Probability of Success:
Evaluation of Florida's Developmental Education Redesign
Based on Cohorts of First-Time-In-College Students from 2009-10 to 2014-15

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Executive Summary

Through the enactment of Senate Bill 1720 (SB 1720), the Florida legislature dramatically changed how developmental education (DE) is offered and for whom it is required. Historically, many students would have been required, based on their performance on a placement exam, to take and pass DE courses prior to introductory college-level (gateway) courses. With placement tests now optional and as many students can now bypass DE when they meet the criteria as exempt students, we sought to better understand how students make enrollment decisions in an environment of increased choice, and how their choices affect their early educational progress.

To determine how student success has changed following the implementation of the legislation, we compared enrollment and passing rates of DE courses and gateway courses for first-time-in-college (FTIC) students before (2009-10 to 2013-14) and one year after the reform was implemented (2014-15), controlling for a number of student background characteristics and measures of high school academic preparation. We also examined how student characteristics were related to enrolling in developmental education courses by instructional modality (i.e., modularized, compressed, contextualized, or co-requisite) and how course modality was related to student success in their developmental courses, gateway courses, and fall-to-spring persistence.

This report addressed these main questions using three analytic samples. The first sample includes all FTIC students in the 2009-10 to 2014-15 entering cohorts in the Florida College System (FCS) who had complete background and high school course-taking data. The second sample includes only those directly affected by the law, or exempt students in 2014 and those who would have likely been affected by the legislation in the earlier cohorts, had the same legislation been implemented during those years. The final sample included only underprepared students. That is, we limited our 2014-15 sample to students who, based on their placement scores, would have tested into developmental math. We disaggregated this group by severely unprepared students, moderately underprepared students, and slightly underprepared students.

Key findings include:

1. In fall 2014 when DE was optional, the likelihood of enrolling in DE mathematics, reading, and writing all decreased substantially, by approximately 11 to 21 percentage points.
2. Students of color, females, those eligible for free or reduced lunch were significantly less likely to enroll in DE courses, as were those who took advanced math and English coursework in high school.
3. The likelihood of passing DE math, reading, or writing decreased in 2014, by 1.5 to 3.2 percentage points.
4. More students enrolled in compressed DE courses (roughly 51-72%) compared to the other modalities (roughly 2-35%, depending on the subject), though a larger share of Black students were enrolled in compressed or contextualized courses; Hispanic students

enrolled in these modalities at lower rates, particularly in math, relative to co-requisite courses.

5. Among students taking DE courses in 2014, students in co-requisite courses had the highest rates of passing the relevant gateway course, followed by compressed, then contextualized, and finally modularized DE courses, though this varied by subject.
6. In fall 2014 when students can directly enroll in gateway courses and DE is optional, the likelihood of enrolling in gateway courses increased for both English (12.7 percentage points) and math (16.2 percentage points).
7. With the influx of enrollment into gateway courses, however, the likelihood of passing declined for English (3.4 percentage points) and math (8.7 percentage points).
8. In some subjects, students who took the DE course in 2014 had higher odds by 1.1 to 1.3 of passing the subsequent gateway course than students who didn't take the DE course. And, more specifically, underprepared students appear to benefit from taking developmental math along with the gateway course instead of bypassing DE altogether, either through co-requisite DE or compressed DE, increasing the odds of passing by 1.4-1.6, respectively.
9. What is promising, however, is that based on the estimate of the whole cohorts, the share of students entering a community college for the first time and successfully passing a gateway course in the first semester has increased for both English (9.4 percentage points) and math (6.1 percentage points).
10. Since the implementation of DE reform the likelihood of an incoming student receiving credit for college-level math in the first semester continues to be higher for Hispanic students (roughly 18%) compared to a similarly prepared White student, a trend that has been present for several years, however we also see a narrowing of a pre-existing achievement gap between similarly prepared White and Black students since the implementation of the DE legislation, with the likelihood of incoming Black students receiving credit for college-level math in the first semester is now the same as for similarly prepared White students (roughly 15%).

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The year of 2014 may have been a watershed year in developmental education (DE) in Florida and beyond. Through Senate Bill 1720 (SB 1720), which was originally passed in 2013 and went into effect in 2014, the Florida legislature drastically redesigned DE policy in the state. The new law mandated that the 28 state colleges (formerly the community colleges) in the Florida College System (FCS) provide DE that is more tailored to the needs of students, giving some students the choice not to participate at all and students the opportunity to select from multiple course delivery modes when deciding to enroll in DE.

Through the enactment of SB 1720, the Florida legislature dramatically changed the rules of how developmental education is offered and for whom it is required. Under the new legislation, students who entered 9th grade in a Florida public school in the 2003-04 school year and afterwards are considered college ready—provided they earned a standard high school diploma. Thus, the law prohibits requiring placement testing or DE courses for these students. It also exempts active duty members of the military from placement testing and developmental coursework. Further, the law requires that colleges offer instruction using techniques thought to shorten the time to enroll in college credit courses, including compressed, contextualized, co-requisite, and modularized delivery modes. Lastly, the legislation mandates enhanced advising and other forms of supplemental support.

Historically, many students would have been required, based on their performance on a placement exam, to take and pass DE courses prior to introductory college-level (gateway) courses. With placement tests now optional and as students can now bypass DE, we sought to better understand how students make enrollment decisions in an environment of increased choice, and how their choices affect their early educational progress. More specifically, we compared enrollment and passing rates of DE courses and gateway courses for entering cohorts of students before and after the reform was implemented, controlling for a number of student background characteristics and measures of high school academic preparation.

In the following sections, we contextualize DE on a national and state level, outline our methods and data, present our results, and discuss the findings as well as directions for additional research. The issue of DE is not a phenomenon unique to Florida. State legislatures across the country are struggling to find ways to promote student attainment of educational credentials. Our findings, then, may be useful for both state policy makers and institutional leaders when they consider DE reforms.

Background

Developmental coursework in postsecondary education—coursework completed after high school that is not yet at the college level—has come under increased scrutiny in recent years, particularly with the large numbers of students who need DE and the cost associated with providing it. Recent estimates indicate that over half of all students seeking an associate's degree require at least one developmental course (Bailey, Jeong, & Cho, 2010; Complete College

America, 2012), and in 2010 the National Center for Education Statistics found that 1.7 million beginning students require at least one DE course each year. Over $3 billion are spent each year providing DE (Alliance for Excellent Education, 2011). In Florida alone, 70% of first-time-in-college (FTIC) community college students are enrolled in at least one developmental course, which cost $154 million during the 2009-10 academic year (Underhill, 2013). However, only a small fraction of students who have taken DE actually earn college-level credentials (Complete College America, 2012). The combined increase in the number of students requiring DE and the cost of providing related courses have sparked interest among scholars, policy makers, and practitioners in assessing the impact of DE on postsecondary outcomes for college students.

Increased scholarly interest in DE has led to some studies evaluating student outcomes; however, the results of previous research have yielded mixed findings (Bettinger & Long, 2009; Boatman & Long, 2010; Calcagno & Long, 2008; Lesik, 2006; Martorell & McFarlin, 2011; Moss & Yeaton, 2006; Scott-Clayton & Rodriguez, 2012). For example, Bettinger and Long (2009) found that community college students in developmental courses are more likely to persist and graduate than similar students who did not receive DE. In contrast, using data from Texas Martorell and McFarlin (2011) found that DE has little impact on academic outcomes. Furthermore, using data from Tennessee, Boatman (2012) as well as Boatman and Long (2010) found, for some students, DE may have a negative effect on persistence in postsecondary education. Specific to Florida, an earlier study by Calcagno and Long (2008) found that DE coursework had a positive effect on short-term persistence, but little effect on eventual four-year degree completion. In sum, the contradictory results point to the need for continued research on this topic to determine what factors and contexts are associated with positive student outcomes in DE. In this report, we investigate the particular case of Florida, a state that has drastically redesigned its DE policy.

Emerging Literature and Policy Context

One key issue in DE is the historical and widespread use of placement tests to assign students to courses upon their intent to register and enroll (Bailey, et al., 2010; Hughes & Scott-Clayton, 2011). While these single-measure, high-stakes tests that dictate which courses students are required to take may be efficient, there is an emerging body of evidence which suggests that single measures of academic ability are not predictive of future success, and could delay students' educational progress (Burdman, 2012; Complete College America, 2012; Hughes & Scott-Clayton, 2011; Scott-Clayton, Crosta, & Belfield, 2014).

Indeed, one recent study found that approximately one-fourth of assessed students are mis-assigned, mainly by being placed into DE courses unnecessarily (Scott-Clayton, Crosta, & Belfield, 2014). Additional research shows that reading and writing placement test scores have no predictive value on students' likelihood of passing the gatekeeper English course (Jenkins, Jaggars, & Roksa, 2009), and once controlling for high school GPA, placement scores were not associated with college GPA (Belfield & Crosta, 2012).

In addition, standardized tests are understood by some researchers to be biased against people of color, African Americans and Latinos in particular. As stated by Ford and Helms (2012), "the notion that tests are colorblind, neutral, and unbiased measures is a fallacy" (p. 187). Previous

research indicates racial, gender, and income-based differences in developmental education enrollment. For example, Attewell, Lavin, Domina, and Levey (2006) found an 11% difference between Black and White students' probability of enrolling in developmental education, even after accounting for high school and demographic background variables. It has also been found that among those needing developmental education, females, Black students, and Hispanic students need more levels of remediation (Bailey, et al. 2010). Put differently, while 55% of White students placed into college-level math, only 14% of Black students and 19% of Hispanic students were placed into college-level math (Bailey, et al. 2010). Similarly, Bettinger and Long (2005) found that in a sample of traditional-aged community college students in Ohio, more than 75% of Black and Latino students were placed into developmental math, as were 62% of women, compared with 55% of White or 54% of male students; similar differences were also found for assignment to developmental English.

Given concerns over the ability of a single high-stakes test to accurately place students into courses and the fact that traditionally underrepresented minority students may be even more disadvantaged by DE and placement tests, many scholars recommend the use of multiple measures or the use of test scores in addition to high school academic factors when determining course placement (Belfield & Crosta, 2012; Ngo, Kwon, Melguizo, Prather, & Bos, n.d.; Scott-Clayton, 2012). Despite these recommendations, there are mixed results on the effectiveness of using multiple measures. For example, just 6% of assessed students were found to benefit from the use of multiple measures, which bumped students into the next highest course (Melguizo, Kosiewicz Prather, & Bos, 2014). Nevertheless, the use of high school transcript data was a better predictor of student success than the use of placement scores. Gordon (1999) claimed a computerized multiple measure placement system resulted in an increase in placement accuracy, and that students placed with this program successfully completed the course into which they were initially placed at higher rates.

There is also some evidence that the use of multiple measures may increase placement into higher-level math courses for African American and Latino students, and students placed into higher-level courses based on multiple measures performed no differently than students who had higher test scores (Ngo & Kwon, 2015). However, previous research indicated that faculty and college administrators had difficulty understanding how each component of the multiple measures system facilitated or hindered student progress and how to appropriately place students into their courses (Melguizo et al., 2014). Thus, despite some challenges to implementation, the use of multiple measures may increase access to college-level courses without negatively affecting passing rates in the more advanced course.

A few states have implemented multiple measures placement policies or limited the use of placement tests. California has been using multiple measures since the conclusion of a civil rights lawsuit in 1991 (Hughes & Scott-Clayton, 2011; Melguizo et al., 2014; Perry, Bahr, Rosin, & Woodward, 2010), and North Carolina has developed a placement strategy that hierarchically includes a combination of high school GPA and test scores (Bracco, Austin, Bugler, & Finkelstein, 2015; Duffy, 2015). Individual colleges in Wisconsin have also used multiple measures placement policies by including non-cognitive factors and/or individualized placement tests with writing components, while a community college in Oregon implemented a self-placement policy based on the use of test scores (Hodara, Jaggars, & Karp, 2012). Still, students

in these states are typically required to take placement tests that are then used as one of several factors determining which courses they will be required to take.

The Florida redesign, however, is a dramatic departure from what has been done with DE in the past: placement tests are no longer required for many students and, as such, students are able to enroll directly in gateway courses regardless of prior academic preparation. The new law has already changed both DE programs and practices across the FCS institutions (Hu, Woods, et al., 2015; Park, Tandberg, Hu, & Hankerson, in press) and student course choices (Park, Woods, et al., in press). While this new policy could potentially improve student postsecondary progression and success, there is some concern that underprepared students, and particularly traditionally underrepresented minority students, may opt to skip DE and enroll directly in gateway courses where they will not be successful, but perhaps could have been had they first taken a DE course.

Research Questions

With the recent changes in Florida affording students the ability to bypass DE and the mixed results around whether flexible placement and DE more generally may harm students' likelihood of success, particularly for traditionally underrepresented students, we ask:

1. What is the pattern of student enrollment in developmental education over time (pre- and post-implementation of SB 1720) and by subject area for different types of students? (RQ1)

2. How are students' demographic characteristics, high school academic preparation, college program of study/degree intention and financial need related to the likelihood of enrolling in developmental education both before and after the implementation of SB 1720? (RQ2)

3. Among students who enroll in developmental education after the implementation of SB 1720, how are students' background characteristics, high school academic preparation, and college program of study/degree intention and financial need related to the likelihood of enrolling in different developmental education options now required by SB 1720? (RQ3)

4. For students in the cohort after the implementation of SB 1720, what is the relationship between the different developmental education options and academic outcomes: persistence from fall to spring in the 2014–15 academic year, developmental education course success, and gateway course success? (RQ4)

5. In comparing the years before and after SB 1720, is there any evidence that SB 1720 is related to student gateway course success? (RQ5)

In this report we addressed each of the research questions stated above in several ways. First, we answer each question with our overall sample of first-time-in-college (FTIC) students in the 2009-10 to 2014-15 cohorts. This sample is described below. Second, we addressed each research question with our exempt and likely-exempt sample. That is, since the legislation only affected certain students, as described above, we focused our analyses on students actually affected by the developmental education reform. Third, for several of the research questions we drew additional

analyses specific to student subgroups. Specifically, we explored differential outcomes by students' race/ethnicity. Fourth, we investigated several outcomes specifically for students most directly affected by the legislation: academically underprepared students in the post-reform period. We organized this report into several separate research studies. In each section we included the sample and methodology specifically used to address the present research question and a discussion of the results. Finally, we discuss directions for future research.

Methodological Overview

In order to address these research questions, we employed a variety of methodological approaches. First, we conducted several descriptive analyses to track relevant student enrollment patterns over time (2009-10 to 2014-15) and to document the patterns of student choice of various developmental education options, before and after the introduction of the developmental education reform in 2014. Second, we examined the factors related to student choice of different developmental education options. Third, we evaluated how student choice of different developmental education options is related to their educational progression. Finally, we examined whether the new developmental education reform is related to student success in Florida.

In the sections that follow we describe our data and variables, present more detailed results from our analyses for each research question and, where appropriate, more details regarding our statistical models. We conclude by offering a summary and outlining the next stages for our project.

2009-2014 Analytic Sample Construction

Our data from the Florida K-20 Data Warehouse consist of cohorts of FTIC students who initially enrolled in the FCS in fall semesters from 2009-2014. We began with 74,717 students for fall 2009, 71,530 students for fall 2010, 72,527 students for fall 2011, 68,438 students for fall 2012, 68,440 students for fall 2013, and 68,315 students for fall 2014.

Our primary sample for the analyses is limited to students for whom we have complete background and high school preparation variables (see Table 1). The sample size for each cohort is as follows: 56,654 in 2009; 54,031 in 2010; 55,289 in 2011; 49,863 in 2012; 53,507 in 2013; 53,733 in 2014. The proportion of each cohort that is White declines over time, whereas the proportion that is Hispanic or eligible for free or reduced-price lunch increases over time. More students over time have Algebra 2 and English honors coursework.

Independent Variables

Our independent variable of interest was a simple indicator for whether a student was in the fall 2014 cohort to reflect the intervention of the developmental education reform. In addition, previous research has shown that educational outcomes are related to student background characteristics and academic preparation (Coleman, Hoffer, & Kilgore, 1982; Hearn, 1988; Kuh et al., 2007; Sewell, Haller, & Ohlendorf, 1970). Thus, we have included variables concerning student background characteristics such as gender, race/ethnicity, and socioeconomic status; and, variables concerning academic preparation such as high school coursework. More specifically, White was used as the reference category for race/ethnicity with dichotomous indicators

representing students from Black, Hispanic, and other racial/ethnic backgrounds. The other race/ethnicity category includes students who are Asian or Pacific Islander, multiracial, another race, or an unknown race/ethnicity. The reference category for gender was male, and we used free/reduced lunch eligibility in high school as a crude estimate of income. High school preparation variables include whether students earned high school credit in the following courses: Algebra 2, trigonometry, another advanced math course, honors English, or Advanced Placement English. Throughout our models, college context is estimated by including college fixed effects. We describe in detail the dependent variables for each research study separately.

Table 1. Overall Analytic Sample Demographics

	2009		2010		2011		2012		2013		2014	
	N	%	N	%	N	%	N	%	N	%	N	%
Background Characteristics												
White	26,508	46.8	23,676	43.8	22,796	41.2	21,014	42.1	21,317	39.8	20,750	38.6
Black	12,433	22.0	12,144	22.5	13,048	23.6	10,794	21.7	12,045	22.5	11,582	21.6
Hispanic	15,146	26.7	15,611	28.9	16,602	30.0	15,277	30.6	17,038	31.8	18,265	34.0
Other race	2,567	4.5	2,600	4.8	2,843	5.1	2,778	5.6	3,107	5.8	3,136	5.8
Female	29,760	52.5	28,258	52.3	28,783	52.1	25,728	51.6	27,533	51.5	28,121	52.3
Free/reduced lunch	19,533	34.5	19,769	36.6	22,183	40.1	20,486	41.1	25,216	47.1	26,914	50.1
High School Variables												
Algebra 2	36,743	64.86	34,869	64.54	38,141	68.98	36,447	73.09	39,037	72.96	40,658	75.67
Trigonometry	3,175	5.6	2,780	5.2	2,747	5.0	2,325	4.7	2,178	4.1	2,621	4.9
Math advanced	8,616	15.2	8,136	15.1	11,623	21.0	11,192	22.5	10,471	19.6	10,500	19.5
English Honors	24,435	43.1	23,330	43.2	25,136	45.5	24,592	49.3	26,564	49.7	27,863	51.9
AP English	5,136	9.1	5,504	10.2	6,354	11.5	6,346	12.7	6,438	12.0	6,358	11.8
N	56,654		54,031		55,289		49,863		53,507		53,733	

Exempt and Likely-Exempt Analytic Sample Construction

In addition, we were interested to see if, in an environment of increased choice, there would be changes in enrollment and passing rates of both developmental and gateway courses. As the legislation gave exempt students the option to exercise additional choice in their course enrollment options, next, we compared only those students who initially began their studies in fall 2014 and were identified as exempt in 2014 to students who initially began their studies in fall semesters from 2009-2013 and who would have likely been exempt had the legislation been implemented earlier. Data provided by the Florida Department of Education from its K-20 Education Data Warehouse (FL-EDW) allows us to make this comparison while controlling for student background characteristics and measures of prior high school academic preparation.

For these analyses, our sample changes slightly, although we begin with the same cohorts of FTIC students who initially enrolled in the FCS in fall semesters from 2009-2014. However, in these analyses we excluded Asian American and Pacific Islander students, as well as students

identified as multiracial or unknown race from the analyses due to the relatively small representation of these groups in our analytic sample.

As discussed above, we sought to compare only those students with the option to bypass DE (the exempt students) in fall 2014 to similar students who would have been exempt in fall semesters of year 2009 to 2013, had the legislation been implemented earlier, based on student high school transcript data.

For students beginning in fall 2009 to 2013, we created flags for "likely" exempt students based upon high school graduation year. For example, for fall 2013, "likely" exempt students are coded as those students who graduated from a Florida public high school in the spring of 2006 or later. The legislation defined exempt status in 2014 as any student who entered 9th grade by 2003-2004 and graduated from a Florida public school. Thus, for the fall 2013 cohort, we assumed on-time graduation from high school and completion of the 9th grade year in 2002-2003, thus arriving at our spring 2006 or later high school graduation as our simulated exempt group. For the fall 2014 cohort, a variable indicating "exempt" status was part of the FCS data—we included data for all students unless they were coded as "exempt-no" in the FCS data. Finally, to control for measures of high school academic preparation we included only those students who had complete high school records. Finally, we excluded students in the "other race" category due to the small number of students in this category and because, in some cases, we disaggregated our results by the three main ethnic/racial groups in Florida: White, Black, and Hispanic students. Thus, our exempt and likely exempt analytic sample consists of 43,821 students for fall 2009, 41,287 students for fall 2010, 42,249 students for fall 2011, 38,703 students for fall 2012, 41,553 students for fall 2013, and 43,530 students for fall 2014. As percentages of the total FTIC cohorts for each year, our analytics samples are roughly 58.6 percent, 57.7 percent, 58.3 percent, 59.7 percent, 60.7 percent and 63.7 percent from fall 2009 to fall 2014, respectively (see Table 2).

Table 2. Descriptive Statistics, by Cohort for Exempt and Likely-Exempt Black, Hispanic, and White Sample

	Fall 2009		Fall 2010		Fall 2011		Fall 2012		Fall 2013		Fall 2014	
	n	%	n	%	n	%	N	%	n	%	n	%
Student Characteristics												
Race/Ethnicity												
Black	9,674	22.1	9,300	22.5	10,003	23.7	8,442	21.8	9,454	22.8	10,023	23.0
Hispanic	12,653	28.9	12,975	31.4	13,849	32.8	13,111	33.9	14,651	35.3	16,080	36.9
White	21,494	49.0	19,012	46.0	18,397	43.5	17,150	44.3	17,448	42.0	17,427	40.0
Female	23,314	53.2	21,879	53.0	22,184	52.5	20,104	51.9	21,467	51.7	22,753	52.3
Free or Reduced Lunch Eligibility	14,902	34.0	14,903	36.1	16,698	39.5	15,902	41.1	19,830	47.7	22,427	51.5
High School Academic Preparation												
Took Algebra 2	32,652	74.5	30,850	74.7	33,589	79.5	32,201	83.2	34,275	82.5	34,521	79.3
Took Trigonometry	2,835	6.5	2,437	5.9	2,378	5.6	2,039	5.3	1,865	4.5	2,172	5.0
Took Other Advanced Math	7,747	17.7	7,279	17.6	10,456	24.7	10,077	26.0	9,275	22.3	8,708	20.0
Earned AP English Credit	4,580	10.5	4,945	12.0	5,649	13.4	5,634	14.6	5,704	13.7	5,178	11.9
Earned Honors English Credit	21,270	48.5	20,180	48.9	21,758	51.5	21,246	54.9	22,881	55.1	23,056	53.0
N	43,821		41,287		42,249		38,703		41,553		43,530	

2014-15 Exempt and Underprepared Analytic Sample

Finally, in some models, we made use of one additional analytic sample that was most directly affected by the legislation: underprepared students in the post-reform period. We focused specifically on math as the gateway math course is linked directly to DE math, as opposed to the gateway English course that is linked to both DE reading and DE writing. These students would have historically been required to take DE, but now have the option to bypass it. Though optional, many students continue to take the PERT in the post-reform period. Prior to the DE reform, the PERT was the common placement tool for all students across the FCS. The PERT ranges from 50-150 and students scoring 50-95 were placed into lower level developmental math, students scoring 96-113 were placed into upper level developmental math, and students scoring 114 or higher were placed in college-level math. Although taking the PERT is now optional for exempt students, many exempt FTIC students in 2014 took the PERT. Specifically, among exempt students in 2014-15, 20,591 had a valid math PERT score. Thus, one way we were able to investigate outcomes was by using actual PERT scores. In doing so, we defined three groups: *severely underprepared* (PERT 50-95; the students who would have been placed the lower level of DE math), *moderately underprepared* (PERT 96-106; the students who would have been placed in the upper level DE, but still far from the cut point) and *slightly under prepared* (PERT 107-113; the students who would have been placed in the upper level DE, and close to the cut point). Of the 20,591 students with a valid math PERT score, 15,303 (74%) had PERT scores below 114 that would have previously placed them into DE math: 5,065 severely underprepared, 6,308 moderately underprepared, and 3,930 slightly underprepared (Table 3).

In addition, White and Black students are inversely, and disproportionally, represented across the preparedness levels. White students comprise 30.6% of severely underprepared students and 42.5% of college-ready students whereas Black students represent 31.8% of underprepared students yet only 16.5% of college-ready students. Hispanic students, however, comprise nearly equal shares of the student population across the bands of preparedness. The largest differences across the bands, however, are noticeable in terms of academic preparation. Nearly all (92.9%) of college-ready students had taken Algebra 2 in high school compared to roughly half (52.3%) of severely under-prepared students. Similar differences, though somewhat smaller in magnitude, can be observed across the other measures of high school academic preparation.

Table 3. Descriptive Statistics by Level of Preparation: 2014 Sample

	Severely Under-prepared (Math PERT 50-95)	Moderately Under-prepared (Math PERT 96-96)	Slightly Under-prepared (Math PERT 107-113)	College-Ready (Math PERT >=114)
Student Background Characteristics (S)				
White	30.6%	38.2%	41.5%	42.5%
Black	31.8%	23.0%	20.2%	16.5%
Hispanic	33.8%	33.8%	32.9%	33.8%
Other Race	3.8%	4.9%	5.5%	7.1%
Free/Reduced Lunch	57.6%	53.6%	51.8%	49.9%
Female	57.5%	53.2%	54.4%	48.9%
High School Academic Preparation (HS)				
Algebra 2	52.3%	70.0%	85.3%	92.9%
Trigonometry	1.0%	2.5%	5.7%	7.0%
Other Advanced Math	4.1%	8.9%	16.3%	30.6%
Honors English	26.2%	43.9%	55.5%	63.3%
AP English	3.2%	7.3%	11.8%	16.3%
N	5,065	6,308	3,930	5,288

Research Question 1:

What is the pattern of student enrollment in developmental education over time (pre- and post-implementation of SB 1720) and by subject area for different types of students?

First, we answer this question with our full 2009-2014 sample. The dependent variables for this question are dichotomous indicators of enrollment in developmental math, reading, or writing.

Enrollment in developmental education remained relatively flat for math between 2009 and 2013, with a sharp decrease in 2014; between 2013 and 2014, math enrollment dropped 19.1 percentage points from 39.3% to 20.2% (Table 4; Figure 1). Developmental reading enrollment had steadily declined between 2009 and 2013, with a sharp drop in 2014. Developmental reading enrollment decreased 12.6 percentage points from 21.1% in 2013 to 8.6% in 2014. Developmental writing enrollment remained steady between 2009 and 2011, with larger decreases beginning in 2012. Between 2013 and 2014, enrollment in developmental writing dropped 6.9 percentage points from 17.4% to 10.5%.

Table 4. Enrollment in Developmental Education in 2009-2014

	2009		2010		2011		2012		2013		2014		Difference Between 2014 and 2013
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean
Math	39.0%	0.488	39.7%	0.489	41.6%	0.493	42.0%	0.494	39.3%	0.488	20.2%	0.401	-19.1
Reading	27.7%	0.448	28.0%	0.449	24.4%	0.429	21.4%	0.410	21.1%	0.408	8.6%	0.280	-12.6
Writing	22.7%	0.419	23.8%	0.426	21.9%	0.414	17.8%	0.382	17.4%	0.379	10.5%	0.306	-6.9

The proportion of students who are White, Black, Hispanic, of another race, female, or eligible for free or reduced lunch and enrolled in developmental math remained relatively stable between 2009 and 2013, with sharp declines in 2014 (Table 5; Figure 2). For example, Hispanic student enrollment ranges between 39.0% and 42.5% between 2009 and 2013, but cuts nearly in half in 2014 to 20.1%. In general, developmental math enrollment for students with higher-level math coursework in high school increased from 2009 to 2012, with small decreases in 2013 and larger decreases in 2014. The same trend holds for students with honors or Advanced Placement English high school coursework.

Student enrollment in developmental reading for each race/ethnicity generally decreases steadily over the 2009-2013 period, with sharper declines in 2014 (Table 5; Figure 3). For females and those eligible for free or reduced-price lunch, enrollment slightly increases until 2013. With small fluctuations, developmental reading enrollment for students with advanced high school coursework remains relatively flat or declines slightly, with sharper declines between 2013 and 2014.

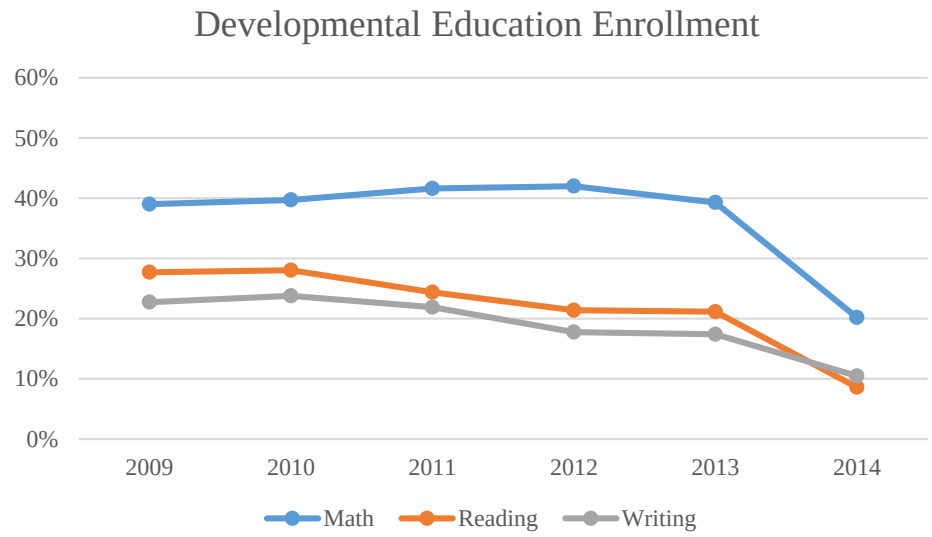

Figure 1. Developmental Education Enrollment Between 2009 and 2014

Development writing enrollment generally declines for students of each race/ethnicity between 2010 and 2014, with large decreases between 2013 and 2014 (Table 5; Figure 4). Again, with small variations, developmental writing enrollment for students with advanced high school coursework remains relatively flat with severe declines between 2013 and 2014.

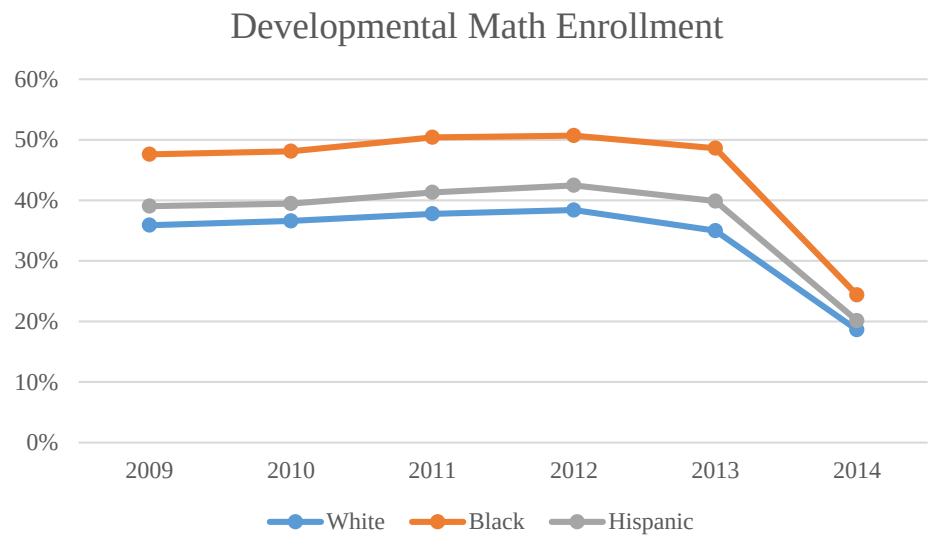

Figure 2. Developmental Math Enrollment Between 2009 and 2014, by Race/Ethnicity

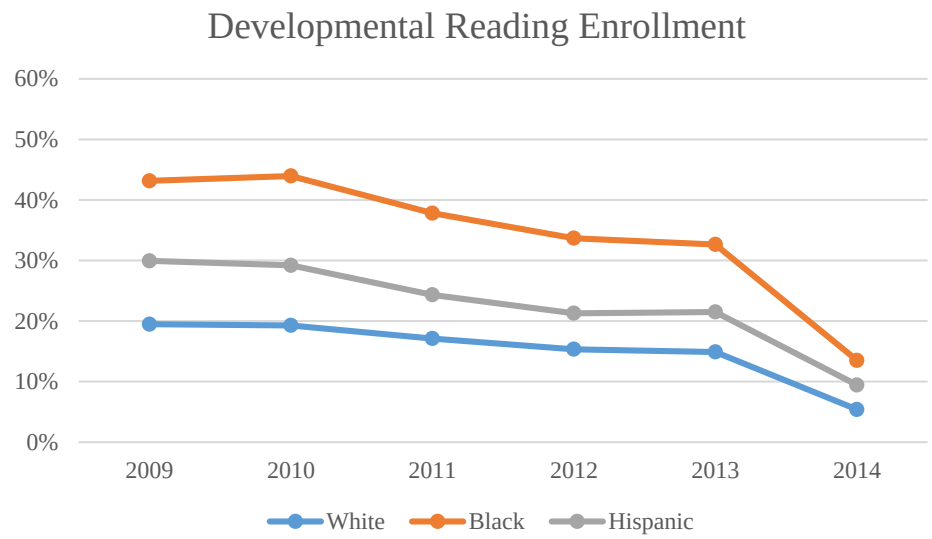

Figure 3. Developmental Reading Enrollment Between 2009 and 2014, by Race/Ethnicity

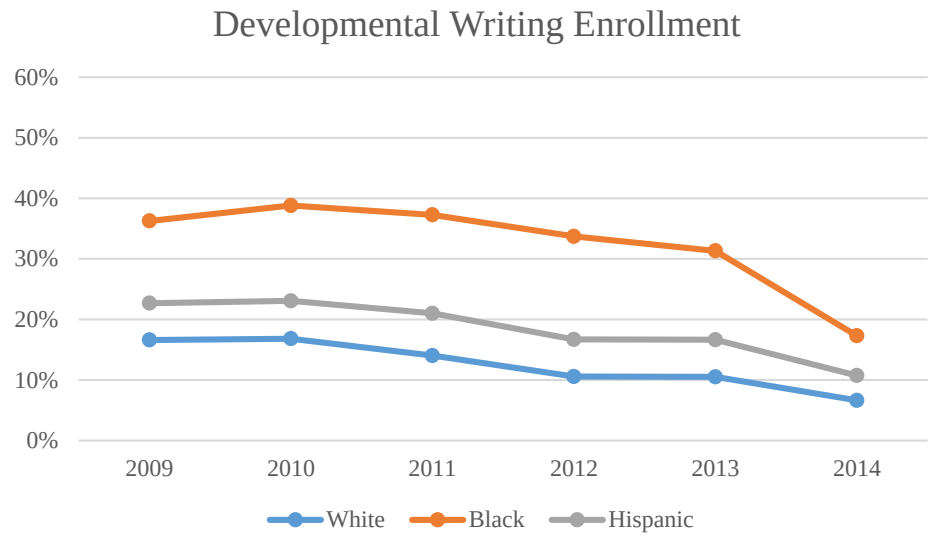

Figure 4. Developmental Writing Enrollment Between 2009 and 2014, by Race/Ethnicity

Developmental course enrollment and passing rates are similar in the exempt and likely-exempt sample (see Table 6). Enrollment in developmental math for exempt and likely-exempt students increased from 37.6% in 2009 to 40.4% in 2012, before dipping in 2013, with a substantial drop in enrollment in fall 2014 to 18.2%. Enrollment in developmental reading for exempt and likely-exempt students tended to decrease from 2009 to 2013 before dropping off in 2014 (27% in 2009 and 7.1% in 2014), and a similar pattern occurred for developmental writing enrollment (22.2% in 2009 and 9.2% in 2014). The proportion of exempt and likely-exempt students that passed developmental math was 65% in 2009 and steadily decreased through 2011, but jumped slightly in 2012, followed by decreases in 2013 and 2014 where it reached its smallest proportion of 57.7%. The proportion of exempt and likely-exempt students that passed developmental reading dipped slightly from 2009 (79.1%) to 2011, and then increased slightly from 2012 to 2013 before dropping to its lowest proportion in 2014 (73.8%). Finally, the same pattern was observed for the proportion of exempt and likely-exempt students that passed developmental writing (75.7% in 2009 and 73.1% in 2014).

Table 5. Enrollment in Developmental Education in 2009-2014 by Student Characteristics

	2009			2010			2011			2012			2013			2014		
	Math	Read	Write	Math	Read	Write	Math	Read	Write	Math	Read	Write	Math	Read	Write	Math	Read	Write
Background Characteristics																		
White	35.9	19.5	16.6	36.6	19.3	16.8	37.8	17.1	14.0	38.4	15.3	10.6	35.0	14.9	10.5	18.6	5.4	6.6
Black	47.4	43.2	36.3	48.1	44.0	38.8	50.4	37.8	37.3	50.7	33.7	33.7	48.6	32.6	31.3	24.4	13.5	17.3
Hispanic	39.0	29.9	22.7	39.5	29.2	23.1	41.3	24.3	21.0	42.5	21.3	16.7	39.9	21.5	16.7	20.1	9.4	10.7
Other race	30.5	24.7	20.7	30.0	26.6	21.4	33.6	21.6	19.6	32.9	20.1	16.1	29.6	17.7	14.9	15.2	6.8	9.1
Female	42.8	30.1	23.0	43.1	30.2	23.8	45.5	25.9	22.6	46.0	22.6	18.6	42.8	22.4	18.3	21.8	8.7	10.8
Free/reduced lunch	43.7	35.9	29.5	44.1	35.9	30.8	46.0	29.7	28.6	46.7	26.3	23.8	43.0	25.6	22.4	22.0	10.8	13.0
High School Variables																		
Algebra 2	31.0	23.1	18.0	32.1	23.2	19.1	34.4	20.6	18.5	36.0	18.3	15.2	32.9	17.8	14.8	15.1	6.4	8.1
Trigono-metry	13.5	11.6	8.9	14.3	13.6	10.2	16.6	10.9	8.9	16.6	11.4	7.9	16.3	11.7	7.9	6.9	3.9	5.2
Advanced Math	14.9	13.3	9.5	15.6	14.6	10.5	21.1	13.5	11.4	21.1	11.4	9.0	14.6	9.9	7.4	5.9	2.6	3.7
English Honors	29.0	15.3	11.3	29.8	16.0	12.0	32.1	14.4	11.7	33.1	13.4	9.7	30.1	12.7	9.2	13.5	3.8	4.8
AP English	19.8	6.6	5.0	21.7	8.1	5.8	23.6	7.5	5.8	23.2	7.2	4.9	19.9	5.7	4.2	8.4	1.5	1.9
N	22,104	15,694	12,879	21,454	15,150	12,847	23,004	13,483	12,106	20,945	10,668	8,859	21,022	11,315	9,313	10,841	4,617	5,627

Table 6. Enrollment and Passing Rate for Exempt and Likely-Exempt Students

	Fall 2009		Fall 2010		Fall 2011		Fall 2012		Fall 2013		Fall 2014	
	n	%	n	%	n	%	n	%	n	%	n	%
Developmental Education												
Took Developmental Math	16,470	37.6	15,807	38.3	16,805	39.8	15,617	40.4	15,482	37.3	7,911	18.2
Took Developmental Reading	11,822	27.0	11,182	27.1	9,652	22.8	7,623	19.7	8,070	19.4	3,082	7.1
Took Developmental Writing	9,706	22.2	9,551	23.1	8,842	20.9	6,520	16.8	6,838	16.5	4,017	9.2
Passed Developmental Math	10,699	65.0	9,891	62.6	9,988	59.4	9,661	61.9	9,223	59.6	4,566	57.7
Passed Developmental Reading	9,351	79.1	8,726	78.0	7,422	76.9	5,930	77.8	6,372	79.0	2,275	73.8
Passed Developmental Writing	7,347	75.7	7,116	74.5	6,500	73.5	4,839	74.2	5,236	76.6	2,936	73.1
Gateway Education												
Took Gateway ENC 1101	20,233	46.2	18,467	44.7	19,657	46.5	19,851	51.3	22,174	53.4	28,097	64.5
Took Gateway MAT 1033	8,277	18.9	7,673	18.6	8,170	19.3	7,388	19.1	9,410	22.6	15,691	36.0
Passed Gateway ENC 1101[A]	15,536	76.8	13,859	75.0	14,584	74.2	14,798	74.5	16,626	75.0	19,643	69.9
Passed Gateway MAT 1033[A]	4,980	60.2	4,598	59.9	5,109	62.5	4,697	63.6	5,890	62.6	7,936	50.6
Passed Gateway ENC 1101[B]	15,536	35.5	13,859	33.6	14,584	34.5	14,798	38.2	16,626	40.0	19,643	45.1
Passed Gateway MAT 1033[B]	4,980	11.4	4,598	11.1	5,109	12.1	4,697	12.1	5,890	14.2	7,936	18.2
N	43,821		41,287		42,249		38,703		41,553		43,530	

Notes: We calculated two types of passing rates: A indicates the gateway passing rates based on the number of students enrolled in the courses, and B indicates the gateway passing rates based on the number of students in the whole cohort.

With the 2014 underprepared sample that focused on math, we took slightly more nuanced approach to understanding enrollment patterns. Using student course-taking records from the FL-EDW, we were able to determine whether students who would have previously been required to take DE math chose to take (1) no math course whatsoever, (2) DE math, (3) gateway math, or (4) both DE and gateway math in the same semester. The students in group (4) can be further disaggregated into two groups: (4a) students who took DE and gateway math concurrently (co-requisite DE), and (4b) students who took DE math as a separate course and then enrolled in gateway math, but did so in the same semester (via compressed courses). Thus, the main difference between these subgroups is that group (4a) had DE math and gateway math concurrently and group (4b) had DE math and gateway math as discrete courses. We coded enrollment in DE math for students enrolled in any non-transfer credit bearing math course designated in the FL-EDW as developmental and we coded enrollment in gateway math for students enrolled in MAT1033: Intermediate Algebra, the state-wide transfer credit bearing math course in Florida. These two codes also allowed us to code group (4): students enrolled in both DE and gateway math. To delineate between groups (4a) and (4b), we made use of start/stop dates of the courses in which students were enrolled and the primary delivery strategy indicators contained in the FL-EDW. Students not enrolling in DE math or gateway math were coded accordingly.

Among the 2014 underprepared sample, 34.9% of underprepared students took DE math, 27.7% took gateway math, and 3.4% took both DE and gateway math, while 34% took no math whatsoever (Figure 5). Table 7 disaggregates these patterns by level of preparedness. The figures in Table 7 suggest that the biggest differences in enrollment patterns across levels are in the share of students enrolling in DE math versus gateway math. Even though DE math is optional, 22.1% of slightly underprepared students enroll solely in DE math, compared to 45.2% of severely underprepared students. At the same time, 15.3% of the most severely underprepared students are enrolling directly in gateway math while 43.0% of slightly underprepared students go directly into gateway math.

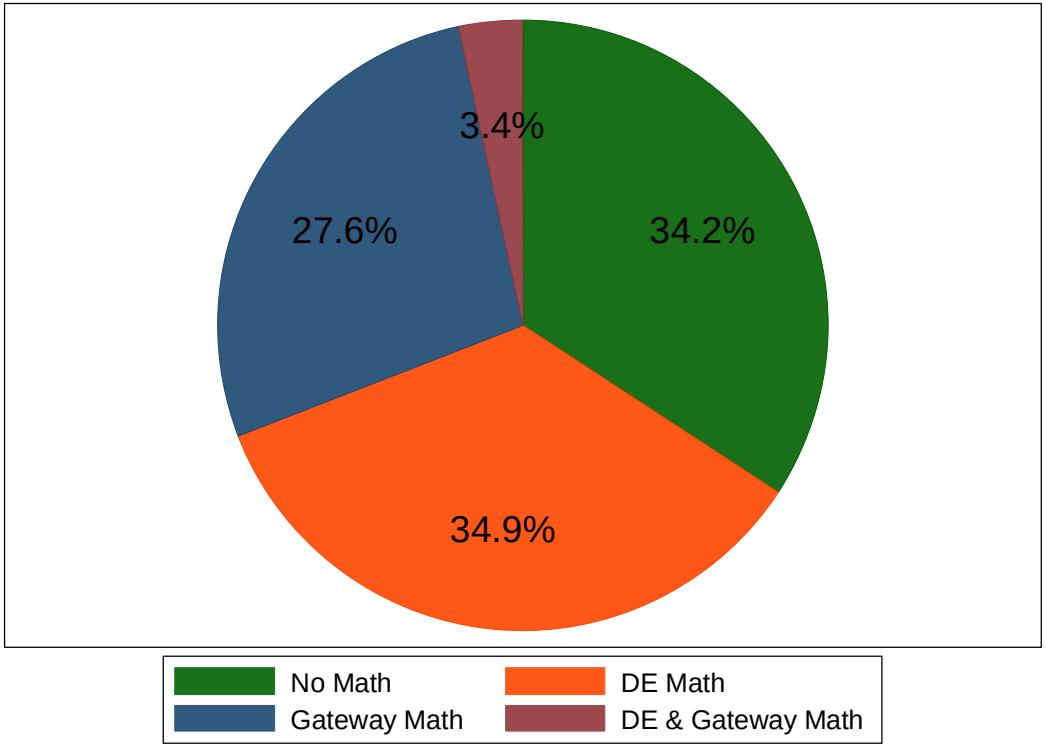

Figure 5. Underprepared Students' Math Enrollment in 2014

Table 7. Enrollment Patterns by Level of Preparation for 2014 Sample

	No Math		DE Math		Gateway Math		DE & Gateway Math		
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Total
Severely Underprepared	1,952	38.50%	2,289	45.20%	773	15.30%	51	1.00%	5,065
Moderately Underprepared	2,096	33.20%	2,180	34.60%	1,775	28.10%	277	4.40%	6,308
Slightly Underprepared	1,187	30.20%	868	22.10%	1,689	43.00%	186	4.70%	3,930
Total	5,235	34.20%	5,337	34.90%	4,237	27.70%	514	3.40%	15,303

Research Question 2:

How are students' demographic characteristics, high school academic preparation, college program of study/degree intention and financial need related to the likelihood of enrolling in developmental education both before and after the implementation of SB 1720?

Because students were no longer required to take developmental education based on their PERT scores, we assessed what student background characteristics and high school preparation variables are related to the likelihood of enrolling in developmental education. We employed the following model:

$$Logit\ (enrolled\ in\ developmental\ education) = \beta_0 + \beta_1(S) + \beta_2(HS) + \beta_3(C)$$

Under this specification, we produced estimates for the vectors *S*, student background characteristics, *HS*, high school preparation variables, and *C*, college context. Student background characteristics include age, race/ethnicity, gender, and free/reduced price lunch eligibility. High school preparation variables include whether the student has earned credit in Algebra 2, trigonometry, another advanced math course, honors English, or Advanced Placement (AP) English. College context is estimated by college fixed-effects. Using this model we first analyzed only students from the pre-reform era (2009-2013) and then only those students from the reform era (2014). In an additional specification to this model, we included all students (2009-2014) and included an indicator for students in the 2014 cohort, comparing students in 2014 to students in the previous cohorts (2009-2013). This indicator captures the difference for students entering a community college in 2014, or the first year of implementation of SB 1720. We also interacted the 2014 cohort indicator with student background and high school preparation variables to determine whether there were differential effects for certain subgroups of students following the implementation of the legislation. Because we specified a logistic regression model, the estimated results ought to be interpreted as odds ratios or the likelihood of something happening. Those statistically significant regression estimates that have values greater than 1.000 indicate increased likelihood. Those estimates with values that are less than 1.000 indicate decreased likelihood.

The first set of analyses includes only students in the pre-reform era (2009-2013). It is evident that compared to White students, Black and Hispanic students are more likely to enroll in developmental math, reading, or writing; students of another race/ethnicity are less likely to enroll in developmental math, but are more likely to enroll in developmental reading or writing, relative to White students (Table 8). Females and those eligible for free or reduced-price lunch have higher odds of enrolling in developmental courses in any subject. Across the board, those with any higher-level math or English coursework in high school have lower odds of enrolling in developmental classes.

Table 8. Predictors of Enrollment in Developmental Math, Reading and Writing for 2009-2013 Cohorts

	Took Dev Math			Took Dev Reading			Took Dev Writing		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
Black	1.511***	1.402***	1.402***	2.662***	2.489***	2.489***	2.985***	2.788***	2.787***
	[0.016]	[0.016]	[0.016]	[0.032]	[0.031]	[0.031]	[0.038]	[0.037]	[0.037]
Hispanic	1.094***	1.161***	1.161***	1.471***	1.532***	1.532***	1.383***	1.427***	1.428***
	[0.011]	[0.012]	[0.012]	[0.017]	[0.019]	[0.019]	[0.018]	[0.019]	[0.019]
Other race	0.763***	0.909***	0.910***	1.290***	1.545***	1.545***	1.321***	1.594***	1.594***
	[0.015]	[0.019]	[0.019]	[0.028]	[0.035]	[0.035]	[0.031]	[0.039]	[0.039]
Female	1.358***	1.489***	1.489***	1.177***	1.333***	1.333***	1.023*	1.157***	1.157***
	[0.011]	[0.013]	[0.013]	[0.011]	[0.013]	[0.013]	[0.010]	[0.012]	[0.012]
Free/reduced lunch	1.207***	1.148***	1.148***	1.273***	1.187***	1.187***	1.378***	1.284***	1.285***
	[0.010]	[0.010]	[0.010]	[0.013]	[0.012]	[0.012]	[0.014]	[0.014]	[0.014]
Algebra 2		0.589***	0.589***		0.799***	0.799***		0.830***	0.830***
		[0.006]	[0.006]		[0.008]	[0.008]		[0.009]	[0.009]
Trigonometry		0.350***	0.350***		0.672***	0.672***		0.623***	0.623***
		[0.009]	[0.009]		[0.019]	[0.019]		[0.020]	[0.020]
Advanced Math		0.370***	0.370***		0.618***	0.618***		0.586***	0.586***
		[0.005]	[0.005]		[0.010]	[0.010]		[0.010]	[0.010]
Honors English		0.744***	0.743***		0.466***	0.466***		0.414***	0.413***
		[0.007]	[0.007]		[0.005]	[0.005]		[0.005]	[0.005]
AP English		0.699***	0.699***		0.387***	0.387***		0.381***	0.381***
		[0.011]	[0.011]		[0.009]	[0.009]		[0.011]	[0.011]
College fixed-effects	no	no	yes	no	no	yes	no	no	yes
Constant	0.477***	0.939***	0.926***	0.184***	0.320***	0.322***	0.149***	0.263***	0.265***
	[0.004]	[0.009]	[0.017]	[0.002]	[0.004]	[0.007]	[0.002]	[0.003]	[0.006]
Ll	-1.79E+05	-1.67E+05	-1.67E+05	-1.45E+05	-1.37E+05	-1.37E+05	-1.32E+05	-1.24E+05	-1.23E+05
chi2	4964.991	29383.5	29407.931	10127.355	27054.005	27078.21	11675.175	28360.144	28391.822
N	269,344	269,344	269,344	269,344	269,344	269,344	269,344	269,344	269,344

Note: * p<0.05, ** p<0.01, *** p<0.001.

The next set of analyses includes only students in the 2014 cohort (Table 9). Compared to White students, Black and Hispanic students are more likely to enroll in developmental math, reading, or writing; students of another race/ethnicity are less likely to enroll in developmental math, but are more likely to enroll in developmental reading or writing, relative to White students. Females and those eligible for free or reduced-price lunch have higher odds of enrolling in developmental courses in any subject. Generally, those with any higher-level math or English coursework in high school have lower odds of enrolling in developmental classes, although the effects of trigonometry do not hold for developmental reading or writing enrollment.

Table 9. Predictors of Enrollment in Developmental Math, Reading and Writing 2014 Cohort

	Took Dev Math			Took Dev Reading			Took Dev Writing		
	M1	M2	M3	M1	M2	M3	M1	M2	M3
Black	1.308***	1.220***	1.218***	2.381***	2.208***	2.211***	2.573***	2.407***	2.408***
	[0.039]	[0.038]	[0.038]	[0.103]	[0.097]	[0.098]	[0.101]	[0.096]	[0.097]
Hispanic	1.038	1.132***	1.131***	1.611***	1.752***	1.753***	1.503***	1.607***	1.606***
	[0.028]	[0.032]	[0.032]	[0.067]	[0.075]	[0.075]	[0.058]	[0.063]	[0.063]
Other race	0.768***	0.871*	0.871*	1.208*	1.410***	1.418***	1.339***	1.558***	1.563***
	[0.041]	[0.048]	[0.048]	[0.094]	[0.112]	[0.113]	[0.091]	[0.109]	[0.110]
Female	1.218***	1.318***	1.318***	0.995	1.111***	1.110**	1.036	1.160***	1.160***
	[0.026]	[0.030]	[0.030]	[0.031]	[0.035]	[0.035]	[0.030]	[0.034]	[0.034]
Free/reduced lunch	1.174***	1.107***	1.108***	1.411***	1.303***	1.302***	1.385***	1.276***	1.277***
	[0.027]	[0.027]	[0.027]	[0.048]	[0.045]	[0.045]	[0.043]	[0.041]	[0.041]
Algebra 2		0.460***	0.459***		0.574***	0.574***		0.637***	0.637***
		[0.011]	[0.011]		[0.020]	[0.020]		[0.020]	[0.020]
Trigonometry		0.426***	0.425***		0.813*	0.814		0.851	0.85
		[0.034]	[0.034]		[0.085]	[0.086]		[0.078]	[0.078]
Advanced Math		0.325***	0.325***		0.495***	0.494***		0.554***	0.555***
		[0.015]	[0.015]		[0.033]	[0.033]		[0.031]	[0.031]
Honors English		0.663***	0.662***		0.381***	0.381***		0.381***	0.380***
		[0.016]	[0.016]		[0.015]	[0.015]		[0.013]	[0.013]
AP English		0.676***	0.676***		0.350***	0.350***		0.334***	0.335***
		[0.034]	[0.034]		[0.038]	[0.038]		[0.032]	[0.032]
College fixed-effects	no	no	yes	no	no	yes	no	no	yes
Constant	0.197***	0.481***	0.475***	0.051***	0.121***	0.120***	0.063***	0.140***	0.147***
	[0.004]	[0.013]	[0.024]	[0.002]	[0.005]	[0.009]	[0.002]	[0.005]	[0.010]
	-	-	-	-	-	-	-	-	-
Ll	2.68E+04	2.48E+04	2.47E+04	1.54E+04	1.42E+04	1.42E+04	1.75E+04	1.63E+04	1.63E+04
chi2	338.381	4517.07	4541.793	751.251	3054.109	3085.206	983.125	3487.162	3513.374
N	53,733	53,733	53,733	53,733	53,733	53,733	53,733	53,733	53,733

Note: * p<0.05, ** p<0.01, *** p<0.001.

The third set of analyses includes students in all cohorts, 2009-2014, with a 2014 year indicator, to determine the effect of enrolling after the implementation of the reform. The full models with institution fixed-effects (models 5 in Table 10) indicate that relative to White students, Black and Hispanic students, as well as students of another race are more likely to take developmental math, reading or writing in the pre-reform period, as are females and those eligible for free or reduced price lunch (i.e. low-income students). Students of another race are less likely than White students to enroll in math, but are more likely to enroll in reading or writing. The 2014 cohort indicator reveals that across the board, students are less likely to enroll in developmental education in 2014, relative to the pooled 2009-2013 cohorts. Similarly, those who have advanced math and English coursework in high school are largely and significantly less likely to enroll in developmental courses of any kind. Interestingly, the effects of the policy (as indicated by the 2014 cohort variable) are less uniform across different student subgroups. For example, whereas Black students in 2014 are less likely to enroll in any developmental course compared to White students, Hispanic students in 2014 are more likely to enroll in reading and writing, compared to

White students. Females, on the other hand, are less likely to enroll in developmental math or reading in 2014, compared to males, but there is no significant relationship for female student enrollment in writing in 2014. Students eligible for free or reduced-price lunch in 2014 have higher odds of taking developmental reading. Students with high school Algebra 2 credit and honors English credit are less likely to take any developmental courses in 2014.

Table 10. Predictors of Enrollment in Developmental Math, Reading and Writing 2009-2014

	Took Dev Math					Took Dev Reading					Took Dev Writing				
	M1	M2	M3	M4	M5	M1	M2	M3	M4	M5	M1	M2	M3	M4	M5
Black	1.486***	1.379***	1.379***	1.401***	1.402***	2.634***	2.463***	2.463***	2.491***	2.489***	2.937***	2.744***	2.744***	2.790***	2.787***
	[0.015]	[0.015]	[0.015]	[0.016]	[0.016]	[0.031]	[0.030]	[0.030]	[0.031]	[0.031]	[0.036]	[0.034]	[0.034]	[0.037]	[0.037]
Hispanic	1.088***	1.158***	1.158***	1.165***	1.161***	1.483***	1.550***	1.550***	1.538***	1.532***	1.397***	1.448***	1.448***	1.433***	1.428***
	[0.010]	[0.011]	[0.011]	[0.012]	[0.012]	[0.017]	[0.018]	[0.018]	[0.019]	[0.019]	[0.017]	[0.018]	[0.018]	[0.019]	[0.019]
Other race	0.764***	0.907***	0.907***	0.913***	0.910***	1.283***	1.535***	1.535***	1.553***	1.545***	1.324***	1.592***	1.593***	1.600***	1.594***
	[0.014]	[0.017]	[0.017]	[0.019]	[0.019]	[0.027]	[0.034]	[0.034]	[0.036]	[0.035]	[0.030]	[0.037]	[0.037]	[0.039]	[0.039]
Female	1.340***	1.468***	1.469***	1.495***	1.489***	1.161***	1.314***	1.314***	1.336***	1.333***	1.024**	1.157***	1.157***	1.159***	1.157***
	[0.010]	[0.012]	[0.012]	[0.013]	[0.013]	[0.010]	[0.012]	[0.012]	[0.013]	[0.013]	[0.009]	[0.011]	[0.011]	[0.012]	[0.012]
Free/red u-ced lunch	1.203***	1.143***	1.143***	1.147***	1.148***	1.284***	1.196***	1.196***	1.186***	1.187***	1.379***	1.284***	1.284***	1.285***	1.285***
	[0.010]	[0.010]	[0.010]	[0.010]	[0.010]	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]	[0.014]	[0.013]	[0.013]	[0.014]	[0.014]
2014 Cohort	0.362***	0.362***	0.362***	0.422***	0.513***	0.269***	0.275***	0.275***	0.295***	0.377***	0.418***	0.436***	0.435***	0.452***	0.534***
	[0.004]	[0.004]	[0.004]	[0.010]	[0.015]	[0.004]	[0.005]	[0.005]	[0.011]	[0.016]	[0.006]	[0.007]	[0.007]	[0.016]	[0.021]
Algebra 2		0.571***	0.571***	0.571***	0.589***		0.778***	0.778***	0.778***	0.799***		0.808***	0.808***	0.808***	0.830***
		[0.005]	[0.005]	[0.005]	[0.006]		[0.008]	[0.008]	[0.008]	[0.008]		[0.008]	[0.008]	[0.008]	[0.009]
Trigono-metry		0.358***	0.358***	0.358***	0.350***		0.682***	0.682***	0.682***	0.672***		0.644***	0.644***	0.644***	0.623***
		[0.009]	[0.009]	[0.009]	[0.009]		[0.019]	[0.019]	[0.019]	[0.019]		[0.020]	[0.020]	[0.020]	[0.020]
Advanced Math		0.368***	0.368***	0.367***	0.370***		0.612***	0.612***	0.612***	0.618***		0.585***	0.585***	0.585***	0.586***
		[0.005]	[0.005]	[0.005]	[0.005]		[0.009]	[0.009]	[0.009]	[0.010]		[0.010]	[0.010]	[0.010]	[0.010]
Honors English		0.734***	0.733***	0.733***	0.743***		0.459***	0.459***	0.459***	0.466***		0.410***	0.410***	0.410***	0.414***
		[0.006]	[0.006]	[0.006]	[0.007]		[0.005]	[0.005]	[0.005]	[0.005]		[0.005]	[0.005]	[0.005]	[0.005]
AP English		0.698***	0.698***	0.698***	0.699***		0.387***	0.387***	0.387***	0.387***		0.378***	0.378***	0.378***	0.381***
		[0.011]	[0.011]	[0.011]	[0.011]		[0.009]	[0.009]	[0.009]	[0.009]		[0.010]	[0.010]	[0.010]	[0.011]
Black* 2014				0.875***	0.869***				0.888**	0.887**				0.858***	0.863***
				[0.028]	[0.029]				[0.040]	[0.041]				[0.036]	[0.036]
Hispanic * 2014				0.944	0.975				1.085	1.144**				1.083	1.125**
				[0.028]	[0.029]				[0.048]	[0.051]				[0.045]	[0.047]
Other* 2014				0.939	0.958				0.874	0.912				0.953	0.978
				[0.055]	[0.056]				[0.072]	[0.075]				[0.070]	[0.073]
Female* 2014				0.863***	0.885***				0.814***	0.833***				0.988	1.003
				[0.021]	[0.021]				[0.027]	[0.028]				[0.030]	[0.031]
F/R Lunch* 2014				0.971	0.965				1.103**	1.098**				0.993	0.993
				[0.025]	[0.025]				[0.039]	[0.040]				[0.033]	[0.033]
Algebra 2 * 2014					0.780***					0.719***					0.767***
					[0.021]					[0.026]					[0.026]

Trigono-metry* 2014					1.216*					1.210					1.366**
					[0.101]					[0.132]					[0.134]
Adv. Math* 2014					0.878**					0.801**					0.945
					[0.041]					[0.055]					[0.056]
Hon. Eng* 2014					0.892***					0.819***					0.920*
					[0.024]					[0.033]					[0.034]
AP Eng* 2014					0.968					0.904					0.876
					[0.051]					[0.100]					[0.087]
College fixed-effects	no	no	yes	yes	yes	no	no	yes	yes	yes	no	no	yes	yes	yes
Constant	0.484***	0.978*	0.964*	0.948**	0.926***	0.184***	0.328***	0.330***	0.328***	0.322***	0.149***	0.268***	0.271***	0.270***	0.266***
	[0.004]	[0.009]	[0.017]	[0.017]	[0.016]	[0.002]	[0.004]	[0.007]	[0.007]	[0.007]	[0.001]	[0.003]	[0.006]	[0.006]	[0.006]
chi2	13644.32	42056.99	42086.16	42149.65	42324.69	18762.49	37794.46	37816.69	37892.04	38078.03	16091.76	35183.94	35214.43	35255.20	35352.80
N	323077	323077	323077	323077	323077	323077	323077	323077	323077	323077	323077	323077	323077	323077	323077

Note: * p<0.05, ** p<0.01, *** p<0.001.

Next, we addressed this research question with our Exempt and Likely-Exempt sample. We also included developmental education course passing rates, and we disaggregated these findings by race/ethnicity. We used the following model to estimate differential effects for Black and Hispanic students, relative to White students, before and after the reform:

$$\text{logit}(y_{ijt}) = \alpha + \beta(2014_t) + \theta(S_{ijt}) + \gamma(HS_{ijt}) + \varphi(2014_t * Black_{ijt}) + \zeta(2014_t * Hispanic_{ijt}) + \delta j$$

Under this specification, *Black* and *Hispanic* are dichotomous indicators for student race/ethnicity. We interact these indicators with the 2014 indicator to determine whether the implementation of the DE policy had a differential effect for Black or Hispanic students. We did not include students in the "other" race category, effectively only including White, Black, and Hispanic students in this analysis. Thus, the estimates for φ and ζ are difference-in-differneces estimates that will indicate whether course enrollment and passing rates changed for Black or Hispanic students in ways that were different for White students.

In order to generate visuals showing the trends in DE and gateway course enrollment and passing rates, we add additional interactions, one for each year, to allow the trend lines to vary across each time period. Thus, the graphs presented show the predicted probability of enrolling or passing a DE or gateway course in each year.

Developmental Education Course Enrollment Rates. Once it became optional, the likelihood of enrolling in developmental education declined across all three subject areas. Specifically, the likelihood of enrolling in DE mathematics, reading, and writing all decreased in 2014: 21.0 percentage points for mathematics, 16.6 percentage points for reading, and 11.1 percentage points for writing (Figure 6; Table 11).

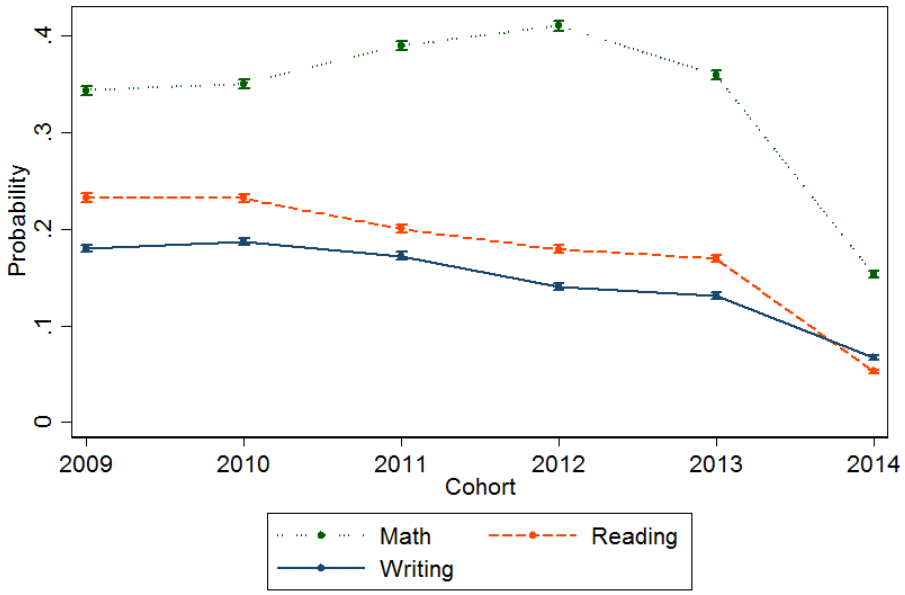

Figure 6. Overall Developmental Education Enrollment, by Subject

Table 11. Predicted Probabilities of Developmental Education Enrollment Rates

	2009-2013	2014	Difference
Mathematics	38.80%	17.80%	-21.00***
Reading	23.40%	6.80%	-16.60***
Writing	20.10%	8.90%	-11.20***

Notes: Predicted probabilities are based on models that include the full array of student characteristics and high school academic preparation.

*p<.05, **p<0.01, ***p<0.001.

Developmental Education Course Passing Rates. Passing rates for developmental courses also declined slightly following the reform, though in much smaller magnitudes than enrollment rates. Among students enrolled in developmental courses, the likelihood of successfully passing DE decreased slightly for mathematics (2.8 percentage points), reading (3.2 percentage points) and writing (1.5 percentage points; Figure 7 & Table 12).

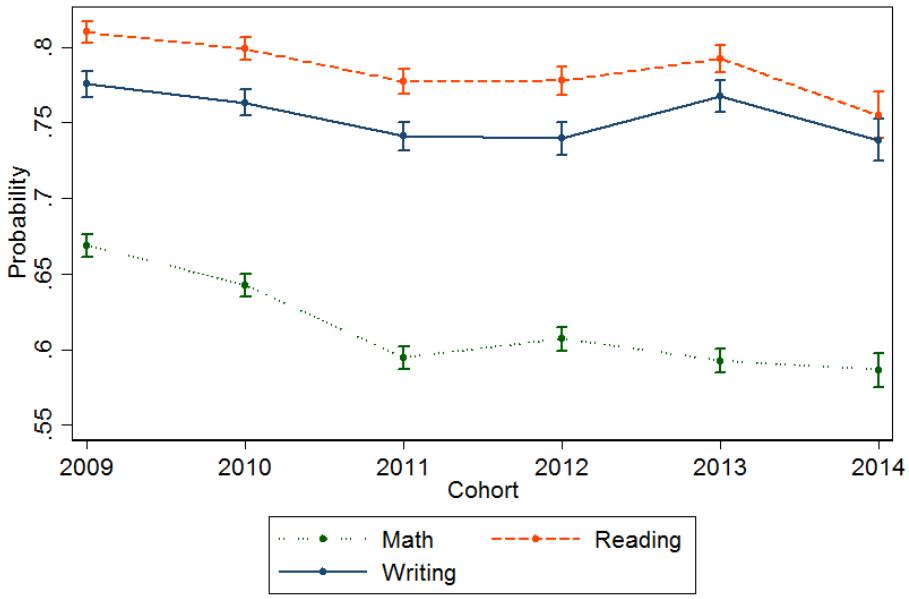

Figure 7. Overall Developmental Education Passing Rates, by Subject

Table 12. *Predicted Probabilities of Developmental Education Passing Rates*

	2009-2013	2014	Difference
Mathematics	61.60%	58.70%	-2.80***
Reading	78.10%	74.90%	-3.20***
Writing	74.80%	73.30%	-1.50***

Notes: *p<0.05, **p<0.01, ***p<0.001. Predicted probabilities are based on models that include the full array of student characteristics and high school academic preparation.

Developmental Education Enrollment by Race/Ethnicity. The most substantial decreases in DE enrollment were for Black students when comparing likely exempt students from previous cohorts to exempt students in the 2014 cohort. The DE math enrollment rate for Black students decreased by 27.0 percentage points, while for similarly prepared White students, enrollment decreased by 18.9 percentage points. In 2014, DE math enrollment for Hispanic students decreased by 21.6 percentage points (Figure 8 & Table 13). Although the decreases were not as substantial as in DE math enrollment, all student subgroups had significant decreases in DE reading enrollment in 2014. When evaluating students by race/ethnicity, Black students decreased the most (22.9 percentage points), followed by Hispanic students (14.8 percentages points), and White students (11.8 percentage points). In terms of DE writing enrollment, the most notable decreases were among Black students in the fall 2014 FTIC cohort, whose rate decreased by 17.7 percentage points compared to the average fall 2009 to 2013 FTIC cohorts. Further, by using marginal effects we can statistically determine whether the declines in DE enrollment rates were different for Black, Hispanic, and White students. More specifically, the decline in DE math was 8.05 and 2.61 percentage points greater for Black and Hispanic students (respectively) than it was for similarly prepared White students. Similar differences exist for DE reading and writing enrollments as well.

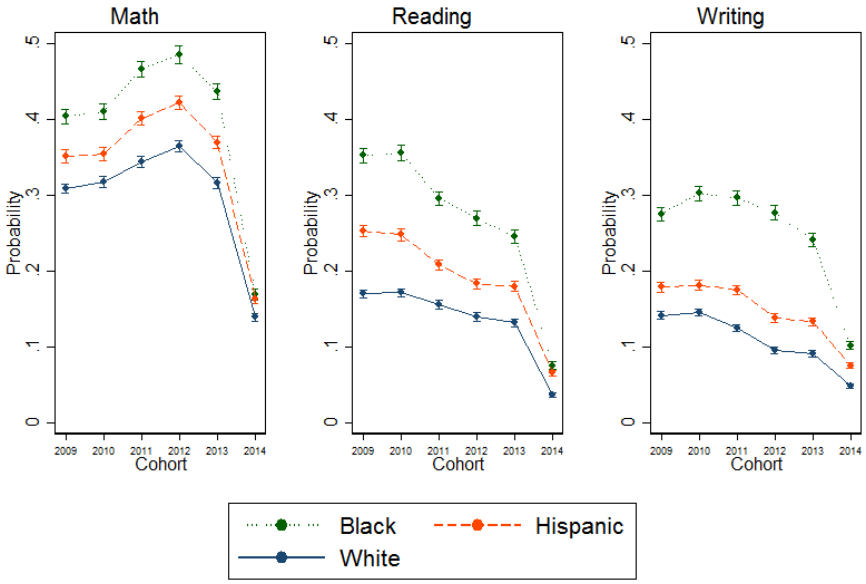

Figure 8. Developmental Education Enrollment Rates, by Subject and Race/Ethnicity

Table 13. Development Education Enrollment Rates

	Mathematics				Reading				Writing			
	2009-2013	2014	Diff		2009-2013	2014	Diff		2009-2013	2014	Diff	
Predicted Probabilities												
Black	43.91%	16.93%	-26.99	***	30.46%	7.58%	-22.88	***	27.88%	10.23%	-17.66	***
Hispanic	37.92%	16.36%	-21.55	***	21.40%	6.61%	-14.79	***	16.13%	7.58%	-8.55	***
White	32.91%	13.97%	-18.94	***	15.40%	3.62%	-11.78	***	12.09%	4.78%	-7.31	***
Marginal Effects												
Black vs White			-8.05	***			-11.1	***			-10.35	***
Hispanic vs White			-2.61	***			-3.01	***			-1.2	***

Notes: * p<0.05, ** p<0.01, *** p<0.001. Marginal effects indicate the changes in enrollment rates for Black (and Hispanic) students relative to White students.

Developmental Education Passing Rates by Race/Ethnicity. Statistically significant changes in DE math course passing were only found among White students when comparing the average of five cohorts from fall 2009 to 2013 to the fall 2014 cohort. White students' DE math passing rates decreased by 9.3 percentage points (Figure 9 & Table 14). In terms of DE reading course success between the previous five fall cohorts and the fall 2014 cohort, there were significant decreases for all groups: Hispanic students (2.6 percentage points), White students (6.3 percentage points,) and Black students (2.8 percentage points). When comparing the average of fall 2009 to 2013 cohorts with the fall 2014 FTIC cohort, the rates of DE writing success decreased for Black students (2.36 percentage points) and White students (5.6 percentage points).

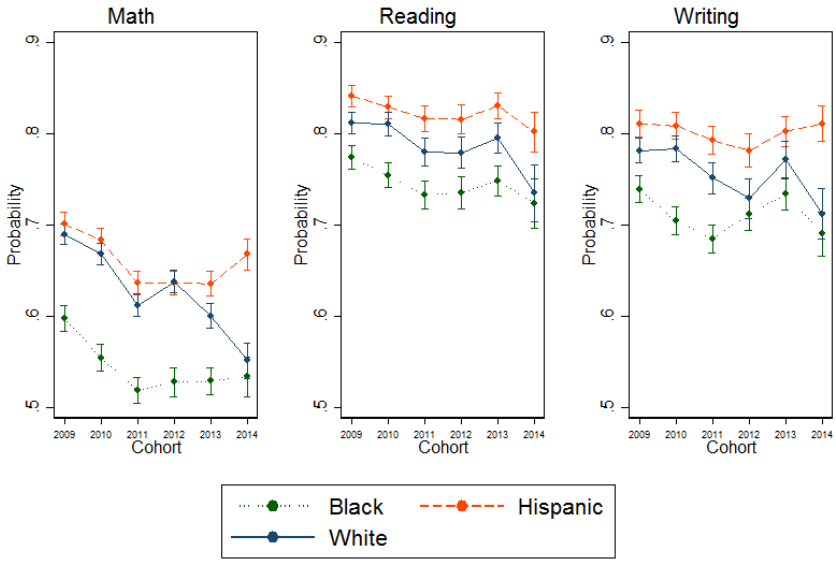

Figure 9. Developmental Education Passing Rates, by Subject and Race/Ethnicity

Table 14. Development Education Passing Rate

	Mathematics				Reading				Writing			
	2009-2013	2014	Diff		2009-2013	2014	Diff		2009-2013	2014	Diff	
Predicted Probabilities												
Black	54.63%	53.44%	-1.18		75.08%	72.31%	-2.77	*	71.37%	69.02%	-2.36	+
Hispanic	65.79%	66.84%	1.06		82.74%	80.17%	-2.57	*	80.02%	81.07%	1.06	
White	64.31%	54.99%	-9.32	***	79.73%	73.39%	-6.34	***	76.72%	71.16%	-5.56	***
Marginal Effects												
Black vs White			8.14	***			3.56%	+			3.20%	
Hispanic vs White			10.37	***			3.76%	+			6.62%	***

Note: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001.

Finally, for the 2014 underprepared sample, we simultaneous modeled enrollment in DE math courses alongside enrollment in gateway math, and simultaneous enrollment in DE and gateway math courses, with enrollment in no math course as the base group, using a multinomial logistic regression model. For ease of interpretation, we provide predicted probabilities and their associated 95% confidence intervals. Table 15 provides predicted probabilities of enrolling in the different pathways, disaggregated by level of preparedness. It is possible to identify statistically significant differences by identifying instances where confidence intervals do not overlap. For instance, slightly underprepared students are both more likely to enroll in gateway math courses in general and are more likely to do so compared to severely and moderately underprepared students. Further, while severely underprepared students are the most likely to enroll in DE math, they are also more likely than moderately and slightly underprepared students to enroll in no math whatsoever. Finally, enrolling in both DE and gateway math in the same semester is the least likely option across all ability levels, with severely underprepared students being the least likely of all to pursue this pathway.

Table 15. Predicted Probabilities of Enrollment Patterns for Underprepared Students

	No Math			DE Math			Gateway Math			DE & Gateway Math		
	Low	Est.	High	Low	Est.	High	Low	Est.	High	Low	Est.	High
Severely Underprepared	37.8%	39.2%	40.5%	44.3%	45.7%	47.1%	13.4%	14.3%	15.3%	0.6%	0.8%	1.1%
Moderately Underprepared	32.8%	34.0%	35.2%	33.8%	35.0%	36.2%	26.1%	27.3%	28.3%	3.3%	3.8%	4.3%
Slightly Underprepared	29.3%	30.7%	32.2%	20.7%	22.0%	23.3%	41.5%	43.1%	44.7%	3.5%	4.2%	4.8%

Research Question 3:

Among students who enroll in developmental education after the implementation of SB 1720, how are students' background characteristics, high school academic preparation, and college program of study/degree intention and financial need related to the likelihood of enrolling in different developmental education options now required by SB 1720?

Here, we assess how students' background characteristics, high school factors, and college factors predict choice of developmental education course type, among students who decide to enroll in developmental education programs. We model students' choice of developmental education course type, for each of the three subject areas, using the following model:

$$Mlogit\ (MOD, COMP, CONT, COREQ) = \beta_0 + \beta_1(S) + \beta_2(HS) + \beta_3(C)$$

The estimates are specific to enrolling into one of the four remedial education options offered under the new Florida law: modularized courses (MOD), compressed courses (COMP), contextualized courses (CONT), and co-requisite courses (COREQ). We considered co-requisite courses as the reference category in these models. Multinomial logistic regression allows us to identify variables that predict different developmental education choices. This is important for future policy that seeks to understand why students are making their developmental education course selections, and to potentially adapt program requirements and advising strategies throughout the state accordingly.

Using the overall sample for 2014 only (since this was the first year that instructional modality was guided by the legislation), descriptive statistics reveal that compressed and modularized developmental instruction were the most common modality across math, reading and writing courses, in terms of the number of students enrolled (Table 16). More than 51% of developmental math students enrolled in compressed math courses, and another 34.5% enrolled in modularized math. 71.6% of developmental reading students enrolled in compressed reading and 19.6% enrolled in modularized courses. Over three-quarters of the students enrolled in developmental writing took a compressed course, and 14.0% took a modularized writing course.

Table 16. Developmental Education Enrollment by Instructional Modality for 2014 Cohort

	Took Math		Took Reading		Took Writing		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Compressed	5,538	51.1	3,297	71.6	4,269	76.0	13,104	62.2
Contextualized	943	8.7	163	3.5	477	8.5	1,583	7.5
Co-requisite	614	5.7	281	6.1	85	1.5	980	4.7
Modularized	3,735	34.5	864	18.8	789	14.0	5,388	25.6
Total	10,830	100.0	4,605	100.0	5,620	100.0	21,055	100.0

Multinomial logistic regression results reveal how student characteristics and high school background variables are related to the type of developmental course in which they enroll. For math, relative to co-requisite courses, Black students are more likely to take compressed and

contextualized courses, whereas Hispanic students are less likely to enroll in these same courses (Table 17). Females are more likely to enroll in modularized math, as are those who are eligible for free/reduced lunch. Students with trigonometry course credit, AP English, or honors English credit from high school have lower odds of enrolling in modularized math, compared to co-requisite math. In other words, students with advanced coursework such as Algebra 2 or honors English coursework are most likely to enroll in co-requisite courses.

Table 17. Predictors of Enrolling in Developmental Math Instructional Modalities

	Developmental Math Strategy								
	Compressed			Contextualized			Modularized		
Black	1.338*	1.389*	1.388*	2.039***	2.134***	2.146***	1.053	1.044	1.044
	[0.170]	[0.179]	[0.179]	[0.297]	[0.314]	[0.316]	[0.138]	[0.138]	[0.139]
Hispanic	0.566***	0.646***	0.644***	0.352***	0.397***	0.395***	0.898	0.937	0.94
	[0.059]	[0.068]	[0.068]	[0.049]	[0.056]	[0.055]	[0.095]	[0.101]	[0.101]
Other race	1.082	1.098	1.081	1.264	1.28	1.254	0.881	0.889	0.872
	[0.244]	[0.249]	[0.246]	[0.333]	[0.339]	[0.333]	[0.207]	[0.210]	[0.207]
Female	0.959	1.051	1.054	0.958	1.03	1.035	1.096	1.207*	1.208*
	[0.082]	[0.092]	[0.092]	[0.101]	[0.110]	[0.111]	[0.096]	[0.108]	[0.108]
Free/reduced lunch	0.981	0.974	0.978	1.086	1.081	1.086	1.253*	1.230*	1.239*
	[0.089]	[0.090]	[0.090]	[0.122]	[0.122]	[0.123]	[0.117]	[0.116]	[0.117]
Algebra 2		0.462***	0.463***		0.489***	0.489***		0.771*	0.771*
		[0.046]	[0.047]		[0.059]	[0.059]		[0.079]	[0.079]
Trigonometry		0.821	0.809		1.579	1.564		0.437**	0.430**
		[0.213]	[0.211]		[0.483]	[0.482]		[0.125]	[0.123]
Advanced Math		1.134	1.128		1.013	1.014		0.778	0.773
		[0.190]	[0.189]		[0.216]	[0.217]		[0.136]	[0.136]
Honors English		0.750**	0.751**		0.776*	0.777*		0.658***	0.657***
		[0.070]	[0.070]		[0.090]	[0.090]		[0.063]	[0.063]
AP English		0.774	0.777		0.973	0.98		0.606**	0.609**
		[0.128]	[0.129]		[0.205]	[0.207]		[0.105]	[0.106]
College fixed-effects	no	no	yes	no	no	Yes	no	no	yes
Constant	10.720***	17.774***	23.186***	1.657***	2.604***	3.727***	5.301***	7.472***	9.131***
	[0.993]	[1.987]	[4.962]	[0.187]	[0.344]	[0.932]	[0.507]	[0.859]	[1.996]
chi2	447.141			695.009			783.35		
N	10830								

Note. * p<0.05, ** p<0.01, *** p<0.001. Reference category is co-requisite.

Black students in developmental reading are less likely to take modularized reading courses, relative to co-requisite reading, and Hispanic students are less likely to enroll in contextualized or modularized reading, relative to co-requisite courses (Table 18). Females have higher odds of taking modularized reading, and low-income students have higher odds of enrolling in modularized or compressed reading. Students with advanced math course credit were less likely to enroll in any other modality, compared to co-requisite courses, but those with honors English, trigonometry, or Algebra 2 credit have lower odds of enrolling in modularized instruction, as compared to co-requisite developmental reading. Further, those with trigonometry or honors English credit have lower odds of taking compressed reading.

Table 18. Predictors of Enrolling in Developmental Reading Instructional Modalities

	Developmental Reading Strategy								
	Compressed			Contextualized			Modularized		
Black	1.471*	1.402	1.394	1.045	1.008	1.014	0.429***	0.414***	0.408***
	[0.272]	[0.261]	[0.261]	[0.276]	[0.267]	[0.270]	[0.085]	[0.083]	[0.082]
Hispanic	0.938	0.926	0.928	0.356***	0.369***	0.370***	0.265***	0.281***	0.279***
	[0.158]	[0.160]	[0.161]	[0.098]	[0.103]	[0.104]	[0.049]	[0.053]	[0.053]
Other race	0.807	0.844	0.855	0.399	0.419	0.428	0.321***	0.351**	0.353**
	[0.229]	[0.243]	[0.248]	[0.203]	[0.215]	[0.221]	[0.103]	[0.114]	[0.116]
Female	1.093	1.182	1.151	1.324	1.437	1.419	1.254	1.372*	1.349*
	[0.136]	[0.150]	[0.147]	[0.264]	[0.289]	[0.287]	[0.174]	[0.193]	[0.191]
Free/reduced lunch	1.496**	1.488**	1.491**	1.317	1.318	1.293	1.545**	1.538**	1.548**
	[0.198]	[0.199]	[0.200]	[0.279]	[0.280]	[0.276]	[0.228]	[0.230]	[0.232]
Algebra 2		0.987	0.99		0.761	0.766		0.722*	0.714*
		[0.137]	[0.138]		[0.165]	[0.166]		[0.111]	[0.110]
Trigonometry		0.477*	0.468*		0.497	0.472		0.407*	0.403*
		[0.141]	[0.140]		[0.327]	[0.312]		[0.161]	[0.160]
Advanced Math		2.156*	2.132*		3.055*	3.041*		2.285*	2.272*
		[0.679]	[0.677]		[1.355]	[1.358]		[0.791]	[0.793]
Honors English		0.491***	0.497***		0.486**	0.490**		0.450***	0.451***
		[0.069]	[0.070]		[0.118]	[0.119]		[0.073]	[0.073]
AP English		0.604	0.617		0.792	0.809		0.683	0.721
		[0.207]	[0.217]		[0.488]	[0.508]		[0.283]	[0.304]
College fixed-effects	no	no	yes	no	no	yes	no	no	yes
Constant	8.118***	9.922***	9.382***	0.626*	0.834	1.229	4.549***	6.410***	7.655***
	[1.225]	[1.659]	[2.754]	[0.143]	[0.207]	[0.517]	[0.726]	[1.136]	[2.430]
chi2	261.493			330.384			394.991		
N	4605								

Note: * p<0.05, ** p<0.01, *** p<0.001. Reference category is co-requisite.

Black students have higher odds of taking compressed or contextualized writing courses as compared to co-requisite writing (Table 19). Hispanic students are more likely to enroll in compressed and modularized writing. Those with Algebra 2 credit have lower odds of enrolling in modularized writing, relative to co-requisite writing courses.

Table 19. Predictors of Enrolling in Developmental Writing Instructional Modalities

	Developmental Writing Strategy								
	Compressed			Contextualized			Modularized		
Black	2.584***	2.593***	2.553***	2.005*	2.044*	2.009*	0.939	0.968	0.945
	[0.707]	[0.711]	[0.702]	[0.586]	[0.598]	[0.590]	[0.269]	[0.277]	[0.272]
Hispanic	5.092***	5.171***	5.105***	1.641	1.697	1.656	2.074*	2.289*	2.243*
	[1.703]	[1.743]	[1.725]	[0.588]	[0.613]	[0.600]	[0.713]	[0.794]	[0.779]
Other race	1.04	1.036	1.019	0.421	0.422	0.424	0.494	0.525	0.522
	[0.395]	[0.395]	[0.391]	[0.192]	[0.193]	[0.195]	[0.203]	[0.217]	[0.217]
Female	0.761	0.767	0.744	0.733	0.717	0.696	0.843	0.849	0.826

	[0.171]	[0.173]	[0.169]	[0.176]	[0.173]	[0.169]	[0.197]	[0.199]	[0.195]
Free/reduced lunch	1.136	1.134	1.127	1.134	1.167	1.159	1.464	1.493	1.496
	[0.265]	[0.266]	[0.266]	[0.285]	[0.295]	[0.294]	[0.357]	[0.366]	[0.368]
Algebra 2		0.902	0.933		0.738	0.756		0.597*	0.610*
		[0.214]	[0.222]		[0.188]	[0.193]		[0.147]	[0.151]
Trigonometry		1.006	1.032		1.811	1.832		1.422	1.467
		[0.740]	[0.764]		[1.390]	[1.415]		[1.082]	[1.123]
Advanced Math		1.315	1.266		1.336	1.305		0.883	0.864
		[0.633]	[0.615]		[0.684]	[0.672]		[0.451]	[0.444]
Honors English		0.901	0.915		1.253	1.28		1.017	1.027
		[0.240]	[0.245]		[0.356]	[0.366]		[0.282]	[0.287]
AP English		0.955	0.947		1.527	1.494		0.735	0.721
		[0.715]	[0.713]		[1.192]	[1.175]		[0.589]	[0.581]
College-fixed effects	no	no	yes	no	no	yes	no	no	yes
Constant	25.874***	27.514***	26.890***	4.677***	4.893***	4.547**	7.522***	9.432***	8.387***
	[5.819]	[7.020]	[12.885]	[1.134]	[1.343]	[2.349]	[1.763]	[2.497]	[4.192]
chi2	217.623				272.696		338.424		
N	5,620								

Note: * p<0.05, ** p<0.01, *** p<0.001. Reference category is co-requisite.

In order to investigate math course enrollment patterns for underprepared students, we disaggregated by levels of preparation. For these analyses, we did not differentiate between groups (4a) and (4b). We made use of a series of single-factor ordered logistic regression models that regressed the levels of preparation (severely, moderately, and slightly) on our measures of student background characteristics and high school course taking indicators. We did this in order to explore whether there were differences in the composition of students identified as severely, moderately, and slightly underprepared; we present these findings as odds ratios with values greater than one being associated with being classified into higher levels of preparation. Then, to inferentially examine the relationship between levels of preparation and enrollment patterns, we conducted a standard multinomial logistic regression specified as:

$$Mlogit\ (DE,\ No\ math,\ Gateway,\ DE\ \&\ Gateway) = \beta_1(moderately) + \beta_2(slightly) + \beta_3(S) + \beta_4(HS)$$

Under this specification, *moderate* and *slightly* are dichotomous indictors (*severely* is the reference group), and *S* and *HS* are vectors of student demographic information and high school course taking indicators. We present our results as relative risk ratios and predicted probabilities of enrollment in the various pathways disaggregated by level of preparation (all other variables set to the within-group mean), with taking developmental education math as the reference category. We also present the 95% confidence intervals for the predicted probabilities. Significant differences across levels of preparation can thus easily be identified if, for instance, the predicted probability for *slightly* underprepared falls outside the confidence interval for *severely* underprepared. The multinomial logistic regression model allowed us to estimate several equations simultaneously and provide estimates of the relationship between levels of student preparation and math course taking patterns. Put differently, this model allowed us to determine whether students in the *moderate* and *slightly* underprepared categories are any more

or less likely to enroll in the four enrollment pathways compared to students in the *severely* underprepared category, after accounting for student demographics and other measures of high school academic preparation.

Table 20 presents the relative risk ratios (the multinomial version of an odds-ratio) from our multinomial logistic regression analysis designed to determine how students' preparation is related to math enrollment pathways; enrolling in developmental education is the reference group. Relative risk ratios (rrr) greater than one indicate a positive relationship while those less than one indicate a negative relationship.

Across the board, the indicators for enrollment in gateway math (rrr = 1.890, 3.776) or enrollment in both developmental education and gateway math (rrr = 4.991, 7.625) were positive and statistically significant for moderately and slightly underprepared students, respectively. In other words, severely underprepared students were the group most likely to enroll in developmental education math. Interestingly, slightly underprepared students (our most prepared group) were more likely to enroll in no math at all than the severely underprepared students, compared to enrollment in developmental education math (rrr = 1.454).

With a few notable exemptions, student background characteristics appear to be unrelated to math enrollment pathways. However, Black students were less likely than White students to enroll in gateway math (rrr = 0.835), female students were less likely than males to enroll in gateway math (rrr = 0.902) and less likely than males to enroll in no math (rrr = 0.878), compared to enrollment in developmental education math. Also, low-income students were less likely to enroll in no math than non-low income students, compared to enrollment in developmental education math (rrr = 0.893). In addition, students with stronger high school records were more likely to enroll in gateway math instead of developmental education math, net of all other factors.

Table 20. Multinomial Logistic Regression Relative Risk Ratios

	No Math	Gateway Math	DE & Gateway Math
Level of Preparedness			
Moderately Underprepared	1.067	1.890***	4.991***
	[0.048]	[0.103]	[0.786]
Slightly Under Prepared	1.454***	3.776***	7.625***
	[0.083]	[0.235]	[1.278]
Student Background Characteristics (S)			
Black	0.975	0.835**	1.321
	[0.051]	[0.050]	[0.196]
Hispanic	0.958	0.993	2.632***
	[0.048]	[0.054]	[0.326]
Other Race	1.045	1.138	1.074
	[0.102]	[0.120]	[0.307]
Female	0.878**	0.902*	1.097

	[0.035]	[0.040]	[0.106]
Free/Reduced Lunch	0.893**	0.947	1.097
	[0.038]	[0.044]	[0.113]
High School Academic Preparation (HS)			
Algebra 2	1.058	2.171***	2.332***
	[0.046]	[0.117]	[0.311]
Trigonometry	1.281	1.256	0.274**
	[0.171]	[0.165]	[0.127]
Other Advanced Math	1.210*	1.730***	1.305
	[0.100]	[0.135]	[0.199]
Honors English	1.126**	1.485***	1.460***
	[0.050]	[0.070]	[0.146]
AP English	1.133	1.288**	0.849
	[0.102]	[0.113]	[0.164]
Constant	0.935	0.211***	0.006***
	[0.048]	[0.014]	[0.001]
chi2	1964.289		
N	15303		

Note: * p<0.05, ** p<0.01, *** p<0.001.

A more straightforward way to compare enrollment patterns by preparation across the different pathways was through examining predicted probabilities and their associated 95% confidence intervals. Table 21 provides predicted probabilities of enrolling in the different pathways, disaggregated by level of preparation. It is possible to identify statistically significant differences by identifying instances where confidence intervals do not overlap. For instance, slightly underprepared students were both more likely to enroll in gateway math courses overall as well as compared to severely and moderately underprepared students. Further, while severely underprepared students were the most likely to enroll in developmental education math, they were also more likely than moderately and slightly underprepared students to enroll in no math whatsoever. Finally, enrolling in both developmental education and gateway math in the same semester was the least likely option across all ability levels, with severely underprepared students being the least likely of all to pursue this pathway.

Table 21. Predicted Probabilities of Enrolling in Developmental Math, by Preparation Level

	No Math			DE Math			Gateway Math			DE & Gateway Math		
	Low	Est.	High	Low	Est.	High	Low	Est.	High	Low	Est.	High
Severely Underprepared	37.8%	39.2%	40.5%	44.3%	45.7%	47.1%	13.4%	14.3%	15.3%	0.6%	0.8%	1.1%
Moderately Underprepared	32.8%	34.0%	35.2%	33.8%	35.0%	36.2%	26.1%	27.3%	28.3%	3.3%	3.8%	4.3%
Slightly Underprepared	29.3%	30.7%	32.2%	20.7%	22.0%	23.3%	41.5%	43.1%	44.7%	3.5%	4.2%	4.8%

Research Question 4:

For students in the cohort after the implementation of SB 1720, what is the relationship between the different developmental education options and academic outcomes: persistence from fall to spring in the 2014–15 academic year, developmental education course success, and gateway course success?

In order to answer this research question, we first examined descriptive statistics for our outcome measures for students who took DE courses in fall 2014, disaggregated by subject and the DE instructional modality in which the students were enrolled. Specifically, examined how likely these who enrolled in DE students were to: (1) pass the DE course on their first attempt in fall 2014, (2) take and pass the associated gateway course in the first year (fall 2014 or spring 2015), and (3) persist from fall 2014 to spring 2015. In math, a total of 10,830 students with a complete high school record enrolled in DE math, and 6,555 (60.5%) of these students passed the DE course on their first attempt in fall 2014. By the end of spring 2015, a total of 4,158 of the students who took DE math in fall 2014 students took the MAT 1033, and 2,044 (49.2) passed the gateway course. Finally, of the 10,830 students who took DE math in fall 2014, 8,526 (78.7%) persisted to the spring 2015 semester. We also explored these statistics across the other subjects and disaggregated by DE delivery modality (Table 22). Notable results include a lower likelihood of passing MAT 1033: Intermediate Algebra in the first year for students who took modularized DE math, and a lower DE pass rate for students who took co-requisite writing.

Table 22. Developmental Education Passing Rates, Gateway Course Passing Rates, and Fall to Spring Persistence for 2014 Cohort DE Students

	Fall 2014 DE Courses			Year 1 Gateway Courses			Fall to Spring Persistence		
	Attempted	Passed	%	Attempted	Passed	%	Attempted	Persist	%
Math									
Overall	10,830	6,555	60.5%	4,158	2,044	49.2%	10,830	8,526	78.7%
Compressed	5,538	3,236	58.4%	2,180	1,207	55.4%	5,538	4,280	77.3%
Context.	943	589	62.5%	199	101	50.8%	943	747	79.2%
Co-Requisite	614	389	63.4%	317	178	56.2%	614	498	81.1%
Modularized	3,735	2,341	62.7%	1,462	558	38.2%	3,735	3,001	80.3%
Reading									
Overall	4,605	3,549	77.1%	2,189	1,377	62.9%	4,605	3,626	78.7%
Compressed	3,297	2,535	76.9%	1,547	949	61.3%	3,297	2,599	78.8%
Context.	163	128	78.5%	72	45	62.5%	163	135	82.8%
Co-Requisite	281	197	70.1%	147	113	76.9%	281	203	72.2%
Modularized	864	689	79.7%	423	270	63.8%	864	689	79.7%

Writing									
Overall	5,620	4,230	75.3%	2,940	1,889	64.3%	5,620	4,436	78.9 %
Compressed	4,269	3,222	75.5%	2,248	1,428	63.5%	4,269	3,378	79.1 %
Context.	477	358	75.1%	273	195	71.4%	477	379	79.5 %
Co-Requisite	85	54	63.5%	68	57	83.8%	85	69	81.2 %
Modularized	789	596	75.5%	351	209	59.5%	789	610	77.3 %

Then, to further answer RQ 4, we analyzed how students' background characteristics and high school context predicted developmental education course success, gateway course success, and fall-to-spring retention. Importantly, by including student background information, we were able to assess how assessed how developmental education course type predicted student success net of student characteristics and prior academic preparation. Still, we note that these results should be viewed with caution due to the great variability in the number of students enrolled in certain specific modalities.

We modeled students' developmental education course success, gateway course success, and fall-spring persistence, for each of the three subject areas, using the following model:

$$Logit\ (y) = \beta_0 + \beta_1(S) + \beta_2(HS) + \beta_3(C) + \beta_4(MOD) + \beta_5(COMP) + \beta_6(CONT) + \beta_7(COREQ)$$

In the full model, those in contextualized math have higher odds of passing their developmental math course than those in modularized courses (Table 23). Black students, compared to White students, are less likely to pass, but Hispanics, females, and those with various high school math and English courses had higher odds of passing their developmental course. Regarding gateway success, those in modularized math had lower odds of passing MAT 1033 by the end of the first year. Females had higher odds of passing their gateway math course, but Black students had lower odds of passing MAT 1033. Females, and Black, Hispanic, and students of another race/ethnicity are more likely to persist compared to White students. Students with Algebra 2, honors English, and AP English credit are more likely to persist, compared to students who did not earn those credits in high school.

Students enrolling in either compressed, contextualized, or modularized reading courses are more likely to pass developmental reading, relative to students enrolling in co-requisite reading (Table 24). Females, and students with Algebra 2, advanced math, or AP English credit from high school are also more likely to pass their developmental reading course. Students in compressed reading or modularized reading, relative to co-requisite reading have lower odds of passing ENC 1101 within the first year. Relative to students in co-requisite reading courses, students in any other developmental reading course have higher odds of persisting from fall to spring semester. Hispanic and Black students, as well as females, are more likely to persist. Algebra 2 credit is also positively related to fall to spring persistence.

Students who enrolled in compressed, contextualized, or modularized writing courses had higher odds of passing their developmental writing course, compared to students in co-requisite writing courses (Table 25). Hispanic students and females are more likely to pass developmental writing, as are students who have Algebra 2 or advanced math credit. Conversely, students in compressed, contextualized, or modularized developmental writing courses have lower odds of passing ENC 1101, relative to those in co-requisite developmental writing courses. Females, and students with Algebra 2 and advanced math also have higher odds of passing their gateway English course. Interestingly, the instructional modality of students' developmental writing course is not significantly related to fall-to-spring persistence. However, Black and Hispanic students, as well as females, have higher odds of persisting from fall to spring. Coursework in Algebra 2 and other advanced math are also positively predictive of persisting within the first year.

Table 23. Predictors of Passing Developmental Math, Gateway Math, and Persisting from Fall 2014 to Spring 2014

	Pass Dev Math in Fall 2014				Pass MAT 1033 within the First Year				Fall 2014 to Spring 2014 Persistence			
Compressed	0.809*	0.875	1.016	1.024	0.969	0.995	1.036	1.036	0.792*	0.818	0.933	0.935
Math	[0.071]	[0.078]	[0.092]	[0.093]	[0.117]	[0.121]	[0.127]	[0.127]	[0.086]	[0.089]	[0.103]	[0.103]
Contextualized	0.962	1.121	1.277*	1.286*	0.805	0.822	0.82	0.82	0.888	0.93	1.038	1.037
Math	[0.103]	[0.122]	[0.142]	[0.143]	[0.146]	[0.150]	[0.151]	[0.151]	[0.116]	[0.123]	[0.139]	[0.139]
Modularized	0.971	0.98	1.095	1.104	0.482***	0.484***	0.499***	0.499***	0.952	0.948	1.047	1.05
Math	[0.088]	[0.089]	[0.102]	[0.103]	[0.060]	[0.061]	[0.064]	[0.064]	[0.106]	[0.106]	[0.118]	[0.119]
Black		0.864**	0.822***	0.822***		0.680***	0.652***	0.652***		1.210**	1.175*	1.180**
		[0.046]	[0.044]	[0.044]		[0.062]	[0.060]	[0.060]		[0.076]	[0.075]	[0.075]
Hispanic		1.555***	1.406***	1.408***		0.958	0.929	0.929		1.424***	1.304***	1.305***
		[0.079]	[0.073]	[0.074]		[0.076]	[0.075]	[0.075]		[0.086]	[0.080]	[0.080]
Other race		1.093	1.058	1.06		1.082	1.024	1.024		1.309*	1.281*	1.274*
		[0.109]	[0.107]	[0.108]		[0.174]	[0.166]	[0.166]		[0.159]	[0.157]	[0.156]
Female		1.299***	1.217***	1.213***		1.276***	1.238**	1.238**		1.469***	1.384***	1.380***
		[0.052]	[0.050]	[0.050]		[0.082]	[0.081]	[0.081]		[0.069]	[0.066]	[0.066]
Free/reduced		0.922	0.921	0.922		0.934	0.921	0.921		0.91	0.913	0.912
lunch		[0.039]	[0.040]	[0.040]		[0.064]	[0.063]	[0.063]		[0.046]	[0.047]	[0.047]
Algebra 2			1.708***	1.708***			1.225**	1.225**			1.569***	1.570***
			[0.074]	[0.074]			[0.090]	[0.090]			[0.080]	[0.080]
Trigonometry			1.700**	1.712**			1.883**	1.883**			1.418	1.433
			[0.314]	[0.317]			[0.451]	[0.451]			[0.329]	[0.333]
Advanced Math			1.613***	1.609***			1.581***	1.581***			1.316*	1.313*
			[0.163]	[0.163]			[0.186]	[0.186]			[0.167]	[0.167]
Honors English			1.216***	1.211***			1.019	1.019			1.213***	1.215***
			[0.056]	[0.056]			[0.070]	[0.070]			[0.067]	[0.068]
AP English			1.270*	1.281*			1.055	1.055			1.601**	1.608**
			[0.136]	[0.138]			[0.140]	[0.140]			[0.238]	[0.239]
College fixed-effects	no	no	no	yes	no	no	no	yes	no	no	no	yes
Constant	1.729***	1.323**	0.848	0.874	1.281*	1.249	1.034	1.034	4.293***	3.023***	2.073***	2.043***
	[0.145]	[0.122]	[0.083]	[0.110]	[0.145]	[0.159]	[0.142]	[0.142]	[0.443]	[0.338]	[0.242]	[0.305]
ll	-7256.87	-7167.32	-7004.92	-6990.23	-2825.76	-2805.21	-2785.12	-2785.12	-5597.75	-5548.65	-5462.77	-5447.52
chi2	22.177	201.288	526.082	555.462	111.51	152.609	192.794	192.794	15.021	113.205	284.964	315.475
N	10,830	10,830	10,830	10,830	4,158	4,158	4,158	4,158	10,830	10,830	10,830	10,830

Notes: * p<0.05, ** p<0.01, *** p<0.001. Reference category is co-requisite.

Table 24. Predictors of Passing Developmental Reading, Gateway English, and Persisting from Fall 2014 to Spring 2014

	Pass Dev Reading in Fall 2014				Pass ENC 1101 within the First Year				Fall 2014 to Spring 2014 Persistence			
Compressed	1.419*	1.474**	1.550**	1.550**	0.477***	0.478***	0.477***	0.490***	1.431*	1.433*	1.548**	1.544**
Reading	[0.194]	[0.204]	[0.220]	[0.220]	[0.097]	[0.097]	[0.098]	[0.102]	[0.200]	[0.202]	[0.223]	[0.224]
Contextualized	1.559	1.676*	1.829*	1.829*	0.501*	0.520*	0.546	0.562	1.853*	1.946**	2.174**	2.164**
Reading	[0.360]	[0.392]	[0.436]	[0.436]	[0.157]	[0.163]	[0.173]	[0.179]	[0.457]	[0.484]	[0.547]	[0.547]
Modularized	1.679***	1.760***	1.992***	1.992***	0.531**	0.526**	0.548**	0.568*	1.513**	1.613**	1.840***	1.836***
Reading	[0.261]	[0.279]	[0.324]	[0.324]	[0.117]	[0.117]	[0.123]	[0.128]	[0.239]	[0.258]	[0.301]	[0.302]
Black		0.897	0.869	0.869		0.8	0.789	0.794		1.172	1.156	1.177
		[0.087]	[0.086]	[0.086]		[0.103]	[0.102]	[0.105]		[0.116]	[0.116]	[0.118]
Hispanic		1.444***	1.234*	1.234*		1.155	1.054	1.058		1.554***	1.380**	1.407***
		[0.145]	[0.127]	[0.127]		[0.141]	[0.131]	[0.134]		[0.157]	[0.142]	[0.146]
Other race		1.336	1.198	1.198		1.353	1.247	1.262		1.061	0.974	0.968
		[0.252]	[0.230]	[0.230]		[0.318]	[0.297]	[0.306]		[0.188]	[0.175]	[0.175]
Female		1.595***	1.574***	1.574***		1.296**	1.289**	1.302**		1.364***	1.337***	1.333***
		[0.113]	[0.114]	[0.114]		[0.117]	[0.118]	[0.121]		[0.099]	[0.098]	[0.099]
Free/reduced lunch		0.896	0.884	0.884		1.021	1.026	1.031		0.969	0.96	0.96
		[0.070]	[0.070]	[0.070]		[0.101]	[0.102]	[0.104]		[0.077]	[0.077]	[0.077]
Algebra 2			2.008***	2.008***			1.375**	1.374**			1.745***	1.748***
			[0.154]	[0.154]			[0.138]	[0.140]			[0.137]	[0.138]
Trigonometry			0.843	0.843			1.342	1.3			1.773	1.727
			[0.231]	[0.231]			[0.407]	[0.400]			[0.609]	[0.594]
Advanced Math			1.824**	1.824**			1.769**	1.827**			0.863	0.858
			[0.389]	[0.389]			[0.337]	[0.353]			[0.147]	[0.147]
Honors English			1.091	1.091			1.082	1.093			1.167	1.182
			[0.104]	[0.104]			[0.114]	[0.117]			[0.113]	[0.116]
AP English			2.999*	2.999*			1.177	1.091			1.878	1.922
			[1.297]	[1.297]			[0.326]	[0.310]			[0.677]	[0.698]
College fixed-effects	no	no	no	yes	no	no	no	yes	no	no	no	yes
Constant	2.345***	1.727***	1.177	1.177	3.324***	2.809***	2.192***	1.971*	2.603***	1.804***	1.276	1.519
	[0.306]	[0.262]	[0.188]	[0.188]	[0.650]	[0.614]	[0.496]	[0.558]	[0.347]	[0.278]	[0.206]	[0.333]
ll	-2474	-2436.2	-2368.4	-2368.4	-1436.07	-1425.51	-1409.62	-1389.54	-2378.07	-2358.56	-2319.92	-2304.54
chi2	11.104	86.709	222.319	222.319	14.957	36.079	67.872	108.014	8.887	47.909	125.189	155.935
N	4,605	4,605	4,605	4,605	2,189	2,189	2,189	2,189	4,605	4,605	4,605	4,605

Notes: * p<0.05, ** p<0.01, *** p<0.001. Reference category is co-requisite.

Table 25. Predictors of Passing Developmental Writing, ENC 1101, and Persisting from Fall 2014 to Spring 2014

	Pass Dev Writing in Fall 2014				Pass ENC 1101 within the First Year				Fall 2014 to Spring 2014 Persistence			
Compressed Writing	1.767*	1.657*	1.690*	1.659*	0.336**	0.321***	0.306***	0.297***	0.879	0.804	0.807	0.817
	[0.403]	[0.383]	[0.396]	[0.391]	[0.112]	[0.107]	[0.103]	[0.101]	[0.246]	[0.227]	[0.229]	[0.233]
Contextualized Writing	1.727*	1.789*	1.858*	1.791*	0.482*	0.485*	0.461*	0.442*	0.897	0.883	0.888	0.891
	[0.430]	[0.450]	[0.474]	[0.459]	[0.172]	[0.173]	[0.165]	[0.160]	[0.269]	[0.266]	[0.270]	[0.271]
Modularized Writing	1.773*	1.683*	1.854*	1.815*	0.284***	0.264***	0.261***	0.254***	0.79	0.756	0.809	0.819
	[0.426]	[0.408]	[0.456]	[0.448]	[0.099]	[0.092]	[0.091]	[0.089]	[0.229]	[0.221]	[0.238]	[0.241]
Black		0.902	0.874	0.869		0.809	0.787*	0.774*		1.227*	1.204*	1.208*
		[0.075]	[0.073]	[0.073]		[0.088]	[0.086]	[0.086]		[0.107]	[0.106]	[0.107]
Hispanic		1.662***	1.480***	1.473***		1.227	1.131	1.132		1.578***	1.417***	1.418***
		[0.148]	[0.134]	[0.134]		[0.130]	[0.122]	[0.124]		[0.143]	[0.131]	[0.131]
Other race		0.965	0.873	0.866		1.044	0.969	0.935		1.21	1.11	1.115
		[0.141]	[0.130]	[0.129]		[0.202]	[0.190]	[0.185]		[0.190]	[0.176]	[0.178]
Female		1.561***	1.565***	1.561***		1.316***	1.311***	1.332***		1.403***	1.385***	1.385***
		[0.098]	[0.100]	[0.100]		[0.103]	[0.104]	[0.107]		[0.092]	[0.092]	[0.093]
Free/reduced lunch		1.026	0.999	0.999		0.907	0.911	0.91		1.049	1.037	1.034
		[0.069]	[0.069]	[0.069]		[0.077]	[0.078]	[0.079]		[0.075]	[0.075]	[0.075]
Algebra 2			1.861***	1.864***			1.319**	1.328**			1.675***	1.673***
			[0.125]	[0.126]			[0.115]	[0.117]			[0.118]	[0.119]
Trigonometry			1.065	1.052			1.315	1.357			1.235	1.188
			[0.245]	[0.243]			[0.330]	[0.344]			[0.314]	[0.303]
Advanced Math			1.650**	1.646**			1.686***	1.710***			1.699**	1.720**
			[0.260]	[0.260]			[0.258]	[0.265]			[0.290]	[0.295]
Honors English			0.919	0.916			1.138	1.122			1.11	1.119
			[0.074]	[0.074]			[0.105]	[0.104]			[0.096]	[0.097]
AP English			1.043	1.042			1.323	1.309			0.989	1.001
			[0.259]	[0.260]			[0.348]	[0.347]			[0.264]	[0.269]
College fixed-effects	no	no	no	yes	no	no	no	yes	no	no	no	yes
Constant	1.742*	1.275	0.934	1.092	5.182***	4.856***	4.010***	3.520***	4.312***	3.004***	2.252**	2.255**
	[0.393]	[0.299]	[0.224]	[0.295]	[1.706]	[1.642]	[1.370]	[1.313]	[1.197]	[0.855]	[0.649]	[0.710]
ll	-3140.78	-3081.55	-3022.7	-3011.01	-1905.23	-1888.87	-1868.06	-1849.18	-2892.63	-2864.56	-2818.55	-2806.17
chi2	5.911	124.367	242.086	265.464	23.052	55.767	97.374	135.145	1.664	57.801	149.833	174.585
N	5,620	5,620	5,620	5,620	2,940	2,940	2,940	2,940	5,620	5,620	5,620	5,620

Notes: * p<0.05, ** p<0.01, *** p<0.001. Reference category is co-requisite.

In order to determine the extent to which underprepared students are successful in the gateway course, and how this relationship may vary by enrollment option and level of preparation, we used a standard logistic regression equation. We included only students in groups (3) and (4)—those who enrolled in gateway courses—and compared their outcomes by enrollment pathway and disaggregating groups (4a) and (4b) in the following model:

$$Logit(Y_i) = \beta_0 + \beta_1(moderate)_i + \beta_2(slightly)_i + \beta_3(coreq)_i + \beta_4(compressed)_i + \delta(S)_i + \gamma(HS)_i$$

Under this specification Y_i is a dichotomous indicator of whether student *i* passed the gateway math course with a grade of C- or better and *moderate*, *slightly*, *S*, and *HS* are as before while *coreq* and *compressed* are indicators for groups (4a) and (4b); the reference group is group 3 (students who enrolled in gateway courses without any developmental education support). Thus, our estimates for *moderate* and *slightly* are in comparision to *severly* underpereared and our estimates for *coreq* and *compressed* are in comparision to no developmental education support. In order to make comparisons between *moderate* and *slightly* underpared students as well as *coreq* and *compressed* pathways, we computed chi-squared statistics comparing the estimates against each other.

This model allowed us to examine whether students at different levels of preparation were sucessful in the gateway course and whether certain pathways may be more beneficial for underpepared students to pass the gateway math course in the first semester[1]. Put differently, this model alllowed us to determine whether underperared students who enroll in the gateway course are any more succesful if they also took developmental education math in the same semester, either in a discrete, compressed format or in concurrent, co-requisite format, compared to taking no developmental education course at all. In presenting these results we again make use of predicted probabilities and associated 95% confidence intervals, disaggregated first by level of preparation and then by whether students took developmental education support in the same semester as taking the gateway course.

Table 26 presents odds ratios from the logistic regression model predicting student success in gateway math. In general, and perhaps unsurprisingly, better-prepared students were more successful in the gateway course. Both slightly underprepared (rrr = 3.174) and somewhat underprepared (rrr = 1.866) were more successful than severely underprepared students, with slightly underprepared students more successful than moderately underprepared students (chi2 = 62.68, $p < 0.001$). Presented as predicted probabilities in Table 27, 23.4% of severely underprepared students passed gateway math, compared to 39.3% of moderately underprepared students and 54.3% of slightly underprepared students.

In terms of student characteristics and measures of high school academic preparation, the results indicate that both are related to gateway course success. White and Hispanic students were more likely to pass the gateway course, as were females, but those eligible for free/reduced lunch were less likely to pass their gateway math course. One point worth noting is that even students who

[1] In an additional iteration of the model, we interacted the levels of preparation with the course delivery methods to determine whether there were any differential relationships of the delivery methods on gateway success for students of varying ability. None of the interactions were statistically significant and a likelihood ratio test showed that the added interactions did not significantly improve model fit. For these reasons, we do not present these results.

were underprepared via their PERT scores benefited from taking rigorous math courses and Advanced Placement English in high school. Students who took trigonometry, for example, were 2.6 times more likely to pass their gateway math course, even after controlling for their relative PERT math score.

When it comes to same-semester developmental education support, underprepared students appeared to benefit from taking developmental education along with the gateway course instead of bypassing developmental education altogether, either through co-requisite developmental education (rrr = 1.381) or compressed developmental education (rrr = 1.556). The difference in the estimates for co-requisite and compressed developmental education, however, is not statistically significant (chi-squared = 0.47, p=0.49). Thus, while both are positive and are statistically significant from taking no developmental education support, there is no evidence to suggest whether either strategy is more beneficial than the other. Table 28 presents the associated predicted probabilities for passing the gateway course for underprepared student: 48.2% for students who took co-requisite developmental education and 53.5% for students who took compressed developmental education along with the gateway course, compared to 40.8% for underprepared students who took no developmental education support.

Table 26. Gateway Course Success for Underprepared Students

Levels of Preparedness	
Moderately Underprepared	1.866***
	[0.179]
Slightly Under Prepared	3.174***
	[0.310]
Enrollment Pathway	
Co-requisite	1.380*
	[0.219]
Compressed	1.575***
	[0.189]
Student Background Characteristics (S)	
Black	0.898
	[0.080]
Hispanic	1.251**
	[0.096]
Other Race	0.972
	[0.143]
Female	1.384***
	[0.087]
Free/Reduced Lunch	0.867*
	[0.058]
High School Academic Preparation (HS)	
Algebra 2	1.607***
	[0.148]
Trigonometry	2.589***
	[0.432]
Other Advanced Math	1.654***
	[0.146]
Honors English	0.966
	[0.064]
AP English	1.246*
	[0.129]
Constant	0.170***
	[0.021]
chi2	426.766
N	4,731

*Note: +p<0.10, * p<0.05, ** p<0.01, *** p<0.001.*

Table 27. Predicted Probability of Passing Gateway Math, by Preparation Level

	Pass Gateway Math		
	Low	Est.	High
Severely Underprepared	20.5%	23.4%	26.3%
Moderately Underprepared	37.1%	39.3%	41.4%
Slightly Underprepared	52.0%	54.3%	56.6%

Table 28. Predicted Probability of Passing Gateway Math, by Gateway Pathway

	Pass Gateway Math		
	Low	Est.	High
Gateway Alone	39.2%	40.8%	42.3%
Gateway + Co-requisite DE	40.7%	48.2%	55.8%
Gateway + Compressed DE	48.0%	53.5%	59.0%

Research Question 5:

In comparing the years before and after SB 1720, is there any evidence that SB 1720 is related to student gateway course success?

To understand whether or not developmental education has improved student success in FCS colleges, we used difference-in-differences modeling to assess how the implementation of SB 1720 has been associated with changes in gateway course success. We used an interrupted time series to evaluate the differences in gateway course success before and after the policy change—the first difference. A traditional interrupted time series only evaluates differences in the linear trajectory before and after the interruption (in this case the policy change); however, the inclusion in our analysis of a second time series for a comparison group (i.e., those who opt to take the course)—the second difference—allows for the ability to contend for threats to internal validity such as history and selection effects. This methodology has been acknowledged as a reasonable quasi-experimental approach when random assignment is not possible, and it improves upon a single interrupted time series by comparing the effects between the comparison group and the group of individuals who opt to not take the remediation coursework. We modeled differences in gateway course passing pre/post SB 1720 using the following logistic regression model:

$$Logit\ (pass\ gateway\ course) = \beta_0 + \beta_1(2014) + \beta_2(take) + \beta_3(2014*take) + \beta_4(controls) \quad \text{(Eq. 6)}$$

β_1 = difference in course success following SB 1720 (simple interrupted time series)
β_2 = difference in course success for those who did and did not take developmental education (no variation pre 2014)
β_3 = difference-in-differences estimator in course success for those students who took DE once it became optional

The interactive effects of these variables reveal that students in the 2014 cohort who take developmental math have higher odds of passing MAT 1033 (Table 29). Black and Hispanic

students and those eligible for free/reduced price lunch have lower odds of passing gateway math, but females and those with higher level math and AP English coursework have higher odds of passing MAT 1033.

Table 29. Predictors of Passing MAT 1033

	Passed MAT 1033					
2014 Cohort	0.785***	0.683***	0.637***	0.651***	0.675***	0.675***
	[0.012]	[0.011]	[0.012]	[0.012]	[0.013]	[0.013]
Took Dev Math		0.432***	0.408***	0.410***	0.483***	0.483***
		[0.007]	[0.007]	[0.007]	[0.009]	[0.009]
2014 Cohort*Took Dev Math			1.346***	1.325***	1.344***	1.345***
			[0.052]	[0.051]	[0.053]	[0.053]
Black				0.716***	0.697***	0.697***
				[0.015]	[0.014]	[0.014]
Hispanic				0.992	0.963*	0.963*
				[0.017]	[0.017]	[0.017]
Other race				1.085*	1.036	1.035
				[0.036]	[0.035]	[0.035]
Female				1.344***	1.287***	1.287***
				[0.019]	[0.019]	[0.019]
Free/reduced lunch				0.919***	0.917***	0.917***
				[0.014]	[0.014]	[0.015]
Algebra 2					1.626***	1.627***
					[0.032]	[0.032]
Trigonometry					1.799***	1.800***
					[0.065]	[0.065]
Advanced Math					1.793***	1.793***
					[0.035]	[0.035]
Honors English					1.013	1.013
					[0.016]	[0.016]
AP English					1.066**	1.066**
					[0.025]	[0.025]
College fixed-effects	no	no	no	no	No	yes
Constant	2.002***	2.701***	2.762***	2.584***	1.445***	1.462***
	[0.016]	[0.027]	[0.029]	[0.040]	[0.033]	[0.052]
	-	-	-	-	-	-
ll	5.86E+04	5.71E+04	5.70E+04	5.66E+04	5.55E+04	5.54E+04
chi2	232.302	3235.035	3294.425	4146.711	6473.959	6491.254
N	175,034	175,034	175,034	175,034	175,034	175,034

Note: * p<0.05, ** p<0.01, *** p<0.001.

Unlike math, there is no interactive effect between the 2014 cohort and students who enrolled in developmental reading (Table 30). That is, there is no differential effect on passing ENC 1101 for students in 2014 who do or do not take developmental reading. Black and Hispanic students, as well as those eligible for free or reduced-price lunch have lower odds of passing gateway English. Females have higher odds of passing their English course. All higher level math and English high school coursework is positively predictive of passing ENC 1101

Table 30. Predictors of Passing ENC 1101 with Developmental Reading

	Passed ENC 1101					
2014 Cohort	0.910***	0.839***	0.837***	0.871***	0.882***	0.883***
	[0.013]	[0.013]	[0.013]	[0.014]	[0.014]	[0.014]
Took Dev Reading		0.376***	0.375***	0.394***	0.455***	0.455***
		[0.006]	[0.007]	[0.007]	[0.009]	[0.009]
2014 Cohort*Took Dev Reading			1.019	1.01	1.051	1.052
			[0.051]	[0.051]	[0.053]	[0.053]
Black				0.662***	0.654***	0.654***
				[0.012]	[0.012]	[0.012]
Hispanic				1.003	0.954**	0.954**
				[0.016]	[0.015]	[0.015]
Other race				1.044	0.954	0.954
				[0.030]	[0.028]	[0.028]
Female				1.418***	1.388***	1.389***
				[0.018]	[0.018]	[0.018]
Free/reduced lunch				0.820***	0.833***	0.833***
				[0.011]	[0.011]	[0.011]
Algebra 2					1.517***	1.516***
					[0.023]	[0.023]
Trigonometry					1.197***	1.197***
					[0.036]	[0.036]
Advanced Math					1.471***	1.471***
					[0.026]	[0.026]
Honors English					1.238***	1.238***
					[0.017]	[0.017]
AP English					1.156***	1.156***
					[0.026]	[0.026]
College fixed-effects	no	no	no	no	no	yes
Constant	4.535***	5.294***	5.296***	5.131***	3.000***	2.930***
	[0.032]	[0.041]	[0.042]	[0.064]	[0.050]	[0.085]
ll	-8.35E+04	-8.19E+04	-8.19E+04	-8.10E+04	-7.96E+04	-7.96E+04
chi2	40.063	3154.724	3154.864	4991.969	7754.322	7787.382
N	175034	175034	175034	175034	175034	175034

Note: * p<0.05, ** p<0.01, *** p<0.001.

The results for the writing models indicate differential positive effects for students who enrolled in developmental writing in 2014 (Table 31). That is, these students have higher odds of passing their gateway English course. As with the math and reading models, Black, Hispanic, and students eligible for free or reduced-price lunch have lower odds of passing ENC 1101, but females and those with higher level math and English high school coursework have higher odds of passing.

Table 31. Predictors of Passing ENC 1101 for Students with Developmental Writing

	Passed ENC 1101					
2014 Cohort	0.910***	0.896***	0.884***	0.919***	0.923***	0.924***
	[0.013]	[0.013]	[0.014]	[0.015]	[0.015]	[0.015]
Took Dev Writing		0.365***	0.357***	0.387***	0.451***	0.450***
		[0.007]	[0.007]	[0.008]	[0.010]	[0.010]
2014 Cohort*Took Dev			1.115*	1.081	1.114*	1.115*
Writing			[0.051]	[0.050]	[0.052]	[0.052]
Black				0.668***	0.658***	0.658***
				[0.012]	[0.012]	[0.012]
Hispanic				0.997	0.948***	0.948***
				[0.016]	[0.015]	[0.015]
Other race				1.044	0.954	0.954
				[0.030]	[0.028]	[0.028]
Female				1.406***	1.377***	1.377***
				[0.018]	[0.018]	[0.018]
Free/reduced lunch				0.824***	0.837***	0.837***
				[0.011]	[0.012]	[0.012]
Algebra 2					1.533***	1.532***
					[0.024]	[0.024]
Trigonometry					1.196***	1.197***
					[0.036]	[0.036]
Advanced Math					1.474***	1.475***
					[0.026]	[0.026]
Honors English					1.239***	1.239***
					[0.017]	[0.017]
AP English					1.165***	1.165***
					[0.026]	[0.026]
College fixed-effects	no	no	no	no	no	yes
Constant	4.535***	5.097***	5.113***	4.959***	2.886***	2.816***
	[0.032]	[0.038]	[0.039]	[0.061]	[0.048]	[0.081]
	-	-	-	-	-	-
ll	8.35E+04	8.21E+04	8.21E+04	8.12E+04	7.98E+04	7.98E+04
chi2	40.063	2841.704	2847.356	4584.919	7448.396	7479.435
N	175,034	175,034	175,034	175,034	175,034	175,034

Note: * p<0.05, ** p<0.01, *** p<0.001.

In the following section, we utilized the Exempt and Likely-Exempt sample. First, we explored gateway course enrollment as a first step to understanding changes in gateway course enrollment and success following the legislation. Then, we examined gateway course passing rates for those who enrolled in the course. Next, we explored overall passing rates for the cohort; that is "net" gateway passing rates for each subject. Finally, we do all of the disaggregating by race/ethnicity to determine differential effects of the legislation on students who are Black or Hispanic, relative to White students.

Gateway Course Enrollment Rates. As might be expected, the likelihood of enrolling in gateway courses dramatically increased following the reform and at nearly equal rates for math and English. Specifically, the likelihood of enrolling in gateway courses increased similarly for

ENC 1101: English Composition I (16.7 percentage points) and MAT 1033: Intermediate Algebra (16.2 percentage points; Figure 10 & Table 32).

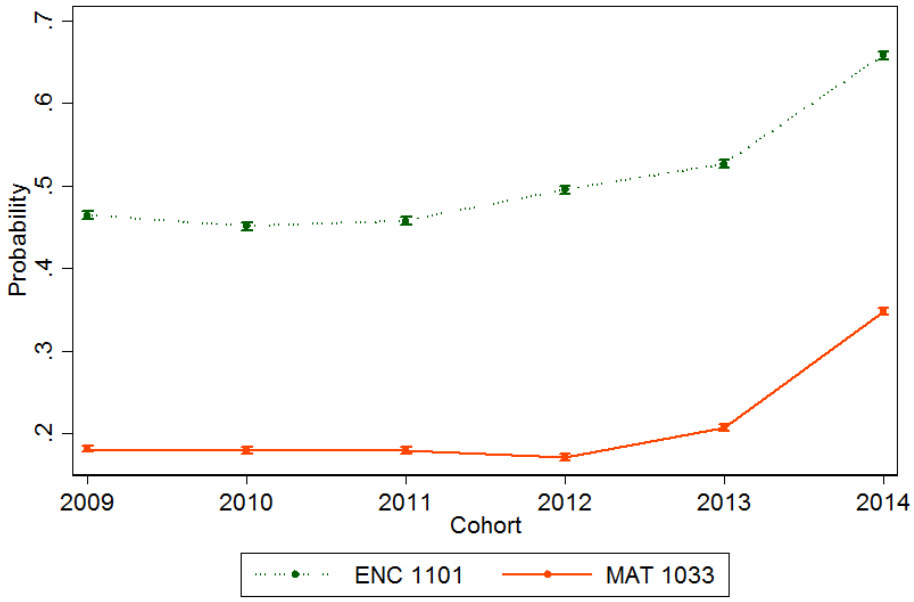

Figure 10. Gateway Course Enrollment, by Subject

Table 32. Predicted Probabilities of Gateway Course Enrollment

	2009-2013	2014	Difference
ENC 1101: English Composition I	48.30%	64.90%	16.7***
MAT 1033: Intermediate Algebra	19.70%	36.00%	16.2***

Notes: *p<.05, **p<0.01, ***p<0.001. Predicted probabilities based on models that include the full array of student characteristics and high school academic preparation.

Course-Based Passing Rates in Gateway Courses. Although enrollment rates increased in gateway courses following the reform, passing rates for students taking gateway courses declined. Specifically among students enrolled, however, the likelihood of passing gateway courses decreased in both ENC 1101: English Composition I (3.4 percentage points) and MAT 1033: Intermediate Algebra (8.7 percentage points; Figure 11 & Table 33).

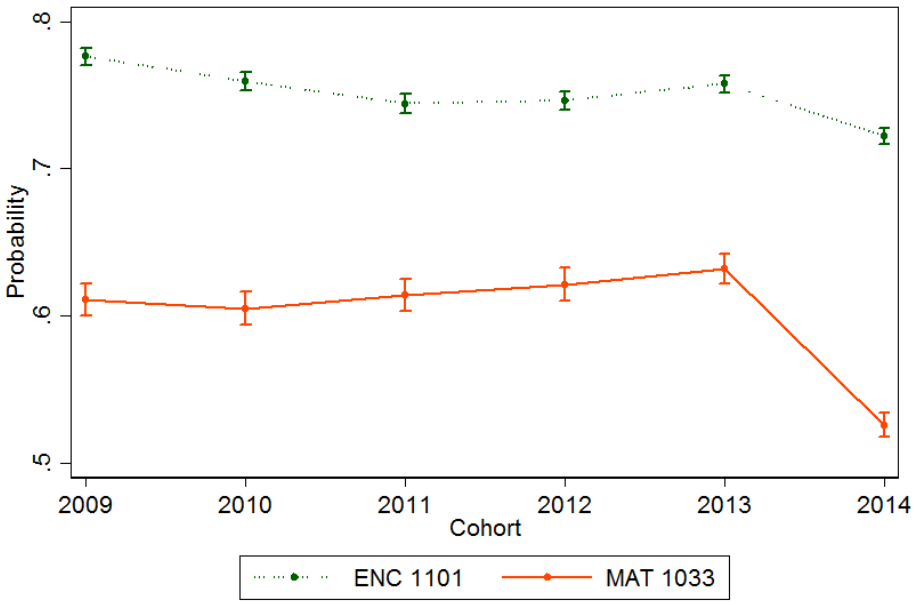

Figure 11. Course-Based Gateway Course Passing Rates, by Subject

Table 33. *Predicted Probabilities of in Course-Based Gateway Course Passing*

	2009-2013	2014	Difference
ENC 1101: English Composition I	74.70%	71.30%	-3.4***
MAT 1033: Intermediate Algebra	61.10%	52.40%	-8.7***

Notes: *p<.05, **p<0.01, ***p<0.001. Predicted probabilities based on models that include the full array of student characteristics and high school academic preparation.

Cohort-Based Passing Rates in Gateway Courses. While average passing rates declined for students enrolled in gateway courses, expanding the analysis to all students in each cohort (rather than only the students enrolled in gateway courses) provides another perspective. This analysis can tell us whether, overall, more students are passing gateway courses following the reform. When examining passing rates based on the cohort, a different story emerges. Specifically, in terms of cohort-based gateway passing rates, both subjects show *increases*: 9.4 percentage points for ENC 1101: English Composition I and 6.1 percentage points for MAT 1033 (Figure 12 & Table 34).

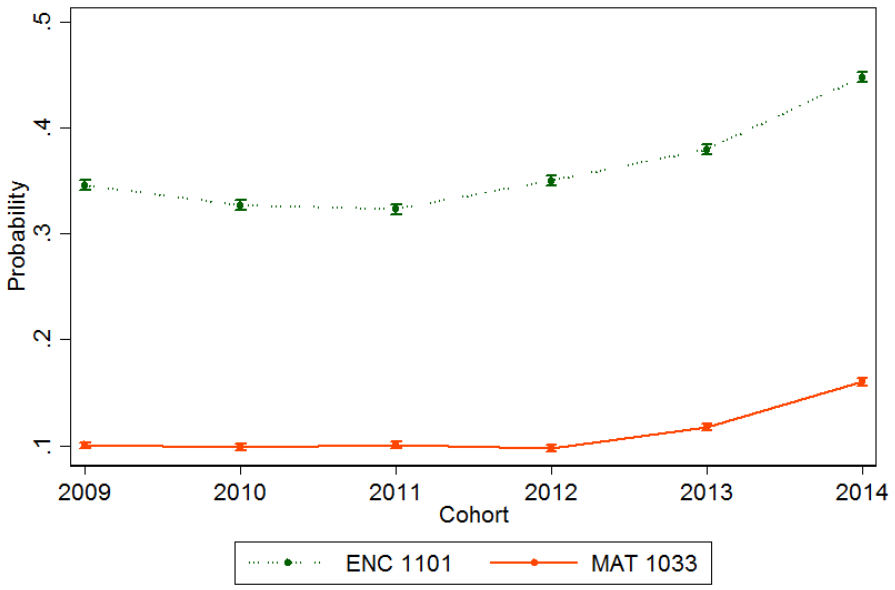

Figure 12. Cohort-Based Gateway Course Passing Rates, by Subject

Table 34. Predicted Probabilities of Cohort-Based Gateway Passing Rates

	2009-2013	2014	Difference
ENC 1101: English Composition I	36.20%	45.60%	9.40***
MAT 1033: Intermediate Algebra	12.20%	18.30%	6.10***

Notes: *p<.05, **p<0.01, ***p<0.001. Predicted probabilities based on models that include the full array of student characteristics and high school academic preparation.

Gateway Course Enrollments by Race/Ethnicity. Given the differences by race/ethnicity in terms of DE enrollment and passing rates, we also sought to understand whether such differences exist for gateway courses. In general, the likelihood of enrolling in MAT 1033: Intermediate Algebra significantly increased for all groups: Black student enrollment increased by 20.1 percentage points, Hispanic student enrollment increased by 17.4 percentage points, and White student enrollment increased by 13.1 percentage points. For ENC 1101: English Composition I, we again observed a trend of increasing enrollment. In 2014, the likelihood of enrolling for Black, Hispanic, and White students were 27.4, 17.6 and 13.0 percentage points higher, respectively, compared to the average of pre-2014 cohorts (Figure 13 & Table 35).

Just as with DE courses, significant differences were found between student subgroups in terms of gateway enrollment. Compared to White students, results indicate that similarly prepared Black students had a greater increase in probability of enrolling in MAT 1033: Intermediate Algebra by 7.7 percentage points, and a greater increasing in the probability of enrolling in ENC 1101: English Composition I by 14.4 percentage points. Hispanic students a greater increase of 4.3 percentage points more likely to enroll in MAT 1033: Intermediate Algebra compared to White students and a 4.6 percentage point greater increase in the likelihood of enrolling in ENC 1101: English Composition I compared to White students.

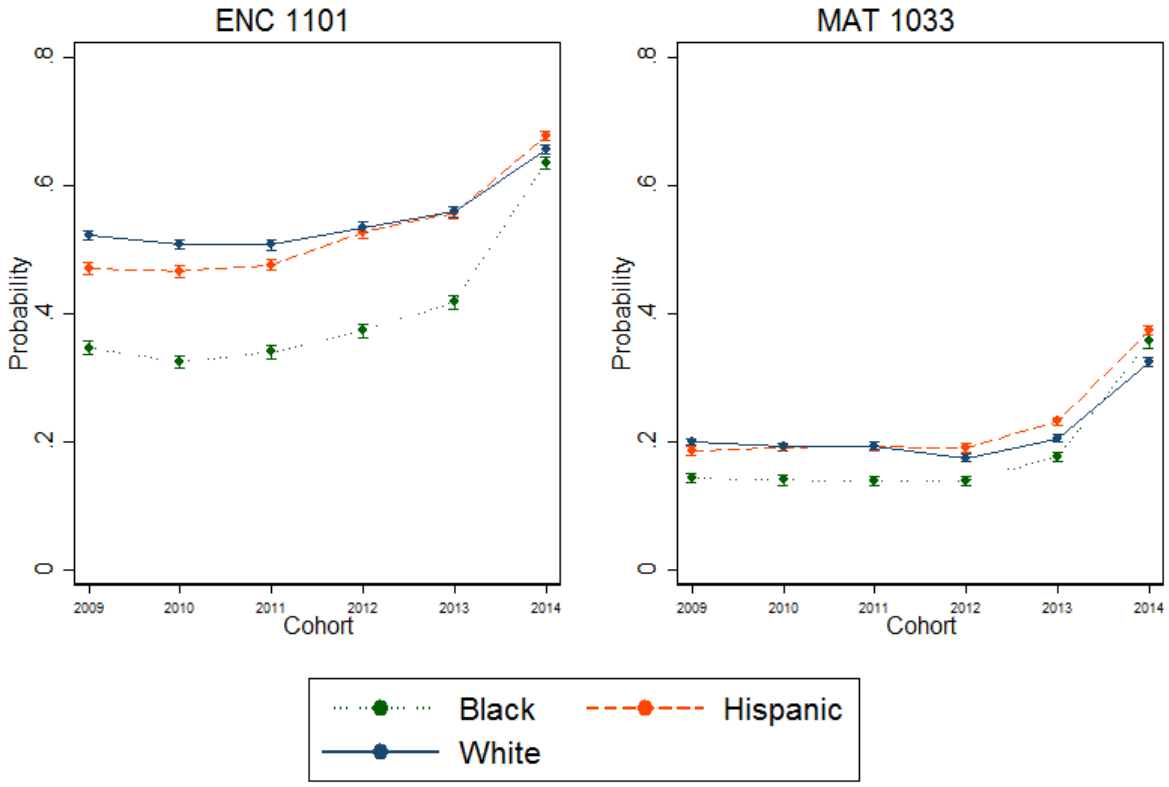

Figure 13. Gateway Course Enrollment Rates, by Race/Ethnicity

Table 35. Gateway Education Enrollment Rates by Race/Ethnicity

	MAT 1033: Intermediate Algebra				ENC 1101: English Composition I			
	2009-2013	2014	Diff		2009-2013	2014	Diff	
Predicted Probabilities								
Black	14.78%	35.58%	20.80	***	35.96%	63.37%	27.40	***
Hispanic	19.92%	37.30%	17.38	***	49.98%	67.58%	17.60	***
White	19.38%	32.46%	13.08	***	52.66%	65.64%	12.98	***
Marginal Effects								
Black vs White			7.72	***			14.42	***
Hispanic vs White			4.30	***			4.62	***

Note: * p<0.05, ** p<0.01, *** p<0.001.

Course-Based Gateway Course Passing Rates. In this section, just as before, we first compare the differences in passing rates among likely-exempt and exempt students enrolled only in fall gateway courses for each racial/ethnic group between pre-2014 cohorts and 2014 cohorts. Then, we extend our sample to all students and estimate passing rate differences for each racial/ethnic group in 2009 to 2013 cohorts and 2014 cohort.

For all racial/ethnic groups, there were significant decreases in the likelihood of passing gateway courses in 2014 compared to those enrolled in the courses in previous cohorts. Black students' likelihood of successfully passing MAT 1033: Intermediate Algebra and ENC 1101: English Composition I were lower by 10.3 percentage points and 5.0 percentage points, respectively. We observed similar trends for Hispanic and White students (Figure 14 & Table 36). Passing rates among students who enrolled decreased 9.2 percentage points in MAT 1033: Intermediate Algebra and 2.7 percentage points in ENC 1101: English Composition I for Hispanic students, and the likelihood of passing the course decreased for White students by 8.6 percentage points and 3.6 percentage points, respectively.

We also compared student subgroups based on race/ethnicity, using marginal effects of the likelihood of passing gateway courses. Among only those who enrolled in ENC 1101: English Composition I, Black students were 1.5 percentage points less likely than their similarly prepared White student counterparts to pass the course. There were no other significant comparisons between Black and White or Hispanic and White students for passing MAT 1033: Intermediate Algebra or ENC 1101: English Composition I; these students all experienced similar drops in gateway passing rates following the DE reform.

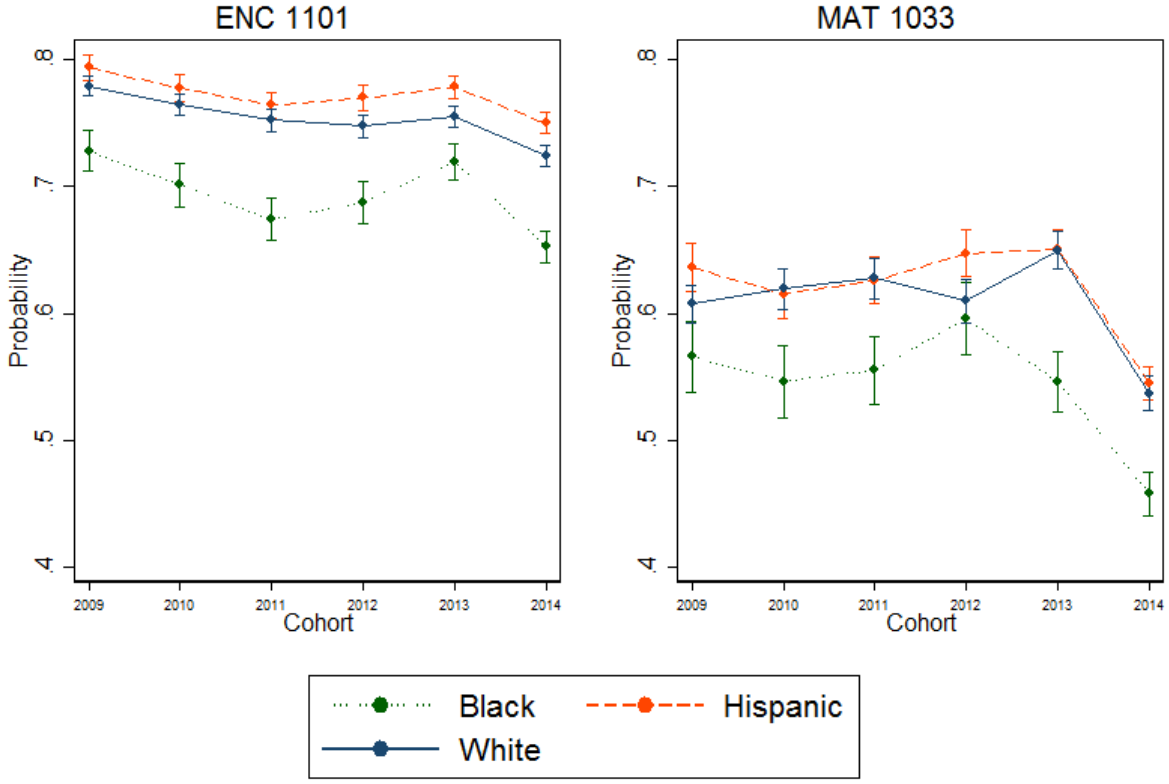

Figure 14. Course-Based Gateway Course Passing Rates, by Race/Ethnicity

Table 36. Course-Based Gateway Course Passing Rates by Race/Ethnicity

	MAT 1033: Intermediate Algebra				ENC 1101: English Composition I			
	2009-2013	2014	Diff		2009-2013	2014	Diff	
Predicted Probabilities								
Black	56.05%	45.74%	-10.31%	***	70.28%	65.27%	-5.01%	***
Hispanic	63.63%	54.47%	-9.15%	***	77.66%	75.00%	-2.66%	***
White	62.33%	53.74%	-8.58%	***	76.02%	72.46%	-3.56%	***
Marginal Effects								
Black vs White			-1.73%				-1.45%	+
Hispanic vs White			-0.57%				0.90%	

Note: + p<.1, * p<0.05, ** p<0.01, *** p<0.001.

Cohort-Based Gateway Course Passing Rates. However, just as before, we found that overall, students had a higher likelihood of passing gateway courses based on the calculation of students as cohorts. Specifically, Black students were 6.8 percentage points more likely to pass MAT 1033: Intermediate Algebra and 14.8 percentage points more likely to pass ENC 1101: English Composition I in 2014 (Table 37). Hispanic students were 6.4 percentage points more likely to pass MAT 1033: Intermediate Algebra and 11.0 percentage points more likely to pass ENC 1101: English Composition I in 2014. White students were 4.4 percentage points more likely to pass MAT 1033: Intermediate Algebra and 6.6 percentage points more likely to pass ENC 1101: English Composition I in 2014 (Figure 15 & Table 37).

In addition, compared to similarly prepared White students Black students had a 2.4 percentage point higher gain in the likelihood of passing MAT 1033: Intermediate Algebra and an 8.1 percentage point higher gain in the likelihood of passing ENC 1101: English Composition I from the pre-policy period to the post-policy period. Similarly, Hispanic students had a 2.1 percentage point higher gain in the likelihood of passing MAT 1033: Intermediate Algebra and a 4.4 percentage point higher gain in the likelihood of passing ENC 1101: English Composition I compared to similarly prepared White students in the fall 2014 cohort. In sum, Hispanic students continued to out-perform White students in both gateway English and math, as had been the case for the last few years. In contrast, for the first time in recent years the Black-White cohort-based achievement gap has substantially narrowed for English and has closed for math as a result of stronger gains for Black students following the reform.

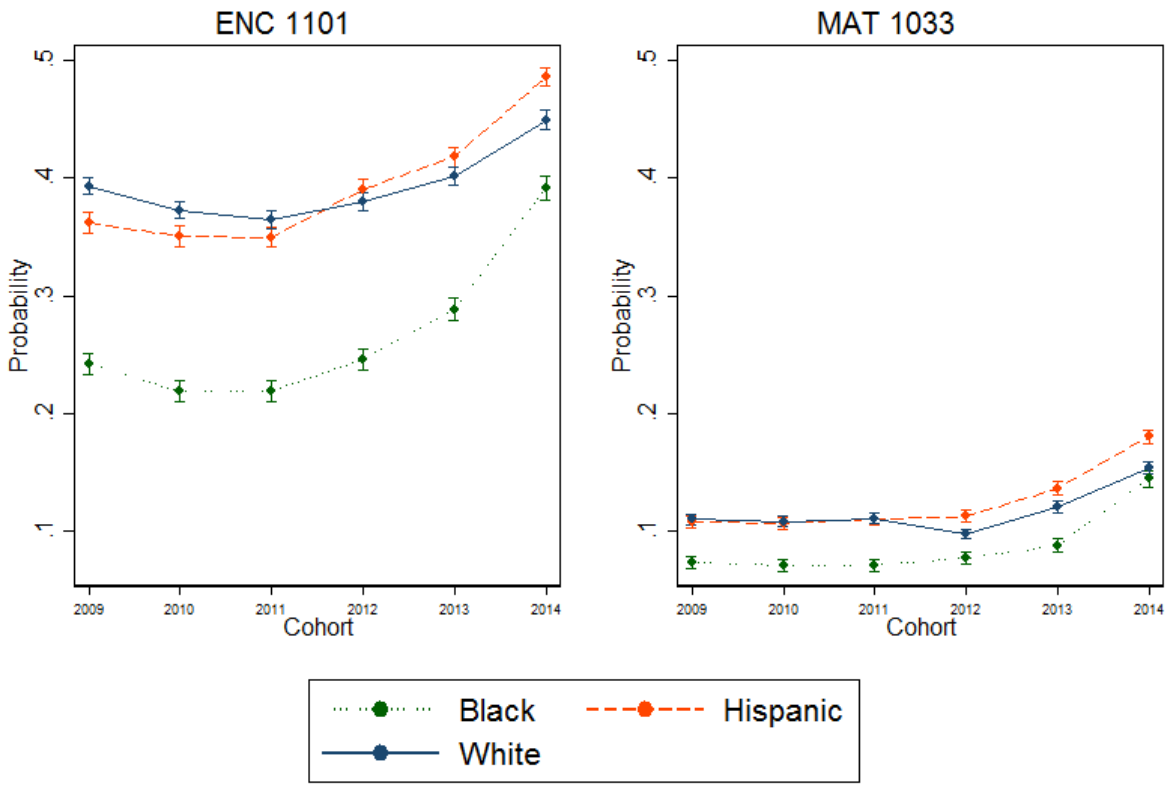

Figure 15. Cohort-Based Gateway Course Passing Rates, by Race/Ethnicity

Table 37. Cohort-Based Gateway Course Passing Rates, by Race/Ethnicity

	MAT 1033: Intermediate Algebra				ENC 1101: English Composition I			
	2009-2013	2014	Diff		2009-2013	2014	Diff	
Predicted Probabilities								
Black	7.64%	14.46%	6.81	***	24.24%	39.02%	14.78	***
Hispanic	11.56%	18.00%	6.44	***	37.43%	48.45%	11.02	***
White	11.00%	15.38%	4.38	***	38.29%	44.95%	6.66	***
Marginal Effects								
Black vs White			2.43	***			8.12	***
Hispanic vs White			2.06	***			4.36	***

Note: * p<0.05, ** p<0.01, *** p<0.001.

Summary and Discussion

The Florida developmental education reform through SB 1720 has important implications on student pathways in postsecondary education and eventual success. In this report we documented the patterns of student enrollment in developmental education and gateway courses and success in respective courses, using data of FTIC student cohorts from 2009-10 to 2014-15. In the following sections we detail our key findings in this report and offer a discussion and conclusion.

1. *In fall 2014 when DE is optional, the likelihood of enrolling in DE mathematics, reading, and writing all decreased substantially, by approximately 11 to 21 percentage points.*

In disaggregating the results by subject area, a more nuanced story appears. More students are bypassing developmental math than reading or writing, yet the changes in enrollment rates across all developmental courses are fairly similar.

2. *Students of color, females, those eligible for free or reduced lunch were significantly less likely to enroll in DE courses, as were those who took advanced math and English coursework in high school.*

Particularly concerning is the finding that low-income students, as measured by their eligibility for free or reduced price lunch, are more likely to bypass DE. For some this may be wise, but for a large share this may be detrimental to their eventual success. Low-income students may be avoiding DE because of the cost in time, and perhaps more importantly, money.

3. *The likelihood of passing DE math, reading, or writing decreased significantly in 2014, by 1.5 to 3.2 percentage points.*

Disaggregating DE courses by subject reveals that decreases in DE passing rates are slightly larger for reading (3.2 percentage points), compared to math (2.8 percentage points) or writing (1.5 percentage points).

4. *More students enrolled in compressed DE courses (roughly 51-72%) compared to the other modalities (roughly 2-35%, depending on the subject), though more Black students were enrolled in compressed or contextualized courses; Hispanic students enrolled in these modalities at lower rates, particularly in math, relative to co-requisite courses.*

This finding should be interpreted with caution because institutions within the FCS had a variety of different course offerings. Some, for example, offered courses in each instructional modality, and some offered courses in only two (as was the minimum requirement set forth in the legislation). We also suggest further exploration of how institutions decided to offer which courses in which modalities, how instructional modality was coded at each institution, and how students were advised into different instructional modalities.

5. *Among students taking DE courses in 2014, students in co-requisite courses had the highest rates of passing the relevant gateway course, followed by compressed, then contextualized, and finally modularized DE courses, though this varied by subject.*

Co-requisite math, reading, and writing courses appear to be associated with higher rates of passing gateway math and English by the end of the first year. Particularly for reading and writing, enrolling in other modalities (i.e., compressed, contextualized, and modularized courses) are associated with lower passing rates of ENC 1101, relative to enrolling in co-requisite developmental courses. However, enrollment in co-requisite reading or writing is associated with lower odds of passing their developmental courses. Thus, co-requisite courses appear to help students' gateway success, but may hinder success within the developmental course. The relationships between co-requisite developmental coursework are inconsistently related to fall-to-spring persistence, depending on the subject in which the course is taken.

6. *In fall 2014 when students can directly enroll in gateway courses and developmental education is optional, the likelihood of enrolling in gateway courses increased for both English (12.7 percentage points) and math (16.2 percentage points).*

Disaggregating enrollment in gateway English and math reveals that increases in gateway course enrollments are slightly higher for math.

7. *With the influx of enrollment into gateway courses, however, the likelihood of passing declined for English (3.4 percentage points) and math (8.7 percentage points).*

This raises concerns that others have voiced over whether students are able to accurately assess their ability and take courses where they will be successful without preparatory DE courses. Further, disaggregating enrollment in gateway English and math reveals that increases in gateway course enrollments are slightly higher for math, but the decrease in passing rates for gateway math is twice the size of the decrease in gateway English.

8. *In some subjects, students who took the DE course in 2014 had higher odds by 1.1 to 1.3 of passing the subsequent gateway course than students who didn't take the DE course. And, specifically, underprepared students appear to benefit from taking developmental math along with the gateway course instead of bypassing DE altogether, either through co-requisite DE or compressed DE, increasing the odds of passing by 1.4-1.6, respectively.*

This finding indicates that for students who need developmental education, enrolling in the course helps their success in their gateway course. Although non-significant for reading, students who enrolled in math or writing in 2014 had higher odds of passing MAT 1033 and ENC 1101, respectively, even after controlling for demographics and prior academic preparation. And, students who are underprepared, as determined by their PERT scores, may particularly benefit from same-semester DE coursework in the form of co-requisite (concurrent) or compressed (condensed) math courses. After conducting chi-squared tests, however, the difference in estimates of the effects of co-requisite versus compressed courses are not significant, indicating that they are equally beneficial to students' gateway success.

9. *What is promising, however, is that the total share of students entering a community college for the first time and successfully passing a gateway course in the first semester has increased for both English (9.4 percentage points) and math (6.1 percentage points).*

On the whole, students are taking and passing gateway courses following the DE reform, giving credence to the notion that by giving students the option to self-place, we will see more net success in gateway courses.

10. *Since the implementation of DE reform the likelihood of an incoming student receiving credit for college-level math in the first semester continues to be higher for Hispanic students (roughly 18%), a trend that has been present for several years, however we also see a narrowing of a pre-existing achievement gap between White and Black students since the implementation of the DE legislation, with the likelihood of incoming Black students receiving credit for college-level math in the first semester is now the same as for similarly prepared White students (roughly 15%).*

Most significantly, gains in the total proportion of students passing gateway courses are higher for Hispanic and Black students than for White students. In fact, similarly prepared Hispanic students continue to out-perform White students, and the Black-White achievement gap in gateway math has closed. Thus, by eliminating the use of placement tests as the sole mechanism for course enrollment decisions, traditionally underrepresented minority students in Florida are performing just as well—if not better—than similarly prepared White students when examining the total percentage of incoming students who successfully pass a gateway course in their first semester of study in a community college.

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