Institutions Share Successes, Failures, and Advice in Moving the Diversity Needle

SIGCSE 2020

In 2016, Heidi Hopper and Jeff Dean, through the Hopper-Dean Foundation, awarded grants to the computer science programs at Berkeley, CMU, MIT, Stanford, and the University of Washington to fund interventions that would advance diversity. We were each given the freedom to choose what strategies to adopt, what stages in the educational pipeline to focus our efforts, and which under-represented populations to address.

A panel session discussing our successes and challenges was to have been presented at SIGCSE 2020, which was cancelled due to the coronavirus pandemic. These videos – one from each school – provide a summary.

Read our paper at https://dl.acm.org/doi/pdf/10.1145/3328778.3366976?download=true

TL;DR : "Diversity Playbook"

- MS + HS + Frosh summer academies
- Engaging HS / non-major courses
- Support for intro through cohorts, more skills courses, and companion courses
- Jr-level research positions
- Staff for K-12 outreach and on-campus diversity

Recommendations

- Examine local needs and play to strengths, existing infrastructure & staffing, and passion
- Resources to inspire, connect, retain, network
- Critical mass important, momentum carries later
- Consider ROI, model, prototype, and iterate!
- Share best practices with others (don't go it alone)

University of Washington
Paul G. Allen School of Computer Science & Engineering

Ed Lazowska

University of Washington
Paul G. Allen School of Computer Science & Engineering

We have a reasonably good track record with gender diversity

- An increasingly diverse leadership

Ana Mari Cauce
University of Washington President

Nancy Allbritton
Dean of Engineering

Magda Balazinska
Director of the Paul G. Allen School

- An increasingly diverse faculty
  - In the past 9 years we have grown by 29 faculty (23 tenure track, 6 lecturer), 15 of whom are women (13 tenure track, 2 lecturers)


Ruth Anderson


Lauren Bricker


Maya Cakmak


Yejin Choi


Emily Fox


Hanna Hajishirzi


Ira Kemelmacher


Rachel Lin

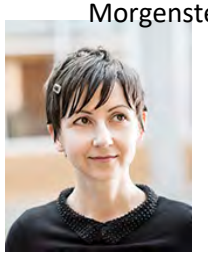

Jen Mankoff


Jamie Morgenstern


Katharina Reinecke


Franzi Roesner


Adriana Schulz


Emina Torlak


Amy Zhang

- An increasingly diverse student body
  - Consistently granting ~1/3 of our Computer Science bachelors degrees to women while tripling our annual degree production

Our Hopper-Dean focus: Underrepresented and economically disadvantaged students at the undergraduate level

- Contextual challenges
  - UW is a large, public, moderately selective R1 university in a tech-heavy city
  - Students are local
    - 70% are Washington residents
    - 3/4^{ths} of those are from the 3-county region that includes Seattle; mostly from King County itself
  - The region is not very diverse
    - King County is 69% Caucasian, 15% Asian, 6% African American, 1% Pacific Islander, 1% Native American, 4% other, 4% multiracial
  - There is reasonable economic diversity (UW is 26% Pell-eligible, 32% first-generation college attendee), however …
    - Income in the region is bimodal (average annual Seattle-area tech worker compensation is $279,000)
    - And there is extreme variability in K-12 quality, strongly correlated with income
- All of this is exacerbated by the capacity constraints of our program
  - Admission to the Allen School is far more competitive than admission to UW overall

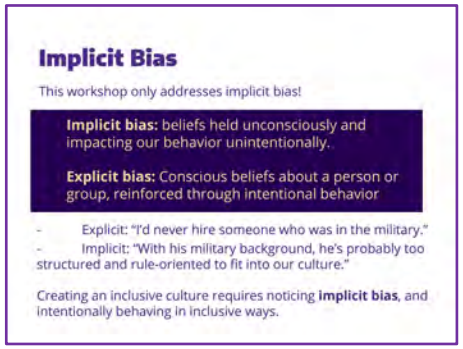
Hopper-Dean interventions

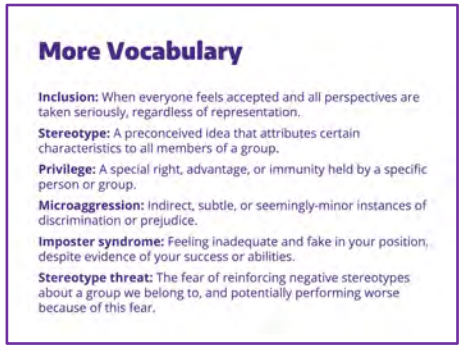
- Deep engagement with STARS program
  - Students are recruited based upon family and high school characteristics
    - Washington State law prohibits the use of race or gender, so proxies are necessary
  - The “ARS” in STARS stands for Academic Red Shirt: students get a fifth year – their first year – with:
    - Problem solving and study skills courses
    - “On-ramp” courses for Calculus I, Computer Science I, Chemistry I, Physics I
    - Cohort-building
  - Subsequently, supplemental workshops associated with:
    - Calculus I, II, and III
    - Computer Science I and II
    - Chemistry I and II
    - Physics I and II
    - Four subsequent math courses
  - And throughout: tough love from Sonya Cunningham

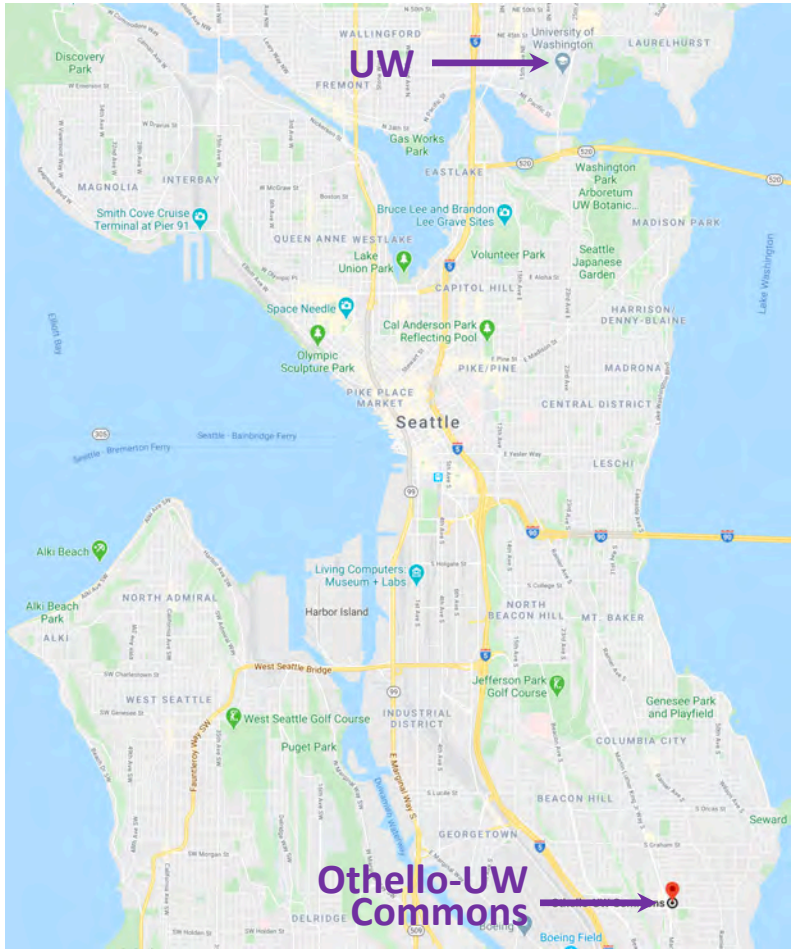
- STARS students perform dramatically better than similar students prior to the STARS intervention
  - E.g., a full grade point higher (on a 4-point scale) in Computer Science I and II
- And they out-perform the overall student body
  - Mean/median/mode final grades for the most offering of CS I (on a 4-point grading scale):
    - STARS students: 3.5 / 3.7 / 3.9
    - Class as a whole:
- It's a high touch, high cost program, but it works

- End-of-summer "Startup" transition course for at-risk first-year students
  - Average freshman GPA of these students is now higher than the department average, despite being significantly more "at risk"
- First-quarter seminar for Community College transfer students
- Targeted K-12 outreach
  - Transitioning from "broad and shallow" to "narrow and deep," focused on schools with populations we particularly want to serve

- Moving our major K-12 summer camp activity from the UW campus to South Seattle
  - A new UW facility adjacent to the Othello light rail station, 9 miles south of campus
- Inclusivity training for all TAs (1,060 TA sections annually, 570 unique TAs, ~80% undergraduate, ~1/3 women)







- A new staff Program Manager for Undergraduate Diversity and Access
  - Visible point of contact, internally and externally
  - Drives many of our programs
  - Ensures that balls don’t get dropped
- A new staff undergraduate-focused Retention Specialist
- A new staff graduate-focused Recruitment & Retention Specialist
  - Not under the Hopper-Dean umbrella, but closely related
- A new faculty Associate Director for Diversity & Inclusion
  - Ditto


Chloe Dolese Mandeville


Leslie Ikeda


Les Sessoms


Jen Mankoff

Major challenges

- Restrictions on affirmative action
  - Washington's Initiative 200 is analogous to California's Proposition 209, and was advanced by the same person, former University of California Regent Ward Connerly
- Constant admissions process changes at both the University level, the College of Engineering level, and the Allen School level
  - Eight significant changes in ten years
  - All are well-intentioned and constructive, but constant change makes tuning and evaluation difficult
- Inadequate evaluation
  - We keep adding efforts based on great ideas, and get positive anecdotal feedback, but we don't know what really works (except for STARS – and within STARS the contributions of the various elements are not clear)
  - Jan Cuny has joined us 20% time to drive evaluation efforts
- Sustainability

Key takeaways

- Local context matters greatly
- Attracting underrepresented and economically disadvantaged students is even more challenging than attracting women
- Supporting and retaining underrepresented and economically disadvantaged students is even *more* more challenging than supporting and retaining women
- Dedicated staff make a huge difference
- Commitment from the top is essential
- There is no silver bullet – success requires constant attention on many fronts
- We – the Paul G. Allen School – are making progress, but we have a long way to go
    - The Hopper-Dean support has been an enabler, but even more importantly, it has been a challenge

Institution and EECS Dept Context

- Basic Background: Celebrating 150 yrs as the flagship public institution of UC system
  - 40,955 students (29,783 undergrads)
  - 3,172 majors between EECS & L&S CS
- Two Hopper-Dean Funded Programs
  - CS Scholars
  - Beauty and Joy of Computing

Campus Unit	Pell Eligible
UC Berkeley	27%
EECS and L&S CS	16%

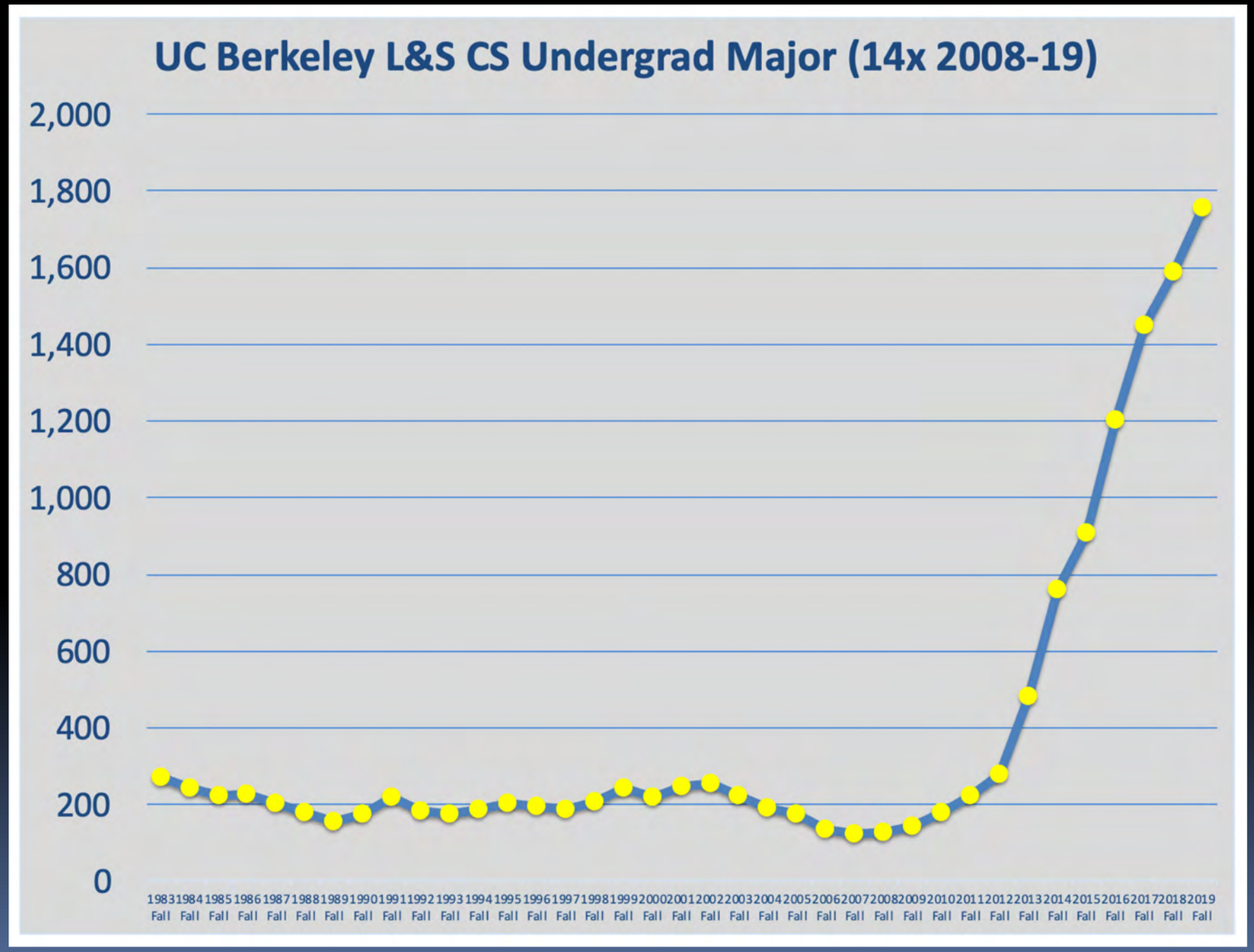
Campus Unit	Female
UC Berkeley	53%
EECS & LSCS	23%

Race/Ethnicity	UCB	CoE	EECS
Asian	39.30%	49.60%	56.31%
International	13.10%	13.90%	14.34%
URM	18.50%	10.20%	5.42%
White	29.00%	26.30%	23.93%

Retention*	Ethnicity	CoE	UCB
Female	Asian	95.10%	94.80%
	International	91.70%	92.80%
	URM	100.00%	88.10%
	White	94.10%	93.00%
Male			
	Asian	92.50%	93.20%
	International	82.70%	89.70%
	URM	84.60%	87.40%
	White	93.80%	88.60%

*Retention: retained or graduated within 6 yrs.

Incredible student demand for CS!



CS Scholars & Beauty and Joy of Computing

CS Scholars (CSS) Context

- Low % of URM and women in CS
- Sp 13: GPA threshold of 3.00 (later 3.30) instituted for admission to L&S Computer Science major
- **Target**: students affected by GPA threshold
- **Area of Focus**
  - Students with weak coding* background
  - Students from underserved communities
- **Activity**: Cohort students through 3 required LD courses (1.5yrs): labs, discussions, lecture. Directed group study, 1:1 tutoring, etc.

* Background experience correlates to success in first required course, CS61A

Beauty and Joy of Computing (BJC) Context

- Intro CS course developed for non-CS majors at the HS Jr - undergrad freshman level (CS10 @ UCB)
- Curricula endorsed by College Board for AP CS Principles; offered prof development to 650+ high school teachers worldwide
- **Target**: HS students and teachers (as well as worldwide audience)
- **Area of Focus**: CS Principles online course BJCx
- **Activity**: Support delivery of BJCx], create autograding exercises, Snap! development

CSS Positive Outcome

- **Positive Outcome**: CS61A performance by CSS is higher than general population and improving over time.
- **Metrics**: Course Passage and completion rates better than general population. 61A GPAs for CSS are consistently rising.
- **Intervention Evaluations**: by CS Professor John DeNero and Director of Undergraduate Instruction Christopher Hunn. Also partnering with UCB Equity & Inclusion Analysts.

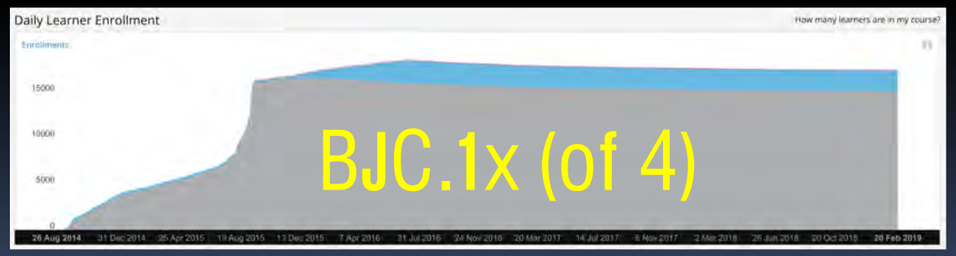
CS Scholars — CS 61A	Fall 2013	Spring 2014	Fall 2014	Spring 2015	Fall 2015	Spring 2016
Students Registered for CS 61A	23	25	18	45	52	49
Passing CS 61A	21	20	17	39	45	40
Pass Rate	**91%**	**80%**	**94%**	**87%**	**87%**	**82%**
General Population — CS 61A						
Students Registered for CS 61A	1098	725	1294	1081	1395	933
	968	599	1247	952	1145	825
Passing CS 61A	778	407	967	691	1060	625
Pass Rate	**71%**	**56%**	**75%**	**64%**	**76%**	**67%**

CSS Grade Points in CS61A				
Cohorts by Gender	Fall 2014	Fall 2015	Fall 2016	Fall 2017
Female	2.59	3	3.11	3.09
Male	2.41	2.65	2.97	3.19
Total	2.5	2.87	3.04	3.19
Grade points grade: A=4.0 ; A- =3.7 ; B+ =3.0 ; B- =2.7 ; C+ =2.30 ; etc.				

BJC Positive Outcome

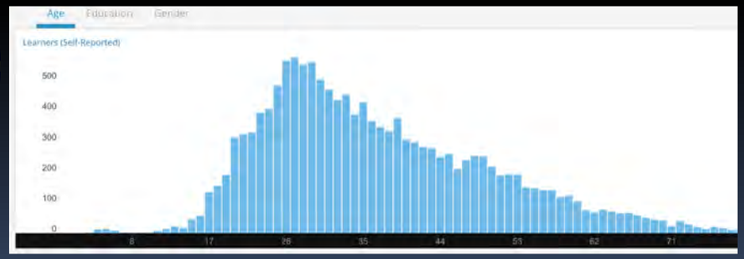
- **Positive Outcome**: 16K students, Female success, 53 Autograding exercises
- **Metrics for success**: Student satisfaction, Success of women vs men, reach, feedback from teachers using the course as a Small Private Online Course (SPOC)
- **Intervention Evaluation**: Yifat Amir did full analysis for her MS project in 2017-2018

16k



BJC.1x (of 4)

500



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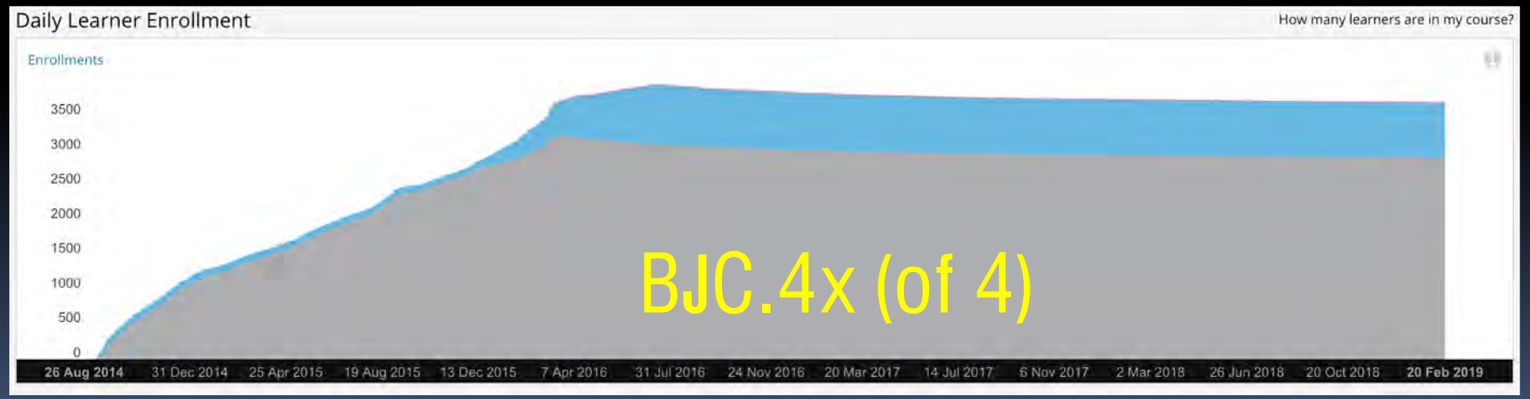
CSS Failure / Challenge

- **Failure, Challenge:** Still working towards a 3.30 GPA average for cohort. Ensuring all cross sections of CS Scholars perform equally well.
- **What did we try:** one-on-one tutoring; additional technical sections & exam review sessions. Cohorting by sub-populations to create critical mass within sec's.
  - Made it to 3.19 average grade points (increased from 2.5 grade!)
- **How did you know it was not working**: While we have not achieved the 3.30 GPA threshold for all, we did see performance improve.

BJC Failure, Challenge

- **Failure, Challenge:** Full student engagement by the end down to few hundred (from 16K), typical in MOOCs. Some autograding exercises brittle.
- **What did we try:** Surveying those who did stay
- **How did you know it was not working:** Numbers dropped, autograding complaints

3k



Key Takeaways

CS Scholars (CSS)

- We believe in the program and want it to continue
- We are building a pipeline where CSS alumni can help mentor and teach future CS Scholars
- The right thing is to pursue funding from State to expand our program so that we have enough resources and don't need GPA cap to turn students away…

Beauty and Joy of Computing (BJC)

- SPOC courses are significantly better than a MOOC alone
- Online courses without a teacher or coach present are a significant challenge; students are not yet autodidacts!
- Auto-grading block-based development environment is hard!

STANFORD COMPUTER SCIENCE
CS PATHFINDERS OVERVIEW

Prof. Moses Charikar

INSTITUTION & DEPARTMENT CONTEXT

Faculty: 55 tenure-track (~20 joint) + 10 lecturers

Students:
256 PhD students
622 MS students (387 MS "co-terms")
948 Undergraduates (declared)
- > 20% of Stanford undergraduates

Student demographics (undergraduate)

• Stanford:	women (50%)	URM (28%)	Pell received (16%)
• CS:	women (34%)	URM (20%)	N/A

Completion (undergraduate)

• Stanford:	4-year (75%)	5-year (90%)	6-year (94%)
• CS:	N/A		

INSTITUTION'S PROGRAM OVERVIEW

Motivation: URMs & women underrepresented in CS compared to their overall representation at Stanford

Target population: URM & women undergrads interested in CS (also prioritize lower income & 1st gen students)

Area of focus: **Support** & create **cohesion** for underrepresented students

Activities

1) Incoming Freshman: CS Summer Academy (4-week)
2) Freshman Year: Companion Academy (1 credit add-on to three intro courses)
3) *Sophomore Year: Summer Software Engineering Academy (10-week)*
4) Junior Year: Research Academy (10-week)
5) All Years: *CS Pathfinders Lunch (monthly)*
   Conference Support (send students to Grace Hopper & Tapia)

ACTIVITIES

1) Incoming Freshman: CS Summer Academy (4-week)
2) Freshman Year: Companion Academy
   (1 credit add-on to three intro courses)
3) *Sophomore Year: Summer Software Engineering Academy (10-week)*
4) **Junior Year: Research Academy (10-week)**

5) All Years: *CS Pathfinders Lunch (monthly)*
   Conference Support
   (send students to Grace Hopper & Tapia)

FIRST SUCCESS/POSITIVE OUTCOME

Strong demand for Companion Academy courses & positive student feedback

Metrics:

- **Expansion** from CS106A to CS 106A/B & CS107 & **enrollment** increase
  - 10 students Winter 2017-18, 29 students Spring 2017-18
  - 61 students Autumn 2018-19, 61 students Winter 2018-19
  - **134 unique students served (43% URM, 58% women)**

Evaluation:

- High ratings from students
  - How much did Pathfinders influence your interest in CS? *50%-a great deal, 25%-a lot*
- Positive comments
  - Interest in majoring in CS? *"Yes because I find CS much less intimidating now"*
  - *"thank you for passing the CS 107 Pathfinders opportunity my way! It was by far the best ACE experience that I've had & it showed in my performance on my final."*
  - *"Keep providing PathFinder courses for students!"*
  - *"The students in pathfinders put in extra effort and, thanks to the extra mentorship, we were able to provide them with extra support. This has had a profound impact on how they identify."*

SECOND SUCCESS/POSITIVE OUTCOME

CS Summer Academy **positively impacting** entire Stanford Summer Engineering Academy (SSEA) program

Metrics:

Summer 2018:	26 CS Pathfinder + 50 SSEA students (54% URM, 54% women)
Summer 2019:	60 SSEA students w/ more CS content

Evaluation:

SSEA students eager for CS Pathfinders content, so **expanding CS content to SSEA program** & growing

1ST CHALLENGE

Bootstrapping challenge as hard to add staff for unproven program

Tried to add **5 new activities** without dedicated staff support. Several people **voluntarily** pulled this off, but our execution suffered.

We knew it wasn't working when:

- We **only got 3 new activities going** (and in the wrong order)
- Noticed that TAs weren't getting paid on time (fixed)
- Grading wasn't built into the system for companion academy (fixed)

2ND CHALLENGE

Evaluation is challenging for a program with so many components & before a cohort has passed through program

Although we collected course & other evaluations, we need to explicitly **define metrics** & **collect data systematically**

FUTURE EFFORTS/SUSTAINABILITY

Key lesson

- Can't rely on faculty to run programs

Next moves

- **Created a new CS diversity staff job** description & obtained departmental approval to hire
- Better define metrics & track data
- Implement lunch & Summer Software Engineering Academy

FUTURE EFFORTS/SUSTAINABILITY

Sustainability

- Hopper-Dean funding allowed us to pilot ideas & made it attractive for Stanford to contribute to CS Diversity efforts
  - CS Department will pay for new diversity staff position
  - SoE Deans office will support companion TAs

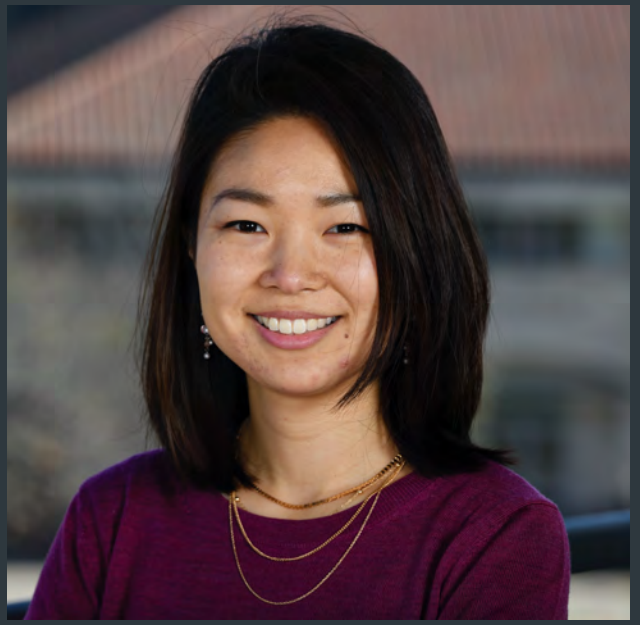
- Fundraise w/ companies/foundations for other components

THANKS

James Landay

Cynthia Lee

Lourdes Andrade



Nan Aoki

STANFORD COMPUTER SCIENCE

CS PATHFINDERS REVIEW

Prof. Moses Charikar

Session 2L: Institutions Share Successes, Failures, and Advice in Moving the Diversity Needle

MIT Saturday Engineering Enrichment and Discovery (SEED) Academy

Eboney Hearn, Executive Director, MIT Office of Engineering Outreach Programs (OEOP)

March 12, 2020

SIGCSE '20: Proceedings of the 51st ACM Technical Symposium on Computer Science Education

We are grateful for the support of the Hopper-Dean Foundation.

MIT and School of Engineering Context

- Overall enrollment (fall 2018): 11,574
  - 4,602 undergraduates, 54% in the School of Engineering
  - 6,972 graduates, 47% in the School of Engineering

- Institute Student demographics (fall 2018):
  - US minority groups: 56% of undergraduates and 22% of graduates
  - URM: 21% of undergraduates and 7% of graduates
  - Women: 46% of undergraduates and 35% of graduates

- SOE Student demographics (fall 2018):
  - US minority groups: 56% of undergraduates and 22% of graduates
  - URM: 21% of undergraduates and 6% of graduates
  - Women: 46% of undergraduates and 31% of graduates

- Percent of undergraduates receiving Federal Pell Grants:
  - 18% in 2017-2018
  - 17% in 2016-2017

- Freshmen retention:
  - Returning in 2018: overall 98.5%, women 99%
  - Returning in 2017: overall 99%, women 99%

- Six-year graduate rate (cohort year 2012):
  - Overall 94%
  - Women 95%
  - US minority groups: 93%

OEOP has a long history at MIT

OEOP administers 3 STEM Programs, free-of-charge

Program	Number	Structure	Content
MITES Minority Introduction to Engineering and Science	80	6-weeks (residential)	5 courses (Life Science, Math, Physics, Humanities, Engineering Elective)
MOSTEC MIT Online Science Technology and Engineering Community	150	6-months (online), 5-days (residential)	2 short courses (Engineering Elective, Science Writing + Enrichment Phase)
SEED Academy **Saturday Engineering Enrichment & Discovery Academy**	**135**	**Up to 5.5 years (Commuter)**	**2 courses (Engineering Project Course + Academic Mentoring)**

OEOP Serves a Diverse Demographic

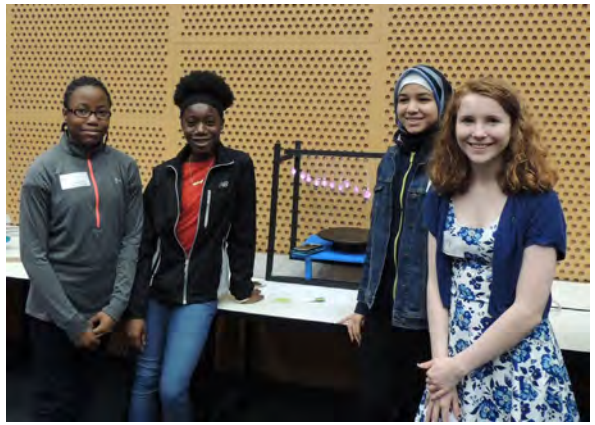
- **~350** middle and high school students
- 81% from **underrepresented** backgrounds in STEM
- 72% from **low-income** backgrounds
- 53% are **first-generation college students**
- 53% identify as **female**

OEOP Approach & Values

Learning

Diversity

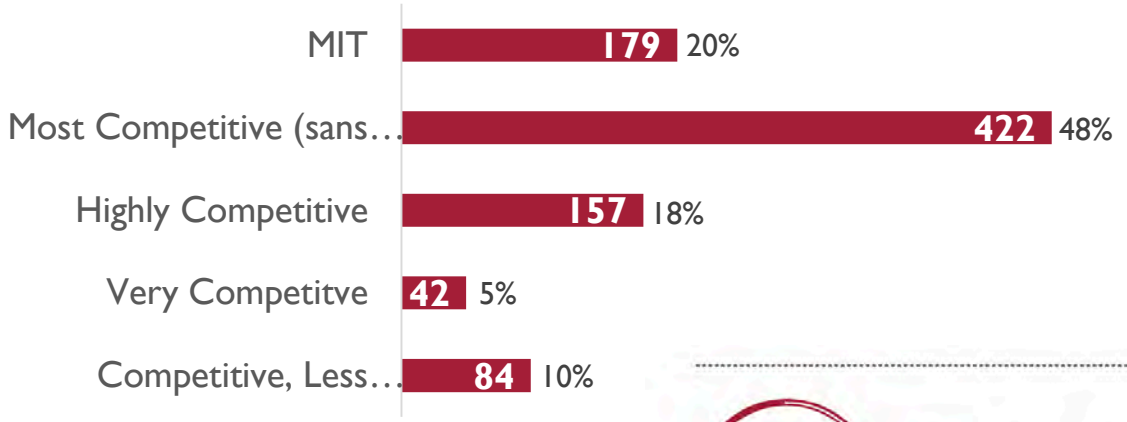
Transformation



Community

Access

OEOP Alumni Attend Selective Schools and Earn Degrees in STEM



- Of 575 alumni with a BS in a STEM field, 129 earned a degree in CS or EECS [22%]. Computer science is the field in which most OEOP alumni earn a bachelor's degree, followed by bio/biomedical engineering [70] and mechanical engineering [55].

79% Data from the past 10 years shows that 79 percent of our alumni who have received a bachelor's degree earn that degree in a STEM field.

90% of OEOP alumni who enrolled in a four-year college in the 2018-19 academic year, attended the **most selective colleges and univerisities in the country**, as defined by the Barron's Profiles of American Colleges criteria.

1 IN 5 ATTEND MIT

In the 2018-19 academic year, 1 in 5 of our OEOP alumni attending US colleges and univeristies attended MIT.

SEED Academy launched in 2002, expanded in 2017, to prepare and inspire

SEED Academy Overview (I)

- Academic/STEM enrichment and career exploration program, meets 16 Saturdays an academic year, between 9:30 AM – 3:30 PM. Transportation provided to students from Lawrence, MA.
- 130-135 7^{th} – 12^{th} graders from Boston, Cambridge, and Lawrence, MA with strong academic record and interest in science and engineering per application and family interviews.
- Two courses completed weekly, Academic Mentoring Seminar and hands-on project course in engineering. By graduation from program, students will complete up to 11 project courses in science and engineering, including computer science, robotics, electronics, civil engineering, mechanical engineering, and biological engineering, to name a few.
- Academic Mentoring Seminar addresses executive functioning, social-emotional learning and development, and college preparation.
- Each semester culminates with oral presentations of projects/designs/inventions presented to families and MIT community members. Symposium include parent seminars on apply to college, financing college, supporting executive function development, and information on summer internships/programs/scholarships in STEM.

SEED Academy Comp Sci. Course Overview (II)

SEED Academy Computer Science (25 students per course)

- Students explore various computer science concepts and topics ranging from how data is transformed and understood by the computer, to what graphics are, and how computers comprehend visuals. Students create different projects using various techniques, and each group of students will be able to demonstrate and explain how they accomplished their projects. Students also focus on the process of writing computer software and complete the course with a working knowledge that will allow them to code in almost any computer language.

SEED Academy Robotics (25 students per course)

- This course provides an introduction to robotics. Upon successful completion, students are able to construct and program a basic robot using a Raspberry Pi and Python. Students also hone their logic and reasoning skills and investigate the definitions of intelligence and artificial intelligence, and the way these concepts impact robotics research and engineering.

SEED Academy Electrical Engineering and Computer Science (EECS) (25 students per course)

- Students investigate electrical engineering and computer science through the frame of engineering, including circuit theory, amplification, feedback, and embedded systems. Students construct electrical engineering projects in a team to present at the end of the term. Projects typically include a significant amount of programming in Python and circuit building. The course is modeled off of the intro-EECS curricula at MIT.

Some expected short and long-term outcomes (I)

- ✓ Expose scholars to rigorous courses in STEM, building their understanding of the engineering design process, providing culturally relevant content
- ✓ Scholars develop 21st century skills; collaboration, public speaking, team work, critical thinking, etc.
- ✓ Increase self-efficacy, interest, motivation and intent to major in STEM
- ✓ Increase knowledge barriers, advantages, and possible outcomes for success with a career in STEM and sense of belonging in STEM

Some expected short and long-term outcomes (II)

- ✓ Build strong community of peers and improve college-readiness
- ✓ Improve understanding of college admissions processes and funding for all types of colleges and universities for scholars and parents
- ✓ 100% of scholars accepted to 4-year college, 100% enroll in 4-year colleges, 75%+ earn a STEM degree and enter careers in STEM

Successful expansion into middle school

- SEED Academy
  - Funding allowed program to expand to include 7th and 8th graders in 2017
  - Metrics based on internally tracked data, as well as qualitative data from surveys and testimonials
    - Retention rate: 94.8%
    - Record number of applicants in 2019

Number of SEED Participants by Grade Level (2015 – present)							
Year	7th	8th	9th	10th	11th	12th	**Total**
2020	20	22	25	27	24	17	**135**
2019	15	16	27	24	18	23	**123**
2018	13	22	27	22	24	21	**129**
2017	18	13	17	26	24	23	**121**
2016	0	0	22	25	24	17	**88**
2015	0	0	18	25	21	22	**86**

"I grew as a person and knowing that I was in such a rigorous program and did not fail and give up…it made me feel like I had more to offer the world. There's so much to the world of STEM and I'm thrilled to go on to college and uncover it."

"The academic rigor has really increased my confidence. I now feel confident that I am capable of performing up to college-level academics."

Increased interest in STEM

- Class of 2018 & 2019: 100% high school graduation rate class, 100% enroll in 4-year colleges
- Of the 2018-2019 entering college freshmen, 71% interested in pursuing a career in science, 86% interested in pursuing a career in mathematics, and 82% interested in pursuing a career in engineering
- Most alumni earn a BS in computer science and electrical engineering
- In 2019, greatest number ever of SEED scholars admitted early to most competitive institutions in the region, including MIT and Harvard College

"SEED Academy provided me with opportunities that I could not find elsewhere. It solidified my desire and has further inspired me to pursue a STEM career in the future. It exposed me to various types of engineering, all of which I do not have the chance to learn in school. In Academic Mentoring Seminar, I found a safe space to talk about important modern-day issues and learned about the college application process. I also met many new people who have become my second family over the past few years."

A Challenge/Failure/Disappointing Outcome

- SEED Academy's goal is persistence in STEM careers.
  - **How do we ensure our program alumni are completing undergraduate degrees in four and six years and moving into STEM careers? How do we better engage program alumni in current programmatic activities?**
    - SEED Academy 6-year college graduation rate is 72% and 4-year college graduation rate is 46% in comparison to OEOP national programs with a 6-year graduation rate of 89%.
    - STEM degree attainment for SEED Academy alumni over last 10 years is 52% in comparison to OEOP national programs at more than 80%.
    - Some data is available to us on careers after college and we know that many alumni are in fact pursuing careers in STEM. We want to better leverage their experience and wisdom in mentoring younger SEED scholars.

A Challenge/Failure/Disappointing Outcome

- SEED Academy's goal is persistence in STEM careers.
  - **How do we measure the effect of the recent expansion into middle school grades? How do we measure the increased attention on college preparation content for underserved high school students?**
    - Middle school pilot classes are only in 10th and 11th grade, respectively
      - Typically track college acceptance, enrollment, major - this data will not be available until 2022 & 2023 for these cohorts
      - What other measures (e.g. interest, motivation, self-efficacy, and confidence) should we utilize to understand the likelihood of persistence in STEM for *middle school* participants?
    - Complete revamp of Academic Mentoring course. Is increased focus on college prep paying off?
      - What SEED Academy college prep activities (e.g. project courses, academic mentoring, college fair, MIT admissions session) are most likely to impact persistence in STEM at top-tier institutions?
      - Colleges to which high school participants are applying and getting into is shifting – largest number of IVY+ early decision admits ever for SEED Academy students this spring

        (4 of 10 admitted early to MIT or Harvard out of 23 total)

Advice for moving diversity needle

1. Utilize strategies from proven models for outreach programs that broaden participation in STEM or build leadership skills for URM and underserved students.

2. Where possible include evaluation and tracking to understand impact and outcomes

3. Supporting URM and underserved K-12 students through STEM career pathways requires acknowledging whole student (both inside and outside of classroom) ex. leveraging parental engagement

4. To be most effective, utilize intentional strategies throughout program implementation to address the unique needs of your students

5. Implement programs with attention to culturally relevant pedagogy, high expectations on what students can achieve, with academic rigor, differentiation, and with communicated belief that students can achieve and will rise to those high expectations.

Future/Sustainability for SEED Academy

- Plans for sustaining intervention:
    - More than 70% of annual budget comes from family foundations and 1% from corporations. The other portion is from MIT. We will seek continued funding from local and national foundations, while building and sharing the case for corporate support from local entities interested in investing in a high achieving, diverse, and local STEM talent pipeline
- Key lesson:
    - Students who enter SEED Academy interested in STEM will largely remain interested in STEM – the Academy has a responsibility to ensure they are prepared for the college application/transition process to pursue those interests, to graduate college, and move into careers.
- What's next:
    - Continue to track college applications and acceptances to evaluate strength of overall program
    - Identify and evaluate additional metrics of success for expansion into middle school
    - Expand program to offer internships through corporate sponsors
    - Increase engagement of SEED Academy alumni to provide mentoring to current students

References

- Clewell, B.C., et al. (2005). *Evaluation of the National Science Foundation Louis Stokes Alliances for Minority Participation Program* (Final Report). Washington, DC: The Urban Institute, p. 39.
- Dabney, K.P., et al., *Out-of-School Time Science Activities and Their Association with Career Interest in STEM.* International Journal of Science Education Part B, 2011: p. 19 pages.
- Hoxby, C. & Avery,C. (2013). *The Missing "One-Offs": The Hidden Supply of High-Achieving, Low-Income Students.* Brookings Papers on Economic Activity.
- Huang, G., Taddese, N., Walter, E., Peng, S.S. (2000). *Entry and Persistence of Women and Minorities in College Science and Engineering,* National Center for Education Statistics (NCES 2000-601). Washington, DC: U.S. Department of Education.
- Hurtado et al. (1999). Enacting Diverse Learning Environments: Improving the Climate for racial/ethnic Diversity in Higher Education, *ASHE-ERIC Higher Education Report* (Volume 26, No. 8) Washington, DC: The George Washington University, Graduate School of Education and Human Development.
- *Learning Science in Informal Environments: People, places, and pursuits*, ed. P. Bell, et al. 2009, Washington, DC: National Academies Press.
- Maton, K.L., Hrabowski, F. A., Ozdemir, M. & Wimms, H. (2008). Enhancing Representation, Retention, and Achievement of Minority Students in Higher Education: A Social transformation Theory of Change, In M. Shinn, & H. Yoshikawa, H. (Eds.), *Toward Positive Youth Development: Transforming Schools and Community Programs*. New York: Oxford University Press, pp. 115-132.
- Mattern, K. D., Marini, J. P., & Shaw, E. J. (2015). Identification of multiple nonreturner profiles to inform the development of targeted college retention interventions. *Journal of College Student Retention: Research, Theory & Practice*, 17(1), 18–43
- Mickelson, R., & Oliver, M. (1991). The demographic fallacy of the Black academic: Does quality rise to the top. In W. Allen, E. Epps, & N. Hani (Eds.), College in Black and White: African American students in predominantly White and in historically Black public universities (pp. 177–195). Albany, NY: State University of New York Press.
- *Next Generation Science Standards*. 2013.
- Sedlacek, W. E. (2011). Using noncognitive variables in assessing readiness for higher education. *Readings on Equal Education, 25*, 187-205.
- Slanger, W. D., Berg, E. A., Fisk, P. S., & Hanson, M. G. (2015). A longitudinal cohort study of student motivational factors related to academic success and retention using the college student inventory. *Journal of College Student Retention: Research, Theory and Practice*, 17(3), 278–302.
- *Standards for K-12 enigneering education?* 2010, Washington, DC: National Academies Press.
- US Department of Education, *(2006) Test of Leadership: Charting the Future of U.S. Higher Education (*September2006*).* A report of the commission appointed by Secretary of Education Margaret Spellings
- Wang, X., *Why Students Choose STEM Majors: Motivation, High School Learning, and Postsecondary Context of Support.* American Educational Research Journal, 2013. **50**(5): p. 1081-1121.

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