Status Report on Implementing ENGR-1113 Foundations of Engineering Mathematics at Oklahoma Christian University

(NSF DUE-0817332 CCLI Phase 3 Study)

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OKLAHOMA CHRISTIAN UNIVERSITY
Since 1950

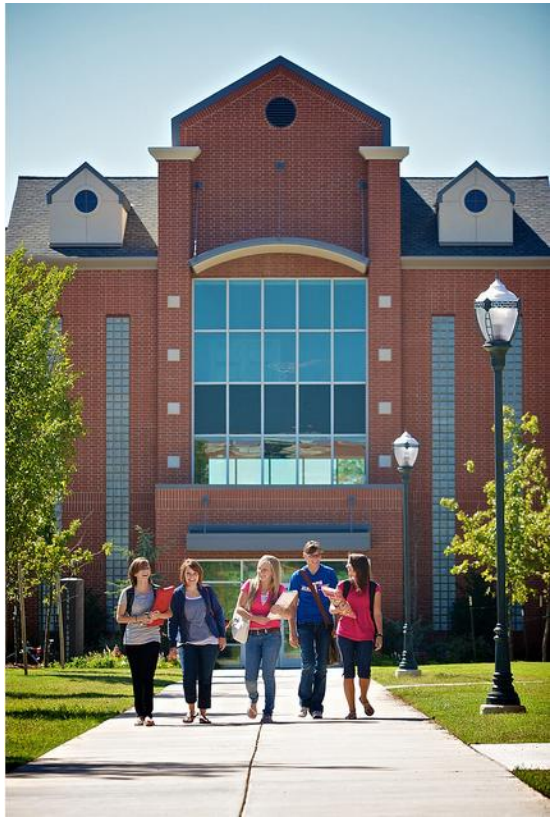
Oklahoma Christian University

- Private, faith-based university in Edmond, OK (north Oklahoma City, 200+ acre campus)
- Enrollment of ~2000 undergraduate and ~250 graduate students
- Three ABET accredited engineering programs (Computer, Electrical, and Mechanical Engineering)
- Essentially common first semester for all engineering programs; allowing all students to participate in the same first semester math offering



Background on ENGR-1113 Foundations of Engineering Mathematics

* Introduced in fall 2009 and taken by ALL enter engineering freshman
* Proceeds Calculus I and all sophomore engineering courses in the curriculum
* The goal is to equip ALL entering students with the resources required to succeed in engineering
  * Emphasizes mature algebra and trigonometry skills, the foundations of differential and integral calculus, and the most basic concepts of differential equations
  * Introduces critical laboratory skills and the use of MATLAB for computational analysis



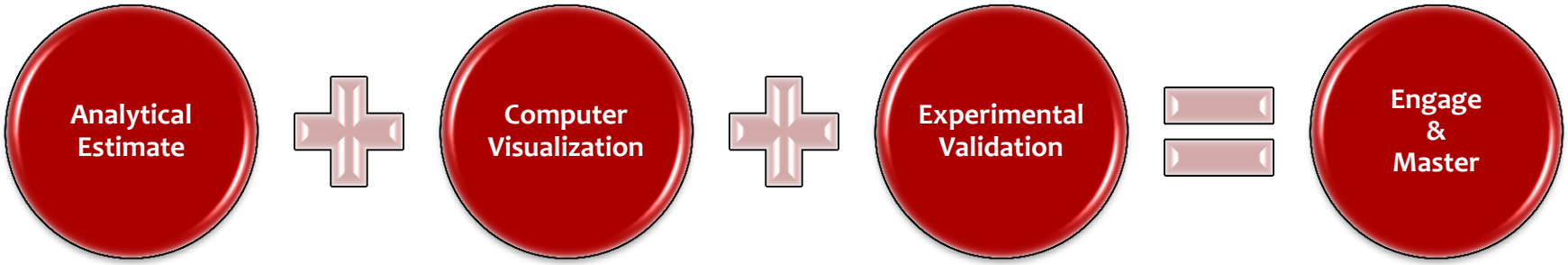
Structure of ENGR-1113 Foundations of Engineering Math

- 3 hour course (semester-based)
- Lectures
  - 50 minutes/day
  - Twice each week
- Laboratory
  - Once a week
  - 3 hour duration
  - Engineering applications
- Assessment
  - Weekly homework
  - Three exams (build to comprehensive final)

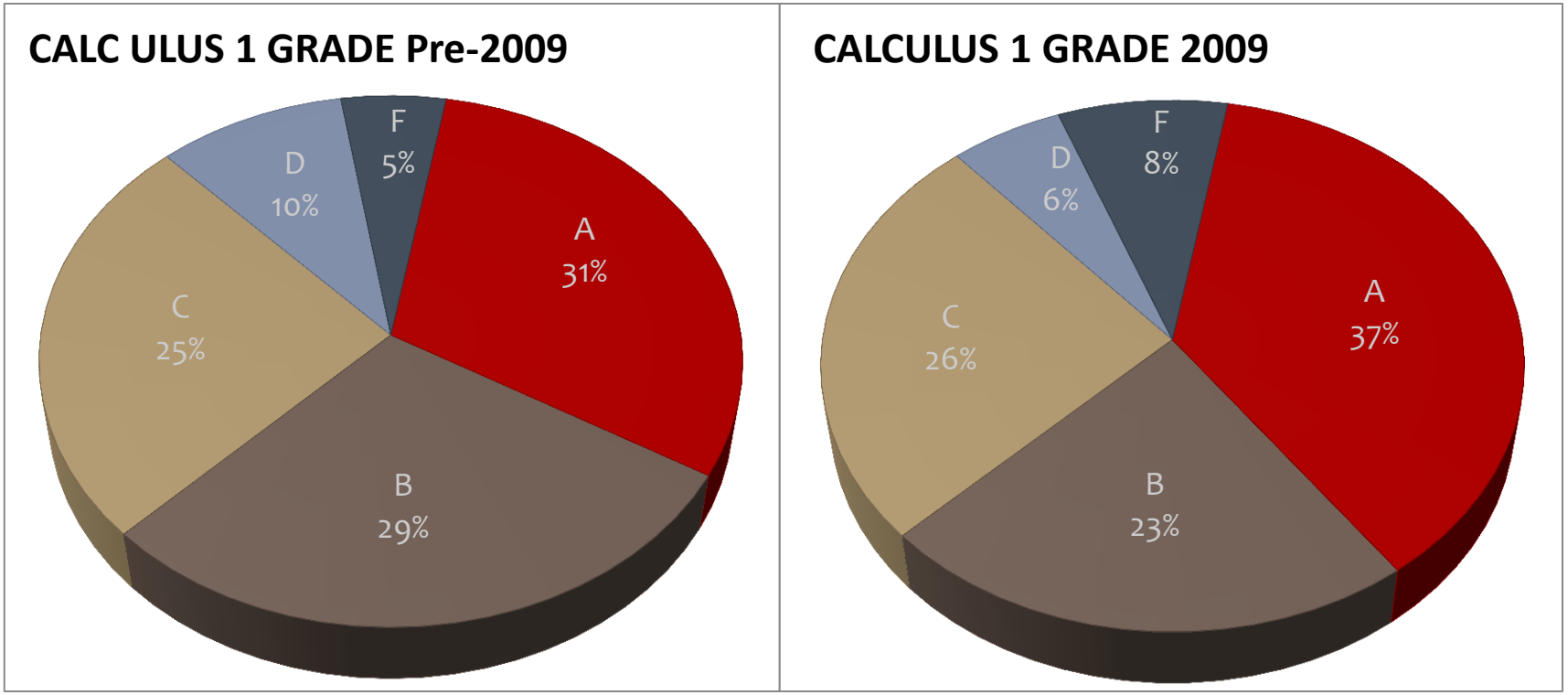
Topic	Lectures	Labs
Algebra	6	2
Trigonometry (include vectors)	5	2
Matrix Algebra	2	1
Calculus Foundations	6	2
Diff. Eqns. Foundations	5	3

Strong Emphasis on Hands-on Learning

* Each class module is reinforced using multiple laboratory experiments that are completed in student teams (two students only)
* All lab assignments use a “mastery” model – requiring students to successful complete the lab to receive a grade (i.e. Pass/Fail)
* Each lab designed to include analytical, computer, and experimental work

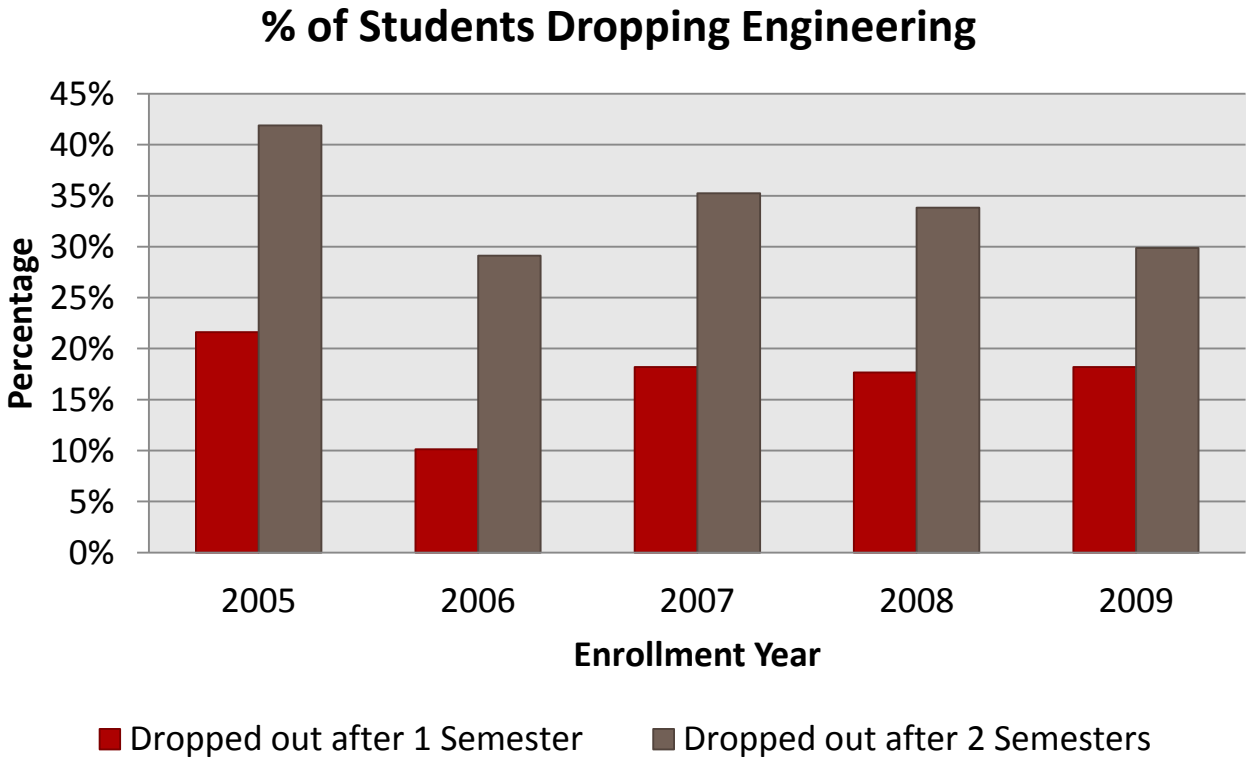


General Performance Results (1 of 2)



Same A+B success rate (60%), but increased A/B ratio (1.61 vs 1.06)

General Performance Results (2 of 2)



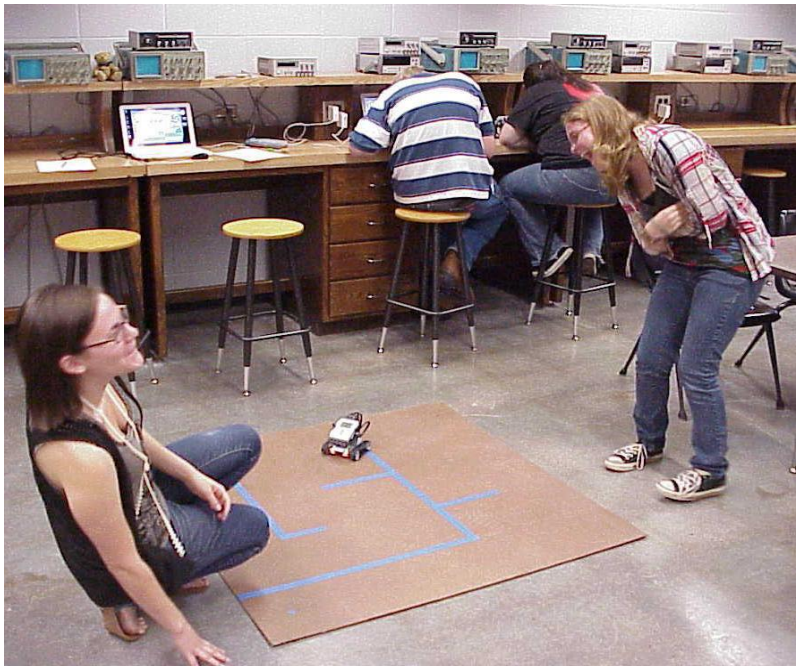
- **Downward trend in student engineering drop rate**
- **Insufficient data, however, to make strong conclusions**
- **Continuing to investigate additional enhancements**

Student Response to the Class

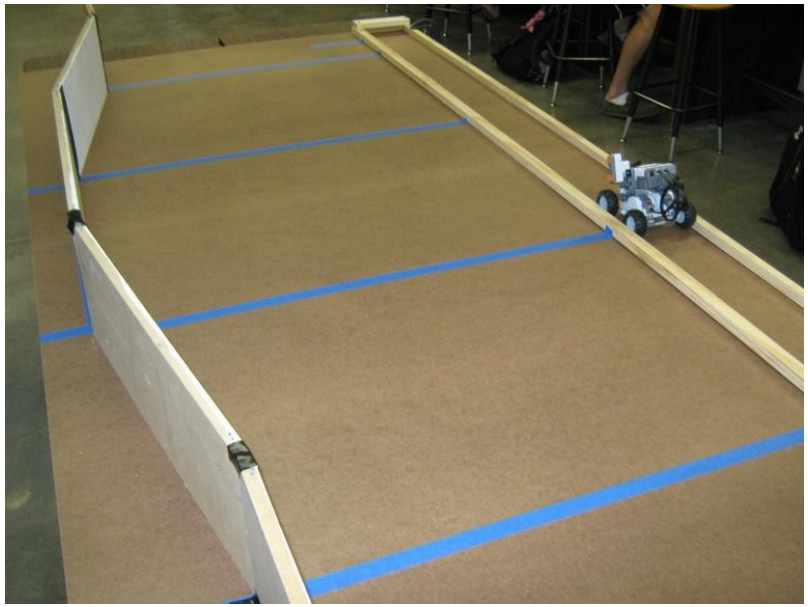
	The lab sections aided my understanding of the lecture material.	This course has increased my motivation to study engineering.	This course has increased my chance of success in engineering.
Strongly Agree	37%	15%	16%
Agree	46%	43%	49%
Neutral	13%	25%	24%
Disagree	4%	11%	9%
Strongly Disagree	1%	5%	1%

Overwhelmingly students found the class to be a valuable influence on their future in the OC Engineering Programs

Enhanced Student Engagement and Desire to Learn
(ASEE 2011 Paper specific to this effort in proceedings)



← Navigation of Maze via Trig
(relative angles, linear scaling)



Integration of Field Area →
(limit concept, integral meaning)

Student Input/Response to the Labs
(ASEE 2011 Paper specific to this effort in preceedings)

We are continuing our efforts to modernize the labs to enhance effectiveness.

	How Engaging? (Rank)	How Effective? (Rank)
Introduction to MATLAB Labs (Programming)	1	3
Resistor circuits and Breadboard use (Algebra)	4	8
Parallel and Series Resistor Circuits Lab (Algebra)	5	7
Lego Mindstorm Maze Lab (Trigonometry)	8	6
Properties and Manipulations of Sinusoids (Trigonometry)	3	1
Two Loop Circuit Application of Systems of Equations (Matrices)	2	2
Freefall Lab (Differentiation)	7	4
Lego Mindstorm Ultrasonic Sensor Lab (Integration)	10	9
Newtonian Cooling Lab (Differential Equations)	9	10
RC Circuit Lab (Differential Equations)	6	5

Conclusions

* Student response to the class STRONGLY justifies continuing this offering for all entering students. The faculty as a whole is also dedicated to continuing and improving ENGR-1113.

* Initial assessment data indicates students are benefiting from the class through improved average Calculus I grades and enhanced retention. More assessment data is required to form strong conclusions, however.

* Moving to a "mastery" model in the laboratories has been very successful – students are more focused on completing the labs and retention of the material seems to be improved. Systematically the labs are also being enhanced with the use of robotics and computer data acquisition (2011 ASEE paper by Newberry).