Remedial Course-Taking Patterns among Recent High School Graduates

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SUMMARY[1]

When they move on to college, Washington state high school graduates enroll in remedial math at high rates. According to the most current state-level data available, 31 percent of the class of 2003 graduates attending a public college or university in Washington took at least one remedial math course in their first year. The remedial rate is even higher among graduates attending a community or technical college, where 47 percent of these graduates enrolled in remedial math in the year following graduation.[2]

Using transcript data from a single school district (compiled for an earlier project), SESRC analyzed the relationship between students' high school math courses/grades and whether or not they required remedial math at area community colleges, if they enrolled in the year after they graduated. Students who did not require remedial math are referred to as "math-ready" in these analyses.

It is difficult to disentangle the key factors contributing to readiness for college-level math, because students who do better in math also tend to take more math courses, and they are more likely to continue in math until graduation. They are also more likely to enroll in college.

Key Findings:

- Algebra II is not functioning efficiently as the key pre-requisite course for college-level math for these students. Only eleven percent (11%) of graduates who did not take math beyond Algebra II were math-ready. In contrast, 38% of students who stopped at Pre-Calculus were math-ready, as were 86% of students who completed high school Calculus.

- A student's grade in Algebra II is a strong predictor of being math-ready. Students with an A grade were far more likely to be math-ready (60%) than those with lower grades (13%). This difference is even starker for students who stop at Algebra II.

- Whether or not a student took a math class in the year before they attempted college math was not a significant predictor of college-level math readiness, once a student's highest math course level was taken into account. Students who stopped with Pre-Calculus in their Junior year and those who stopped with Pre-Calculus in their Senior year had the same rate of math-readiness (38%).

- While higher-level math courses are a powerful predictor of math-readiness, some students were math-ready after having completed only Algebra II. Others completed Pre-Calculus or Calculus courses, but still required remedial coursework.

[1] This analysis was supported by the OSPI Office of Research, Evaluation and Accountability.
[2] Source: The Washington State Graduate Follow-up Study. http://www.sesrc.wsu.edu/gfs/GFS_Reports/class_2003.asp
State Board for Community & Technical Colleges reports a similar 49% rate using a different method.
http://www.sbctc.ctc.edu/data/rsrchrpts/Resh04-1.doc

Background

For a previous research project, SESRC created a research database of student transcript information for the 2004 graduates of a mid-sized school district in Washington State. This district graciously permitted SESRC to use this data for an OSPI-sponsored analysis of remedial enrollment in math. The analysis focused on three nearby community colleges, where 62 percent of the total postsecondary enrollments occurred. The class of 2004 included 197 graduates who attended a community college in the 2004-05 school year and for whom math-readiness can be determined from community college records[3].

This project explored the relationship of high school coursework and grades to remedial enrollments in the first year after graduation. Questions analyzed include the statistical relationship between remedial math enrollment and:

- whether students took Algebra II, traditionally the pre-requisite for college-level math,
- grades in Algebra II,
- whether students took math in their senior year (or in the year prior to enrolling in Running Start).

Students were identified as math-ready in this study when they were permitted to enroll in college-level math courses at a local community college after graduation. Students were identified as not math-ready when they enrolled in a remedial (pre-college or developmental) math course at the same colleges. Usually those determinations of readiness are based on a standardized math placement test. Some students may be accepted based on other evidence of preparedness, and some students may opt into remedial courses based on considerations other than placement tests. However, placement test scores are the major assessment mechanism. Therefore, this study is actually analyzing "test-readiness" rather than "math-readiness." This study does not address the question of whether the placement tests are effective, nor how high school courses and grades relate to performance once students begin working at the college level.

Findings:

1. Overall, 24% of the students included in this sample were math-ready.

2. Algebra II is not functioning efficiently as the pre-requisite course for entry to college-level math for these students.

3. In addition to completing at least Pre-Calculus, the other strongest correlate of college-level math readiness was a student's grade in Algebra II.

4. Whether or not a student took a high school math class in the year before they attempted college-level math did not have an independent effect on readiness for college-level math.

5. Both number of math credits and level of math courses are imperfect indicators of math readiness.

[3] The three local colleges graciously provided enrollment data for the fall and winter quarters of 2004-2005.

Overview

The study sample includes all graduates from the Class of 2004 who:

- took at least one class from a district high school in each of the last four years,
- did not have any transfer or correspondence courses on their transcript, and
- were not disabled, home schooled, in an ESL program, or in Special Education.

Of these approximately 600 graduates, 218 enrolled at one of the three community colleges in their area. These three community colleges provided over 50 percent of the postsecondary enrollment for this graduating class of 2004[4].

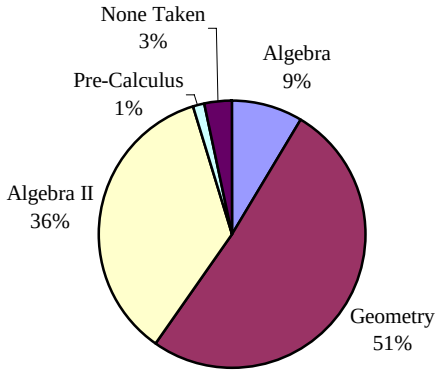
Finding #1: Overall, 24% of students included in this study were math-ready.

Of the 218 who enrolled at these local colleges, this study focused on the 197 who either took a placement test or otherwise were allowed to enroll in a math course in the Fall or Winter Quarter. Of the 197 enrollments, 47 were in a college-level course and 150 in a remedial-level math course. The 47 out of 197 provides the 24% math-ready statistic.

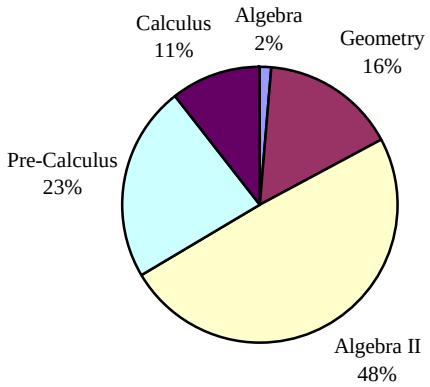
Extent of Math Preparation in High School[5]

Approximately half of the students who attended one of the three community colleges had enrolled in Geometry their sophomore year and another 36% had enrolled in Algebra II. (See chart at left) Of the graduates in this study, 18% had stopped their high school math at Algebra or Geometry, almost half stopped taking math at the Algebra II level (48%), approximately one quarter studied up through Pre-Calculus, and 11% took Calculus in high school. (See chart at right)

Level of Math Taken Sophomore Year



Highest Level of Math Taken

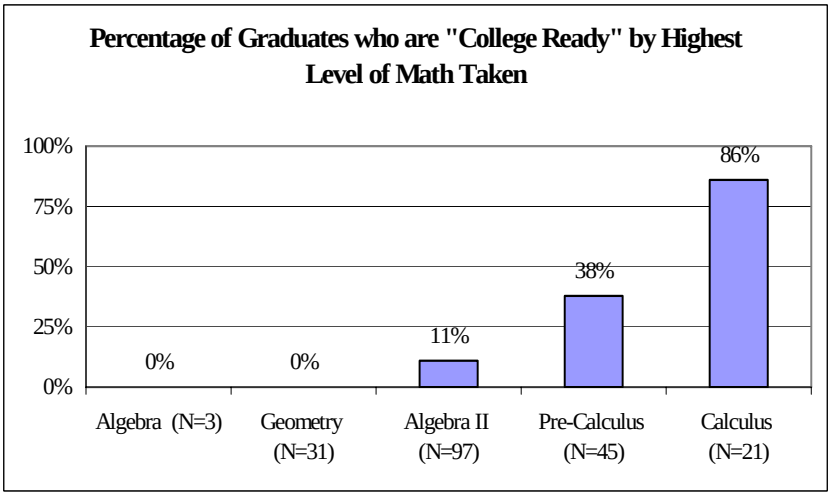


[4] Source: 2003 College Enrollment Study results for this district. For a copy of the state report, please see www.sesrc.wsu.edu/nsc.

[5] Throughout this analysis, only courses in which a student recorded a passing grade were counted. Failed courses (grades F or NC) were disregarded.

Finding #2: Algebra II is not functioning effectively as the key pre-requisite course to college-level math for these students.

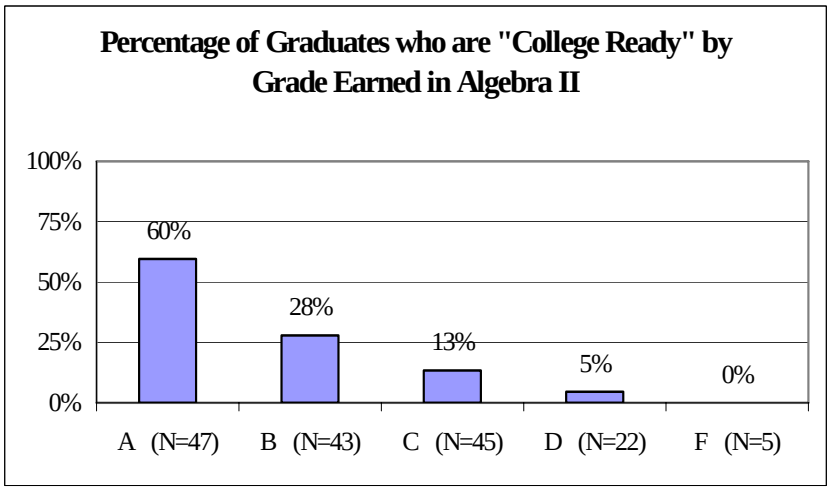
Only eleven percent (11%) of graduates who took math only through Algebra II were math-ready; 38% of students who stopped at Pre-Calculus were math-ready, and 86% of students who completed Calculus did not need remediation in math.



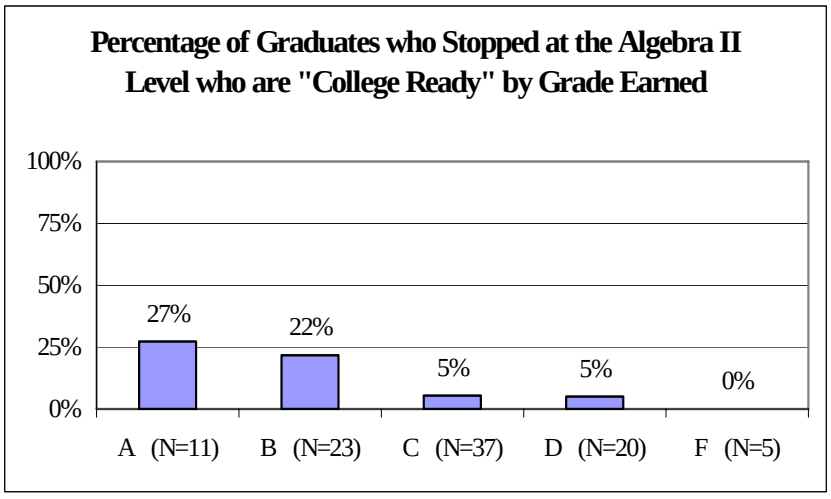
When the rates of remedial enrollments in math were tabulated by the highest level of math completed, it was clear that - at least for this sample - Algebra II does not routinely serve as adequate preparation for placing into college-level math[6].

Finding #3: In addition to completing at least Pre-Calculus, the other strongest correlate of being ready for college-level math was a student's grade in Algebra II.

Students who earned an A in Algebra II were math-ready 60% of the time compared to 28% of students who earned a B and 13% of students who earned a C. This effect was most noticeable among students who took no math beyond Algebra II.



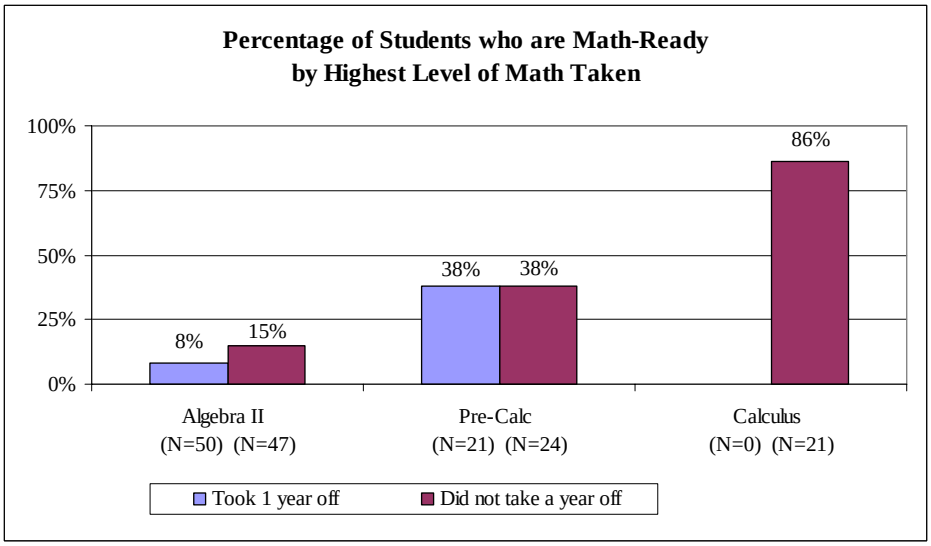
Disentangling the effect of grades from the effect of taking higher levels of math is difficult since students who earn A's in Algebra II are more likely to eventually take Pre-Calculus and Calculus than students with lower Algebra II grades. Focusing exclusively on the 97 graduates who took no math above the Algebra II level, 24% of the students who earned an A or B were math-ready compared to 5% of students earning lower grades (C or D).



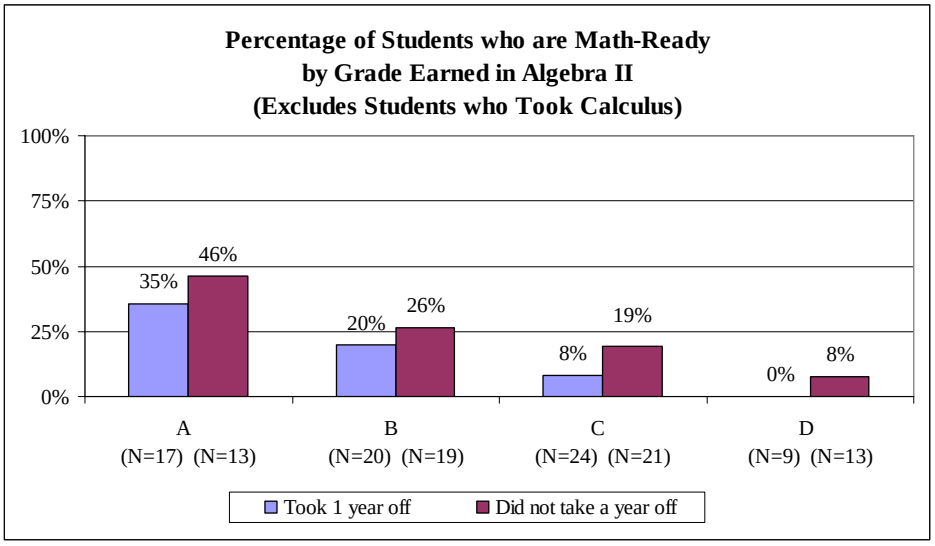
[6] Clifford Adelman from the U.S. Department of Education is the author most often cited regarding the importance of Algebra II for college math preparedness.

Finding #4: Whether or not a student took a high school math class in the year before they attempted college math did not have a significant independent effect on readiness for college-level math. After adjustment for the grade earned in Algebra II, or for the student's highest math course, the effect of taking a year off from math studies is very limited.[7]

As shown in the chart at right, when the data is analyzed by the highest math course taken, it made no difference whether or not the student was enrolled in math the year before attempting college math. Math readiness rates are similar regardless of course timing.[8]



There is possibly a small benefit for taking math every year for students who did poorly in Algebra II. For the small sample of students who earned a C or D in Algebra II, not skipping a year is associated with a small increase in odds from 6% to 15%. However, this is an unusual group. The experience of students who persevere in math after low grades in Algebra II may not be broadly applicable.[9]



[7] In the vast majority of cases where a graduate "took one year off", they did not enroll in math their senior year. However, in two cases, they did not enroll in a math course in their junior year and then took a Running Start math class in their senior year, followed by more math courses at the college after they graduated.

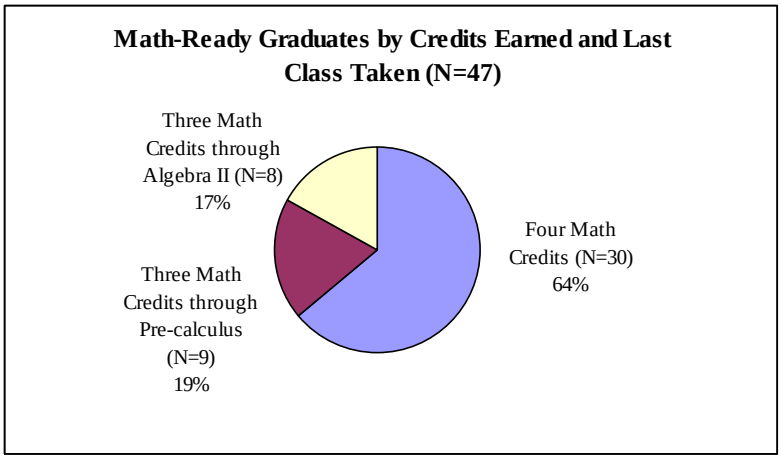
[8] Somewhat different results can be obtained if Running Start students who did not attend a local community college after graduation are included in this analysis. However, including these students would skew the comparison, because data is unavailable on any similar students who did not enter Running Start because they were not math-ready. Thus inclusion would cause an upward bias in the math readiness rates. For that reason, only Running Start students who later attended a local community college are included.

[9] This analysis excludes students taking high school Calculus because it is very rare for a student to be able to take Calculus except by taking math in all four years of high school.

Finding #5: While both the number of math credits and highest level math course are significant predictors of math readiness, both are far from perfect predictors. Therefore, any preparedness standard based on either criterion will include some students who cannot pass the standard placement tests, as well as excluding some students who can.

Some of the students who were found to be math-ready had three or fewer high school math courses.[10] Data problems prevent a precise answer, but at a minimum, 12% of students who took no math beyond Algebra II were found to be math-ready at entrance to a local community college.

Even this low percentage of Algebra II level students is a non-trivial proportion of the graduating class. One- sixth of the students in this study who were identified as math-ready by their local community college would clearly not have met a four-math-course standard because their highest course was Algebra II. Of the 47 graduates who placed into college-level math, eight did not take courses beyond Algebra II. An additional nine showed three years of high school math that included Pre-Calculus.



While the majority of students who have college-level math skills did take four years of math in high school, completion of Pre-Calculus may be a better predictor of college readiness than completion of a pre-determined number of years of study. However, there is no perfect indicator in the transcript data. As noted above, over 60% of the students who advanced through high school Pre-Calculus still required remedial math – as did one out of seven who completed high school Calculus.

As a strictly statistical matter, getting an A in Algebra II is the only single factor that comes close to high school Calculus as a predictor of math readiness. Math readiness rates were not significantly different comparing students who stopped with an A in Algebra II with students who got a B in Algebra II but also took Pre-Calculus, and did not also take high school Calculus.

Next Steps

Further analysis using multivariate logistic regression might reveal combinations of courses and grades that provide more accurate indication of math readiness. Where standardized test scores such as SAT or WASL are available, they might also contribute to identifying stronger statistical relationships. However, obtaining larger samples of students from a variety districts is necessary before these results should be widely generalized.

In addition, because the ultimate goal is alignment of secondary preparation, not with placement tests, but with the functional requirements of college-level coursework, a broader investigation and validation of the current preparedness assessment instruments may be in order.

[10] Typically, those three courses were Algebra, Geometry, and Algebra II.