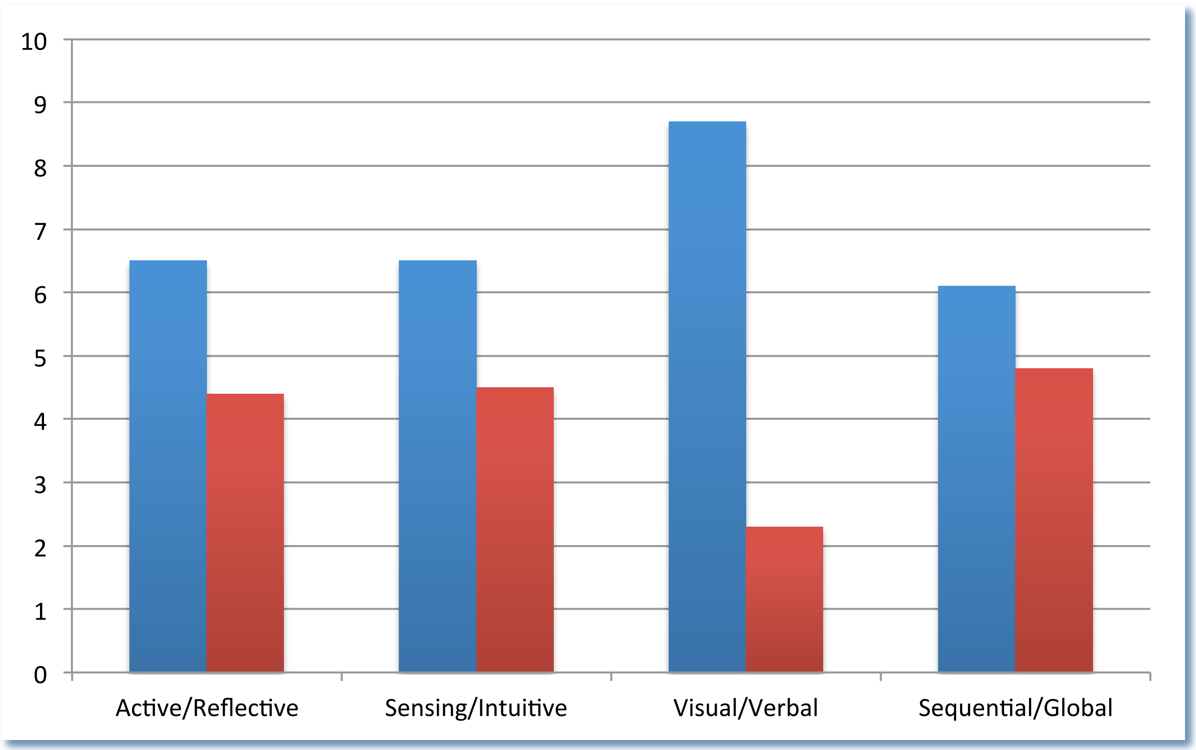
Sequential

- Learning through logical, linear steps

Global

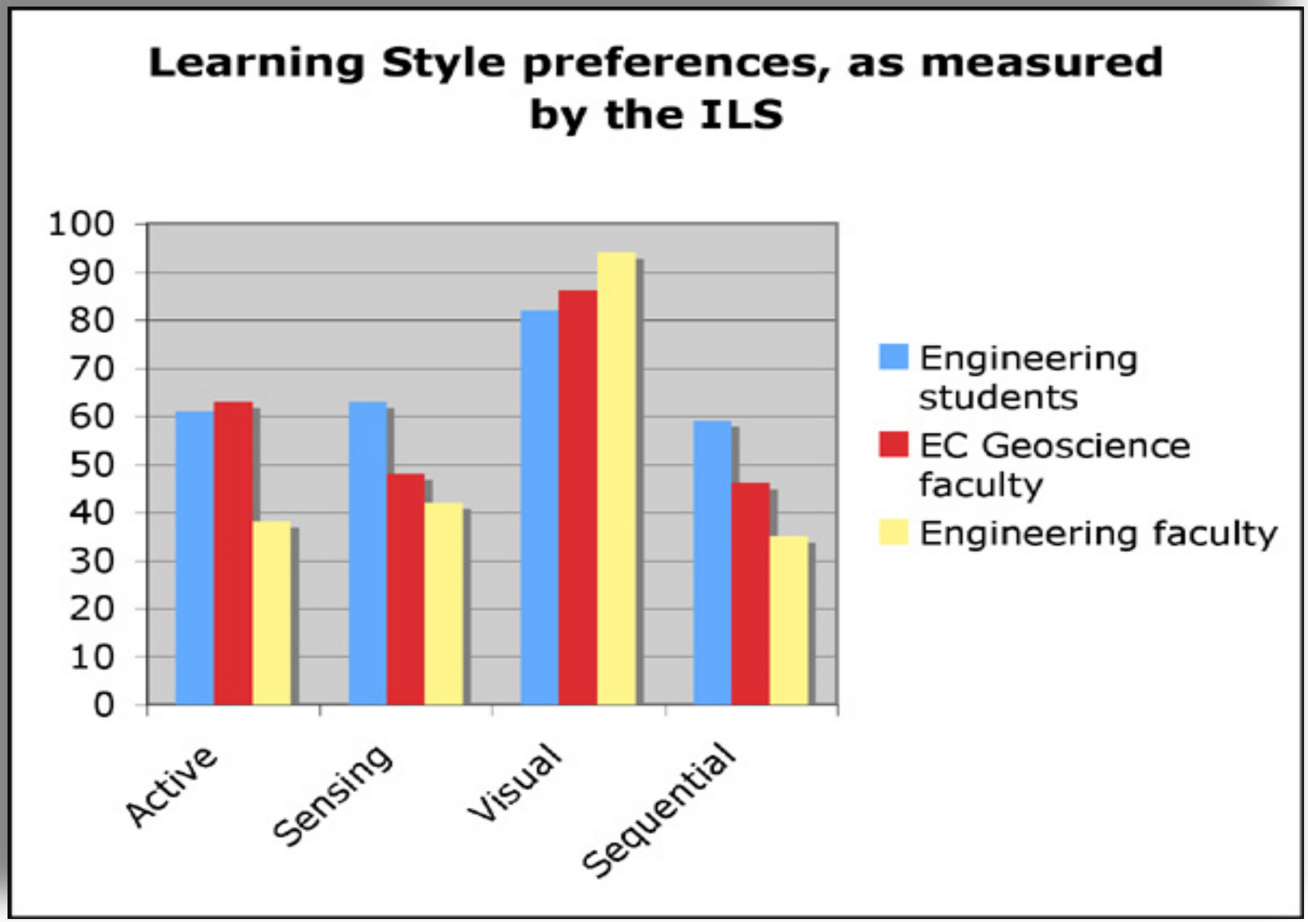
- Learning through first grasping the “big picture”

Learning Style Scores for TTU Freshmen



- Everyone has a score for both extremes in a given dichotomy
- Graph represents the average score in each category for over 150 students from freshman engineering class

Learning Styles of Students versus Faculty



Graph by Carol Ormand, using data from Felder and Spurlin (2005)

Avoiding Common Misperceptions About Learning Styles

- The categories represent a range, not an either-or. For example, everyone has some global learner characteristics and some sequential learner characteristics
- The preferences are just that, *preference*. Learning style preferences are not necessarily correlated with ability.

Learning Styles and Retention

- Retention rates after 2 years in most engineering programs are abysmal, ranging from 17% (computer science) to around 38%.
- Why do students leave?
  - They are not prepared
  - They are unhappy
  - Other reasons – social, cultural isolation, etc
- When do students leave? Overwhelmingly after the first and second year
- Where do they go?
- Learning style differences may explain why students feel discouraged, have poor performance despite reasonable preparation, and are overall unhappy in engineering school

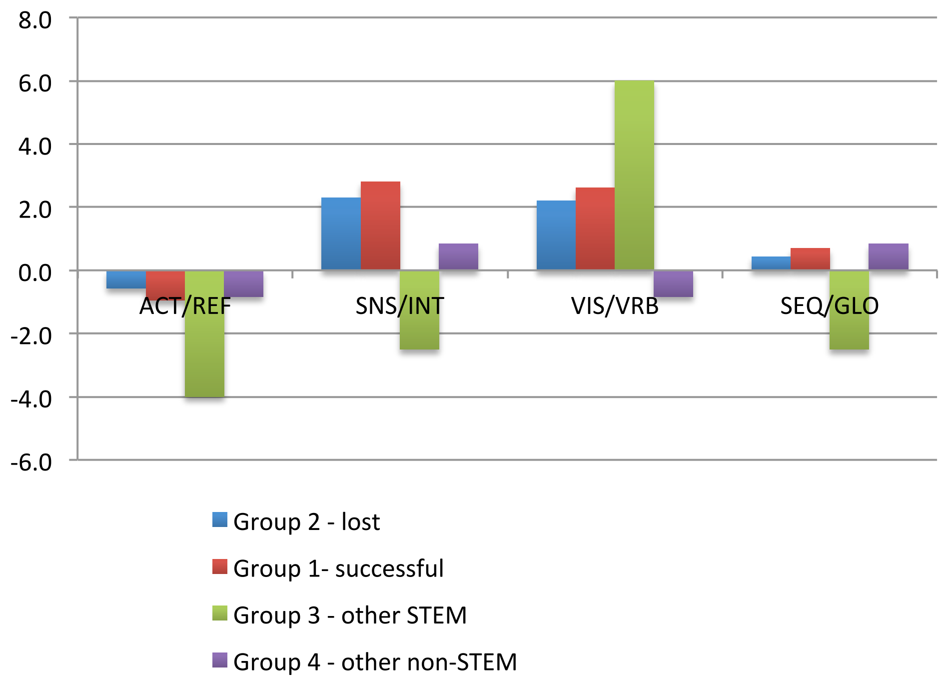
Our Preliminary Data on Retention and Learning Styles

- Felder LSI was administered to over 100 freshmen in intro engineering classes at TTU
- Most students were true freshmen; all signed consent forms
- Students were tracked for 2 years and follow-up was done to assess retention

Retention and Learning Styles – 4 categories of students

- **Group 1**: These students were retained in an engineering program and were either juniors or seniors in good standing five semesters after taking the freshmen classes. They are categorized as "successful".
- **Group 2**: These students are categorized as "lost", meaning they no longer show up as being enrolled in any degree program at the university.
- **Group 3**: These students transferred out of the College of Engineering and into another STEM discipline – typically mathematics or physics, and are in good standing.
- **Group 4**: These students transferred out of the College of Engineering and into a non-STEM discipline, where they are currently in good academic standing.

Results



- Students who left engineering and were “lost” had a similar profile to successful students
- Students who left engineering for other STEM disciplines were considerably different, as were those who left engineering for non-STEM disciplines

Thoughts on Results

- “lost students” are may be students who were not academically prepared or left for family or financial reasons, or transferred to other engineering schools
- Students who transferred to other disciplines, particularly other STEM disciplines were more likely to have different learning styles from engineering students at large

Learning Styles in an EE Circuits class

Average Score	Type
0.8	Referential
4.2	Sensing
4.4	Visual
0.9	Global

- EE circuits students have tendencies to be less “active” learners than a general freshman engineering class
- EE circuits students are more “global” than a general freshman engineering class

Addressing the Needs of All Students

- Introduction of hardware exercises, using the myDAQ
  - Unlike standard labs, students can use myDAQs at home
  - Exercises were designed to address areas where students have difficulty in circuits – voltage divider, phase and amplitude
  - Exercises were also designed such that they were easy for students to do independently
- Remedial mathematics lectures, example problems, software applications

Bridging the Gap in Circuits

Problem:

Learning styles and teaching styles do not always match, particularly for active learners

Solution:

MyDAQ

NATIONAL INSTRUMENTS

Things to Note in Designing Student Exercises

- Use many visual prompts, including photographs of bread-boarded circuits, screenshots, and schematics
- Keep exercises short and simple, emphasizing one concept as it is being covered in class
- See the exercises at:

https://sites.google.com/site/bakercircuits/

Difficult/Important Concepts in Circuits

- Voltage division and voltage being equal across elements in parallel – easy to do voltage, not so easy to do current
- Thevenin equivalent circuits – easy to do very basic, single source circuits
- Phase/magnitude AC concepts – perfect for the myDAQ
- RC time constant – also very easy to do

The NI MyDAQ

myDAQ Connections

Analog Input:

2 channels, 200kS/s, 16-bit

Analog Output:

2 channels, 200kS/s, 16-bit

3.5mm stereo audio jacks

Digital I/O: 8 LVTTL lines

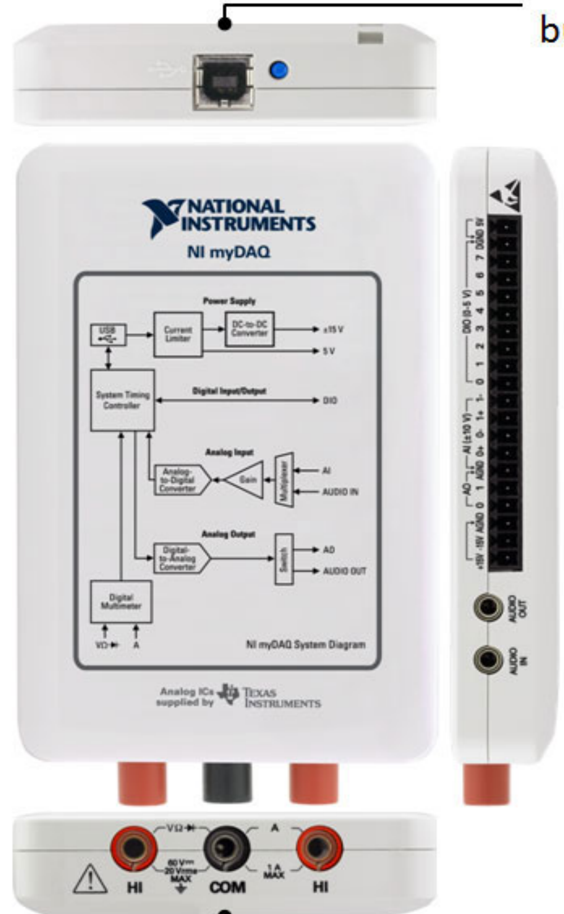
Counter: 1 counter/timer

Integrated DMM: V, A, Ohm

Power Supply: +5V, +/-15V

Screw term + mass term option

Bus Powered (USB) operation



USB controlled, bus powered

Power Supply: +5V

8 DIO lines, 1 counter

2 AI lines

2 AO lines

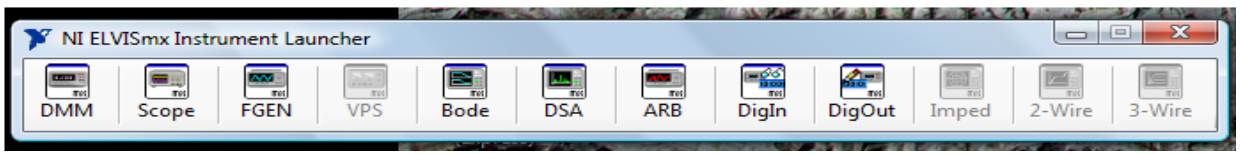
Power Supply: +/- 15 V

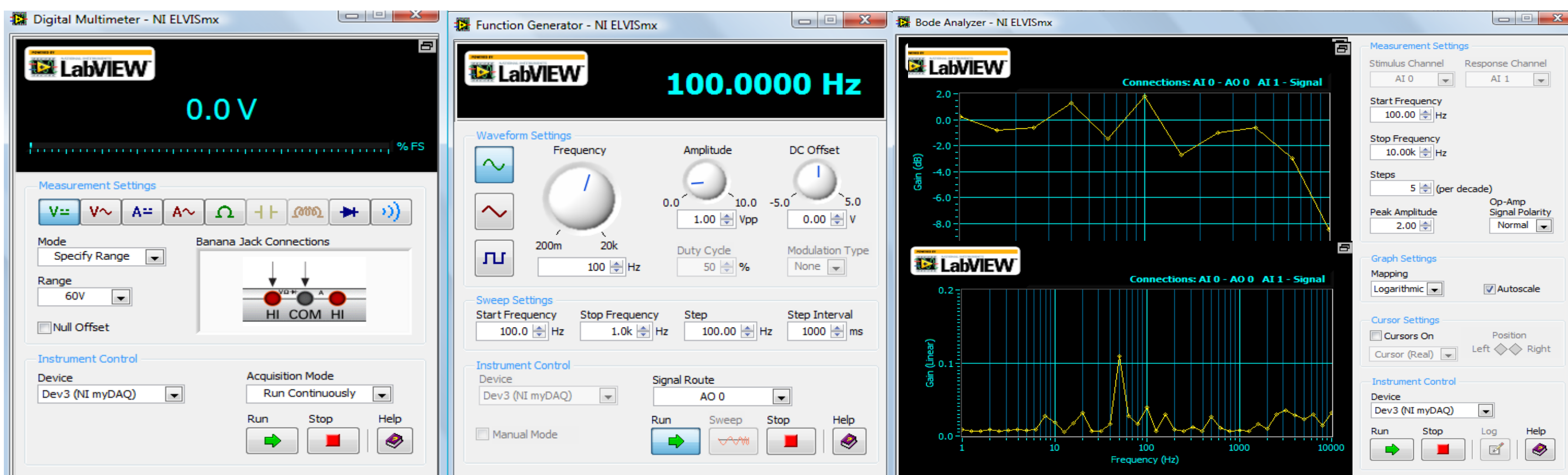
Audio IN/OUT

Integrated DMM

MyDAQ Features

- Multimeter, Oscilloscope, Signal Generator, Bode Plot Analyzer
- Labview Software Suite

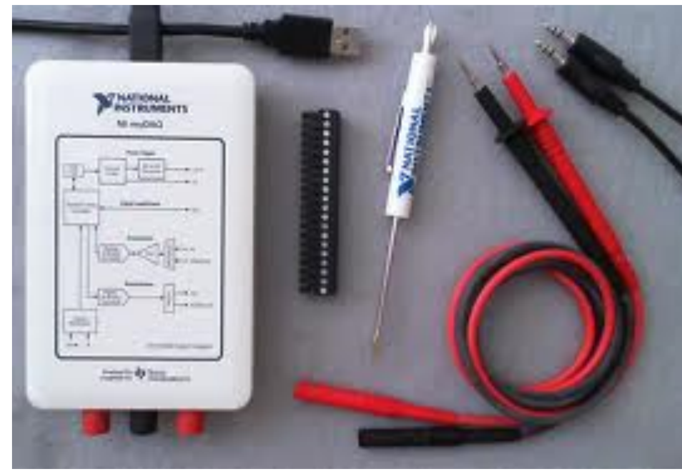


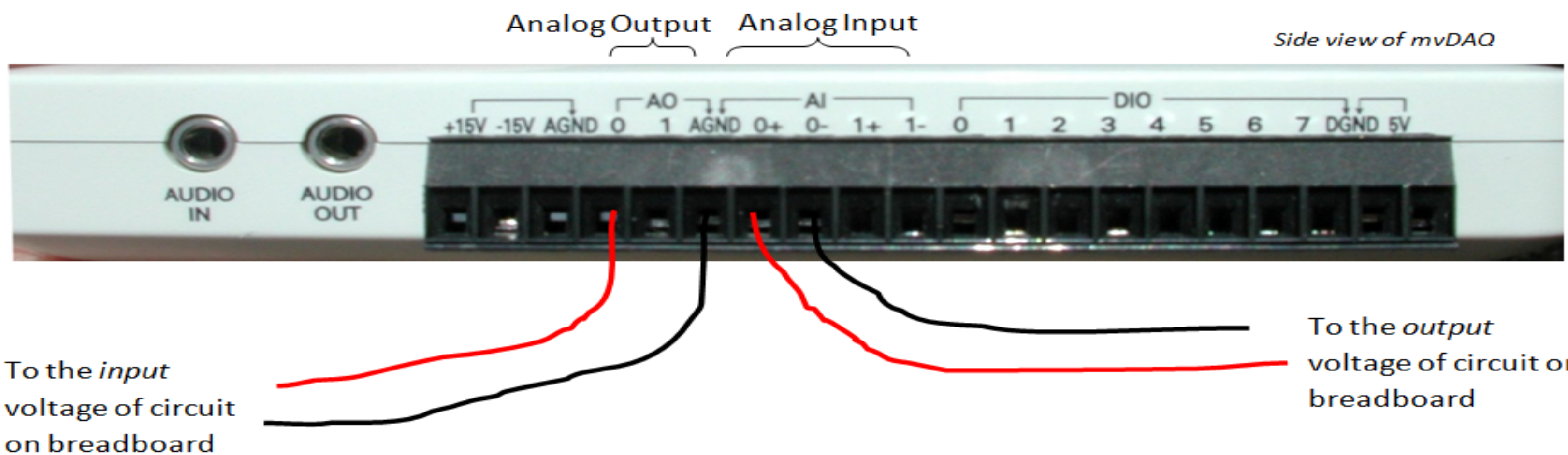


MyDAQ Setup

MyDAQ Hardware Exercises

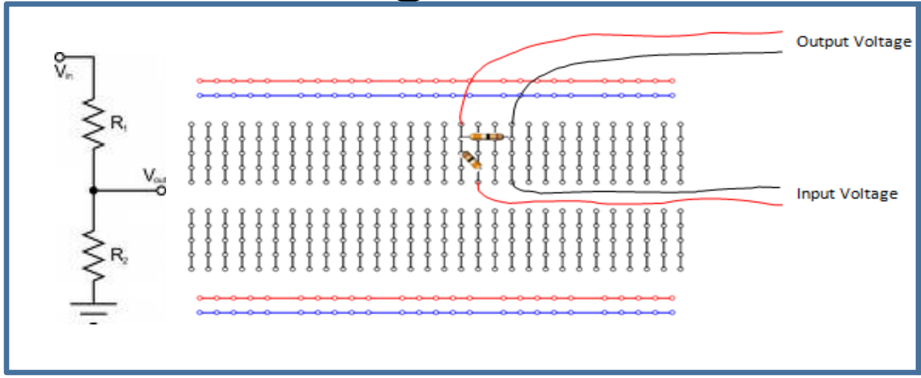
- Voltage and Current Division
- Thevenin and Norton's Theorems
- RC Response
- AC Circuits, Phase Shift

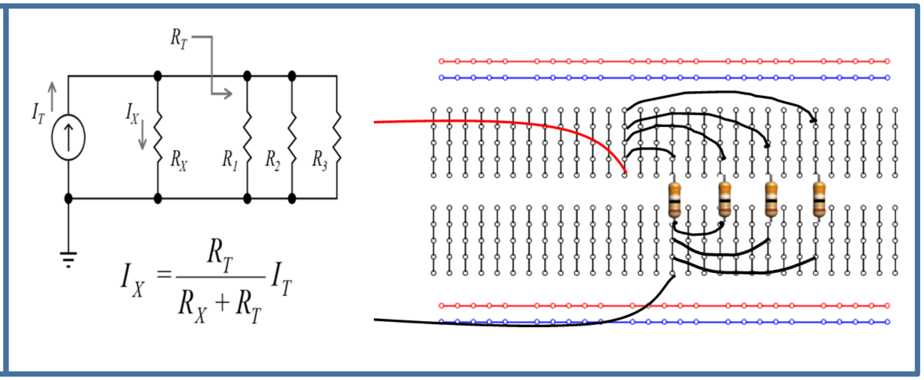


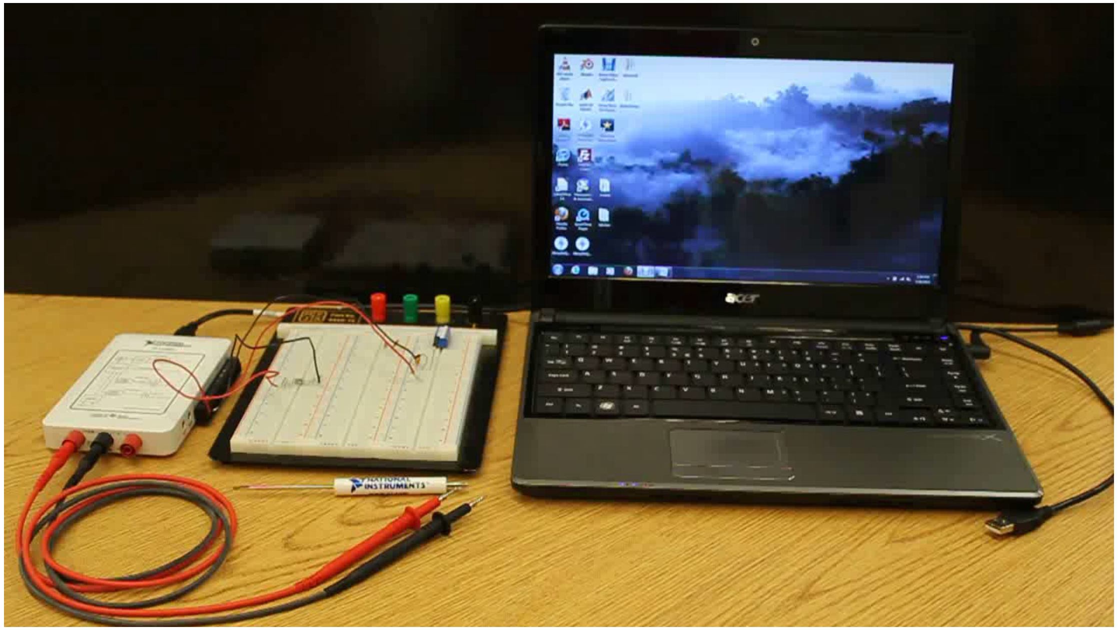


Voltage and Current Exercises

- Designed to mirror the actual schematic

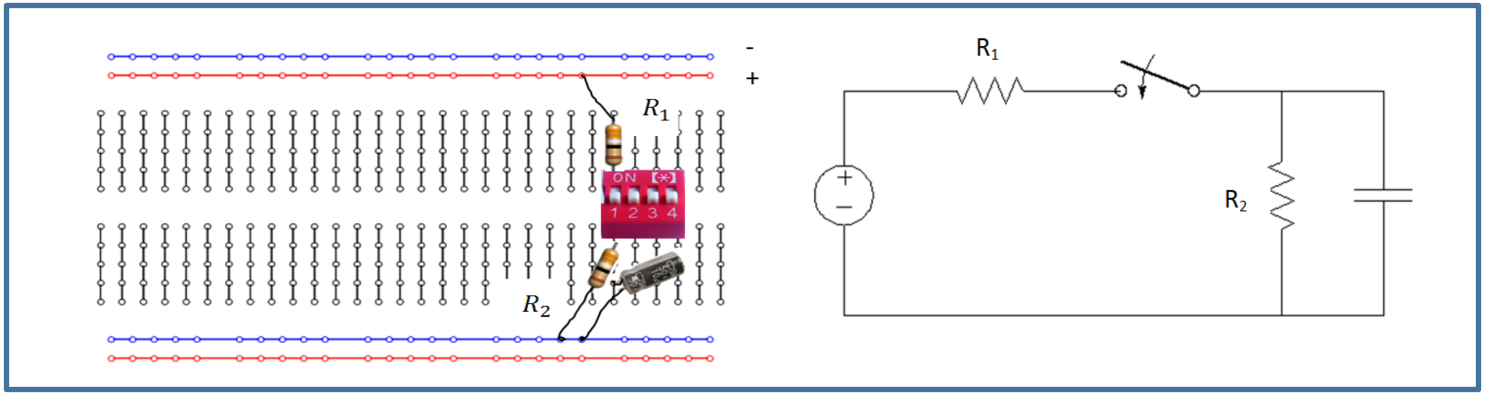


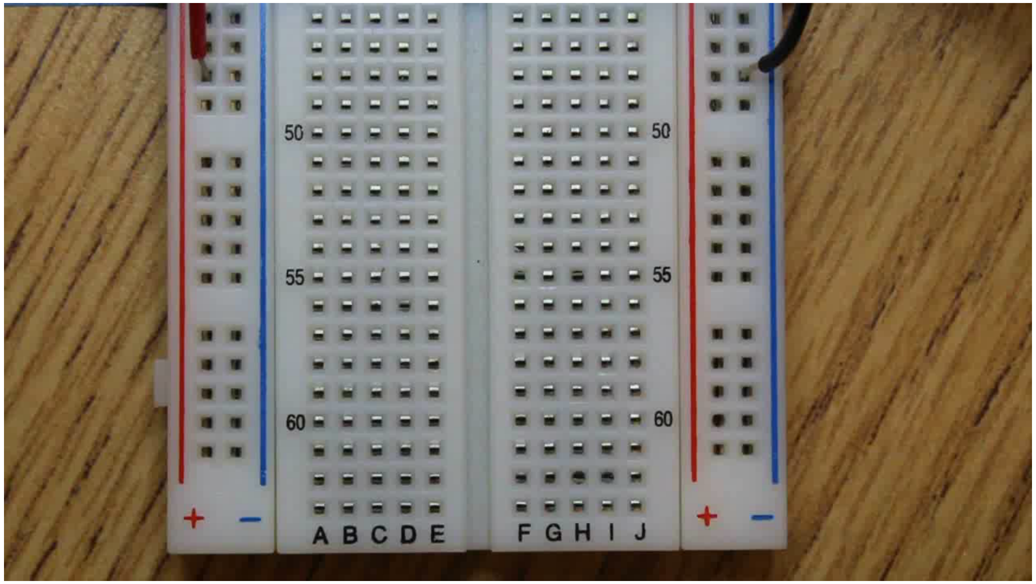




RC Response

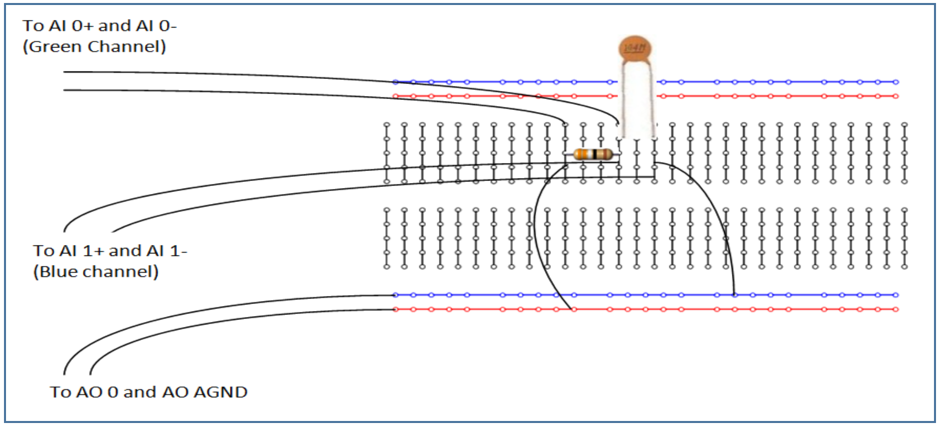
- Observing the time constant

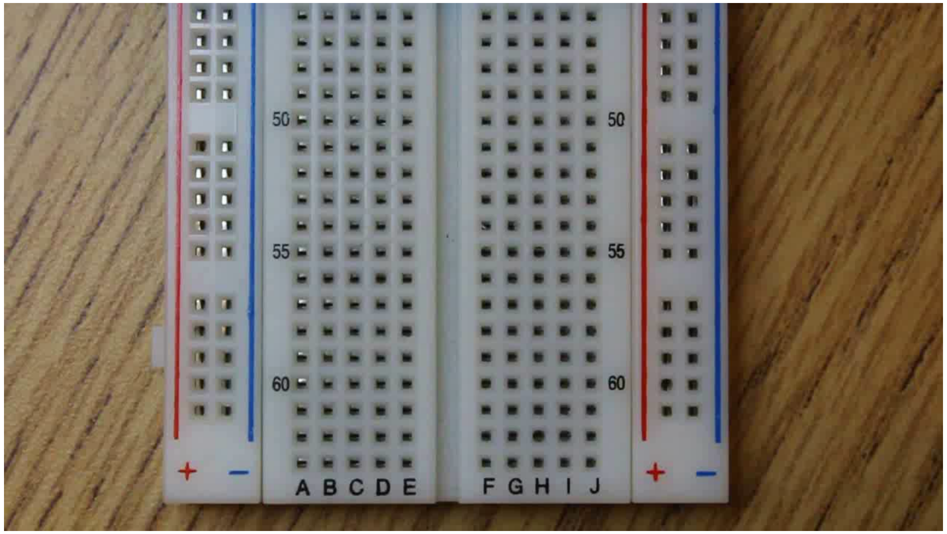




AC Current and Phase Shift

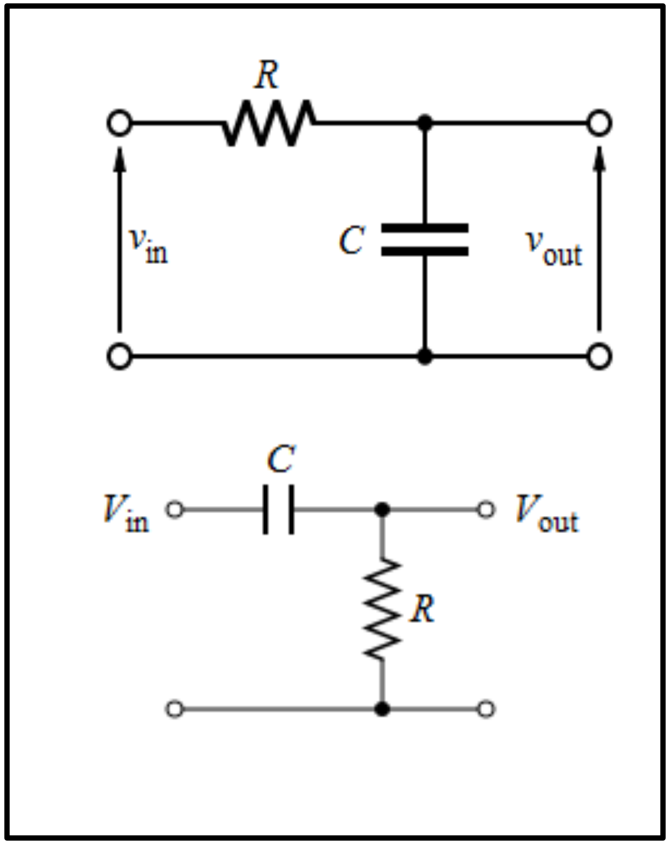
- Students can explore phase shift between components

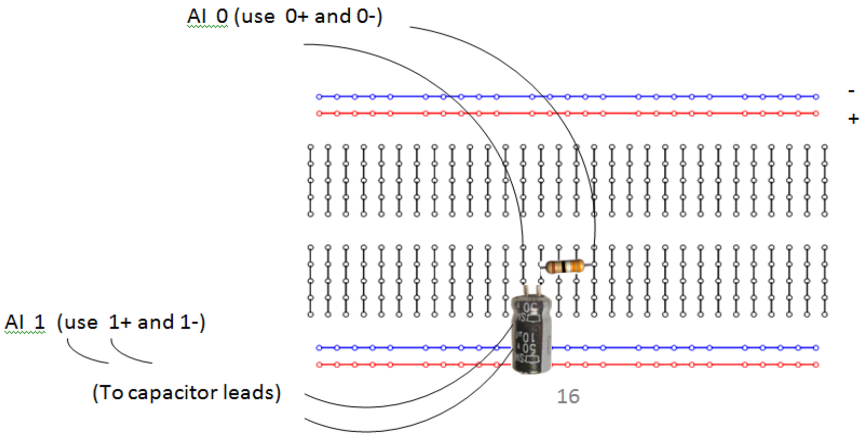


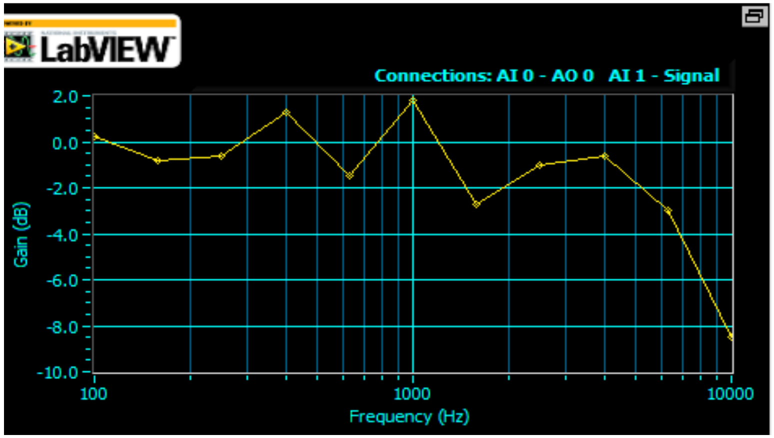


Low Pass and High Pass Filters

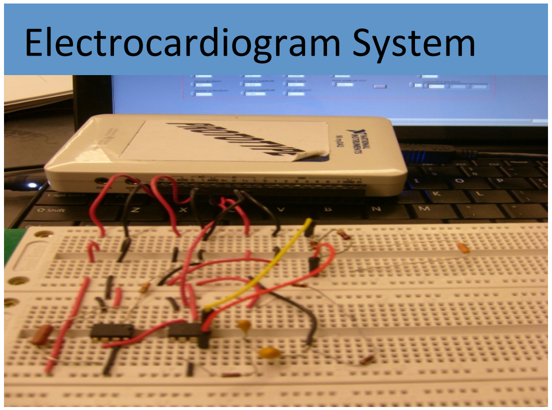
- Simple filters using the same RC circuit

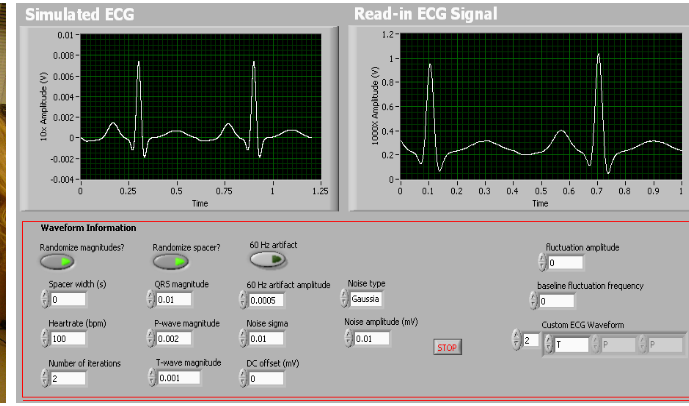


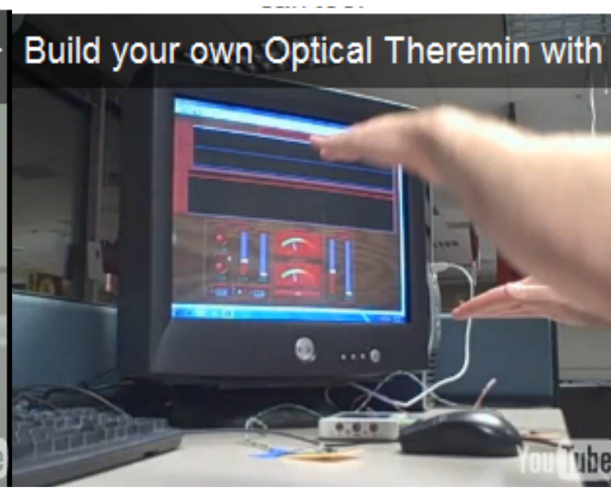


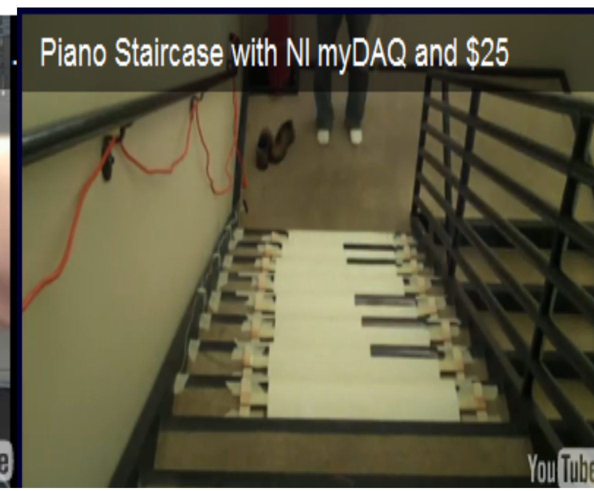


MyDAQ Projects



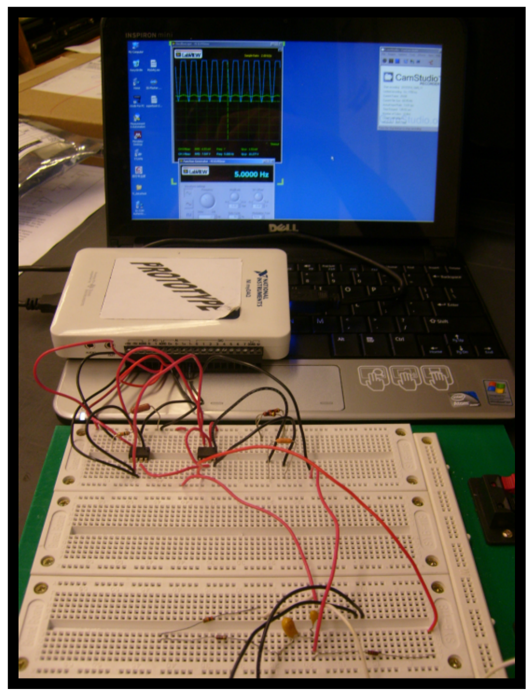






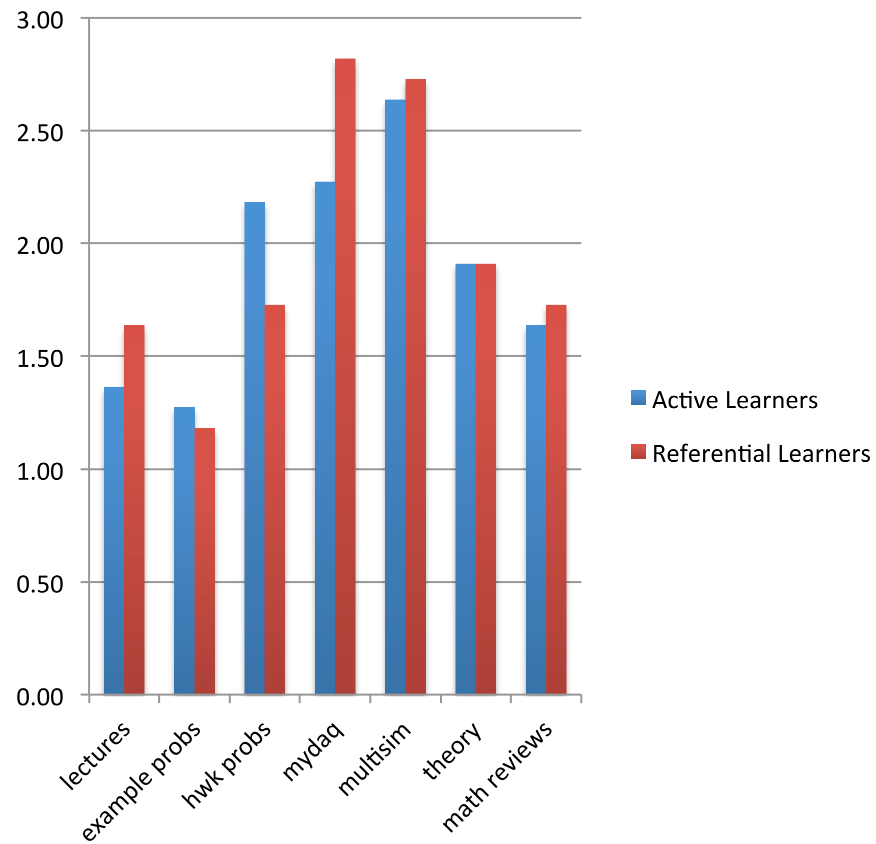
Hypothesis

Many engineering students need an active, sensory component in learning; the MyDAQ can provide this.



Results – Student Assessments

- Students rated different approaches as to how helpful they were – 1 being very helpful, 5 being not at all helpful
- Note that the myDAQ was much more highly rated among active learners, while referential learners clearly preferred the homework problems



Conclusion

- Hands-on activities, like the myDAQ, provide a tool for reaching students who have an active learning profile and prefer a hands-on approach to learning
- Because of apparent learning styles distributions, this may be even more important in freshmen classes and in non-EE classes

Future Work

- Some surprises, good and bad
  - Students will not buy and install their own software (Labview) voluntarily
  - Students who were surveyed reported that they did not do any additional exercises on the hardware outside of what was assigned in class
  - Students did not report any problems with the hardware
- Experimenting this year with "flipped" class – students watch video lectures for homework, work problems and use myDAQs in class
- This year, thanks to a donation from NI, Labview software will be provided to students in the test group
- The simulation component, Multisim, will be more closely tied in with the hardware component and homework assignments
- Reaching beyond circuits – integrating the myDAQ throughout the curriculum, from the freshman year, through senior design classes

References

- Felder, Richard M. and Joni Spurlin, 2005. Applications, Reliability, and Validity of the Index of Learning Styles ,International Journal of Engineering Education, v. 21, n. 1, pp. 103-112.