



PHYSICS

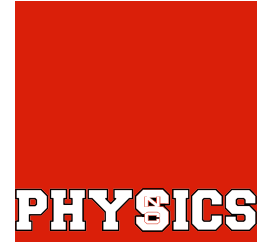
How I Met Your Motherboard

Integrating Smartphones into Classrooms

Colleen Lanz Countryman
Michael A. Paesler, William R. Sams
North Carolina State University

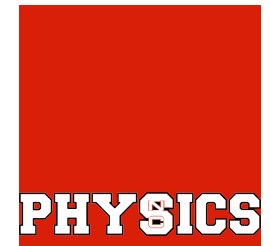
MyTech:

Measurements Using Everyday Technologies



- Motivation
 - Rising costs
 - Confusing black box equipment
 - Popularity of smartphones
 - Capabilities of smartphones
- Objectives of MyTech and Research Questions
- Study Design
 - App Programming
 - Adaptation of Curriculum
 - Tests and Research Methodology
- Preliminary Analysis

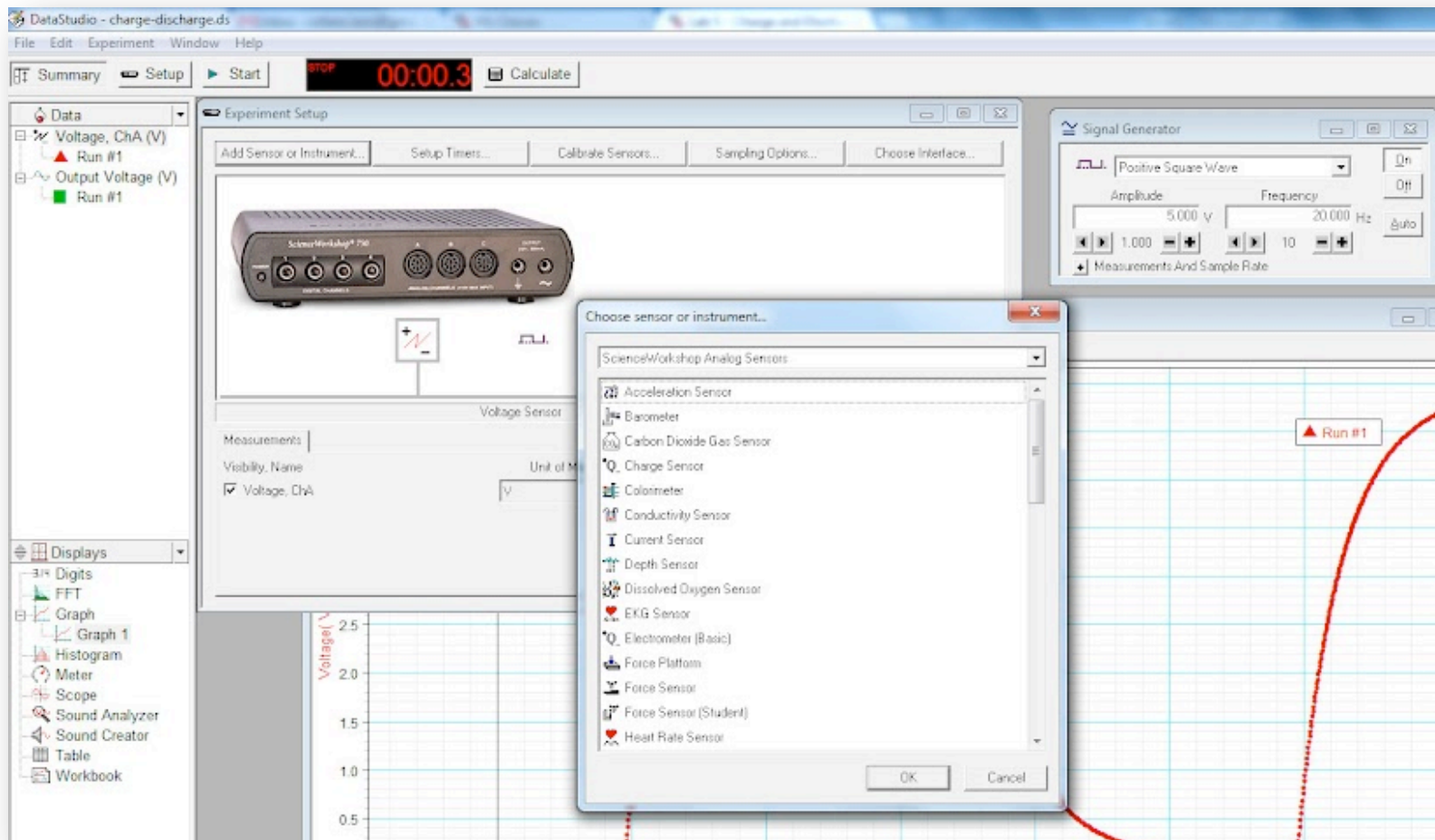
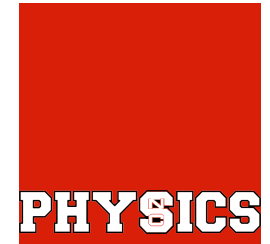
Obstacles Impeding the Pedagogical Vision



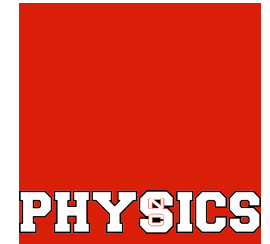
1. Operational and attitudinal difficulties with “black box” interfaces



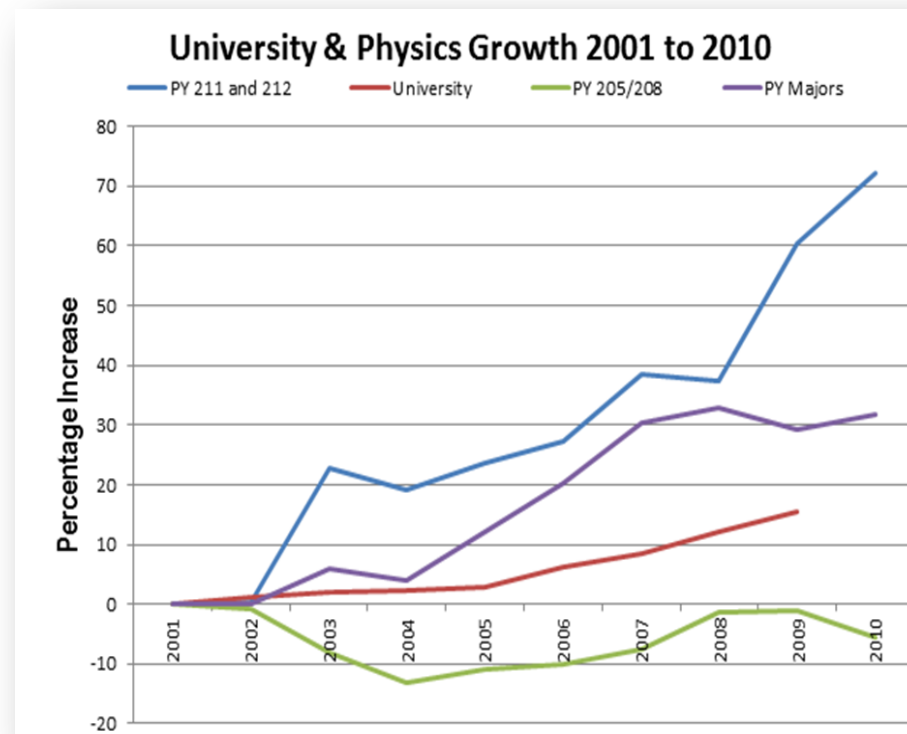
Current Data-Taking PASCO DataStudio Interface Used at NCSU



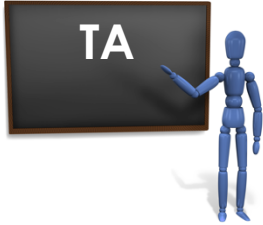



Obstacles Impeding the Pedagogical Vision

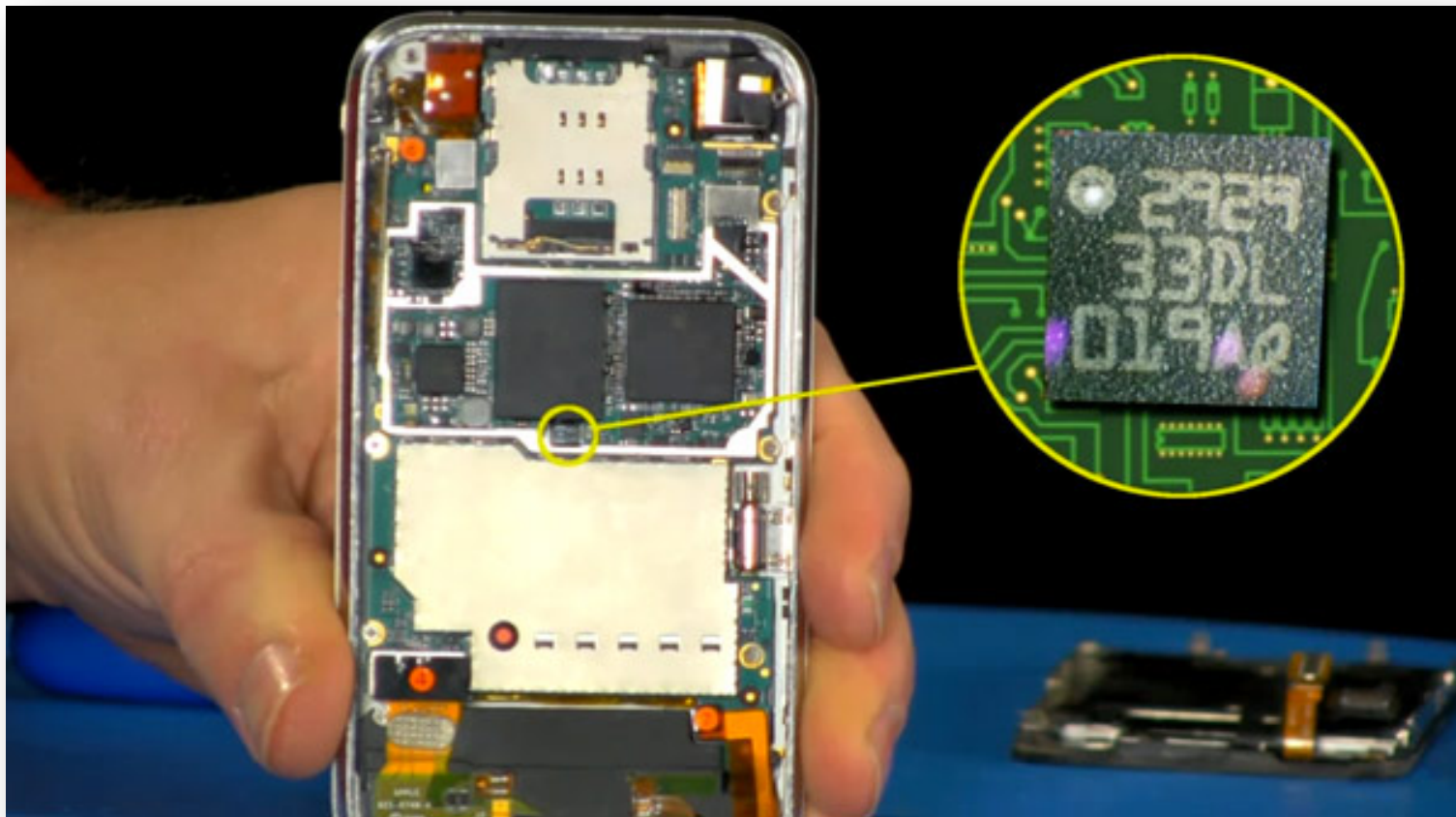
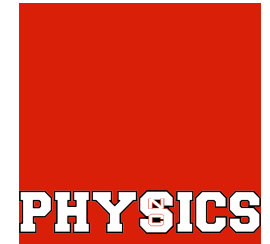


1. Operational and attitudinal difficulties with “black box” interfaces
2. Rising enrollments make costs prohibitive

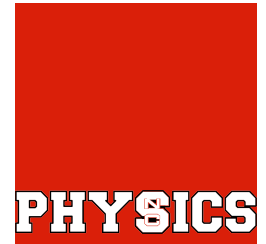


Institution Cost	Traditional Lab	MyTech Lab
<p>Set-Up</p> 	\$8.4K/lab	\$5.5K/lab
<p>Data Collection</p> 	\$13K/lab	\$0/lab
<p>TA</p> 	\$100/student/semester	
<p>Room</p> 	2.5 ft ² /student/semester	

Accelerometer iPhone Chip

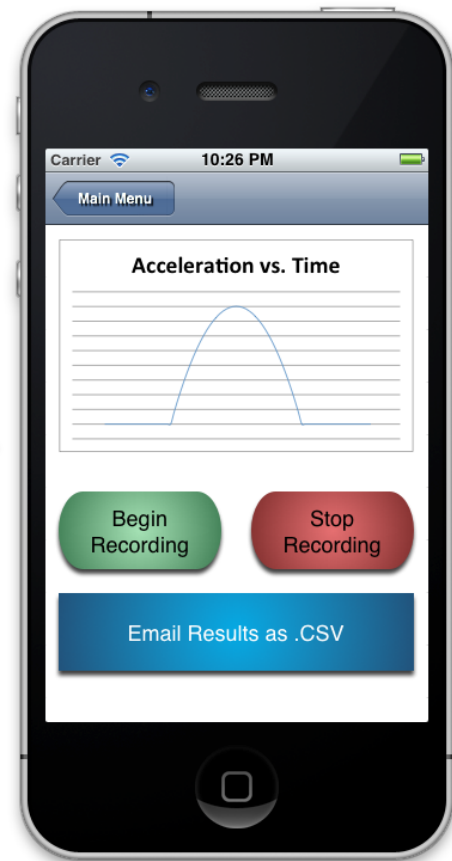
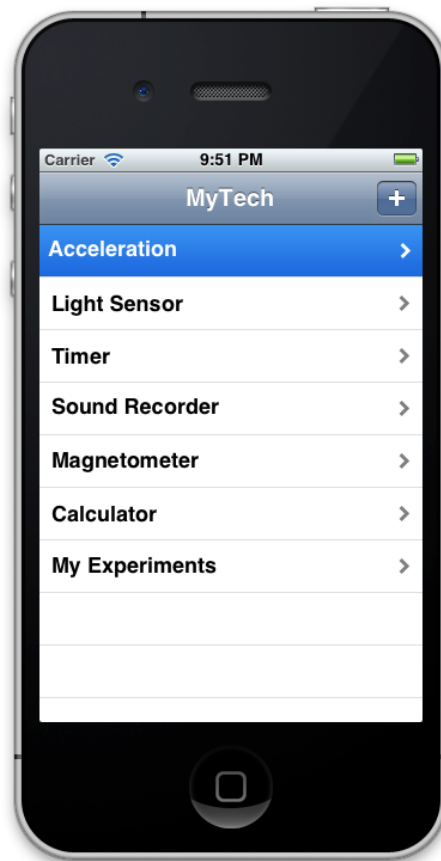
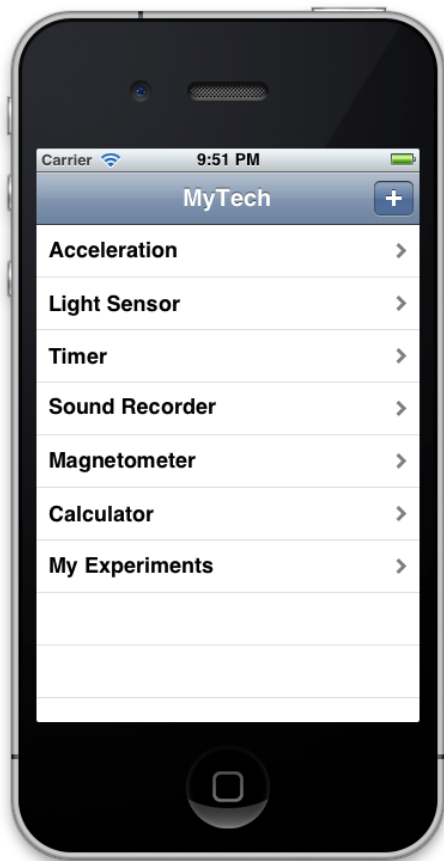
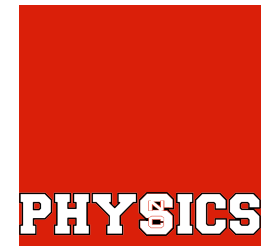


MyTech Research Objectives

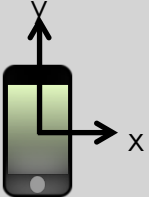
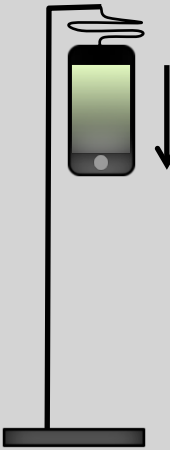
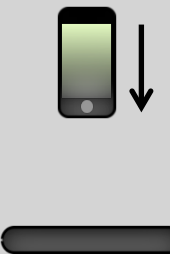
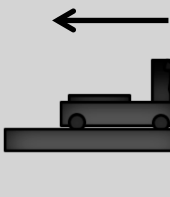


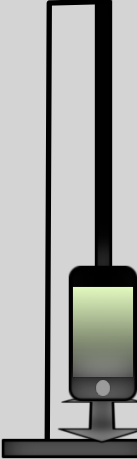
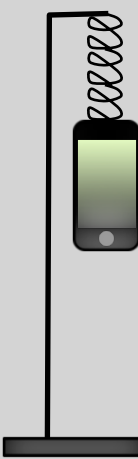


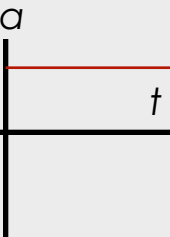
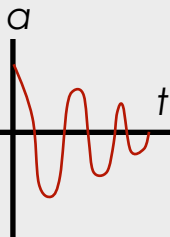
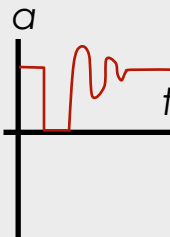
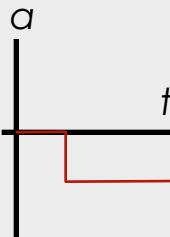
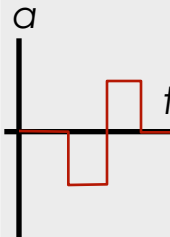
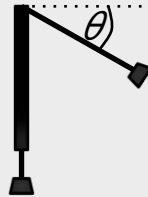
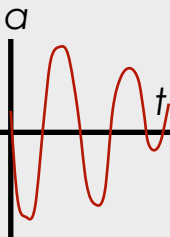
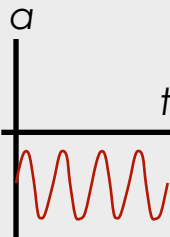
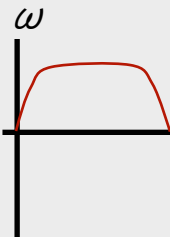
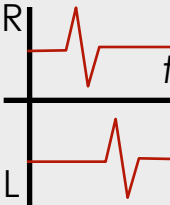


- Create a new app
- Develop a suite of labs
- Construct tools for video analysis
- Determine learning benefits
- Determine attitudinal benefits
- Disseminate results

App Design

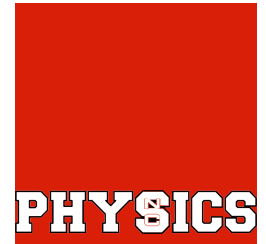


Curriculum

iPhone's Axes	Bungee Acceleration	Free Fall	Motion with a Fan	Impulse and Momentum	Circular Motion	Pendulum	Spring Pendulum	Rotation	Speed of Sound
									
									

Research Questions

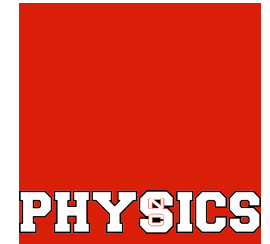
Evaluation Measures



What is the added value of MyTech instruction in student...

- ... learning of physics concepts
 - QERL observation
 - Pre/post surveys of skills: TUG-K

Qualitative Education Research Lab

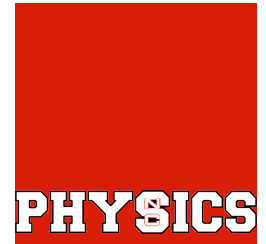


- Designed for researchers studying students interacting in a group setting
- Four cameras with four conference microphones
- Unobtrusive viewing from behind one-way mirrors



Research Questions

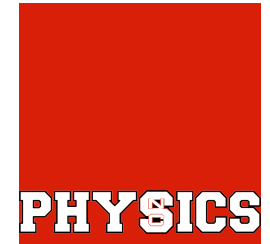
Evaluation Measures



What is the added value of MyTech instruction in student...

- ... learning of physics concepts
 - QERL observation
 - Pre/post surveys of skills: TUG-K
- ... attitudes about lab experience
 - QERL observation
 - Pre/post surveys of attitudes: CLASS
- ... use of devices out-of-school
 - Pre/post surveys of usage
 - Post-survey of anxiety: adapted CARS Test

The Coding and Analysis Process

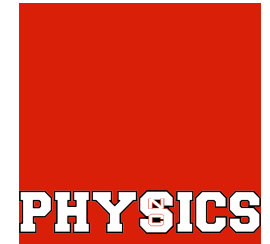


Raw Movie
Files

Coding Helper

Ind. Student
Temporal
Analysis

The Coding and Analysis Process

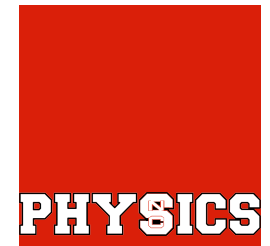


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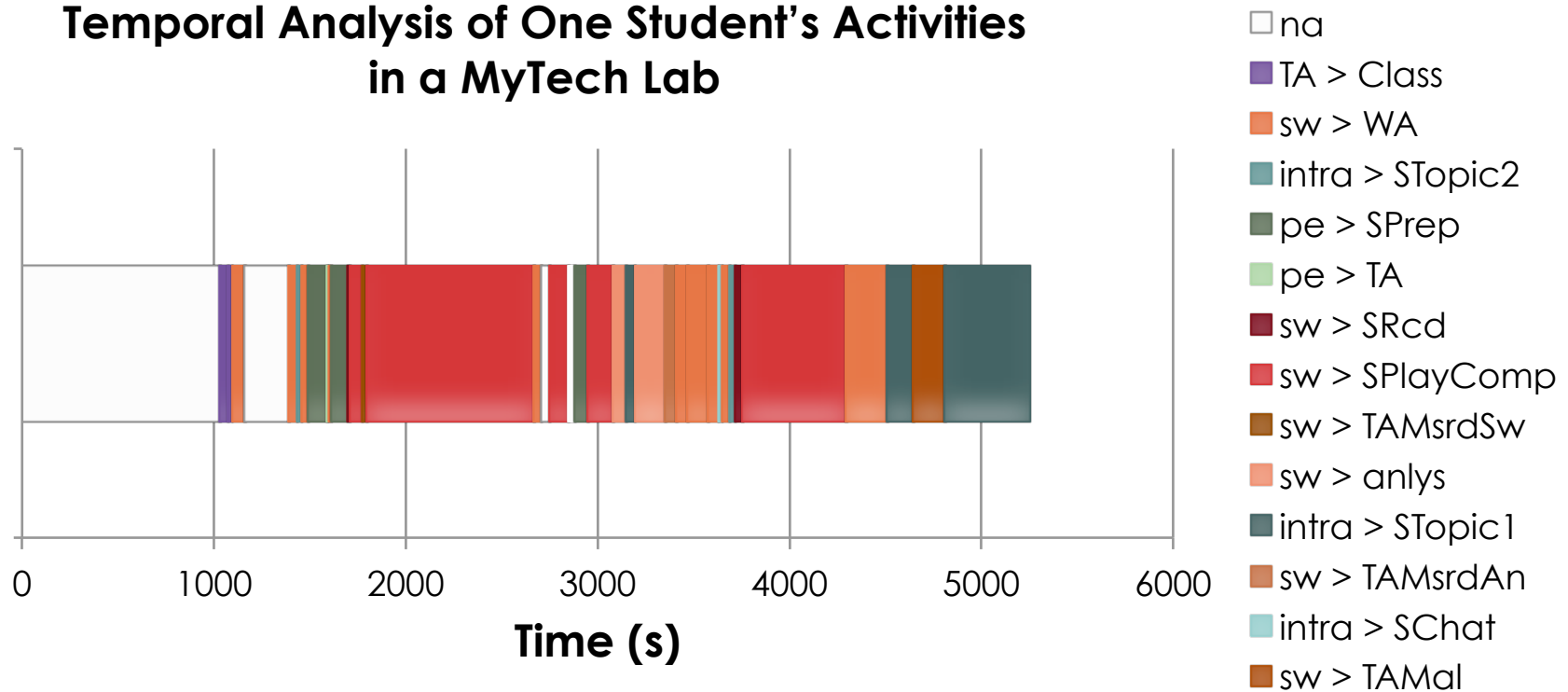
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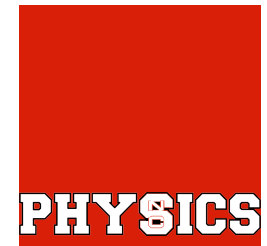
The Coding and Analysis Process



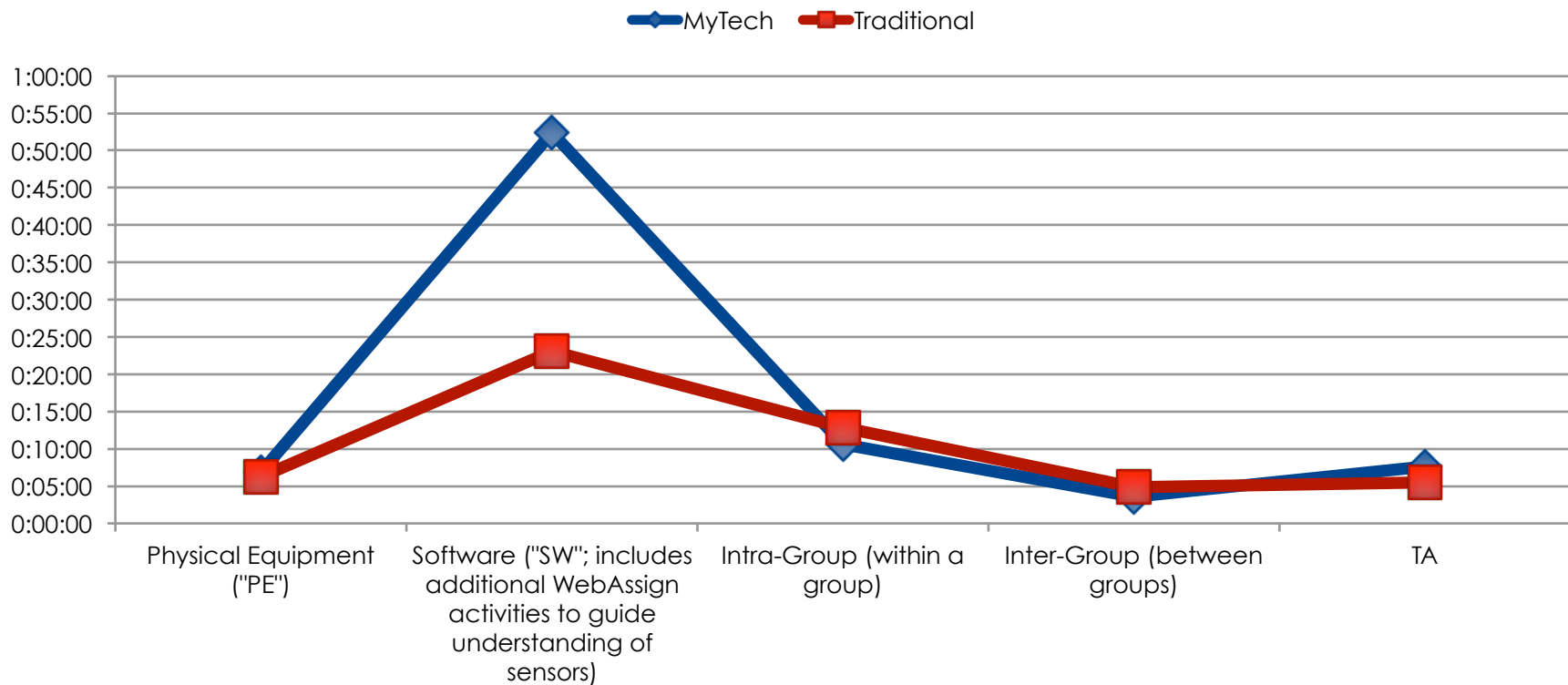
**Sample Output:
Temporal Analysis of One Student's Activities
in a MyTech Lab**



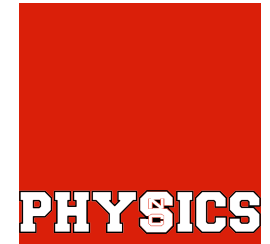
MyTech vs Traditional Comparison



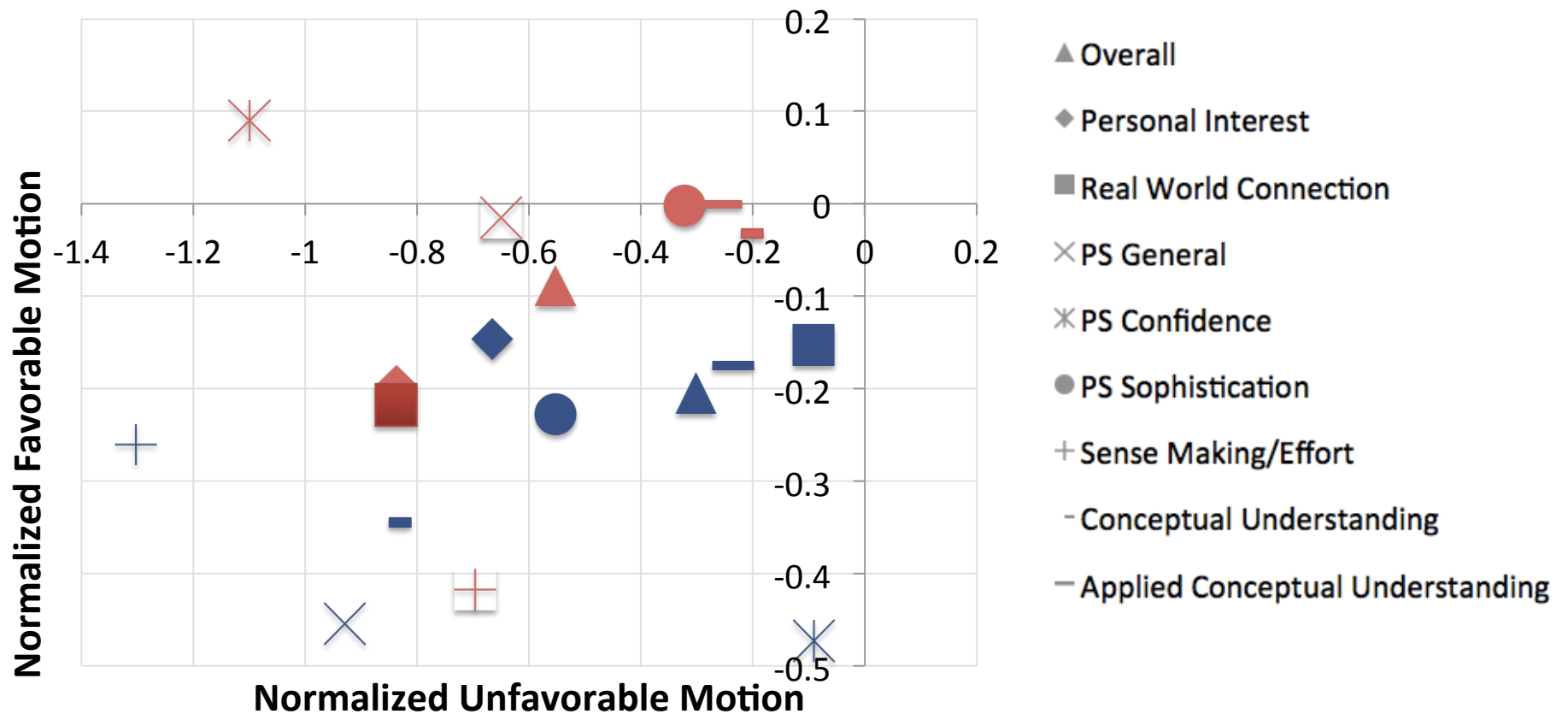
Average Time Spent (per Student) on Each Category of In-Lab Interactions



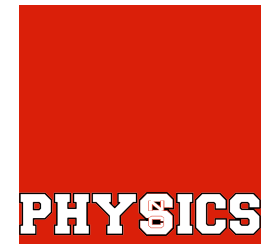
Attitudinal Results from the CLASS



Attitudinal Results from the CLASS¹
Normalized Pre- and Post-Test Movement
MyTech and Traditional Labs

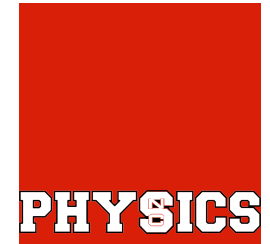


Kinematics Graph Skill Results from the TUG-K



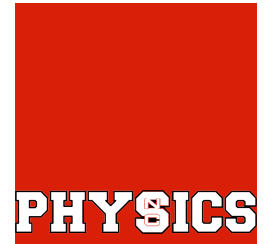
	MyTech	Traditional
n	25	23
Pre-Test Average	66%	66%
Post-Test Average	73%	74%
Grade Shift	+7%	+8%
Normalized Gain	0.2098	0.2348
Standard Deviation in Shift	0.183	0.238

Self-Reported Technological Usage Shifts



Shift	MyTech	Traditional
Daily Computer Use (hour)	+0.13	-1.5
Daily Smartphone Use (hour)	+0.36	-2.0
In-Class Smartphone Use	-6.1%	+10.4%

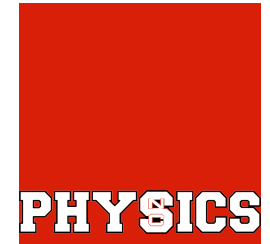
What's Left to Do



- This semester
 - Fine tune last semester's labs and record two new sections
 - Perform IRR for temporal analysis
 - Complete analysis of videos for all the labs
 - Take student fabrication of data into account
 - Start analyzing data from Meredith College

- Next semester
 - Analyze all data from this semester
 - Consider obtaining more data from NCSU and Meredith
 - Publish in the "iPhysics Lab" column of *The Physics Teacher*

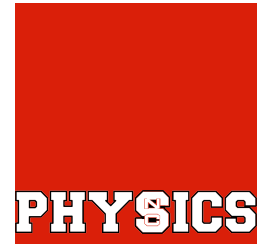
Research Team



- Dr. Paesler
- Dr. Beichner
- NCSU PER Group
- Collaborators:
 - Dr. Blanchard (Science Education)
 - Dr. Mehlenbacher (Leadership, Policy and Adult & Higher Education)
 - Dr. Riehn (Physics)



References



1. Adams, W. K. (2005). The Design and Validation of the Colorado Learning Attitudes about Science Survey. *AIP Conference Proceedings*, 790, 45–48. doi:10.1063/1.2084697
2. Beichner, R. J. (1994). Testing student interpretation of kinematics graphs. *American Journal of Physics*, 62(8), 750. doi:10.1119/1.17449
3. Heinssen, R. K., Glass, C. R., & Knight, L. A. (1987). Assessing computer anxiety: Development and validation of the Computer Anxiety Rating Scale. *Computers in Human Behavior*, 3(1), 49–59. doi:10.1016/0747-5632(87)90010-0
4. West, E. A., Paul, C. A., Webb, D., & Potter, W. H. (2013). Variation of instructor-student interactions in an introductory interactive physics course. *Physical Review Special Topics - Physics Education Research*, 9(1), 010109. doi:10.1103/PhysRevSTPER.9.010109