Characteristics of Successful Programs In College Calculus

Barriers and Opportunities in Completing 2- and 4-year STEM Degrees
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MAA

MAA Study of Calculus

Characteristics of Successful Programs in College Calculus

DRL REESE
#0910240

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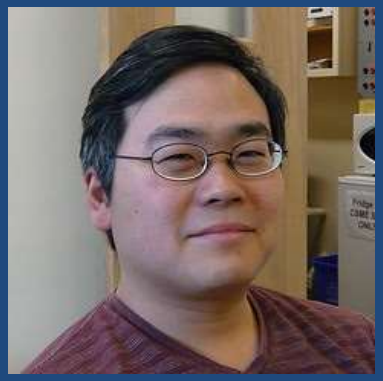
Colleges



Eric Hsu
San Francisco State
Comprehensive
Universities

Sean Larsen
Portland State
Undergraduate
Colleges

Fall 2010
Phase I: Survey

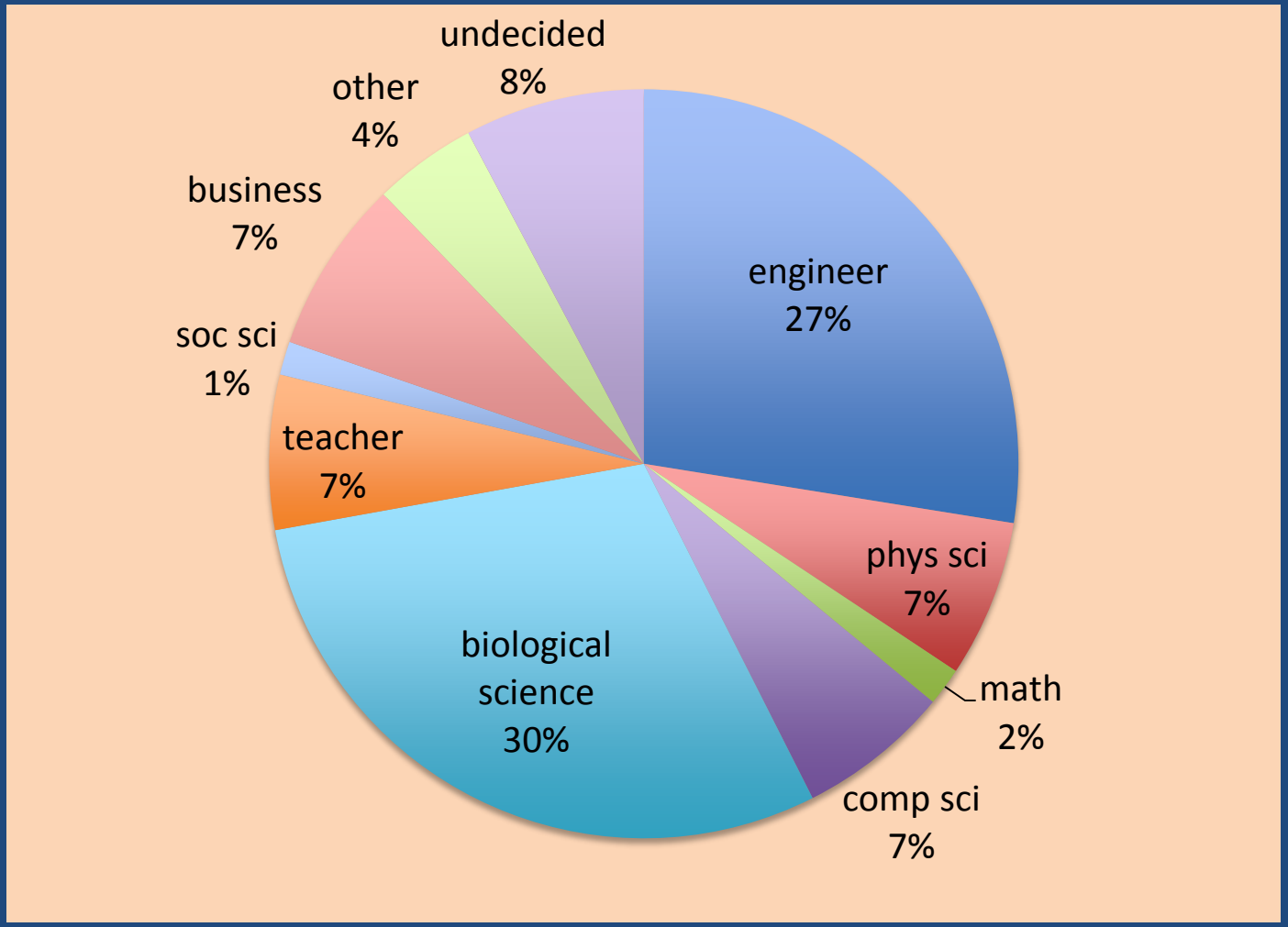
Responses from

213 colleges and universities

502 instructors representing
663 Calculus I classes and
26,257 students

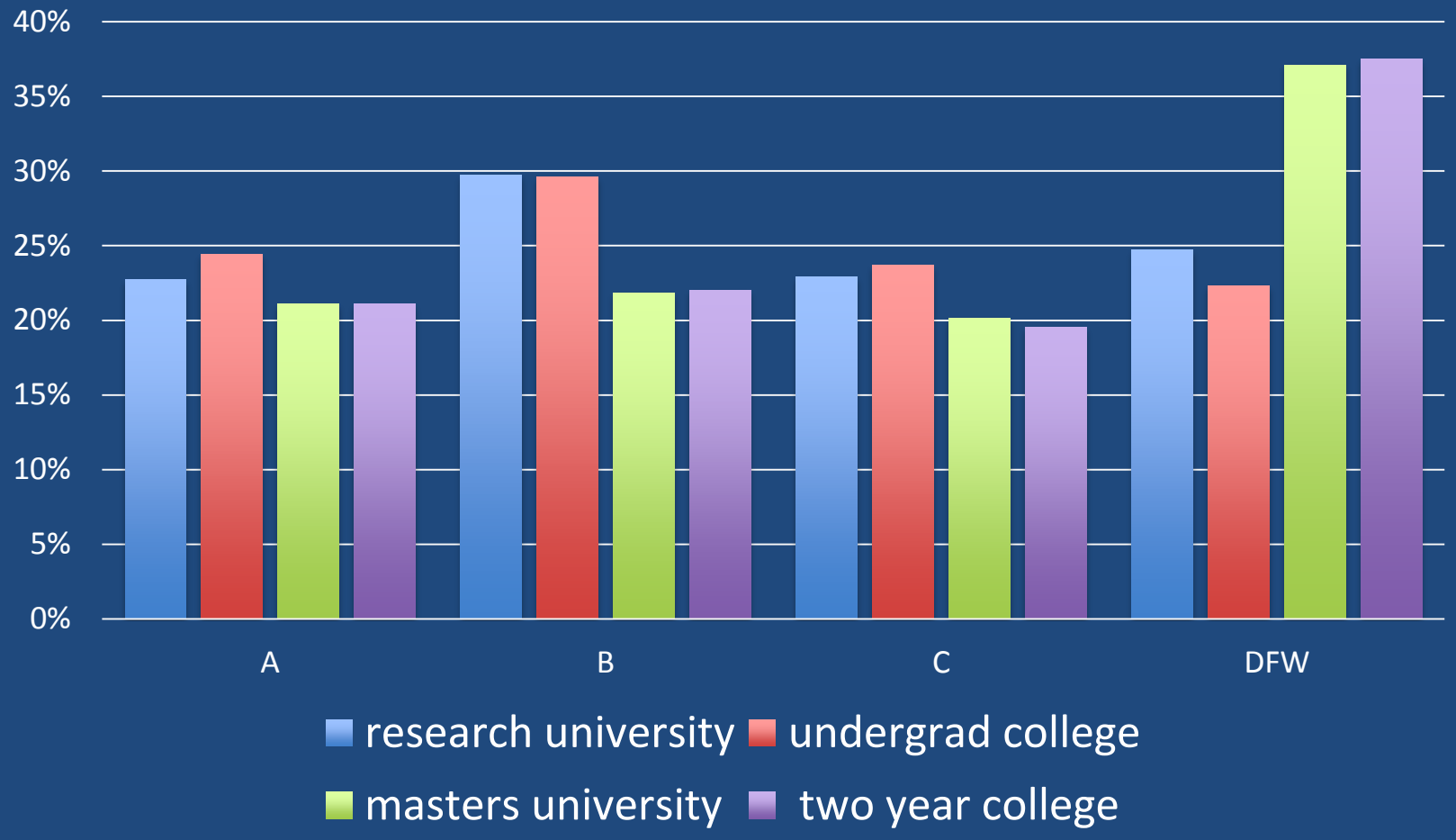
14,184 students

Career goals of students in Mainstream Calculus I



	research	masters	undergrad	2 year
Average high school math GPA	3.77	3.58	3.64	3.37
Took calculus in high school	70%	43%	53%	24%
≥ 3 on AP Calc	26%	9%	14%	5%

Grade Distributions



Instructor reported grades

Students were surveyed at both start and end of term.

Strong selection bias at end of term:

~ 40% were getting an A

~ 40% were getting a B

~ 20% were getting a C

Essentially none (< 4%) were getting D, F, or W

Statistically significant drops in confidence, enjoyment, and desire to continue

Variable	All Institutions		Research Universities	
	Mean (SD)	Effect Size	Mean (SD)	Effect Size
I am confident in my mathematical abilities (1–6)	4.89 (1.01) 4.42 (1.18)	−0.46	4.93 (1.01) 4.40 (1.19)	−0.47
I enjoy doing mathematics (1–6)	4.63 (1.27) 4.28 (1.37)	−0.27	4.69 (1.24) 4.28 (1.35)	−0.33
If I had a choice, I would continue to take mathematics (1–4)	2.93 (1.02) 2.84 (1.08)	−0.09	2.97 (1.00) 2.83 (1.07)	−0.14

lowest = strongly disagree, highest = strongly agree

Switcher Analysis:

Chris Rasmussen and Jess Ellis

Switcher = self-identified at start of term as intending to take Calculus II, changed plans by end of term

Overall rate: 14%

Men: 11%, Women: 20%

Switcher Rates:

16% at large research universities

19% for classes taught by GTAs

- 6% for engineers
- 12% science
- 16% science/math teachers
- 23% pre-med
- 27% business

HS calculus had no statistically significant effect

Reason for not continuing in Calculus	percentage
I changed my major and now do not need to take Calculus II	51%
I have too many other courses I need to complete	33%
My experience in Calculus I made me decide not to take Calculus II	32%
To do well in Calculus II, I would need to spend more time and effort than I can afford	31%
I do not believe I understand the ideas of Calculus I well enough to take Calculus II	23%
My grade in Calculus I was not good enough for me to continue to Calculus II	11%

Statistically significant differences between Switchers and Persisters ($p < 0.05$)

	Switchers	Persisters
Visits per month to instructor and/or tutors	3.2	2.4
Hours per week studying calculus	6.8	6.2
Hours per week studying all subjects	18.2	17.2
Percent belonging to study group	13%	9%

“Good Teaching”

My Calculus Instructor:

- listened carefully to my questions and comments
- allowed time for me to understand difficult ideas
- presented more than one method for solving problems
- asked questions to determine if I understood what was being discussed
- discussed applications of calculus
- encouraged students to seek help during office hours
- frequently prepared extra material

Assignments were challenging but doable

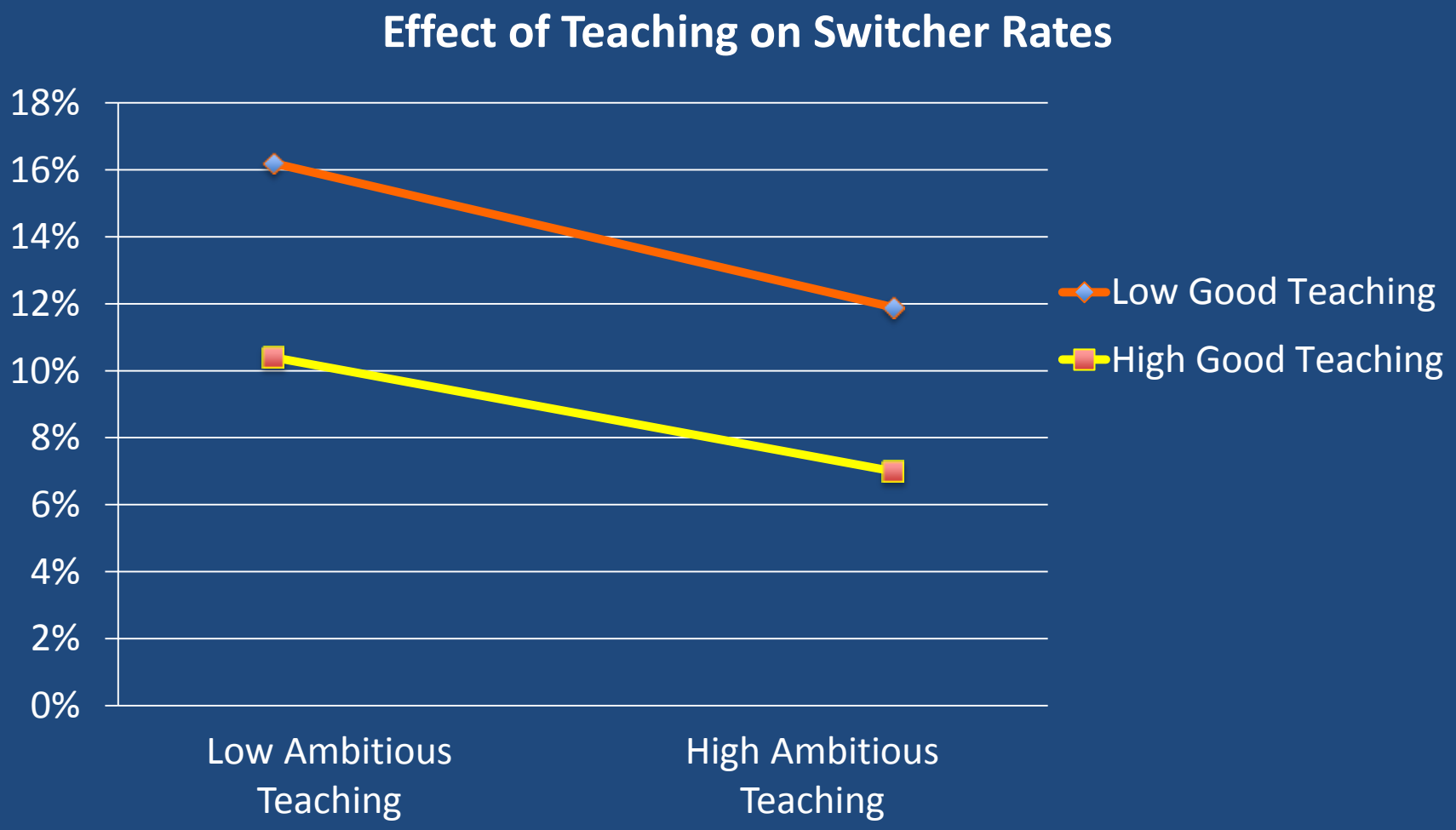
My exams were graded fairly

My calculus exams were a good assessment of what I learned

“Ambitious Teaching”

My Calculus Instructor:

- Required me to explain my thinking on homework and exams
- Required students to work together
- Had students give presentations
- Held class discussions
- Put word problems in the homework and on the exams
- Put questions on the exams unlike those done in class
- Returned assignments with helpful feedback and comments


Effect of Teaching on Switcher Rates
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
Low Ambitious Teaching
High Ambitious Teaching
Low Good Teaching
High Good Teaching

Fall 2012
Phase II: 16 Case Study Visits

Teams of 3 researchers on 3-day visit to each of 4 colleges or universities identified by:

- Maintenance or improvement of student affective measures, *e.g.* confidence
- Higher than expected grade distributions
- Higher than expected rates of student persistence

Common characteristics of successful programs:

- Collegiality and shared sense of responsibility for Calculus
- Attention and responsiveness to local data, including effectiveness of placement procedures and retention rates
- Well-run and well-utilized tutoring centers with aggressive encouragement for all students to use this resource

Common characteristics of successful programs:

- Strong programs for training Graduate Teaching Assistants
- Promotion of active learning strategies and rigorous courses

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