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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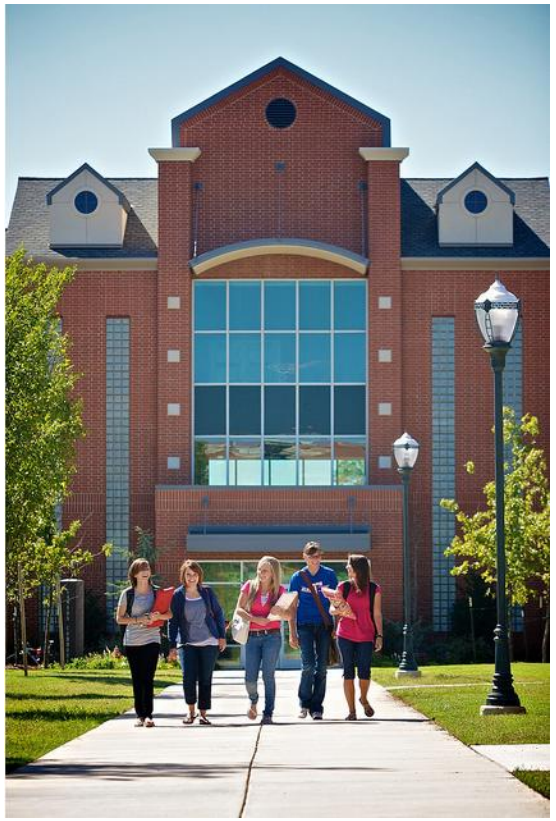
Oklahoma Christian University

- 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)
- Typical freshman engineering class size of 60 to 65 students



Background on ENGR-1113 Foundations of Engineering Mathematics

* Introduced in fall 2009 … taken by ALL entering engineering freshman.
* Precedes or parallels Calculus I.
* Precedes all core Engineering and Physics courses.
* Aims to equip ALL entering engineering students for success. Student retention is the key driver of the class.



Historical Structure of ENGR-1113

Most Recently Fall 2011

- **3 hour lecture + lab course**
  - Strong starter review
  - Emphasis on Calculus basics
- **Laboratory**
  - 3/hours each week
  - Graded on mastery
- **Assessment**
  - Weekly homework
  - Two unit exams
  - Comprehensive final exam

Topics (2 Lectures/Week)	Weeks
Algebra & Trig	4
Vectors	2
Complex Numbers	1.5
Harmonic Functions	1.5
Matrix Algebra	1
Calculus Foundations	4

Performance Results (1 of 3)

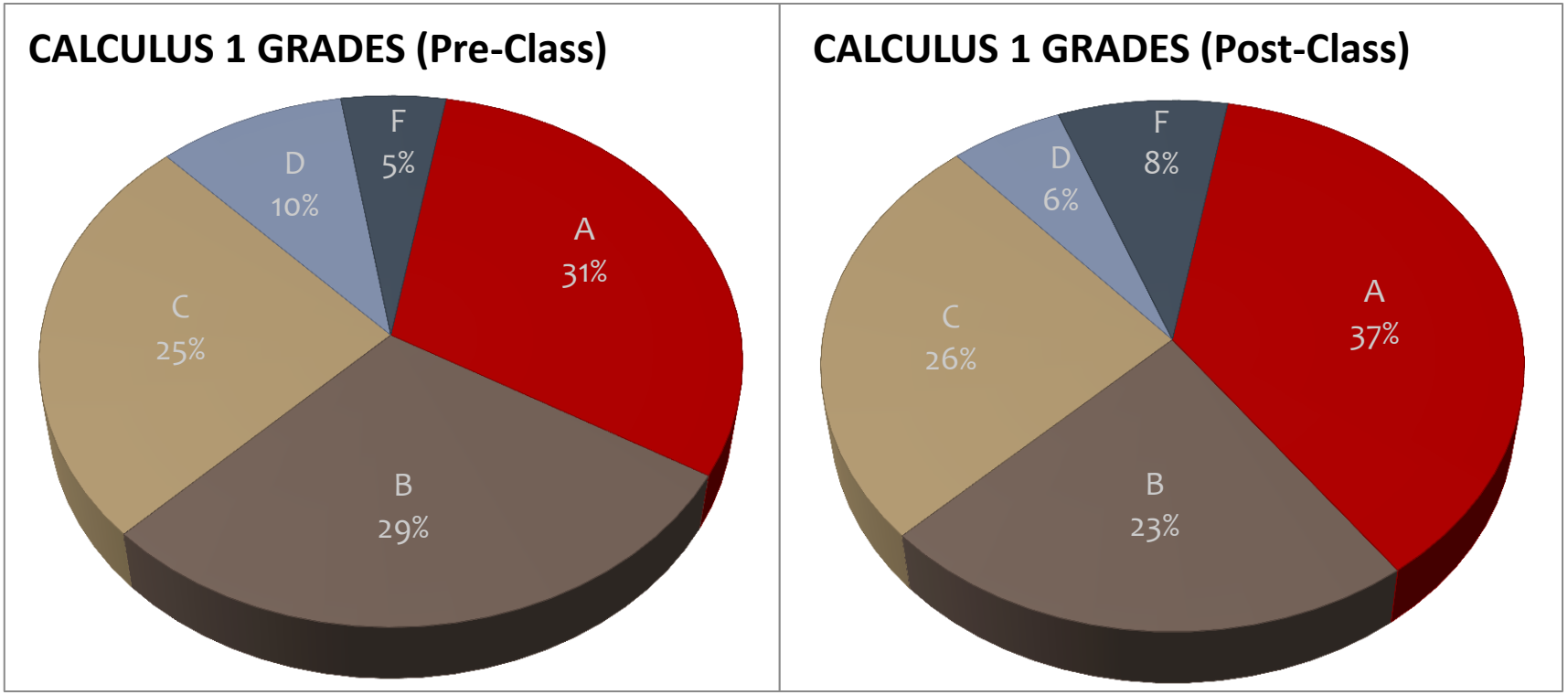
Fall 2011 Survey Results (62 Students)

Student Survey Results Oklahoma Christian University - OC 2011-12 (Year 4)	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
This course has increased my motivation to study engineering.	11.3%	43.5%	33.9%	6.5%	4.8%
This course has increased my chances of success in engineering.	21.0%	45.2%	29.0%	3.2%	1.6%
This course has increased my motivation to study math.	8.1%	37.1%	37.1%	16.1%	1.6%
This course has increased my chances of success in future math courses.	11.3%	61.3%	19.4%	6.5%	1.6%
The lab sections aided my understanding of the lecture material.	22.6%	45.2%	25.8%	3.2%	3.2%

Generally students self-report the class to have value. Yet student motivation is not as positively influenced as desired.

Performance Results (2 of 3)

Based on Limited "Post-Class" Data



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

Performance Results (3 of 3)

Trends from Student Free Form Feedback

- No proven increase in student retention can be linked to ENGR-1113 at OC yet; though students generally self report the class is beneficial.
- Limited available data indicates the class strengthens stronger math students and has a neutral impact on the weaker math students.
- Mathematically stronger students self-report that they benefit from the class much more than mathematically weaker students.
- Students with less mathematical preparation (ACT Math < 27) often struggle; reporting that the pace is too fast.

Updated Structure of ENGR-1113

To be Implemented Fall 2012

- **3 hour lecture course**
  - Reduced initial review of basics
  - More on vectors, complex #'s, harmonic functions, and matrices
  - Calculus exposure retained; but not the key mission
- **Semester Project**
  - Comprehensive in content
  - Team based
- **Demonstrations Replace Labs**
  - In-class by Instructor
  - Reclaims time for lectures

Topics (3 Lectures/Week)	Weeks
Algebra & Trig	3
Vectors	2
Complex Numbers	2
Harmonic Functions	2
Matrix Algebra	2
Calculus *(Semester Project Concurrent with Lectures)*	3

Labs vs. Demonstrations

Trends from Student Free Form Feedback

Labs

* Allows individual student involvement (+)
* Fosters experience with lab equipment (+)
* Requires training in proper use of lab equipment; increasing time demands (–)
* Failures in execution can hide the planned learning (–)

Demonstrations

* Retains the physical link between the math and engineering (+)
* Performed by experienced instructors; reducing the risk of failure (+)
* Allows for guided discussion as the instructor is leading (+)
* Lacks individual student execution (–)

Conclusions (1 of 2)

* Student feedback and preliminary performance results justify continuing the course.
* The faculty is committed to enhancing integration of the class with the OC Engineering curriculum.
* The diversity of mathematical preparation within the entering engineering class is extremely broad. This fact makes it challenging to have a single class required of all students.

Conclusions (2 of 2)

* The OC ENGR-1113 offering is being modified to …
  * Retain the experiential element of the labs using in-class demonstrations by the instructor (while recovering time)
  * Increase time spent on core engineering math topics (vectors, complex numbers, harmonic functions, matrices)
  * Include a comprehensive semester project (small team based) to integrate all the topics of the class into a single engineering case