The Transformation of Colorado's Developmental Education Program

Student Outcomes

Khudodod Khudododov
Heather McKay
Suzanne Michael

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RUTGERS
Education and Employment Research Center

School of Management and Labor Relations
Janice H. Levin Building
94 Rockafeller Road
Piscataway, New Jersey 08854

smlr.rutgers.edu/eerc

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THE TRANSFORMATION OF COLORADO'S DEVELOPMENTAL EDUCATION PROGRAM: STUDENT OUTCOMES

This is one of two reports being issued by Rutgers' Education and Employment Research Center (EERC) on the redesigns of developmental education (DE) across 15 community colleges in Colorado. The current report focuses on student outcomes subsequent to the implementation of curricular redesigns recommended by Colorado's Developmental Education Task Force (DETF). It begins by explaining the context for the redesigns alongside a review supporting literature and a summary of the work of the DETF. This is followed by sections on methodology and the creation of comparative cohorts; outcomes using frequency rates; multivariate analyses that examine factors that may affect student outcomes; and an examination of the impact of DE course completion on wage rates. A second EERC report focuses on the process of transforming developmental education in Colorado between fall 2008 and fall 2014.[1]

This report and its companion qualitative report are the results of data collection and analysis undertaken by EERC as the third-party evaluator for a US Department of Labor Trade Adjustment Assistance Act grant to the Colorado Community College System (CCCS).

PART ONE: SETTING THE CONTEXT

Across the nation, community colleges act not only as the first opportunity for many individuals to engage with higher education but also, in many areas, as the only option for individuals seeking to further their education and/or prepare themselves for the job market. In Colorado, a largely rural state, the 13 colleges of the CCCS[2]—along with two independent colleges, Aims and Colorado Mountain College—offer a wide range of degree and certificate programs to help students develop critical skills for employment in the changing global economy and to provide the foundation for those students who wish to continue on to four-year academic institutions.[3]

[1] EERC's qualitative report includes a) an examination of strategies and models and the work of Colorado's Developmental Education Task Force, b) a discussion of the challenges that emerged in the process of developing and implementing these strategies, and c) recommendations for next steps.

[2] The 13 colleges under the Colorado Community College system are Arapahoe Community College, Community College of Aurora, Colorado Northwest Community College, Community College of Denver, Front Range Community College, Lamar Community College, Morgan Community College, Northeast Junior College, Otero Junior College, Pikes Peak Community College, Pueblo Community College , Red Rocks Community College, and Trinidad State Junior College.

[3] Colorado Community College System. (2013a). *Colorado's #1 source of higher education access and opportunity*. Retrieved from http://www.cccs.edu/

Educational studies over the past decade report that the majority of students entering community colleges across the United States require one or more developmental education (DE) courses.[4, 5, 6] Students referred to DE, however, face tremendous challenges progressing through those developmental pathways,[7] successfully completing a degree or certificate, and/or transferring to a four-year institution. As one administrator commented, we are "*bleeding students through our current model.*"

In addition to academic problems, faculty and administrators have registered concerns about the expanding population of students who are balancing college studies with the nonacademic challenges they face, such as arranging child care and work schedules to accommodate academic demands.[8, 9, 10] Because of this, many of these students are at additional risk for not completing a course of study and earning a credential.

In the 2012–13 academic year, close to 64 percent of first-time enrollees (recent high school graduates and nontraditional students) in a certificate or degree program at one of Colorado's community colleges required remediation in one or more subjects—math, reading, and/or English.[11] Almost 50 percent of these students required the successful completion of two or more remedial courses before they could enroll in a gateway or college-level course.[12] The need for remediation in Colorado during this period, while slightly lower than in prior years, mirrors national trends, with close to 60 percent of entering community college students requiring remediation.[13, 14]

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[4] Bailey, T., & Cho-Woo, S. (2010). *Issue brief: Developmental education in community colleges.* New York: Columbia University, Teachers College, Community College Research Center.
[5] Scott-Clayton, J. (2012). *Do high-stakes placement exams predict college success?* (Working Paper No. 41). New York: Columbia University, Teachers College, Community College Research Center.
[6] Bailey & Cho-Woo (2010), op. cit.
[7] Ibid.
[8] Bettinger, E., & Baker, R. (2011). *The effects of student coaching in college: An evaluation of a randomized experiment in student mentoring*. Retrieved from https://ed.stanford.edu/sites/default/files/bettinger_baker_030711.pdf
[9]Bettinger, E. P., Long, B. T., Oreopoulos, P., & Sanbonmatsu, L. (2009). *The role of simplification and information in college decisions: Results from the H&R Block FAFSA experiment* (Working Paper No. 15361). Washington, DC: National Bureau of Economic Research.
[10] Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of Educational Research, 45*, 89–125; Tinto V. (1998). College as communities: Exploring the educational character of student persistence. *Journal of Higher Education, 68*, 599–623.
[11] Colorado Commission on Higher Education. (2014). *The 2013 Legislative report on remedial education*. Retrieved from http://highered.colorado.gov/Publications/Reports/Remedial/FY2013/2013_Remedial_relmay14_rev071614.pdf
[12] Colorado Community College System. (2013c). *Academic year 2012-2013: Remedial enrollment and course completion rates*. Retrieved from https://www.cccs.edu/wp-content/uploads/2012/09/AY2013RemedialReport.pdf
[13] Edgecombe, N., Cormier, M.S., Bickerstaff, S., & Barragan, M. (2013). *Strengthening developmental education reforms: Evidence on implementation efforts from the scaling innovation project* (Working Paper No. 61). New York: Columbia University, Teachers College, Community College Research Center.
[14] Bailey, T. (2009). Challenge and opportunity: Rethinking the role and function of developmental education in community college. *New Directions for Community Colleges*, *145*, 11–30.

Unfortunately, for many students enrollment in a remedial course does not lead to a successful community college experience. In fact, during the 2012–13 academic year only 62 percent of recent high school graduates who required remediation successfully completed their DE programs.[15] And of those students who passed the required DE course, only 57.6 percent enrolled in any classes the next academic year.[16] These percentages highlight three persistent concerns that are reflected in the following terms: *retention*, which refers to both students' successful completion of required DE courses and their continued enrollment in courses leading to a certificate or degree, and *completion*—their attainment of a certificate or degree.

A 2009 cohort study undertaken by Colorado Community College System (CCCS)[17] provides evidence of a sobering reality: Most students who enter college requiring remedial courses never actually earn a degree. The CCCS study that tracked remedial students in math (recent high school and nontraditional students enrolled in Math 030, 060, and 090)[18] found that only 44 percent of those students passed their required DE course(s), and only 60 percent of the ones who passed went on to enroll in a gateway college math course. While 70 percent of these continuing students successfully passed their gateway course, only half of those successful students ultimately graduated with an associates' degree within four years of entrance. In sum, at the end of this cycle only 8 percent of the all students who had started with remedial math graduated with a degree within four years.

The study's authors note that the actual proportion of graduates might be slightly larger given that a) some students may have transferred to four-year colleges and did not apply for an associate's degree and b) some part-time students may have been successful beyond the four years of observation.[19] Even so, the small fraction of students who start with remedial math and go on to earn a degree is alarming.

For community college students, the costs for noncompletion of credit-bearing certificate and degree programs are significant in terms of time, missed opportunity to gain knowledge and skill, and lowered potential to increase earnings over the course of their work life.[20] Furthermore, in contrast to the benefits of wage gains for credential earners, research shows that noncompletion may result in psychological costs—such as a sense of failure and lower self-worth—as well as student debt absent a credential.[21]

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[15] Colorado Commission on Higher Education. (2014), op. cit. p. 6.
[16] Ibid, p. 17.
[17] Nawrocki, K. K., Baker, E. D., & Corash, K. (2009). *Success of remedial math students in the Colorado Community College System: A longitudinal study.* Denver: Colorado Community College System. Retrieved from: https://www.cccs.edu/wp-content/uploads/2013/09/Success-of-Remedial-Math-Students.pdf
[18] Ibid, p. 8.
[19] Ibid, p. 15.
[20] Booth, C., & Bahr, P. (2013). *The missing piece: Quantifying non-completion pathways to success.* San Francisco: California Learning Works. Retrieved from http://www.learningworksca.org/wpcontent/uploads/2013/10/MissingPiece_05.pdf
[21] Bailey, T. (2009). *Challenge and opportunity: Rethinking the role and function of developmental education in community college* (Working Paper No. 14). New York: Columbia University, Teachers College, Community College Research Center.

For state and federal governments and for society as a whole, the costs of noncompletion are also significant. A less skilled and less competitive workforce means lower incomes and a reduced tax base. A 2012 study by the conservative American Enterprise Institute illustrates the dramatic impact of completion rates on students and society. The Enterprise study estimated that a 50 percent increase in completion of community college programs nationally would result in 160,000 additional graduates, who in turn would increase their lifetime earnings by $30 billion and contribute an additional $5.3 billion to federal and state tax revenues.[22]

In this context, across the nation, a perfect storm of issues and challenges facing both students and colleges became recognized as a critical 21st-century problem. College enrollments were growing significantly larger, in part a consequence of the stagnant economy, and increasing numbers of newly enrolled students were in need of remediation in math, reading, and/or English. At the same time, students were no longer able to get federal financial aid to pay for remedial education courses that did not teach at least high school-level content—thus, the lowest level of developmental math, Math 030, could no longer be covered by those funds.

In response, colleges across the nation started to focus more intensely on addressing barriers to retention and completion.

A Brief Review of the Literature

Researchers have identified a wide range of factors that contribute to the poor outcomes experienced by so many developmental education students. These include:

- the validity of placement tests;[23, 24]
- the long sequence of development courses; [25]
- the cost of the noncredit DE courses;
- the absence of sensitivity to and/or sufficient resources to address the diverse academic and nonacademic issues that challenge these students both within and outside the classroom;[26]
- issues related to part-time status, especially with regard to financial aid limitations; and
- the often limited success of colleges to successfully integrate DE students into their communities.[27]

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[22] Schneider, M., & Yin, L. M. (2012). *Completion matters: The high cost of low community college graduation rates* (Education Outlook No. 2). Washington, DC: American Enterprise Institute for Public Policy Research, p.13.
[23] Crisp, G. & Delgado, C. (2014). The impact of developmental education on community college persistence and vertical transfer. *Community College Review*, *42*(2), 99–117.
[24] Scott-Clayton (2012), op. cit.
[25] Bailey & Cho (2010), op. cit.
[26] Jacob, J. W., Xiong, W., Ye, H. (2015). Professional development programmes at world-class universities. *Palgrave Communications, 1*(20152), p. 1–27.
[27] Bickerstaff, S., Barragan, M., & Rucks-Ahidiana, Z. (2012*). "I came in unsure of everything": Community college students' shifts in confidence* (Working Paper No. 48). New York: Columbia University, Teachers College, Community College Research Center.

A recent review by EERC of the literature on developmental education identified a multitude of studies that, taken together, suggest that a holistic, multipronged approach is required to increase the success rate of community college students. Such an approach would involve the alignment of state and institutional polices; improved K–12 preparation; college-wide institutional commitments, including resource allocation; changes in course structure and sequencing; shifts in pedagogy; and the provision of additional student supports.[28, 29]

At the same time, the literature reflects an ongoing debate about DE itself that centers on the most effective strategies to help students succeed.

Some researchers, including Crisp and Delgado, suggest that DE enrollment does not increase the odds of persistence to second-year college coursework[30] and thus enrollment is not a good predictor for later performance in college-level courses.[31, 32] Other studies have found that that specific subject-matter placement-test scores and high school GPAs *can* be predictive of students' college-level course success. For example, Scott-Clayton found that placement tests can be a predictor of college success, though their predictive power was higher for math (at 58 percent accuracy) than it was for English (at only 43 percent accuracy). [33] A similar study by Belfield & Crosta[34] examined the correlation between students' Accuplacer or Compass placement tests and their college GPA and found that, while a weak positive correlation does exist, it is not as strong as the correlation between student's high school GPA and his or her college GPA. In their analysis, then, high school GPA was a better predictor of college success.

In the last decade, in response to mixed or negative results with respect to the impact of developmental education on student outcomes, many colleges have attempted to revise their DE curriculums and restructure the nature of DE programming as a whole. Time to completion of traditional DE sequences has been a major focus of these activities. Many colleges have developed new *acceleration models* that are designed to shorten the time it takes for students to complete their DE pathways. These models tend to employ one or more of the following interrelated strategies:

a) course compression through curricular redesign;

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[28] Lotkowski, V. A., Robbins, S. B., & Noeth, R. J. (2004). *The role of academic and non-academic factors in improving college retention* (ACT Policy Report). ACT, Inc. Retrieved from http://www.act.org/research/policymakers/pdf/college_retention.pdf

[29] Varney, J. (2007). Intrusive advising. *Academic Advising Today, 30*(3).

[30] Crisp & Delgado (2013), op. cit.

[31] Calcagno, J. C., & Long, B.T. (2008). *The impact of postsecondary remediation using a regression discontinuity approach: Addressing endogenous sorting and noncompliance* (Working Paper No. 14194). Washington, DC: National Bureau of Economic Research.

[32] Martorell, P., and McFarlin, Jr., I. (2010). Help or hindrance? The effects of college remediation on academic and labor market outcomes. *Review of Economics and Statistics, 93*(2), 436–54.

[33] Scott-Clayton (2012), op. cit.

[34] Belfield, C. R., & Crosta, P. M. (2012*). Predicting success in college: The importance of placement tests and high school transcripts* (Working Paper No. 42). New York: Columbia University, Teachers College, Community College Research Center.

b) splitting a term into two courses; and/or
c) mainstreaming — pairing a DE course with a college-level course.[35, 36, 37]

These strategies are meant to reduce the time it takes for a student to move from required DE courses to his/her enrollment in a college-level course. Recent studies indicate that accelerated models have a positive impact on student performance in terms of how they perform both in their in DE courses as well as in their subsequent college-level courses.[38, 39] Other strategies that colleges have used in their efforts to improve student outcomes include contextualization of content; adding supplemental instructional support, such as required labs; and expanding a range of student-support services. These strategies are discussed at length in the EERC's qualitative report.

The Colorado Response

Over the past decade, Colorado has been experimenting with many of the above strategies in order to improve retention and completion rates at the community-college level. These pilot initiatives received complete or partial funding from a number of foundations—e.g., Lumina, the Gates, the Ford[40]—and/or state and federal agencies—e.g., US Department of Education.[41] Initiatives, which often straddled and/or complemented one another (such as activities under the Complete College America[42] initiative and a Lumina grant), have resulted in the development of a number of innovative strategies that modified or transformed the structure, curriculum, and/or pedagogy of DE courses in math, reading, and composition. A number of these initiatives—e.g., the FastStart program offered by the Community College of Denver—also involved expanding student-support services to address both the academic and nonacademic issues that can interfere with a student's ability to successfully complete his or her course of study.[43]

In 2012, the Colorado Community College System (CCCS) received a three-year Trade Adjustment Assistance Community College Career Training (TAACCCT) grant from the US Department of Labor to: a) transform developmental education and b) transform energy programs within the state to online and hybrid formats. Concurrent with the TAACCCT grant, the state leadership established the Colorado Developmental Education Task Force (DETF). This faculty-led task force,

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[35]Academy Administration Practice. (2013). *Models of accelerated developmental education: Prepared for Tarrant County Community College District*. Washington, DC: Hanover Research. Retrieved from https://www.tccd.edu/documents/About%20TCC/Institutional%20Research/TCCD_Models_of_Accelerated_Developmental_Education_Oct2013.pdf

[36] Venzia, A. & Hughes, K. L. (2013). Acceleration strategies in the new developmental education landscape. *New Directions for Community Colleges, 164*, p. 37–45.

[37] Hanover Research (2013), op. cit.

[38] Ibid.

[39] Venezia & Hughes (2013), op. cit.

[40] Baker, E.D. (2012). The challenge of scaling successful policy innovations. (p. 225–45) In A. P. Kelly & M. Schneider (eds.) *Getting to graduation: The completion agenda in higher education*. Baltimore, MD: Johns Hopkins University.

[41] Ibid.

[42] JVA Consulting. (2012). *Completion Innovation Challenge Grant evaluation: Prepared for Complete College Colorado*. Colorado: JVA Consulting.

[43] Bragg, D. D., Baker, E. D., & Puryear, M. (2010, December). *2010 follow-up of Community College of Denver FastStart program.* Champaign: University of Illinois, Office of Community College Research and Leadership.

which included representatives from the 13 CCCS colleges as well as from two independent community colleges (Aims and Colorado Mountain College) and one district four-year institution (Colorado Mesa University), was charged with a systemic transformation of Colorado's DE programming. The following report only looks at results from the 13 CCCS colleges.

In the spring of 2013, the recommendations developed by the DETF were passed by the Colorado state legislature. With the passage of these recommendations, Colorado transformed its DE programming in four critical ways:

- reducing the DE requirement from a sequence of courses (e.g., 030, 060, 090, 099) to a single semester-long course;
- integrating English and reading into a single discipline, College Composition and Reading (CCR);
- creating two separate math pathways—quantitative literacy (Math 050) and pre-algebra (Math 055)—tailored to different academic and career interests; and
- creating *soft-landing options* either on campus or in the community for students who do not meet the DE cut score based on state assessment tests.

The remainder of this report focuses on CCCS student outcomes from the first three semesters (fall 2013, spring 2014, and fall 2014) of Colorado's statewide redesigns. When looking at these findings, it should be noted that this study looks at very early implementation of the state redesigns, and in many cases, each term reflects the first time a college used redesigned strategies in their DE courses. Because of this, these courses faced all the same challenges that any new course offerings tend to encounter, such as those related to perfecting a new curriculum.

PART TWO: METHODOLOGY

EERC's data for this report come from the 13 community colleges that make up the Colorado Community College System. We did not include data from the two independent community colleges, Aims and Colorado Mountain College (CMC), for two substantial reasons. Aims did not offer any redesigned courses and thus was not included. CMC, on the other hand, offered a few redesigned courses and was included in an initial DE report, but it has not been included here because of the low number of both courses and students involved in that redesign. We did not receive data from Colorado Mesa University.

For the purposes of this report, *the redesigns* refers to redesigned courses in English/CCR and math that were offered during redesign time period: specifically, the fall 2013, spring 2014, and fall 2014 academic terms. Students enrolled in these redesigned courses comprise the "redesign or treatment cohort." To facilitate the measurement of impact, a sample comparative cohort was drawn from among students enrolled in DE courses during summer 2007, fall 2007, spring 2008, and fall 2008. These students make up the "historic cohort" and the period in which they took their courses, the historic period. (See descriptions of the redesigned courses below and demographic profiles of the two cohorts in Table 2.)

The redesigned courses in English—now called *College Composition and Reading* (CCR)—are CCR 091, 092, 093, and 094. The comparative courses from the historic period are English 030, 060, and 090.

> ***CCR 092 (5 credits)*:** Reading and writing is integrated, and students work on content from multiple disciplines (contextualization).
>
> ***CCR 092 (5 credits) with CCR 091 (1-credit lab)*:** In addition to taking CCR 092 as described above, students testing into the lowest remedial level must enroll in a corequisite complementary lab to further prepare them for college-level coursework.
>
> ***CCR 093 Studio D (3 credits) with GT co-enrollment*:** College composition and reading for students who need only modest remediation is taken concurrently with a 100-level predetermined discipline strand. The discipline-specific content in these concurrent courses is designated *GT*, or *Guaranteed to Transfer*. The discipline strands include Communication, Arts & Humanities, Social Science, Science, and Career and Technical Education. CCR 093 is offered in a number of ways, from team-taught learning communities to linked classes offered jointly to a common cohort but taught by different instructors.
>
> ***CCR 094 Studio (4 credits) with English 121 co-enrollment*:** A reading and writing course taken concurrently with English 121 in a learning-community format for students requiring modest remediation.

For math, the focus of attention is on the two new math pathways—MAT 050 and MAT 055—as well as on the labs associated with those pathways: MAT 091, MAT 092, MAT 093, and MAT 025. The comparative math courses from the historic cohort period are MAT 030, 060, and 090.

> ***MAT 050 Quantitative Literacy (4 credits)*:** This course is intended for students testing at the medium and high levels of remedial math who express an interest in enrolling in a 100-level non-algebra or non-transfer math course. Passing this course allows a student to continue on an academic pathway for non-algebra Career and Technical Education (CTE), associate degree, and transfer courses.
>
> ***MAT 055 Algebraic Literacy (4 credits)*:** This course is intended for students testing at the medium and high levels of remedial math and who express interest in taking a 100-level algebra course and/or those interested in STEM careers and possible transfer to four-year institutions. The curriculum for this course involves content necessary to prepare for MAT 121 and MAT 122.
>
> ***MAT 025 Algebraic Literacy Lab (1 credit)*:** A support lab to be taken as a corequisite with MAT 055 for students who test below the Algebraic Literacy placement score.
>
> ***MAT 091 Applied Quant Lab (1 credit)*:** A support lab to be taken as a corequisite with MAT 103, 107, 108, 109, or 112 for students who test at the high end of the remedial scale.

***MAT 092 Quant Lab (1 credit)*:** A support lab taken as a corequisite with MAT 120, 135, 155, or 156 for students who test at the high end of the remedial scale.

***MAT 093 Algebra Lab (1 credit)*:** A support lab taken as a corequisite with MAT 121 or 123 for students who test at the high end of the remedial scale.[44]

Note that the state intended the single-course math pathways outlined above to be mutually exclusive. However, EERC has found that some students are moving from MAT 050 to MAT 055, using MAT 050 as a first step towards possible STEM-career pathways. This was not the intention of the state redesign. It is currently unclear whether this is an issue related to student advising or to students simply changing their minds with regard to their academic and/or career goals in the course of taking MAT 050. Further, there have also been cases in which students who did not successfully complete MAT 055 subsequently registered for MAT 050 in order to progress out of DE math. Again, this was not the intention of the state redesigns. Sequential enrollment and double-back enrollment patterns need to be examined further to better understand the factors contributing to the use of two rather than one of the math pathways.

For the comparative analysis, we employed descriptive statistics or frequencies for the dependent variables (see Table 1). Furthermore, to understand the cohort differences with respect to demographic and other student characteristics, we performed either a chi-square test of association or a t-test to report effect size. Additionally, nominal and ordinal logistic regressions were used to understand the effect of cohort membership (i.e., historic vs. state-redesign cohort membership) on a student's time to enrollment, likelihood to complete, and level of success (i.e., the grade he or she earned) at the college level, controlling for a number of demographic characteristics. In a similar fashion, logistic regression was used to understand the effect of the different redesigns on enrollment in and completion of college-level (level 100+) courses in English and math, again controlling for students' demographic characteristics. Finally, we used propensity score matching to deepen our understanding of the effect of the state redesigns.

The data for all student results came from the individual colleges via the Banner system. Data was collected centrally from Banner by CCCS and provided to Rutgers' EERC. The data included course history, student characteristics, and degree information. Data on wages came from the Unemployment Insurance (UI) data system and were received from the Colorado Department of Labor and Employment.

The variables used in our analysis are described in Tables 1-A (dependent variables) and 1-B (independent variables).

[44] In general, while we do include MAT 091 in our analysis, we have not included MAT 092 and 093 in the analysis because the N sizes were low. A separate analysis of the success of these students would need to be done because they start out at a much higher level of math proficiency. Further, while these labs might appear to be comparable to the CCR 03 and CCR 094 co-enrollment options with 100-level courses, they are in fact more like labs than actual defined courses.

TABLE 1-A: DEPENDENT VARIABLES

Variables	Measurement	Comments
- *Time to enrollment in ENG 121* - *Time to enrollment in GT course* - *Time to enrollment in a 100-level-or-above college course for MAT*	- Measured as the time it took from a student's first DE course to first ENG 121 course. - Measured as the time it took from student's first DE course to first General Transfer (GT) course. - Measured as the time it took from student's first DE course to his/her enrollment in a first college-level course	This difference is expressed in discrete number of terms ranging from 0 to 4 or more. For the purposes of this analysis, ENG 121 is not considered a GT course.
- *Grade in ENG 121* - *Grade in first GT course* - *Grade in first MAT 100+ course*	- The student's final course grade: A, B, C, D, or F	Only grades of C or better are considered passing grades.
- *Enrollment in ENG 121, MAT 100+, or any GT course* - *Completion of ENG 121, MAT 100+, or any GT course* - *Retention*	- Enrolled in college-level courses or not - Passed (received a grade of C or better in) a college-level course or not - Continuously enrolled - two semesters subsequent to completion of DE course	
- *Wages at enrollment of DE and wages at completion of DE*	- Annual salary in dollars	Data from CCCS using the US Department of Labor Unemployment Insurance data.

TABLE 1-B: INDEPENDENT VARIABLES

Variables	Measurement	Comments
- *Gender*	Male, female	
- *Ethnicity*	White, Black, Hispanic, Asian or Pacific Islander, American Indian/Alaska Native	
- *Enrollment status*	Whether a student is half time, full time, three-quarter time, less than half time, or is a first-term student	It should be noted that enrollment status here is time sensitive. Our data does not capture the status of the students across semesters but only once. First-term students are those who are first-time students.
- *Veteran status*	Veteran, nonveteran	Veteran refers to Vietnam and other eligible veterans, and other protected veterans as noted in college data sets.
- *Age at first DE course*	Student's age when he/she first enrolled in a DE course	
- *Accuplacer score*	Accuplacer scores are a continuous measure and are used as such in our analysis. Includes Accuplacer Sentence Skills score for English and either Accuplacer Arithmetic or Elementary Algebra score for math	The longer-ago a student took the Accuplacer exam prior to his/her enrollment in a DE course, the more biased his/her score becomes—these scores are seen to improve or mature over time. We therefore limit scores to within 8 months prior to DE enrollment.

Our first step was to create the comparative cohort samples. For the state-redesign cohort we used the entire population of students who had taken a CCR or math pathway course between fall 2013 and fall 2014. The comparison cohort was made up of students who were enrolled in DE courses during the historic period—between summer 2007 and fall 2008. The 2007–08 academic years were chosen as the baseline or historic period because they largely predated significant pilots and experiments in DE and preceded the resources provided through the TAACCCT grant.

All students included in the analysis were unique to their cohort—that is, no student included in the analysis was enrolled in courses during both the redesign and historic periods. We ensured this by confirming that no student in the state-redesign cohort had ever taken a DE course prior to their

enrollment in the redesigned DE pathway. We can thus conclude that no student outcomes have been affected by prior DE coursework. In addition to the students' course histories, the demographic and other characteristics of the state-redesign cohort were matched in the selection of students to be included in the historic cohort.

PART THREE: OUTCOMES

Outcomes for English/College Composition and Reading

We begin our comparative analysis with English and College Composition and Reading (CCR).

English/CCR Cohort Samples

The cohorts used for this analysis are profiled in Table 2. Most of the variables are proportionally similar across the two cohorts. The only marked difference is in the enrollment status for the students—full or part time. The historic cohort had more students in full-time status than the state-redesign cohort.

To understand whether there were any statistically significant demographic and academic differences between the cohorts we conducted either a chi-square analysis (if the variable of interest was categorical) or a t-test (if the variable of interest was continuous). We also examined the effect size for each chi-square analysis and t-test to understand the practical significance of the association or difference per cohort.[45]

We found that ethnicity ($\chi^2 = 150.97$; $p = 0.000$; effect size = 0.08), veteran status ($\chi^2 = 198.72$; $p = 0.000$; effect size = 0.098), and age (t[df=20801] = -4.738; $p = 0.000$; effect size = 0.065) were significantly associated with a cohort. However, the strength of these associations was so limited as to make them insignificant in practical terms.[46] We also found that the mean difference between the two cohorts was statistically significant with regard to both enrollment status ($\chi^2 = 3164.43$; $p = 0.000$; effect size = 0.39) and Accuplacer Sentence Skills score (t[8093] = 6.199; $p = 0.000$ effect size = 0.12).The association between cohort membership and Accuplacer Sentence Skills score is small, but the association between cohort membership and enrollment status falls within the moderate range. Given that enrollment status can affect any of the dependent variables, it is important that both cohorts have a proportional number of students with respect to enrollment status. Thus, the moderate effect size of that association indicates that it could potentially interfere with our analysis. To address this issue, we used propensity score matching to eliminate this effect, a technique we will discuss later in our analysis.

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[45] Effect size measures are calculated to understand how strong the association or difference is between the two variables. Different measures exist for different tests; for example, a chi-square test has a different computation of effect size than a t-test.

[46] For ethnicity, veteran status, and age, effect sizes fell below 0.1, the measure at which an association may be considered to have a small effect according to Cohen's system of classification. For enrollment status, the effect was greater than 0.3, the measure at which Cohen considers an association to have a moderate effect (Cohen, J. [1988]. *Statistical power analysis for behavioral sciences*. Hillsdale, NJ: Erlbaum).

TABLE 2: DEMOGRAPHIC PROFILE OF HISTORIC AND STATE-REDESIGN ENGLISH COHORT SAMPLES

Demographics	Historic	State Redesign
Gender	**10633**	**10138**
Female	*56.2%*	*54.9%*
Male	*43.9%*	*45.1%*
Ethnicity	**10155**	**9272**
White Non-Hispanic	*53.%*	*45.6%*
Black Non-Hispanic	*12.5%*	*15.1%*
Hispanic	*26.9%*	*30.4%*
Asian or Pacific Islander	*6.0%*	*5.6%*
American Indian/Alaskan Native	*1.7%*	*3.3%*
Veteran status	**10640**	**10171**
No	*97.3%*	*93.1%*
Yes	*2.7%*	*6.9%*
Age at first DE	**10640**	**10163**
Mean	*24.23*	*23.68*
SD	*8.42*	*8.49*
Accuplacer Sentence Skills score	**4504**	**8501**
Mean	*71.40*	*73.15*
SD	*16.00*	*13.82*
Enrollment status	**10575**	**10171**
Full time	*53.6%*	*29.9%*
Three-quarter time	*4.6%*	*22.8%*
Half time	*29.0%*	*21.9%*
Less than half time	*12.2%*	*13.2%*
First-term students	*0.7%*	*12.3%*

Time to Enrollment in ENG 121 or First GT Course by Cohort

Table 3 presents the frequencies for each cohort in terms of time to enrollment in ENG 121, which is typically the first college-level English course a student enrolls in after completing a DE English/reading program, and GT courses. The table compares the time it took for students to enroll in either ENG 121 or a GT course after enrolling in their first DE course in either English (if they were in the historic cohort) or CCR (if they were in the state-redesign cohort). Table 3 looks only at those students who enrolled in ENG 121 or a GT course following or concurrently with DE enrollment.

TABLE 3: TIME TO ENROLLMENT IN ENG 121 AND GENERAL TRANSFER (GT) BY COHORT

	Historic	State Redesign
Time to ENG 121	**4809**	**5539**
Zero Terms	4.7%	82.0%
One Term	46.1%	12.4%
Two Terms	16.3%	5.0%
Three Terms	13.8%	0.5%
Four or More Terms	19.2%	N/A
Time to First GT	**6859**	**5024**
Zero Terms	55.2%	74.7%
One Term	19.6%	18.2%
Two Terms	8.0%	6.5%
Three Terms	7.0%	0.6%
Four or More Terms	10.2%	N/A

Table 3 reveals a marked difference between the historic and state-redesign cohorts with respect to the time it took students to enroll in higher-level English and General Transfer courses. Specifically, it took less time for students enrolled in the redesigned CCR courses to do so than it did for students in the historic courses. For example, 82 percent of the state-redesign cohort took zero terms to enroll in ENG 121 compared to only 4.7% percent of the historic cohort. The large number of students entering ENG 121 in zero semesters can be directly linked to the new options for co-enrolling made available to students with the redesign: i.e., students taking 094 or 093 courses are now co-enrolled in DE and a college-level course during the same semester. Other improvements in time to college-level enrollment in English are evidence of the positive effect of acceleration on student retention. At this point, no student from the state-redesign cohort could have taken four or more semesters to enroll in a GT or ENG 121 course. This is different from the historic cohort, in which 19.2 percent of students took four or more semesters to enroll in ENG 121. This result should be looked at further as data from more semesters become available for analysis.

In sum, it is clear that already—even in this early stage post-DETF—the redesign in English has had a substantial impact on reducing the time it takes for students to enroll in college-level courses.

EERC also analyzed time to enrollment in ENG 121 by college; these results are presented in Table 4. Again this table is looking at only those DE students who enrolled in ENG 121. See Appendix A for college-by-college data with regard to time to enrollment in a GT course.

TABLE 4: TIME TO ENG 121 BY COLLEGE AND COHORT

	Historic						State Redesign[47]				
School	Zero terms	One term	Two terms	Three terms	Four+ terms	N	Zero terms	One term	Two terms	Three terms	N
ACC	2.4%	48.5%	17.7%	13.1%	18.3%	328	91.0%	4.5%	4.5%	0.0%	177
CCA	3.5%	41.3%	15.7%	14.4%	25.1%	458	82.4%	12.4%	3.8%	1.4%	785
CCD	5.2%	44.4%	14.8%	13.2%	22.4%	843	55.4%	34.3%	9.3%	0.9%	653
CNCC	25.0%	40.0%	10.0%	15.0%	10.0%	40	75.9%	20.7%	1.1%	2.3%	87
FRCC	3.3%	45.9%	19.6%	14.4%	16.8%	1108	85.6%	8.0%	6.4%	0.0%	834
LCC	2.2%	39.1%	17.4%	23.9%	17.4%	46	78.4%	18.9%	1.4%	1.4%	74
MCC	2.2%	48.9%	24.4%	11.1%	13.3%	45	89.2%	8.1%	2.7%	0.0%	37
NJC	14.7%	54.3%	7.8%	12.9%	10.3%	116	96.0%	2.7%	1.3%	0.0%	75
OJC	4.1%	68.4%	7.1%	12.2%	8.2%	98	80.9%	15.8%	0.5%	2.7%	183
PCC	6.6%	47.5%	15.4%	13.8%	16.7%	514	80.2%	15.4%	3.9%	0.5%	748
PPCC	4.4%	44.0%	15.9%	13.4%	22.3%	793	89.9%	5.4%	4.7%	0.0%	1309
RRCC	2.2%	47.8%	16.3%	15.0%	18.8%	320	89.3%	4.7%	6.1%	0.0%	428
TSJC	10.0%	52.0%	14.0%	13.0%	11.0%	100	82.6%	14.1%	2.7%	0.7%	149
Total	**4.7%**	**46.1%**	**16.3%**	**13.8%**	**19.2%**	**4809**	**82.0%**	**12.4%**	**5.0%**	**0.5%**	**5539**

Our analysis by college reveals the same overall patterns that were found for the total cohorts, but some interesting details emerge at this level of analysis. It's clear here again, for example, that even at the college level, time to enrollment in ENG 121 was consistently lower for the state-redesign cohort than it was for the historic cohort. But while the majority of colleges show 80–90 percent of students in the state-redesign cohort completing ENG 121 in zero terms, a few colleges—most notably CCD at only 55.4 percent—drop below that range.

There are a number of possible explanations for these differences. They may simply be a reflection of the colleges' different rollout schedules. They may also result from the choices colleges made as to which redesigned courses—and how many sections of each course—to offer. In addition, colleges were able to choose how they wanted to deliver each of the redesigned courses, which may have impacted the results. For example, there were noted differences in how 094 was offered across colleges. Some colleges followed the ALP learning-community model; others used multiple instructors. Some combined multiple sections of DE into a single ENG 121, while others did the opposite, distributing students from a single DE class into several ENG 121 sections.

There may also have been differences in the way colleges handled student advisement. Some may have actively encouraged students to co-enroll in 094 and ENG 121, for example, while others were more inclined to recommend registering for 092 or 093. There may have been a particularly wide range of differences in the advisement of students who tested into the lowest level of English—some or all might have been advised to take one of the soft-landing options at colleges in which

[47] At the time of this analysis there were only three terms in which state redesigns had been implemented; thus the category "four or more terms" was not created for this cohort and that column has been left out of this table.

those options were available. As a result, by college there may be differences as to which low-testing students were included in any of the state-redesigned courses analyzed here.

Student Grades in ENG 121 or First GT Course by Cohort

Next, we examined the grades students received in the college-level courses they took after—or, in the case of co-enrollment, while—completing their required historic or redesigned DE course pathway.

TABLE 5: ENG 121 AND GT COURSE GRADES BY COHORT

	Historic	State Design
Grade in ENG 121	**4270**	**5035**
F	10.6%	18.8%
D	6.5%	5.7%
C	21.4%	18.8%
B	34.9%	30.6%
A	26.5%	26.1%
Grade in First GT	**6475**	**5097**
F	19.1%	18.3%
D	7.2%	6.2%
C	18.9%	19.1%
B	25.5%	26.4%
A	29.3%	30.0%

Overall, students in the state-redesign cohort had less successful grade outcomes than students in the historic cohort. While there was only a small proportional difference between cohorts with regard to students earning a C or better in their first GT course ($\chi^2 = 5.15$; $p = 0.023$)—75.5 percent of state-redesign students compared to 73.7 percent of students in the historic cohort—that gap was slightly wider with regard to ENG 121 grades ($\chi^2 = 74.5$, $p = 0.000$). About 82.8 percent of students in the historic cohort earned a grade of C or higher in English 121 as compared to 75.5 percent of state-redesign students. Although both of these associations are statistically significant, their effect sizes—which fell below the "small" range—indicate that there is no practical difference among the cohorts with respect to earning a C or higher grade in either ENG 121 or the first GT course. These changes in grades are not drastic (one faculty member noted that these numbers demonstrate that the redesign *"caused no harm"*), which is an interesting finding that could be read to suggest success with the redesign strategy to date. Drastic curricular change like this could have resulted in much larger changes in grades than these data reveal.

Moreover, it should be noted that the redesign involves the strategy of *acceleration*, which means that students in the historic cohort likely had many more semesters of DE to help them prepare for success in their entry-level college courses. In fact, students co-enrolled in CCR 093 or 094 and a college-level course would have had no prior DE experience to draw from at all. These findings should certainly be looked at over time, but at this point we believe that the slight proportional

differences observed between the two cohorts is an indication that the redesigned English pathways are working and should not be any cause for concern.

EERC found additional positive results for the state redesign when we examined ENG 121 grades across schools (see Table 6). In that analysis, the state-redesign cohort often did better than their counterparts in the historic cohort. Again, this analysis included only those students who enrolled in college-level coursework.

TABLE 6: GRADE IN ENG 121 COURSE BY COLLEGE AND COHORT

School	Historic						State Redesign					
	F	**D**	**C**	**B**	**A**	**N**	**F**	**D**	**C**	**B**	**A**	**N**
ACC	9.2%	6.2%	27.4%	32.5%	24.7%	292	22.1%	5.5%	22.1%	22.7%	27.6%	163
CCA	10.1%	6.9%	23.4%	36.9%	22.7%	406	18.0%	5.3%	17.6%	33.1%	26.1%	735
CCD	12.9%	7.8%	20.4%	35.2%	23.8%	770	22.3%	6.6%	17.8%	30.7%	22.6%	574
CNCC	17.1%	11.4%	28.6%	34.3%	8.6%	35	15.7%	7.2%	24.1%	38.6%	14.5%	83
FRCC	8.5%	5.7%	18.9%	37.2%	29.7%	987	18.1%	3.8%	16.0%	31.7%	30.4%	773
LCC	10.3%	0.0%	23.1%	41.0%	25.6%	39	33.3%	4.5%	25.8%	34.8%	1.5%	66
MCC	7.7%	12.8%	17.9%	38.5%	23.1%	39	21.2%	21.2%	24.2%	24.2%	9.1%	33
NJC	9.7%	8.7%	28.2%	35.9%	17.5%	103	21.0%	21.0%	29.0%	24.2%	4.8%	62
OJC	14.9%	5.3%	23.4%	24.5%	31.9%	94	14.1%	5.3%	23.5%	31.8%	25.3%	170
PCC	11.8%	5.5%	21.2%	29.3%	32.1%	433	10.7%	7.5%	19.2%	32.7%	29.9%	615
PPCC	10.4%	7.7%	21.9%	34.9%	25.0%	699	21.9%	4.9%	18.6%	29.8%	24.8%	1227
RRCC	8.1%	5.3%	21.1%	39.4%	26.1%	284	18.8%	4.3%	18.3%	24.9%	33.8%	394
TSJC	20.2%	1.1%	15.7%	25.8%	37.1%	89	15.0%	7.9%	24.3%	30.7%	22.1%	140
Total	**10.6%**	**6.5%**	**21.4%**	**34.9%**	**26.5%**	**4270**	**18.8%**	**5.7%**	**18.8%**	**30.6%**	**26.1%**	**5035**

In terms of students earning a grade of A in ENG 121, we see that students in the state-redesign cohort at ACC, CCA, CNCC, FRCC, and RRCC performed better than students in the historic cohort (Table 6). At other schools, including LCC, MCC, and NJC, the proportion of students earning an A was notably lower among the state-redesign cohort than among the historic cohort. Here again we suggest exercising some caution when interpreting these findings, both because of the redesigns' accelerated nature and because the numbers for cohorts at several colleges were relatively small.

We found mixed results across colleges for students earning an A in their first GT course. As presented in Table 7, half of the colleges reported a higher proportion of students in the historic cohort earning A's in their first GT course compared to students in the state-redesign cohort. Given that the subject of the first GT course varied across and within colleges, and because this was the first offering of the redesigned courses, these findings should be looked at with some caution.

TABLE 7: GRADE IN FIRST GT COURSE BY COLLEGE AND COHORT

School	Historic						State Redesign					
	F	D	C	B	A	N	F	D	C	B	A	N
ACC	18.9%	6.8%	18.9%	29.5%	25.8%	438	20.4%	8.1%	17.7%	23.1%	30.6%	186
CCA	20.4%	7.7%	16.6%	23.8%	31.5%	597	19.8%	4.4%	19.4%	24.2%	32.2%	587
CCD	19.5%	7.7%	19.1%	23.4%	30.3%	1153	20.6%	4.5%	20.0%	27.6%	27.3%	880
CNCC	23.4%	10.4%	26.0%	19.5%	20.8%	77	10.5%	8.3%	24.8%	35.3%	21.1%	133
FRCC	17.9%	8.3%	21.0%	26.2%	26.6%	1422	20.6%	7.4%	18.4%	28.3%	25.3%	1031
LCC	25.3%	2.7%	20.0%	22.7%	29.3%	75	17.2%	5.7%	17.2%	32.2%	27.6%	87
MCC	1.8%	3.6%	21.8%	30.9%	41.8%	55	16.7%	8.3%	20.8%	20.8%	33.3%	24
NJC	19.3%	11.4%	21.7%	15.1%	32.5%	166	25.0%	9.8%	21.4%	22.3%	21.4%	112
OJC	28.0%	4.9%	18.2%	18.2%	30.8%	143	11.9%	5.0%	37.6%	22.9%	22.5%	218
PCC	16.0%	4.2%	18.5%	28.4%	32.8%	637	13.4%	5.9%	16.1%	26.8%	37.8%	627
PPCC	19.1%	6.9%	17.7%	28.2%	28.2%	1138	20.5%	7.4%	16.3%	27.6%	28.2%	784
RRCC	21.2%	7.9%	17.4%	23.9%	29.6%	443	11.9%	7.2%	18.3%	20.0%	42.6%	235
TSJC	20.6%	6.1%	16.0%	22.1%	35.1%	131	13.5%	2.6%	14.0%	21.8%	48.2%	193
Total	**19.1%**	**7.2%**	**18.9%**	**25.5%**	**29.3%**	**6475**	**18.3%**	**6.2%**	**19.1%**	**26.4%**	**30.0%**	**5097**

Comparisons of the Redesigned College Composition and Reading Courses

To what extent were outcomes different by College Composition and Reading course options? In Table 8 we present cohort-level data for these outcomes. Some of the variations in outcomes may be the result of differences in rollout given that some colleges only offered a single CCR option and others offered several different options. Further, some colleges reported data for only one term while others—especially those that had launched CCR options in fall 2013—were able to report several terms of CCR data.

TABLE 8: ENROLLMENT AND COMPLETION RATES BY STATE-REDESIGN CCR OPTION

	Enrolled in College-Level Course			Passed College-Level Course		
	Total	Enrolled	Not enrolled	Total	Pass	No Pass
DE	**Enrolled in ENG 121**			**Passed ENG 121**		
CCR 091	153	11.1%	88.9%	15	93.3%	6.7%
CCR 092	4611	16.7%	83.3%	671	76.3%	23.7%
CCR 093	790	27.2%	72.8%	187	75.9%	24.1%
CCR094*	4617	98.2%	1.8%	4162	75.3%	24.7%
DE	**Enrolled in GT Course**			**Passed GT Course**		
CCR 091	153	48.4%	51.6%	71	64.8%	35.2%
CCR 092	4611	39.1%	60.9%	1829	76.2%	23.8%
CCR 093	790	94.4%	5.6%	725	69.5%	30.5%
CCR 094*	4617	52.0%	48.9%	2472	77.1%	22.9%

*Students in CCR 094 were co-enrolled in ENG 121.

In most cases, "enrollment in college-level course" refers to a student sitting in English 121. As students in CCR 094 were co-enrolled in English 121, these students report almost 100 percent enrollment for a college-level course—suggesting the clear advantage of CCR 094 for moving students forward. As the raw numbers in the N columns in Table 8 suggest, CCR 091 and CCR 093 were not as widely implemented during the study period. However, they do show some positive results in terms of passing rates. As more colleges begin to implement these redesign options and offer more sections, it will be important to analyze whether the gains shown here persist, grow, or decline.

Results from the chi-square test revealed that redesign option is associated with enrollment. For ENG 121 ($\chi^2 = 6562.78$, $p = 0.000$), the association was statistically significant. The effect size was, however, not strong at 0.80. For GT ($\chi^2 = 851.13$, $p = 0.000$), the association was also statistically significant, but the effect size was small to moderate at 0.29. When analyzing completion rates, however—measured as earning a grade of C or higher—there was no statistically significant association for ENG 121, and the statistically significant association that emerged with regard to GT ($\chi^2 = 22.5$, $p = 0.000$) had an effect size (0.06) that indicated the association bears little practical significance.

Finally, we also examined time to enrollment in ENG 121 for the different CCR options. Again, almost 100% of students in CCR 094 were immediately enrolled in an ENG 121 course. Most of those in CCR 091, CCR 092, and CCR 093 were enrolled after one term.

TABLE 9: TIME TO ENROLLMENT IN ENG 121 BY STATE-REDESIGN CCR OPTION

State Redesign	Zero terms	One term	Two terms	Three terms	N
CCR 091	5.9%	76.5%	17.6%	0.0%	17
CCR 092	0.9%	67.0%	29.1%	3.0%	772
CCR 093	2.3%	73.0%	21.4%	3.3%	215
CCR 094	99.9%	0.0%	0.1%	0.0%	4535
Total	**82.0%**	**12.4%**	**5.0%**	**0.5%**	**5539**

Outcomes for Math

We now turn to student outcomes for the redesign of DE math, which involved the creation of two distinct pathways: quantitative literacy (MAT 050) and algebraic literacy (MAT 055).

Math Cohort Samples

TABLE 10: DEMOGRAPHIC PROFILE OF HISTORIC AND STATE-REDESIGN MATH COHORTS

Demographics	HISTORIC	STATE REDESIGN
Gender	**12244**	**15393**
Female	*59.6%*	*55.4%*
Male	*40.4%*	*44.6%*
Ethnicity	**11765**	**13715**
White Non-Hispanic	*62.2%*	*52.6%*
Black Non-Hispanic	*10.0%*	*11.1%*
Hispanic	*23.3%*	*28.7%*
Asian or Pacific Islander	*2.9%*	*4.3%*
American Indian or Alaskan Native	*1.6%*	*3.3%*
Veteran status	**12248**	**15414**
No	*96.7%*	*94.6%*
Yes	*3.3%*	*5.4%*
Age at first DE	**12248**	**15414**
Mean	*26.22*	*23.67*
SD	*9.16*	*8.56*
Accuplacer Arithmetic Score	**3917**	**4298**
Mean	*53.08*	*50.15*
SD	*25.03*	*23.15*
Accuplacer Elementary Algebra Score	**2503**	**8754**
Mean	*39.20*	*46.97*
SD	*12.42*	*16.99*
Enrollment Status	**12169**	**15414**
Full time	*53.5%*	*28.8%*
Three-quarter time	*4.2%*	*17.9%*
Half time	*27.2%*	*20.2%*
Less than half time	*14.5%*	*23.0%*
First-term students	*0.6%*	*10.1%*

As we did above with the English cohorts, we performed chi-square tests and t-tests where appropriate to determine if there were any statistically significant associations or differences between the math cohorts with respect to demographic and academic characteristics. We found that cohort membership was significantly associated with gender ($\chi^2 = 48.17$, $p = 0.000$, effect size = 0.042), ethnicity ($\chi^2 = 280.59$, $p = 0.000$, effect size = 0.11), veteran status ($\chi^2 = 68.44$, $p = 0.000$, effect size = 0.05), and enrollment status ($\chi^2 = 3551.7$, $p = 0.000$, effect size = 0.36). Additionally, t-test results indicate statistically significant differences in average age ($t[25421] = -23.61$, $p = 0.000$), effect size=0.29 Accuplacer Arithmetic score ($t[7981] = -5.492$, $p = 0.000$, effect size=0.12), and Accuplacer Elementary Algebra score ($t[5446] = 25.27$, $p = 0.000$, effect size=0.48) between the cohorts. We found

that this difference was larger for Accuplacer Elementary Algebra score (mean difference of 7.8) than it was for Accuplacer Arithmetic score (mean difference of 2.9) and age (mean difference of 2.5).[48]

Although the associations described above were found to be statistically significant, all of their effect sizes were weak with the exception of enrollment status and Accuplacer Elementary Algebra score. The larger effect size for enrollment status is reflected in the percentages shown in Table 10. About 53 percent of the students in the historic cohort reported full-time status compared to only 29 percent of the students in the state-redesign cohort. As mentioned earlier, this difference in enrollment status can have an effect on our analysis by influencing rates for any of the dependent variables, such as college performance.[49] The reader needs to keep this in mind when reviewing the following frequency rates. Below, in the regression analysis section, we adjust for these differences.

Table 10 also shows that members of the state-redesign cohort earned a slightly higher mean score on the Accuplacer Elementary Algebra exam. The fact that this difference both is statistically significant and has a moderate effect size indicates that those students may have been slightly better prepared for success in DE math than were their counterparts in the historic cohort. This could partially explain any differences that emerge with regard to success rates in DE math (especially MAT 055, the pre-algebra pathway) and college-level math courses between the cohorts.

Time to Enrollment in MAT 100+ by Cohort

Table 11 presents the frequencies for each cohort in terms of time to enrollment in a college-level math course subsequent to students completing one of the new math pathway courses, MAT 050 or MAT 055, as well as MAT 025 (the lab for MAT 055).[50] Again this analysis is specifically looking at those students who enrolled in 100-level math courses.

TABLE 11: TIME TO ENROLLMENT IN MAT 100+

	Historic	State Redesign
Time to MAT 100+ course	**1462**	**1900**
Zero Terms	1.0%	8.7%
One Term	28.2%	51.0%
Two Terms	13.7%	28.8%
Three Terms	18.5%	11.5%
Four or More Terms	38.5%	0.0%

[48] The effect size for Accuplacer Elementary Algebra score was 0.47, a moderate effect according to Cohen (1988). The effect sizes for Accuplacer Arithmetic and age were 0.28 and 0.11 respectively, which both fall into the "small" range.
[49] Grades are correlated with enrollment status.
[50] As earlier noted, we have not included in this analysis outcomes for students who were enrolled in MAT 091, 092, or 093. These are all lab courses designed to support students who are already enrolled in a college-level math (MAT 100+) course.

Students who enrolled in the redesigned math pathways enrolled far more quickly in college-level math courses[51] than did their counterparts in the historic cohort. In fact, 9 percent of students in the state-redesigned math pathways enrolled in a college-level math concurrently with their DE course (zero terms) in comparison to only 1 percent in the historic cohort. Overall, close to 60 percent of state-redesign students enrolled in a 100-level math course either while completing or immediately after completing their DE math course as compared to only 29 percent of the historic cohort who did so.

Enrollment percentages differ greatly from those found for CCR—while both redesigns show improvements with regard to time to enrollment, the improvement in math is far less dramatic than in CCR. The likely reason is that for CCR there were two options—CCR 093 and CCR 094—in which students were co-enrolled in DE and a college-level course. For math, three labs were offered as co-requisites for higher-testing DE math students who enrolled in college-level math courses (Math 091, 092 and 093), but there were no co-enrollment options for students who tested at lower levels. Additional tracking over time for these labs would be helpful. It may be helpful for math faculty to examine the results that their CCR counterparts are having with their co-enrollment strategies and to explore whether and how those strategies might be effectively implemented in their departments.

TABLE 12: TIME TO FIRST MAT 100+ COURSE BY SCHOOL FOR HISTORIC AND STATE-REDESIGN COHORT

School	Historic						State Redesign				
	Zero terms	One term	Two terms	Three terms	Four terms +	N	Zero terms	One term	Two terms	Three terms	N
ACC	0.0%	23.8%	14.3%	19.0%	42.9%	63	0.0%	57.8%	42.2%	0.0%	45
CCA	2.5%	22.5%	5.0%	5.0%	65.0%	40	2.6%	55.1%	42.3%	0.0%	78
CCD	2.2%	24.2%	13.7%	23.6%	36.3%	182	1.1%	54.3%	24.7%	19.9%	562
CNCC	0.0%	40.0%	5.0%	15.0%	40.0%	20	10.0%	52.5%	7.5%	30.0%	40
FRCC	0.8%	26.9%	16.9%	17.4%	38.0%	242	10.5%	42.0%	47.5%	0.0%	314
LCC	0.0%	22.2%	11.1%	16.7%	50.0%	18	16.7%	55.6%	13.9%	13.9%	36
MCC	0.0%	15.0%	15.0%	25.0%	45.0%	20	0.0%	28.6%	71.4%	0.0%	7
NJC	0.0%	30.8%	7.7%	23.1%	38.5%	26	0.0%	50.0%	50.0%	0.0%	10
OJC	0.0%	23.5%	35.3%	23.5%	17.6%	17	0.8%	60.7%	18.9%	19.7%	122
PCC	0.4%	33.7%	10.6%	16.1%	39.2%	255	11.5%	54.6%	18.7%	15.1%	390
PPCC	1.2%	26.7%	12.9%	19.4%	39.8%	412	28.2%	31.1%	40.7%	0.0%	177
RRCC	1.1%	40.2%	21.7%	8.7%	28.3%	92	100.0%	0.0%	0.0%	0.0%	1
TSJC	0.0%	26.7%	13.3%	29.3%	30.7%	75	14.4%	61.9%	18.6%	5.1%	118
Total	**1.0%**	**28.2%**	**13.7%**	**18.5%**	**38.5%**	**1462**	**8.7%**	**51.0%**	**28.8%**	**11.5%**	**1900**

[51] For our analysis we used college-level math courses numbered 100 and above (see end of this report for a list of these courses). The following 100-level math courses were excluded: MAT 101, MAT 106, MAT 111, MAT 175, MAT 178, MAT 179, and MAT 275. The decision to exclude these courses was made by the CCCS and was based on the content of the courses.

Table 12 looks at just those students who enrolled in MAT 100+. Overall, across the colleges, we found a larger percentage of earlier enrollments in 100-level math courses among students in the state-redesign cohort than among students in the historic cohort. For example, at ACC, enrollment within one semester of DE completion more than doubled, jumping from 23.8% of students in the historic cohort to 57.8% of state-redesign students. At TSJC, the impact was even more dramatic, with early enrollments rising from 26.7% among the historic cohort to 76.3% of the state-redesign cohort—an increase of about 285%. As indicated above, we have to be cautious with these results given the different rollout of the pathway courses, the sample size, and the impact of time censoring. This is particularly important at MCC, NJC, and RRCC, where the state-redesign sample size was very small. In fact, at RRCC, while we found 100% enrollment within zero terms, this sample only includes one student.

Student Grades in MAT 100+ by Cohort

TABLE 13: MAT 100+ COURSE GRADES BY COHORT

	HISTORIC	STATE REDESIGN
Grade in MAT 100+	**1276**	**1557**
F	11.4%	14.0%
D	5.8%	9.6%
C	23.6%	26.3%
B	30.8%	28.2%
A	28.4%	21.9%

In Table 13, we see a relatively small difference in the proportion of students earning a C or better in their MAT 100+ courses between the two cohorts: 83 percent for the historic cohort versus 76 percent in the state-redesign cohort. On the other end of the spectrum, 23.6 percent of state-redesign students received a D or F as compared to only 17.2 percent of students in the historic cohort. That the difference is not greater is a positive sign for the state redesign, which accelerated the DE math pathway for students.[52] However, these findings suggest the need to track outcomes over a longer period of time to see if this difference persists—if not, the difference we see here is likely a result of the "hiccups" of implementing the new math pathways.

[52] Indeed, this finding contradicts our earlier prediction, based on the difference in Accuplacer Elementary Algebra scores between the cohorts observed in our demographic analysis, that students in the state-redesign cohort would fare better than their historic-cohort counterparts with regard to successful completion of their college-level coursework. It is possible that this discrepancy is a result of the decision to omit MAT 091, 092, and 093 from our analysis. Because those are lab courses designed to support high-scoring DE students with their 100-level coursework, it follows that omitting those students from the analysis inadvertently resulted in biasing our math results by removing the highest performing students from the state-redesign cohort.

TABLE 14: COURSE GRADE IN MAT 100+ BY COLLEGE AND COHORT

School	Historic						State Redesign					
	F	D	C	B	A	N	F	D	C	B	A	N
ACC	13.6%	3.4%	23.7%	27.1%	32.2%	59	8.6%	5.7%	17.1%	37.1%	31.4%	35
CCA	6.5%	3.2%	22.6%	29.0%	38.7%	31	4.3%	5.8%	21.7%	34.8%	33.3%	69
CCD	7.1%	6.0%	31.5%	28.6%	26.8%	168	18.4%	13.8%	29.1%	25.9%	12.8%	413
CNCC	13.3%	6.7%	26.7%	26.7%	26.7%	15	21.9%	12.5%	21.9%	18.8%	25.0%	32
FRCC	11.8%	5.4%	20.6%	32.8%	29.4%	204	14.9%	7.2%	24.1%	28.1%	25.7%	249
LCC	5.9%	0.0%	35.3%	23.5%	35.3%	17	9.7%	9.7%	35.5%	32.3%	12.9%	31
MCC	0.0%	0.0%	18.8%	37.5%	43.8%	16	0.0%	16.7%	16.7%	50.0%	16.7%	6
NJC	16.7%	4.2%	37.5%	16.7%	25.0%	24	0.0%	33.3%	66.7%	0.0%	0.0%	6
OJC	25.0%	0.0%	6.3%	18.8%	50.0%	16	13.6%	10.0%	29.1%	29.1%	18.2%	110
PCC	11.2%	3.4%	23.2%	30.0%	32.2%	233	9.2%	6.4%	26.0%	29.8%	28.6%	346
PPCC	11.6%	8.7%	22.9%	33.9%	22.9%	345	18.2%	14.2%	21.6%	25.0%	20.9%	148
RRCC	10.7%	7.1%	17.9%	28.6%	35.7%	84	N/A	N/A	N/A	N/A	N/A	N/A
TSJC	20.3%	6.3%	21.9%	32.8%	18.8%	64	13.4%	4.5%	27.7%	30.4%	24.1%	112
Total	**11.4%**	**5.8%**	**23.6%**	**30.8%**	**28.4%**	**1276**	**14.0%**	**9.6%**	**26.3%**	**28.2%**	**21.9%**	**1557**

Overall, the difference in percentages of students who earned a C or better in the state-redesign cohort was about 6 percentage points lower than that of the historic cohort. However, when we look at completion rates (defined as earning a grade of C or better) at each college individually, as shown on Table 14, we see that students in the state-redesign cohort at several colleges did slightly better (e.g., ACC, OJC), and at one college—TSJC—they did relatively better.[53] It will be important to look more closely at these three colleges—especially at TSJC—to understand what might be contributing to their positive results. Again, however, we need to take into account the small sample size at some of the schools in the state-redesign cohorts (specifically, MCC and NJC) and view these results with caution.

Comparisons of the Redesigned Math Pathways

TABLE 15: ENROLLMENT AND COMPLETION RATES BY STATE-REDESIGN MATH PATHWAY

	Enroll MAT 100+			Pass MAT 100+		
	Total	Enrolled	Not enrolled	Total	Pass	No Pass
MAT 050	9436	8.9%	91.1%	697	79.6%	20.4%
MAT 055	4478	16.2%	83.8%	583	73.6%	26.4%
MAT 055/MAT 025	1260	14.9%	85.1%	140	75.0%	25.0%
MAT 091	164	89.0%	11.0%	137	73.0%	27.0%

Table 15 compares the outcomes for students enrolled in the two major math pathways and the students who co-enrolled in Math 055 and Math 025 (its lab). It also looks at Math 091, which

[53] Note, no tests of significance were done for by college outcomes.

provides an opportunity to examine a 100-level co-requisite experience on math outcomes.[54] A higher proportion of students in MAT 055 went on to enroll in a math 100-level course during the study period—31.1 percent compared to only 8.9 percent for students in Math 050. However, overall it should be noted that the rates for enrollment in a math 100-level courses are low.

At the same time, as seen on Table 16, 51 percent of students in one of the two pathways enrolled in 100-level math courses within one term after completion of their DE math course. Time censoring thus may have impacted these outcomes. In other words, if the pattern of enrollment is a minimum of one semester between completion of MAT pathways and a student's enrollment in college-level math, not enough semesters passed during the study period to capture the actual rate of enrollment. Further, as indicated in EERC's qualitative report,[55] many colleges chose to launch Math 055 before MAT 050, which would have differentially affected opportunities for MAT 050 students to enroll within the study period.

Table 16 also shows that there was a similar success rate of students enrolling in a 100-level math course within one term of DE course completion regardless of whether they took Math 050 or 055. This is a positive outcome and bodes well for the state-redesigned pathways.

TABLE 16: TIME TO ENROLLMENT BY STATE-REDESIGN MATH OPTION

State Redesign	Zero terms	One term	Two terms	Three terms	N
MAT 050	0.4%	48.6%	32.0%	19.0%	840
MAT 055	2.6%	61.7%	29.5%	6.2%	726
MAT 055/MAT 025	1.1%	59.0%	34.0%	5.9%	188
MAT 091	96.6%	1.4%	0.7%	1.4%	146
Total	**8.7%**	**51.0%**	**28.8%**	**11.5%**	**1900**

Echoing the co-enrollment options discussed earlier with regard to College Composition and Reading, in which students can take a DE course concurrent to a 100-level subject-matter course (CCR 093) or ENG 121 (CCR 094), the state-redesigned MAT 091 lab is an opportunity for higher-testing DE math students to co-enroll in a 100-level math course while taking MAT 091.

This of course contrasts with the enrollment pattern of the historic cohort; students in that cohort tended to take longer to enroll in 100-level math. The outcomes to date reflect the effect of redesign on acceleration and on bridging the gap between the DE and college-level courses. As mentioned above, co-enrollment options should be explored further for math. To date, few schools have employed this strategy, but it may prove to be very effective at accelerating students to the college level.

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[54] Co-enrollment strategies are being discussed as an option for math delivery in Colorado, so the inclusion of MAT 091 in this report is meant to inform those discussions. Due to the low N size, however, any results regarding MAT 091 discussed here will need to be further examined as more colleges adopt this strategy. Other math labs were not included in the analysis due to even smaller sample sizes.

[55] Michael, S. & Mckay, H. (2015). The transformation of Colorado's developmental education program: Observations and findings. Piscataway, NJ: Rutgers University, School of Management and Labor Relations, Education and Employment Research Center.

PART FOUR: MULTIVARIATE ANALYSES

The next step of our analysis was to test out the relationship between the dependent variables (time to enrollment, grade C or better, and college-level course completion) and the independent variables (cohort, redesign, and student characteristics) in the cohort samples, and then to do further analyses using propensity matching to adjust for differences in the samples.

Regression Analysis

The regression analyses below identify which of the independent variables listed in Table 1 had an effect on student outcomes. We used ordinal logistic regression when our outcome variable was measured on an ordinal scale (e.g., time to enrollment) and binary logistic regression when our outcome variable was dichotomous (i.e., grade C or better, enrollment, and completion). Results are reported separately for CCR and math. Both ordinal and binary logistic regression assesses the *odds ratio*, or the probability, of an outcome variable given the independent variable. In our regression analysis, we include in each table only the variables that are statistically significant at $p<0.05$. Variables that are not statistically significant are not shown in the tables.

It should be noted that we are taking time to enrollment for all of the CCR options including the co-enrolled CCR 04/ENG 121 option.

Similarly, students enrolled in MAT 091 took this lab concurrent to taking a MAT 100-level course, affecting the time to enrollment outcome.

We begin our analysis comparing the two cohorts—historic and state redesign; this analysis is followed by zeroing in on the different options offered under the state redesigns only.

English/College Composition and Reading

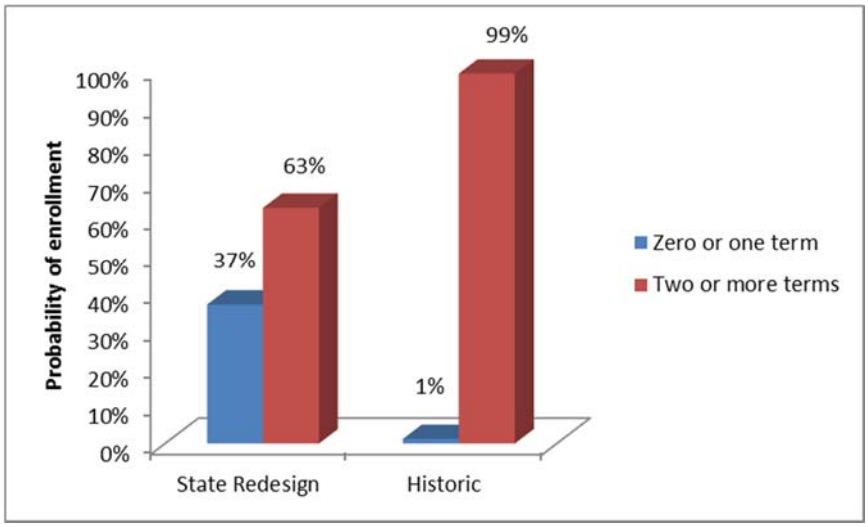
Effects on Time to Enrollment in English 121 and GT Courses[56]

The ordinal logistic regression found that membership in one of the cohorts (historic or state redesign) as well as employment and veteran status were related to time to enrollment in ENG 121. The figure below illustrates that for students in the state-redesign cohort the probability of time to enrollment at zero or one term was 37% compared to only 1% for the historic cohort; on the other hand, the probability of time to enrollment at two or more terms was 63% for students in the state-redesign cohort as compared to 99% for the historic cohort. This confirms our prior finding, revealed by examining the descriptive statistics of each cohort, that students in the historic cohort

[56] We have only included in this analysis students who enrolled in an ENG 100+, GT, or English 121 course. We did not include students who took one of the CCR options but did not go on to enroll in a course that fell into one of these categories.

took far longer to move from a DE course to a college-level course than did those in the state-redesign cohort.

FIGURE 1: EFFECT OF COHORT MEMBERSHIP ON TIME TO ENG 121 ENROLLMENT



In Figure 2, which is based on the data shown in Table 17, the intercept is the probability or the odds given that the predictors included in the model are set at zero—thus, when the independent variable is dichotomous, the intercept represents the odds ratios for the response that is not represented by the one entered into the model. In the model depicted in Figure 2, then, the intercept line represents the odds of enrollment at each time interval for a student a) in the historic cohort who is b) white, c) a nonveteran, and d) not employed.

In the model depicted here, we can see that cohort membership [57]had a substantial effect on time to enrollment because it changes the shape of the model's predictive curve drastically. Comparing the intercept and cohort curves shows that enrollment at lower terms increased with membership in the state-redesign cohort as compared to membership in the historic cohort, while enrollment at 4 or more terms decreased. This finding is consistent with the descriptive statistics provided above on time to enrollment, which revealed a major difference in the pattern of time to enrollment among the two cohorts (see Table 3).

In contrast, ethnicity, veteran status (veteran = 1), employment status (employed = 1), enrollment status, and Accuplacer Sentence Skills score did not change time to enrollment very much—those lines move quite smoothly in tandem with the intercept line.

[57] The coding of the variable cohort is State Redesign =1 and Historic=0

FIGURE 2: THE EFFECT OF COHORT, ETHNICITY, EMPLOYMENT, VETERAN STATUS, AND ENROLLMENT STATUS ON THE PROBABILITY OF ENG 121 ENROLLMENT AT DIFFERENT TERMS

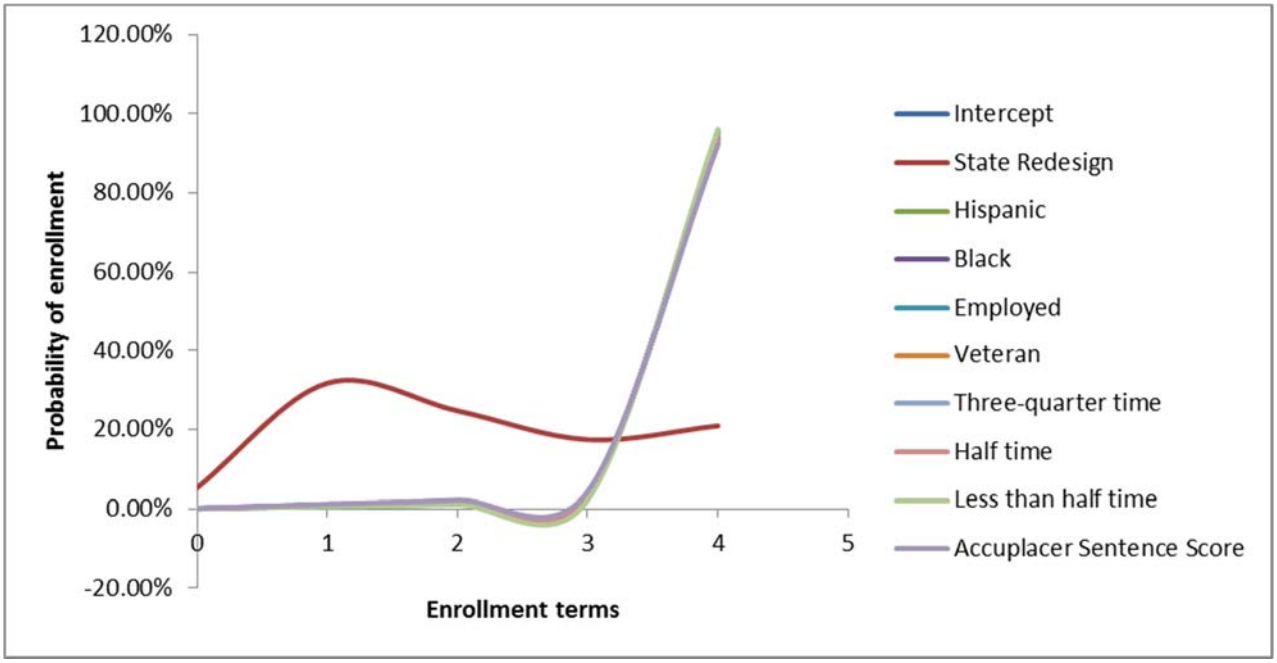


TABLE 17: PROBABILITY OF TIME TO ENROLLMENT IN ENG 121

	Zero terms	One term	Two terms	Three terms	Four or more terms
Intercept	0.12%	1.10%	2.05%	4.09%	92.65%
State Redesign	5.26%	31.70%	24.72%	17.42%	20.90%
Ethnicity					
Hispanic	0.10%	0.92%	1.73%	3.48%	93.77%
Black	0.00%	1.01%	1.71%	3.45%	93.84%
Employed	0.07%	0.64%	1.21%	2.48%	95.61%
Veteran	0.08%	0.72%	1.37%	2.78%	95.05%
Enrollment status					
Three-quarter time	0.08%	0.80%	1.51%	3.06%	94.54%
Half time	0.10%	0.91%	1.70%	3.43%	93.87%
Less than half time	0.06%	0.57%	1.08%	2.21%	96.08%
Accuplacer Sentence Skills Score	0.12%	1.17%	2.18%	4.32%	92.21%

Time to enrollment in a GT course shows a different picture; those probabilities are shown in Table 18. Here, gender, age at first DE, and enrollment status all affected the time to enrollment in a GT course in addition to employment and veteran status. It still took more time for students in the

historic cohort to enroll in GT courses than it did for students in the state-redesign cohort[58]—the probability of enrollment at zero terms was much lower for the historic cohort (58 percent) than it was for the state-redesign cohort (83 percent). With regard to enrollment status categories, full-time students had the highest probability of enrollment at zero terms (58 percent). Age and Accuplacer Sentence Skills Score had almost similar effect, which are almost in line with the intercept.

TABLE 18: PROBABILITY OF TIME TO ENROLLMENT IN FIRST GT COURSE

	Zero terms	One term	Two terms	Three terms	Four or more terms
Intercept	58%	24%	9%	4%	5%
State Redesign	83%	11%	3%	1%	1%
Hispanic	53%	26%	11%	5%	6%
Male	65%	21%	8%	3%	3%
Employed	44%	28%	14%	6%	8%
Veteran	49%	27%	12%	5%	6%
Enrollment status					
Three-quarter time	46%	28%	13%	6%	7%
Half time	34%	29%	17%	9%	11%
Less than half time	40%	29%	15%	7%	9%
First-term students	0%	71%	14%	7%	8%
Age at start of DE	57%	24%	10%	4%	5%
Accuplacer Sentence Skills score	58%	24%	9%	4%	5%

Note: All the predictors included here are significant at $p < 0.05$ level.

Effects on Students' Likelihood to Pass ENG 121 and GT with Grade C or Higher

We then turned to a comparison of the two cohorts with respect to the successful completion of their ENG 121 and GT courses.

Table 19 shows that the probability of earning a C or higher in English 121 was effected by cohort membership, race/ethnicity, gender, and age—the same factors that affected time to enrollment in

[58] An ordinal logistic regression calculates the cumulative log odds of the ordered categories (zero terms, one term, two terms, three terms, and four or more terms). That means that the proportion of each of this ordered category will sum up to one. To calculate individual probabilities for each of the ordered categories we simply subtract within the cumulative proportions. For example, the cumulative proportion for four or more terms and less was 1 and the cumulative probability for three terms and less was 0.990009 and therefore the probability of four or more terms would be 1-0.990009, which is 0.0099. Similarly, the cumulative proportion of two terms and less was 0.98 and the cumulative proportion of three terms and less was 0.99, so the probability of three terms will be 0.99-0.98 = 0.01. In other words, the individual probabilities of each of the categories are the difference of the proportions. In Table 18, then, the probability of students in the historic cohort enrolling at zero terms is 0.59 compared to the probability for state-redesign students (represented by the intercept coefficient), which is 0.80. So, students in the historic cohort were less likely to enroll at zero terms than were students in state-redesign cohort.

a GT course. Those in the state-redesign cohort had slightly lower odds of earning a C or better in ENG 121 when compared to members of the historic cohort. Black and American Indian/Alaska native students had lower odds of earning a grade of C or higher compared to white students, and females had higher odds of doing so compared to males. Age was positively related to earning a C or higher: the older the student, the more likely he or she was to pass ENG 121.

TABLE 19: SUMMARY OF LOGISTIC REGRESSION[59] ANALYSIS FOR VARIABLES PREDICTING GRADE C OR HIGHER IN ENG 121

						95% Confidence Interval for EXP(B)	
	Beta	Standard Error	Degree of Freedom	Sig.	Exp(Beta)	Lower	Upper
State Redesign	-0.326	0.084	1	0.000	0.722	0.611	0.851
Ethnicity			4	0.000			
Black	-0.47	0.092	1	0.000	0.625	0.522	0.749
American Indian/ Alaska Native	-0.506	0.178	1	0.004	0.603	0.425	0.855
Male	-0.39	0.066	1	0.000	0.677	0.595	0.771
Age at First DE	0.025	0.004	1	0.000	1.025	1.016	1.034
Constant	0.951	0.24	1	0.000	2.589		

Conversely, Table 20 indicates that the probability of earning a C or better in a GT course was higher for students in the state-redesign cohort compared to members of the historic cohort. For the state-redesign cohort the probability of earning grade C or higher was 74 percent in contrast to 69 percent for the historic cohort. Some similarities to the ENG 121 analysis do emerge, however. Across race/ethnic groups, black, Hispanic, and American Indian/Alaska native students again had lower odds of passing their first GT course than did to white students (though in this case, Asian/Pacific Islander students had higher odds of doing so than did their white counterparts). Again we see that males had a lower probability of passing their college-level GT courses than females did, and the chances of earning a C or higher grade increased with age. Finally, those enrolled as three-quarter time, half time, or first-term students had lower odds of successfully completing their GT course compared to full-time students.

[59] In logistic regression, *Beta* is the coefficient for the intercept (dependent variable) and each of the independent variables. The coefficient is represented in terms of the *log of odds*. Taking the log of odds is a transformation technique used to make interpretation easier, since the range of odds usually goes from 0 to positive infinity while the range of log of odds is from negative to positive infinity. The log of odds is a better coefficient because negative log of odds can be seen to relate to smaller odds and smaller probability, and positive log of odds to higher odds and greater probability. In other words, the Beta coefficient explains how the independent variables affect the dependent variable. The *standard error* is a measure of how the sample is representative of the population. A larger standard error is usually related to a less representative sample. The *degree of freedom* relates to the predictors entered into the model. Each predictor is counted as one degree of freedom. *Significance* (Sig.) expresses whether the coefficient is statistically significant (i.e., the *p* value), and Exp(Beta) is an *exponent of the Beta coefficient* that transforms the log of odds into odds that can be used to transform into probabilities. The last two columns provide the range of values expected to fall within the upper and lower limit of values for the exponent of Beta at a 95% *confidence interval*.

TABLE 20: SUMMARY OF LOGISTIC REGRESSION ANALYSIS FOR VARIABLES PREDICTING GRADE C OR HIGHER IN GT COURSE

	Beta	Standard Error	Degree of Freedom	Sig.	Exp(Beta)	95% Confidence Interval for EXP(B) Lower	Upper
State Redesign	0.251	0.069	1	0.000	1.286	1.123	1.472
Ethnicity			4	0.000			
Black	-0.468	0.084	1	0.000	0.626	0.531	0.738
Hispanic	-0.19	0.07	1	0.007	0.827	0.72	0.949
Asian/Pacific Islander	0.284	0.135	1	0.035	1.329	1.02	1.732
American Indian/ Alaska Native	-0.452	0.165	1	0.006	0.636	0.46	0.88
Male	-0.461	0.06	1	0.000	0.631	0.561	0.709
Age First DE	0.022	0.004	1	0.000	1.022	1.014	1.03
Enrollment status			4	0.000			
Three-quarter time	-0.717	0.087	1	0.000	0.488	0.412	0.578
Half time	-0.22	0.08	1	0.006	0.802	0.686	0.938
First-term students	-0.363	0.144	1	0.012	0.696	0.524	0.923
Constant	0.802	0.195	1	0.000	2.231		

Future Enrollment and Success in English 121 and GT Courses Across State-Redesigned CCR Options

We next will explore whether and how the different state-redesigned DE course options affected students' probability of enrollment in ENG 121 or a GT course and/or the grade received in that course. For this analysis we therefore limited our data set to consider only students in the state-redesign cohort who enrolled in one of the redesigned CCR courses: CCR 091, CCR 092, CCR 093, and CCR 094. In our analyses, we control for students' demographic characteristics, Accuplacer Sentence Skills score, and enrollment status. We measure enrollment as a dichotomous variable indicating whether a student enrolled in a college-level course (ENG 121 or GT). It is assumed that those DE pathways that are paired with college-level courses (i.e., CCR 094 with ENG 121 and CCR 093 with GT) will have a greater effect on enrollment.

TABLE 21: SUMMARY OF LOGISTIC REGRESSION ANALYSIS FOR VARIABLES PREDICTING CONCURRENT OR FUTURE ENROLLMENT ENG 121

	Beta	Standard Error	Degree of Freedom	Sig.	Exp(Beta)	95% Confidence Interval for EXP(B) Lower	Upper
Veteran	0.619	0.166	1	0.000	1.857	1.343	2.569
Male	-0.256	0.084	1	0.002	0.774	0.657	0.913
Age at First DE	0.012	0.005	1	0.012	1.012	1.003	1.021
Employed	1.441	0.09	1	0.000	4.226	3.542	5.043
Accuplacer Sentence Skills score	-0.007	0.004	1	0.035	0.993	0.986	0.999
Enrollment Status			4	0.000			
Three-quarter time	-0.227	0.111	1	0.040	0.797	0.641	0.99
Half time	-0.43	0.118	1	0.000	0.65	0.516	0.819
Less than half time	-0.56	0.14	1	0.000	0.571	0.434	0.752
First-term students	-0.589	0.15	1	0.000	0.555	0.413	0.745
First DE			3	0.000			
CCR 091	-0.825	0.344	1	0.017	0.438	0.223	0.861
CCR 093	0.741	0.119	1	0.000	2.097	1.66	2.65
CCR 094	6.33	0.178	1	0.000	561.189	396.273	794.736
Constant	-1.424	0.283	1	0.000	0.241		

The results shown in Table 21 indicate that students who enrolled in CCR 093 and CCR 094 had higher odds of enrolling in ENG 121 than did those students who took CCR 091 or CCR 092. (Students in CCR 091 had the lowest probability of ENG 121 enrollment overall.) Again, the fact that students enrolled in CCR 094 had the highest probability of ENG 121 enrollment is no surprise given that these students were concurrently enrolled in CCR 094 and ENG 121 according to that pathway's design. We also notice the odds of enrollment are higher for veterans compared to nonveterans (1.857) and for the employed as compared to the unemployed (4.226). Males, on the other hand, had lower odds of enrollment than females (0.657). Comparing across categories of enrollment status, students in three-quarter time, half time, less than half time, or first-term status had lower odds of enrollment than full-time students had.

TABLE 22: SUMMARY OF LOGISTIC REGRESSION ANALYSIS FOR VARIABLES PREDICTING CONCURRENT OR FUTURE ENROLLMENT IN A GT COURSE

	Beta	Standard Error	Degree of Freedom	Sig.	Exp(Beta)	95% Confidence Interval for EXP(B) Lower	Upper
Veteran	0.301	0.101	1	0.003	1.352	1.11	1.646
Age at First DE	-0.002	0.003	1	0.526	0.998	0.992	1.004
Employed	0.762	0.063	1	0.000	2.143	1.895	2.423
Accuplacer Sentence Skills score	-0.007	0.002	1	0.001	0.993	0.988	0.997
Enrollment status			4	0.000			
Three-quarter time	-0.931	0.068	1	0.000	0.394	0.345	0.451
Half time	-1.33	0.072	1	0.000	0.265	0.23	0.304
Less than half time	-1.399	0.091	1	0.000	0.247	0.207	0.295
First-term students	-0.775	0.089	1	0.000	0.461	0.387	0.548
First DE [60]			3	0.000			
CCR 093	3.762	0.206	1	0.000	43.033	28.76	64.391
CCR 094	0.526	0.066	1	0.000	1.692	1.488	1.924
Constant	0.768	0.185	1	0.000	2.156		

We found that enrollment in GT courses were related to students' redesign pathway as well as other characteristics. As shown in Table 22, students who took CCR 093 or CCR 094 had higher odds of enrolling in a GT course than did students who enrolled in CCR 092. Those who were employed had twice the odds of enrolling in a GT course than those who were not employed. Comparing enrollment status, students enrolled full time had better odds of enrolling in a GT course than the rest.

We next looked at the effects of our dependent variables on students' likelihood to pass the first ENG 121 or GT course in which they enrolled. Again we define "passing" as earning a C or better as the final course grade.

[60] While CCR 091 was used in the analysis, its impact was not significant, i.e., it did not have a higher or lower affect than CCR 092, and thus not included in the above table.

TABLE 23: SUMMARY OF LOGISTIC REGRESSION ANALYSIS FOR VARIABLES PREDICTING GRADE C OR HIGHER IN ENG 121

	Beta	Standard Error	Degree of Freedom	Sig.	Exp(Beta)	95% Confidence Interval for EXP(B) Lower	Upper
Ethnicity			4	0.000			
Black	-0.448	0.11	1	0.000	0.639	0.515	0.793
American Indian/ Alaska Native	-0.631	0.195	1	0.001	0.532	0.363	0.779
Male	-0.475	0.078	1	0.000	0.622	0.534	0.724
Age at First DE	0.017	0.005	1	0.001	1.017	1.007	1.027
Constant	0.782	0.315	1	0.013	2.186		

Our findings indicate that the odds for passing ENG 121 were unrelated to the redesigned CCR course in which students enrolled (Table 23). As we found earlier with respect to GT courses, ethnicity and gender both emerged as significant predictors of success in this model, with black, American Indian/Native Alaskan, and male students having lower odds of passing ENG 121 than white or female students.

TABLE 24: SUMMARY OF LOGISTIC REGRESSION ANALYSIS FOR VARIABLES PREDICTING GRADE C OR HIGHER IN STUDENTS' FIRST GT COURSE

	Beta	Standard Error	Degree of Freedom	Sig.	Exp(Beta)	95% Confidence Interval for EXP(B) Lower	Upper
Ethnicity			4	0.000			
Black	-0.405	0.112	1	0.000	0.667	0.536	0.83
American Indian/ Alaska Native	-0.567	0.192	1	0.003	0.567	0.389	0.827
Male	-0.448	0.078	1	0.000	0.639	0.548	0.745
Enrollment status			4	0.000			
Three-quarter time	-0.536	0.099	1	0.000	0.585	0.481	0.711
First-term students	-0.305	0.148	1	0.039	0.737	0.552	0.985
First DE			3	0.000			
CCR 091	-0.973	0.29	1	0.001	0.378	0.214	0.668
CCR 093	-0.364	0.13	1	0.005	0.695	0.539	0.896
Constant	1.363	0.282	1	0.000	3.906		

Table 24 presents the odds of students' passing their first GT course with a C or better. We found that passing the GT course was related to the student's redesign pathway, race/ethnicity, and enrollment status. In particular, students who took CCR 091 and CCR 093 had lower odds of passing their first GT course than did students who took CCR 092. The probability of students

passing their GT course was 60[61] percent for CCR 091 and 73 percent for CCR 093 while it was 80 percent for CCR 092. These findings are almost similar to descriptive analysis provided in Table 8 above. With regard to demographic characteristics, black students as well as American Indian/Alaska native students had lower odds of passing their first GT course than did white students. Females were more likely than males to earn a C or better in their first GT course. Finally, full-time students were more likely to pass than were students who were registered at three-quarter time or as first-term students.

Math

Again, we begin our analysis by comparing the two cohorts—historic and state redesign. This analysis is followed by one in which we will narrow our focus to compare the different math options offered under the state redesigns.

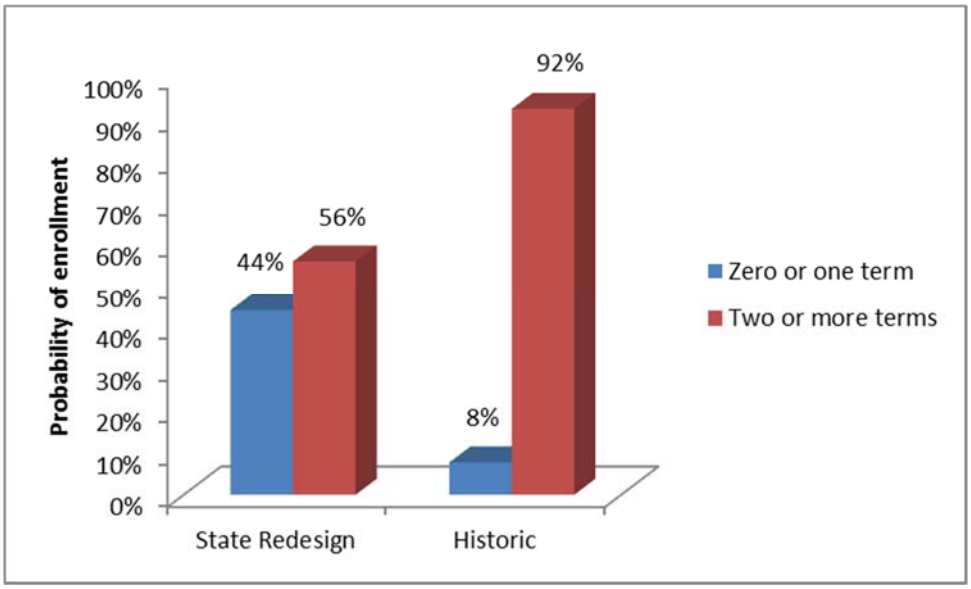
The Effect of Cohort Membership on Time to Enrollment in a College-Level Math Course (MAT 100+)

As we did with English/College Composition and Reading, we begin our examination with an ordinal regression analysis looking at the effect of cohort membership on time to enrollment in a MAT 100+ course. Our analysis looks at times to enrollment across all the MAT redesign options. Note, since students in MAT 091 are co-enrolled in a college-level course, our inclusion of MAT 091 students in the analysis adds a strong influence the time to enrollment rate of the state-redesign cohort. In other words, the state-redesign cohort is weighted towards earlier (zero to one) terms.

Of all the variables entered into our model, the cohort variable (membership in either the historic or state-redesign cohort) had the greatest impact on MAT 100+ enrollment. Additional control variables bearing statistically significant, though not as dramatic effects included Accuplacer Arithmetic score, age at which the first DE course was taken, and both employment and veteran status. With all other variables held constant, the probability of a student enrolling in a college-level math course within zero to one term of registering for DE math was higher if that student was a member of the state-redesign cohort than if he or she was a member of the historic cohort. As shown in Figure 3, while about 44% percent of the state-redesign cohort registered for a 100-level math course in that time frame, only about 8% of their counterparts in the historic cohort did so. In contrast, the probability of first enrollment occurring at two or higher terms was 92% for the historic cohort compared with 56% for the state-redesign cohort.

[61] Percentages are calculated using Beta values from the table.

FIGURE 3: THE EFFECT OF COHORT ON TIME TO ENROLLMENT IN A COLLEGE-LEVEL MATH (MAT 100+) COURSE



As shown in Figure 4, the probability of enrollment for the state-redesign cohort increases at zero to one term and thereafter decreases substantially, indicating the great effect of state-redesign-cohort membership. In contrast the rest of the variables, though statistically significant, are close to the intercept line, indicating less effect.

FIGURE 4: THE EFFECTS OF ACCUPLACER ARITHMETIC SCORE, VETERAN STATUS, COHORT MEMBERSHIP, AND EMPLOYMENT ON TIME TO ENROLLMENT IN A COLLEGE-LEVEL MATH (MAT 100+) COURSE

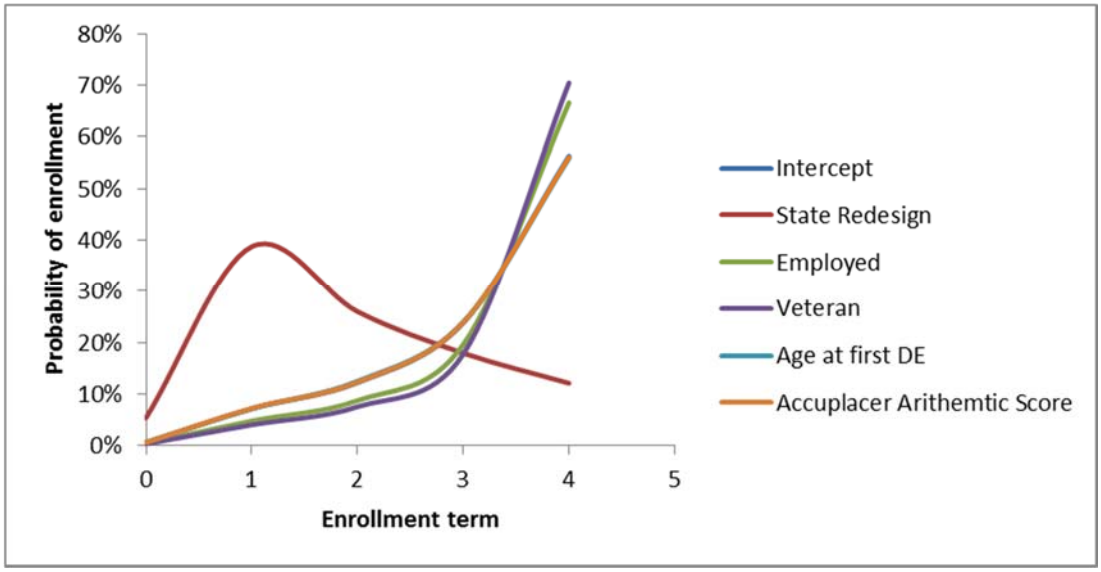


Table 25 provides the statistics that are depicted in the figure above.

TABLE 25: PROBABILITY OF TIME TO ENROLLMENT IN MAT 100+ COURSE

	Zero terms	One term	Two terms	Three terms	Four or more terms
Intercept	1%	7%	12%	24%	56%
State Redesign	5%	39%	26%	18%	12%
Employed	0%	5%	9%	20%	67%
Veteran	0%	4%	8%	18%	70%
Age at first DE	1%	7%	12%	24%	56%
Accuplacer Arithmetic Score	1%	7%	12%	24%	56%

The Effect of Cohort Membership on Passing College-Level Math (MAT 100+)

As in our analysis of performance in English and GT courses, we consider "passing" to be students' earning a grade of C or better in their first MAT 100+ course. Table 26 shows that cohort membership had no significant effect on course grades in college-level math. The only statistically significant predictors of performance in MAT 100+ were age at first DE, Accuplacer Arithmetic score, and race/ethnicity. Each unit increase in age increased the odds of getting a C or better by 1.04—thus, the odds of passing rose with age—but Black and Hispanic students had lower odds of passing their first college-level math course than did white students. Unit increases in Accuplacer Arithmetic score had a statistically but not practically significant effect. A close look at the values for Accuplacer Arithmetic score reveals that the Beta, though positive at .0008, is very small, and the *p* value of .048 barely makes it under the threshold of statistical significance (<.05).

TABLE 26: SUMMARY OF LOGISTIC REGRESSION ANALYSIS FOR VARIABLES PREDICTING GRADE C OR HIGHER IN MAT 100+

						95% Confidence Interval for EXP(B)	
	Beta	Standard Error	Degree of Freedom	Sig.	Exp(Beta)	Lower	Upper
Ethnicity			4	0.055			
Black	-0.669	0.321	1	0.037	0.512	0.273	0.96
Hispanic	-0.477	0.203	1	0.019	0.621	0.417	0.924
Age	0.046	0.011	1	0.000	1.047	1.024	1.071
Accuplacer Arithmetic	0.008	0.004	1	0.048	1.008	1	1.016
Constant	0.324	0.409	1	0.428	1.383		

Future Enrollment and Success in College-Level Math Courses Across State-Redesigned MAT Options

As presented below in Table 27, the different state-redesigned MAT options were significantly related to students' enrollment in a MAT 100+ course. When we coded the MAT options into a single categorical variable, we decided to designate MAT 050 as the reference category. This decision was based on the similarity of content between MAT 050 and the historic DE math

courses. It is interesting to note that when we entered all redesign pathways into the model—MAT 055, MAT 091, and MAT 055/MAT 025 (a course-and-lab combination)—the odds for enrollment in college-level math were greater for students in these courses than students who enrolled in MAT 050. The odds of MAT 100+ enrollment were highest for students who took MAT 091, which makes sense given that students in MAT 091 were concurrently enrolled in MAT 100+ courses by design. But we also observed that those who took MAT 055 paired with MAT 025 had greater odds of enrollment in a college-level course (2.69 times higher) than those who enrolled in MAT 050. Students who took MAT 055 alone increased in the odds of enrollment 1.32 over their 050-enrolled counterparts. In addition, a one-unit increase in age tended to increase the odds of enrollment by 1.02 points. The odds of MAT 100+ enrollment for those employed were 2.44 times higher than for those not employed. Students in less-than-half-time status and those in three-quarter-time status had lower odds of enrollment in college-level math than did full-time students.

TABLE 27: SUMMARY OF LOGISTIC REGRESSION ANALYSIS FOR VARIABLES PREDICTING CONCURRENT OR FUTURE ENROLLMENT IN MAT 100+ (STATE REDESIGN ONLY)

						95% Confidence Interval for EXP(B)	
	Beta	Standard Error	Degree of Freedom	Sig.	Exp(Beta)	Lower	Upper
Age	0.022	0.005	1	0.000	1.022	1.012	1.033
Employed	0.893	0.112	1	0.000	2.442	1.96	3.043
Enrollment status			4	0.000			
Three-quarter time	-0.729	0.154	1	0.000	0.483	0.357	0.653
Less than half time	-0.385	0.167	1	0.021	0.681	0.491	0.944
First DE			3	0.000			
MAT 055	0.592	0.159	1	0.000	1.807	1.323	2.467
MAT 091	3.888	0.335	1	0.000	48.81	25.306	94.144
MAT 055/MAT 025	0.99	0.169	1	0.000	2.69	1.93	3.75
Constant	-2.76	0.19	1	0.000	0.063		

We did not find the individual redesign options related to passing a college-level math course (Table 28). Only a student's race/ethnicity and age were related to passing MAT 100+. The probability of passing college-level math was 24 percent for black students compared to 42 percent for white students. An increase in age was related to a slight increase in the odds of passing MAT 100+.

TABLE 28: SUMMARY OF LOGISTIC REGRESSION ANALYSIS FOR VARIABLES PREDICTING GRADE C OR HIGHER IN MAT 100+ (STATE REDESIGN ONLY)

	Beta	Standard Error	Degree of Freedom	Sig.	Exp(B)	95% Confidence Interval for EXP(B) Lower	Upper
Ethnicity			4	0.170			
Black	-0.844	0.416	1	0.042	0.43	0.19	0.971
Age	0.053	0.016	1	0.001	1.055	1.023	1.088
Constant	-0.303	0.5	1	0.545	0.739		

Propensity Score Matching Analysis

Next we did propensity matching to equalize the cohorts across the various demographic and academic characteristics mentioned above [see Table 29 (English) and Table 34 (math) below]. The use of propensity score matching adjusts for any selection bias that may have occurred when the samples were created. For this part of our analysis we used *cohort* as the dependent variable and *ethnicity*, *age*, *employment*, *veteran status*, *enrollment status* and either *Accuplacer Sentence Skills score* (for English data) or *Accuplacer Arithmetic score* (for math data) as the independent variables. We selected these variables by a running logistic regression using only the variables that emerged as significantly related to the dependent variable *cohort* in the analyses presented in the previous section. Following propensity score matching we checked for the difference of independent variables per each cohort to make sure that there is no statistically significant difference post-match. Results are presented in the appendix to this report.

Subsequent to propensity matching, we engaged in further regression analysis. For both English and math the post-match results show substantial reductions in the differences previously observed between the cohorts for each of the above mentioned characteristics.

English/College Composition and Reading

TABLE 29: DIFFERENCE IN COHORT BEFORE AND AFTER MATCH

	BEFORE MATCH		AFTER MATCH	
COHORT	Number	Percent	Number	Percent
Historic	10713	51%	3073	50%
State Redesign	10128	49%	3073	50%
Total	**20841**	**100%**	**6146**	**100%**

Effects on Time to Enrollment in the College-level English or GT Course

In line with the findings from ordinal logistic regression above, the results displayed in Table 30 reveal that students in the state-redesign cohort had a higher probability of enrolling in ENG 121 at zero terms or one terms than students in the historic cohort had. The probability of a student

taking four of more terms to enroll in English 121 was 66 percent for the historic cohort, indicating that students in this cohort took far longer than their state-redesign counterparts to enroll in English 121. For veterans, the probability of time to enrollment at four or more terms was 76 percent, higher than those with nonveteran status. Students who were employed had a higher probability of ENG 121 enrollment at four or more terms than did students who were not employed. These results also indicate that students enrolled half time or less than half time had a higher probability of enrollment at four or more terms than students enrolled full time. In addition we found that the Accuplacer score made a difference, although the differences are more apparent at four or more terms than in earlier terms.

TABLE 30: SUMMARY OF LOGISTIC REGRESSION ANALYSIS FOR VARIABLES PREDICTING TIME TO ENROLLMENT IN ENG 121

	Zero terms	**One term**	**Two terms**	**Three terms**	**Four or more terms**
Intercept	0.02	0.10	0.09	0.13	0.66
State redesign	0.26	0.40	0.13	0.09	0.12
Accuplacer Sentence Skills score	0.03	0.10	0.09	0.13	0.65
Employed	0.02	0.08	0.08	0.12	0.71
Veteran	0.01	0.06	0.06	0.10	0.76
Hispanic	0.02	0.09	0.08	0.12	0.69
Enrollment status					
Less than half time	0.02	0.06	0.06	0.10	0.76
Half time	0.02	0.08	0.08	0.12	0.69

For time to enrollment in a GT course (Table 31), we found the same result in propensity score analysis as in the original regression analysis described above. That is, compared to the state-redesign cohort, the historic cohort had a lower probability of enrolling at zero terms. . Males had a higher probability of enrolling at zero terms than females. In addition, the probability of enrolling at zero terms was higher for those students with full-time status compared to those registered at half time and less than half time. For full-time students the probability of enrolling at zero terms was 0.51 (the intercept term) compared to 0.33 for less than half time and 0.28 for half time students. In contrast, students in full-time status had a lower probability of enrollment at zero terms compared to students in three-quarter time status. Students who were employed had lower probability of enrolling at zero terms than students who were not employed. Increases in both age and Accuplacer Sentence Skills scores again emerged as statistically significant in this post-match analysis, but we can now see that they did not generally lead to longer gaps prior to enrollment. A one-unit change in Accuplacer scores, for example, reduced the odds of time to enrollment in a GT course by only 0.98.

TABLE 31: SUMMARY OF LOGISTIC REGRESSION ANALYSIS FOR VARIABLES PREDICTING TIME TO ENROLLMENT IN FIRST GT COURSE

	Zero terms	One term	Two terms	Three terms	Four or more terms
Intercept	0.51	0.27	0.10	0.05	0.07
State redesign	0.80	0.13	0.04	0.02	0.02
Accuplacer Sentence Skills score	0.51	0.27	0.10	0.05	0.07
Age at first DE	0.50	0.27	0.11	0.05	0.07
Employed	0.37	0.29	0.14	0.08	0.12
Male	0.59	0.24	0.08	0.04	0.05
Hispanic	0.45	0.28	0.12	0.06	0.09
Enrollment Status					
Less than half time	0.33	0.29	0.15	0.09	0.14
Half time	0.28	0.28	0.17	0.10	0.17
Three-quarter time	0.59	0.24	0.08	0.04	0.05

Effects on Passing the College-Level English or GT Course

Post-match regression results for this model are presented in Table 32. Students in the historic cohort had a slightly better probability of earning a higher grade in ENG 121 than did students in the state-redesign cohort. The odds of earning a C or better were lower for black and American Indian/Alaska native students than they were for white students. Again males had lower odds of passing than females, and increases in age corresponded to increases in the odds of passing. It is clear that there is some evidence of racial bias emerging in the analysis. CCCS is currently looking at the issue of racial bias in teaching. These findings should be explored further and may help to inform this work.

TABLE 32: SUMMARY OF LOGISTIC REGRESSION ANALYSIS FOR VARIABLES PREDICTING GRADE C OR HIGHER IN ENG 121

						95% C.I.for EXP(Beta)	
	Beta	Standard Error	Degree of Freedom	Sig.	Exp(Beta)	Lower	Upper
State redesign	-0.339	0.098	1	0.001	0.712	0.588	0.864
Ethnicity			4	0.000			
Black	-0.516	0.129	1	0.000	0.597	0.464	0.769
American Indian/ Alaska Native	-0.689	0.268	1	0.010	0.502	0.297	0.849
Male	-0.362	0.094	1	0.000	0.696	0.579	0.837
Age at first DE	0.03	0.006	1	0.000	1.03	1.018	1.043
Constant	0.568	0.326	1	0.082	1.764		

In the GT course post-match enrollment model, shown in Table 33, students in the historic cohort had a lower probability of earning a C or better grade than students in the state-redesign cohort. The probability for members of the state-redesign cohort earning C or better was 72 percent compared to 67 percent for members of the historic cohort. Ethnicity, gender, enrollment status, age, and Accuplacer Sentence Skills score were also significantly related to passing the GT course. Black and Hispanic students had lower odds of earning a C or better than their white counterparts, and females had higher odds of passing than males did. Full-time students had higher odds of passing than did students who were enrolled at three-quarter time and half time. Finally, age and Accuplacer Sentence Skills score was positively related to grade attainment.

TABLE 33: SUMMARY OF LOGISTIC REGRESSION ANALYSIS FOR VARIABLES PREDICTING GRADE C OR HIGHER IN FIRST GT COURSE

						95% C.I. for EXP(Beta)	
	Beta	**Standard Error**	**Degree of Freedom**	**Sig.**	**Exp(Beta)**	**Lower**	**Upper**
State redesign	0.277	0.082	1	0.001	1.319	1.123	1.548
Ethnicity			4	0.000			
Black	-0.502	0.114	1	0.000	0.605	0.484	0.757
Hispanic	-0.302	0.096	1	0.002	0.739	0.612	0.893
Male	-0.384	0.082	1	0.000	0.681	0.58	0.801
Age at first DE	0.02	0.005	1	0.000	1.02	1.009	1.031
Accuplacer Sentence Skills score	0.006	0.003	1	0.046	1.006	1	1.011
Enrollment status			4	0.000			
Three-quarter time	-1.185	0.146	1	0.000	0.306	0.229	0.407
Half time	-0.302	0.1	1	0.003	0.739	0.608	0.899
Constant	0.691	0.262	1	0.008	1.995		

Math

We now move to math. Again we used propensity score matching to further examine the probability of the different student outcomes. The first step was to equalize the two cohorts in terms of our demographic and academic characteristics of interest. For this we used *cohort* as the dependent variable and *race/ethnicity*, *age*, *employment*, *veteran status*, *enrollment status*, and *Accuplacer Arithmetic score* as the independent variables. This removed any selection bias that may have occurred when the samples were initially created.

TABLE 34: DIFFERENCE IN COHORTS BEFORE AND AFTER MATCH

COHORT	BEFORE MATCH		AFTER MATCH	
	Number	Percent	Number	Percent
Historic	6114	44.2	2324	50
State redesign	7714	55.8	2324	50
Total	**13828**	**100**	**4648**	**100**

Time to Enrollment in College-Level Math (MAT 100+)

Again, subsequent to propensity matching, we engaged in regression analysis. We began with time to enrollment. As Table 35 below suggests, the post-match results are very similar to our regression results prior to propensity score matching. Those in the historic cohort had a higher probability of registering for MAT 100+ courses after three or four terms post-DE. In contrast, the state-redesign cohort was more likely to take MAT 100+ courses within zero to one term of taking their CCR course. There were some differences between the pre- and post-match models with regard to enrollment in college-level math, however. Employment and veteran status no longer had a statistically significant effect on enrollment, whereas age and Accuplacer Arithmetic score newly emerged as related—although with little practical effect.

TABLE 35: PROBABILITY OF TIME TO ENROLLMENT IN MAT 100+ COURSE

	Zero terms	One term	Two terms	Three terms	Four or more terms
Intercept	0.01	0.08	0.09	0.15	0.67
State redesign	0.07	0.27	0.19	0.19	0.29
Age at first DE	0.01	0.08	0.09	0.15	0.67
Accuplacer Arithmetic score	0.01	0.08	0.09	0.15	0.67

Effects on Passing College-Level Math (MAT 100+)

In our post-matching models, we did not find that cohort membership had a statistically significant relationship to passing college-level math (MAT 100+) courses with a C grade or better. We only found age and Accuplacer Arithmetic score positively related to passing MAT 100+. Since cohort membership did not have an effect on the odds of passing MAT 100+ with grade C or higher in either model, we conclude that at this stage, the state redesigns to the DE math curriculum in Colorado have neither sped up nor slowed down the passing of MAT 100+. Since the redesigns are relatively new, however, it's possible that positive outcomes could emerge in future research.

TABLE 33: SUMMARY OF LOGISTIC REGRESSION ANALYSIS FOR VARIABLES PREDICTING GRADE C OR HIGHER IN FIRST MAT 100+ COURSE

	Beta	Standard Error	Degree of Freedom	Sig.	Exp(Beta)	95% C.I. for EXP(Beta) Lower	Upper
Age at first DE	0.035	0.013	1	0.006	1.036	1.01	1.062
Accuplacer Arithmetic score	0.011	0.005	1	0.021	1.011	1.002	1.021
Constant	0.3	0.479	1	0.531	1.35		

PART FIVE: WAGE OUTCOMES

There are multiple factors that affect a student's wages including the type of industry in which he/she works, the position and hours worked, the length of time in a position, and the general current economic climate. The historic period used for the study was at the beginning of the most recent large scale national recession. Recovery has been uneven geographically and by industry, and that unevenness is reflected across Colorado's very diverse regions.

Wage Results in Context

To set the context for our analysis, we reviewed 2007–13 data from the US Census' American Community Survey[62](ACS) (Three-year Estimate) for Colorado. Data from 2013 onwards was not available. Although some data are missing, the data we have suggest the importance of economic context. The Colorado ACS data used in this section provide information on various characteristics of the population, including employment rates and wages. Figure 5 presents statewide employment rates just before and through the first years of the state redesigns. . We see a downward trend from 2007 to 2008, from which point the number of unemployed steadily increases until it stabilizes somewhat between 2012 and 2013. However, despite some post-recession gains, the unemployment rate in Colorado was higher in 2013 than it was in 2007.

[62] United States Census Bureau. (2013). *American Community Survey Colorado 2007-2013.* Retrieved from https://www.census.gov/programs-surveys/acs/

FIGURE 5: PERCENT UNEMPLOYED, COLORADO, BASED ON DATA FROM THE AMERICAN COMMUNITY SURVEY

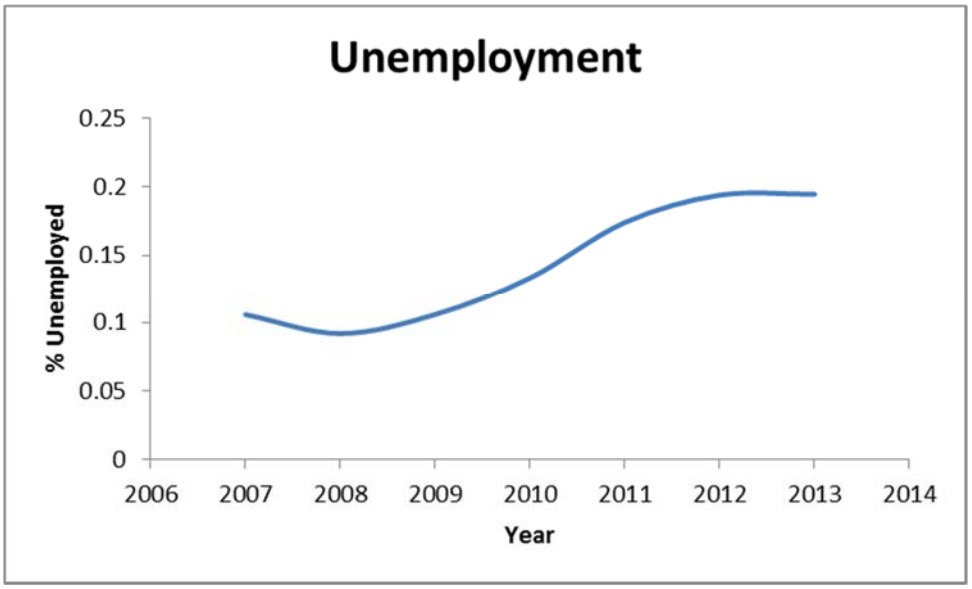
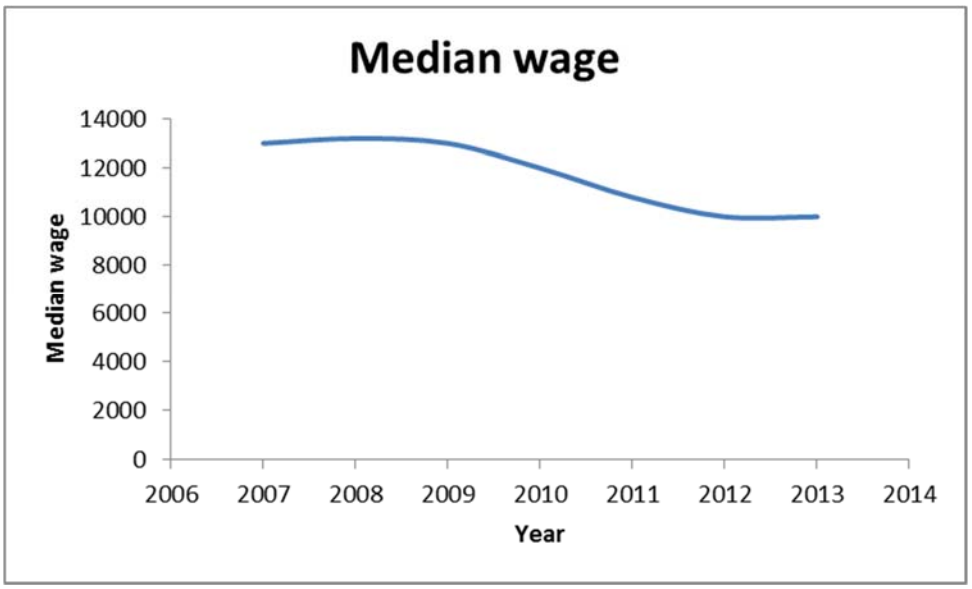


Figure 6 displays the trend in Colorado's median wages. Mirroring the trend we saw with regard to employment rates, the median wage decreased steadily after reaching a high between 2007 and 2008 until it began to stabilize between 2012 and 2013. The median wage in 2013, however, was considerably lower than it was in 2007.

FIGURE 6: MEDIAN WAGE, COLORADO, BASED ON DATA FROM AMERICAN COMMUNITY SURVEY



Effects of Historic and Redesigned English/CCR Courses on Wage Outcomes

Although EERC recognizes there is not necessarily a direct causal relation between a DE course and changes in wages, prior studies have shown that completion of a DE reading and writing course leads to better earnings.[63] We therefore include in this report Unemployment Insurance (UI) data on the wages received by historic-cohort students (those who took English 030, 060, and 090) and by state-redesign-cohort students (those who took CCR 091, 092, 093, and 094).

We use *Beginning* to denote the average wages at the time a student first enrolled in a DE English course. *Complete* refers the average wages in subsequent terms after the completion of the DE course. It is important to note that UI data on wages for the redesigned CCR courses are subject to *time censoring*. In other words, given that either no or few semesters elapsed between the time some students completed their DE course and the time we requested the UI data, the wages reported for those students will not reflect their actual wage at the time of course completion. This is because UI wage data has significant lags—generally six months.

The figures in Table 41 show that students in the historic cohort began with higher wages and, subsequent to their enrollment in a DE course, increased their wages by about $623. With slightly lower wages at the start, the state-redesign cohort also saw an increase in wages, but in their case it was usually a very small one. This might be an effect of time censoring, so further tracking is important to confirm this pattern. Of note is that the 21 students enrolled in the lab course CCR 091, which is associated with CCR 092 (and probably includes the students beginning CCR 092 with the least adequate skill set), showed the biggest gains across the CCR courses. However, given some outliers with large wage gains, this finding needs further investigation.[64] Nevertheless, evidence of wage gains after the completion of DE courses might validate prior studies that indicate wage gains with improved competency in reading and writing.[65]

[63] Hodara, M., & Xu, D. (2014). *Does developmental education improve labor market outcomes? Evidence from two states* (A CAPSEE Working Paper). New York: Columbia University, Teachers College, Center for Analysis of Postsecondary Education and Employment.
[64] Martorell & McFarlin (2010), op. cit.
[65] Hodara & Xu (2014), op.cit.

*TABLE 41: DIFFERENCE IN AVERAGE WAGES AT FIRST DE AND TWO SUBSEQUENT SEMESTERS**

Historic	N	Beginning Wage	N	Complete Wage	Difference
English 030	284	$3062	343	$3510	$447
English 060	1389	$3361	1639	$4008	$647
English 090	4269	$3654	4954	$4285	$630
Total	***5942***	***$3558***	***6936***	***$4181***	***$623***
State Redesign	**N**	**Beginning Wage**	**N**	**Complete Wage**	**Difference**
CCR 091	17	$2076	20	$2559[66]	$483
CCR 092	879	$3441	801	$3575	$134
CCR 093	186	$2658	193	$2885	$227
CCR 094	1033	$3482	930	$3644	$161
Total	***2115***	***$3382***	***1944***	***$3529***	***$147***

**All wages have been rounded to nearest dollar.*

In Table 42, we break down average wages by college. Here the pattern remains that most students earned higher wages after they took their first DE course. The exception here is for ACC. However, without more details about all the students—their jobs and if there were changes in full-time or part-time status—these data are only suggestive and require cautious interpretations. Further, for residential colleges—like NJC, for example—the consistent loss in wage value may relate to students shifting their employment from another location—in NJC's case, to Sterling, Colorado—where the jobs might be more limited or where they may tend to offer lower wages.

Again, we present these findings more to encourage further research than to definitively report outcome patterns.

[66] One case in which the complete wage was very high was considered an outlier and was removed from the analysis.

TABLE 42: DIFFERENCE IN AVERAGE WAGES BY COLLEGE FOR THE HISTORIC AND THE STATE-REDESIGN COHORTS*

	Historic			State Redesign		
School	Beginning Wage	Complete Wage	Difference	Beginning Wage	Complete Wage	Difference
ACC	4180 (n=453)	4990 (n=517)	810	4397 (n=32)	3910 (n=28)	-487
CCA	4534 (n=555)	5480 (n=648)	946	3950 (n=426)	4225 (n=441)	275
CCD	3431 (n=1353)	3956 (n=1576)	525	2961 (n=381)	3227 (351)	265
CNCC	2794 (n=41)	4368 (n=56)	1574	2007 (n=30)	2336 (n=56)	329
FRCC	3763 (n=1273)	4364 (n=1454)	600	3735 (n=318)	3796 (n=209)	61
LCC	2098 (n=42)	2900 (n=51)	802	2473 (n=14)	2635 (n=23)	163
MCC	3827 (n=43)	4518 (n=50)	691	3161 (n=7)	4633 (n=4)	1472
NJC	3203 (n=72)	2667 (n=129)	-536	3494 (n=5)	2955 (n=3)	-539
OJC	2273 (n=84)	2637 (n=117)	364	2226 (n=29)	2302 (n=56)	75
PCC	3044 (n=551)	3541 (n=644)	497	2730 (n=327)	3047 (n=348)	316
PPCC	3354 (n=993)	4062 (n=1135)	709	3600 (n=373)	3666 (n=284)	66
RRCC	3246 (n=382)	4043 (n=425)	797	3581 (n=135)	4132 (n=97)	551
TSJC	2450 (n=97)	2892 (n=130)	442	2486 (n=38)	2796 (n=45)	310
Total	**3558 (n=5942)**	**4181 (n=6936)**	**623**	**3382 (n=2115)**	**3534 (n=1945)**	**153**

*All wages have been rounded to nearest dollar.

Examining Post-DE English/CCR Wage Increases Using a Paired Sample T-Test[67]

Table 43 shows that across the cohorts, students generally earned higher wages after their DE course. At the same time, we found some cohort differences. The wages of students in the historic cohort increased slightly more than the wages of students in the state-redesign cohort. However, as indicated previously, this might be due to the fact that the figures we have for the members of the state-redesign cohort are impacted by data censoring—less time passed between course completion and wage reports. It is important to note that once we controlled for other variables, the redesign did not have any effect on wage increases.

[67] A paired sample t-test is a statistical technique that tests the difference between pre- and post-measurement when the variables being measured are numeric. In this section we are looking at the difference between complete wage and beginning wage, which are both numeric variables, to see if the difference in pre-DE and post-DE wage is statistically significant. We can see on Table 41 that wage difference is positive across both cohorts. To understand whether those observed gains are statistically significant, we performed a paired sample t-test. The t-test analysis looks at the difference in beginning and complete wage across cohorts.

TABLE 43: PAIRED SAMPLE T-TEST FOR BEGINNING WAGES AND COMPLETE WAGES ACROSS COHORTS

Paired Samples Statistics	Mean	N	Std. Deviation	Std. Error Mean	
Beginning Wages	3628	6830	3479	42	
Complete Wages	4323	6830	4174	51	
	Mean Difference	**Std. Deviation**	**t**	**df**	**Sig. (2-tailed)**
Beginning Wages to Complete Wages	-695	3136	-18	6829	0.000

Effects of Historic and Redesigned Math Courses on Wage Outcomes

TABLE 44: DIFFERENCE IN AVERAGE WAGES AT FIRST DE MATH COURSE AND TWO SUBSEQUENT SEMESTERS

Historic	Beginning Wage	Complete Wage	Difference
MAT 030	3669	4380	711
MAT 060	4402	5168	766
MAT 090	4185	4853	668
Total	**4073**	**4787**	**714**
State Redesign	**Beginning Wage**	**Complete Wage**	**Difference**
MAT 050	4269	4578	309
MAT 055	4308	4861	553
MAT 091	3420	4451	1031
MAT 055/MAT 025	3963	4573	610
Total	**4245**	**4660**	**415**

*All wages have been rounded to nearest dollar.

Similar to the pattern of outcomes we saw above for English/College Composition and Reading, students in the historic math cohort experienced larger wages differences subsequent to completion of their DE math course than the students in the state-redesign cohort. But again, this might be a result of time censoring.

TABLE 45: DIFFERENCES IN WAGE BY COLLEGE FOR HISTORIC AND STATE-REDESIGN COHORTS

	Historic			State Redesign		
School	Beginning Wage	Complete Wage	Difference	Beginning Wage	Complete Wage	Difference
ACC	4609 (n=526)	5291 (n=555)	682	5110 (n=82)	5970 (n=42)	860
CCA	5294 (n=531)	6344 (n=597)	1050	5724 (n=146)	5317 (n=97)	-407
CCD	4176 (n=1478)	4904 (n=1659)	729	4257 (n=1394)	4816 (n=1399)	560
CNCC	4844 (n=64)	6258 (n=76)	1414	2883 (n=53)	3467 (n=55)	585
FRCC	4137 (n=1559)	4805 (n=1745)	668	4 729 (n=403)	5129(n=271)	384
LCC	2788 (n=57)	3067 (n=66)	279	2698 (n=16)	2958 (n=20)	260
MCC	3911 (n=66)	4374 (N=87)	465	3139 (n=15(	3483 (n=12)	343
NJC	2276 (n=99)	2900 (n=138)	623	2241 (n=13)	1535 (n=7)	-706
OJC	2589 (n=84)	2873 (n=133)	284	3198 (n=55)	2791 (n=58)	-407
PCC	3250 (n=623)	3829 (n=713)	579	3903 (n=449)	4455 (n=454)	552
PPCC	3680 (n=1361)	4488 (n=1469)	809	3856 (n=127)	4190 (n=100)	333
RRCC	4726 (n=500)	5562 (n=559)	837	**	**	**
TSJC	2986 (n=120)	3438 (n=153)	452	2366 (n=55)	3237 (n=58)	870
Total	4071 (n=7070)	4784 (7953)	713	4242 (n=2808)	4657 (n=2573)	415

** For RRCC most of the first DE happened in fall 2014, so the corresponding wage data is censored. As a result, there is no wage data for this row.

As noted above, for the entire state-redesign cohort, the wage data by college reflects time censoring at some schools. In addition, given that approximately 50 percent of the state-redesign students took their first redesigned math course in fall 2014, there is limited wage data or relatively little change in their wage data within the study period. Further tracking is needed to identify ongoing patterns of change.

Examining Post-DE Math Wage Increases Using Paired Sample T-Test

A paired sample t-test for the beginning wage and complete wage for the entire sample shows a significant result; that is, wages at subsequent semesters after the wage at first DE are higher for both the students in the historic cohort and those in the state-redesign cohort. This may be reflect the impact of additional academic credits on access to higher paid employment options and/or related to promotions during the study period. Only more detailed examination of students' actual jobs and titles will clarify the factors that contribute to higher wages in both cohorts.

TABLE 46: PAIRED SAMPLE T-TEST FOR BEGINNING WAGE AND COMPLETE WAGE

Wage	Mean	N	Std. Deviation	Std. Error Mean	
Beginning Wages	4246.9118	8411	3681.56411	40.14288	
Complete Wages	5011.0014	8411	4422.91069	48.22635	
	Mean Difference	**Standard Deviation**	**t**	**df**	**Sig.**
Beginning Wages to Complete Wages	-764.09	2719.502	-25.768	8410	0.000

Over time it will be important to continue to track employment and wage patterns to see whether employment and wage trends parallel our current findings or new trends are established. It will also be important to re-examine the historic trend found in prior studies[68] that indicate a pattern of increased wages for students who gain additional proficiency in math and/or English.

PART SIX: CONCLUSION

The analysis of student outcomes presented above shows some very positive early results for the redesign of developmental education by the Colorado Community College System. Particularly of note are the enrollment and completion results of the corequisite options in CCR. However, while these early results are useful, it will be important to continue to examine the redesign over time, both throughout the system and within individual colleges. Below we propose some next steps for research.

FUTURE RESEARCH

- Track what happens with students who test at the lower levels of the Accuplacer assessment or its replacement assessment.

- Identify and track the development of soft-landing options and their use by potential students. Track the matriculation of soft landing students into DE courses or college-level courses.

- Engage in deeper exploration of advising services: the who, when, and how.

- Examine differences in the pedagogy used for state-redesign courses—for example, the types of learning communities being used (e.g., sequential team; co-teaching in one classroom; different faculty member, multiple sections), the use of modular units for math, and the use of conceptual vs. procedural teaching of math courses.

- Examine the subjects that are being linked to CCR 093 and the success of students by subject matter. In addition, track the model and pedagogy being used, e.g. co-teaching, sequential classes, learning communities, etc.

- Examine how CCR 094 is being taught, e.g. co-teaching, sequential classes, learning communities, etc. ;as well as the challenges and successes that emerge as more sections of these courses are offered at more schools.

- Track wage changes over time for students taking the redesigned DE courses.

- Track differences in retention and completion outcomes over time for students in MAT 055 and MAT 050, as well as students taking MAT 025.

- Explore the differences in retention and completion outcomes for students who enroll in MAT 091 and 093—these may in fact be very different students, so we will have to be cautious in recommending acceleration through co-enrollment in math as we have recommended with CCR 093 and 094.

- Look more closely at patterns in both math and English that indicate poorer outcomes for minority students as compared to white students, as well as at differences in gender outcomes.

- Investigate the following questions: What ongoing process (assumptions and interactions) biases are occurring in the classroom? To what degree are institutional and process biases related? How can colleges address these? Further, to what degree can the colleges implement programs to counteract prior disadvantages some of these students experienced that impact their current performance?

APPENDIX

TABLE A-I: TIME TO COLLEGE-LEVEL ENGLISH (ENG 100+) COURSES BY SCHOOL FOR THE HISTORIC AND THE STATE-REDESIGN COHORTS

School	Historic						State Redesign				
	Zero Terms	One Term	Two Terms	Three Terms	Four or More Terms	N	Zero Terms	One Term	Two Terms	Three Terms	N
ACC	2.9%	46.7%	18.1%	13.2%	19.2%	349	90.4%	5.1%	4.5%	0.0%	178
CCA	3.6%	41.1%	15.3%	14.0%	26.0%	470	82.3%	12.3%	3.8%	1.5%	786
CCD	7.8%	41.9%	14.2%	12.9%	23.3%	916	55.6%	33.9%	9.4%	1.1%	660
CNCC	27.3%	36.4%	9.1%	13.6%	13.6%	44	76.4%	20.2%	1.1%	2.2%	89
FRCC	3.5%	44.8%	19.3%	14.4%	18.0%	1145	85.2%	8.3%	6.5%	0.0%	842
LCC	2.0%	38.8%	16.3%	24.5%	18.4%	49	78.4%	18.9%	1.4%	1.4%	74
MCC	2.0%	46.0%	24.0%	12.0%	16.0%	50	89.2%	8.1%	2.7%	0.0%	37
NJC	14.4%	52.3%	8.3%	12.9%	12.1%	132	96.0%	2.7%	1.3%	0.0%	75
OJC	3.9%	67.6%	7.8%	11.8%	8.8%	102	79.7%	16.6%	1.1%	2.7%	187
PCC	6.9%	46.6%	15.2%	13.9%	17.4%	539	78.3%	16.2%	4.6%	0.9%	766
PPCC	4.6%	42.5%	15.7%	13.2%	24.1%	855	88.8%	6.0%	5.2%	0.0%	1326
RRCC	3.0%	46.9%	15.7%	15.1%	19.3%	337	89.0%	4.9%	6.1%	0.0%	429
TSJC	9.5%	52.4%	13.3%	12.4%	12.4%	105	82.6%	14.1%	2.7%	0.7%	149
Total	5.3%	44.7%	15.9%	13.7%	20.3%	5093	81.4%	12.8%	5.3%	0.6%	5598

TABLE A-II: TIME TO GT COURSE BY SCHOOL FOR THE HISTORIC AND THE STATE-REDESIGN COHORTS

School	Historic						State Redesign				
	Zero Terms	One Term	Two Terms	Three Terms	Three or More Terms	N	Zero Terms	One Term	Two Terms	Three Terms	N
ACC	57.9%	20.4%	6.5%	5.6%	9.6%	480	93.1%	5.3%	1.6%	0.0%	188
CCA	54.2%	22.2%	7.2%	6.6%	9.8%	625	61.7%	30.3%	5.2%	2.8%	575
CCD	35.4%	23.6%	10.4%	12.7%	17.9%	1222	81.0%	13.3%	5.3%	0.3%	901
CNCC	72.2%	19.0%	2.5%	2.5%	3.8%	79	93.1%	3.1%	1.5%	2.3%	131
FRCC	63.4%	16.0%	7.7%	5.3%	7.7%	1516	86.4%	8.9%	4.7%	0.0%	940
LCC	78.1%	12.3%	4.1%	2.7%	2.7%	73	81.3%	16.0%	2.7%	0.0%	75
MCC	38.5%	32.7%	11.5%	9.6%	7.7%	52	79.2%	16.7%	4.2%	0.0%	24
NJC	73.1%	18.0%	2.4%	4.2%	2.4%	167	98.3%	1.7%	0.0%	0.0%	118
OJC	75.2%	12.8%	6.7%	1.3%	4.0%	149	95.5%	2.5%	2.0%	0.0%	202
PCC	48.9%	25.1%	9.7%	6.2%	10.1%	662	61.0%	31.7%	6.1%	1.2%	690
PPCC	56.5%	17.6%	8.2%	6.7%	10.9%	1238	58.1%	27.6%	14.2%	0.0%	800
RRCC	67.8%	15.5%	4.9%	5.3%	6.6%	453	58.9%	22.8%	18.3%	0.0%	197
TSJC	53.8%	21.0%	14.0%	5.6%	5.6%	143	90.7%	6.6%	1.6%	1.1%	183
Total	55.2%	19.6%	8.0%	7.0%	10.2%	6859	74.7%	18.2%	6.5%	0.6%	5024

TABLE A-III MAT 100+ COURSES USED IN THE ANALYSIS

Course Number	Course Title
103	Math for Clinical Calculations
107	Career Math
107	Career Math: Agriculture
107	Career Math: Ag Emphasis
107	Career Math: Line Techs
108	Technical Mathematics
109	Geometry
112	Financial Mathematics
120	Math for Liberal Arts: MA1
121	College Algebra
121	College Algebra: MA1
121	College Algebra: MA1
122	College Trigonometry: MA1
123	Finite Mathematics: MA1
125	Survey of Calculus: MA1
135	Intro to Statistics
135	Intro to Statistics: MA1
155	Integrated Math I: MA1
155	Integrated Mathematics
156	Integrated Math II: MA1
166	Pre-Calculus: MA1
201	Calculus I: MA1
202	Calculus II : MA1
203	Calculus III: MA1
204	Calculus III/Engineer App: MA1
265	Differential Equations: MA1
266	Diff Eq/Linear Algebra

TABLE A-V: DIFFERENCE IN PERCENTAGE AND MEAN VALUE BEFORE AND AFTER MATCHING FOR ENGLISH BETWEEN STATE-REDESIGN AND HISTORIC COHORT

Predictors	Before match***			After match		
	Historic	State Redesign	Difference	Historic	State Redesign	Difference
Ethnicity	**10155**	**9272**	**-883.00**	**3073**	**3073**	**0.00**
White	*53.00%*	*45.60%*	*-7.40%*	*45.90%*	*46.50%*	*0.60%*
Black	*12.50%*	*15.10%*	*2.60%*	*16.40%*	*16.50%*	*0.10%*
Hispanic	*26.90%*	*30.40%*	*3.50%*	*29.40%*	*28.40%*	*-1.00%*
Asian	*6.00%*	*5.60%*	*-0.40%*	*5.70%*	*6.20%*	*0.50%*
American Indian/Alaska Native	*1.70%*	*3.30%*	*1.60%*	*2.60%*	*2.40%*	*-0.20%*
Veteran status	**10640**	**10171**	**-469.00**	**3073**	**3073**	**0.00**
Veteran	*2.70%*	*6.90%*	*4.20%*	*4.60%*	*4.70%*	*0.10%*
Nonveteran	*97.30%*	*93.10%*	*-4.20%*	*95.40%*	*95.30%*	*-0.10%*
Employment status	**10640**	**10171**	**-469.00**	**3073**	**3073**	**0.00**
Employed	*55.80%*	*20.80%*	*-35.00%*	*35.70%*	*36.10%*	*0.40%*
Not employed	*44.20%*	*79.20%*	*35.00%*	*64.30%*	*63.90%*	*-0.40%*
Enrollment status	**10575**	**10171**	**-404.00**	**3073**	**3073**	**0.00**
Full time	*53.60%*	*29.90%*	*-23.70%*	*50.90%*	*51.60%*	*0.70%*
Three-quarter time	*4.60%*	*22.80%*	*18.20%*	*8.70%*	*8.90%*	*0.20%*
Half time	*29.00%*	*21.90%*	*-7.10%*	*30.70%*	*29.50%*	*-1.20%*
Less than half time	*12.20%*	*13.20%*	*1.00%*	*9.30%*	*9.50%*	*0.20%*
First-term students	*0.70%*	*12.30%*	*11.60%*	*0.40%*	*0.40%*	*0.00%*
Age at first DE	**10640**	**10163**	**-477.00**	**3073**	**3073**	**0.00**
Mean	*24.23*	*23.68*	*-0.55*	*24.26*	*24.44*	*0.18*
Standard Deviation	*8.422*	*8.49*	*0.07*	*8.414*	*9.02*	*0.606*
Accuplacer Sentence Skills score	**4504**	**8501**	**3997.00**	**3073**	**3073**	**0.00**
Mean	*71.40*	*73.15*	*1.75*	*72.19*	*72.48*	*0.29*
Standard Deviation	*16.02*	*13.83*	*-2.19*	*15.85*	*13.98*	*-1.87*

*** All differences before matching were statistically significant

TABLE A-IV: DIFFERENCE IN PERCENTAGE AND MEAN VALUE BEFORE AND AFTER MATCHING FOR MATH BETWEEN STATE REDESIGN AND HISTORIC COHORT

Predictors	Before match***			After match		
	Historic	State Redesign	Difference	Historic	State Redesign	Difference
Ethnicity	**11760**	**13710**	**1950.00**	**2324**	**2324**	**0.00**
White	*62.20%*	*52.60%*	*-9.60%*	*56.00%*	*56.30%*	*0.30%*
Black	*10.00%*	*11.20%*	*1.20%*	*11.70%*	*11.80%*	*0.10%*
Hispanic	*23.30%*	*28.70%*	*5.40%*	*27.30%*	*26.20%*	*-1.10%*
Asian	*2.90%*	*4.30%*	*1.40%*	*2.80%*	*3.00%*	*0.20%*
American Indian/ Alaska Native	*1.60%*	*3.30%*	*1.70%*	*2.20%*	*2.60%*	*0.40%*
Veteran status	**12243**	**15409**	**3166.00**	**2324**	**2324**	**0.00**
Veteran	*3.30%*	*5.40%*	*2.10%*	*4.70%*	*5.80%*	*1.10%*
Nonveteran	*96.70%*	*94.60%*	*-2.10%*	*95.30%*	*94.20%*	*-1.10%*
Employment status	**12243**	**15409**	**3166.00**	**2324**	**2324**	**0.00**
Employed	*57.30%*	*18.10%*	*-39.20%*	*27.20%*	*25.30%*	*-1.90%*
Not employed	*42.70%*	*81.90%*	*39.20%*	*72.80%*	*74.70%*	*1.90%*
Enrollment status	**12164**	**15409**	**3245.00**	**2324**	**2324**	**0.00**
Full time	*53.50%*	*28.80%*	*-24.70%*	*54.30%*	*53.10%*	*-1.20%*
Three-quarter time	*4.30%*	*17.90%*	*13.60%*	*9.90%*	*10.40%*	*0.50%*
Half time	*27.20%*	*20.20%*	*-7.00%*	*25.90%*	*26.80%*	*0.90%*
Less than half time	*14.50%*	*23.00%*	*8.50%*	*9.60%*	*9.30%*	*-0.30%*
First-term students	*0.60%*	*10.10%*	*9.50%*	*0.30%*	*0.40%*	*0.10%*
Age at first DE	**12243**	**15409**	**3166.00**	**2324**	**2324**	**0.00**
Mean	*53.09*	*50.15*	*-2.94*	*25.93*	*25.59*	*-0.34*
Standard Deviation	*25.04*	*23.15*	*-1.88*	*9.04*	*9.85*	*0.81*
Accuplacer Arithmetic score	**3916**	**4298**	**382.00**	**2324**	**2324**	**0.00**
Mean	*26.23*	*9.16*	*-17.07*	*52.34*	*51.94*	*-0.40*
Standard Deviation	*23.68*	*8.56*	*-15.12*	*24.72*	*23.76*	*-0.96*

*** All differences before matching were statistically significant

TABLE A-V: NUMBER OF MAT 091, MAT 092, AND MAT 093 DEVELOPMENTAL EDUCATION SECTIONS OFFERED BY COLLEGE

School	MAT 091	MAT 092	MAT 093
ACC	0	0	0
CCA	0	0	0
CCD	0	0	0
CNCC	4	2	20
FRCC	32	2	44
LCC	6	3	11
MCC	0	0	0
NJC	0	0	0
OJC	0	0	3
PCC	58	0	0
PPCC	47	0	0
RRCC	0	0	0
TSJC	18	1	8
Total	**165**	**8**	**86**