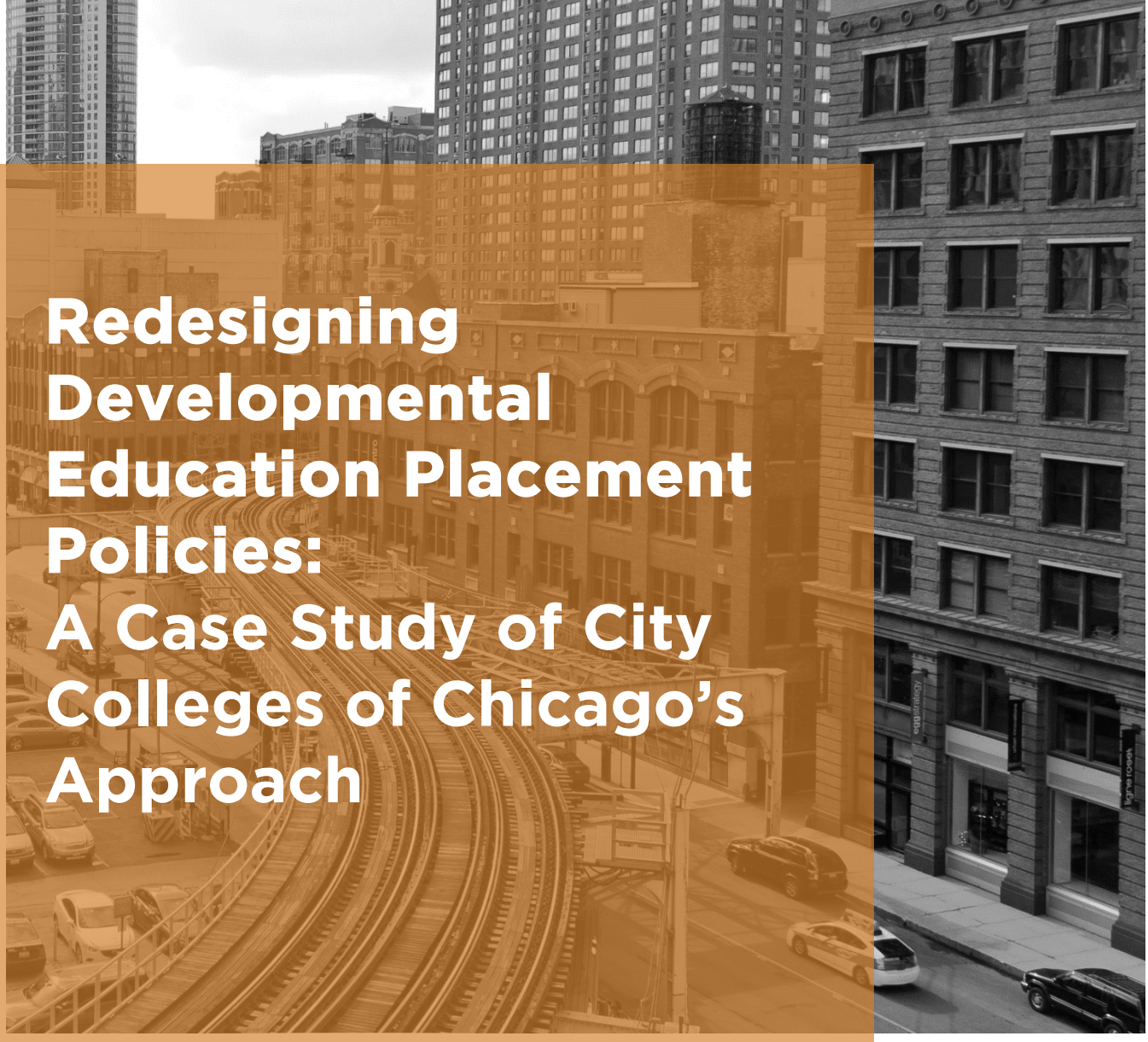


Redesigning Developmental Education Placement Policies: A Case Study of City Colleges of Chicago's Approach

May 2023

Kelly Hallberg, Ph.D.
Emileigh Harrison
Stephen Stapleton
Kafi Moragne-Patterson, Ph.D.

UCHICAGO URBANLABS INCLUSIVE ECONOMY LAB

Science in Service of Cities

Introduction

Research shows that early academic momentum, including taking and passing key gateway courses during the first year of college, is associated with higher rates of degree completion (Attewell et. al, 2012; Wang, 2017). Yet more than two-thirds of community college students are required to take at least one developmental education course before enrolling in introductory, college-level math and English, and many never complete these courses (Chen, 2016). To explain this, some point to inadequate academic preparation at the secondary level (Bettinger et al., 2013; Scott-Clayton, 2011), while others focus on course placement policies that limit direct access to college-level coursework (Belfield & Crosta, 2012). Our country's history of racial and economic segregation, coupled with unequal funding of secondary and post-secondary education, mean that both barriers disproportionately impact Black and Latinx students and students from low-income households, contributing to a disparities in degree attainment.

There is growing interest nationally in rethinking how college students are placed in their first English and math courses. Higher education institutions across the country are reevaluating how standardized assessments are used in determining which courses students can take, with a growing number of institutions adopting placement policies that consider multiple measures of readiness for college-level coursework. In parallel, policymakers are increasingly supporting efforts to directly place more students into credit bearing courses.

Consistent with these trends nationally, City Colleges of Chicago (CCC) has made increasing early academic momentum a central component of the district's broader efforts to increase completion and decrease the degree divide. While research conducted in other community college districts can provide important insights to inform these efforts, the leadership of CCC recognized early that taking local context into account would be critical to designing policies that would best serve students and be implemented successfully. This report details the work CCC did, in partnership with the UChicago Inclusive Economy Lab (IEL), to ensure the district's new placement policy was both informed by data and inclusive of feedback from key stakeholders.

The report proceeds as follows: We begin by providing a brief overview of the national context and research literature on developmental education placement and early academic momentum. We then turn to the specific context and features of CCC that are important to understanding the district's approach to developmental education. Next, we provide an overview of the process the Inclusive Economy Lab took to engage with both student data and the perspectives of key district stakeholders and summarize the findings from this engagement. We conclude by describing how the learnings from this process informed the district's new placement policy and how the district will continue learning and adapting the policies to meet students' needs moving forward.

National Context and Existing Literature

Early academic momentum is typically defined by the number of credit-bearing courses students take and pass during their first year of college. Adelman (1999; 2006) was the first to highlight the importance of early momentum, not only in mechanically accruing the number of requisite credits to graduate "on time," but also in setting the stage for future academic success. Subsequent work has confirmed that this early momentum is a critical predictor of degree attainment in both four- and two-year colleges (Attewell et. al., 2012; Wang, 2017; Clovis & Chang, 2021). Recently, educators have begun looking beyond overall credit attainment to focus on the completion of key courses that align with students' academic plans and that

contribute to degree attainment (Bailey, Jaggars, & Jenkins, 2015). Part of this effort has focused on students quickly taking and passing gateway courses in English and math, critical introductory-level courses that unlock access to degree pre-requisites (Belfield et al., 2019).

Despite the importance of these courses for students' academic trajectory, myriad barriers exist to enrolling and passing gateway courses. From an early age, students from low-income backgrounds face systemic barriers that often limit their opportunity to prepare for academic success in college. Key differences in school quality and educational experiences affect their likelihood of earning a college degree in myriad ways. For example, because of racial and economic segregation, students from wealthier backgrounds often attend well-resourced schools with higher expenditures per pupil, smaller student-to-counselor ratios, and a rich array of courses designed to prepare students for the academic demands of college, giving them a strong advantage (Charles, 2003; Kozol, 1991; Lareau & Goyette, 2014; Vigdor & Ludwig, 2007). Without access to these resources to help build an academic foundation for college success, many low-income students face barriers to gaining academic momentum (Duncan & Murnane, 2011).

In addition to these structural barriers to skill development, many educators and researchers worry that the design of developmental education itself can act as a barrier to early academic momentum. Developmental education is intended as a tool to support students in becoming prepared for college-level coursework (Cullinan et al., 2018). It takes many forms, including co-requisites where students simultaneously enroll in college-level English and math with some support, exclusively developmental classes that must be completed before taking college-level classes, and foundational studies courses that are taken prior to developmental classes.

The stakes for appropriate placement in the developmental education sequence are high, as these classes can affect a student's likelihood of securing a degree in important ways. For example, if students are placed into advanced coursework before they are ready, they may become discouraged, earn poor grades, and choose to unenroll (Burdman, 2012). On the other hand—because developmental education courses do not earn degree credits, but still incur tuition and must be completed to gain access to gateway courses—students who are unnecessarily placed into the developmental sequence experience prolonged time to degree and higher costs, both of which may also lead to unenrolling (Lichtenberger & Wilson, 2019a&b).

Historically, to identify the appropriate level of coursework, schools used standardized tests, such as the SAT/ACT, along with specialized developmental assessments. Research, however, suggests that one-time assessments are not the best predictors of students' success in college-level coursework, especially for students from diverse backgrounds, whose skills, abilities, and potential contributions are not always accurately measured by standardized tests (Bahr, 2016; Bracco et al., 2014). Importantly, the evidence suggests that these assessments tend to under, rather than over, place students. Put differently, students may lose access to courses they may have been successful in and this lost access is disproportionately impacting students of color and students from low-income backgrounds (Belfield & Crosta, 2012; Scott-Clayton, 2021).

In response to this body of literature and advocacy attention, there has been a growing effort nationally to improve course placement policies to ensure that these courses are targeted to students who are unlikely to succeed in gateway coursework without them. Central to these efforts has been examining whether additional measures – e.g., writing assessments, self-evaluation or self-placement, and grade point average (GPA) – can portend a student's readiness for college-level coursework better than standardized tests alone. Early research has

found that high school transcript information, such as courses completed, grades, and overall GPA, can be more accurate in placing students into appropriate coursework (Scott-Clayton et al., 2014; Barnett et al., 2018; Woods et al., 2018; Ganga & Mazzariello, 2019). Some argue that GPA should play a central role in placement because it acts as an aggregate measure of performance over multiple years, providing relevant insight into students' content knowledge and other behaviors, such as attendance and participation (Rutschow et al., 2019). Consistent with this line of reasoning, Bahr et al.'s recent (2019) study found that cumulative high school GPA is the most consistently useful predictor of students' performance across differing levels of math and English coursework.

Multiple measure placement policies have now been adopted by more than half of community colleges in the country and several systems have mandated them (Rutschow & Myers, 2018). And some states have gone even further. In 2017, California passed a law preventing colleges from using placement test for developmental education placement and prohibited placement in these courses unless a student was deemed, "highly unlikely to succeed in credit bearing coursework. A 2012 Florida law went even further, exempting all students who entered a public high school after 2002 from college placement tests and developmental coursework.

Developmental Education Placement at CCC

With most new students entering CCC required to take developmental courses in English (65%) and math (62%), CCC has increasingly made early academic momentum a core component of district efforts to increase completion and eliminate the degree gap. Prior to the fall of 2018, course placement policies differed across the seven colleges in the CCC system. To streamline placement for students (many of whom take courses at multiple campuses during their time at CCC), the district adopted a standardized approach to course placement. Beginning in the fall of 2018, all students in the district with a math SAT score below 530 take the ALEKS Placement, Preparation, and Learning (ALEKS PPL) assessment to determine their first math course. In parallel, CCC English faculty developed a homegrown holistic placement model (known as the Read to Write or RtW) that aims to combat biases inherent in standardized tests through student self-assessment, adaptations for English language learners, and culturally relevant reading passages. All students with an English SAT score below 540 must take the RtW to determine their first English course. Around this time, the district established a key performance indicator (KPI) tracking rates of taking and passing college-level English and math.

Building on these early efforts, in 2019, CCC convened a cross-functional committee of faculty and staff to identify changes to policy and practice that could increase early academic momentum. One of the committee's core recommendations was to develop a placement profile that integrates multiple measures of student aptitude to pilot and consider for use district-wide. The committee expressed a particular desire to better understand the power of high school GPA in the Chicago context to predict student performance in gateway math and English.

At the same time, policymakers at the state level started to focus on supporting early academic momentum and developmental education placement. In March 2021, Governor Pritzker signed the Developmental Education Reform Act (DERA) into law. As a part of a broader set of reforms aimed at addressing inequities in degree completion by race and income status and instituting evidenced-based practices for placement and delivery of developmental education, the Act mandated the use of multiple measures for developmental education placement for the first time in Illinois. Specifically, the Act states, "On or before May 1, 2022, a community college shall use each of the following measures, as appropriate, to determine the placement of a student in introductory college-level English language or mathematics coursework: (1) A student's

cumulative high school grade point average; (2) A student's successful completion of an appropriate high school transition course in mathematics or English; (3) A student's successful completion of an appropriate developmental education or introductory college-level English language or mathematics course at another regionally accredited postsecondary educational institution" (Illinois General Assembly, 2022).

The recommendations of the cross-functional CCC committee combined with this mandate from the state legislation provided the impetus for CCC to reevaluate its developmental placement policy with specific attention paid to the incorporation of high school GPA. To that end, the district partnered with IEL to examine the predictive power on GPA and explore the role it might play in in a revised placement profile.

Approach to Stakeholder Engagement

IEL and CCC's research practice partnership focused on developmental education placement was predicated on two assumptions. First, better decisions are made when they are informed by data. Like many policy issues, developmental education placement can be contentious, with differing stakeholders possessing diametrically opposing views of the situation. At IEL, we believe that turning to the data can help bring these stakeholders together to develop a shared understanding and language about a situation. Data can be used to test assumptions and identity and track shared goals. However, we also believe that data that is not properly contextualized can be unhelpful at best and misleading at worst. Bringing key stakeholder perspectives to the table is critical in ensuring data are interpreted correctly.

These assumptions shaped our approach to working together, especially our decision to form a research advisory committee. The committee was made up of 13 district stakeholders from CCC, including English, math, and science faculty from across the seven City Colleges and district administrative staff. Members of the committee were selected by the Provost based on their knowledge of developmental education placement in the district and because they brought differing perspectives on the best approach forward. The committee met seven times during the first half of 2021. Initial discussions provided opportunities for the committee to provide input on the research team's analysis plan and ensuring that the approach considered district context and history. The remaining meetings were spent reviewing the analytic output from IEL and co-interpreting the findings as a group.

Analytic Approach

The analyses the committee examined drew on administrative data from Chicago Public Schools (CPS) and CCC. We examined the course outcomes for all students who graduated from CPS and subsequently enrolled in CCC between Fall 2018 and Spring 2020. This includes all first-time CCC students, both those who were new to college and those who transferred from other post-secondary institutions. By linking CPS and CCC data, we observed demographic information, high school academic achievement (test scores and GPA), which math and English courses a student took at CCC and how they performed in that course for the over 8,000 students in our sample.

These data allowed us to answer the following research questions, which we co-developed with leadership at CCC and the research advisory committee:

- **RQ1** How much of the variation in performance in students' first math and English courses is explained by high school GPA?
    - To what extent does this vary across CPS high schools?
    - How does this compare to other predictors of course performance (e.g., standardized assessment scores)?
- **RQ2** Does the predictive power of GPA differ by student and school subgroups?
- **RQ3** How might factors from multiple measures be combined in a placement profile?
- **RQ4** How could adopting a new placement profile shift the number and composition of students placed into foundational studies, developmental, and gateway coursework?

To answer the first two research questions, we used a ***hierarchical linear modelling*** approach. This statistical modelling allows us to examine the relation between high school GPA and course performance of students who take gateway English and math, accounting for the fact that students attended different high schools. To answer the third research question, we employed a decision tree analysis. ***Decision tree analysis*** is a machine learning approach that considers multiple measures at the same time and provides a data driven approach to identifying which factors and what levels of those factors maximize a students' chances of successfully completing each math or English course. A ***simulation analysis*** was used to answer the fourth research question. This analysis allowed us to explore how different potential placement profiles would change the number of students being placed into each level of English and math course as well as the demographic composition of these students. A more detailed description of these analytic approaches can be found in the Appendix.

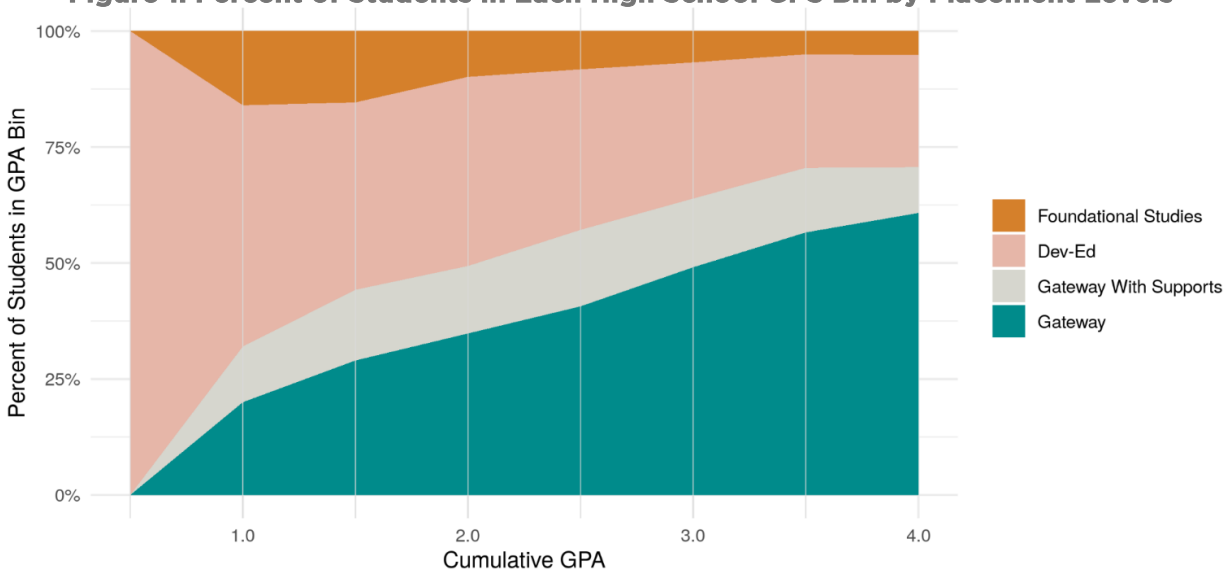
Findings

The research team identified seven key finding from these analyses. These findings are detailed below.

Key Finding 1 – There is substantial variation in high school GPA for students who initially enroll in each level of the developmental education sequence.

Figure 1 below shows the portion of students who were placed into each level of math and English course by high school GPA bin. While this figure shows that students with higher GPAs were more likely to directly place into gateway coursework without support, having a high GPA is not a guarantee of having access to college-level coursework. At each GPA band, we see students who are placed into all four types of courses. In fact, only approximately half of students with high school GPAs between 3.5 and 4.0 placed directly into gateway courses.

Figure 1. Percent of Students in Each High School GPS Bin by Placement Levels



Key Finding 2 – The odds of passing gateway math and English increases with students' high school GPA.

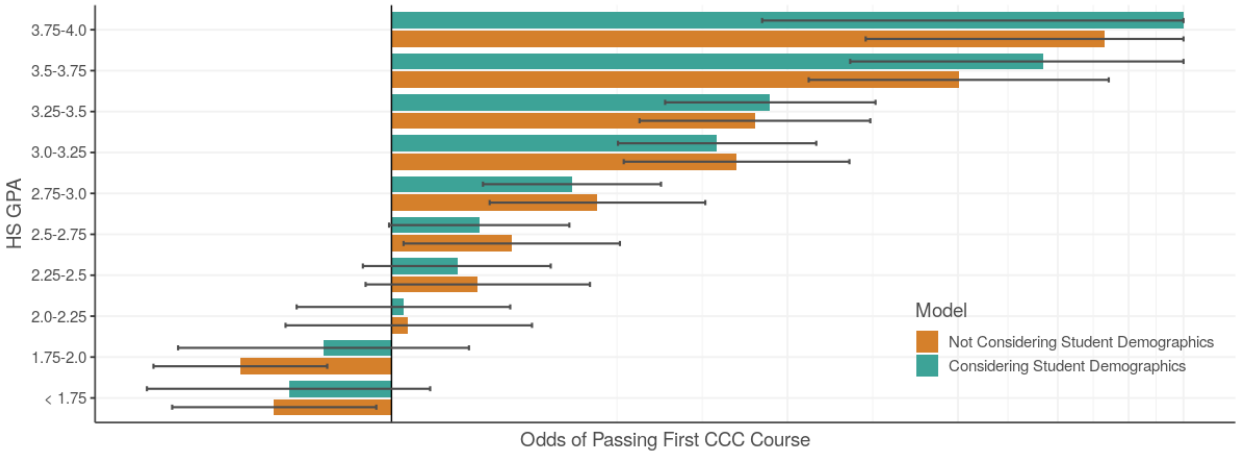
The hierarchical linear models run by the research team demonstrate that high school GPA is highly predictive of students' performance in their gateway English and math courses. Figures 2 and 3 depict the odds of passing gateway math and English respectively by high school GPA bins. For both subject areas, students with higher GPAs were much more likely to pass gateway courses. For example, students with high school GPAs of a 2.75 or higher had an 80 percent chance or better of passing their gateway math course and students with a 3.0 or higher had an 80 percent chance of passing their gateway English courses. In contrast, students with high school GPAs of 2.0 or lower had less than a 50 percent chance of passing either gateway math or English.

Notably, the odds of passing gateway math and English increase with students' high school GPA in a consistent pattern that persists even when considering student demographics. In Figures 2 and 3, the turquoise bars show the relationship between high school GPA bands and the odds of passing gateway courses after controlling for high school ESL status, gender,

race/ethnicity, and free or reduced-price lunch status. If the relationship between GPA and the odds of passing changed substantively after considering these characteristics, it would suggest GPA serves as a less consistent signal of future gateway performance for certain groups of students. The fact that both models demonstrate a very similar relationship between GPA and course performance suggests this relationship is independent of demographic characteristics, assuaging potential equity concerns.

Figure 2. Odds of Passing Gateway Math by High School GPA

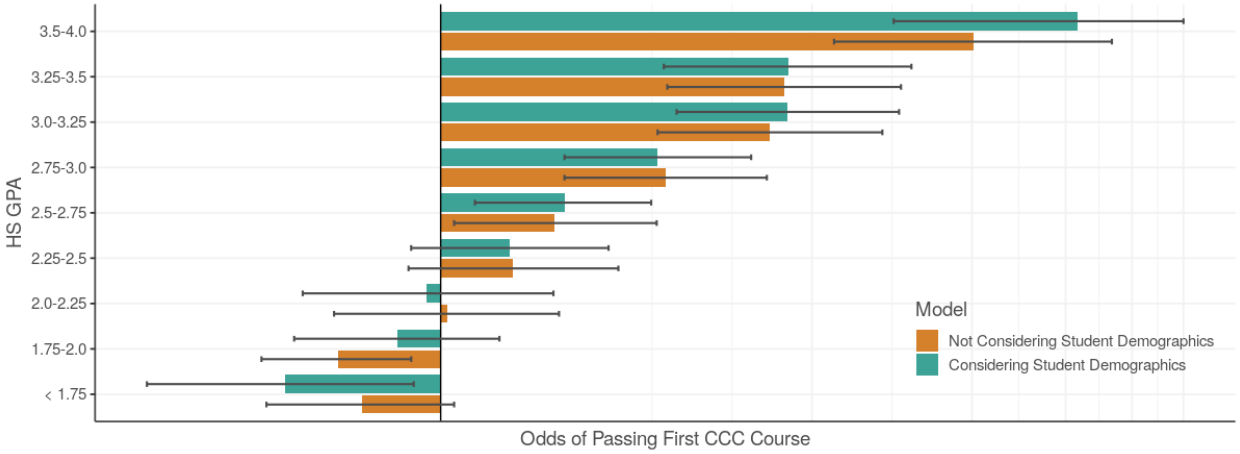
Odds are estimated both with and without controls for student characteristics like race/ethnicity and gender.



Student-level controls are ESL status, binary gender, race/ethnicity, and free/reduced lunch status. Odds constrained to 25 for ease of interpretation.

Figure 3. Figure 2. Odds of Passing Gateway English by High School GPA

Odds are estimated both with and without controls for student characteristics like race/ethnicity and gender.



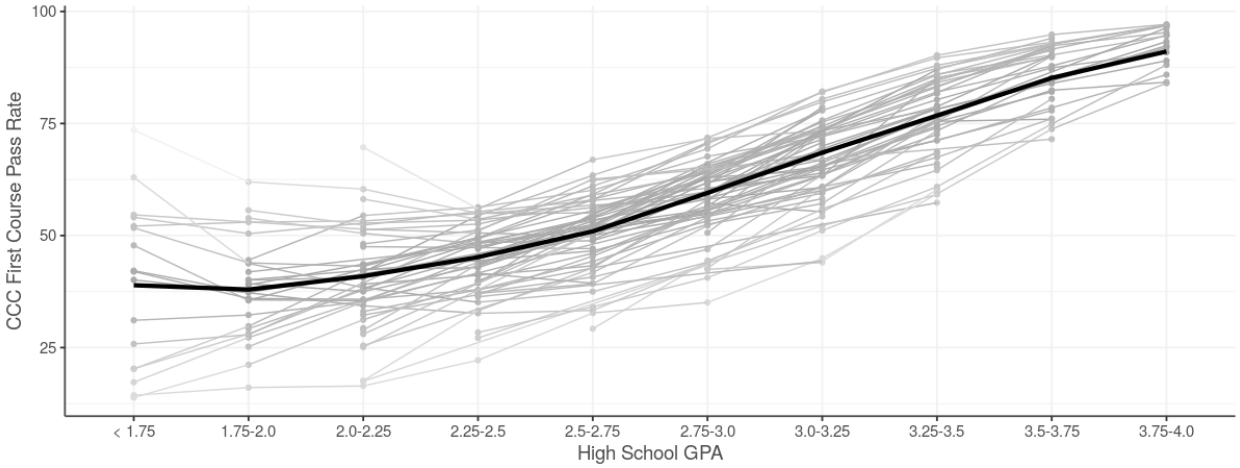
Student-level controls are ESL status, binary gender, race/ethnicity, and free/reduced lunch status. Convergence issues meant GPA 3.5-4.0 needed to be aggregated.

KEY FINDING 3. WHILE A HIGH GPA IS GENERALLY ASSOCIATED WITH HIGHER PASS RATES, THERE IS SOME VARIABILITY ACROSS HIGH SCHOOLS.

Figures 4 and 5 below detail the relationship between high school GPA and pass rates in math and English, respectively. The dark line depicts the average relationship between GPA and passing a gateway course, while each grey line represents this relationship for alumni of a particular CPS high school. Across the district, students with higher high school GPAs are more likely to pass their gateway courses. We also see that this relationship holds within most CPS high schools. Across any given high school, a student with a higher GPA is more likely to pass their gateway courses than a student with a lower GPA. However, there is some variability in

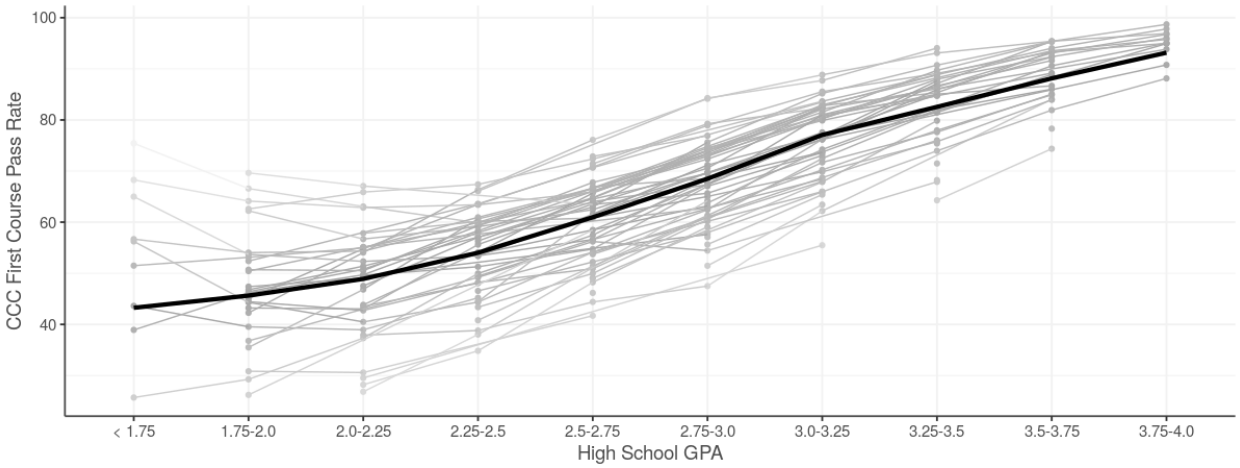
pass rates across schools. Looking at any given GPA band, we see that students who attended some high schools pass their English and math courses at much higher rates than students with similar GPAs from other high schools. These cross-school differences tend to be largest for students with lower high school GPAs. This can be seen in how tightly the grey lines of each high school cluster as GPA increases from left to right. Students with GPAs above a 3.0 pass gateway courses at relatively high rates regardless of which high school they attended.

Figure 4. Relationship between High School GPA and Gateway Math Pass Rates, Overall and by High School



Points are by-high school average predicted pass rates based on the 2-level HLM including student attribute controls, with the dark line indicating the average model prediction. High schools with fewer than five students in a given bin are omitted.

Figure 5. Relationship between High School GPA and Gateway English Pass Rates, Overall and by High School



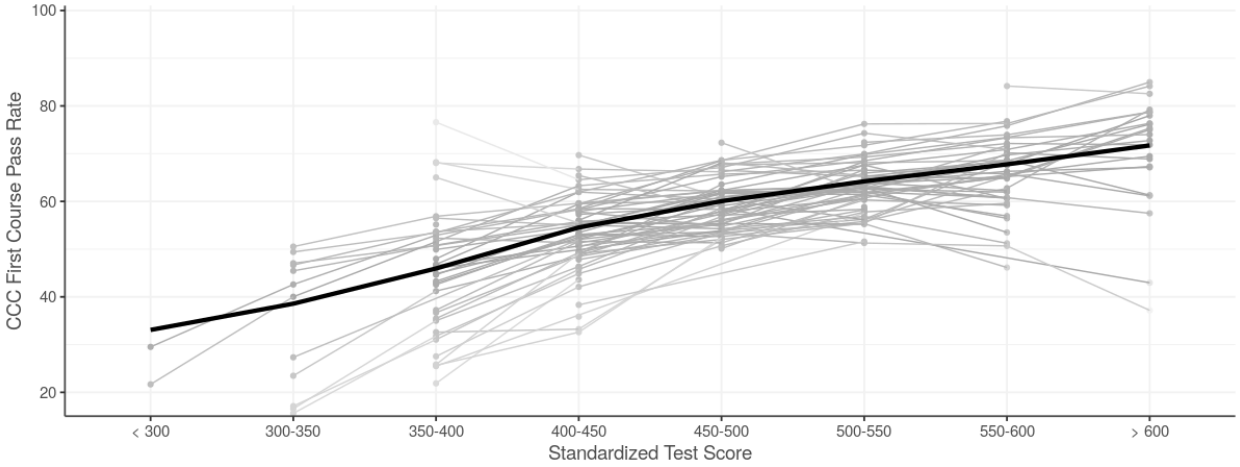
Points are by-high school average predicted pass rates based on the 2-level HLM including student attribute controls, with the dark line indicating the average model prediction. High schools with fewer than five students in a given bin are omitted.

KEY FINDING 4. HIGH SCHOOL GPA IS MORE PREDICTIVE OF PASSING GATEWAY MATH THAN SAT SCORES.

Standardized tests are commonly used to place students in college courses. However, our analyses reveal that GPA is more predictive of course performance than the SAT. Figure 6 depicts the relationship between SAT and passing gateway math, both overall and by individual high school attended. Several things are notable about this figure. First, while there is a positive relationship between SAT score and passing a gateway math course (students with higher SAT

scores are more likely to pass), this relationship is not as strong as the relationship between high school GPA and courses performance. Second, similar to GPA, there is variability across high schools in the relationship between SAT score and course performance. However, unlike GPA, this variability is consistent across the full range of SAT scores. That is, even for students with the highest SAT scores, we still see substantial variability in pass rates by high school.

Figure 6. Relationship between SAT and Gateway Math Pass Rates, Overall and by High School

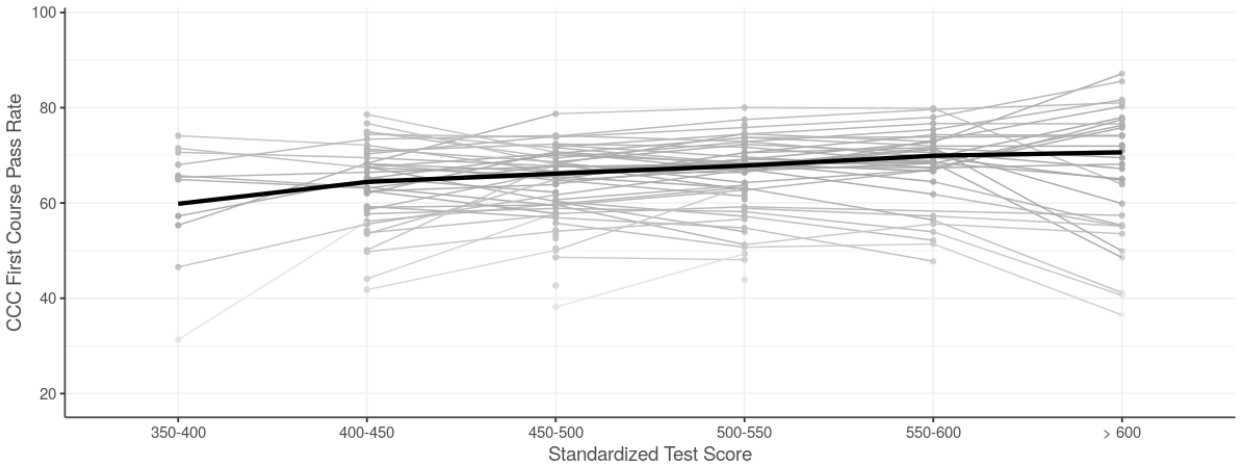


Points are by-high school average predicted pass rates based on the 2-level HLM including student attribute controls, with the dark line indicating the average model prediction. High schools with fewer than five students in a given bin are omitted.

KEY FINDING 5. SAT SCORES ARE NOT PREDICTIVE OF PASSING GATEWAY ENGLISH.

Figure 7 provides a similar representation of the relationship between SAT and passing gateway English. As is evident from the relatively flat line, the relationship between SAT score and gateway English performance is substantially weaker than the relationship between high school GPA and English course performance and even than the relationship between SAT score and math course performance. In fact, the slope of the line is not statistically significant, meaning that we cannot rule out the possibility that there is no relationship between a student's SAT score and their likelihood of passing gateway English. Like the relationship between SAT score and math course performance, there is also substantial variation in this relationship across CPS high schools. Taken together, these findings suggest that SAT may be a worse predictor of gateway course success than GPA.

Figure 7. Relationship between SAT and Gateway English Pass Rates, Overall and by High School



Points are by-high school average predicted pass rates based on the 2-level HLM including student attribute controls, with the dark line indicating the average model prediction. High schools with fewer than five students in a given bin are omitted.

KEY FINDING 6. IT IS POSSIBLE TO DESIGN MULTIPLE MEASURES PLACEMENT POLICIES THAT ARE LIKELY TO MAINTAIN OR IMPROVE HISTORICAL PASS RATES IN EACH COURSE IN THE DEVELOPMENTAL MATH AND ENGLISH PATHWAYS.

As we described above, the research team implemented a data mining technique, known as decision tree analysis, to identify which factors and what levels of those factors maximize a students' chances of successfully completing math and English courses. Drawing on a set of pre-specified variables (see Appendix: Table 1), the decision tree algorithm iteratively selects variables and thresholds on those variables that most efficiently divide students into subgroups of students with increasingly similar outcomes (i.e. passing their first CCC math or English course). Using this approach, we identified groups of students who passed a given course in the math and English developmental education sequence at a rate as high or higher than the historical pass rate for that course. This approach allowed us to identify cut scores that are associated with higher course pass rates than have been seen historically. These data informed cut scores would place more students directly into college-level math and English courses. The cut scores identified by this approach as well as the number of students that were placed under the existing CCC policy and would be placed if these cut scores were implemented district-wide can be found in Tables 2 and 3 below.

Table 2. Math Decision Tree Results

	Cut scores	New Enrollment	Old Enrollment
College Algebra (MATH 140)	Senior/Junior Cumulative GPA ≥ 2.8	4,632	3,754
General Education Math (MATH 118)	Senior/Junior Cumulative GPA ≥ 2.9 **OR** Senior/Junior Cumulative GPA ≥ 1.9 **and** Math SAT Score ≥ 425		

Statistics (MATH 125)	Cumulative GPA ≥ 3		
Dev-Ed (MATH 90, MATH 99, MATH 98, FS 3003 + FS 3004)	Math Courses Taken in CPS ≥ 5 **and** Cumulative GPA ≥ 1.7	1,175	2,136
Foundational Studies	--	576	493

Table 3. English Decision Tree Results

	Cut scores	**New Enrollment**	**Old Enrollment**
College Level (ENGLISH 101)	Senior/Junior Cumulative GPA ≥ 2.7	3,880	3,420
College Level with Supports (ENGLISH 101 + ENGLISH 97)	Senior/Junior Cumulative GPA ≥ 1.8 **AND EITHER** Senior/Junior Cumulative English GPA ≥ 2.3 **or** English SAT Score ≥ 415	2,465	1,655
Accelerated Dev Ed (ENGLISH 96)	English SAT Score ≥ 395	857	2,486
Foundational Studies	--	861	502

KEY FINDING 7. CHANGING PLACEMENT POLICIES COULD INCREASE DIRECT PLACEMENT INTO GATEWAY COURSES IN PARTICULAR FOR STUDENTS WHO IDENTIFY AS BLACK AND HISPANIC.

Figures 8 and 9 depict the net changes in placement that would have occurred had students been placed according to the empirically derived cut scores described above rather than according to CCC's historical test-based placement policy. While we see increases in access to gateway coursework across the board, most students who move into gateway courses or gateway coursework with supports (CCC's co-requisite model) identify as Black or Latinx. This suggests that changing the district placement policies could play a role in the districts' broader efforts to reduce the degree divide.

Figure 8. Change in the number of students placed using decision tree cutoffs by math placement level

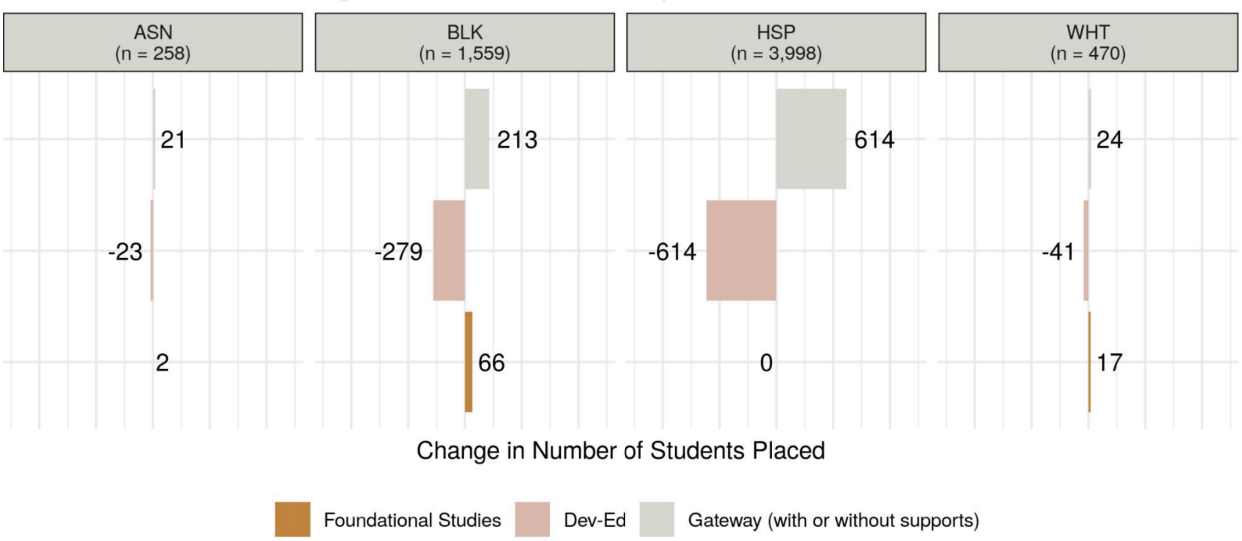
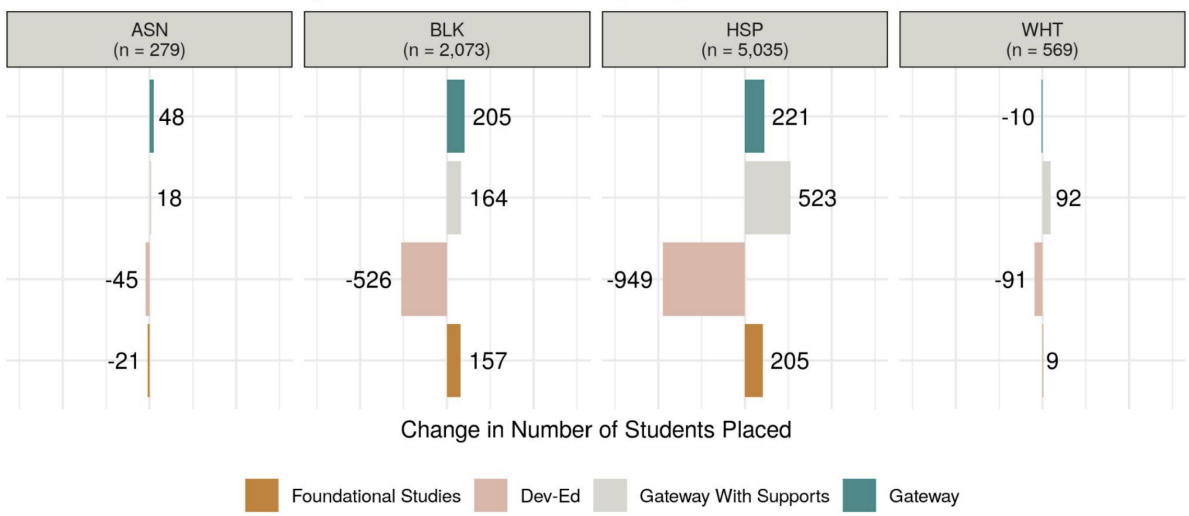


Figure 9. Change in the number of students placed using decision tree cutoffs by English placement level



Policy Impact

These findings were shared iteratively with the advisory committee over the course of seven committee meetings during the first half of 2021. The committee was instrumental in shaping many aspects of the analysis, including the variables included in the decision tree analysis as well as which subgroups were examined when assessing the relationship between high school GPA and course performance. The committee also provided important context for interpreting the findings.

At the conclusion of the committee's work, the analytic findings were shared with the Provost and the Vice Presidents for Academic and Student Affairs from each of the seven City Colleges of Chicago. Committee members attended these presentations with the Provost and Vice Presidents and a group of English and math faculty were each provided the opportunity to share their respective recommendations for how these findings should be incorporated into the district's new placement policy. Based on the findings as well as the faculty recommendations, the Vice Presidents formulated a new placement policy intended to be both reflective of the analytic results and consistent with the mandates of the Developmental Education Reform Act. The Provost was ultimately responsible for signing off on the new policy.

Ultimately, CCC adopted a revised placement policy that incorporates high school GPA with the existing placement measures by providing entry to the next level of placement for all students who have a cumulative unweighted high school GPA of 3.0 or higher based on at least seven semesters of high school coursework. The revised placement policy is depicted in Tables 4 and 5 below.

Table 4. Revised English Placement Policy

RTW Score	Placement with GPA < 3.0	Placement with GPA ≥ 3.0
6	College Level (ENG 101)	College Level (ENG 101)
5	College Level with Supports (ENG 101/097)	College Level (ENG 101)
3	Dev Ed (ENG 096)	College Level with Supports (ENG 101/097)

Table 5. Revised Math Placement Policy

Aleks Score	Placement with GPA < 3.0	Placement with GPA ≥ 3.0
≥ 46	College level math (118, 125, 140)	College level math (118, 125, 140)
30-45	Advanced Dev Ed (118/18, 125/25, 99)	College level math (118, 125, 140)
20-29	Traditional Dev Ed (90, 98, FS 3003)	Advanced Dev Ed (118/18, 125/25, 99)

When the district adopted this new policy, the Provost made a commitment to evaluating the impact for students and faculty. To follow through on this commitment, the Inclusive Economy Lab will conduct a mixed method evaluation of the new policy that will:

(1) Provide a descriptive picture of how the policy shifts course placement for CCC students,
(2) Examine the impact of this change on students' short- and longer-term academic outcomes; and
(3) Assess how the policy change was experienced by students and faculty.

This iterative approach to context-informed and data-driven approach to policy making has the potential to serve as a template for future efforts building research practice partnerships that lead to policy changes and set the stage for continued learning and improvement.

Appendix

Analytic Approach

Hierarchical Linear Modelling

Research questions one and two are focused on understanding how much high school GPA can tell us about a students' readiness for college-level coursework. Specifically, we examine how predictive high school GPA is for how a student will perform in their first English and math course at CCC. To explore this relationship, the research team implemented a statistical modeling approach known as hierarchical linear modelling (HLM). HLM accounts for the fact that students attend different high schools and allows us to examine the extent to which the relationship between high school GPA and course performance varies across schools. Following the approach employed by Allensworth and Clark (2020),[1] we implemented the following modelling approach:

$$\log\left({p_{pass}}/{1-p_{pass}}\right)_{ij} = \gamma_{00} + \sum_{s=1}^{11}\gamma_{s0}\,(G)_{ij} + \sum_{s=1}^{11}u_{s0}\,(G)_{ij} + r_{ij}$$

Where p_{pass} is an indicator of whether student *i* in high school *j* passed their first CCC Math or English course, *G* is a vector of dummy variables representing high school GPA bands, u_{s0} is the high school-level variance in CCC course pass rates within GPA band. This modelling approach allowed us to non-parametrically explore the relationship between GPA band and students' odds of passing their first English or Math course at CCC. By examining the variance components (u_{s0}), we were able to empirically assess the extent to which the relationship between GPA and course passing is consistent across high schools. Finally, by comparing this model to the unconditional model (which does not include GPA as a predictor), we were able to estimate the portion of variance in course performance that GPA band explains. Because all high schools will not have students in all GPA bands, we also ran models that include a continuous version of high school GPA to calculate the average school effect across all GPA bins. As a point of comparison, we used an analogous modeling approach to examine the relationship between student standardized assessment scores including the SAT, ACT, and ALEKS PPL.[2]

Consistent with our desire to focus on equity and disparate impacts, we disaggregated the above results across multiple dimensions to determine how the predictive power of high school GPA varies based on student identity facets. Specifically, we examined whether the relationship between GPA (and the other predictors explored above) is significantly mediated by a variety of student or school characteristics, including student demographics, the length of time between when as student was in high school and their matriculation at CCC, and the type of high school they attended.

---

[1] Note: Our approach differs from Allensworth's in that we focus on a different outcome measure: successful passing of one's first Math and English course, whereas their model is designed to predict four-year college completion. Further, their analysis only extends to students who enrolled in four-year colleges, whereas our analysis will be conditional on enrollment in and thus, specific to, the community college context in Chicago.

[2] Because RtW score only range from one to six, with the majority of students receiving a one, three, or six, a similar approach was not possible for the English placement assessment.

Decision Tree Analysis

The research team also aimed to identify a data informed approach to combining information from different data sources (e.g. high school GPA, standardized assessments, high school course taking patterns) in a new placement policy. To that end, we employed a data mining technique known as decision tree analysis. This analytic approach, following that employed by Bahr et al. (2019), allowed for the consideration of multiple measures at the same time and provides a data driven approach to identifying which factors and what levels of those factors maximize a students' chances of successfully completing each math or English course. Drawing on a set of pre-specified variables, the decision tree algorithm iteratively selects variables and thresholds on those variables that most efficiently divide students into subgroups of students with increasingly similar outcomes.

As in the analyses above, the outcome of interest for the decision tree analysis was a dichotomous indictor of whether a student passed their first math or English course at CCC. To maximize the usefulness of the analysis, we analyzed each level of developmental and college-level math and English separately. The independent variables to which the algorithm had access are listed in Table 1 below. The result was a decision tree that divides students based on their input variables (such as having a cumulative high school GPA > 3.0) into subgroups with similar likelihoods of passing a given course in the math or English sequence.

Table 1. Independent Variables Included in Decision Tree Analysis

All Trees	English Trees	Math Trees
• Senior/Junior unweighted GPA • Cumulative unweighted GPA • Number of grades in CPS	• Max SAT EBRW Score • Max CCC English Placement Test score • Unweighted GPA for Junior/Senior English courses • Number of high school English courses taken in CPS • Took an English course in senior year • Number of AP/IB English courses taken in high school • Took at least one AP/IB English course • Passed an AP/IB English course with at least a B • Passed an AP/IB English course with at least a C • Took at least one ESL course • Passed ESL courses with at least a B • Passed ESL courses with at least a C • Had an ESL flag in high school • Had an ESL flag for at least two years • Had an ESL flag for at least five years • Graduated with an ESL flag	• Max SAT Math Score • Max ALEKS Placement Test score • Unweighted GPA for Junior/Senior Math courses • Number of high school Math courses taken in CPS • Took a Math course in senior year • Number of AP/IB Math courses taken in high school • Took at least one AP/IB Math course • Passed an AP/IB Math course with at least a B • Passed an AP/IB Math course with at least a C

Simulation Analysis

Finally, the researcher team wanted to explore how different potential placement profiles would change the number of students being placed into each level of English and math course as well as the demographic composition of these students. To this end, we conducted a simulation analysis in which we applied several different placement rules to determine which courses students who enrolled in CCC between fall 2018 and Spring 2020 would have been placed into had that placement policy been in effect when they enrolled. We then compared these placements with the status quo placement policy that was in place at the time.

Works Cited

Adelman, C. (1999). Answer in the toolbox: Academic intensity, attendance patterns, and bachelor's degree attainment. Available at http://www.ed.gov/pubs/Toolbox/toolbox.html.

Adelman, C. (2006). The toolbox revisited: Paths to degree completion from high school through college. Washington, DC: U.S. Department of Education. Available at http://www2.ed.gov/rschstat/research/pubs/toolboxrevisit/toolbox.pdf.

Attewell, P., Heil, S. & Reisel, L. (2012). What is academic momentum? And does it matter? Educational Evaluation and Policy Analysis, 34, 1, 27-44.

Barnett, E.A., Kopko, E., Cullinan, D., & Belfield, C.R. (2020). Who Should Take College Level Courses? Impact Findings from an Evaluation of a Multiple Measures Assessment Strategy. New York: The Center for the Analysis of Postsecondary Research.

Bahr, P. R., Fagioli, L. P., Hetts, J., Hayward, C., Willett, T., Lamoree, D., ... & Baker, R. B. (2019). Improving placement accuracy in California's community colleges using multiple measures of high school achievement. Community College Review, 47(2), 178-211.

Bailey, T. Jaggars, S.S., & Jenkins, D. (2015). Redesigning America's Community Colleges: A Clearer Path to Student Success. Cambridge, MA: Harvard University Press.

Belfield, C., Jenkins, P. D., & Lahr, H. E. (2016). Is corequisite remediation cost-effective? Early findings from Tennessee (CCRC Research Brief 62). Columbia university, Teachers College, Community College Research Center.

Bettinger, E. P., Boatman, A., & Long, B. T. (2013). Student supports: Developmental education and other academic programs. The Future of Children, 23(1), 93–115.

Bracco, K. R., Dadgar, M., Austin, K., Klarin, B., Broek, M., Finkelstein, N., Mundry, S., & Bugler, D. (2014). Exploring the use of multiple measures for placement into college-level courses: Seeking alternatives or improvements to the use of a single standardized test. WestEd. https://www.wested.org/wp-content/uploads/2016/11/1397164696product55812B-3.pdf

Burdman, P. (2012). Where to begin? The evolving role of placement exams for students starting college. Washington, DC: Jobs for the Future. Retrieved from http://www.achievingthedream.org/sites/default/files/resources/Where_to_Begin.pdf.

Charles, C. Z. (2003). The Dynamics of Racial Residential Segregation. Annual Review of Sociology, 29(1), 167–207. https://doi.org/10.1146/annurev.soc.29.010202.100002.

Chen, X. (2016). Remedial course taking at U.S. Public 2- and 4-year institutions: Scope, experiences, and outcomes (NCES 2016-405). U.S. Department of Education, National Center for Education Statistics. http://nces.ed.gov/pubsearch.

Clovis, M.A. & Chang, M. (2021). Effects of momentum on degree attainment for students beginning college at 2-year institutions. Journal of College Student Retention, 23(2), 322- 336.

Duncan, G. J., & Murnane, R. J. (2011). Whither opportunity? Rising inequality, schools, and children's life chances. New York, NY: Russell Sage Foundation.

Ganga, E.C., & Mazzariello, A. N. (2019). Modernizing College Course Placement by Using Multiple Measures.

Illinois General Assembly. (2022). Illinois Compiled Statutes Chapter 110, Act 175, Section 100 15. Retrieved from https://www.ilga.gov/ftp/ILCS/Ch%200110/Act%200175/011001750K100-15.html.

Kozol, J. (1991). Savage Inequalities: Children in America's Schools. New York, NY: Broadway Paperbacks.

Lareau, A., & Goyette, K. (Eds.). (2014). Choosing Homes, Choosing Schools. Russell Sage Foundation.

Lichtenberger, E. & Wilson, N. (2019a). Remediation data in Illinois' higher education system. PowerPoint presentation for SJR 41 on September 9, 2019 at Harold Washington College.

Lichtenberger, E., & Wilson, N. (2019b). Developmental education data in Illinois' higher education system: Focus on equity. PowerPoint presentation for SJR 41 on November 1, 2019 at Governors State University.

Rutschow, E.Z. & Mayer, A.K. (2018). Early Findings from a National Survey of Developmental Education Practices. New York: Center for the Analysis of Postsecondary Readiness.

Scott-Clayton, J., Crosta, P. M., & Belfield, C. (2014). Improving the targeting of treatment: Evidence from college remediation. Educational Evaluation and Policy Analysis, 36(3), 371– 393.

Scott-Clayton, J. (2021). The shapeless river: Does a lack of structure inhibit students' progress at community colleges? (CCRC Working Paper No. 25). Assessment of Evidence Series, Community College Research Center, Columbia university.

Vigdor, J. L., & Ludwig, J. (2008). Segregation and the Test Score Gap. In K. Magnuson & J. Waldfogel (Series Ed.), Steady Gains and Stalled Progress: Inequality and the Black-White Test Score Gap (pp. 181–211). Russell Sage Foundation.

Wang, X. (2017). Toward a holistic theoretical model of momentum for community college student success. In M. B. Paulsen (Ed.), Higher education: Handbook of Theory and Research (pp. 259–308). Springer.

Woods, C. S., Park, T., Hu, S., & Betrand Jones, T. (2018). How high school coursework predicts introductory college-level course success. Community College Review, 46(2), 176- 196.