

ASSESSING THE ALGEBRA-BASED ELECTRICITY AND MAGNETISM STUDIO: FIRST STEPS

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Introduction: Intro Physics at UCF

- 2nd biggest college, enrolling more than 56,000 students
 - Rapid growth from ~33,000 in 2000 (>60%)
- Over 2000 students enrolled in intro math-based physics
- Course structure in flux
 - Small lectures (~90) or big lectures (~300)?
 - Studios (~54)?

“Studio” Physics Instruction

- Focus on integration between course components
 - Workshop Physics¹
 - Studio Physics at RPI²
 - New Studio format at Kansas State³
 - SCALE-UP⁴
- To lecture or not to lecture?
- Studio at UCF
 - Full integration
 - Minimal lecturing
 - E&M materials based on work by Beth Thacker, adapted at UCF by Drs. Dubey & Bindell

¹Laws, 1991; ²Wilson, 1994; ³Sorenson *et al.*, 2006; ⁴Beichner *et al.*, 2007

Comparison: First Steps

- Do we detect a difference in learning between students enrolled in the algebra-based E&M traditional lecture and studio section taught by the *same instructor*?
- Data Sources:
 - SEMCO¹
 - Common quiz question

¹Churukian, 2002

Class Descriptions

Lecture (~90 students)



Studio (~54 students, in groups of 3, 2 groups/table)



Recitation/Lab (~30 students)



Recitation/Lab (~30 students)



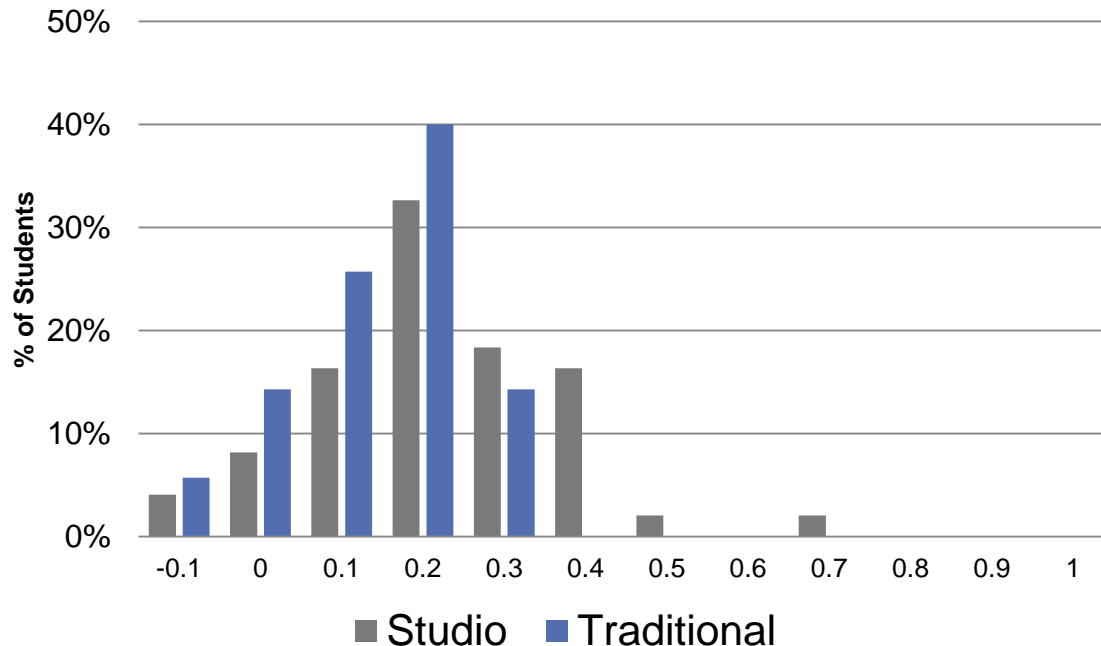
Recitation/Lab (~30 students)



Overall SEMCO Results

	N*	Pretest Avg (SD)	Post-test Avg (SD)	Norm. Gain
Studio	48	24.5% (7.0%)	38.6% (10.6%)	18.6%
Traditional	34**	22.1% (6.6%)	30.3% (8.2%)	10.4%

Normalized Gain



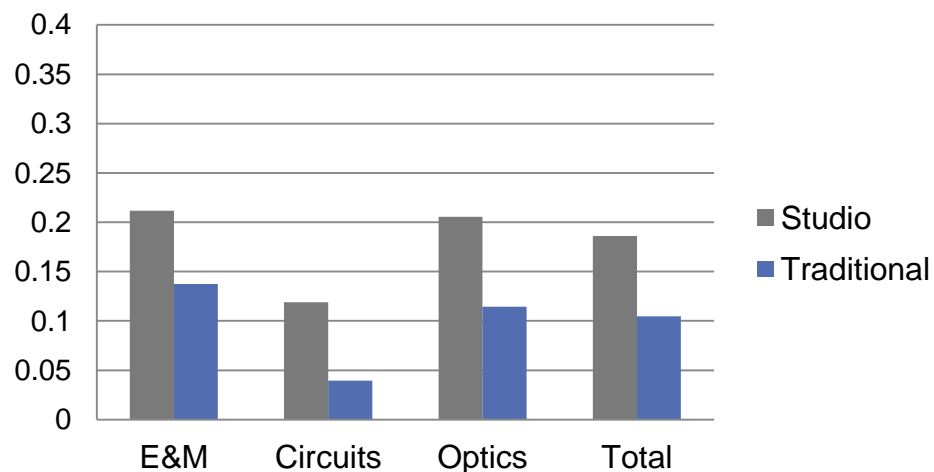
- Significant effect of course on post-test score, $F(1, 79)=12.51, p=.001$
- Pre-test score not significantly related to post-test score, $F(1, 79)=2.69, p=.105$

*Matched pre/post only
**One section missing

SEMCO Results: By Topic

	Pre-test		Post-test	
	Studio	Trad	Studio	Trad
E&M	19.4%	19.7%	36.5%	30.7%
Circuits	24.1%	17.0%	33.1%	20.3%
Optics	33.1%	30.6%	46.9%	38.5%
Total	24.5%	22.1%	38.6%	30.3%

Normalized Gain by Topic



Problem Solving: Description

One component of a magnetic field has a magnitude of 0.054 T and points along the $+x$ axis, while the other component has a magnitude of 0.034 T and points along the $-y$ axis. A particle carrying a charge of $+2.50 \times 10^{-5}$ C is moving along the $+z$ axis at a speed of 3.20×10^3 m/s.

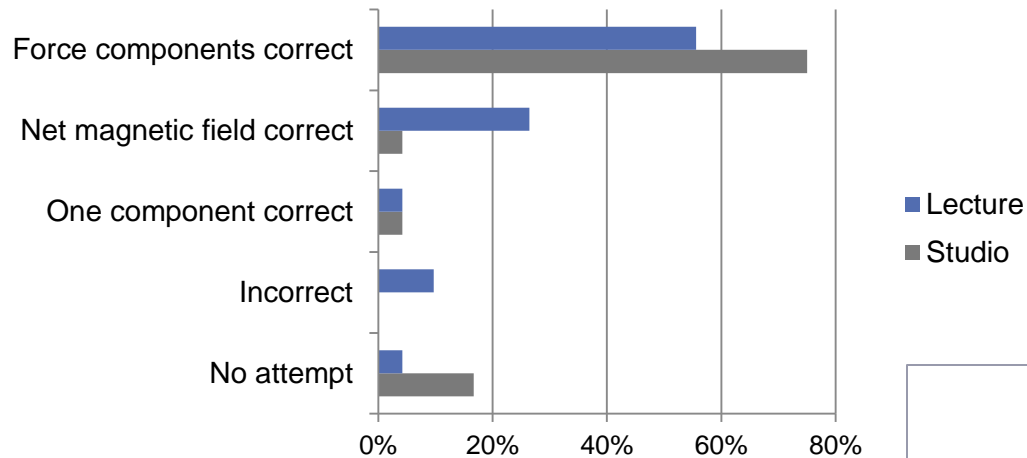
- (a) Find the magnitude of the net magnetic force that acts on the particle.
- (b) Determine the angle that the net force makes with respect to the $+x$ axis.

Problem requires:

- *Combining vector components* to find magnetic force magnitude
- *Right hand rule¹* and *trig* to find the direction of force

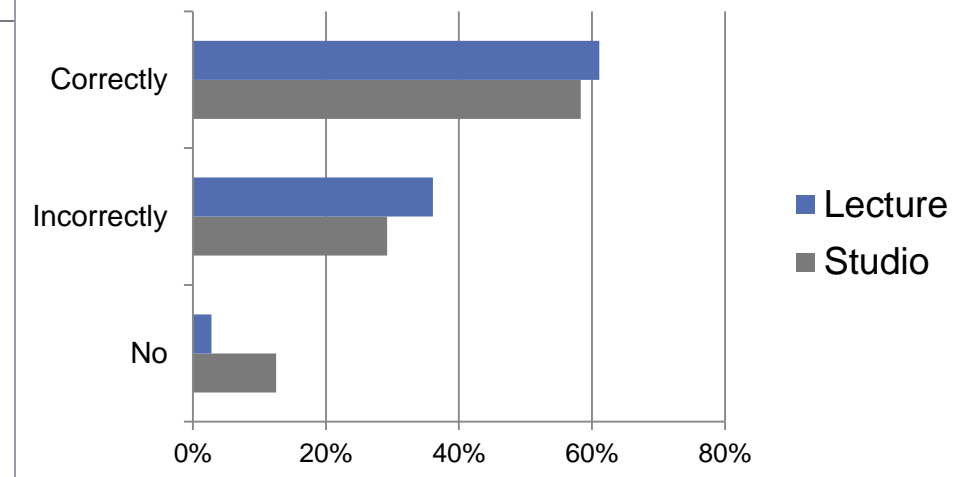
Problem Solving Results: Magnitude

Did student try to use vectors?



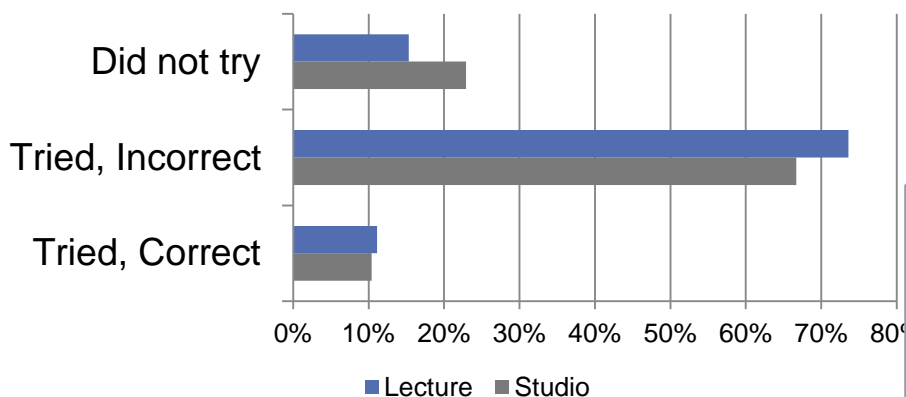
- Lecture students more frequently used net magnetic field
- More studio students did not attempt to use vectors

Did student find magnitude of force?



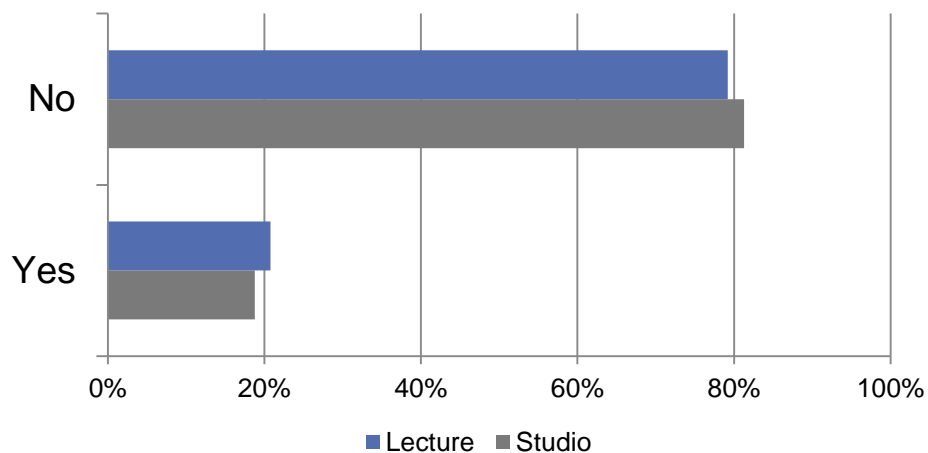
Problem Solving Results: Direction

Did student find the direction of force?



- Most students found direction of magnetic field, not force
- One student in each section explicitly stated that she used “right hand rule”

Did student use RHR?



Conclusions & Future Work

- Significant difference in favor of Studio evident in SEMCO scores
- Present analysis of problem-solving skills shows similar performance in Studio and Lecture sections
- Further analysis planned with Docktor's problem solving rubric¹

¹Docktor, 2010