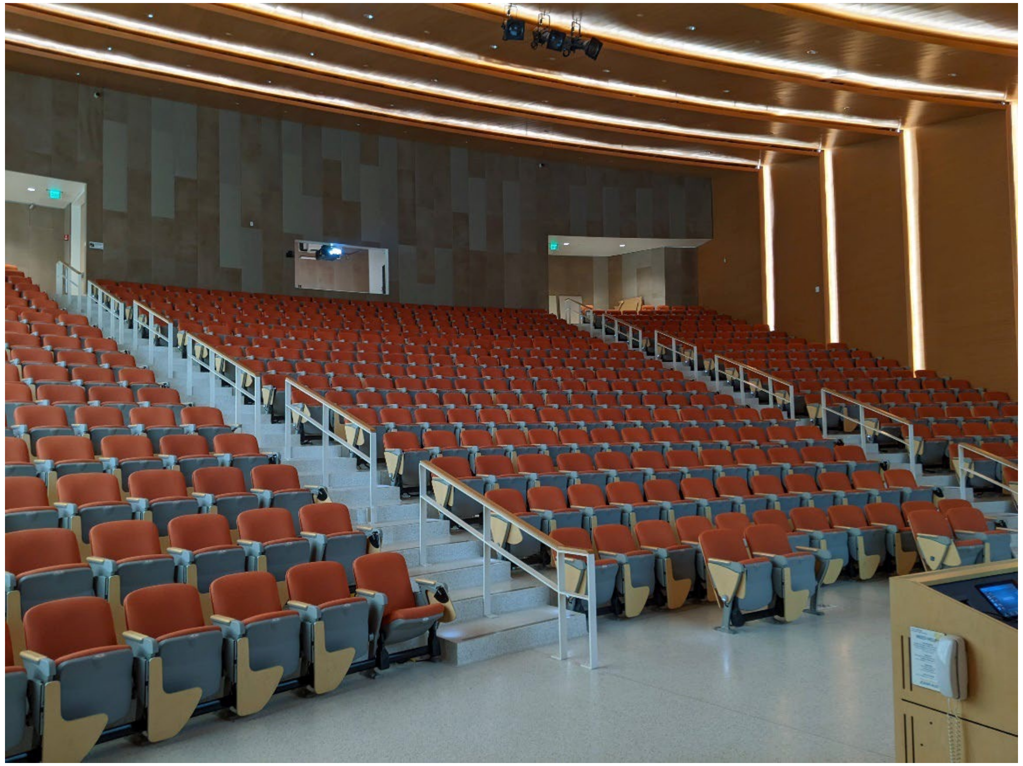
Livin' Large: Lessons Learned from the Large-Lecture Lifestyle

David Quarfoot
Associate Teaching Professor
Department of Mathematics
dquarfoot@ucsd.edu



UCSD's Jeannie Auditorium: 600 seats

Up and Running

socrative.com $\gg$ Login $\gg$ Student Login $\gg$ Room Name = QUARFOOT

OR

App store $\gg$ Socrative Student

Choate Rosemary Hall
2001-2008, private boarding
Class sizes: 5-15 students

University of Utah
2008-2010, public
30-60 students

Roxbury Latin School
2010-2012, private day
5-15 students

UCSD
2016-present, public
80-400 students

Up and Up (and Up!)

UCSD Total Enrollment 1960-2015
2023 Enrollment: 41885 (U+G)

My recent class sizes: 450, 240, 90, 250, 80, 130, 320, etc.

Winter 2023 Class Sizes (after drop deadline)

- Precalc (100, 100, 120)
- Calc 1 non-STEM (240, 240, 200, 200)
- Calc 1 STEM (260, 200, 160)
- Calc 2 non-STEM (140, 330, 200, 130, 100)
- Calc 2 STEM (160, 400, 150)
- Intro Stats (200, 130, 200)
- Linear Algebra (500, 160, 130)

1960	107
1961	156
1962	205
1963	283
1964	560
1965	1,438
1966	2,183
1967	2,967
1968	3,662
1969	4,622
1970	5,499
1971	6,026
1972	6,547
1973	7,383
1974	8,251
1975	8,940
1976	9,446
1977	9,562
1978	9,951
1979	10,270
1980	10,488
1981	11,357
1982	12,164
1983	12,724
1984	13,357
1985	13,908
1986	14,990
1987	15,634
1988	16,252
1989	16,595
1990	16,808
1991	16,978
1992	17,240
1993	16,853
1994	16,577
1995	17,101
1996	16,896
1997	17,454
1998	18,137
1999	18,664
2000	18,907
2001	20,249
2002	22,128
2003	23,225
2004	23,675
2005	24,240
2006	25,109
2007	25,810
2008	26,266
2009	27,117
2010	27,815
2011	27,176
2012	26,855
2013	28,052
2014	29,146
2015	30,412

Lesson 1: Use Flexible Class Policies

Let p be the probability that a random student will miss a deadline, skip a class/discussion, not take an exam, etc. for any reason.

Let $X \sim Binom(n, p)$ be the number of students in a class of n who fail to meet a deadline, skip class, etc.

$$E(X) = np$$

- $n = 25, p = 0.05$: $25 \cdot 0.05 = 1.25 \dfrac{\text{exceptions}}{\text{event}}$
- $n = 200, p = 0.05$: $200 \cdot 0.05 = 10$
- $n = 450, p = 0.07$: $450 \cdot 0.07 = 31.5$

$$\times \frac{\text{number of events}}{\text{course}}$$

Flexible Class Policies I Use

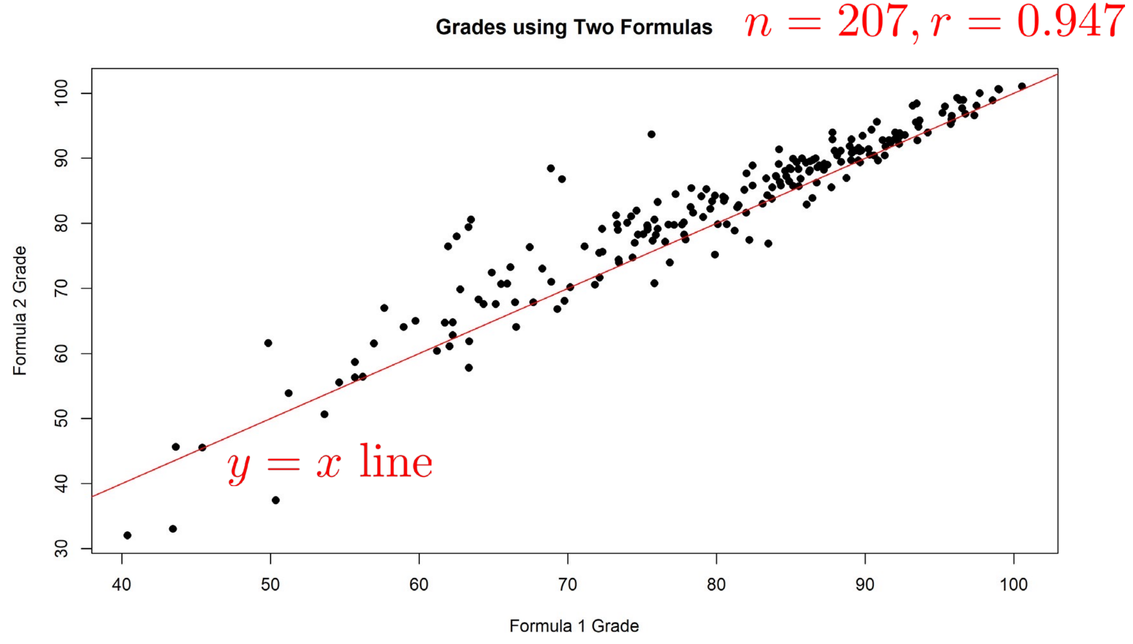
To Socrative! Class Policies Brainstorm

- Drop x of y homework assignments/attendance checks
- Classes always podcast
- Head off tech excuses (HW due at 9 PM with 2 hour tech issue window)
- Drop x of y exams with final exam replacement

<u>Formula 1:</u>
30% Homework (out of 95% of max points)
20% Exam 1
20% Exam 2
30% Final Exam

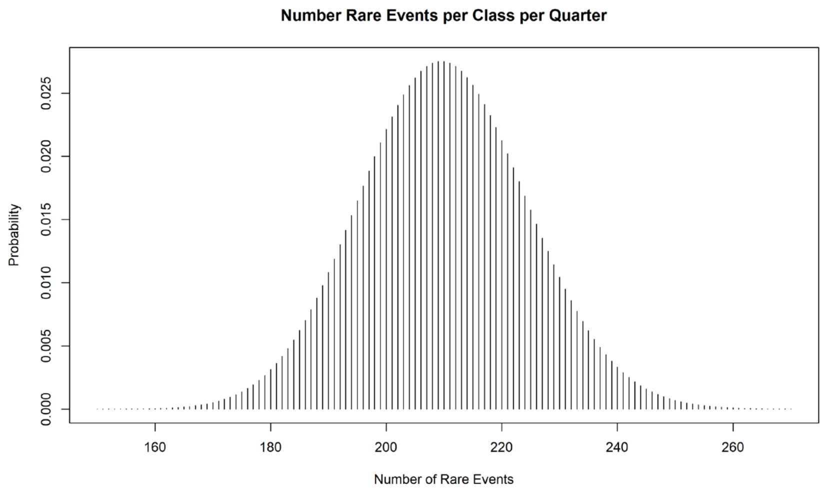
<u>Formula 2:</u>
30% Homework (out of 95% of max points)
20% Better Exam score

50% Final Exam
(This formula basically replaces the lower Exam score with the Final Exam Score.)



Lesson 2: Rare and Ultra-rare Events Occur Many Times

$$\text{Let } \lambda = \frac{1 \text{ rare event}}{100 \text{ student-day}} \cdot \frac{300 \text{ students} \cdot 70 \text{ days}}{1 \text{ class-quarter}} = 210 \, \frac{\text{rare events}}{\text{class-quarter}}$$



$$X \sim Pois(\lambda = 210)$$

- Forget calculator at exam
- Car breakdown
- Submitted wrong homework

$$\text{Let } \lambda = \frac{1 \text{ ultra-rare event}}{1000 \text{ student-day}} \cdot \frac{300 \text{ students} \cdot 70 \text{ days}}{1 \text{ class-quarter}} = 21 \, \frac{\text{ultra-rare events}}{\text{class-quarter}}$$

Athlete concussion, car drove into apartment, suicide email, death in family, car accident, scooter accident, drug abuse, housing loss, 3x class repeat, etc.

Lesson 3: Little Hope of a Shared Knowledge Base

Let p be the probability a random student is familiar with a problem's context.

Your Turn: Given a class of size n, what is the probability all students will be familiar with the context?

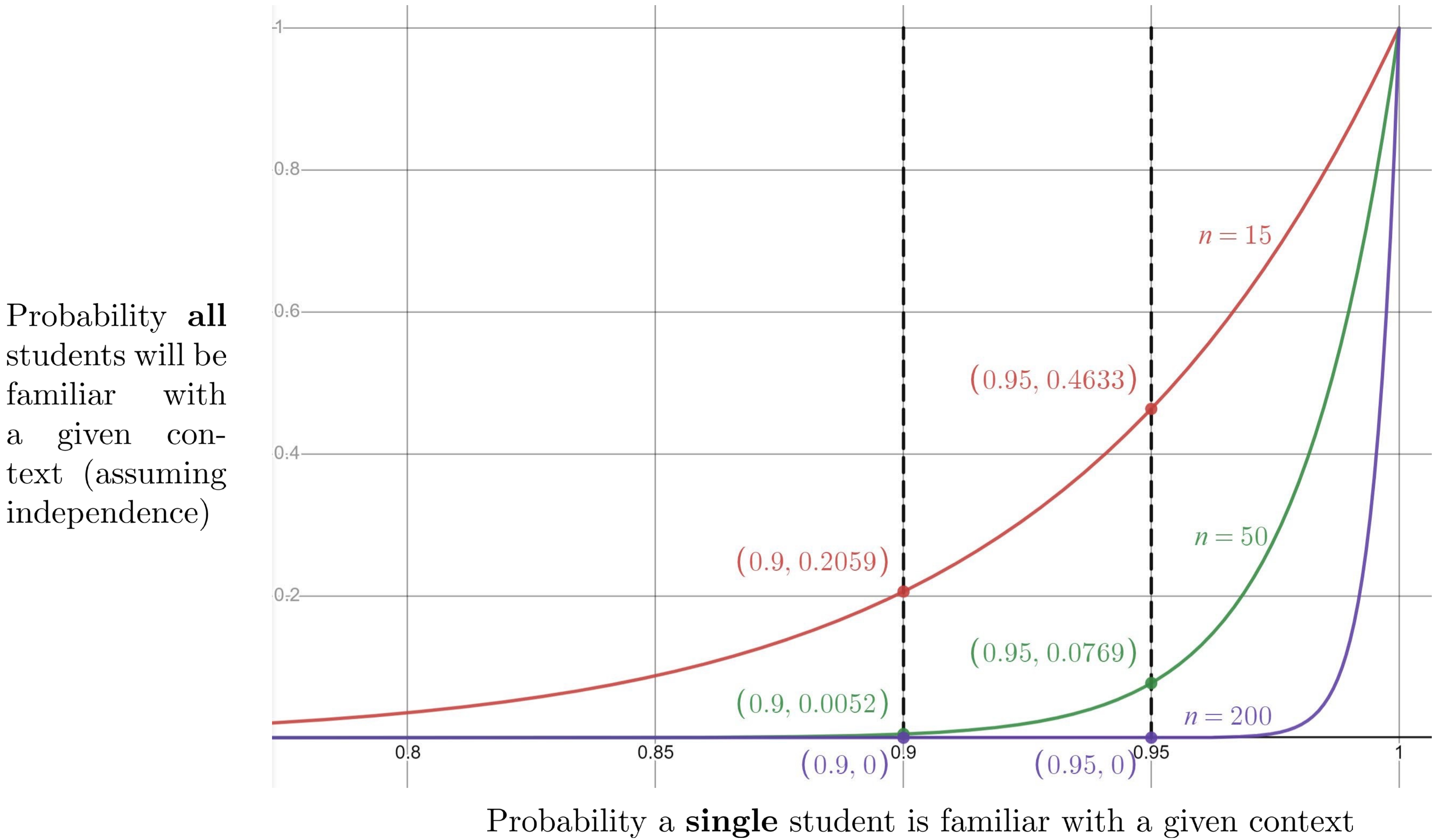
Let S_i be the event that student i knows the context.

$$P(S_1 \text{ and } S_2 \text{ and } \ldots \text{ and } S_n) \overset{\text{ind.}}{=} P(S_1) \cdot P(S_2) \cdots P(S_n) = p^n$$

Example: $(0.9)^{15} \approx 0.206$ $\quad (0.9)^{50} \approx 0.005$ $\quad (0.9)^{200} \approx 7 \cdot 10^{-10} \approx 0$

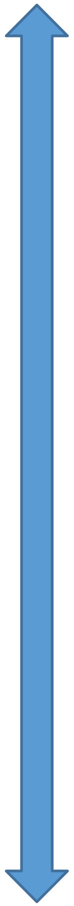
My failed settings: (American) deck of cards, baseball, prime numbers, term "divisible", north/south/etc.

Probability of a Shared Knowledge Base (Class Sizes: 15, 50, 200)



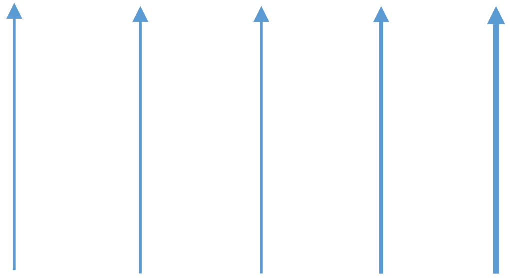
Lesson 4: You Must Consider the Larger Physical Space

More apparent



- Voice amplification, restating
- Write larger
- Use thicker chalk, thicker graphics
- Laser pointers/bluetooth distances
- Color distinctions wash with distance
- Energy/lesson sparkle must scale

Less apparent



Powerpoint weights:
0.5, 0.75, 1, 1.5, 2.25

Vibrato in larger spaces study

Videos here, Manim code here (videos not viewable in PDF file)

Lesson 5: Students Have Space and Interaction-Ratio Expectations

"... there is more to space besides navigation and assessment: people have different emotional experiences at different places, which create emotionally tinged representations of space." Paper

Contrast: Haunted house vs. house you grew up in vs. White House

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Interaction Ratios

To Socrative! IR Example Brainstorm

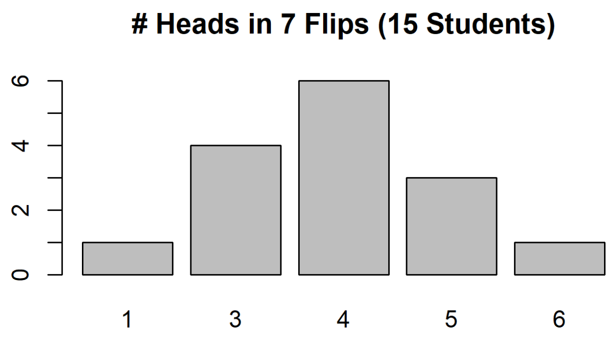
$1 : 1$			$\sim 1 : 20$			$\sim 1 : 200$		
tutor	:	tutee	teacher	:	small class	teacher	:	large class
partner	:	spouse	coach	:	sports team	movie	:	theater-goers
owner	:	pet	chair	:	department	plane	:	passengers
therapist	:	patient	Bachelorette	:	suitors	performer	:	audience

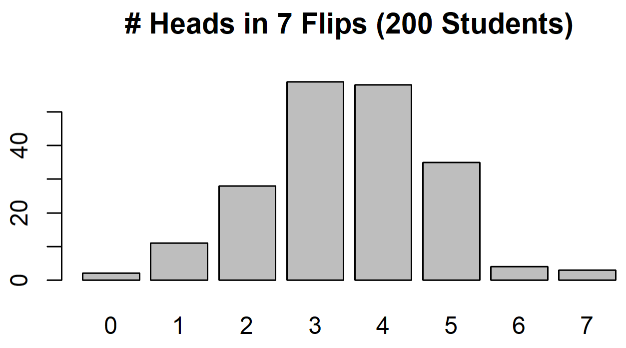
deeply known, partnership, active ⟷ anonymous, transactional, passive

Large-Lecture Affordances

1. Quality student-generated data sets!

- Real-time analysis   To Socrative! Data Generation!
- Distributions are better realized





- Narrow confidence intervals, high-powered hypothesis tests
- Less common misconceptions appear

2. The class size (m) can imitate ideas $\to \infty$

$$X \to \begin{cases} \{x_{11}, x_{12}, \ldots, x_{1n}\} \to \overline{x}_1 \\ \{x_{21}, x_{22}, \ldots, x_{2n}\} \to \overline{x}_2 \\ \quad \cdots \qquad\qquad\qquad \cdots \\ \{x_{m1}, x_{m2}, \ldots, x_{mn}\} \to \overline{x}_m \end{cases} \to \text{Histogram of } \overline{x} \text{ values (i.e., sampling distribution)}$$

limits, Riemann sum approximations, improper integrals, Central Limit Thm.

3. Greater reach (breadth vs. depth trade-off)

Small school: 50 students/year $\cdot$ 30 years $=$ 1500 students/career

Large school: 1000 students/year $\cdot$ 30 years $=$ 30000 students/career

4. High probability at least 1 person knows a specialty area

Let p be the probability a random student knows about a topic.

$$\begin{aligned} P(\text{at least 1 knows}) &= 1 - P(\text{no one knows}) \\ &= 1 - P(S_1 \text{ doesn't know and } \cdots \text{ and } S_n \text{ doesn't know}) \\ &\overset{\text{ind.}}{=} 1 - (1-p)\cdots(1-p) = 1 - (1-p)^n. \end{aligned}$$

$$\text{For } p = \frac{1}{50},\ P(\text{at least 1 knows}) \approx \begin{cases} 0.26, & n = 15 \\ 0.64, & n = 50 \\ 0.98, & n = 200 \end{cases}$$

Exotic settings where at least one student knew: Xenoblade Chronicles 2 item farming, age cutoffs in the Canadian ed system, pronoun avoidance for transgender students, two-sport pro athletes, engine size (liters) and MPG ratings for cars

Thanks and Questions

dquarfoot@ucsd.edu

Lessons:

1. Use flexible class policies
2. Rare and ultra-rare events occur many times
3. Little hope of a shared knowledge base
4. You must consider the larger physical space
5. Students have space and interaction-ratio expectations

Affordances:

1. Quality student-generated data sets
2. The class size can imitate ideas $\to \infty$
3. Greater reach
4. High probability at least 1 person knows a specialty area