



ENGR 2194 - Fundamentals of Mathematics for Engineers

Lisa Abrams, PhD (OSU)

Lisa Barclay (OSU)

Leroy Long, PhD (now at Embry-Riddle Aeronautical University)

Jamie Paulson (OSU)





Agenda

- Our school
- Course rationale
 - Math placement
 - Retention data before this course
- Course content
- Academic outcomes
- Student responses
- Future






Our School

- Large (58,322 students) public university in the Midwest
- 14 majors within the College of Engineering (COE)
- 7752 undergraduate students in the COE (not including the Knowlton School of Arch)
 - 20.1% female
 - 6.3% under-represented minority
- New engineering students are either directly enrolled into the College of Engineering (holistic review) or enrolled in the College of Arts & Sciences (Exploration major)
- All students take first two semesters of Fundamentals of Engineering



Math Placement Test

| Math Placement | Math Content You Qualify For | Recommended ENGR Course |
|---|------------------------------|-------------------------|
|  | Calculus/Math 1151 | ENGR 1181 |
|  | Pre-Calculus/Math 1150 | ENGR 1181 |
|  | College Algebra/Math 1148 | Gen Ed |

✿ Chemistry 1210/12150 requires level L or M Physics 1250 requires level L

✿ Scholars placing in level N are eligible to take ENGR 1181



Retention Stats of Math 1148 Students

- 1070 students took Math 1148 (College Algebra) in Autumn 2012
 - 78 of those students were first year OSU students who indicated Engineering (ENG, EXP)
- As of Autumn 2013, 50 of those were still in Engineering
 - 64% retention compared to 80% retention of the general 2012 ENGR population
- As of Autumn 2014, 23 of those are still in Engineering
 - 30% retention compared to 69% retention of the general 2012 ENGR population



Diversity Stats of Math 1148 Students

- 20 URM, 13 Female students were first year OSU students who indicated Engineering (ENG, EXP) and took Math 1148 Autumn 2012
- As of Autumn 2013, 14 URM, 9 Female students are still in Engineering
 - 70%/69% retention compared to 75%/77% retention of the general 2012 ENGR population
- As of Autumn 2014, 7 URM, 3 Female students are still in Engineering
 - 35%/23% retention compared to 59%/65% retention of the general 2012 ENGR population



ENGR 2194

- Modeled after the Wright State model
- 4 credit hours
- Piloted Autumn 2014 and Autumn 2015 with the blessing of Math Dept
- Meets daily (55 minute lectures (3), 125 minute lab, 80 minute recitation)



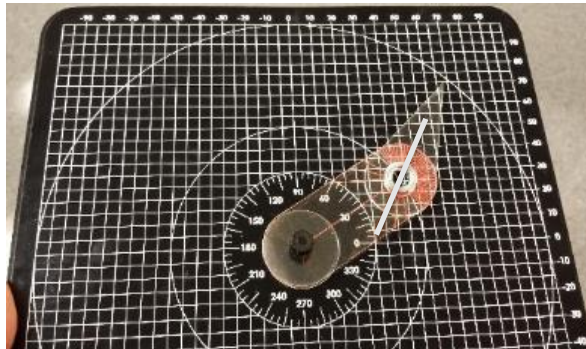
Math Topics

1. Straight Lines
2. Quadratic Equations
3. Trigonometry
4. Two-Dimensional Vectors
5. Complex Numbers
6. Sinusoids
7. Systems of Equations
8. Derivatives
9. Integrals
10. Differential Equations



Lab Topics

1. One-loop circuit
2. One & two-link planar robots
3. Harmonic signals
4. Two-loop circuit
5. Free-fall
6. Work & energy in a spring
7. Leaking bucket
8. Spring-mass vibration
9. Excel and Matlab





Recitation Topics

1. How learning works
2. Goal setting
3. Time management
4. Self-awareness &
personal responsibility
5. Test-taking strategies
6. Scheduling tips
7. Stress management
8. 13 best ideas



Academic Outcomes for Students Who:

- Entered as NFYS (New First Year Semester Students) on Columbus campus in AU12, AU13, AU14, or AU15
- Enrolled as Engineering (UENG) or Exploration (UEXP) with a declared Engineering AOI (Area of Interest) during their first autumn
- Earned a grade in Math 1148 in their first autumn

N=20 of 204 total students who completed ENGR 2194

- Additional students enrolled in ENGR 2194 but did not meet above criteria



Student Outcomes: Math

- Students who completed ENGR 2194 earned higher average grades in Math 1148 & 1149

| Course | Completed ENGR 2194 | | | | Total | |
|-----------|---------------------|--------|--------------|--------|--------------|--------|
| | N | | Y | | | |
| | AVG Grade | Number | AVG Grade | Number | AVG Grade | Number |
| MATH 1148 | 2.5 | 174 | 3.1 | 52 | 2.7 | 226 |
| MATH 1149 | 2.6 | 100 | 2.9 | 28 | 2.6 | 128 |



Student Outcomes: Math

- Students who completed ENGR 2194 earned lower average grades in Math 1151

| Course | Completed ENGR 2194 | | | | Total | |
|-----------|---------------------|--------|--------------|--------|--------------|--------|
| | N | | Y | | | |
| | AVG Grade | Number | AVG Grade | Number | AVG Grade | Number |
| MATH 1151 | 1.7 | 92 | 1.1 | 20 | 1.6 | 112 |

- Of all Autumn 2014 students, more of those who completed ENGR 2194 (20 out of 30, as compared to 7 out of 19) continued on to Math 1151



Student Outcomes: FE (Fundamentals of Engineering)

- Students who completed ENGR 2194 earned slightly higher average grades in ENGR 1181.01, but earned lower grades in ENGR 1182.01

| Course | Completed ENGR 2194 | | | | Total | |
|-----------------|---------------------|--------|--------------|--------|--------------|--------|
| | N | | Y | | | |
| | AVG Grade | Number | AVG Grade | Number | AVG Grade | Number |
| ENGR 1181.01 | 2.6 | 91 | 2.7 | 25 | 2.6 | 116 |
| ENGR 1182.01 | 3.3 | 50 | 2.9 | 17 | 3.2 | 67 |



Student Outcomes: URM

- Black and Hispanic students who completed ENGR 2194 earned higher average grades in Math 1148 & 1149 than their peers who did not take ENGR 2194

| Completed ENGR 2194 | Course | American Indian/ Alaska Native | | Asian | | Black or African American | | Hispanic | | None Given/Race Unknown | | Two or More Races | | White | | Total | |
|------------------------|-----------|---|---|--------------|---|---------------------------------|----|--------------|----|-------------------------------|---|----------------------|---|--------------|----|--------------|-----|
| | | AVG Grade | # | AVG Grade | # | AVG Grade | # | AVG Grade | # | AVG Grade | # | AVG Grade | # | AVG Grade | # | AVG Grade | # |
| N | MATH 1148 | 1.0 | 2 | 2.9 | 7 | 2.3 | 42 | 1.7 | 13 | 2.9 | 4 | 3.0 | 7 | 2.7 | 99 | 2.5 | 174 |
| | MATH 1149 | | | 2.2 | 4 | 2.3 | 19 | 3.0 | 5 | 2.4 | 5 | 2.1 | 7 | 2.7 | 60 | 2.6 | 100 |
| Y | MATH 1148 | | | 3.5 | 2 | 2.4 | 9 | 3.0 | 4 | 3.2 | 2 | 3.4 | 2 | 3.2 | 33 | 3.1 | 52 |
| | MATH 1149 | | | | | 3.4 | 3 | 3.3 | 1 | | | 3.3 | 1 | 2.8 | 23 | 2.9 | 28 |



Student Outcomes: F

- Female students who completed ENGR 2194 earned higher average grades in Math 1148 & 1149 than their peers who did not take ENGR 2194

| Completed ENGR 2194 | Course | F | | M | | Total | |
|------------------------|-----------|--------------|----|--------------|-----|--------------|-----|
| | | AVG Grade | # | AVG Grade | # | AVG Grade | # |
| N | MATH 1148 | 2.6 | 31 | 2.5 | 143 | 2.5 | 174 |
| | MATH 1149 | 2.5 | 23 | 2.6 | 77 | 2.6 | 100 |
| Y | MATH 1148 | 3.1 | 17 | 3.0 | 35 | 3.1 | 52 |
| | MATH 1149 | 3.5 | 7 | 2.7 | 21 | 2.9 | 28 |



Student Outcomes: Retention

- Engineering students who completed ENGR 2194 in Autumn 2014 were retained at 83% one year later, a rate in line with the overall first year retention rate for the college

| Admit Term | Took ENGR 2194 | Program in Admit Term | Total | AU13 Enrollment Status | AU15 Enrollment Status | | | | | | | |
|------------|----------------------|-----------------------|-----------|------------------------|------------------------|-----|------|-----|---------------|-----|--------------|-----|
| | | | | UENG | UENG | | UEXP | | Other Program | | Not Enrolled | |
| | | | | # | # | % | # | % | # | % | # | % |
| AU14 | N | UENG | 7 | | 2 | 29% | 1 | 14% | 3 | 43% | 1 | 14% |
| | | UEXP | 12 | | 1 | 8% | 8 | 67% | 3 | 25% | | |
| | | <i>Subtotal</i> | <i>19</i> | | 3 | 16% | 9 | 47% | 6 | 32% | 1 | 5% |
| | Y | UENG | 18 | | 15 | 83% | 2 | 11% | 1 | 6% | | |
| | | UEXP | 12 | | | | 10 | 83% | | | 2 | 17% |
| | | <i>Subtotal</i> | <i>30</i> | | 15 | 50% | 12 | 40% | 1 | 3% | 2 | 7% |
| | <i>AU14 Subtotal</i> | | <i>49</i> | | 18 | 37% | 21 | 43% | 7 | 14% | 3 | 6% |



Student Responses

“I really enjoyed this class and I believe it has improved my math skills and over all thinking process greatly.”

“I am so thankful that this opportunity was provided to me. I am much more confident in my math and critical thinking skills and feel much better about beginning the engineering curriculum next semester. It was a course that I thoroughly enjoyed going to and would recommend to future..students..”



Student Responses

“The workload taught me how to prepare for my future classes and the instructors helped me with this preparation. I’m grateful for the student connections that I’ve made. Support and connections are critical to my success.”



Future

- LSAMP and/or PREFACE summer bridge program
- One more pilot
- Permanent course? Columbus campus? Regional campuses?



Newly Established Department

Connect with us

- Now and at ASEE 2017 in Columbus

New initiatives

- Developing a Ph.D. program in engineering education
- Expanding our faculty and staff

Learn more

- Visit eed.osu.edu