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University of Toledo
Engineering Applications of Math

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Undergraduate Engineering at UT

- ABET accredited Engineering Science programs
  - BioE, ChE, CivE, CSE, EE, ME
  - Target population for WSU Engineering Mathematics
- ABET accredited Engineering Technology programs
  - Construction, Computer, Electrical, Information Technology and Mechanical
- Mandatory co-op program for all Engineering Science students
  - Three semesters of co-op are required
  - Requires students to stay on schedule in their curriculum

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Undergraduate Engineering at UT

- Engineering Science credentials
  - ACT composite 25.9
  - ACT Math 27.3
  - HS GPA 3.66
- First to second year retention
  - 76% remaining in Engineering
  - 87% remaining at UT
- Credentials, retention & subsequent data from 2007-10 entering classes
  - Offered ENG math course over this same time frame

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Mathematics for UT Engineering

- Mathematics placement depends on level of preparation and placement test scores
- MATH 1320 College Algebra (3 hrs)
- MATH 1330 Trigonometry (3 hrs)
- MATH 1340 College Algebra & Trig (4 hrs)
- MATH 1980 Trigonometry Review (1 hr)
- MATH 1850 Calculus I (4 hrs)
- MATH 1920 Honors Calculus I (4 hrs)
- MATH 1860 Calculus II (4 hrs) and higher

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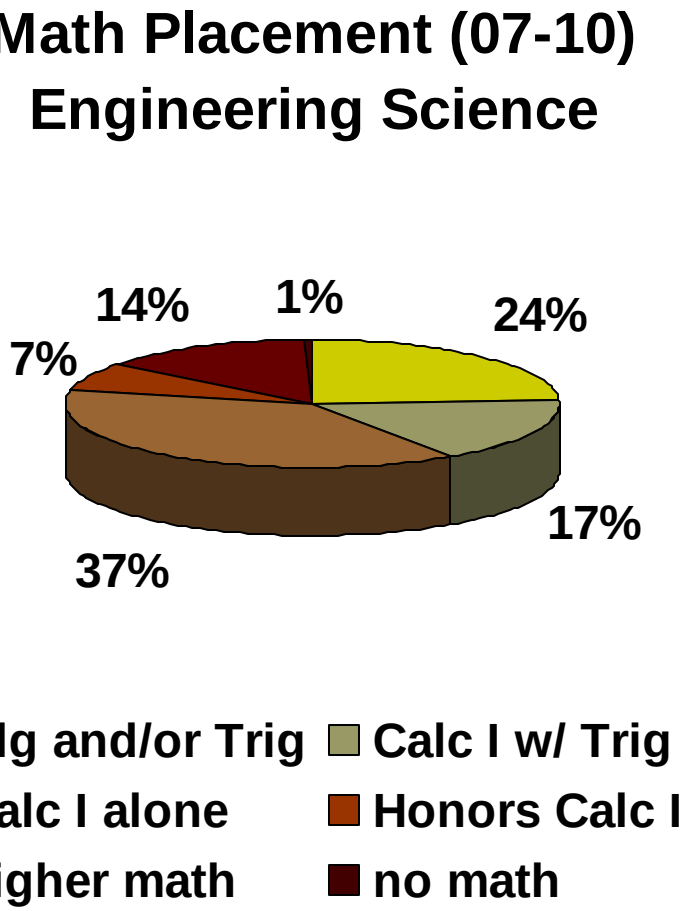
Mathematics for UT Engineering

- Resulting pathways to Calculus I for DHS students
- Start in MATH 1320 and/or MATH 1330 before MATH 1850
- Start in MATH 1340 before MATH 1850
- Intensive two-week summer MATH camp before MATH 1850
- Direct entry into MATH 1850 supplemented by MATH 1980
- Direct entry into MATH 1850 without supplemental instruction
- Qualifying honors students can choose MATH 1920 instead of MATH 1850
- Students with AP, IB or post-secondary credit can proceed directly into Calculus II or higher

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Mathematics Placement

- Placement in Mathematics courses based on various factors
  - ACT or SAT Mathematics score
  - Elementary or College Algebra placement test
  - Trigonometry placement test
- Our goal is to have students take Calculus I as soon as possible
  - Required for Physics and subsequent Engineering coursework
  - Many students go out on their first co-op after 3rd semester
  - 3 out of 4 first year students are on target or better



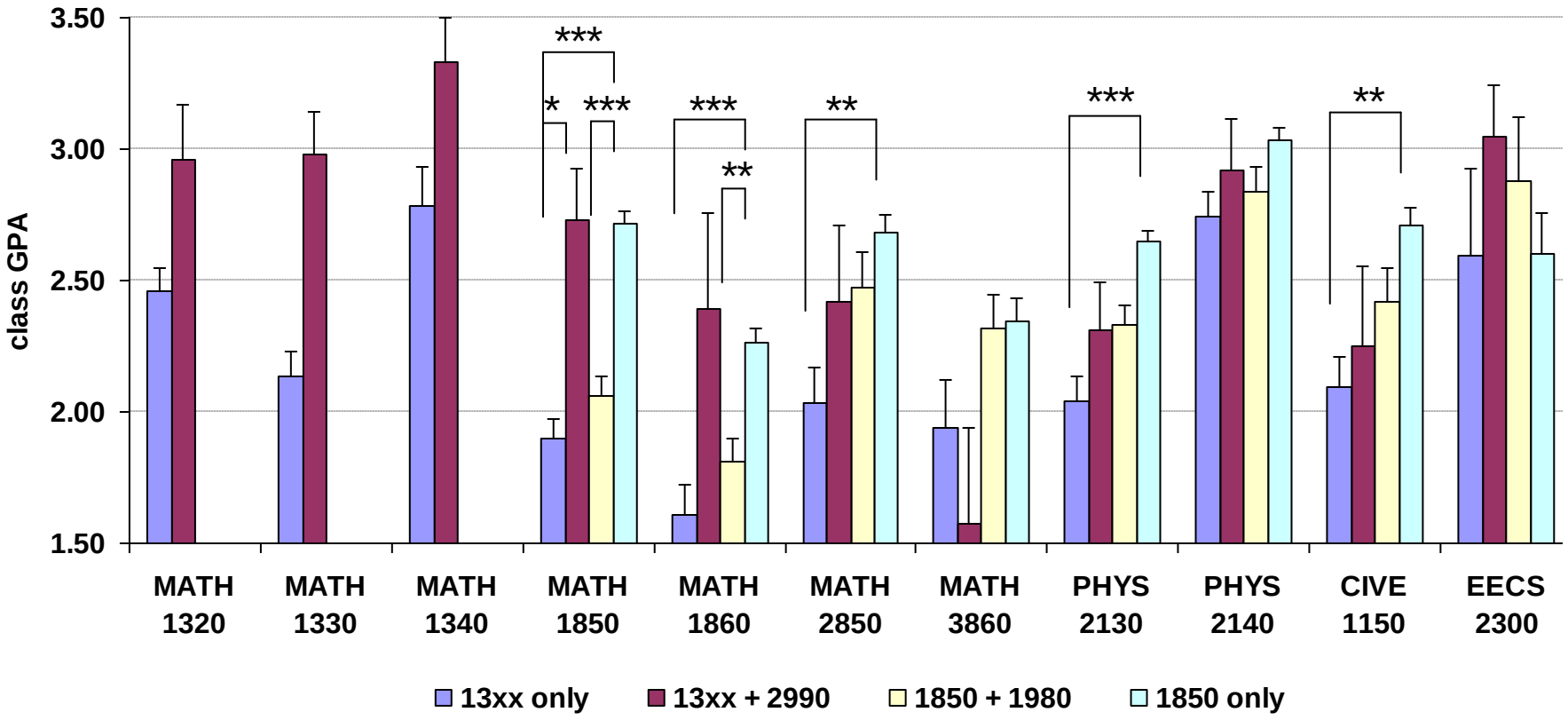
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UT Engineering Applications Course

- Supplement instruction for students that place into MATH 1320/30/40 Algebra and Trigonometry courses
  - Goal is to improve student performance when they take Calculus I
- Adapted Wright State Mathematics for Engineering Applications Course materials to create optional course
  - Topics range from vectors to differential equations
  - Present applications for each topic then introduce theory
  - Parallel hands-on laboratory reinforces lecture topics
- Provide tangible benefits to encourage students to enroll
  - Reimbursed students for extra tuition incurred for taking course
  - Physics department allows students that complete this course to enroll in Physics I and Calculus I simultaneously

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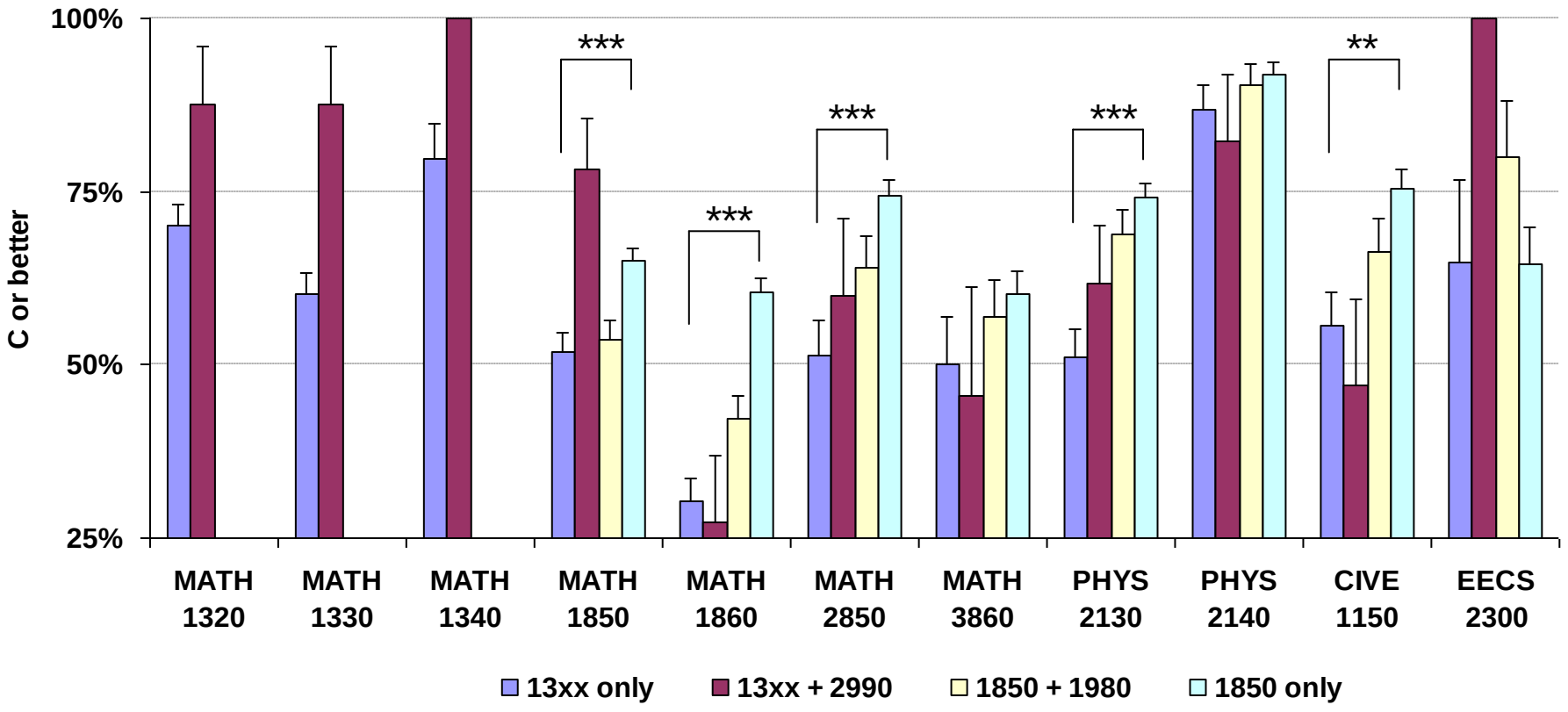
GPA in core courses



* p < 0.05, ** p < 0.01, *** p < 0.001

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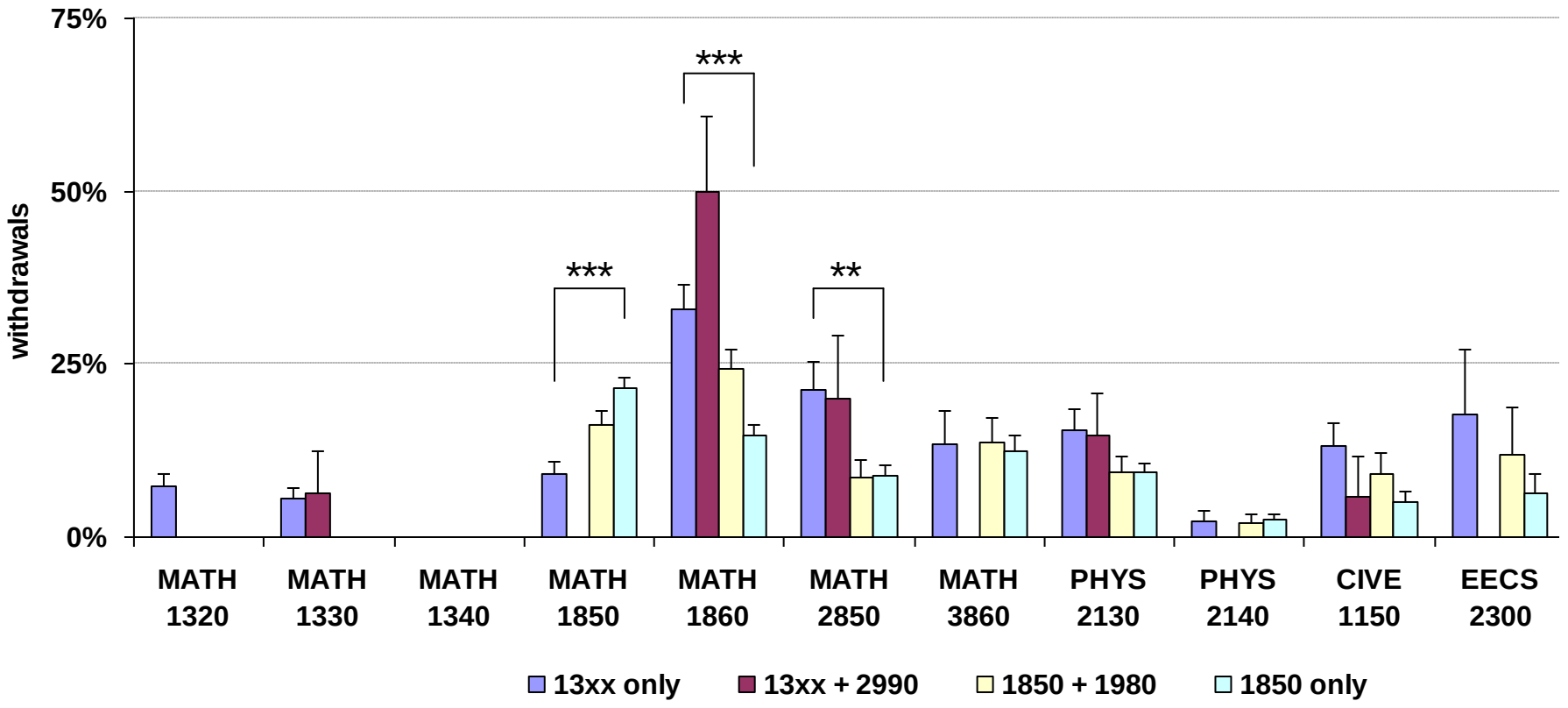
C or better in core courses



* p < 0.05, ** p < 0.01, *** p < 0.001

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Withdrawal rate from core courses



* p < 0.05, ** p < 0.01, *** p < 0.001

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Summary of results

- Improved performance in semester during and after ENG math course
- ENG math students perform better than non-ENG math cohort in concurrent pre-calculus courses
- Significant improvement in first Calculus course during the following semester
- Performed better than students placed into Calculus I with trigonometry supplement
- Not adversely affected by concurrent placement into first Calculus and Physics courses

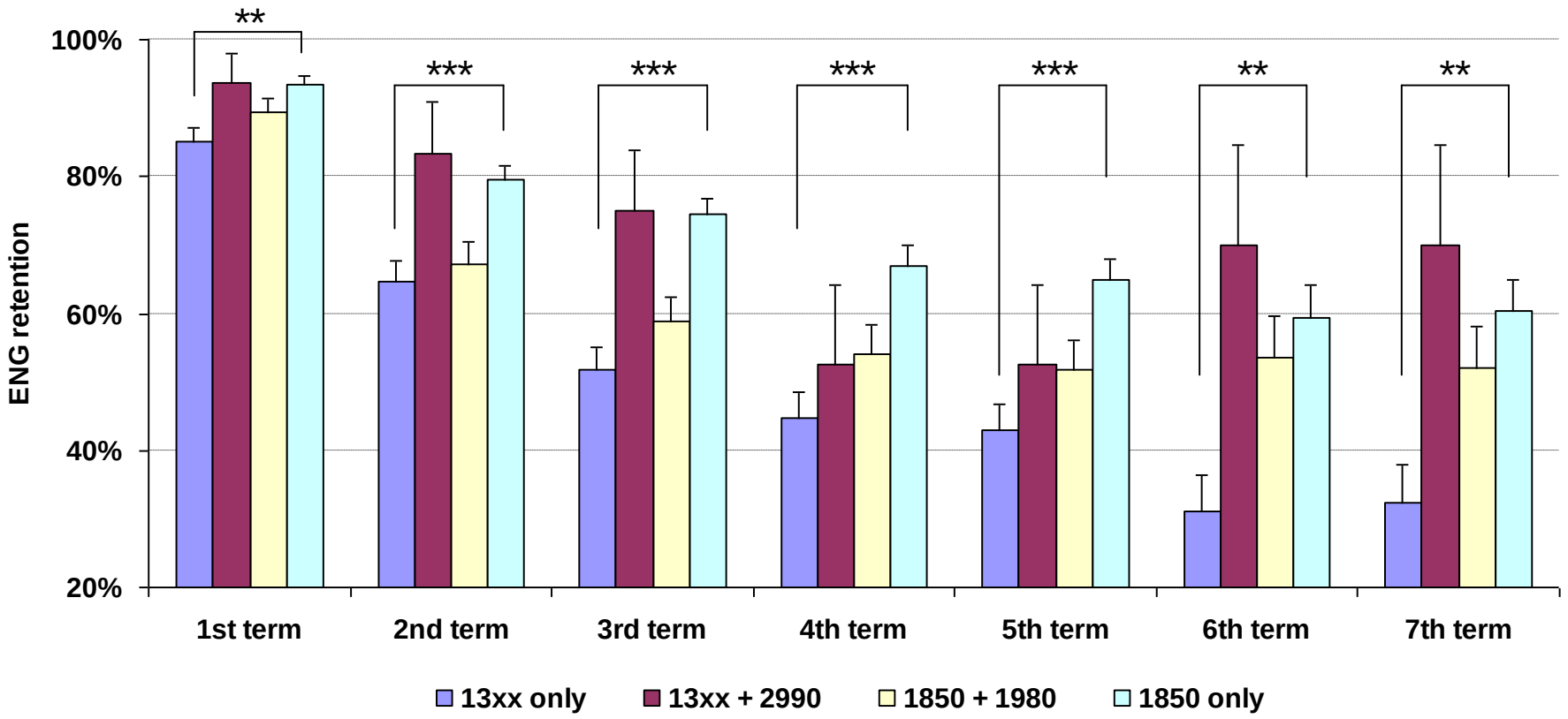
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Summary of results

- Gains from ENG math course is not sustained during all subsequent core courses
- High withdrawal rate from Calculus II
- Poor performance in first core ENG course (Statics)
  - Surprising result with focus of ENG math course on ENG applications
- Poor performance in Differential Equations
- Sustained gains in retention for ENG math students despite lack of sustained improvement in subsequent courses

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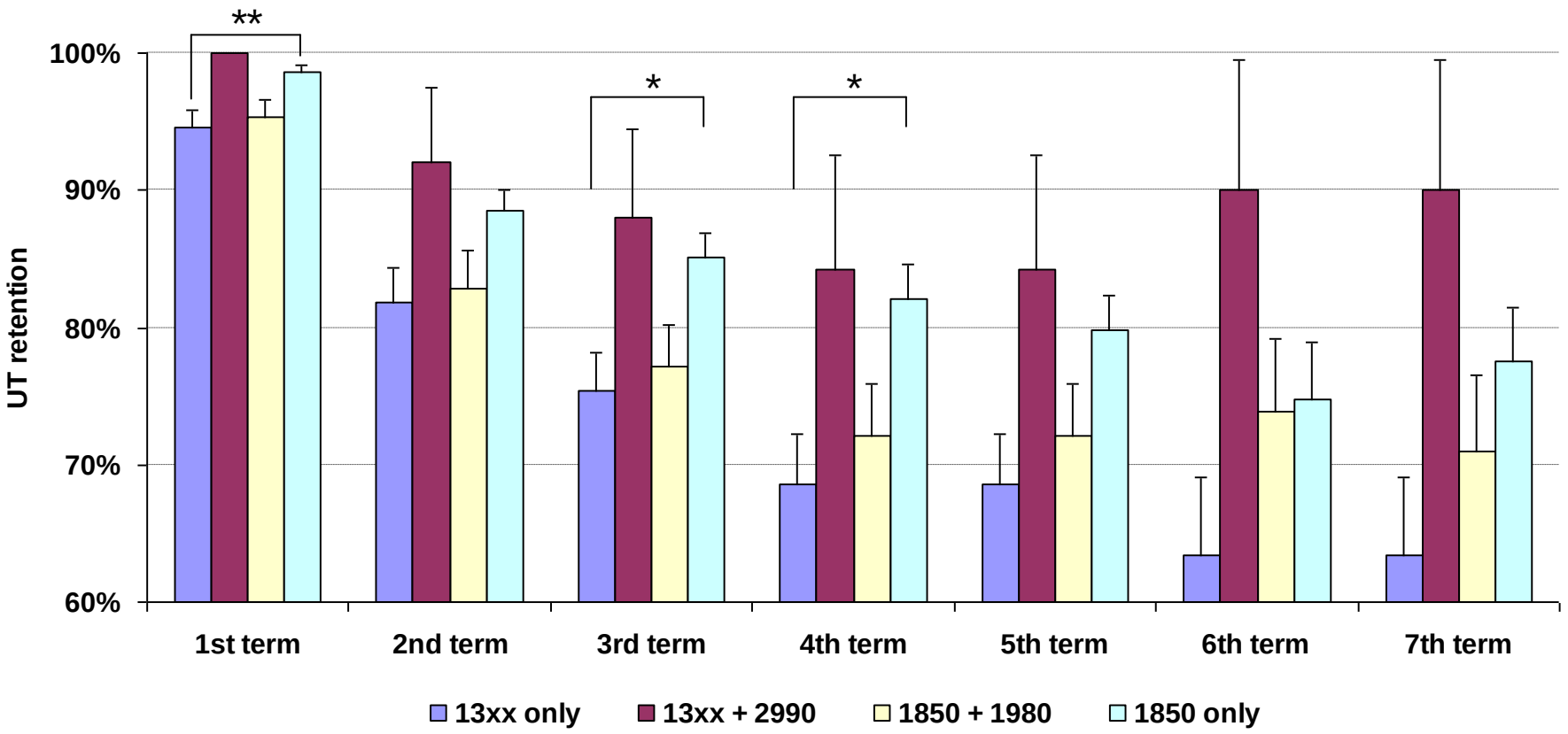
ENG retention rate



* p < 0.05, ** p < 0.01, *** p < 0.001

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UT retention rate



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Conclusions and future directions

- ENG math course improves performance of underqualified students in their first Calculus and Physics courses
- Lack of sustained benefit in later core courses suggests need for continued support
  - Booster course, tutoring or peer mentoring programs during subsequent semesters
  - More detailed analysis underway with colleague from the College of Education
- No longer investigating partnership with MATH department to extend this course to more students
- Now investigating partnerships with local high schools to provide dual level offering