

RESEARCH BRIEF: CONCURRENT ENROLLMENT AND THE STEM PIPELINE

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Increasing student enrollment and success in Science, Technology, Engineering, and Math (STEM) continues to be a priority for Utah employers, policymakers, and university administrators. This research brief is the second in a series of UEPC studies that explores the pipeline into STEM fields. The [first study](#) identified factors that predicted earned credit in College Algebra (Math 1050) in Utah. That study and a [replication](#), found that students enrolled concurrently were significantly more likely to earn credit in College Algebra than students enrolled in college. Specifically, the first study found that:

- 96% of the students who were concurrently enrolled in Math 1050 earned credit, compared to
- 76% of the students who were enrolled in Math 1050 during college earned credit.
- When 11 other demographic and academic factors were considered simultaneously, similar students were three times more likely to earn Math 1050 credit if they took the course through concurrent enrollment.

While these results seemed to indicate a substantial benefit to taking Math 1050 through concurrent enrollment, further research was needed to understand this finding. Foremost among the questions raised by our initial findings was how well the two Math 1050 enrollment types (concurrent or college) indicated student success in future college math courses.

Concurrent Enrollment and Subsequent College Math Performance

In Utah, students seeking STEM degrees frequently take Math 1050 (College Algebra) and then Math 1060¹ (Trigonometry). These two courses together are considered Precalculus. Passing Precalculus (or equivalent credentials) is required for enrollment in Math 1210, which is college Calculus. Successful completion of college Calculus is a requirement for all STEM degrees.

Given this common math sequence for students seeking STEM degrees, this study addresses whether there were differences in the subsequent math performance of concurrently enrolled and college enrolled Precalculus (Math 1050 and Math 1060) students. Specifically, we address the following questions:

- 1) Did Precalculus enrollment type (concurrent enrollment or college enrollment) predict different rates of repeating Precalculus classes?
- 2) Did Precalculus enrollment type (concurrent enrollment or college enrollment) predict college Calculus grades?

Study Sample

This study sample began with the population of 4,167 Utah college students who were enrolled in Calculus while in college between fall 2006 and spring 2012. After using the following criteria, 1,185 students were included in this study—593 took Precalculus through concurrent enrollment and 592 took Precalculus through college enrollment. The aggregate group of students who were included in this study met the following criteria:

- Student took Precalculus (both Math 1050 and Math 1060) through concurrent enrollment or college enrollment,
- Student took no other courses in math departments during the time between Precalculus and Calculus,
- Student earned a letter grade (A-E/F) in Calculus or withdrew from the course (i.e., no incompletes, audits, etc.), and
- Student was recorded as a Utah high school student in the Utah State Office of Education state's educational database in at least one year between grades 9 through 12.

Enrollment Types

Concurrent Enrollment

Students enroll in a college course while in high school and earn high school and college credit.

College Enrollment

Students enroll in a college course after high school and earn college credit.

Question 1. Did Precalculus enrollment type (concurrent or college) predict different rates of repeating Precalculus classes?

We used descriptive and parametric statistics to determine the repeating rates for both students who concurrently enrolled and those who enrolled in Precalculus during college who earned grades of C- or better. We found that:

- Concurrently and college enrolled students repeated Math 1050 at the same rate (5.5%).
- Concurrently enrolled students repeated Math 1060 more often than those who enrolled during college (4.7% and 1.2%, respectively)².
- Overall, there were no statistical differences in repeating rates of Precalculus (Math 1050 and 1060) between concurrent (8.2%) and college (6.2%) enrollment types³.

Question 2. Did Precalculus enrollment type predict college Calculus grades?

Students who took Precalculus through concurrent enrollment had an average college Calculus grade of C+ (2.5 on a four point scale). Students who took Precalculus during college enrollment had an average college Calculus grade of C (2.2 on a four point scale). The difference in Calculus grades may have been expected independent of enrollment type because the students who took Precalculus through concurrent enrollment were, on average, students with higher math scores (see Table 1) than those students who took Precalculus while enrolled in college. The differences illustrated in Table 1 existed before the students took Precalculus and are predictors of success in Calculus⁴.

Table 1. Difference in academic achievement between the two enrollment types prior to taking Precalculus

Academic Achievement Indicators	Concurrent Enrollment Precalculus	College Enrollment Precalculus
Geometry CRT Score*	176	169
Math ACT Score**	26	23
High School GPA	3.74	3.53

*Range=130-199, Proficient=160 or above, standard deviation=10

**Range=1-36, Math benchmark for college readiness=22⁵

To account for academic differences prior to taking Precalculus, we used a regression model that allowed us to consider the effect of enrollment type independent of geometry CRT scores, math ACT scores, and high school GPA⁶. When we compared similar students in this way, we found that enrollment type did not predict Calculus grades⁷. In other words, the differences in Calculus grades between the two Precalculus enrollment types were completely accounted for by pre-existing differences and could not be attributed to type of enrollment.

Conclusions

Our previous [research brief](#) indicated that students taking Math 1050 through concurrent enrollment were more likely to pass the course on the first time than students taking the course once they were enrolled in college. While those results seemed to indicate a substantial benefit to taking Math 1050 in high school, previous results did not address how well taking the course through concurrent enrollment facilitated the readiness of students for future college math courses, if it did at all. In response, the current research was conducted to determine if students taking Precalculus through concurrent enrollment performed as well in future math classes as students who waited to take the course once enrolled in college. The current study suggests that passing Precalculus while concurrently enrolled or while enrolled during college led to essentially the same outcomes. Moreover, we discovered that students who took Precalculus through concurrent enrollment repeated the courses at approximately the same rate and performed no better or worse in Calculus than their academically similar peers who took Precalculus while enrolled in college. Thus, we conclude that while concurrent enrollment may have advantages for students, these benefits do not extend to an increased readiness or performance advantage in additional math courses.

¹ In Utah, most students who take Math 1050 through concurrent enrollment also take Math 1060 the following semester through concurrent enrollment. Therefore, we could not use performance in Math 1060 as an outcome variable.

² $\chi^2_{(1, N=1185)}=11.680, P=.001$; Continuity correction applied to adjust for degrees of freedom.

³ $\chi^2_{(1, 1181)}=1.382, P=.240$; Continuity correction applied to adjust for degrees of freedom.

⁴ Research has shown that High school GPA and math scores predict success in Calculus. For examples see, Domina, T., & Saldana, J. (2012). Does raising the bar level the playing field? Mathematics curricular intensification and inequality in American high schools, 1982–2004. *American Educational Research Journal*, 49(4), 685-708. Pyzdrowski, L. J., Sun, Y., Curtis, R., Miller, D., Winn, G., & Hensel, R. A. (2013). Readiness and attitudes as indicators for success in college calculus. *International Journal of Science and Mathematics Education*, 11(3), 529-554.

⁵ ACT (February 2013). Readiness matters: The impact of college readiness on college persistence and degree completion. ACT Policy Report. Iowa City, IA.

⁶ Stepwise linear regression was used to predict grades in college Calculus on a 4 point scale from enrollment type in the first step and from Math ACT score, Geometry CRT score, and High School GPA. Geometry, math ACT, and GPA scores were used because they showed the strongest simple correlations with the outcomes and were correlated with enrollment type in our preliminary exploration of the data. A significance level was set at .05.

⁷ Results from stepwise linear regression: Step One (Calculus predicted from Enrollment type): $F(1,449)=10.581, p=.001; R^2=.023$; Enrollment type $B=3.253, p<.001$. Step Two (Calculus predicted from Enrollment type, ACT, CRT, and GPA): $F(4, 446)=15.269, p<.001; R^2=.12$; Enrollment type $B=-.011, p<.828$; ACT $B=.190, p=.001$; ACT $B=.036, p=.506$; GPA $B=.238, p<.001$.

Data for this research was accessible through Utah's state longitudinal data system database administered by the Utah Data Alliance. The Utah Data Alliance (UDA) and its partners (Utah State Office of Education, Utah System of Higher Education, Utah College of Applied Technology, the Utah Department of Workforce Services, Utah Education Network, and the Utah Education Policy Center), do not endorse or sanction any part of this research including the methods, results, and conclusions. All errors are the responsibility of the author.