Mathematics at the Transition from K-12 to Higher Education

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May 5, 2019
Approximately 800,000 high school students enroll in calculus each year, more than half the 1.5 million who matriculate as full-time students in four-year undergraduate programs.

Most Calculus I Students Took Calculus in High School

<table>
<thead>
<tr>
<th>Course taking in High School</th>
<th>By students in Calculus I at PhD Universities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>percentage</td>
</tr>
<tr>
<td>Algebra II* ≤ 10th grade</td>
<td>77%</td>
</tr>
<tr>
<td>Precalculus* ≤ 11th grade</td>
<td>67%</td>
</tr>
<tr>
<td>Calculus ≤ 12th grade</td>
<td>67%</td>
</tr>
<tr>
<td>Statistics ≤ 12th grade</td>
<td>9%</td>
</tr>
</tbody>
</table>

* Does not count students who took an integrated curriculum

Growth in Dual Credit

Enrollment Age 17 or below (IPEDS)
7% average annual growth

NACEP, 2018.
Percent of Students Completing One Dual Credit Course by Ethnicity

Percent of students completing one dual credit course

- Black or African American
- Hispanic/Latino
- White

Year: 2012-2013 to 2016-2017

<table>
<thead>
<tr>
<th>Year</th>
<th>Black or African American</th>
<th>Hispanic/Latino</th>
<th>White</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012-2013</td>
<td>6.7%</td>
<td>44.8%</td>
<td></td>
</tr>
<tr>
<td>2013-2014</td>
<td>6.7%</td>
<td>45.0%</td>
<td></td>
</tr>
<tr>
<td>2014-2015</td>
<td>6.9%</td>
<td>46.4%</td>
<td></td>
</tr>
<tr>
<td>2015-2016</td>
<td>7.1%</td>
<td>49.0%</td>
<td></td>
</tr>
<tr>
<td>2016-2017</td>
<td>7.4%</td>
<td>49.6%</td>
<td>36.5%</td>
</tr>
</tbody>
</table>
Repeating and passing rates among students within the sample

<table>
<thead>
<tr>
<th>Description</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra 1 pass rate in grade 8 among students who first took algebra 1 in grade 8</td>
<td>62.69</td>
</tr>
<tr>
<td>Algebra 1 pass rate in grade 9 among students who first took algebra 1 in grade 9</td>
<td>37.60</td>
</tr>
<tr>
<td>Proportion of the sample who took algebra 1 in grades 8 and 9</td>
<td>22.72</td>
</tr>
<tr>
<td>Proportion of the sample who took algebra 1 in grades 9 and 10</td>
<td>13.49</td>
</tr>
<tr>
<td>Proportion of the sample who took algebra 1 in grades 8, 9, and 10</td>
<td>4.43</td>
</tr>
<tr>
<td>Proportion of the sample who ever repeated algebra 1</td>
<td>33.57</td>
</tr>
<tr>
<td>Proportion of the sample who ever repeated geometry</td>
<td>15.96</td>
</tr>
<tr>
<td>Proportion of the sample who ever repeated algebra 2</td>
<td>10.17</td>
</tr>
<tr>
<td>Proportion of the sample who ever repeated algebra 1, geometry, or algebra 2</td>
<td>49.70</td>
</tr>
<tr>
<td>Proportion of the sample who ever passed algebra 2</td>
<td>44.24</td>
</tr>
<tr>
<td>Proportion of the sample who did not take a math course in grade 12</td>
<td>30.18</td>
</tr>
</tbody>
</table>

Finkelstein, 2014.
The Need For Reform

FIGURE 2. STUDENT PROGRESSION THROUGH THE DEVELOPMENTAL MATH SEQUENCES

Quick structural change

Mathematics pathways are structured so that:

1) All students, regardless of college readiness, enter directly into mathematics pathways aligned to their programs of study.

2) Students complete their first college-level math requirement in their first year of college.

Continuous improvement

Students engage in a high-quality learning experience in math pathways designed so that:

3) Co-requisite strategies to support students as learners are integrated into courses and are aligned across the institution.

4) Instruction incorporates evidence-based curriculum and pedagogy.
Pathways aligned placement

2-Year College Student Enrollment into Programs of Study

- Require Calculus: 20%
- Do not require Calculus: 80%

4-Year College Student Enrollment into Programs of Study

- Require Calculus: 28%
- Do not require Calculus: 72%

Emerging Texas Math Pathways

**Meta-Major**
- Liberal Arts, Fine Arts, and Humanities
- Social Sciences and Social Services
- Nursing and Health Professions

**Math Pathway**
- Quantitative Reasoning Pathway—Math 1332 Contemporary Math
- Statistical Reasoning Pathway—Math 1342 Elementary Statistical Methods

**Algebraically-Intensive**
- Business and Accounting
- Teaching and Education
- Science, Technology, Engineering, and Math

**Math Pathway**
- Business Pathway—Math 1324 Mathematics for Business
- Teacher Pathway—Math 1350 Fundamentals of Math I (Math 1314 is a prerequisite)
- STEM Pathway—Math 2413 Calculus I (with Math 1314 College Algebra and 2312 Pre-Calculus if needed)
States Implementing Co-Requisite Math at Scale
Figure 2. A Preponderance of Evidence
More students succeed in less time with accelerated models

Consistent results across multiple sites using different models show that more students earn credit in less time with accelerated models.

Sources: Indiana (Complete College America, 2016); CUNY (Logue et al., 2016); Tennessee (Tennessee Board of Regents, 2016); Statway (Sowers & Yamada, 2015); CAP (California Acceleration Project, 2015); TX NMP (Rutschow & Diamond, 2015); and AtD (Bailey et al., 2010).

DCMP (2019). The Case for Mathematics Pathways
Georgia Co-Requisite Model

Source: Denley, T., CoRequisite Developmental Mathematics
Georgia Co-Requisite Model

Source: Denley, T., CoRequisite Developmental Mathematics
Systemic dimensions of math pathway reforms

- Student-centered
- Faculty-driven
- Administrator-supported
- Policy-enabled
- Culturally-reinforced
The University System of Georgia Mathematics Task Force

“...charged with determining how the System’s colleges could dramatically improve success rates in gateway mathematics courses without compromising the disciplinary integrity of these courses.”

—From University System of Georgia: Transforming College Mathematics
Ohio Board of Regents’ Charge to the Mathematics Steering Committee

To develop expectations and processes that result in each campus offering pathways in mathematics that yield
(1) increased success for students in the study of mathematics;
(2) a higher percentage of students completing degree programs; and
(3) effective transferability of credits for students moving from one institution to another.
States using high school data for college placement

Which States Allow Multiple Measures Placement?

Source: 50-State Comparison on Developmental Education Policies

Source: ECS, 2019
A Common Vision for the Undergraduate Mathematics Program in 2025

The primary goal of this initiative is to develop a shared vision in the mathematical sciences community of the need to modernize the undergraduate mathematics program, especially the first two years.

- Common themes highlighted through initial examination of seven existing curriculum guides published by mathematical sciences professional associations.

www.maa.org/programs/faculty-and-departments/common-vision
The Correlational Study: STEM

$r(10) = -.64, p = .025$

High score = need brilliance

Leslie, Cimpian, & Meyer, in prep.
Supporting seamless transitions

Taking Alignment to the Next Level

How K-12 and Higher Education Can Collaborate to Support Student Success

RIGHT NOW, A FIRST-YEAR STUDENT SITS IN A COLLEGE CLASSROOM BEING ILL-SERVED BY DEVELOPMENTAL MATH.

Students must be set up for success in their first year at college. Developmental math and English courses can stand in the way of their path to a degree. Strong Start to Finish is shifting that path so that every student can start strong, to finish strong.

EVERY STUDENT DESERVES A STRONG START TO FINISH. WE ARE HERE TO MAKE IT HAPPEN.
Tunnel of Eupalinus