Maximizing Gateway Math Throughput for Students Who Did Not Complete Algebra 2 in High School

September 29, 2021

A MMAP Webinar

theRPgroup

Research • Planning • Professional Development
for California Community Colleges

Today's Agenda

- Review of new paper "Maximizing Math Throughput of Students Who Did Not Complete Algebra 2 in High School"
- Framing the question
- Description of the Study
  - Methods
  - Sample
- Findings
- Discussion/Q&A

Get the Paper at RPGroup.org

Maximizing Math Through-put of Students Who Did Not Complete Algebra 2 in High School

https://bit.ly/Maximize-Math-Throughput-Alg2

Context of the Study

Why was this study needed?

The Algebra 2 Exemption

- The CCCCO's default placement rules typically require *direct placement of students into transferable, college-level math*.
- The most common exemption to this rule is when:
  - A student did not complete Algebra 2 while in high school

  AND
  - That student is pursuing a STEM program of study

The Intermediate Algebra Question

- Does placement into Intermediate Algebra maximize the throughput of students who did not complete Algebra 2 while in high school (versus placement into transferable, college-level math)?

- *Note that Algebra 2 and Intermediate Algebra cover essentially the same material. However, we will use "Algebra 2" to refer to the high school version of the course and "Intermediate Algebra" to refer to the community college version of the course. Additionally, we use Algebra 2 as an umbrella term for all similar courses, including Integrated Math III.*

What is throughput?

Throughput rate is the percentage of a given cohort of students who complete a key gateway course—in this case a transferable, college-level math course—within a designated time frame.

Research Questions (RQs) Addressed

- RQ 1: Among community college students, what is the distribution of the highest level of math course completed while in high school? What proportion did not successfully complete Algebra 2?
- RQ 2: Among students who did not complete Algebra 2 in high school, what is the throughput rate of those who enrolled directly in either a transferable, college-level SLAM or B-STEM-pathway math class at a community college and how does it compare to the throughput rate of those who initially enrolled in Intermediate Algebra at a community college?
- RQ 2.1: How do historical patterns of throughput for community college students who did not successfully complete Algebra 2 in high school compare to the throughput results attained after the implementation of AB 705?
- RQ 3: What is the effect of different levels of high school math course attainment on math throughput at the community college after controlling for variations in high school GPA?
- RQ 4: Among students who have declared a STEM program of study and who have not completed Algebra 2 in high school, which placement— transferable, college-level math vs. Intermediate Algebra—maximizes the probability of completing a STEM pathway math class at the community college?

Research Questions (RQs) Simplified

- What percentage of incoming community college students have not completed Algebra 2 while in high school?
- What is the *throughput* of students who have not completed Algebra 2 in high school if they begin in Intermediate Algebra at the community college vs. transferable, college-level math?
- Do students who are pursuing a STEM program of attain higher throughput rates if they start in Intermediate Algebra or transferable college math?
- How does high school GPA factor into the picture?

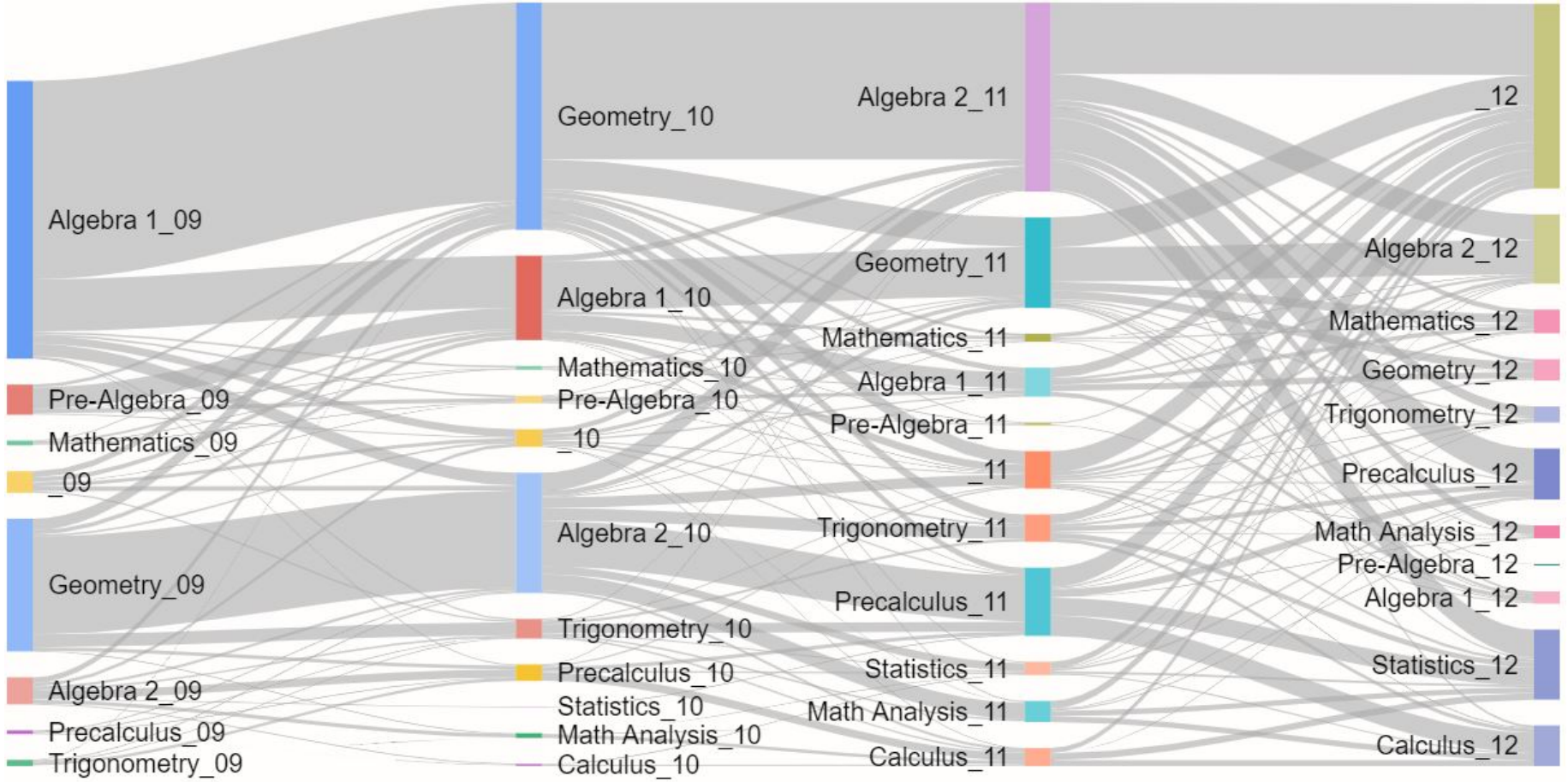
One study, two samples

- The first sample relied on students with complete high school records.
  - N = 440,920
  - Used to identify a minimum set of information necessary to determine if a student had completed Algebra 2 in high school.
- The second, expanded sample was used to answer the remaining research questions.
  - N = 1,251,165

Criteria for Inclusion in Sample 1

- Cumulative GPA was reported for each high school grade level (9th through 12th grades (“complete high school record”)
- Math course codes and descriptions were available for at least two grade levels
- A community college math enrollment was recorded

Sankey Diagram of High School Math Enrollment Patterns



Criteria for Inclusion in Sample 2

- Overall cumulative high school GPA reported for at least one grade level
- Math course enrollment record for at least 11th grade or 12th grade
- If a student's highest math class in 11th or 12th grade was Geometry, they must also have a prior math class on record (e.g., if Geometry in 11th grade and no math in 12th grade they must also have a lower-level math class enrollment record)
- A community college math enrollment was recorded

Description of Sample 1 and Sample 2

Characteristic	Sample 1		Sample 2	
	Count or Average	Percentage or Standard Deviation	Count or Average	Percentage or Standard Deviation
Female	228,369	51.8%	648,532	51.8%
Male	212,551	48.2%	602,633	48.2%
Asian	51,977	11.8%	161,587	12.9%
Black	19,211	4.4%	61,977	5.0%
Latinx	241,730	54.8%	624,459	49.9%
Native American	1,265	0.3%	4,602	0.4%
Pacific Islander	1,775	0.4%	6,333	0.5%
White	88,132	20%	276,307	22.1%
Multi-Ethnic	16,283	3.7%	40,234	3.2%
Unknown Ethnicity/race	20,547	4.7%	75,666	6.0%
Completed Alg. 2 or Higher in High School	286,371	64.9%	769,492	61.5%
Program of study available	137,937	31.3%	401,996	32.1%
Declared STEM Program of Study	24,842	5.6%	74,120	5.9%
Number of HS Math Courses Recorded	3.5	0.630	2.64	0.998
Number of HS Math Courses Passed	2.5	1.151	1.86	1.141
High School GPA	2.70	0.614	2.68	0.654
Age at Time of First CCC Math Enrollment	18.7	0.397	18.8	4.896
Total Headcount	440,920	100%	1,251,165	100%

High School Math Course-Taking Findings

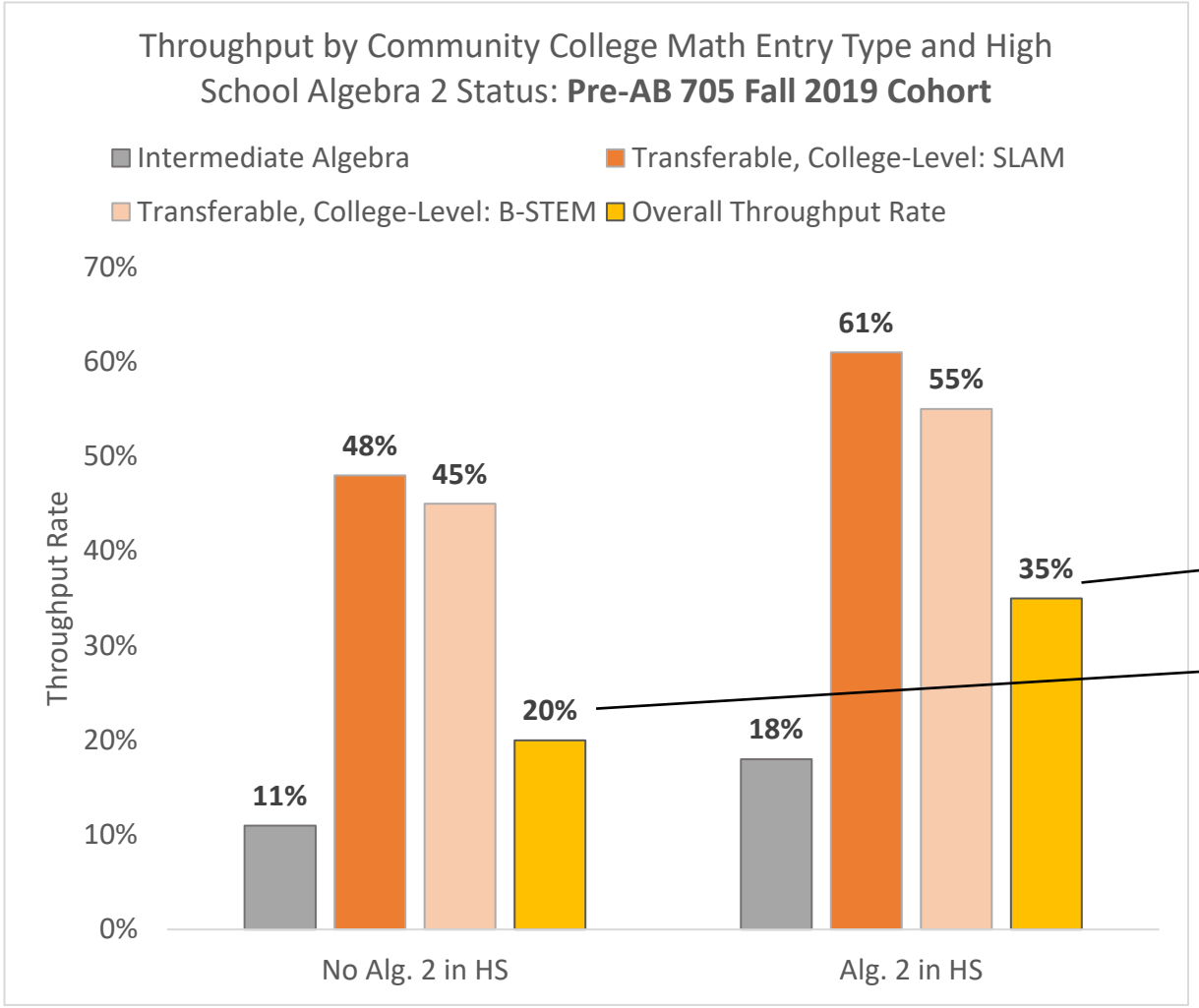
- Algebra I → Geometry → Algebra 2 → No Math was the most common course-taking pattern (8% of students)
  - Course-Taking patterns were highly variable
- Typical 12th grade math enrollments were Statistics (14%) and Algebra 2 (14%) but about 37% enrolled in no math at all
  - Finkelstein et al. found between a quarter and a third of California students took no math in 12th grade
  - Asim et al (2019) also found that about a quarter of 12th grade students were math abstainers and that higher achieving students were less likely to skip
- 65% of Sample 1 and 62% of Sample 2 had completed Algebra 2

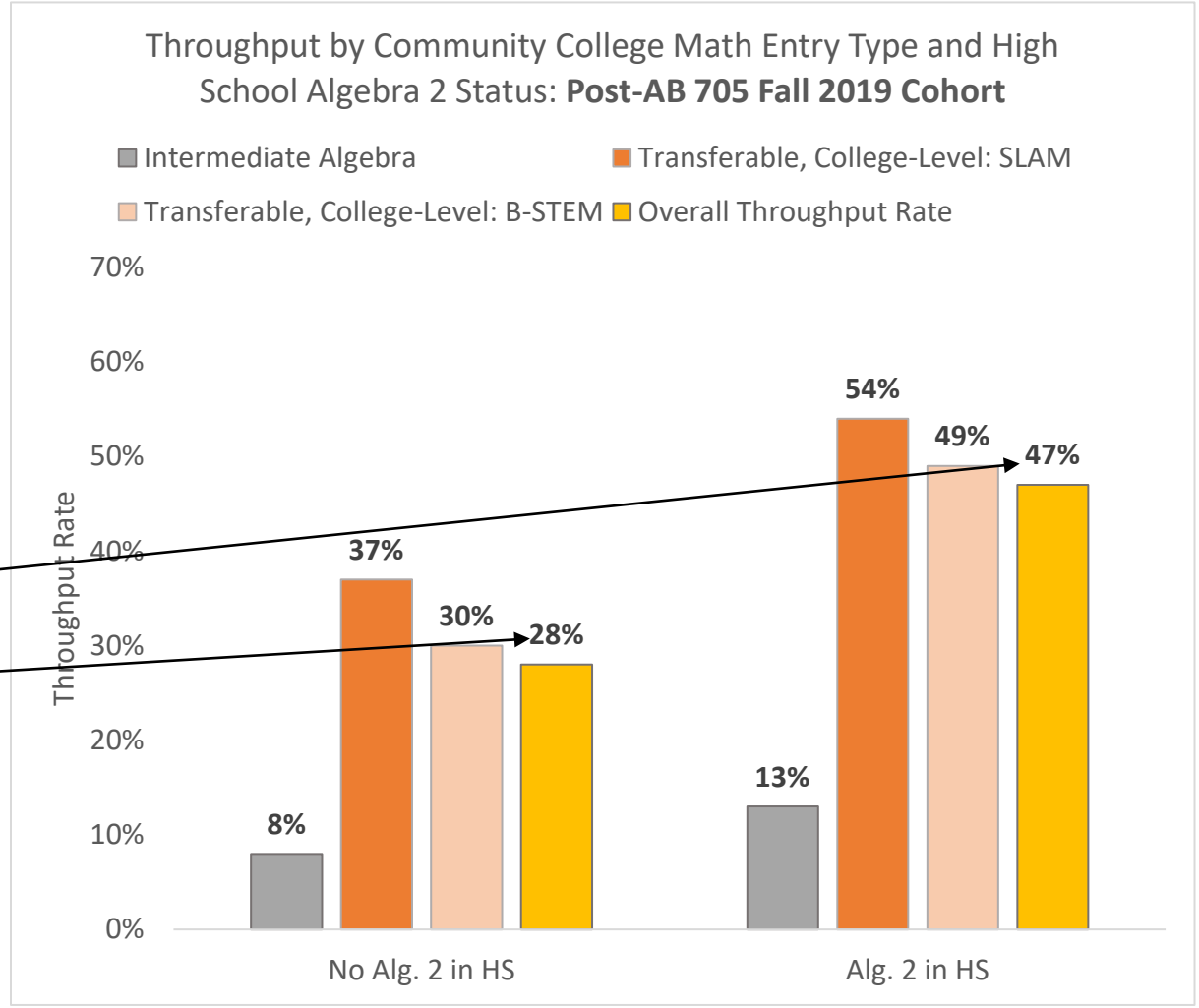
Research Questions 2 & 2.1

RQ 2: Among students who did not complete Algebra 2 in high school, what is the throughput rate of those who enrolled directly in either a transferable, college-level SLAM or B-STEM-pathway math class at a community college and how does it compare to the throughput rate of those who initially enrolled in Intermediate Algebra at a community college?

RQ 2.1: How do historical patterns of throughput for community college students who did not successfully complete Algebra 2 in high school compare to the throughput results attained after the implementation of AB 705?

Simpson's Paradox





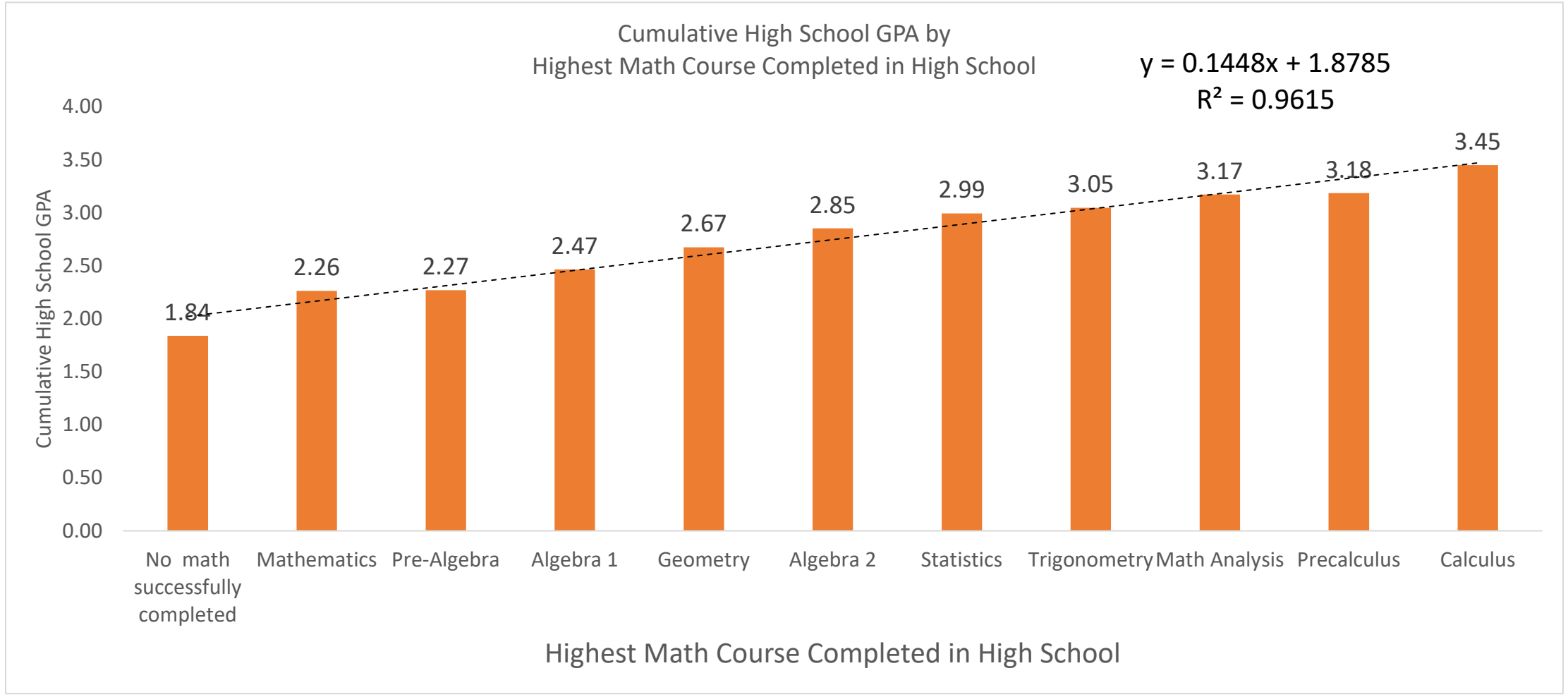
Key findings

- Among fall 2019 community college students who had not successfully completed Algebra 2 while in high school:
  - Only 8% of those beginning in Intermediate Algebra completed any transferable math within one year (i.e., they achieved an 8% throughput rate). Those who began in a transferable, college-level statistics or liberal arts math (SLAM) class experienced a 37% throughput rate
  - Those who entered directly into a transferable, college-level B-STEM math class achieved a 30% throughput rate
- Overall throughput rate increased for the Post-AB 705 (fall 2019) cohort relative to prior years (38% vs. 28%)
- Presence of a Simpson's Paradox may contribute to different perspectives on the impact of AB 705

Research Question 3

RQ 3: What is the effect of different levels of high school math course attainment on math throughput at the community college after controlling for variations in high school GPA?

Association of High School GPA with Highest Math Class Completed



Multivariate Model

	B	S.E.	Wald	df	Sig.	Odds Ratio
High school GPA	1.233	.007	30,101.173	1	< .000	3.430
Enter at transferable, college-level math	1.898	.007	64,070.512	1	<.000	**6.671**
Highest high school math is prior to Algebra 2	-.113	.013	74.539	1	<.000	.893
Highest high school math is subsequent to Algebra 2	.393	.009	1823.256	1	<.000	1.481
Constant	-5.115	.022	56,052.266	1	<.000	.006

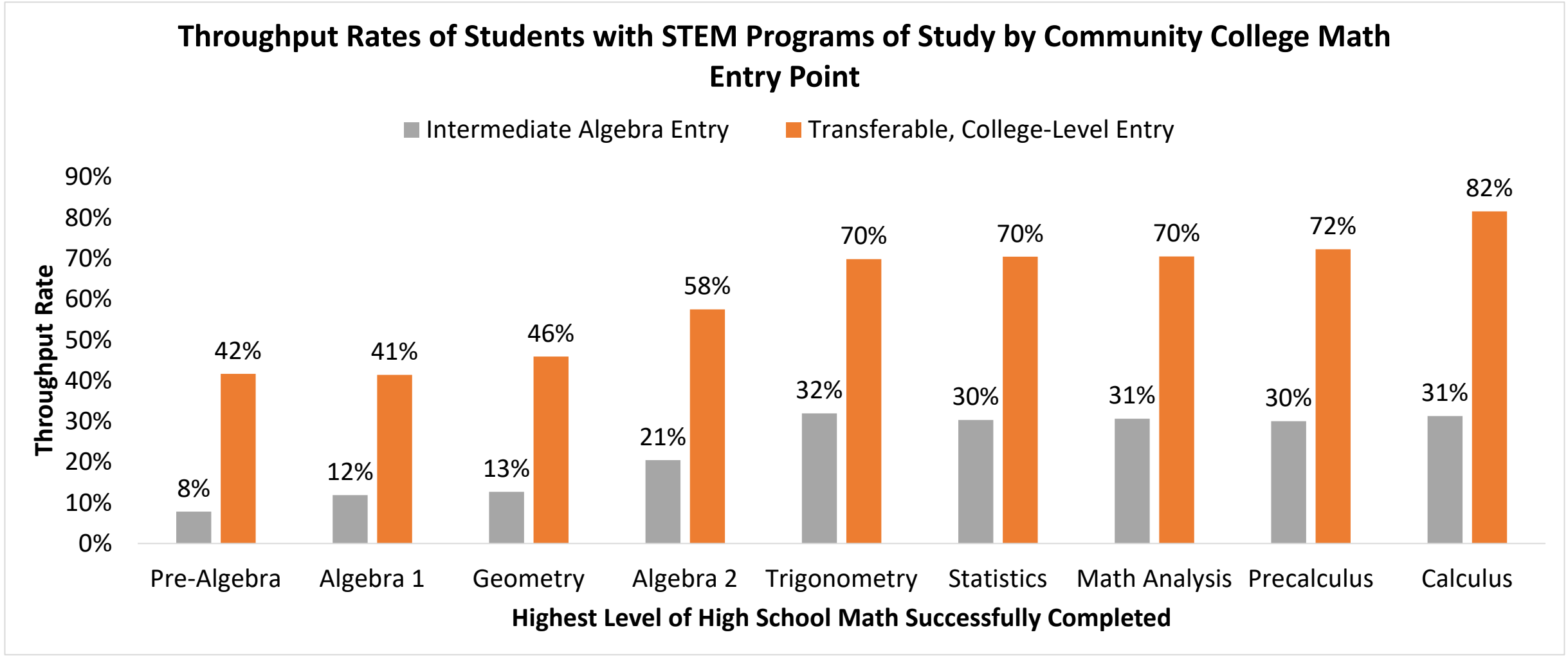
Key finding for RQ3

- Statistically controlling for high school GPA and the level of math class completed in high school showed that **students who entered directly into a transferable, college-level math class were 6.7 times more likely to complete a gateway math class** in their first year than were students who began their community college math pathway in Intermediate Algebra.

Research Question 4

RQ 4: Among students who have declared a STEM program of study and who have not completed Algebra 2 in high school, which placement— transferable, college-level math vs. Intermediate Algebra—maximizes the probability of completing a STEM pathway math class at the community college?

STEM Students' Math Throughput



Key findings

- Students who had not completed Algebra 2 in high school were much more likely to achieve math throughput if they began in transferable, college-level math than if they began in Intermediate Algebra.
- STEM students throughput rates fell into three tiers:
  - Those with less than Algebra 2 in high school (~45%)
  - Those with exactly Algebra 2 in high school (~60%)
  - Those with greater than Algebra 2 in high school (~70% to 80%)

How could this be???

- The problem of attrition
- The problem of underplacement
- The problem of engagement (or discouragement)
- (Mis)alignment of dev ed with college-level curriculum
- (Mis)alignment of math pathway with program of study

Why is Throughput Rising?

Structural

Corequisite dev ed addresses attrition

Reduction in dev ed units that do not generate momentum toward degree completion or transfer

College-level placement avoids underplacement (repetition of courses already completed)

Program-specific math pathways

Instructional

Support for students' affective and basic needs

Humanized pedagogy (facilitating learning vs. policing learning)

Just-in-time support

Flipped classrooms, etc.

Types of Concurrent/Corequisite Remediation

1. Paired classes (with or without same instructor in both)
    a. Accelerated Learning Program (ALP) model mixes dev ed-assigned and college-level assigned students in base class; dev ed-assigned students also attend a corequisite class. Includes wrap-around, holistic support.
2. Enhanced or extended classes (additional time/units added to the base class with same instructor)
3. Non Course-Based Option (NCBO) - Popular in Texas for students near the college-level assessment test cut-off. An intensive pre-class dev ed experience (unit-bearing).
4. Technology-mediated models. Independent lab with computer adaptive models that review fundamental concepts.

Recommendations, Limitations, and Further Research

Recommendations

High School Math Profile	Typical Throughput Results	Recommended Support
Successfully completed a high school math class subsequent to Algebra 2, (e.g., precalculus) with at least a "C-"	Highest average throughput rate	Transferable, college-level math placement; Additional support optional
Successfully completed Algebra 2 in high school (but not higher) with at least a "C-"	Middling throughput rate	Transferable, college-level math placement; Moderate level of additional support required
Successfully completed less than Algebra 2 in high school	Lowest average throughput rate	Transferable, college-level math placement; Highest intensity of additional support needed, including holistic support for non-academic issues

Limitations

- Extra-curricular math instruction not accounted for
- Students who were missing more math-taking data may be systematically different than those included in the study
- Equated Integrated Math courses with traditional counterparts
- COVID-19 pandemic hit in March 2020 (however spring 2020 math pass rates actually went up 3 points relative to spring 2019)
- Students in the sample represent those California high school students who go on to community college. University matriculants and non-postsecondary matriculants may have different profiles and outcomes.

Further research

- How and to what extent do specific innovations (e.g., placement practices, just-in-time remediation, self-remediation, enhanced classes, corequisite remediation, embedded tutoring, required supplemental instruction, faculty professional development, equity initiatives) uniquely or in combination support increased math throughput?
- Which pathways and practices have been most effective in closing equity gaps not just in access but in learning and completion?
- What are the downstream effects of changes in access to key gateway math classes?
- What are the postsecondary implications of variability across high school districts in promoting continuous engagement with math?
- Do high school math pathways that connect to students' aspirations, postsecondary pathways, and career goals increase math engagement for high school students who might otherwise skip math in their senior year? Do these new high school math pathways (e.g., IDS) increase student success and equitable achievement in postsecondary math coursework?
- Are variations in the degree to which math courses (including Intermediate Algebra) tend to be either procedurally-oriented vs. conceptually-oriented vary both across different courses and across sections of the same course related to increased student engagement and success?

Q&A

Get the Paper at RPGroup.org

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https://bit.ly/Maximize-Math-Throughput-Alg2

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