What are the Factors that May Impact Student Gains in Introductory Statistics?

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Our Context: Curry College

At Curry, we will meet you where you are and help you discover who you want to be.

Curry is on your side, wherever you are in the journey.

We're always in your corner.

Our Data

- Comprehensive Assessment of Outcomes in a First Statistics Course (CAOS) administered pre-/post-

- Demographic Questions

- Integrated Post-Secondary Education Data System (IPEDS) data

- Instructor Surveys/Interviews about Implementation

- Curriculum-Based Mathematics Placement Assessment

Our Inquiries

- Are there significant differences in student growth, as measured by the CAOS, with regard to:
    - Curriculum type
    - Pedagogy
    - Modality

- Are there significant differences in student growth, as measured by the CAOS, when student factors are explored:
    - Students with learning disabilities
    - First-generation college students
    - Students with weaker mathematical backgrounds

Modality & Practice Matrix

	Fall 2019	Fall 2019	Fall 2019	Fall 2019	Spring 2020	Summer 2020	Fall 2020	Fall 2020	Spring 2021	Spring 2021
Instructor	2	1	various	2	1	2	2	2	various	1
Curriculum	Consensus	SBI	Consensus	Consensus	SBI	SBI	SBI	SBI	Consensus	SBI
Results	n=17/16 +0.96	n=22/21 +5.88	n=20/11 +0.66	n=13/10 +10.46	n=22/14 -8.73	n=19/13 -9.96	n=8/7 -1.60	n=19/18 +4.39	n=92/20 +3.83	n=39/26 +5.06
Students	traditional undergrad	traditional undergrad	embedded support	Int'l	traditional undergrad	continuing education	continuing education	traditional undergrad	traditional undergrad	traditional undergrad
Pedagogy	flipped	student-centered*	lecture/ practice	flipped	moderate student-centered inquiry implementation*				lecture/ practice	moderate*
Modality	F2F	F2F	F2F	F2F	F2F then online (COVID)	online synch.	online (synch. optional)	hyflex	online synch.	hyflex

Instructor 1: author, piloter; Instructor 2: co-author; Various: other instructors who have taught this course at this institution for many years

Data Cleaning Process
(complete records only, pooling)

	Fall 2019	Fall 2019	Fall 2019	Fall 2019	Spring 2020	Summer 2020	Fall 2020	Fall 2020	Spring 2021	Spring 2021
Instructor	2	1	various	2	1	2	2	2	various	1
Curriculum	Consensus	SBI	Consensus	Consensus	SBI	SBI	SBI	SBI	Consensus	SBI
Results	n=16 +1.09	n=21 +9.50	n=11 +0.75	n=10 +12.37	n=14 -7.86	n=13 +5.38	n=7 -3.21	n=18 +4.72	n=20 -2.24	n=26 +3.20
Students	traditional undergrad	traditional undergrad	embedded support	Int'l	traditional undergrad	continuing education	continuing education	traditional undergrad	traditional undergrad	traditional undergrad
Pedagogy	flipped	student-centered*	lecture/ practice	flipped		moderate student-centered inquiry implementation*			lecture/ practice	moderate*
Modality	F2F	F2F	F2F	F2F	F2F then online (COVID)	online synch.	online (synch. optional)	hyflex	online synch.	hyflex

Removed from Analysis:
- International Student Section (Consensus/Flipped)
  [we suspect the gains may have been due to academic language gains (supported by interview data)]
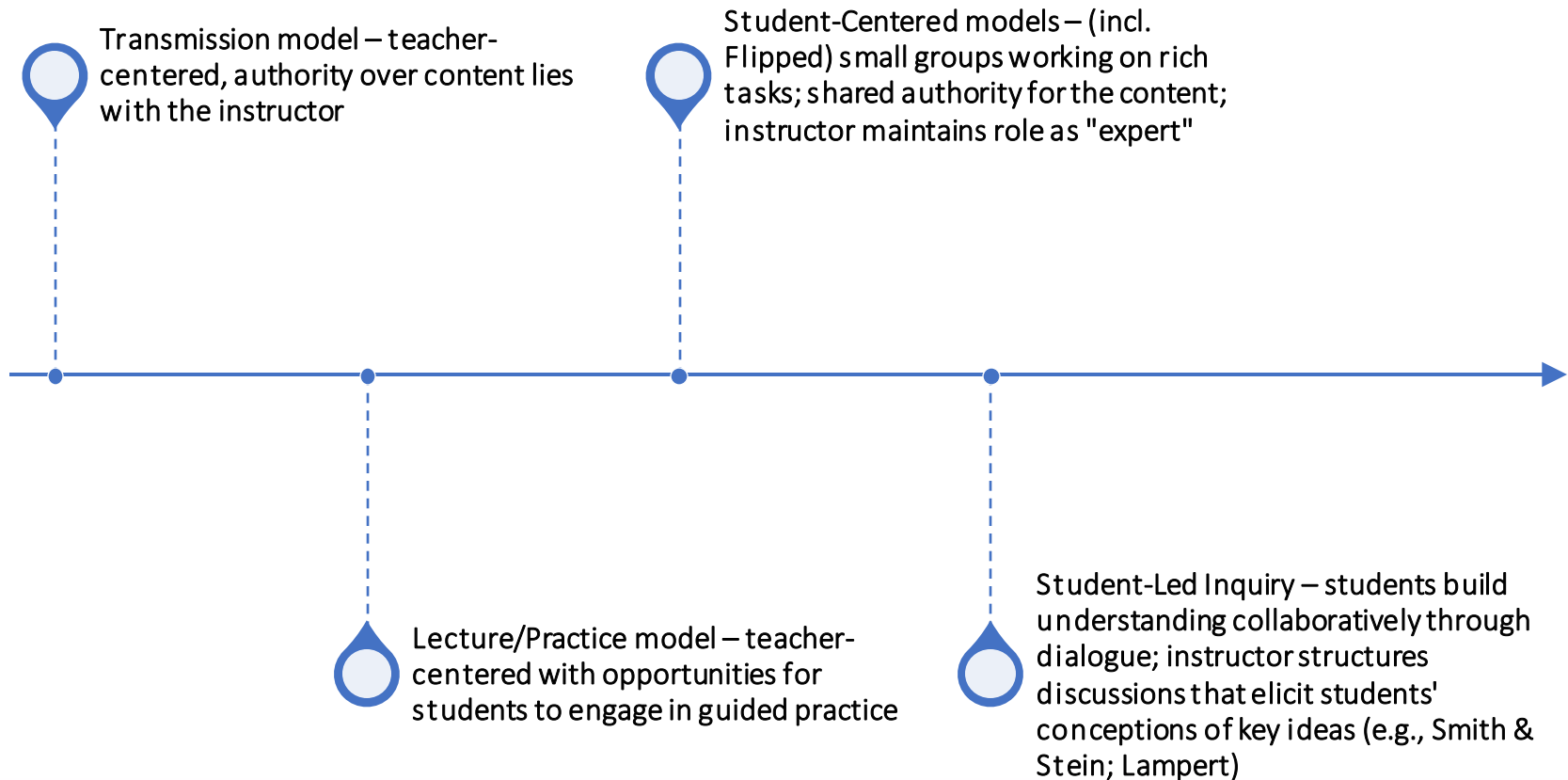- COVID semester

Inquiry #1

- Are there significant differences in student growth, as measured by the CAOS, with regard to:
  - Curriculum type
    - Consensus vs. SBI (Pre/Post Differences)
    - -0.3637 (SD = 10.47, n = 47) vs. 3.3730 (SD = 11.86, n = 64)
    - p = 0.0411
  - Pedagogy
    - Moderate+ Inquiry vs. Lecture/Practice (Pre/Post Differences)
    - 2.9114 (SD = 12.11, n = 80) vs. -1.141 (SD = 8.77, n = 31)
    - p = 0.0274
  - Modality
    - No statistically significant findings
    - F2F trends toward gains, as compared with other modalities

Inquiry #2

- Are there significant differences in student growth, as measured by the CAOS, when student factors are explored:
  - Students with learning disabilities (SBI vs. Consensus)
    - 6.875 (SD = 11.16, n = 8) vs. -1.667 (SD = 8.00, n = 9)
    - p = 0.0485
  - First-generation college students (SBI vs. Consensus)
    - sample sizes too small; no significant findings
  - Students with weaker mathematical backgrounds (SBI vs. Consensus)
    - Difference not statistically signifant; trends toward SBI beneficial to students scoring below Median on math placement assessment

Pedagogy Types

Transmission model – teacher-centered, authority over content lies with the instructor

Student-Centered models – (incl. Flipped) small groups working on rich tasks; shared authority for the content; instructor maintains role as "expert"

Lecture/Practice model – teacher-centered with opportunities for students to engage in guided practice

Student-Led Inquiry – students build understanding collaboratively through dialogue; instructor structures discussions that elicit students' conceptions of key ideas (e.g., Smith & Stein; Lampert)

Our Preliminary Findings

- Even with imperfect pedagogical implementation, **SBI is better at developing students' conceptual understanding** compared to high-quality implementation of the consensus curriculum.
  - Even compared to courses that use active learning
- However, SBI does not teach itself, even with the provided videos and resources. **Students need opportunities to talk about course content with instructor and each other.**

Implications

- Substantial curricular and pedagogical change requires the allocation of resources. Are there benefits to students and do they outweigh the costs?

- Who is disadvantaged by our current practices? Are there alternatives that benefit these students and others?

- Initiating a system of program assessment allows us to be proactive about, rather than reactive to, emerging issues.

Thank You!

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