

What We Know About Effective Technology Use in Developmental Education

Presenters:

- Xuehan Zhou, University of California, Irvine
- Whitney Kozakowski, Harvard University
- Camielle Headlam, MDRC
- Angela Boatman, Boston College

**Reimagining
Developmental
Education**

CAPR \ 2019

#CAPR2019

Online vs. Face-to-face: The Impact on Developmental and Subsequent Coursework

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Florence Ran

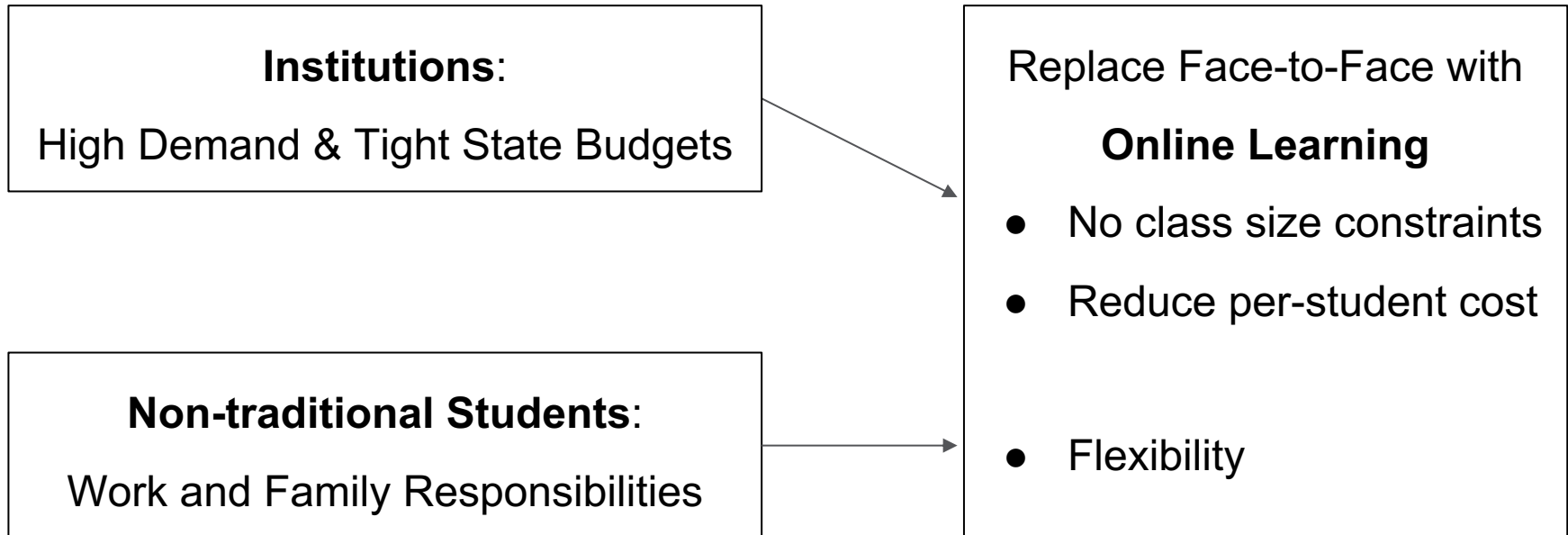
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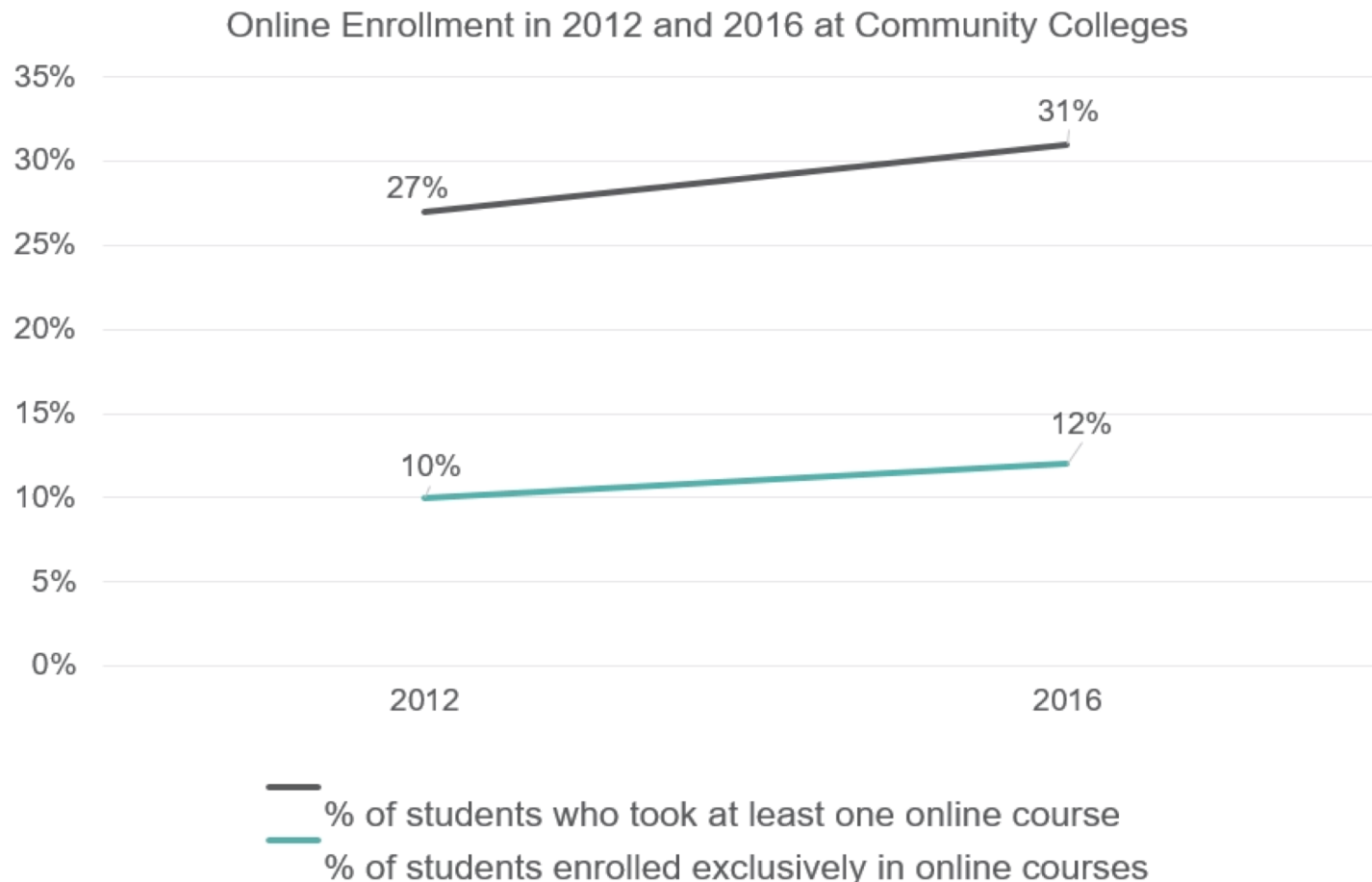
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Why Online Learning in Developmental Education?

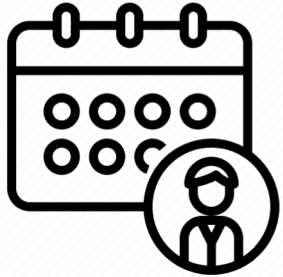


Rapid Growth of Online Learning at Community Colleges

- Online learning is prevalent among all the coursework at community colleges.



Benefits of Online Learning at Community Colleges



Flexibility to study based on their personal schedule

+



Personalized instruction and feedback

+



Identify struggling students and provide suggestions

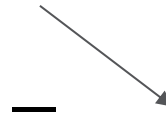
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Students' success in online developmental courses

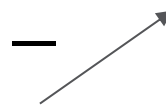
Challenges of Online Learning at Community Colleges



Increased need for self-directed learning skills

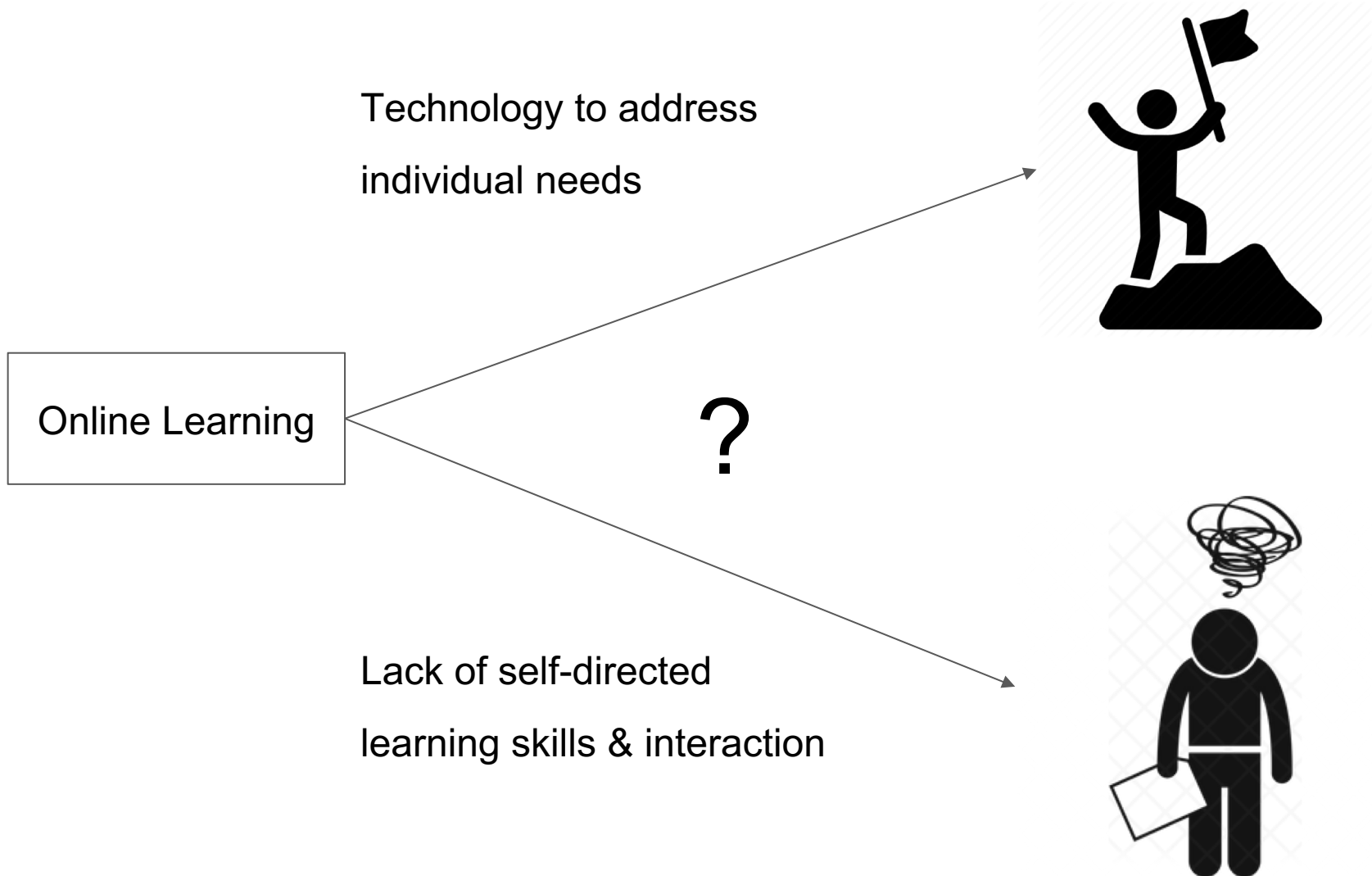


Academically underprepared students' success in online developmental courses



Lack of student-instructor & peer interaction

Benefit from or Subject to Online Learning?



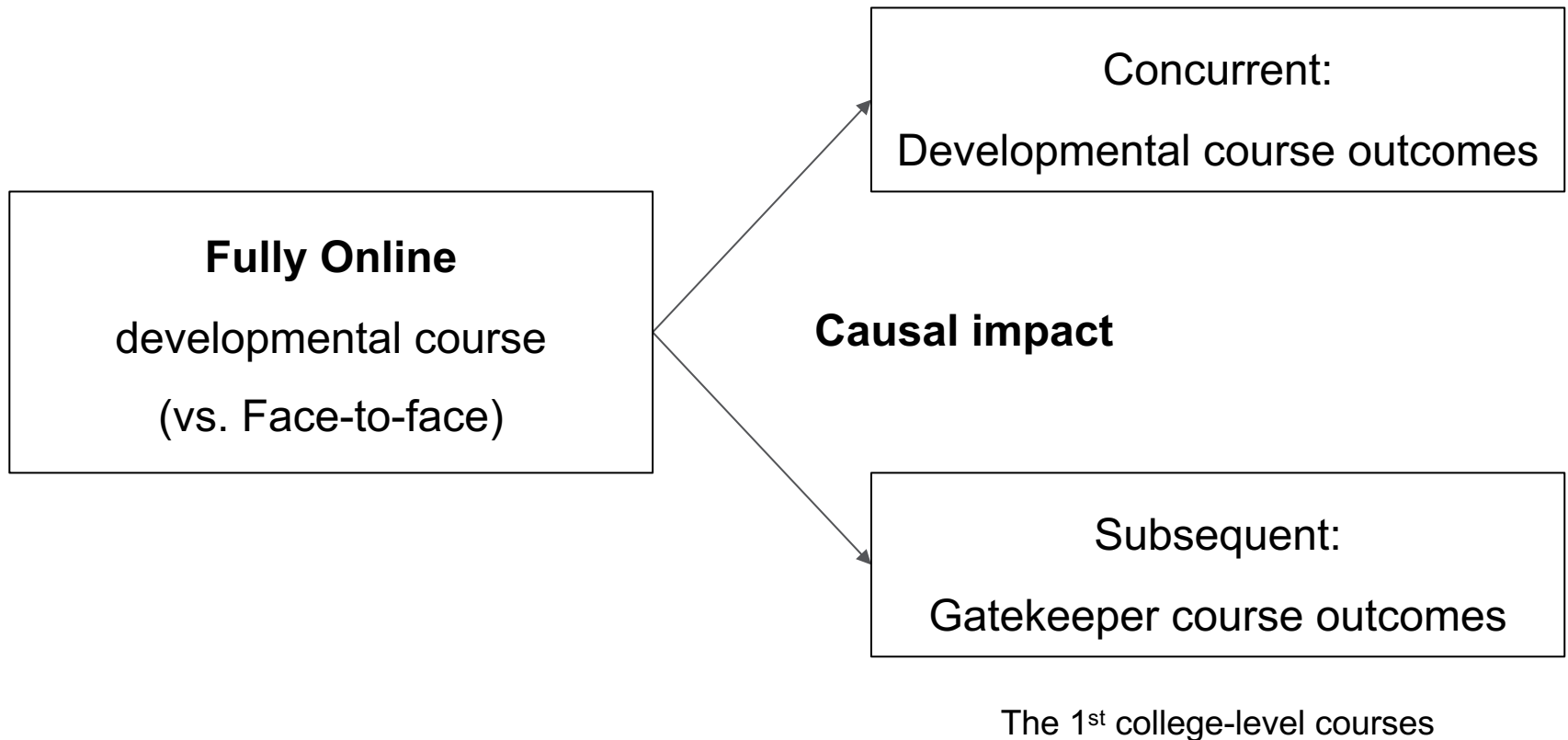
Benefit from or Subject to Online Learning?

Related Literature

- Cung, Xu, Eichhorn, & Warschauer (2019)
 - A public four-year university
 - Blended VS. Fully online
 - Fully online format has negative impacts on final grades
- Kozakowski (2019)
 - Administrative data from the Kentucky Community and Technical College System
 - Blended VS. Face-to-face lecture
 - Blended format reduces math developmental course pass rates, college persistence, and degree attainment
- Research Gap:
 - Developmental courses
 - Fully online VS. Face-to-face

Benefit from or Subject to Online Learning?

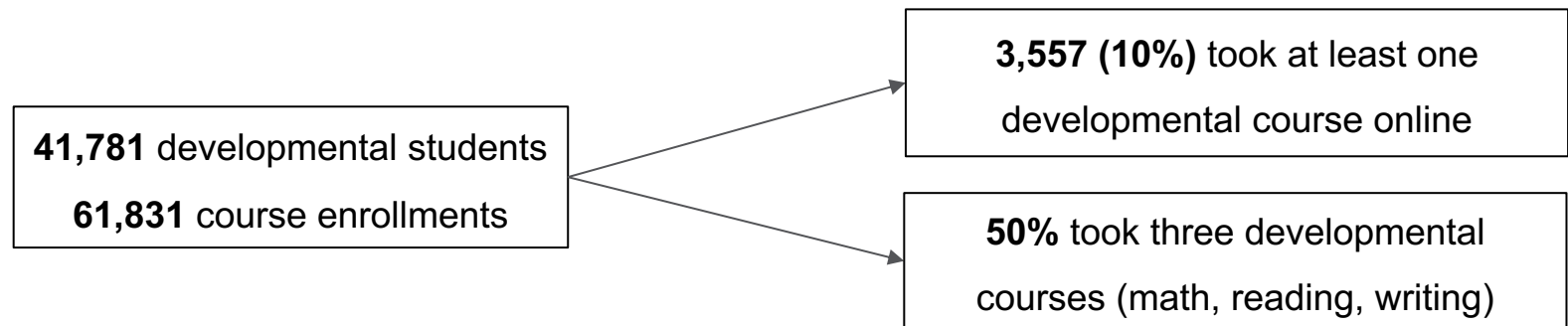
Research Questions



Data and Research Background

Data & State Context

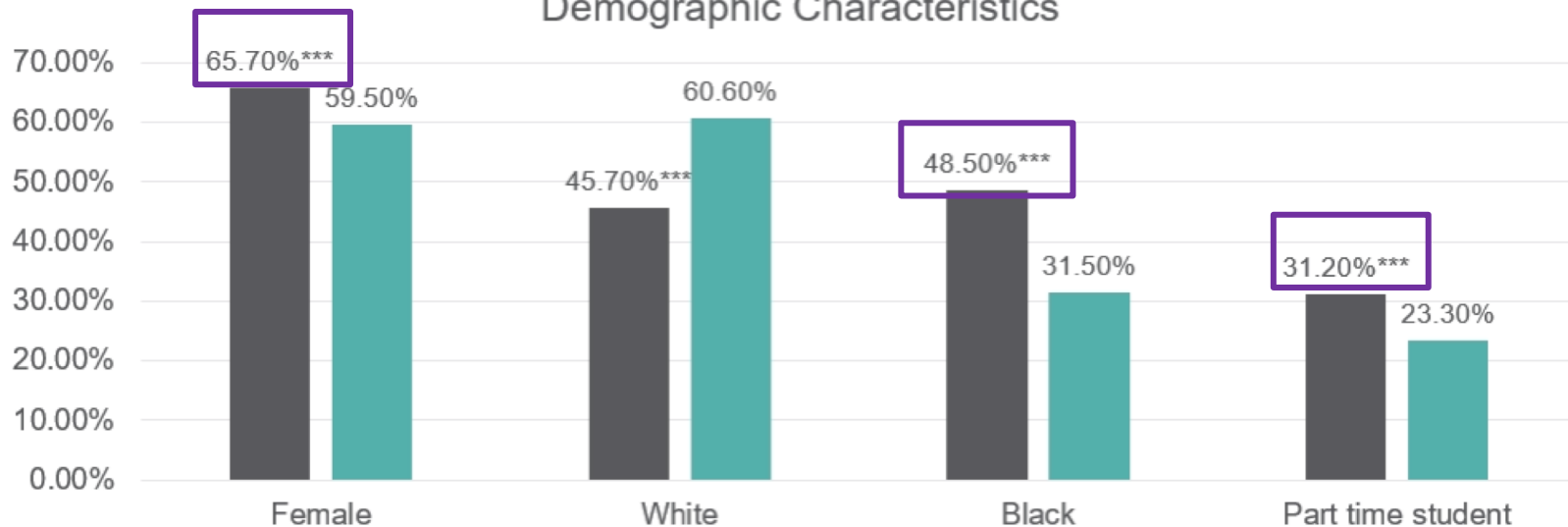
- Administrative data from an anonymous state community college system (ASCCS)



- Enrolled from 2005 fall to 2009 summer
- Tracked until 2012 summer
- Transcript, student demographic info, prior academic achievement
- Instructor demographic info

Developmental Student: Ever-online VS. Never-online

Demographic Characteristics

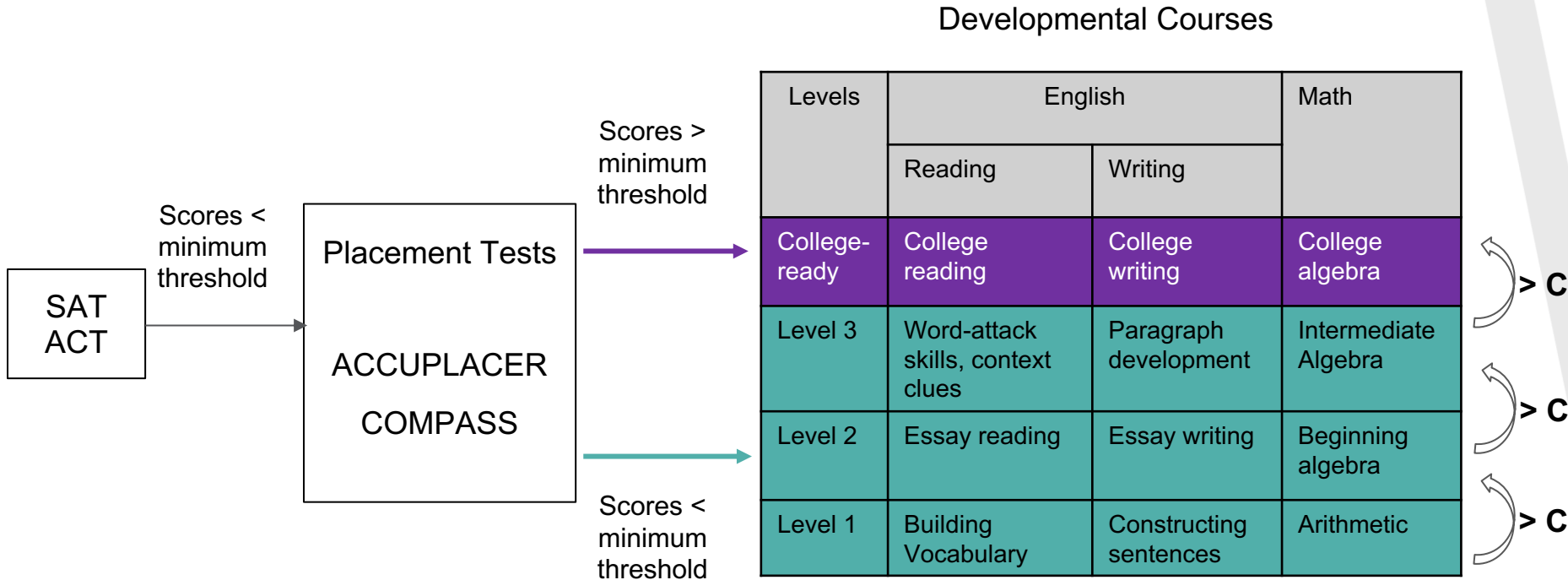


Standardized Prior Test Scores



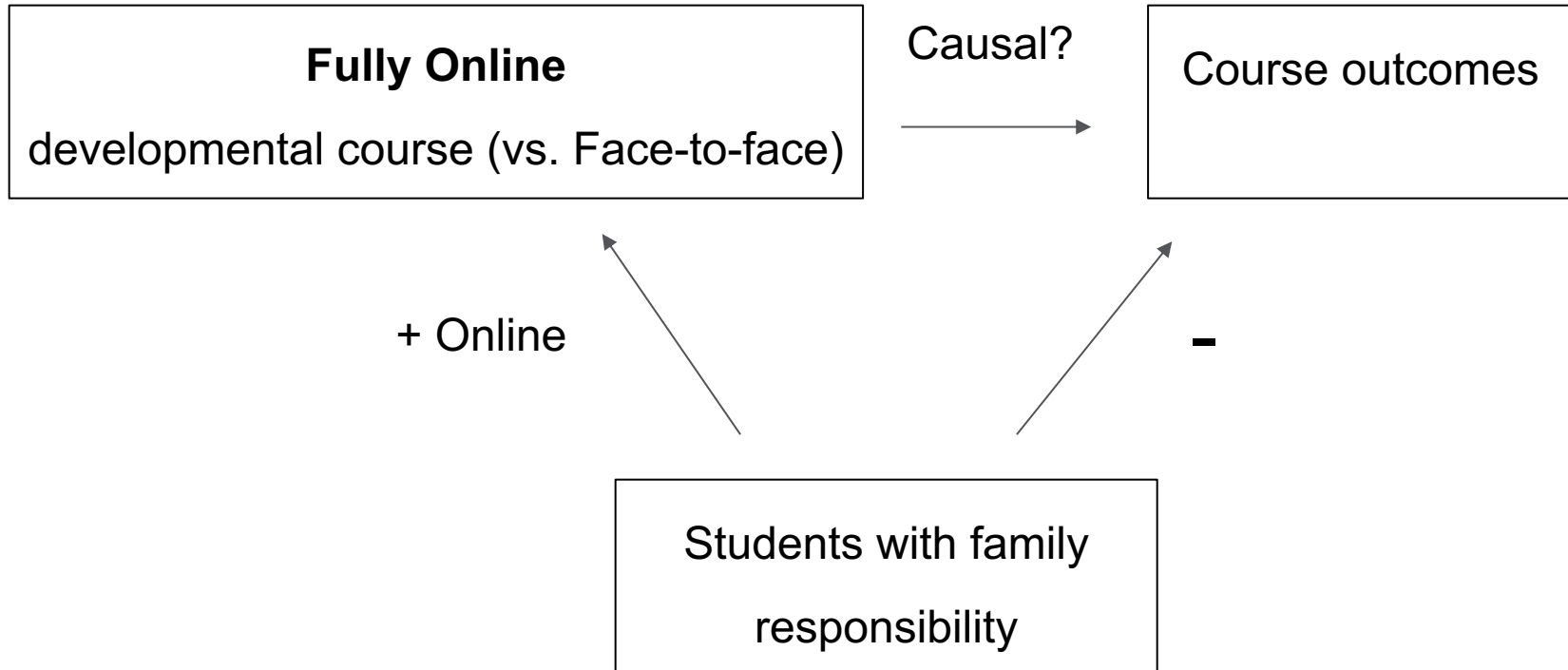
Developmental Education at ASCCS

Placement Tests & Developmental Course Sequence



- Developmental students are required to complete all the developmental courses during their first academic year

Addressing Sorting Issues



- **Two-way fixed effect:** Individual fixed effect & College-by-course fixed effect

Addressing Sorting Issues

Student ID	Developmental Course	Course ID	Online	Grade
Amy	Reading	101	1	A
Amy	Writing	201	0	B
Amy	Math	301	1	A-
Brian	Reading	102	0	A+
Brian	Writing	201	0	A
Brian	Math	301	1	B+
Clark	Reading	101	1	A
Clark	Writing	202	1	A-
Clark	Math	302	0	A

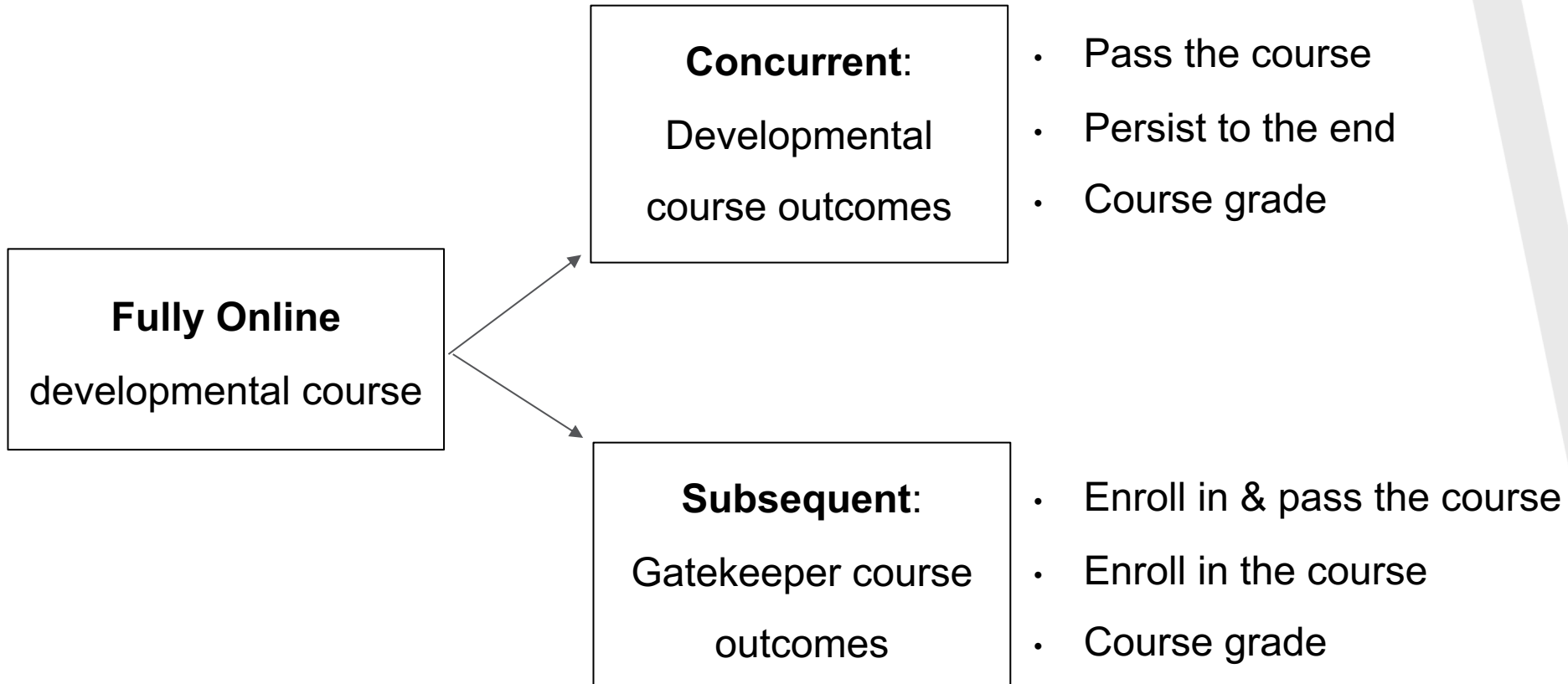
Individual Fixed Effect

Control for individual characteristics that are constant within a student

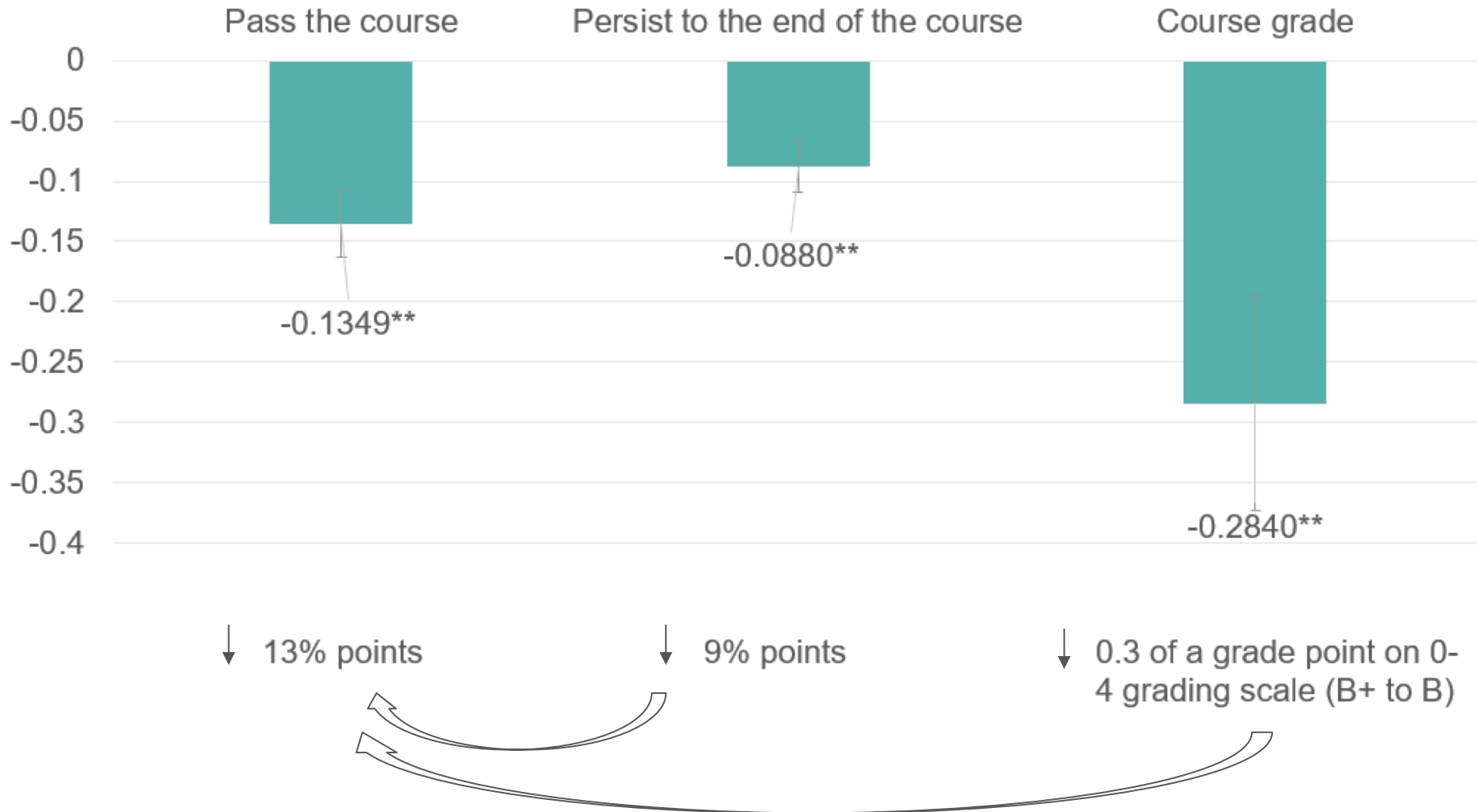
College-by-Course Fixed Effect

Comparing students enrolled in the same course at the same college

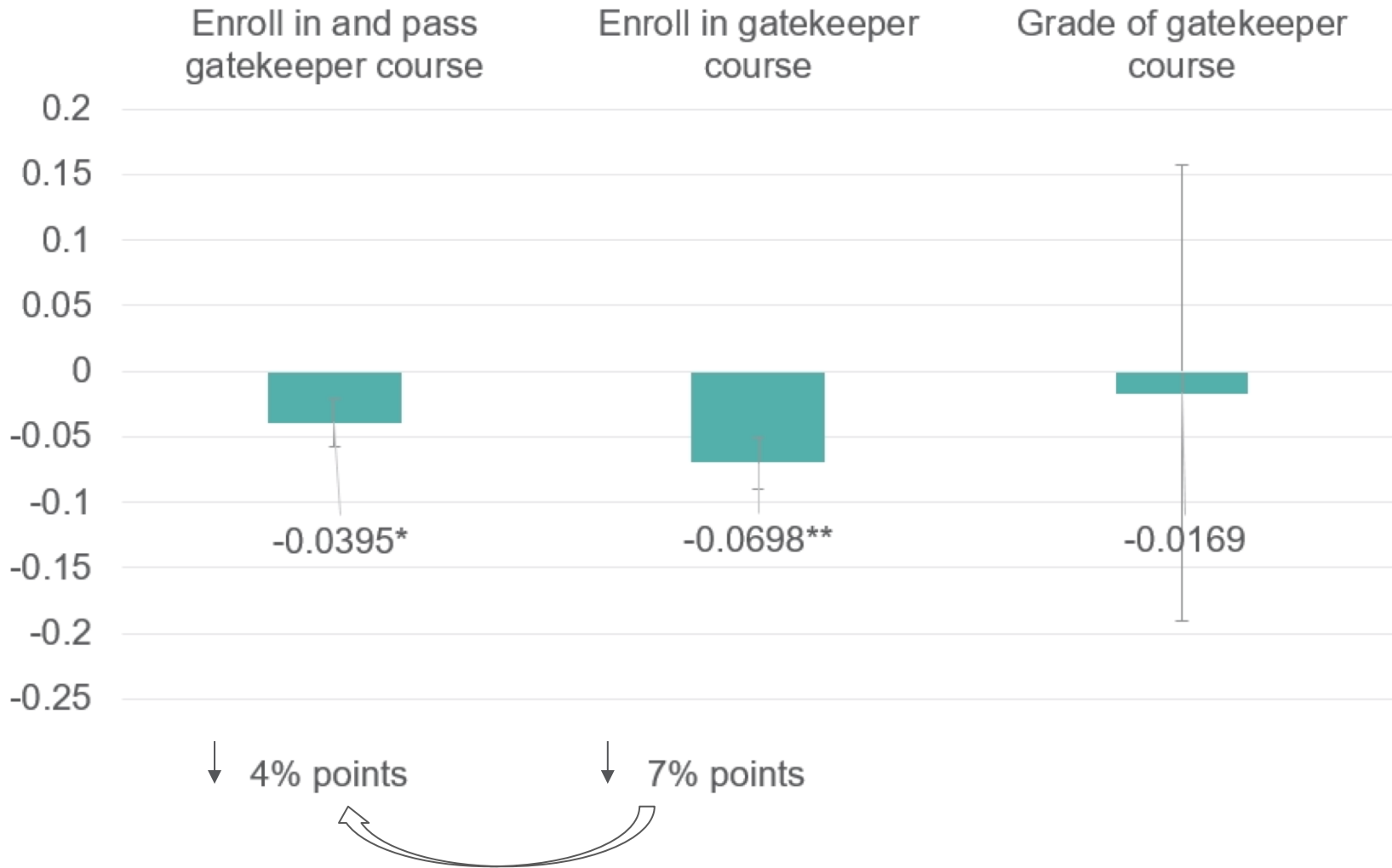
Outcome Measures



Results: Impact on Developmental Course Outcomes



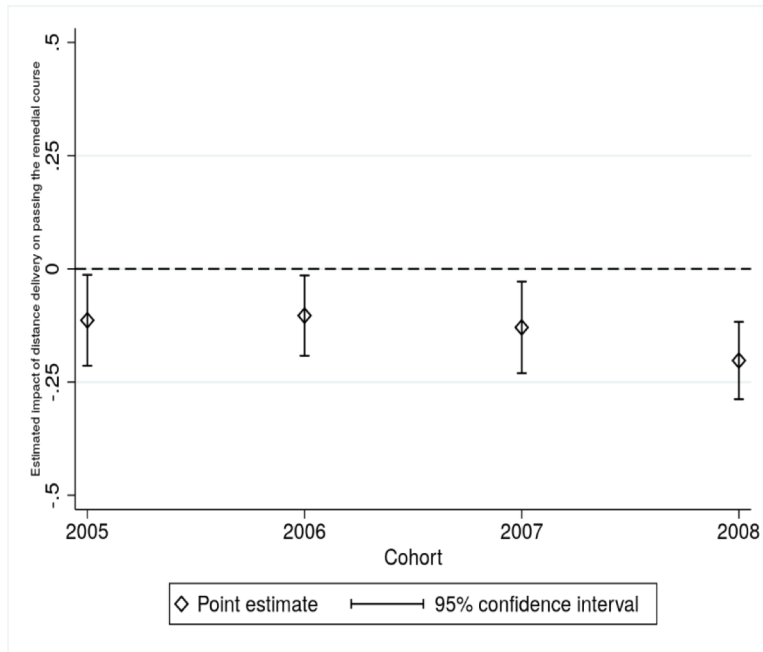
Results: Impact on Gatekeeper Course Outcomes



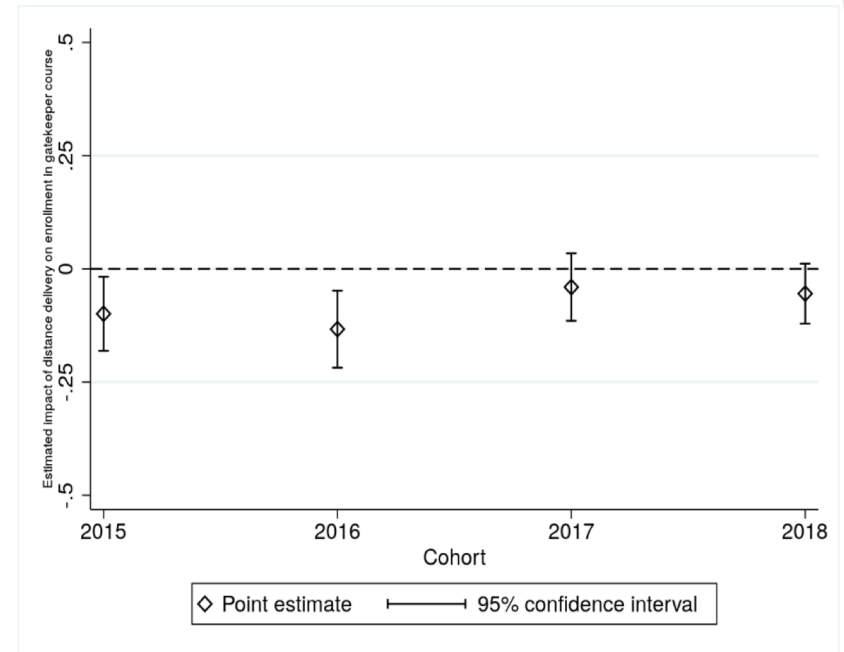
Results: Effectiveness of Online Learning Over Time

Estimated Effect of Course Delivery Format by Cohort

Outcome: Pass the Developmental Course

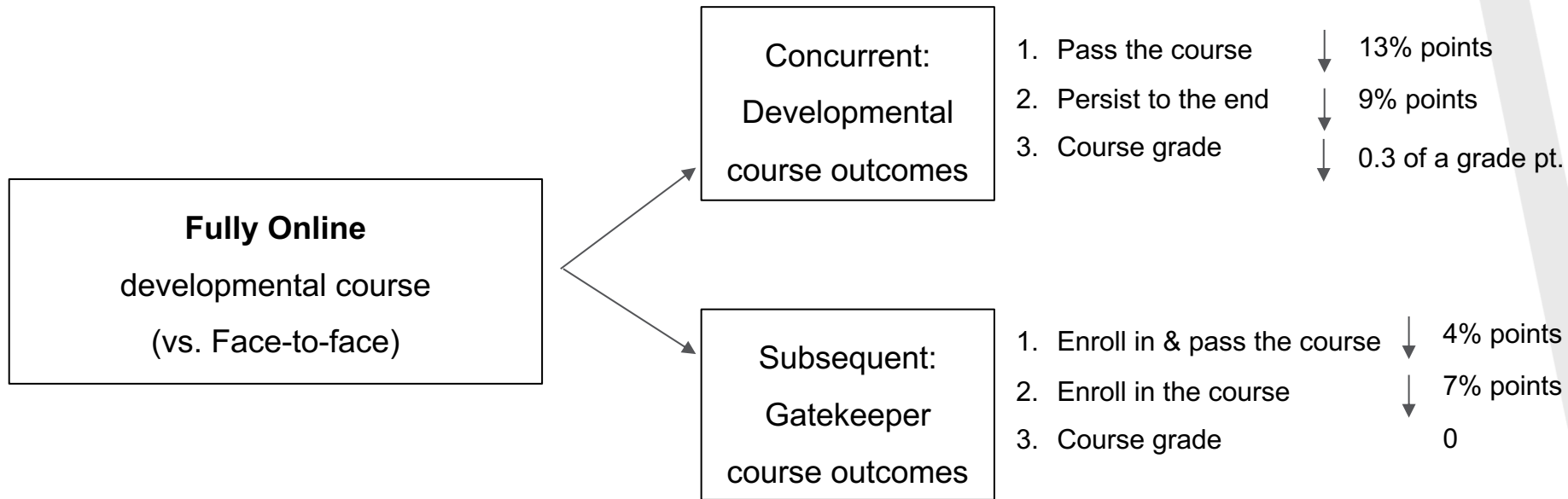


Outcome: Enroll in Gatekeeper Course in the Corresponding Subject Area



- The estimates are consistently negative
- Do not identify any noticeable trend in improvement of online format over time

Summary of Findings

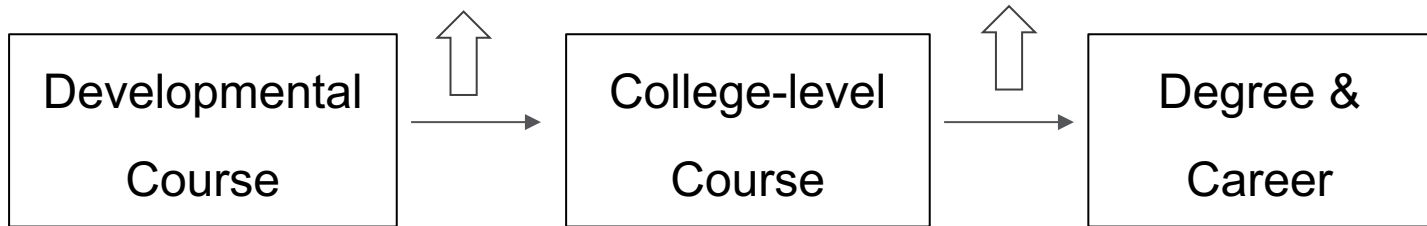


- **Online courses at community colleges do not support students as effectively as face-to-face lectures**

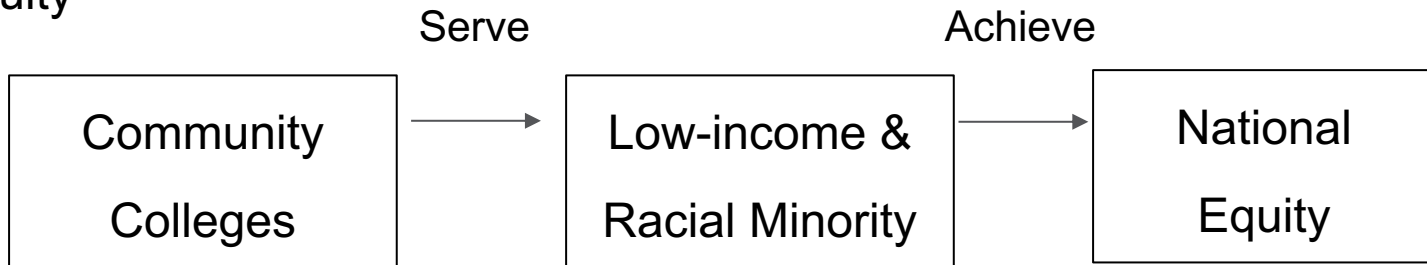
Implications

Overall Policy Implications

1. Effectiveness



2. Equity



- Special attention on the **improvement** of online developmental courses
- Support instructors/students by taking advantage of the benefits of online learning

Implications

Specific Practical Suggestions

Assist **instructors** in identifying instructional practices to facilitate online teaching and learning

Assist **students** in developing personal interaction & self-directed learning skills

Assist **Institutions** in identifying effective online course features



Improve online developmental education

Current Research at UCI

Working Papers & Survey Development & Course Observations

- **Working Papers:**
 - Open-ended survey data collected from instructors and students
 - Structural topic modeling & Human coding
 - **Working paper 1:** Examine instructors' and students' perceptions of effective/ ineffective instructional practices
 - **Working paper 2:** Examine students' perceptions of effective/ ineffective learning practices
- **Survey Development:**
 - Identify effective and ineffective online instructors and students
- **Online Course Observations:**
 - Identify effective online course features

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Thank you!

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The Center for the Analysis of Postsecondary Readiness (CAPR) is funded through a grant (R305C140007) from the Institute of Education Sciences, U.S. Department of Education.

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Moving the Classroom to the Computer Lab: Using the emporium model in developmental math

Whitney Kozakowski
Harvard University

This research was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305B150012 to Harvard University. The opinions expressed are those of the author.

Hybrid Models of Instruction

- ❑ Growth of hybrid models of instruction in remedial courses that **blend in-person elements** with **online/computer lab-based work**
- ❑ **Emporium model** is one popular option:
 - ❑ **Substitutes traditional in-class lectures with computer-based instruction in a lab**
 - ❑ Course content often spaced out over **modules** with students working at own pace
 - ❑ **Instructors/TAs on-site** to answer questions
- ❑ Started at VA Tech in 1997, but has spread



Emporium Model

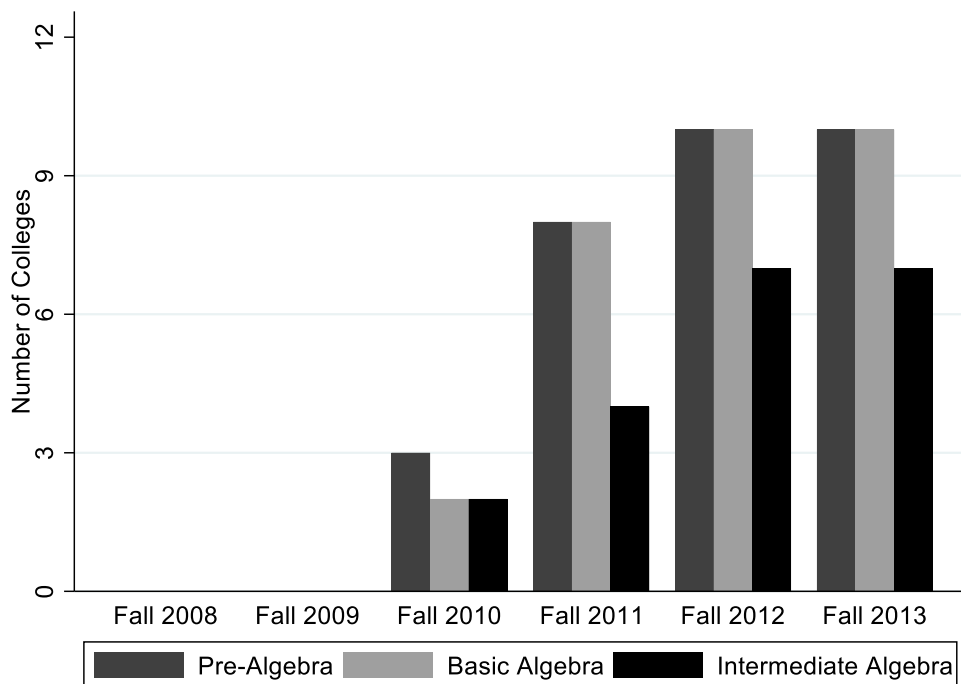
- ❑ How might it help students to succeed?
 - ❑ **Adaptive** to students needs
 - ❑ Can **go at own speed**/complete more courses per semester
 - ❑ Places students in position of **actively engaging** with material in class
- ❑ How might it hinder students?
 - ❑ Students may **struggle to pace themselves**
 - ❑ **May not interact with peers or faculty/TAs** as much
 - ❑ Puts a lot of responsibility on student to **monitor/manage their learning**



Context

- ❑ In 2009, Kentucky CPE encouraged adoption of “**accelerated, online, and/or alternative learning formats**” to improve success in remedial courses as part of unified strategy to improve degree completion rates
- ❑ By fall 2013, 10 KY Community & Technical Colleges (KCTCS) had adopted the emporium model

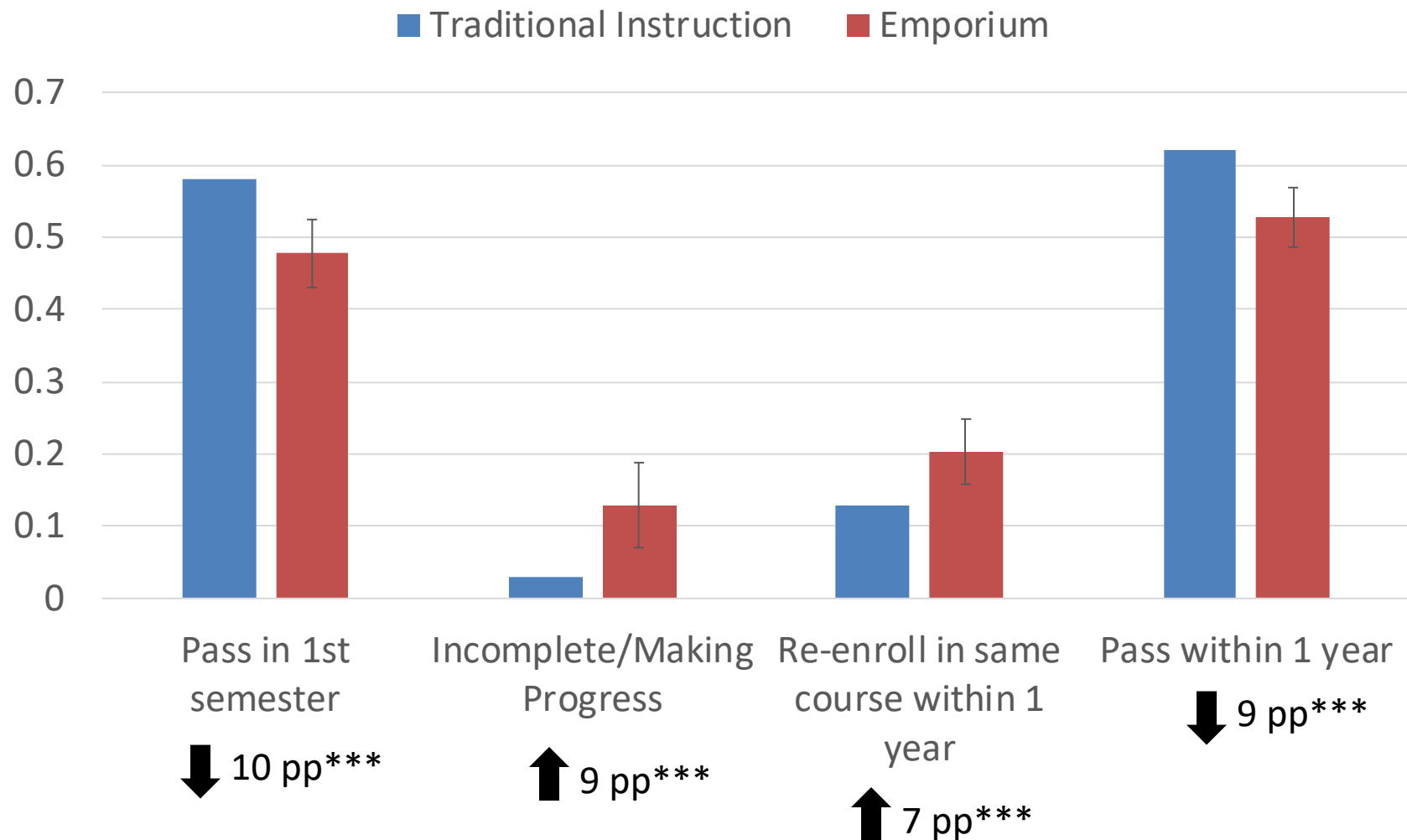
Emporium Model Adoption in KCTCS



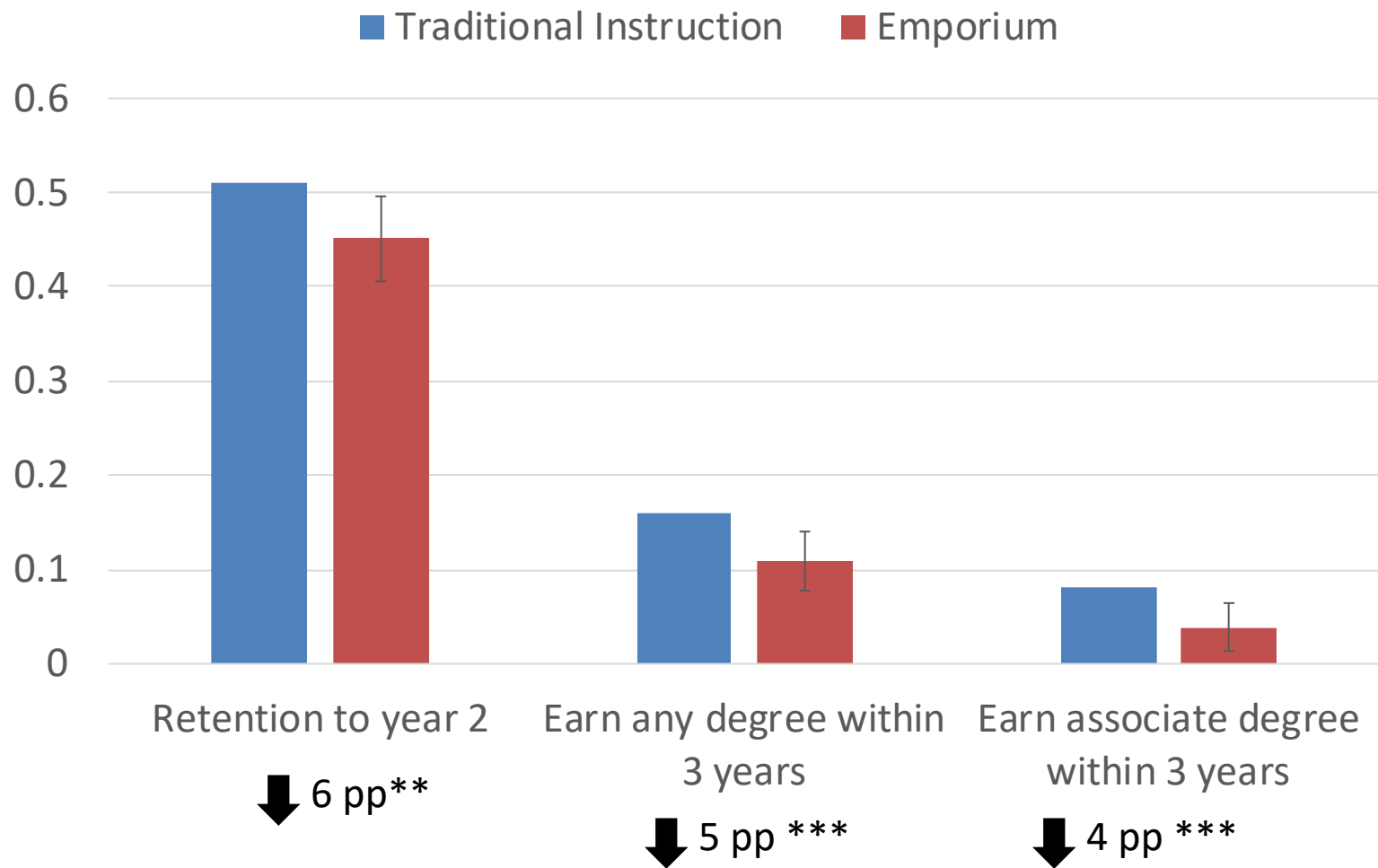
This Paper

- ❑ Use a **quasi-experimental design** that uses **variation in the timing of the adoption of the emporium model** across colleges and courses within KCTCS to estimate effect of adopting the model
 - ❑ Comparison is relative to **traditional in-class instruction**
- ❑ Sample:
 - ❑ Students who **enroll in any remedial math course** within their **first term** of college (n=34,050 observations)
 - ❑ This group **similar to average remedial student** in many ways (e.g. similar ACT math and English scores, course enrollments, demographics), but are more likely to be enrolled **full-time** and a **year younger** on average (If anything, may think these students **more likely to succeed** in remediation)

Results



Results



Results

- ❑ **Effects on pass rates and degree attainment consistent across all levels of remediation**
- ❑ **Larger negative effects for males** (14 pp less likely to pass in first year vs 6 pp reduction for females; 9.2 pp less likely to earn degree vs 3 pp reduction for females)

Discussion

- ❑ Suggests **caution is warranted** in using this model with students in remedial courses

- ❑ Consistent with negative findings from studies comparing online to in-person courses:
 - ❑ Also see in these studies general pattern that of larger negative effects for students with lower levels of academic preparation (Bettinger, et al, 2017; Xu and Jaggars, 2013)

- ❑ Why might students struggle?
 - ❑ These courses may require **more self-management skills** than traditional ones
 - ❑ Manage own progress
 - ❑ Need to know when to ask for help and not be shy to do so
 - ❑ **Less interaction with peers and professors** may hurt attachment to college and reduce likelihood of passing

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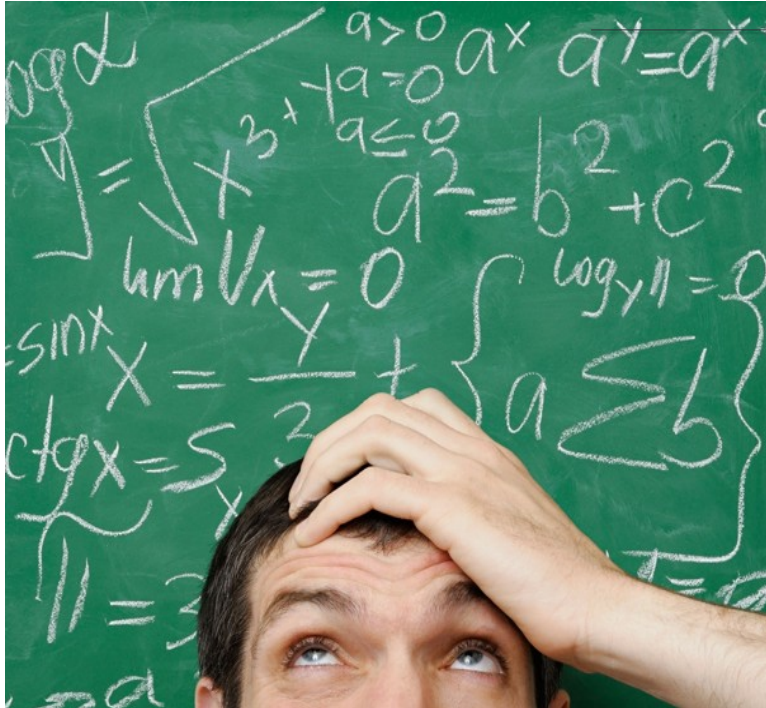
Rigorous Evidence on a Widely-Used Developmental Math Strategy: Modular, Computer-Assisted Courses

Camielle Headlam
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November 2019



Developmental Math: A Barrier to Student Progress



< 25% of students who enroll in developmental education courses earn a degree from a community college within 8 years.¹

Developmental math, in particular, is a major hurdle

¹Bailey & Cho (2010).

A Homegrown Solution: ModMath



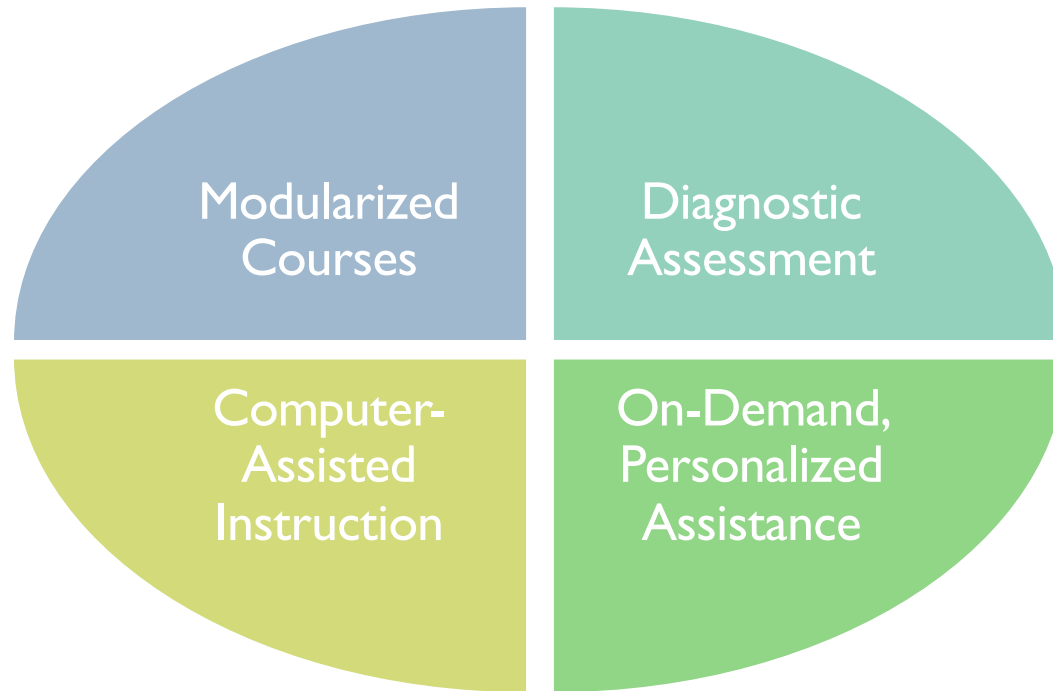
- Public community college
- Tarrant County, Texas
- At the time of the study:
Northeast campus served
~15,000 students

Began to pilot ModMath in 2008

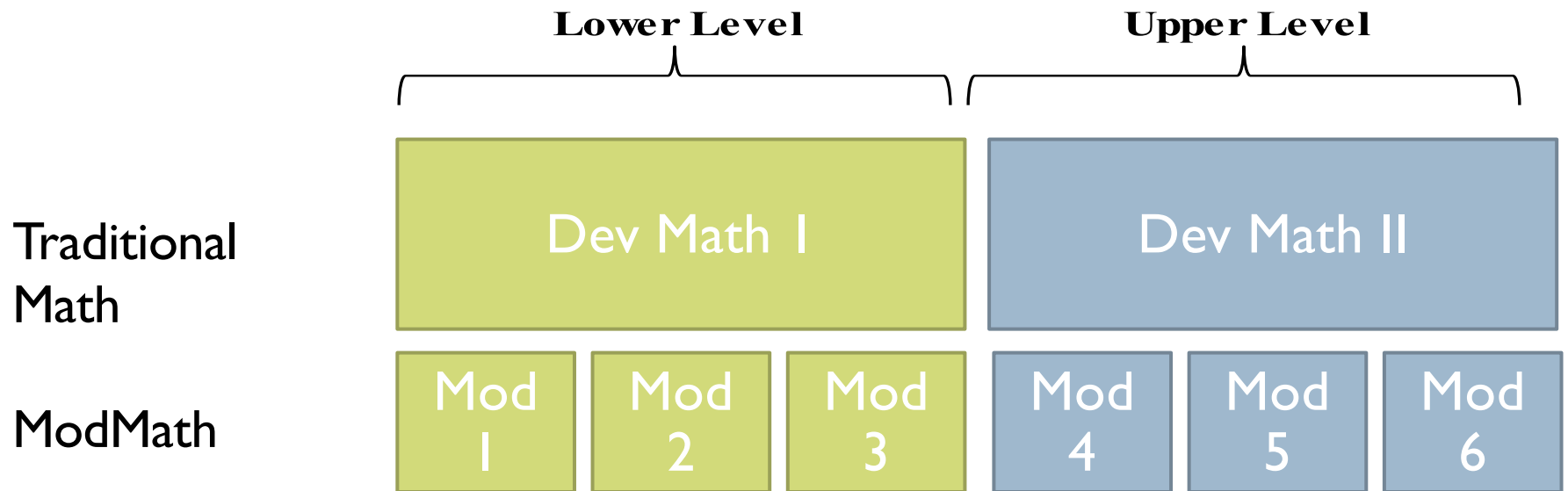
- to increase dev math completion
- to give students “credit” for mastered material
- to allow students to maintain momentum even if they need to stop out periodically.

¹Rutschow & Mayer, personal communication, February 6, 2018

ModMath: Key Components



Modular Courses





A Common Solution: Modular, Computer-Assisted Courses



A 2016 survey of 911 two- and four-year U.S. colleges:¹

- 40% offered self-paced approaches
- 32% used computer-based learning

Reforms range from

- Statewide policy changes (Virginia and N. Carolina) to
- Individual college and homegrown programs (Tarrant County College, Texas)

¹Rutschow & Mayer, personal communication, February 6, 2018

A Rigorous Evaluation: ModMath Study

Randomized Controlled Trial (RCT)



Impact Research



Implementation Research

MDRC randomly assigned **1408 students** from fall 2013 – fall 2015, to either:

ModMath Group

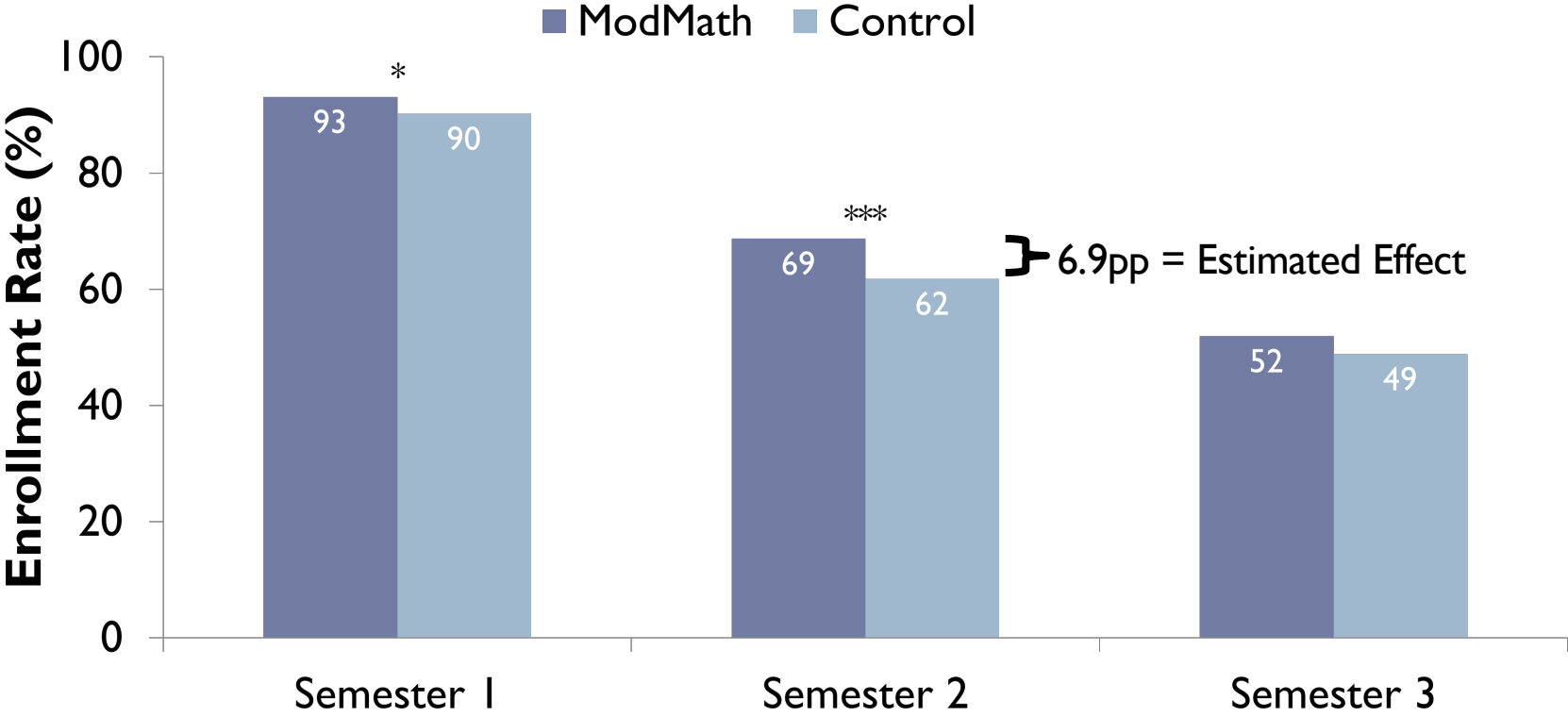
v.

Control Group

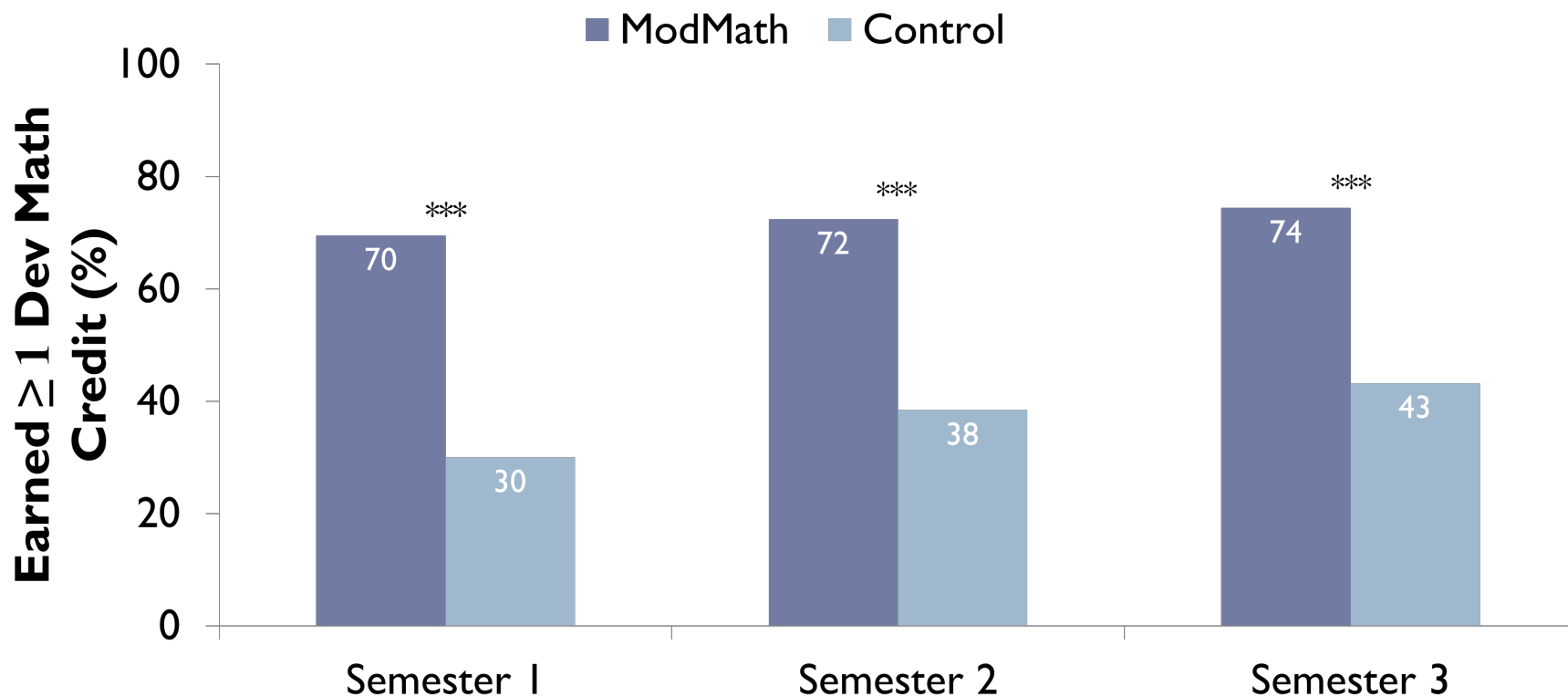


The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305A130125 to MDRC. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education

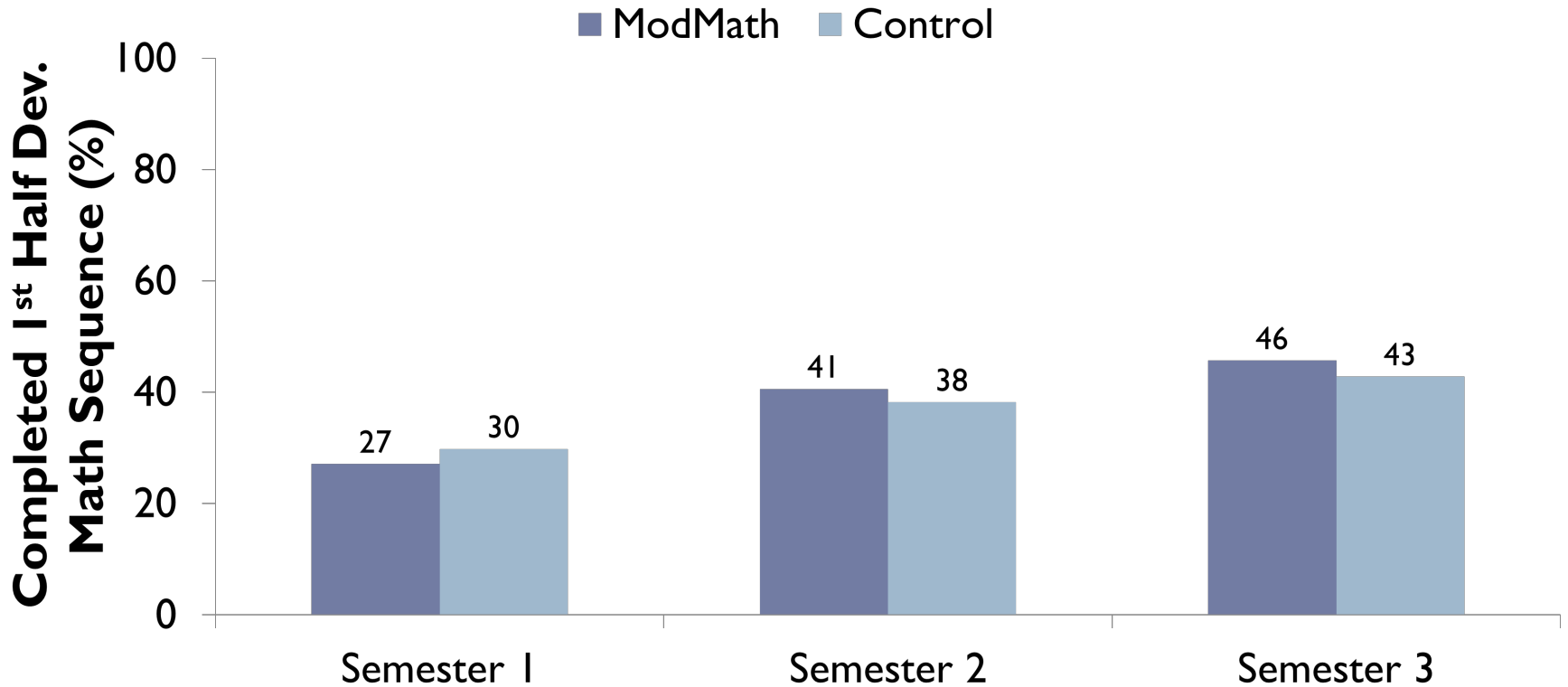
ModMath Increases Early Enrollment



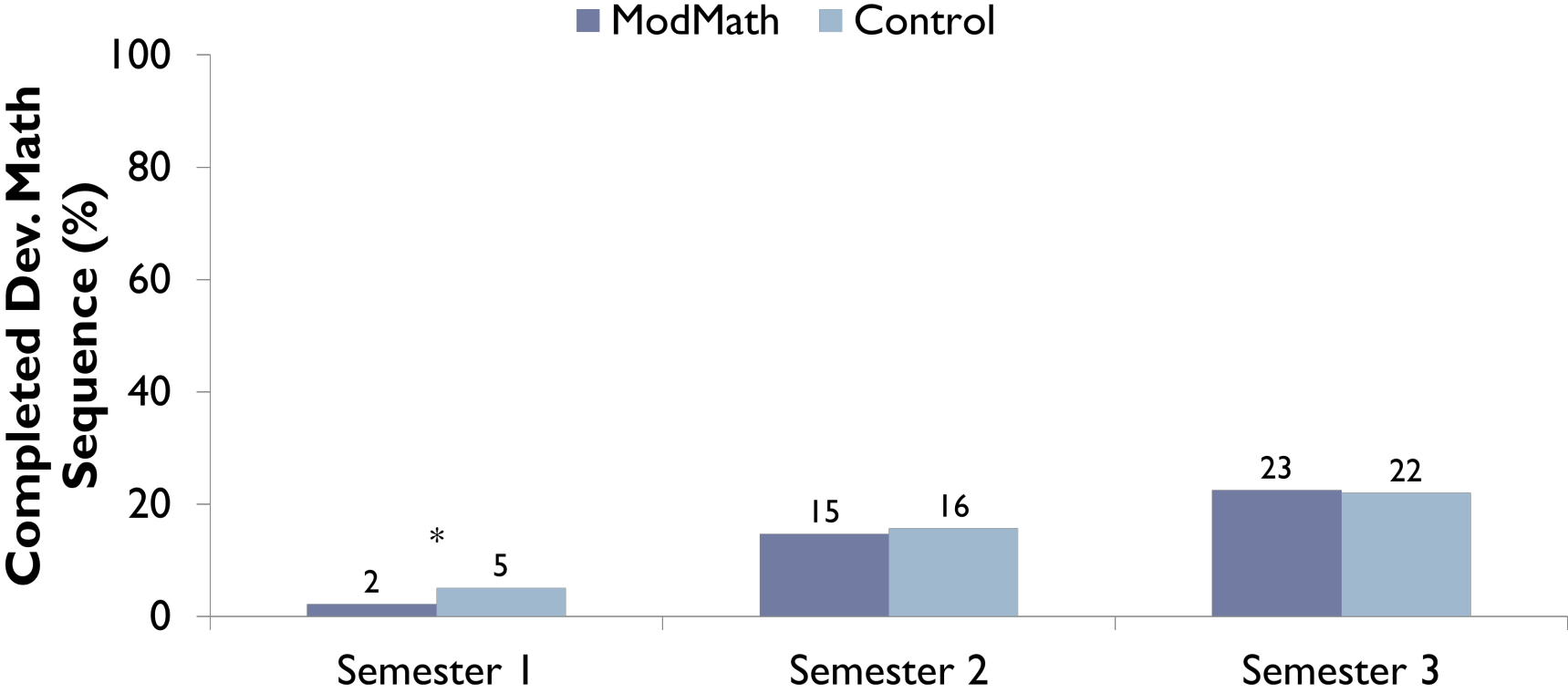
ModMath Students More Likely to Earn at Least 1 Dev Math Credit



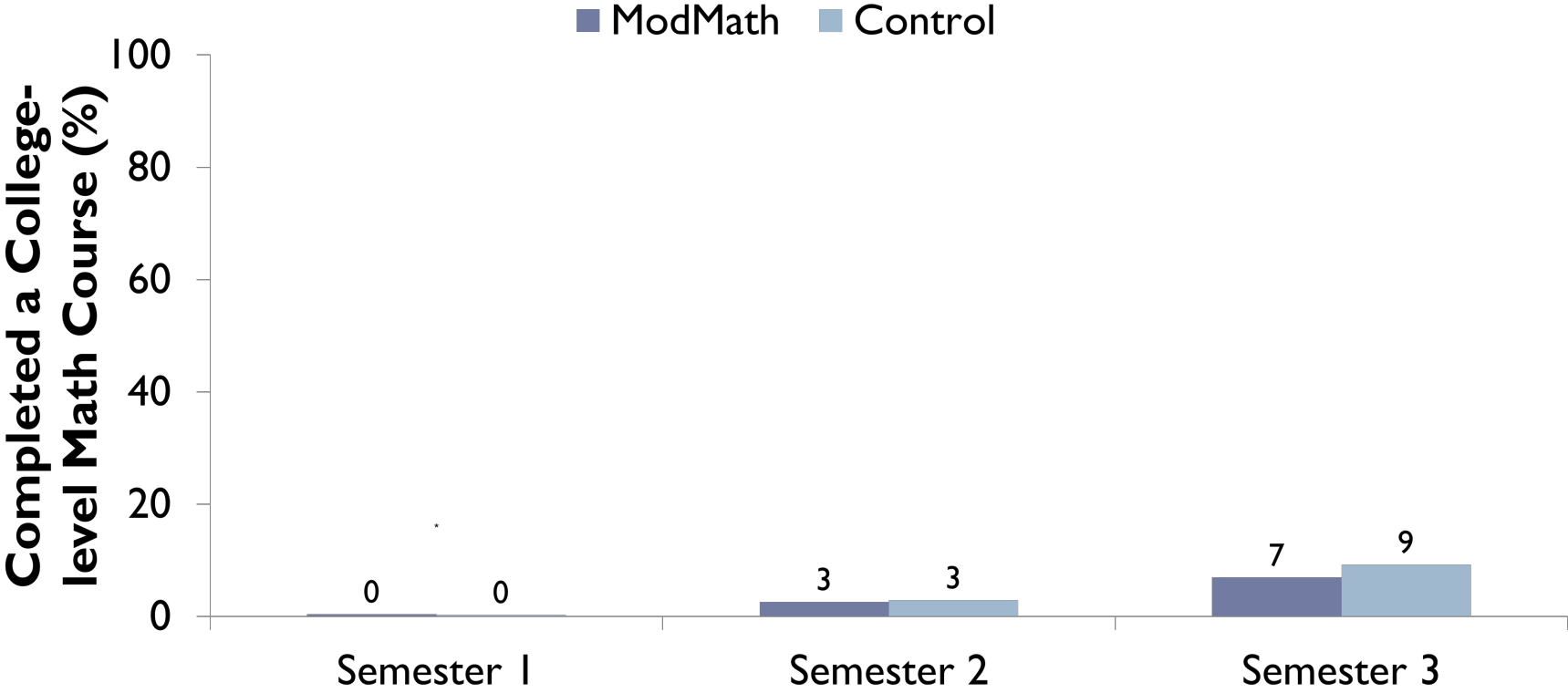
ModMath Students Similarly Likely to Complete the First Half of the Dev Math Sequence



ModMath Students Similarly Likely to Complete the Full Dev Math Sequence



ModMath Students Similarly Likely to Complete the Full Dev Math Sequence

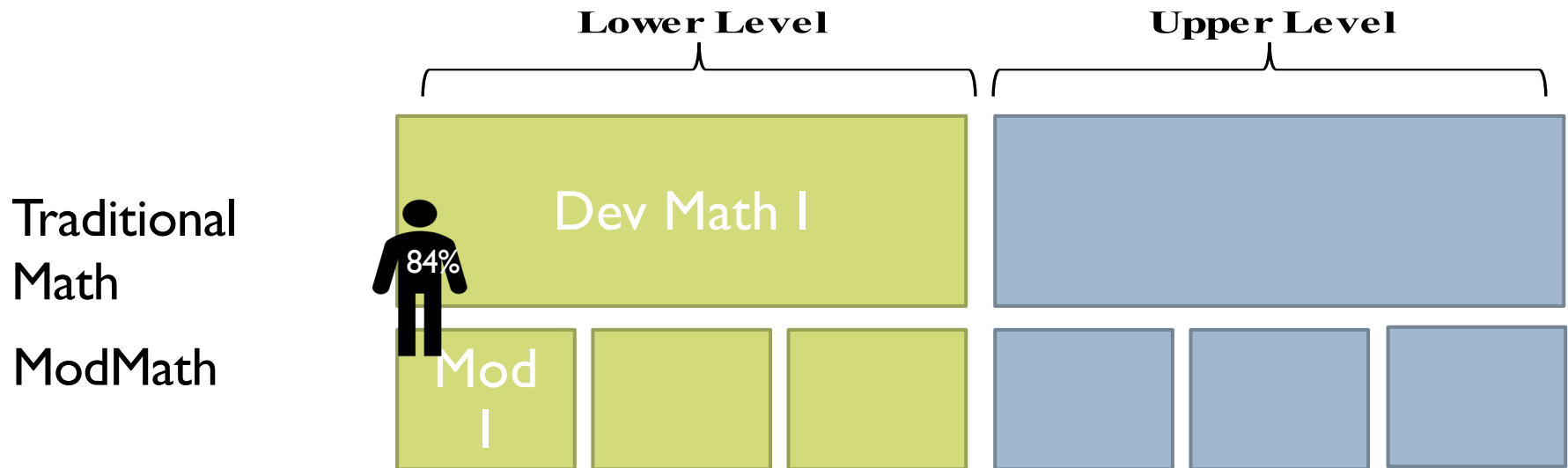


Why?

- ❖ ModMath was well implemented
- ❖ Strong in-class treatment contrast (although both groups had access to Computer Software (MyMathLab))

Diagnostic assessment did not alter placement for the majority of students

- 84% students placed at the beginning of sequence – Mod I or Dev Math I



Modules used for course repetition more frequently than acceleration

- 24% repeated modules; 1% skipped modules
- Very common for self-paced, computer-assisted courses
- Students' backgrounds make it more likely that they will progress slower as opposed to faster



A Sense of Accomplishment After Passing a Mod

“I’ve taken many, many remedial classes and haven’t gotten anywhere...I’m almost finished with my college career...and the only thing that’s holding me back is the math requirements...but I will say I **passed my first mod with an A**, which I’ve never done that, **so something must be working.**”

-ModMath student



ModMath increased instructor-student interactions

“It’s so much easier than lectures because I don’t feel pressure to just hurry up and just understand it... **I don’t really like asking questions in front of a big group of people** because I’m scared I’m gonna ask a stupid question.”

ModMath student

In ModMath **“we can have time to ask the instructor the questions that we have... and get the answers to your questions quickly”**

-ModMath student

A Few Takeaway Lessons:

- ModMath is an option (consider the cost)
- Guided self-pacing is necessary for computer-assisted courses
- Incorporate “small wins” and personalized assistance to facilitate student engagement
- Helpful to know what works, what doesn't work, and what is equally as good

Thank you!



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Computer-Based Math Remediation:

**The Hybrid Emporium Model in Two-
and Four-Year Colleges in Tennessee**

Angela Boatman
Associate Professor, Boston College

In collaboration with Jenna W. Kramer & Stephany Cuevas

#CAPR2019

Classes conducted in computer labs

Traditional lectures replaced with interactive, instructional software

Self-paced

Faculty serve more as tutors who deliver individualized instruction as opposed to lecturers

The Hybrid Emporium Model

Research Questions

- Do technology-based developmental math courses result in higher course pass rates and persistence rates for students than the traditional version of these courses?
 - Do results differ between community colleges and four-year colleges and by gender, age, and prior level of academic preparation?
- How do students and faculty respond to the hybrid emporium model?



The Hybrid Emporium Model in TN

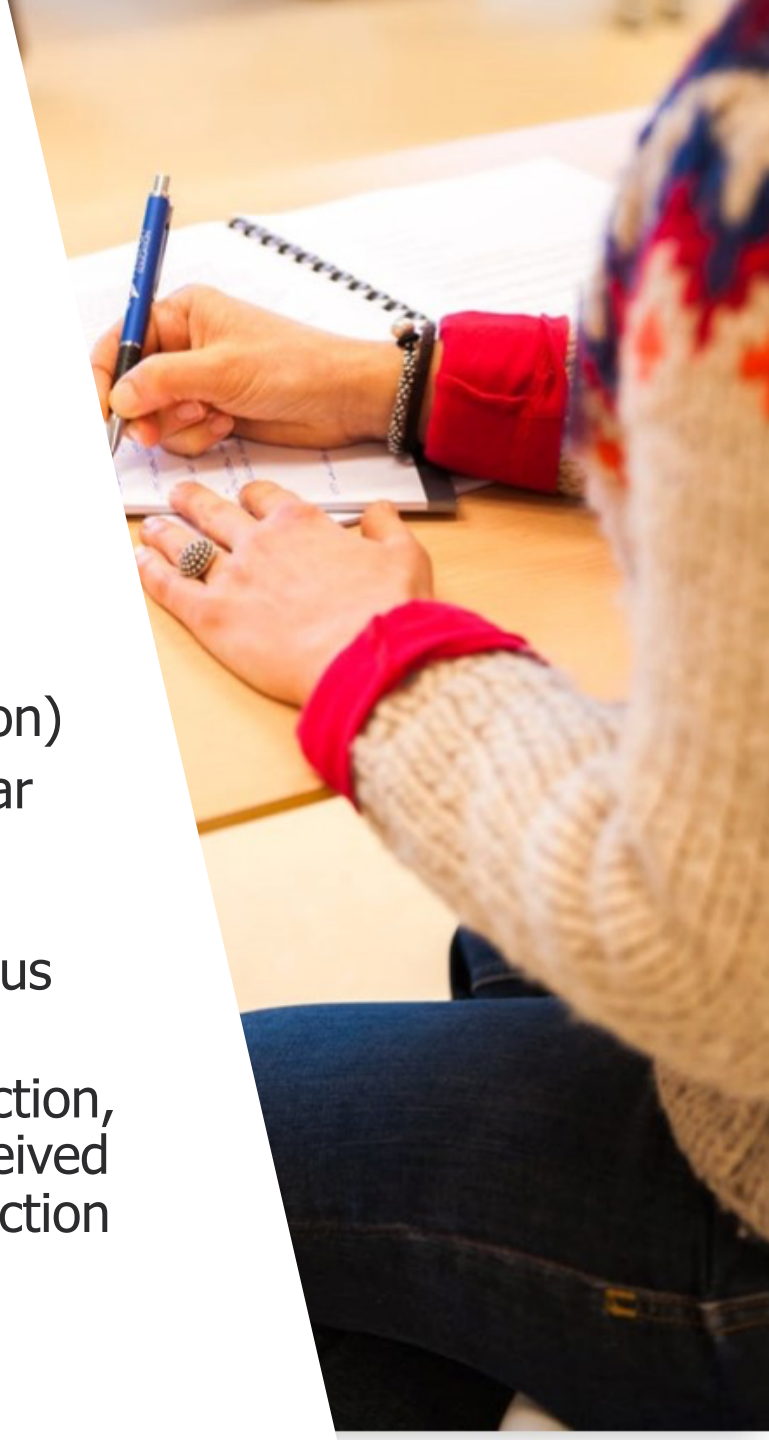
- 13 community colleges, 6 public universities
- 2008-09: Early adopters
- 2011: Increase the adoption of the model to all public institutions (developmental math, reading, and writing)
- 2013: Full implementation
 - Colleges varied in the degree to which they fully implemented the model
- 2012: Eliminated developmental education from 4-year institutions

Data

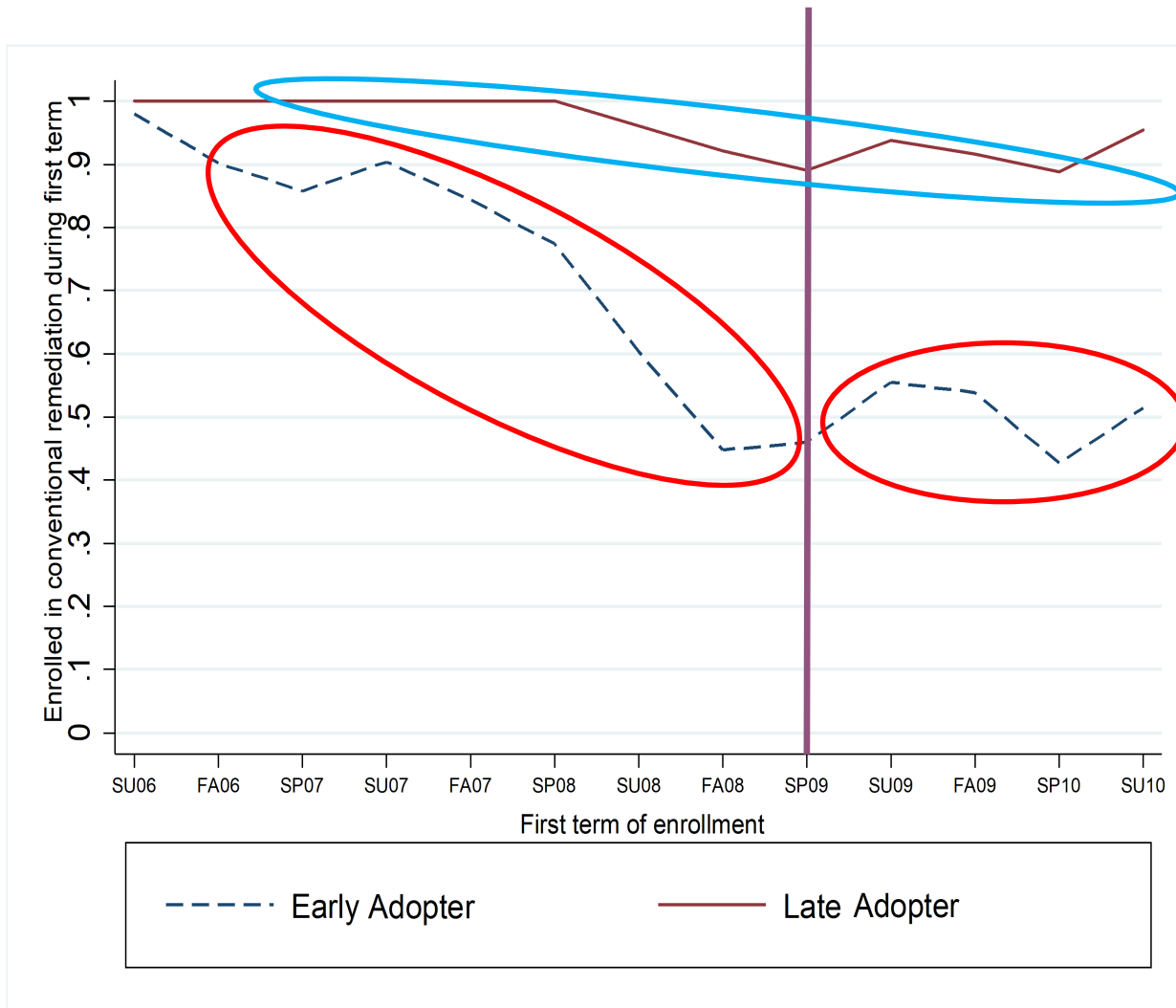
2005-06 to 2010-11 cohorts followed through 2015-16 at 19 public colleges

Qualitative data

- Site Visits:
 - Purposive sampling (max variation)
 - Four 2-year colleges & two 4-year colleges
- Classroom observations, faculty/administrator interviews, student focus groups
 - Areas of focus: classroom instruction, logistics, social experience, perceived benefits and challenges of instruction and assessment



Percent of Community College Dev Math Students Enrolled in a Conventional Course



Impact of Hybrid Emporium Model on Student Outcomes

	2-Year Colleges	
	DD	Comparison Mean
Passed First Developmental Math	-0.010 (0.028)	0.64
Terms to completion of developmental math	-0.240 (0.212)	2.01
Passed First College-Level Math	-0.057** (0.022)	0.41
Cumulative credits within 6 semesters	-1.56*** (0.575)	23.52
Retention from year 1 to year 2	-0.065* (0.015)	0.45
Earned any credential within 6 years	-0.037** (0.015)	0.21

Controls: Gender, age, ACT math score, HS GPA, lottery status, year and college-by-course fixed effects

Sensitivity Analyses: Event study, covariate balancing, falsification tests

Impact of Hybrid Emporium Model on Student Outcomes

	2-Year Colleges		4-Year Colleges	
	DD	Comparison Mean	DD	Comparison Mean
Passed First Developmental Math	-0.010 (0.028)	0.64	0.054** (0.025)	0.78
Terms to completion of developmental math	-0.240 (0.212)	2.01	0.502*** (0.093)	1.42
Passed First College-Level Math	-0.057** (0.022)	0.41	-0.054*** (0.015)	0.43
Cumulative credits within 6 semesters	-1.56*** (0.575)	23.52	-1.059 (0.940)	40.76
Retention from year 1 to year 2	-0.065* (0.015)	0.45	0.006 (0.018)	0.49
Earned any credential within 6 years	-0.037** (0.015)	0.21	-0.056 (0.032)	0.46

Controls: Gender, age, ACT math score, HS GPA, lottery status, year and college-by-course fixed effects

Sensitivity Analyses: Event study, covariate balancing, falsification tests

Heterogeneous Effects

Gender:

- No differences in passing developmental math
- Negative credit and degree attainment effects larger for males (2 yrs)
- Females less likely to pass college-level math (4 yrs)

Age:

- Negative effects on passing college-level math, credit attainment, and degree completion driven by students under age 23. Older students more likely to pass Dev Math course (2 yrs)
- Negative effects on passing college-level math driven by students under age 23 (2 yrs)

ACT Math Score:

- Negative effects across outcomes driven by students with ACT Math scores ≥ 16 (2 yrs)

Student Focus Groups

Transcription, Two stage, line-by-line coding to identify emergent categories and themes

- Cognitive accessibility
 - Increasing access to material
 - Affording abundant opportunities for practice
 - Providing immediate feedback
- Social accessibility
 - Multiple avenues for relationships with instructors
 - Deeping relationships with instructors

Students overwhelmingly express a preference for experience of technology-driven instruction in developmental math





I enjoy the fact that we were kind of forced into the math lab, because otherwise I would have been way too intimidated to go into it. Kind of like a girl going to the gym to lift weights: like we want to do it, but we're afraid we're going to look stupid...Because I hear math lab, and I think 'There's a bunch of geeky people in there,' and that I'm just...like I'm going to stick out like a sore thumb because I don't...know what pi is. And so being in there for my math class kind of helped to make that a less intimidating environment.

Faculty Interviews

- Hybrid emporium model helps track student performance, provide more targeted assistance, and communicate directly with students.
- Expressed concerns over:
 - “Gaming”/ mimicking the modules
 - Some students struggling to keep pace
 - Difficulty incorporating relevant teacher-led instructional time
 - Perpetuating the same educational outcomes in the absence of additional supports
 - Desire for research on student outcomes





"I could not and still cannot wrap my brain around that, how those students are struggling, can get by with no instruction. Are they not the ones that need it the most?"

"I just, I think they need more time. I think they need more attention. I think they need more education and study skills. None of which we can give them really under the current model."

Implications

- Positive student experience but lackluster outcomes suggests unaddressed barriers to learning.
 - Are negative mid- and long-term relationships between the emporium model and student outcomes due to differences in the quality of instruction, supports, and relationships in subsequent (math) classes?
 - Assumptions made about students' ability to self-pace
- Curricular experts and faculty should leverage qualitative and quantitative research to fine-tune instruction and student assessment to ensure mastery of foundational math skills.



Leaders in Tennessee are to be applauded not only for adopting a new approach to remediation, but also for taking the risk to assess its impact. American higher education has avoided taking a hard look at the benefits of remediation for far too long.

–Chronicle of Higher Education, Dec. 16, 2018

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