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

September 29, 2021
A MMAP Webinar
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 Throughput of Students Who Did Not Complete Algebra 2 in High School

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

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<th>Characteristic</th>
<th>Sample 1</th>
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<th>Sample 2</th>
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<td>Declared STEM Program of Study</td>
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<td>Total Headcount</td>
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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

Throughput by Community College Math Entry Type and High School Algebra 2 Status: Pre-AB 705 Fall 2019 Cohort

Throughput by Community College Math Entry Type and High School Algebra 2 Status: Post-AB 705 Fall 2019 Cohort
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

Cumulative High School GPA by
Highest Math Course Completed in High School

$y = 0.1448x + 1.8785$

$R^2 = 0.9615$
### Multivariate Model

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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

Throughput Rates of Students with STEM Programs of Study by Community College Math Entry Point

- Intermediate Algebra Entry
- Transferable, College-Level Entry

Highest Level of High School Math Successfully Completed:

- Pre-Algebra: 8%
- Algebra 1: 12%
- Geometry: 13%
- Algebra 2: 21%
- Trigonometry: 32%
- Statistics: 30%
- Math Analysis: 31%
- Precalculus: 30%
- Calculus: 31%
- Intermediate Algebra Entry: 42%
- Transferable, College-Level Entry: 41%
- Intermediate Algebra Entry: 46%
- Transferable, College-Level Entry: 58%
- Intermediate Algebra Entry: 70%
- Transferable, College-Level Entry: 70%
- Intermediate Algebra Entry: 70%
- Transferable, College-Level Entry: 70%
- Intermediate Algebra Entry: 72%
- Transferable, College-Level Entry: 82%
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

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

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