UC Davis Students and Learning

Presentation by Center for Educational Effectiveness

New Faculty Orientation
September 21, 2015

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CEE

UCDAVIS
UNDERGRADUATE EDUCATION

What is the CEE Mission?

Our primary goals are to enhance student learning, maximize instructional value, and improve retention rates and time to graduation for all students.

To achieve our goals we innovate instructional solutions via research and development; build sustainable instructional capability; and promote cross-campus communities committed to teaching and learning, focusing on areas with greatest potential for student/instructor impact.

Session Objectives

- Introduce Center for Educational Effectiveness
- Reflect on inspiring educators
- Describe the UC Davis Learner and their challenges
- Discuss teaching topics and challenges
- Equip instructors with core strategies
- Offer additional opportunities for engagement

WHO WAS A MEMORABLE INSTRUCTOR?

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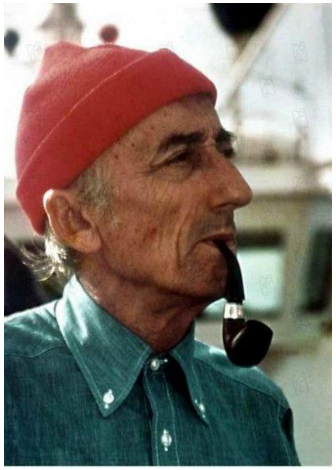
WHO ARE THE CLASS OF 2019?



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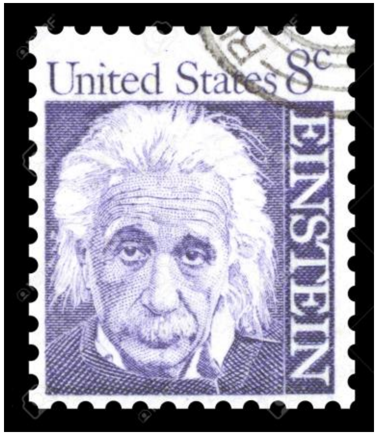

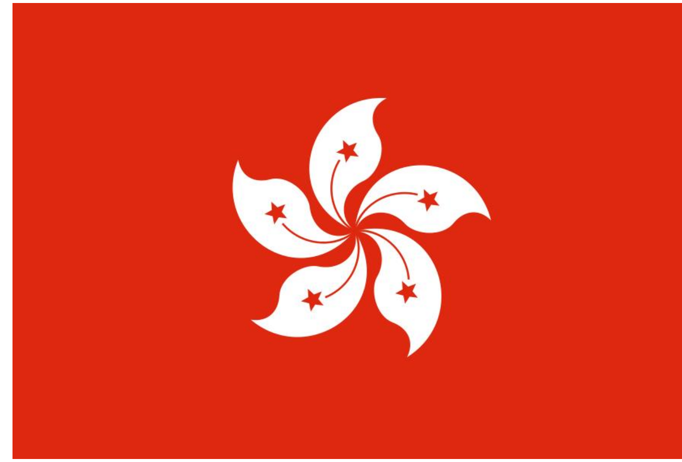

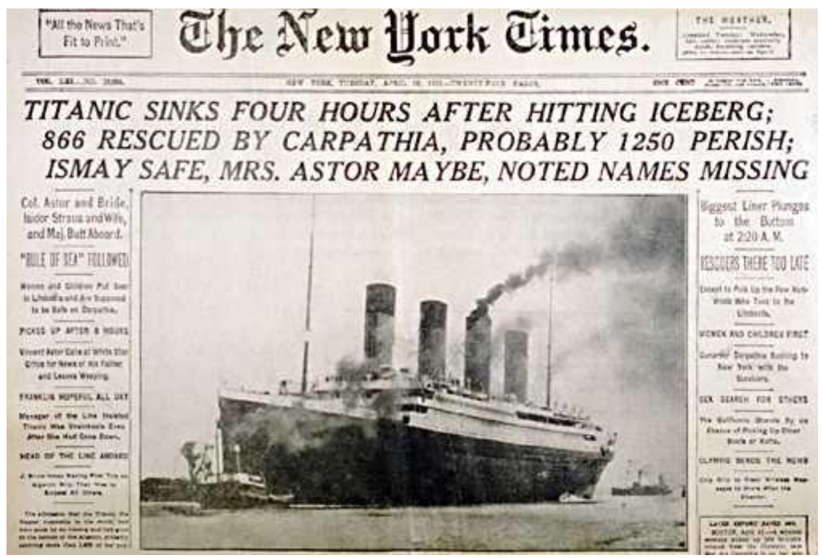
"All the News That's Fit to Print."

The New York Times.

TITANIC SINKS FOUR HOURS AFTER HITTING ICEBERG;
866 RESCUED BY CARPATHIA, PROBABLY 1250 PERISH;
ISMAY SAFE, MRS. ASTOR MAYBE, NOTED NAMES MISSING

Col. Astor and Bride, Isidor Straus and Wife, and Maj. Butt Aboard.

"RULE OF SEA" FOLLOWED

Biggest Liner Plunges to the Bottom at 2:20 A. M.

RESCUERS THERE TOO LATE

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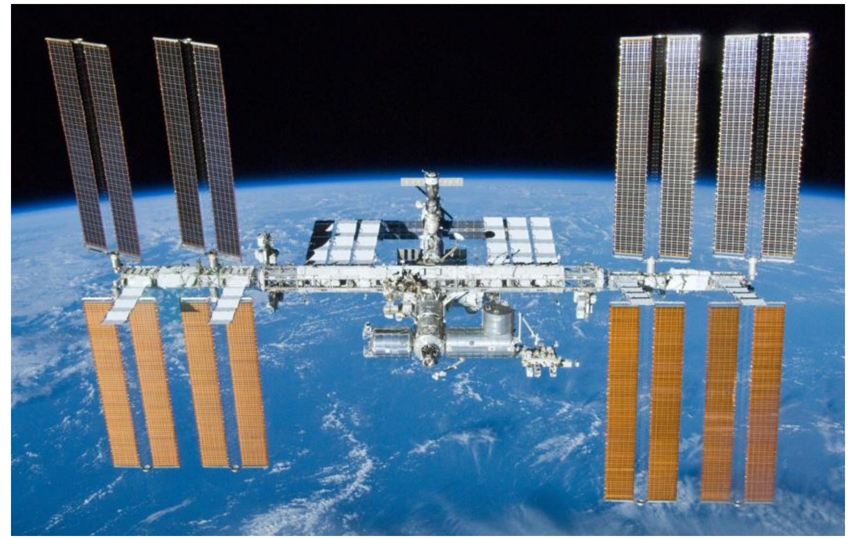
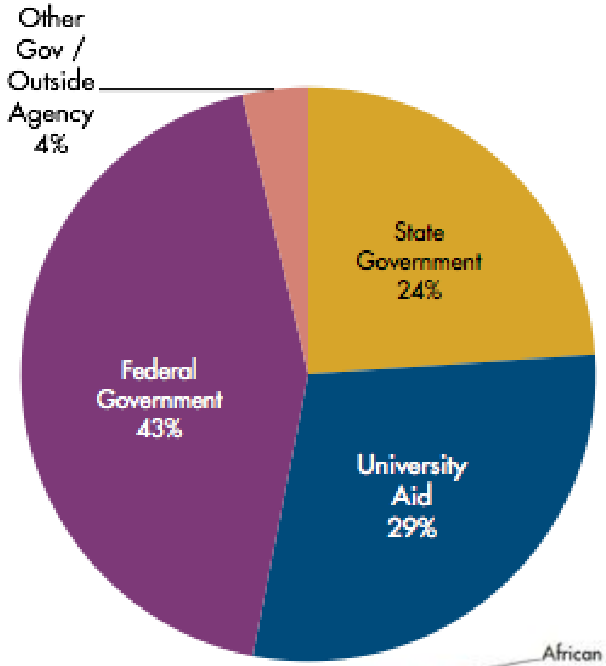
WHO ARE THE CLASS OF 2019?

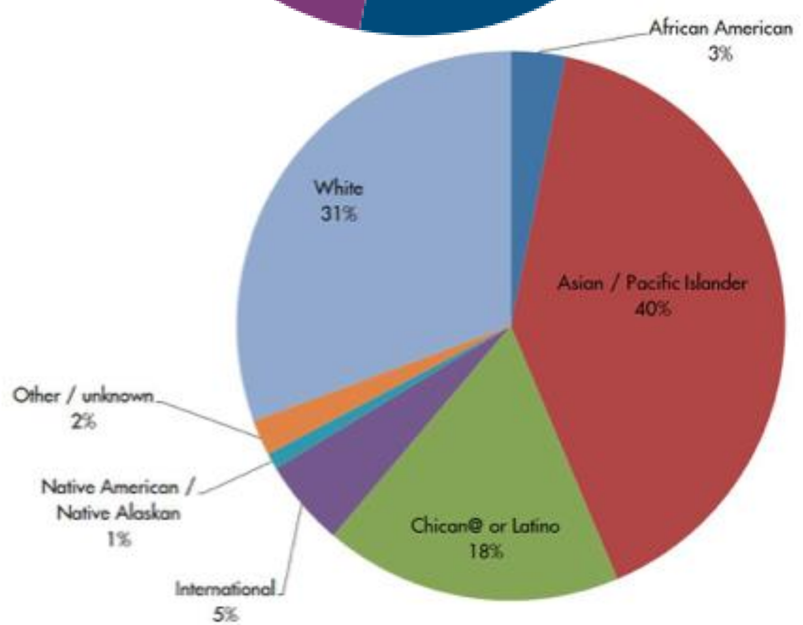
Now—from your car—you can place or receive calls from any place in the world with General Electric's Simultaneous Duplex Mobile Telephone.



WHO ARE UC DAVIS STUDENTS?



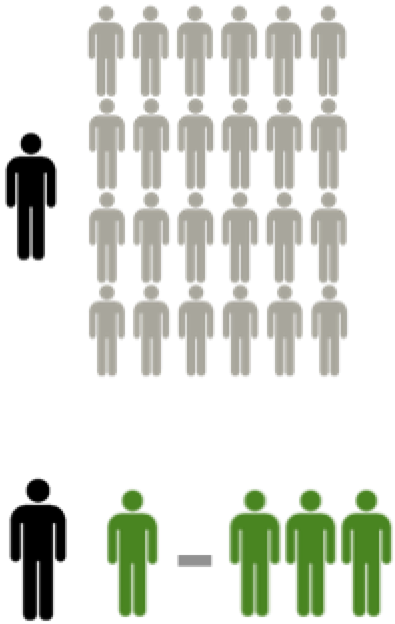
Name (click to view profile) Last	First	Middle	PreferredName	Level	Units	Class	Major
Farias	Cristal	Vargas	Cristal	UG	0	FR	LMAT
Li	Stella		Stella	UG	0	FR	LENL
Rivera	Dianna	Priscilla	Dianna	UG	0	FR	LUHU
Alas-Viana	Sarah	Noelle	Sarah	UG	0	FR	LMAT
Dominguez	Mary	Lupe	Mary	UG	0	FR	LASD
Hong	Kristi	Yoon Jung	Kristi	UG	0	FR	LUSS
Pinon	Jenelle	Veronica	Jenelle	UG	0	FR	AANS
Aguirre	Sarai	Nicole	Sarai	UG	0	FR	AANS
Proshak	Angelina		Angelina	UG	0	FR	ANSC
Hernandez-Lopez	Amaris	Jocelyn	Amaris	UG	0	FR	AANM
Prasad	Priscilla	Payal	Priscilla	UG	0	FR	BNPB
Tweedy	Carolina	Elena	Carolina	UG	0	FR	BBIS
Liang	Anthony	Lin	Anthony	UG	0	FR	BULS
Singh	Anushka		Anushka	UG	0	FR	ECOM
Roy	Althea	Balingit	Althea	UG	0	FR	ECOM
Uribe	Olaf		Olaf	UG	0	FR	EEEL
Gonzalez	Logan	Andrew	Logan	UG	0	FR	ECSE
Atmadja	Stanford	Soendoro	Stanford	UG	0	FR	ECML
Valdovinos	Jaime		Jaime	UG	0	FR	BNPB
Hernandez	Paola		Paola	UG	0	FR	AEXP
De Leon	Ramon	Agustin	Ramon	UG	0	FR	AANS
Carcamo	Luis	Eduardo	Luis	UG	0	FR	LMUS
Jiang	Chaohao		Chaohao	UG	0	SO	EEEL
Garcia	Edna	Jasmin	Edna	UG	0	FR	LUSS
Covarrubia	Jennifer		Jennifer	UG	0	FR	BBIS



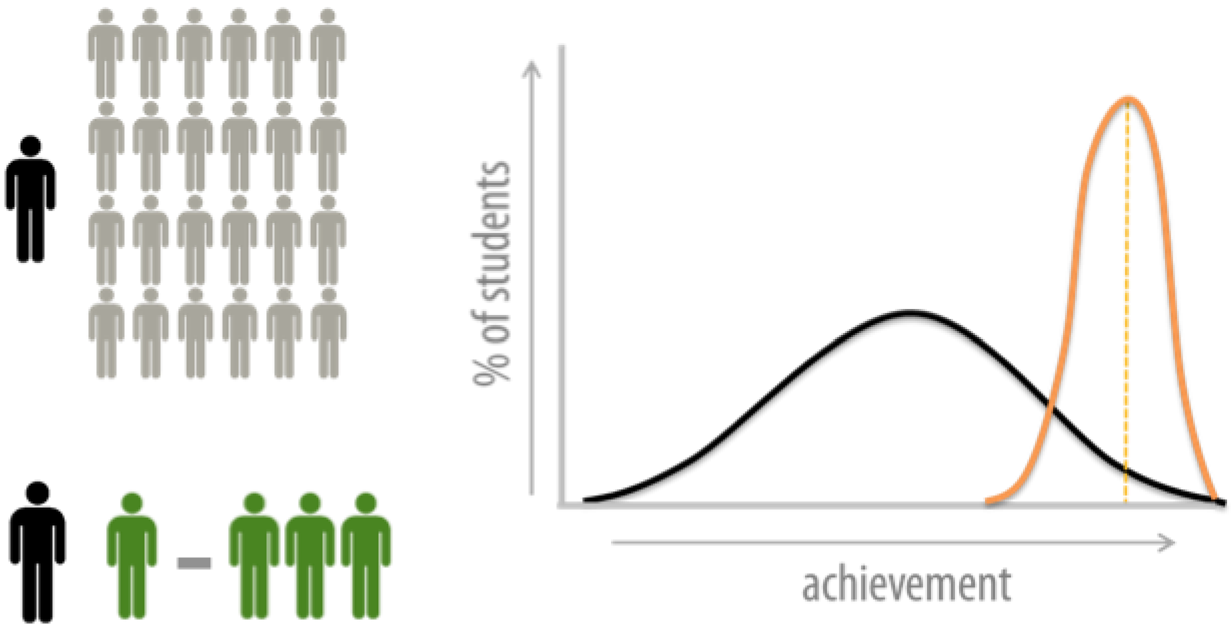
What do we know about

LEARNING?

Learning Science



Learning Science



Learning Science

engineering and testing
learning environments

TABLE I

Effect of selected alterable variables on student achievement (see Appendix)

		Effect size	Percentile equivalent
D[a]	Tutorial instruction	2.00	98
D	Reinforcement	1.20	
A	Feedback-corrective (ML)	1.00	84
D	Cues and explanations	1.00	
(A)D	Student classroom participation	1.00	
A	Student time on task	1.00[b]	
A	Improved reading/study skills	1.00	
C	Cooperative learning	.80	79
D	Homework (graded)	.80	
D	Classroom morale	.60	73
A	Initial cognitive prerequisites	.60	
C	Home environment intervention	.50[b]	69
D	Peer and cross-age remedial tutoring	.40	66
D	Homework (assigned)	.30	62
D	Higher order questions	.30	
(D)B	New science & math curricula	.30[b]	
D	Teacher expectancy	.30	
C	Peer group influence	.20	58
B	Advance organizers	.20	

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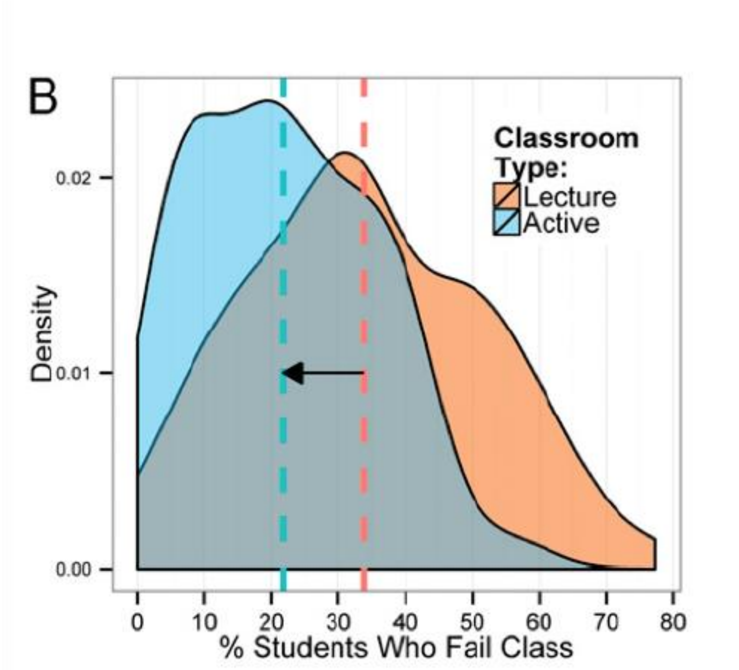
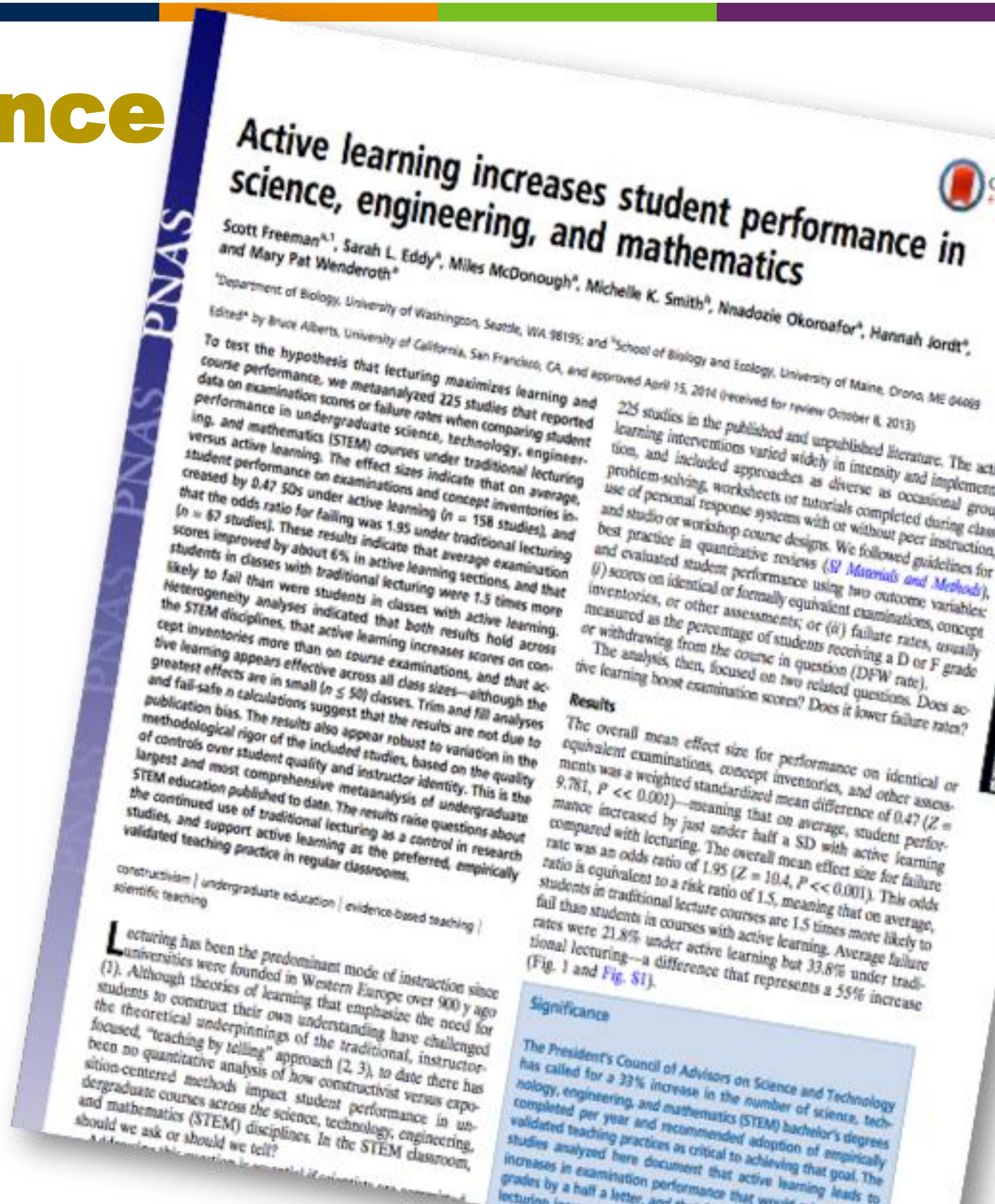
A	Feedback-corrective (ML)	1.00	84
D	Cues and explanations	1.00	
A)D	Student classroom participation	1.00	
A	Student time on task	1.00[b]	

Learning Science

ACTIVE LEARNING





PNAS

Active learning increases student performance in science, engineering, and mathematics

Scott Freeman[a,1], Sarah L. Eddy[a], Miles McDonough[a], Michelle K. Smith[b], Nnadozie Okoroafor[a], Hannah Jordt[a], and Mary Pat Wenderoth[a]

[a]Department of Biology, University of Washington, Seattle, WA 98195; and [b]School of Biology and Ecology, University of Maine, Orono, ME 04469

Edited* by Bruce Alberts, University of California, San Francisco, CA, and approved April 15, 2014 (received for review October 8, 2013)

To test the hypothesis that lecturing maximizes learning and course performance, we metaanalyzed 225 studies that reported data on examination scores or failure rates when comparing student performance in undergraduate science, technology, engineering, and mathematics (STEM) courses under traditional lecturing versus active learning. The effect sizes indicate that on average, student performance on examinations and concept inventories increased by 0.47 SDs under active learning ($n = 158$ studies), and that the odds ratio for failing was 1.95 under traditional lecturing ($n = 67$ studies). These results indicate that average examination scores improved by about 6% in active learning sections, and that students in classes with traditional lecturing were 1.5 times more likely to fail than were students in classes with active learning. Heterogeneity analyses indicated that both results hold across the STEM disciplines, that active learning increases scores on concept inventories more than on course examinations, and that active learning appears effective across all class sizes—although the greatest effects are in small ($n \leq 50$) classes. Trim and fill analyses and fail-safe n calculations suggest that the results are not due to publication bias. The results also appear robust to variation in the methodological rigor of the included studies, based on the quality of controls over student quality and instructor identity. This is the largest and most comprehensive metaanalysis of undergraduate STEM education published to date. The results raise questions about the continued use of traditional lecturing as a control in research studies, and support active learning as the preferred, empirically validated teaching practice in regular classrooms.

constructivism | undergraduate education | evidence-based teaching | scientific teaching

Lecturing has been the predominant mode of instruction since universities were founded in Western Europe over 900 y ago (1). Although theories of learning that emphasize the need for students to construct their own understanding have challenged the theoretical underpinnings of the traditional, instructor-focused, "teaching by telling" approach (2, 3), to date there has been no quantitative analysis of how constructivist versus exposition-centered methods impact student performance in undergraduate courses across the science, technology, engineering, and mathematics (STEM) disciplines. In the STEM classroom, should we ask or should we tell?

225 studies in the published and unpublished literature. The acti learning interventions varied widely in intensity and implement tion, and included approaches as diverse as occasional grou problem-solving, worksheets or tutorials completed during class use of personal response systems with or without peer instruction, and studio or workshop course designs. We followed guidelines for best practice in quantitative reviews (SI Materials and Methods), and evaluated student performance using two outcome variables: (i) scores on identical or formally equivalent examinations, concept inventories, or other assessments; or (ii) failure rates, usually measured as the percentage of students receiving a D or F grade or withdrawing from the course in question (DFW rate).

The analysis, then, focused on two related questions. Does active learning boost examination scores? Does it lower failure rates?

Results

The overall mean effect size for performance on identical or equivalent examinations, concept inventories, and other assessments was a weighted standardized mean difference of 0.47 ($Z = 9.781$, $P << 0.001$)—meaning that on average, student performance increased by just under half a SD with active learning compared with lecturing. The overall mean effect size for failure rate was an odds ratio of 1.95 ($Z = 10.4$, $P << 0.001$). This odds ratio is equivalent to a risk ratio of 1.5, meaning that on average, students in traditional lecture courses are 1.5 times more likely to fail than students in courses with active learning. Average failure rates were 21.8% under active learning but 33.8% under traditional lecturing—a difference that represents a 55% increase (Fig. 1 and Fig. S1).

Significance

The President's Council of Advisors on Science and Technology has called for a 33% increase in the number of science, technology, engineering, and mathematics (STEM) bachelor's degrees completed per year and recommended adoption of empirically validated teaching practices as critical to achieving that goal. The studies analyzed here document that active learning leads to increases in examination performance that would raise average grades by a half a letter,

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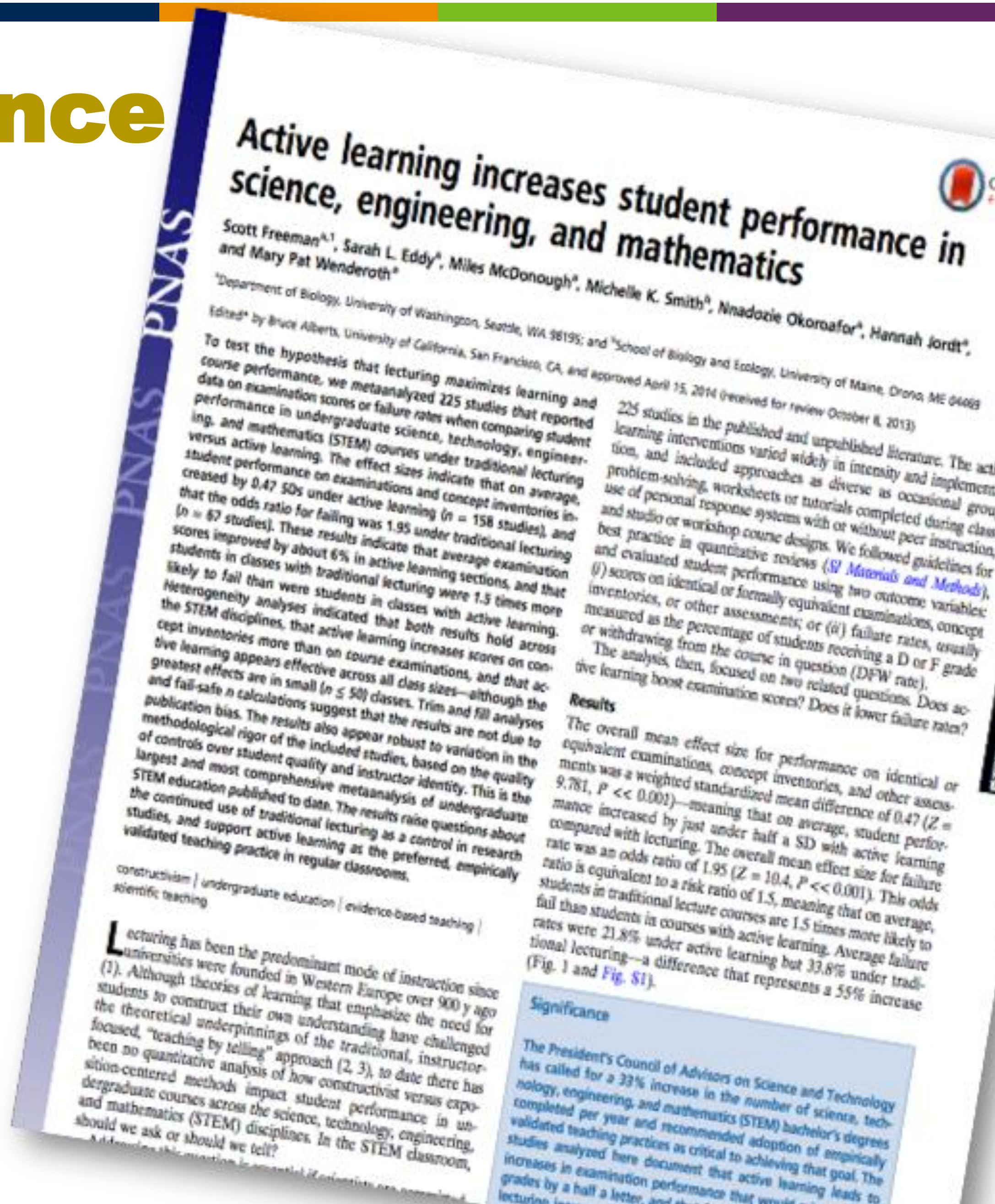
ACTIVE LEARNING

>Time on Task
- >Engagement
- >Practice
- >Feedback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TEACHING TOPICS

- What wakes|keeps you up when thinking about teaching?

- What current (hot) topics are on your mind with regard to teaching?

- What resources would you like to support further exploration?

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CLOSING POINTS

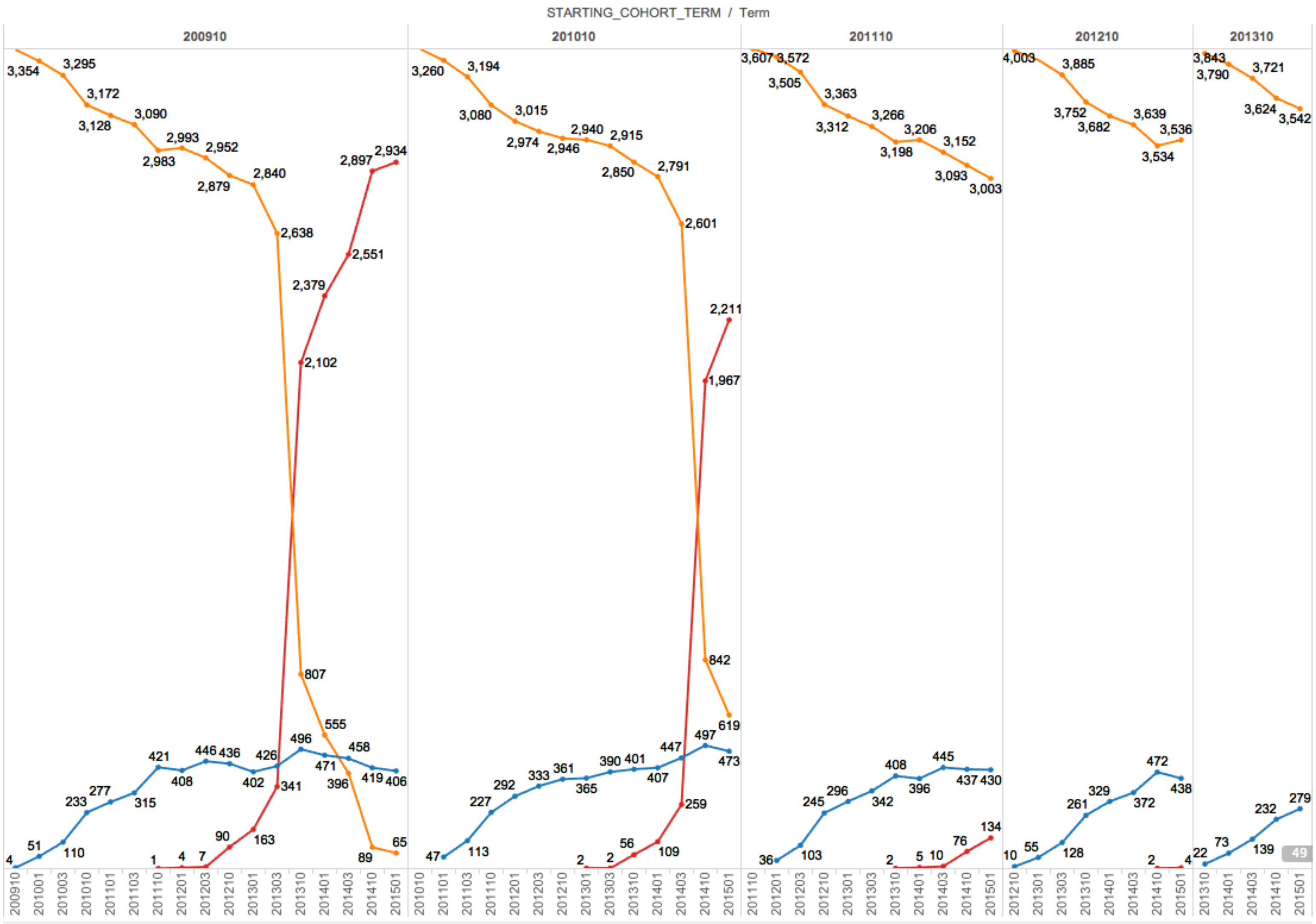
High Expectations
(Needed Knowledge & Skills)

Practice
(Deliberate & Progressive)

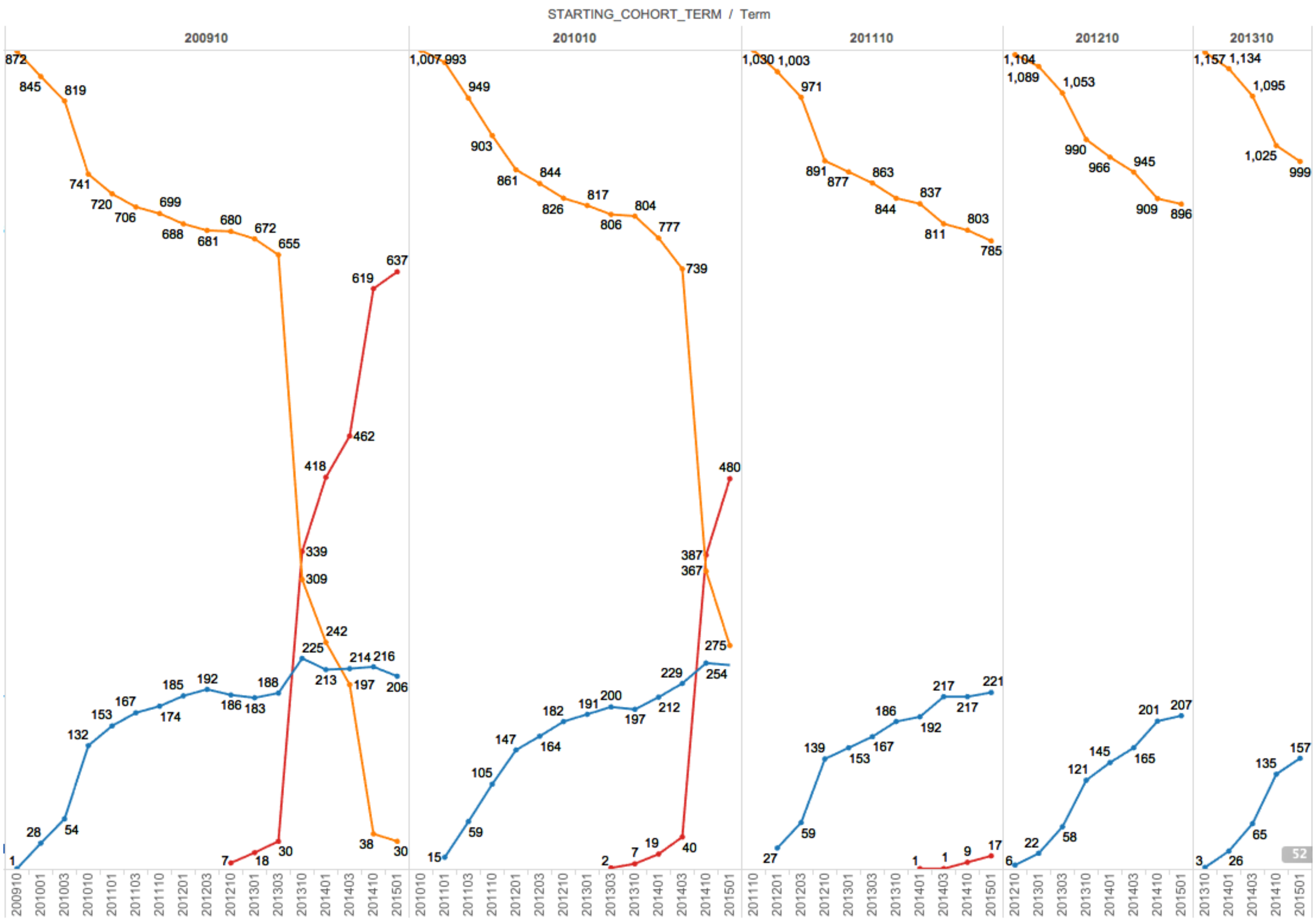
Feedback
(Immediate, Formative)

High Engagement
(Relevance, Application)

Patterns – All Students



Patterns – URM Students



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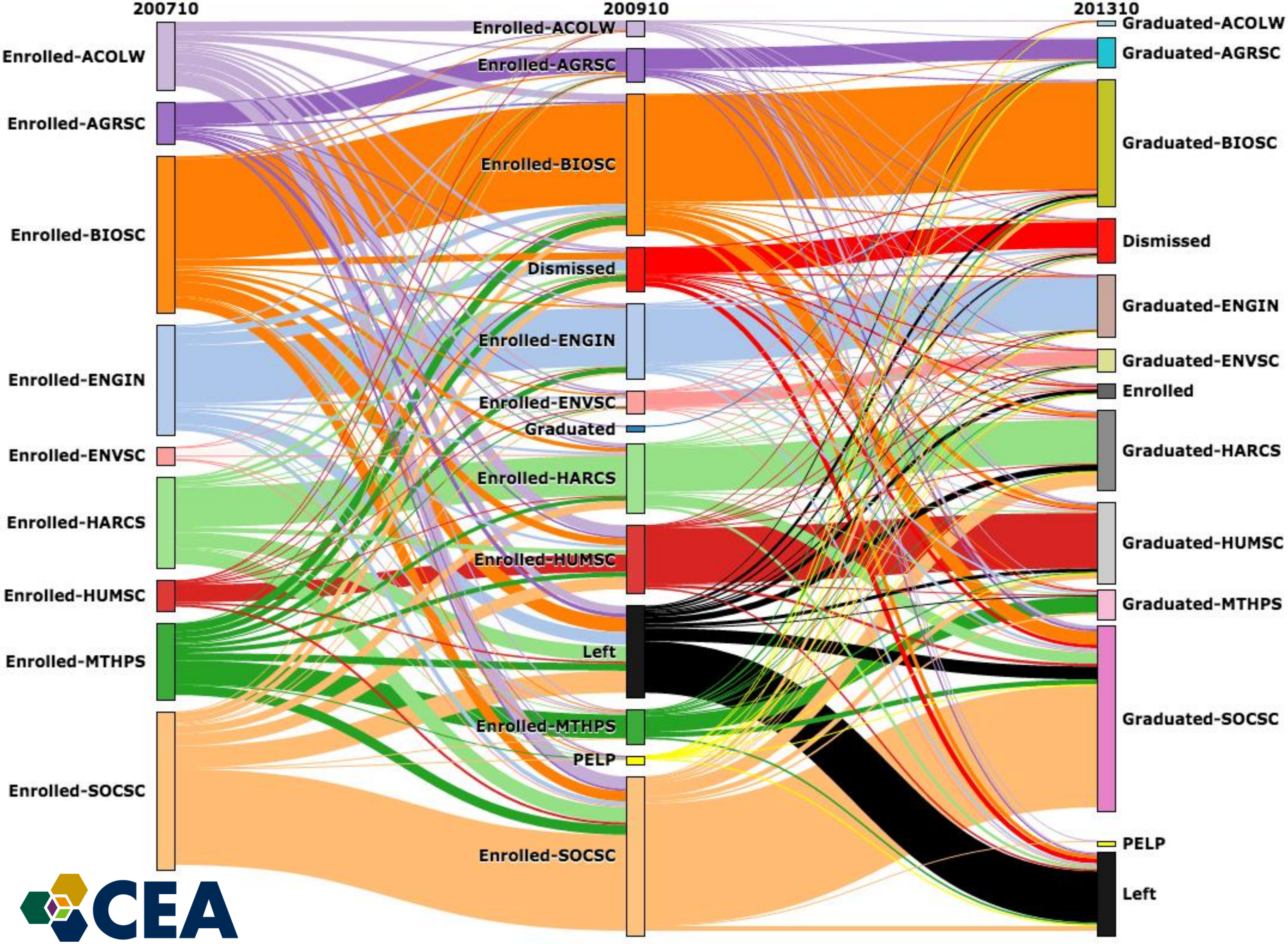

200710
200910
201310
Enrolled-ACOLW
Enrolled-AGRSC
Enrolled-BIOSC
Enrolled-ENGIN
Enrolled-ENVSC
Enrolled-HARCS
Enrolled-HUMSC
Enrolled-MTHPS
Enrolled-SOCSC
Enrolled-ACOLW
Enrolled-AGRSC
Enrolled-BIOSC
Dismissed
Enrolled-ENGIN
Enrolled-ENVSC
Graduated
Enrolled-HARCS
Enrolled-HUMSC
Left
Enrolled-MTHPS
PELP
Enrolled-SOCSC
Graduated-ACOLW
Graduated-AGRSC
Graduated-BIOSC
Dismissed
Graduated-ENGIN
Graduated-ENVSC
Enrolled
Graduated-HARCS
Graduated-HUMSC
Graduated-MTHPS
Graduated-SOCSC
PELP
Left
CEA

4-Yr Graduation Probability

The goal of this model is to estimate an individual student's probability of

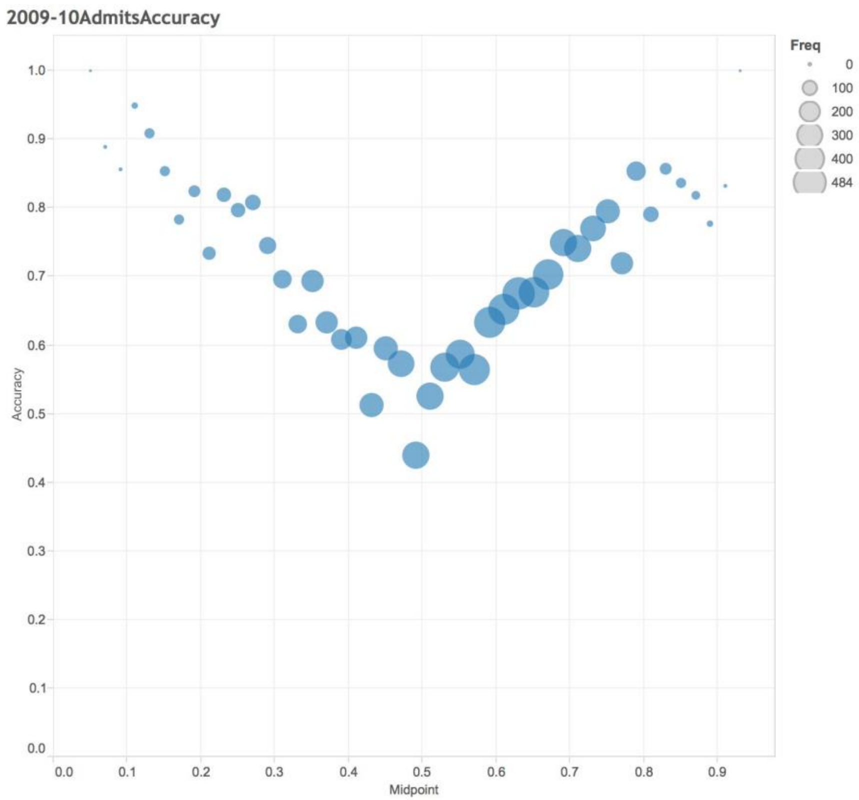
• Graduating in 4, in major declared, in discipline declared, in STEM/NON declared

Random Forest model (500-1000 trees), 30,000 students for training and 8000 to test

ADMISSION - GRAD in 4

q0g4

Factor	**Importance**
GPA	1270.39
HOUSEHOLDINCOME	1220.83
DISTANCE	1173.03
SAT	1168.59
HSSTRENGTH	1146.56
SAT2TOTAL	1060.13
DISCIPLINE	903.43
APCREDIT	730.39
ATOGTOTAL	704.96
ATOGS2	572.52
ATOGS1	542.16
FAMSIZEP	478.88
ETH	375.54
SEX	262.09
LANG	249.39
EOP	172.74
APPCAT	110.13



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Support Structure in UE

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UC Davis Center for Educational Analytics

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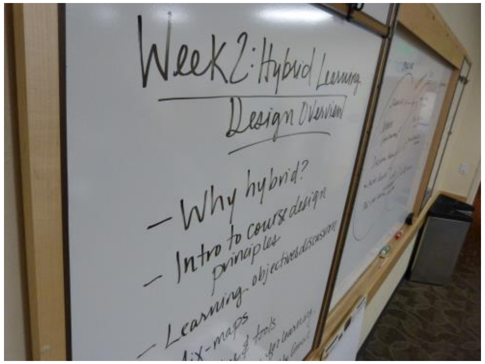
New Faculty Community

Weekly Plan & Potential Topics
Welcome (Solicit for core topics)
Today's Students
Assessing Learning
How Learning Works
Course Design
Active Learning
Integrating Technology
Diversity
OPEN
Year One Reflections



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“Shoptalk” Brown Bags

Topic Discussion (45min)	Practice / Drill (15min)	Shop Talk (30min)
Teaching: Active Learning Techniques (ALT)	Cold Call (CC)	*open discussion*
Research: SOTL Standards of Evidence	Evaluate Exp Designs	*open discussion*
Teaching: Flipping it Well	CC, Break it Down (BD)	*open discussion*
Research: SOTL - Asking Good Questions	Eval SOTL Hyp / ?’s	*open discussion*
Teaching: Leveraging Technology in Classroom	Circulate, Error Norming	*open discussion*
Research: Assessment Design	Blooming	*open discussion*
Teaching: Designing Awesome Tests	Question Eval / Rev	*open discussion*
Research: SOTL - The Grant World	Translating Calls	*open discussion*
Teaching: Raising the Bar - Higher order thinking	Blooming	*open discussion*
Research: Data, Demographics, and Stats	Eval SOTL data / figures	*open discussion*
Teaching: Aligning Goals and CIA	Writing useful LGs	*open discussion*
Research: Experimental Design	Eva exp designs	*open discussion*

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Let's Collaborate!

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