Obtaining Experimental Evidence Regarding the Effectiveness of Interventions Intended to Support the Success of Freshman STEM Undergraduates

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Study Motivation

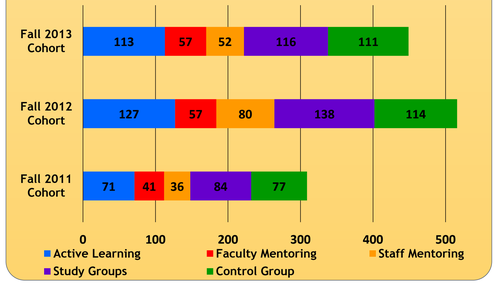
- National imperative to increase the number of STEM graduates
  - Enhance our economic competitiveness
  - Solve broad range of societal problems
  - Educate next generation of scientists & engineers
- Ability to increase STEM graduates hinges upon:
  - Recruiting from diverse pool, including traditionally underrepresented groups
  - Supporting student success to retain and graduate STEM students
- Successful STEM retention programs involve simultaneous use of multiple support techniques
  - E.g. UMBC's Meyerhoff Scholars Program
  - Provides comprehensive personal, academic and financial support
  - Very expensive on a per-student basis
  - Expense limits impact to a small group of students
- New techniques must be identified that have both high impact on retention and graduation rates and low net costs

Goals and Research Questions

- Conduct a rigorous, comparative study of the effects of intervention programs designed to improve undergraduate student success in STEM majors
- Intent-to-Treat
  - What are the effects on student outcomes of providing access and encouragement to participate in different types of interventions programs?
- Treatment-on-the-Treated Effect
  - What are the effects on student outcomes of participation in different types of interventions?

Implementation

- Participant Eligibility and Recruitment
  - New freshmen in Fall 2011, 2012, or 2013
  - Intent to pursue a STEM major
  - Eligible to register for College Algebra or higher
  - Non-inclusion in a structured scholarship program
- One-year intervention initiated in first semester of freshman year
- Interventions
  - Pro-active mentoring, ongoing retention risk assessment, with high-status faculty
  - Pro-active mentoring, ongoing retention risk assessment, with staff
  - Supporting formation and maintenance of study groups
  - Active learning in key foundational math courses
  - Treatment-as-usual control group
- Intervention Changes for Cohort 2 and 3
  - Recruitment to RCT initiated during admissions inquiry phase with letters from Provost
  - Community-building and dedicated orientation week activities added to increase study retention
  - Intervention-specific webpages launched to improve communication
  - Faculty attended Active Learning training sessions
  - Study Group tool kits developed
  - Improved and expanded at-risk reporting
  - Modified procedures for registration to increase adherence to active learning treatment
- Multi-treatment RCT



Results

Estimated ITT Effects on Freshman Year 1 GPA in STEM Courses

Treatment Group	Cohort 1	Cohorts 2 and 3
Active Learning	0.022 (0.1499)	0.075 (0.0815)
Study Groups	0.169 (0.1415)	0.040 (0.0806)
Proactive Mentoring – Faculty	-0.038 (0.1760)	0.070 (0.1020)
Proactive Mentoring – Staff	0.264 (0.1863)	-0.079 (0.0967)

*p<.10; **p<.05; ***p<.01. Standard errors in parenthesis.
Based on OLS models that control for SAT Math Score, SAT Reading Score, SAT Writing Score, High School GPA, Number of AP credits, Ethnicity, Gender, Residence, and Cohort.

Test for null hypothesis that coefficients for members of cohort 1 = coefficients for members of cohort 2 = coefficients for members of cohort 3: F(30, 1061)=1.138 (p=0.279).

Test for null hypothesis that coefficients for members of cohort 2 = coefficients for members of cohort 3: F(15, 806)=0.739 (p=0.746).

Test for null hypothesis that coefficients for members of cohort 1 = coefficients for members of cohort 2 and cohort 3 combined: F(15, 1076)=1.546 (p=0.083).

Estimated ITT Effects on Exit from UMBC (All Cohorts)

	Treatment Groups			
Semester	Active Learning	Study Groups	Proactive Mentoring - Faculty	Proactive Mentoring - Staff
2	-0.005 (0.010)	-0.022** (0.009)	-0.009 (0.011)	-0.013 (0.011)
3	-0.008 (0.016)	-0.036** (0.014)	-0.015 (0.019)	-0.022 (0.017)
4	-0.006 (0.012)	-0.027** (0.011)	-0.012 (0.014)	-0.017 (0.013)
5	-0.006 (0.011)	-0.026** (0.011)	-0.011 (0.014	-0.016 (0.013)
6	-0.002 0.005	-0.010 (0.006)	-0.004 (0.006)	-0.006 (0.006)
7	-0.005 (0.009)	-0.020** (0.010)	-0.009 (0.011)	-0.012 (0.010)

*p<.10; **p<.05; ***p<.01. Standard errors in parenthesis.

Based on discrete-time hazard model that controls for SAT Math Score, SAT Reading Score, SAT Writing Score, High School GPA, Number of AP credits, Ethnicity, Residence, Gender, Semester, and Cohort.

Estimated ITT Effects on Freshman Year 1 GPA in STEM Courses by Gender

Treatment Group	Cohort 1		Cohorts 2 and 3	
	Males	Females	Male	Females
Active Learning	-0.076 (0.2036)	0.283 (0.2227)	0.009 (0.1074)	0.210* (0.1202)
Study Groups	0.074 (0.1882)	0.409* (0.2194)	-0.033 (0.1056)	0.222* (0.1203)
Proactive Mentoring – Faculty	-0.106 (0.2195)	0.202 (0.3204)	0.107 (0.1361)	-0.012 (0.1455)
Proactive Mentoring – Staff	0.374 (0.2497)	0.068 (0.2830)	-0.148 (0.1306)	0.021 (0.1354)

*p<.10; **p<.05; ***p<.01. Standard errors in parenthesis.
Based on OLS models that control for SAT Math Score, SAT Reading Score, SAT Writing Score, High School GPA, Number of AP credits, Ethnicity, Residence, and Cohort.

Test for null hypothesis that coefficients for males=coefficients for females in cohort 1: F(14,241)=0.744.

Test for null hypothesis that coefficients for males=coefficients for females in cohorts 2 and 3 combined: F(15,806)=1.519*.

Conclusions

- Supporting formation and maintenance of study groups appears to have a positive effect on retention
- Support formation and maintenance of study groups may have a positive effect on first year GPA for female students
- Impact of supporting formation and maintenance of study groups is perplexing as it appears to have had minimal impact on actual study group participation
- GPA finding should be viewed with caution
  - Based upon exploratory, not confirmatory, subgroup analysis (Bloom and Michalopoulos, 2013)

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Evaluation, Integration, and Institutionalization of Initiatives to Enhance STEM Student Success
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