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Getting College and Career Ready During State Transition Toward the Common Core State Standards

ZEYU XU
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WORKING PAPER 127 • MARCH 2015

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Zeyu Xu
American Institutes for Research
CALDER

Kennan Cepa
American Institutes for Research
CALDER

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Acknowledgments

We acknowledge support from the Bill & Melinda Gates Foundation for this study. We thank the Kentucky Department of Education for providing us with the required data. This research has benefitted from the helpful input of Mike Garet, Dan Goldhaber, Angela Minnici, Toni Smith, and Fannie Tseng. Tiffany Chu provided excellent research assistance. Any and all errors are solely the responsibility of the study's authors, and the views expressed are those of the authors and should not be attributed to their institutions, the study's funders, or the agencies supplying data.

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Working Paper 127
March 2015

Abstract

This study provides a first look at how student college- and career-readiness have progressed in the early years of the Common Core State Standards (CCSS) implementation. It is motivated by concern that changes triggered by the standards transition might be disruptive to student learning in the short run, even when those changes may become beneficial once fully implemented. Using longitudinal administrative data from Kentucky, an early adopter of the CCSS, we followed three cohorts of students from the end of the 8th grade to the end of the 11th grade and found that students exposed to the CCSS—including students in both high- and low-poverty schools—made faster progress in learning than similar students who were not exposed to the standards. Although it is not conclusive whether cross-cohort improvement was entirely attributable to the standards reform, we found that students made large gains in proficiency in the years immediately before and after the transition. Additionally, we found student performance in subjects that adopted CCSS-aligned curriculum framework experienced larger, more immediate improvement than student performance in subjects that carried over last-generation curriculum framework.

1. Introduction

As of October 2014, 43 states have adopted the new Common Core State Standards (CCSS or "Common Core"). The Common Core standards, sponsored by the National Governors Association and the Council of Chief State School Officers, were developed in 2009, released by mid-2010 (NGA/CCSSO, 2010), and represent a cross-state effort to adopt a set of "college- and career-ready standards for kindergarten through 12th grade in English language arts/literacy and mathematics."[1] The CCSS initiative grew out of concerns that existing state standards are not adequately preparing students with the knowledge and skills needed to compete globally (Kober & Rentner, 2011), necessitating a clearer set of learning expectations that are consistent from state to state. The initiative is also thought to offer the benefit of allowing for cross-state collaboration on the development of teaching materials, common assessment systems, and tools and support for educators and schools.

The CCSS initiative is not without controversy, and it has become increasingly polarizing.[2] Advocates and opponents disagree on many aspects of the CCSS. Key points of contention include the standards themselves, the transparency of the development of these standards, their accompanying standardized tests, the appropriateness of student proficiency levels and their implications on performance gaps between high- and low-poverty students, the financial cost of implementation, the adequacy of supports for implementation, as well as the roles played by federal and corporate entities in the development and adoption of these standards.

The implementation of CCSS-aligned state education standards typically has been accompanied by curriculum framework revisions, student assessment redesigns, and school accountability and educator evaluation system overhauls (Rentner, 2013). Although the new standards may improve

[1] http://www.corestandards.org/about-the-standards/frequently-asked-questions. Accessed October 29, 2014.
[2] See, for instance, discussions in Education Week (2014); Hess & McShane (2014); Marchitello (2014); and Rotberg (2014).

student learning once they are fully implemented, there is also the possibility that these types of changes could prove disruptive to student learning in the short run. For example, in a survey of deputy superintendents of education in 40 CCSS states, 34 states reported that finding adequate staff and financial resources to support all of the necessary CCSS implementation activities is a major (22 states) or minor (12 states) challenge (Rentner, 2013). Furthermore, schools and districts that were already more constrained in staffing capacity and financial resources before the CCSS implementation—such as those serving predominantly low-income students—are likely to face more challenges during the CCSS transition.[3]

The net (potentially only short-term) effect of these two competing hypotheses—the potential benefits of having more rigorous education standards and the possible disruption to student learning during the early implementation phase—on student learning is unclear. To date, there is little empirical research on the effect of the CCSS on student outcomes. Granted, no state has fully implemented the CCSS 3 years after their adoption (Rentner, 2013), and it may take even longer for the full effect of the CCSS to be reflected in high school students' college- and career-readiness if students need CCSS-infused instruction pre-high school to take advantage of CCSS instruction in high school. However, tens of millions[4] of students across the country will have completed their high school study before their schools fully implement the CCSS. Whether college- and career-readiness improved among high school students affected by the early stages of CCSS implementation is an important question that has yet to be addressed.

[3] Transition issues during the early stages of major educational changes sometimes lead to short-term effects that are not necessarily indicative of the longer term effects of a program or intervention. For example, in an evaluation of Success for All, Borman and colleagues (2007) found no effects in the first 2 years after program implementation, but found positive reading outcomes by Year 3. Citing Fullan (2001), Borman and colleagues suggest that educational change takes time and that schools may face performance setbacks in the early years. Similarly, evaluating IMPACT in the District of Columbia Public Schools, Dee and Wyckoff (2013) found no statistically significant effect on teacher composition after 1 year of implementation but significant effects by Year 2.

[4] Authors' calculation based on three cohorts of projected 12th-grade public school enrollment from Hussar & Bailey (2014).

This paper starts to fill in this gap. We focus on Kentucky, which adopted the CCSS in 2010 and started its implementation in the 2011–12 school year. Kentucky is one of the few states that have required all 11th graders to take the ACT—a test intended explicitly to evaluate students' college-level proficiency and widely used in the college admission process.[5] Moreover, because Kentucky requires *all* 11th graders to take this test and has since 2007, we can measure the proficiency of *all* students—not just students who have already decided to go to college (a common problem with analysis of college admission tests generally) before and after the implementation of Common Core standards.

We compared the ACT performance of three cohorts of eighth-grade students who started high school with similar levels of academic proficiency. The first cohort took the ACT in 2010–11, so it was not affected by the CCSS implementation. The second and third cohort took the ACT in 2011–12 and 2012–13—1 and 2 years after the initial implementation of the CCSS, respectively. We found students in the latter two cohorts outperformed comparable students from the first cohort in terms of ACT composite scores. Additional analyses were conducted to explore the extent to which student "exposure" to CCSS implementation is responsible for cross-cohort differences in ACT performance. First, we exploited the availability of ACT subject area scores in math, English, reading, and science and investigated whether cross-cohort improvement was more pronounced in subjects whose curriculum framework aligned with the CCSS (math and English language/arts [ELA]) than in subjects (reading and science) that did not receive curriculum overhauls. Results from a difference-in-differences type analysis were consistent with this hypothesis, suggesting that the progress observed in the overall student ACT performance could be associated with curriculum framework changes. Second, we conducted a falsification test by moving the start of the CCSS implementation 1 year before its actual date. If cross-cohort differences in ACT scores

[5] We used ACT scores as a measure of college- and career-readiness. There is no independent evaluation on how well ACT scores can measure career-readiness, even though the ACT, Inc., argues that ACT scores are indicative of workforce-preparedness (ACT, 2010). In Kentucky, career-readiness is determined using additional criteria such as industry certificates, Kentucky Occupational Skills Standards Assessment (KOSSA), Armed Services Vocational Aptitude Battery (ASVAB), and ACT WorkKeys.

are attributable to the CCSS implementation, we should not detect any cohort effects before the CCSS transition started. This falsification exercise indicated that ACT performance gains made by Cohort 2 and 3 students over Cohort 1 are not entirely attributable to the CCSS implementation. Rather, the evidence suggested that most of the performance gains were made in the years both immediately *before* (2010–11) and *after* (2011–12) the implementation of the CCSS.

Overall, we observed significant progress in college- and career-readiness among students in more recent cohorts that were affected by the CCSS transition. We also found that the positive gains students made during this period accrued to students in high- and low-poverty schools alike. However, we are cautious about drawing strong conclusions, because we lack compelling evidence on the causal relationship between improved student performance and the implementation of the new standards. The rest of this paper is organized as follows: In the next section, we provide a brief overview about the CCSS, education standards reform in general, and the transition to the CCSS standards in Kentucky. Section 3 describes the data we used in our analyses. Section 4 outlines the research design. We discuss our results in Sections 5 and 6.

2. Standards-Based Education Reforms and the CCSS in Kentucky

Standards-based educational reform aims to bring classroom curriculum and content in alignment with student learning goals (Ladd & Figlio, 2010). In the 1980s, states implemented minimum standards for student learning; and the 1990s ushered in a national movement toward raising these minimum standards (Swanson & Stevenson, 2002). Mandating accountability, the No Child Left Behind Act (NCLB) of 2001 focused on getting students to proficiency in math and reading, as defined by each state's proficiency goals. In addition, NCLB incentivized improved student performance through "sanctions and awards" (NCLB of 2001, sec. 2Aiii).

The CCSS initiative extends these earlier reforms by providing a common set of standards for ELA and mathematics, "defin[ing] the rigorous skills and knowledge…that need to be effectively taught

and learned for students to be ready to succeed academically in credit-bearing, college-entry courses and in workforce training programs" (Common Core State Standards Initiative Standards-Setting Criteria, 2010, p. 5). Unlike NCLB's disparate, state-level achievement standards, the CCSS initiative creates a common set of standards that states may elect to adopt. Although CCSS prescribes academic goals, it does not determine specific curricula for states or districts.

Existing content analysis (Carmichael, Martino, Porter-Magee, & Wilson, 2010; Porter, McMaken, Hwang & Yang, 2011) on state standards shows that the CCSS require a modest increase in cognitive skills in math, and a larger increase for English, when compared to previous state-level standards. Although differences between existing standards and the CCSS vary across states, advocates of the CCSS reckon Kentucky's last-generation standards as "clearly inferior" to the CCSS (Carmichael et al., 2010), awarding Kentucky a score of "D" for both math and ELA prior to CCSS, but awarding the CCSS an "A–" and "B+" for math and ELA, respectively.

Currently, little empirical research exists on the extent to which the central goal of the CCSS—improved college- and career-readiness—has been achieved. The studies that have appeared tend to focus on content analysis (Carmichael et al., 2010; Porter et al., 2011) or the implementation process (Cristol & Ramsey, 2014; Cushing, Fulbeck, & Perry, 2014; Rentner, 2013), rather than student outcomes.

In contrast to the limited CCSS literature, a multitude of studies exist on prior standards reforms, many focusing on whether standards reforms have improved student achievement (e.g., Carnoy & Loeb, 2002; Dee & Jacob, 2011; Figlio & Ladd, 2008; Figlio & Rouse, 2006; Rouse, Hannaway, Goldhaber, & Figlio, 2013; Hanushek & Raymond, 2005; Jacob, 2007). Most studies found, for example, that fourth-grade students had improved math scores after the implementation of NCLB (Dee & Jacob, 2011; Jacob, 2007; Nichols, Glass, & Berliner, 2012). However, they found less evidence that reading scores

improved. In general, these studies find that standards reforms and their accompanying accountability reforms improve students' academic achievement.

Most studies on prior standards reforms examine student outcomes at Grades 4 or 8, and very few investigate the effect of standards-based education reforms on high school and college outcomes. Donovan, Figlio, and Rush (2006) examined the effects of school accountability on college-bound high school students' later performance and study habits in college. Using administrative data from a large, selective university and study habits of students within six large, computer-based classes in the same university, Donovan and colleagues (2006) found that high-performing students under accountability systems were more likely to "cram" for class in college but had improved performance in their college courses. In particular, these students did better in math and other technical classes in college than students who attended the same high schools before the implementation of accountability policies.

Common Core in Kentucky

The CCSS implementation timeline and strategy vary widely across states, districts and schools (Cristol & Ramsey, 2014; Cushing, et al, 2014; Rentner, 2013). In Kentucky, schools began implementing the CCSS-aligned Kentucky Core Academic Standards (KCAS) in 2011. Before 2011, Kentucky's education standards were the Kentucky Program of Studies (POS). The 2006 Core Content for Assessment described the particular skills and concepts that would be assessed in each grade under POS. The POS-aligned Kentucky Core Content Test (KCCT) was a series of state tests designed to measure students' learning in reading, math, science, social studies, and writing. Senate Bill 1, enacted by the General Assembly in 2009, directed the Kentucky Department of Education (KDE) to revise state content standards and launched Kentucky's transition toward the CCSS-aligned KCAS. Adopted by the Kentucky State Board of Education in June 2010, these new standards were developed jointly by the National Governors Association and the Council of Chief State School Officers. Under the KCAS, the ELA and math

curriculum frameworks are now aligned with the CCSS, whereas the curricula for all other subject areas are carried over from POS.[6]

Along with the implementation of KCAS, a plethora of other changes took place in Kentucky in 2011–12. First, starting from the 2011–12 school year, the Kentucky Performance Rating for Educational Progress (K-PREP) tests replaced the KCCT. Students in Grades 3 through 8 are required to take K-PREP in reading, math, science, social studies, and writing. In addition, students started to take K-PREP end-of-course tests for high-school level courses including English II, algebra II, biology, and U.S. history. Second, in 2011–12, Kentucky started field testing major components of its newly designed teacher evaluation system called the "Kentucky Teacher Professional Growth and Effectiveness System."[7] The new system evaluates teacher performance based on multiple measures, including student growth, student surveys, and observations by peers and evaluators. Finally, a new school accountability model, "Unbridled Learning: College/Career-Readiness for All," took effect in the 2011–12 school year.[8] The new model measures and categorizes school performance based on student achievement in the five content areas, student-achievement growth, measures of student-achievement gap among student subgroups, high school graduation rates, and college- and career-readiness. Since the U.S. Department of Education granted Kentucky a No Child Left Behind (NCLB, 2001) waiver in February 2012, Kentucky can use the Unbridled Learning model to report both state- and federal-level accountability measures.

As we attempt to document student progress in college- and career-readiness during the first 2 years of CCSS implementation, it is important to keep in mind all of these changes that are likely to affect students' overall schooling experiences. Further complicating the situation, Kentucky's 172 districts vary in terms of KCAS rollout plans and implementation strategies (Cushing et al., 2014). With

[6] See http://education.ky.gov/curriculum/docs/Documents/KCAS%20-%20June%202013.pdf for more details about KCAS.
[7] See http://www.kentuckyteacher.org/wp-content/uploads/2012/04/Field-Test-Guide-2-2-12.pdf for more details about the new teacher evaluation system.
[8] More details can be found at http://education.ky.gov/comm/ul/Pages/default.aspx.

diverse student needs, accountability pressure, and resource constraints, we hypothesize that the quality, scope, and strategy of standards implementation between high- and low-poverty schools may well be very different. Therefore, our study pays particular attention to how student experiences and outcomes diverge between those enrolled in high-poverty schools and those in low-poverty schools.

3. Data

The longitudinal data we use in this study were provided by the KDE. The data include detailed records for individual students, school personnel, and student course-taking records from school years 2008–09 through 2012–13, covering 3 years pre-KCAS and 2 years post-KCAS. Teachers and students are assigned unique identifiers that can be used to track individuals over time; students and teachers also can be linked to specific classrooms. Available student-level data include background characteristics (e.g., age, gender, race/ethnicity, and free or reduced-price lunch (FRPL) eligibility, special education status, and English language learner [ELL] designation), enrollment, and state assessment scores.

Before the 2011–12 school year, Kentucky students in Grades 3–8 took the KCCT in reading, mathematics, social studies, and writing. Since then, the state has transitioned to the K-PREP assessments for the same grades and subjects. Both KCCT and K-PREP are administered at the end of each grade between April and June. Beginning in the 2007–08 school year, all students in Grades 10 and 11 take the PLAN and the ACT, respectively. Both tests are provided by the ACT, Inc. The PLAN is administered every September to all incoming 10th-grade students. The ACT, on the other hand, is administered near the end of Grade 11 every March. For both the ACT and the PLAN, our data include composite scores as well as four subscores (English, mathematics, reading, and science). Student scores on both the PLAN and the KCCT can be used to control for student baseline academic achievement in our analyses.

Student college- and career-readiness is the central outcome that the CCSS was designed to improve. While ACT scores are an imperfect measure of student college- and career-readiness,[9] the ACT is a recognized exam for college admission, and ACT scores are found to predict student grades in the first year of college (Allen, 2013; Allen & Sconing, 2005). For some institutions, ACT scores may be the "best *single* predictor of first-year college course performance" (Maruyama, 2012). Similarly, Bettinger, Evans and Pope (2011) found that student ACT performance on the English and mathematics subsections is highly related to college outcomes and that ACT composite scores are predictive of college dropout rates. Since 2005, the ACT has tested English, math, science, reading, and has an optional writing section. Students receive scores ranging from 1 to 36 on each section. In addition, the ACT creates a composite score, which is a rounded average of each subsection (excluding writing).

Prior research has identified a few concerns about using the ACT score as a measure of college- and career-readiness. In studies like ours, the most pertinent concern is that ACT performance does not represent the full distribution of student college- and career-readiness because most of those students who take the exam have already decided whether or not to attend college by the time they take the ACT (Clark, Rothstein, & Schanzenbach, 2009; Goodman 2013; Roderick, Nagaoka, & Coca, 2009). In places where students take the ACT on a voluntary basis, any changes in the average ACT performance could reflect real improvement in college- and career-readiness, or changes in the student population who elects to take the ACT, or both. But, as noted above, all Kentucky students are required to take the ACT whether or not they plan to attend college. The mandatory nature of ACT test taking in Kentucky allows us to observe changes in student college- and career-readiness that are representative of the entire high

[9] College- and career-readiness is difficult to measure, and literature suggests that multiple dimensions should be considered (Conley, 2007; Conley, 2010; Roderick et al., 2009). Roderick and colleagues (2009) argue that "content knowledge and basic skills, core academic skills, non-cognitive skills and norms of performance, 'college knowledge'" all constitute college readiness. In part, colleges use standardized achievement tests to measure "cognitive ability, basic skills, content knowledge, and common academic skills" (Roderick et al., 2009, p. 185).

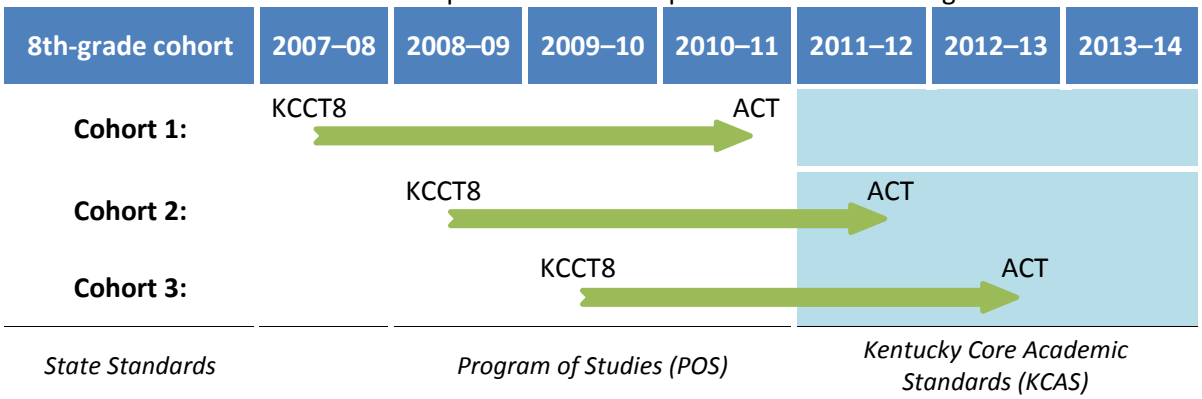
school student population in the state. Therefore, we focus on student ACT test scores as the key outcome of interest in this study.

4. Research Design

Our data allow us to observe three cohorts of 8th-grade students and follow them until the end of the 11th grade (Exhibit 1). For all three cohorts, student academic preparation for high school is measured by the KCCT at the end of the eighth grade. At the end of the 11th grade, the ACT measures high school students' general educational development and their capability to complete college-level work. Neither the KCCT tests nor the ACT has changed during the test years of interest. Therefore, student performance at both the starting and the end points is measured with the same test instruments for all three cohorts and is not affected by changing test familiarity.

As Exhibit 1 shows, the three cohorts of eighth-grade students differ in student exposure to CCSS-aligned KCAS. The first cohort of students enrolled in the eighth grade in 2007–08 and had no exposure to KCAS before sitting for the ACT in 2010–11. In contrast, the second and third cohorts of eighth-grade students had spent 1 and 2 years, respectively, of their high school careers under KCAS before taking the ACT. We take advantage of this cross-cohort variation in student exposure to KCAS and address the following question: For students starting high school at similar performance levels and with similar background characteristics, did more "exposure" to KCAS predict higher ACT scores in Grade 11?

Exhibit 1. Cross-cohort comparison of KCAS exposure: 2007–08 through 2012–13



It is important to keep in mind that "exposure" not only captures the quantity of schooling a student received under KCAS but likely also reflects the expanding scope of CCSS implementation during the first couple of years since the transition. In addition, 2011–12 marks not only the implementation of new state education standards but also the accompanying changes in student assessment, state school accountability system, and teacher evaluation system. We use exposure to capture the totality of all KCAS-related changes that students experienced in their high school-learning environment.

Using student-level data, we first estimate the following cross-cohort model:

$$ACT\ Composite\ Score_i = \alpha_0 + \boldsymbol{Score_i^{'grade\ 8}\alpha_1} + \alpha_2 Cohort2_i + \alpha_3 Cohort3_i + \boldsymbol{x_i'\gamma} + \varepsilon_i \quad (1)$$

Here, student *i*'s ACT composite score varies by her cohort, as well as her eighth-grade KCCT scores and background characteristics $\boldsymbol{x}_i'$. The KCCT score vector includes student scores in all four tested subject areas: reading, mathematics, social studies, and writing scores. Student background characteristics include FRPL eligibility, race/ethnicity, ELL status, and special education status. All ACT and KCCT scores are standardized by subject across all years rather than within each year in order to capture cohort-to-cohort variation in high school readiness. We are interested in the estimates for coefficients α_2 and α_3, which represent the ACT performance differentials between students affected by KCAS implementation and similar students not affected by the new state standards.[10]

An area of debate is whether the implementation of CCSS may have differential effects on different student subgroups. In particular, local administrators, teachers, principals, and other staff working in high-poverty districts and schools feel generally less prepared to implement the standards

[10] Another potentially important control variable is high school tracking. Jackson (forthcoming) demonstrates that high school tracks are associated with student test score gains. In our case, whether or not a student follows an academic track may predict his or her ACT performance. Unfortunately, we do not have detailed course-taking information to infer student tracks. However, the omission of high school tracks as a control variable will not have a large impact on our estimates of cohort coefficients unless the proportion of students following various high school tracks has changed significantly across cohorts.

than their counterparts in low-poverty districts and schools (Finnan, 2014). High-poverty schools often lag behind schools serving less disadvantaged students in resources needed to provide professional development for teachers and academic and other supports for students (Regional Equity Assistance Centers, 2013). To explore this issue, we estimate the cross-cohort model of equation (1) for students in low and high school-poverty contexts separately. Within each school type, we further split students into those who are eligible for FRPL and those who are not in order to capture the interplay between individual- and school-level poverty conditions. School-level poverty context is measured by the percentage of FRPL-eligible students in a school. For students who attended multiple schools between Grades 9 and 11, we use the average FRPL percentage across schools. We define schools in the top one-fifth of the school poverty distribution in Kentucky (>55% FRPL) as high poverty, and those in the bottom fifth (≤35%) as low poverty. (See Figure 1 for the distribution of school poverty among Kentucky public high schools.)

Sensitivity Analyses

To gauge the extent to which the implementation of KCAS is directly responsible for any estimated cross-cohort differences in student ACT performance, we conducted two sensitivity analyses. First, when Kentucky implemented the new state standards, it decided to adopt revised, CCSS-aligned curriculum framework for English and mathematics ("targeted subjects") but carried over the reading and science ("untargeted subjects") curricula from the old regime. This allows us to implement a difference-in-differences type of analysis by comparing cross-cohort changes in ACT scores on targeted subjects with cross-cohort changes on untargeted subjects. The ACT performance trends on untargeted subjects serve as our "counterfactuals," representing what might have happened across all subject areas in the absence of curriculum reform. If CCSS-aligned curriculum framework did make a difference, we would expect a stronger association between KCAS exposure and student ACT performance on targeted subjects than on untargeted subjects. To test this hypothesis, we estimated the following model:

$$ACT\ Subject\ Score_{is} = \alpha_0 + \boldsymbol{Score}_i^{'grade\ 8}\boldsymbol{\alpha_1} + \alpha_2 Cohort2_i + \alpha_3 Cohort3_i + \alpha_4 T_s$$
$$+\alpha_5 T_s * Cohort2_i + \alpha_6 T_s * Cohort3_i + \boldsymbol{x}_i'\boldsymbol{\gamma} + \varepsilon_i \quad (2)$$

Instead of using ACT composite score, this cross-subject, cross-cohort model uses ACT subject-specific score (student *i*'s score on subject *s*, which includes English, math, reading, and science) as the dependent variable. Compared to model (1), model (2) adds an indicator variable *T* for targeted subjects and its interaction with cohort dummy variables. Coefficients α_2 and α_3 now represent cross-cohort differences in ACT performance on untargeted subjects (reading and science). The coefficients of interest, α_5 and α_6, estimate the extent to which cross-cohort progress in student ACT performance on targeted subjects (English and math) differs from that for untargeted subjects. Because the unit of analysis is student-by-subject, the total sample size is inflated by a factor of four. Therefore, we need to cluster standard error estimates at the student level to take into account cross-subject correlation of scores within individual students.

One complication in our difference-in-differences design is that the CCSS for ELA also aims to raise the literacy standards in history/social studies, science, and technical subjects. The goal is to help students achieve the literacy skills and understandings required for college- and career-readiness in multiple disciplines.[11] In other words, "untargeted" subjects, at least in theory, are not completely untouched by the curriculum reform. Insofar as this design feature of the CCSS was implemented authentically, our difference-in-differences coefficients (α_5 and α_6) estimate the lower-bound effect of curriculum reform. However, these ELA standards are not meant to replace content standards in those subject areas but rather to supplement them. Therefore, even if the revised English curriculum framework benefits student performance in other subject areas, the benefits to those subject areas are likely to be less immediate and pronounced than what we might expect for directly targeted subject areas.

[11] http://www.corestandards.org/wp-content/uploads/ELA_Standards.pdf

A second concern with model (1) is that it takes into account only cross-cohort performance differentials at a single point in time. However, between the end of the 8th grade and the 11th grade, students from the three cohorts could have followed different performance *trajectories*, either due to unobserved student characteristics or due to education interventions or programs implemented right before the KCAS. In other words, cross-cohort improvement in student performance may have started before the implementation of the KCAS. We tested this by creating a pseudo year of change. Because KCAS was not actually implemented in the pseudo year, we should not detect any cross-cohort differences if the implementation of KCAS was directly responsible for those differences. Implementing this strategy, however, requires the ACT (or similar tests aligned with the ACT) to be administered to the same students repeatedly. The Kentucky assessment system provides us with a rare opportunity to conduct this falsification test, as it requires all 10th-grade students take the PLAN tests. The PLAN, often considered the "Pre-ACT" assessment, helps students understand their college- and career-readiness midway through high school and plan accordingly for their remaining high school years. The PLAN scores are highly predictive of student performance on the ACT. In our sample, the correlations between the two test scores range from 0.70 to 0.86.

Because the PLAN is administered at the beginning of the 10th grade every September, none of the three cohorts under investigation had any meaningful exposure to KCAS implementation by the time they took the PLAN. The timing of the PLAN administration allows us to examine whether students from the three cohorts, otherwise comparable in terms of background characteristics and performance at the start of high school, had already been on different learning trajectories before the KCAS implementation. This analysis was carried out by re-estimating model (1) after replacing the ACT composite scores with the PLAN composite scores, standardized across cohorts.

5. Findings

Descriptive Statistics

Descriptive statistics in Table 1 show that students from Cohorts 2 and 3 outperformed Cohort 1 students on ACT composite score by 0.18 and 0.25 points, respectively. These differences are equivalent to about 4%–5% of a standard deviation (1 standard deviation = 4.84 points). To put the magnitude of these differences into context, Lipsey and colleagues (2012) report the annual achievement gain from Grade 10 to Grade 11 is around 0.15 standard deviations in nationally normed test scores. Therefore, the cross-cohort gains in ACT performance are roughly equivalent to 3 months of additional learning.

It is premature, however to jump to strong conclusions, as the three cohorts of 11th-grade students also differ in other ways. First, students from the latter two cohorts appear to be more disadvantaged than Cohort 1 students, with higher percentages of students eligible for FRPL (53% and 56% vs. 48%) and slightly higher percentages of minority students (13% vs. 12%). On the other hand, compared with Cohort 1 students who took the ACT prior to KCAS, students in the second and third cohort started high school with generally higher achievement levels. On eighth-grade math, for instance, students from the latter two cohorts scored 6%of a standard deviation higher than students from the first cohort. On both eighth-grade reading and writing, Cohort 3 students outperformed Cohort 1 students by an even larger margin of about 9% of a standard deviation. Although the eighth-grade performance gap between students in Cohort 2 and Cohort 1 is smaller on these subjects, those differences remain statistically significant.

Cross-Cohort Regressions

Table 2 reports cross-cohort changes in student ACT performance for all students and for student subgroups categorized by individual and school poverty circumstances. Results suggest that exposure to KCAS is associated with higher ACT composite scores (column 1). Specifically, compared to

Cohort 1 students with comparable starting academic proficiency and background characteristics, Cohort 2 students scored 3% of a standard deviation higher at the end of the first year of KCAS implementation. Students under the KCAS regime for 2 years (Cohort 3) outscored Cohort 1 students by slightly more, 4% of a standard deviation (and the differential between Cohorts 2 and 3, 1% of a standard deviation, is statistically significant at the 0.05 level).

In columns 2 through 5 of Table 2, we explore whether there appears to be heterogeneity in the association between KCAS exposure and ACT performance across student- and school-poverty subgroups. There is some evidence of this. Students in both Cohorts 2 and 3 outscored Cohort 1 students in low-poverty schools. In other words, all students (regardless of FRPL eligibility) in low-poverty schools improved their ACT performance after a single year of exposure to KCAS implementation. By comparison, among students in high-poverty schools (particularly those eligible for FRPL), only Cohort 3 students outperformed their Cohort 1 counterparts, suggesting that it took longer exposure to KCAS for students in high-poverty schools to demonstrate significant progress in ACT performance. These findings raise the concern that students in high-poverty schools may have lost ground to students in low-poverty schools in terms of performance growth between the 8th and the 11th grade. One possible reason, as discussed earlier, is that high-poverty schools are generally perceived as less prepared in providing teachers and students with the resources and support required by the standards transition. And opponents of the CCSS often cite the new standards as a potential distraction to ongoing efforts in narrowing the student performance gap between high- and low-poverty students (Rotberg, 2014). However, we cannot pinpoint when such divergence in growth started to emerge. That is, we are uncertain whether students in high-poverty schools started to fall behind their counterparts in low-poverty schools before or after the implementation of KCAS.

Cross-Subject, Cross-Cohort Analysis

Next we use the ACT subject area scores to estimate a difference-in-differences type model. These models use cross-cohort differences in student ACT performance on untargeted subjects—subjects that did not receive curriculum framework overhaul—as the counterfactual, representing how cross-cohort patterns in ACT performance might have looked in the absence of curriculum alignment with the CCSS. If CCSS-aligned standards are indeed superior to Kentucky's last-generation standards, as claimed by advocates of the CCSS (Carmichael et al., 2010), we should observe more pronounced cross-cohort improvement in ACT performance on targeted subjects that now have adopted CCSS-aligned curriculum frameworks. This hypothesis is supported by comparisons between Cohort 1 and 2 students (Table 3). We detected no statistically significant improvement in ACT performance on untargeted subjects (reading and science). The coefficient on "Untargeted subjects, Cohort 2012" is 0.00. By comparison, ACT performance on targeted subjects (math and English) improved after a single year of KCAS, significantly outpacing cross-cohort student-performance trajectory on untargeted subjects by 5% of a standard deviation (the coefficient on "Targeted subjects, Cohort 2012" is 0.05). Importantly, Cohort 2 students in both high- and low-poverty schools improved significantly on targeted subjects relative to untargeted subjects. The lack of progress in overall ACT performance from Cohort 1 to Cohort 2 in high-poverty schools reported in Table 2 seems to be due to the deteriorating (although statistically insignificant) performance on untargeted subjects, negating the gains students made on targeted subjects.

Cross-subject comparisons between Cohorts 1 and 3, however, demonstrated a different pattern. By the end of the second year of KCAS implementation, Cohort 3 students outscored Cohort 1 students on both targeted and untargeted subjects. On untargeted subjects, student performance improved by 4% of a standard deviation. On targeted subjects, the improvement was smaller (by 2% of a standard deviation) but remained statistically significant (0.04 – 0.02 = 0.02 standard deviations). These patterns were consistently observed for students enrolled in both high- and low-poverty schools. One

interpretation of the difference in Cohort 2 and Cohort 3 coefficients is that curriculum changes not only benefit those directly targeted subjects, but also other subject areas, albeit in a more tangential way. As discussed earlier, the CCSS-aligned ELA framework is intended to help improve literacy skills required in other subject areas. This design feature implies that student performance on untargeted subjects is likely to benefit from ELA curriculum change, with a lag as improved literacy skills trickle down to these other subjects.

Cross-Cohort Differences: When Did the Divergence Begin?

Starting high school with similar test scores, students from Cohorts 2 and 3 made more progress in terms of academic proficiency than Cohort 1 students by the end of the 11th grade. However, it remains unclear when such cross-cohort divergence began. If students from the three cohorts had been on different performance *trajectories* prior to KCAS despite having similar starting performance *levels*, our findings should not be completely attributed to KCAS implementation. To investigate this possibility, we compared student's 10th-grade PLAN composite scores across cohorts. All three cohorts took the 10th-grade PLAN *before* the implementation of KCAS; therefore, we should expect no cross-cohort differences in 10th-grade scores if KCAS implementation was responsible for improved student learning. Indeed, we find no difference in 10th-grade performance between students in Cohorts 1 and 2 (Table 4), lending support to the interpretation that KCAS implementation likely led to improved ACT performance from Cohort 1 to Cohort 2. By comparison, Cohort 3 students outscored Cohort 1 students at the start of the 10th grade by 4% of a standard deviation. That is, there is strong evidence that Cohort 3 students started pulling ahead of comparable Cohort 1 students before KCAS implementation.[12]

[12] We also re-estimated the cross-subject, cross-cohort model presented in Table 3 by replacing ACT subject scores with corresponding PLAN subject scores. Findings are similar to what is reported here for PLAN composite scores: We found no diverging performance trajectories between Cohort 1 and 2 on any subjects by Grade 10. However, Cohort 3 significantly outperformed Cohort 1 on the PLAN on both untargeted and targeted subjects, raising questions about the extent to which ACT performance gains achieved by Cohort 3 on all subjects can be attributed to KCAS.

Our falsification test appears to have reached contradictory conclusions as to whether we should attribute cross-cohort improvement in ACT performance to KCAS implementation. What we have learned from this exercise is that, between the 8th grade and the start of the 10th grade, students in Cohorts 1 and 2 seemed to be on the same learning trajectory, whereas the learning trajectory is steeper for Cohort 3 students. It becomes clear that controlling for student academic proficiency at a single point in time is insufficient to account for important baseline cross-cohort differences. We therefore augmented models (1) and (2) by controlling for 10th-grade PLAN scores in addition to the 8th-grade KCCT scores. The augmented models allowed us to answer the question: Among students who started high school at similar levels and remained comparable in academic performance at the start of Grade 10, did those in later cohorts outperform those in the first cohort? The augmented models, however, may run the risk of overcontrolling: It is possible that schools adjusted their instructions in earlier grades while anticipating that performance expectations in later grades will be different after the standards reform. If that were the case, 10th-grade scores of later cohorts could reflect changes induced by KCAS; therefore, controlling for those scores would remove part of the "KCAS impact" on student performance.

Table 5 shows results of the augmented models. For both models, adding the PLAN score explains an additional 13%–18% of the total variation in student ACT scores. Focusing on ACT composite scores, estimates in the top panel of Table 5 show that students from both Cohorts 2 and 3 still significantly outperformed Cohort 1 students. Cohort 2 students scored 2% of a standard deviation higher on average. Interestingly, after controlling for the PLAN score, Cohort 2 students from both high- and low-poverty schools improved their ACT performance relative to their counterparts in Cohort 1, alleviating the concern that recent changes in the school system triggered by KCAS may have disproportionate, adverse effects on students in high-poverty schools.

Although Table 2 reports that Cohort 3 students experienced larger cumulative gains between the 8th and the 11th grade relative to Cohort 2 students when both are compared to Cohort 1 students, most of the gains accrued to Cohort 3 students had been achieved before KCAS, by the time when they started Grade 10. Consequently, once the PLAN score is controlled for, Cohort 3 students outscored Cohort 1 students on the ACT by just 1% of a standard deviation on average. The difference nevertheless remained statistically significant. The results in the top panel of Table 5 indicate that exposure to KCAS was correlated with improved college- and career-readiness, but higher "dosage" of exposure was not necessarily associated with continual improvement in student readiness.

Comparing results reported in Tables 4 and 5, it appears that Cohort 2 students made significant progress in Grades 10 and 11 (from 2010–11 to 2011–12), whereas Cohort 3 students made most of the gains in the 9th grade (2010–11) and continued to improve (at a slower rate) in Grades 10 and 11 (from 2011–12 to 2012–13). Although Cohorts 2 and 3 differ in the grades in which progress was observed, both cohorts improved relative to the first cohort during the same time period (that is, in the year immediately before the KCAS implementation and the years after).

The bottom panel in Table 5 reports cross-subject differences in cross-cohort gains in ACT performance after taking into account 10th-grade PLAN subject scores. Similar to results reported in Table 3, by the end of the first year of KCAS, there was no statistically significant difference in ACT performance on untargeted subjects between Cohort 1 and Cohort 2 students. On the other hand, ACT scores on targeted subjects improved significantly (0.02 standard deviations) during the same period. Two years into the KCAS, however, ACT performance on both targeted and untargeted subjects improved (and by the same magnitude since the coefficient on "Targeted subjects: Cohort 2013" is 0). These patterns were largely consistent across student subgroups regardless of school poverty context. These findings appear to confirm that the new math and ELA curriculum framework did make a

difference, and that reformed ELA curriculum might indeed have benefitted non-ELA subjects with some delay.

6. Discussion

Our study provides a first look at how student college- and career-readiness progressed in the early years of the CCSS implementation in Kentucky. The study was motivated by concerns that changes triggered by the KCAS transition might be disruptive to student learning in the short run, even when those changes may become beneficial once they are fully implemented. In addition, we were concerned that multiple concurrent changes in the school system might place a disproportionate burden on high-poverty schools, adversely affecting student learning in those school environments.

Following three consecutive cohorts of Kentucky students from 8th grade through 11th grade, we found that students in the two more recent cohorts made faster progress in learning than students from the earliest cohort and that they scored significantly higher on the ACT. Although students in more recent cohorts had increasing exposure to KCAS, it is not conclusive that the progress made in student college- and career-readiness is attributable to the new education standards. In fact, most of the progress probably was achieved before the implementation of KCAS.

On the basis of these findings, we can only reasonably conclude that students—including students enrolled in both high- and low-poverty schools—made significant progress toward college- and career-readiness in the year immediately before as well as during the years of the KCAS implementation. While it is unclear what might have changed in the pre-KCAS year or whether those changes were KCAS-induced, one speculation is that in anticipation of the upcoming standards reform, some schools and districts might have started gearing up for the KCAS transition in the 2010–11 school year.[13] However,

[13] There are anecdotal references to implementation activities starting in 2010 after Kentucky adopted the KCAS in February 2010. A number of other states also reported teaching CCSS-aligned curricula in English and math as early as 2010–11 (Rentner, 2013).

those activities were probably unlikely to generate benefits to student learning both fast enough and widespread enough to be reflected in statewide average test scores.

We also found that students made more progress on subjects directly targeted by KCAS than on untargeted subjects after the first year of KCAS implementation. But the cross-subject difference disappeared by the end of Year 2 of KCAS implementation. This pattern seems to be consistent with the hypothesis that the new CCSS-aligned ELA curriculum will benefit non-ELA subject areas in a less immediate way. We caution, however, that we cannot demonstrate our hypothesis to be the *only* explanation for the observed pattern. For example, it is possible that Cohort 2 students made most of the progress on targeted subjects in the year immediately before the adoption of the new curriculum, so that curriculum changes were not responsible for observed improved student performance.

Detractors of CCSS sometimes worry whether the CCSS can deliver on its promise to improve college- and career-readiness. Similarly, we worried that Kentucky's transition to CCSS might disrupt student learning in the short term, especially in high-poverty schools. In the short term, our findings suggest that fears about CCSS's impact on student outcomes may be overstated. Only 2 years after the CCSS implementation, Kentucky students are scoring higher on the ACT than students who were not taught under CCSS-aligned curricula. However, these student achievement gains are small, suggesting that some of the claims about the benefits of CCSS may also be overstated. In addition, our findings only represent outcomes after 2 years of the CCSS implementation. With additional data and time, research will gain a clearer picture of the outcomes of the CCSS implementation.

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Tables and Figures

Figure 1. Distribution of the percentage of students eligible for free/reduced-price lunch (FRPL) in school, high schools, 2009–2013

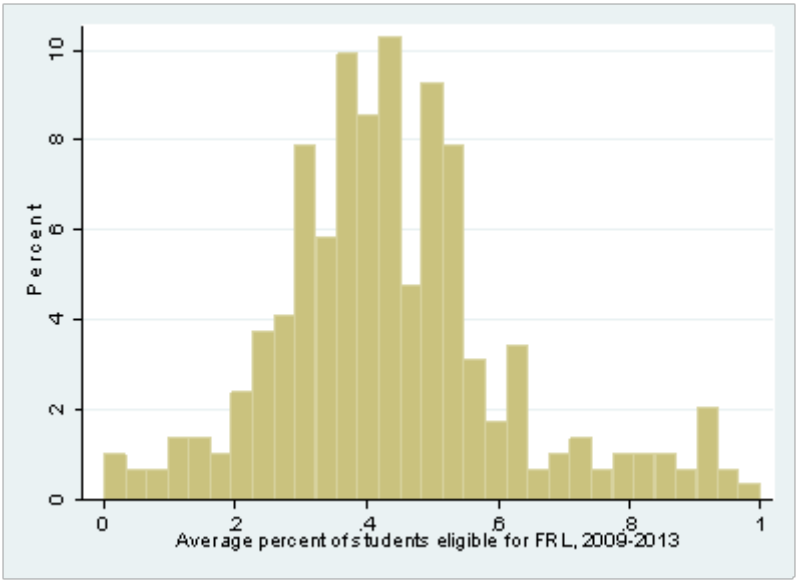

Table 1. Student performance and background characteristics, by cohort

	All		2011 Cohort		2012 Cohort		2013 Cohort	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Student performance								
8th-grade KCCT								
Mathematics	0.14	0.95	0.10	0.96	0.16**	0.94	0.16**	0.94
Reading	0.14	0.95	0.11	0.94	0.12**	0.96	0.20**	0.94
Social studies	0.14	0.95	0.16	0.94	0.13**	0.96	0.13**	0.95
Writing	0.14	0.96	0.10	0.95	0.12**	0.97	0.19**	0.95
10th-grade PLAN								
Composite	17.31	3.63	17.21	3.60	17.29**	3.68	17.42**	3.61
Mathematics	16.39	4.28	16.41	4.43	16.24**	4.16	16.55**	4.25
English	17.26	4.29	17.10	4.36	17.40**	4.37	17.27**	4.11
Reading	16.92	4.51	16.76	4.45	16.96**	4.53	17.03**	4.53
Science	18.14	3.53	18.06	3.33	18.02	3.62	18.35**	3.60
11th-grade ACT								
Composite	19.23	4.84	19.08	4.81	19.26**	4.91	19.33**	4.79
Mathematics	18.57	6.24	18.36	6.22	18.76**	6.30	18.56**	6.19
English	18.95	4.50	18.79	4.51	19.03**	4.54	19.02**	4.45
Reading	19.41	5.83	19.32	5.66	19.34	5.91	19.58**	5.91
Science	19.45	4.81	19.31	4.86	19.40**	4.93	19.64**	4.62
Student background characteristics (percent)								
Black	9.32	29.07	9.18	28.87	9.56	29.41	9.19	28.89
Hispanic	2.31	15.02	2.02	14.07	2.28**	14.93	2.63**	15.99
Other minority	1.31	11.38	1.02	10.03	1.30**	11.31	1.62**	12.63
Male	50.01	50.00	49.95	50.00	49.82	50.00	50.27	50.00
Special education	2.41	15.33	0.01	1.13	0.12**	3.41	7.29**	26.00
LEP	0.38	6.16	0.38	6.13	0.39	6.21	0.38	6.14
FRPL-eligible	52.33	49.95	47.71	49.95	53.06**	49.91	56.01**	49.64
Observations	100,212		31,595		36,139		32,478	

Note: ** denotes the statistic is significantly different from Cohort 1 at $p<0.05$.

Table 2. Cross-cohort comparisons of ACT composite scores, by school poverty and student FRPL eligibility

[Standard errors in parentheses]

	(1)	(2)	(3)	(4)	(5)
		High-Poverty Schools		Low-Poverty Schools	
VARIABLES	All	FRPL students	Non-FRPL students	FRPL students	Non-FRPL students
Cohort 2012	0.03***	0.02	0.04	0.03**	0.03***
	(0.00)	(0.01)	(0.03)	(0.01)	(0.01)
Cohort 2013	0.04***	0.04***	0.04	0.03**	0.02**
	(0.00)	(0.01)	(0.03)	(0.01)	(0.01)
8th-grade KCCT scores					
Mathematics	0.40***	0.27***	0.39***	0.42***	0.56***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Reading	0.15***	0.17***	0.13***	0.12***	0.11***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Social studies	0.23***	0.17***	0.26***	0.24***	0.27***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Writing	0.12***	0.07***	0.11***	0.09***	0.11***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Background characteristics					
Black	-0.03***	-0.08***	-0.14***	-0.06***	-0.08***
	(0.01)	(0.01)	(0.03)	(0.02)	(0.02)
Hispanics	-0.08***	-0.08***	0.07	-0.13***	-0.07*
	(0.01)	(0.03)	(0.09)	(0.03)	(0.04)
Other race	0.01	0.00	-0.31**	0.04	-0.03
	(0.02)	(0.05)	(0.15)	(0.04)	(0.04)
Male	0.03***	0.00	0.09***	0.01	0.07***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Special education	-0.14***	-0.15***	0.09	-0.07**	0.05
	(0.01)	(0.03)	(0.09)	(0.03)	(0.04)
LEP	0.16***	0.03	0.40	0.01	0.28
	(0.03)	(0.04)	(0.33)	(0.07)	(0.23)
FRPL-eligible	-0.22***				
	(0.00)				
Constant	-0.04***	-0.30***	-0.16***	-0.16***	-0.05***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Observations	100,212	10,381	2,814	10,039	20,679
R-squared	0.64	0.53	0.64	0.61	0.64

Note: The reference cohort took the ACT in the 2010–11 school year. The reference racial group is white.

*** p<0.01, ** p<0.05, * p<0.1

Table 3. Cross-subject cross-cohort comparisons of ACT subject scores, by school poverty and student FRPL eligibility

[Robust standard errors clustered at the student level in parentheses]

	(1)	(2)	(3)	(4)	(5)
		High-Poverty Schools		Low-Poverty Schools	
VARIABLES	All	FRPL students	Non-FRPL students	FRPL students	Non-FRPL students
Untargeted subjects,	-0.00	-0.02	0.01	-0.01	-0.01
Cohort 2012	(0.00)	(0.01)	(0.03)	(0.01)	(0.01)
Untargeted subjects,	0.04***	0.04***	0.04	0.04**	0.02*
Cohort 2013	(0.00)	(0.01)	(0.03)	(0.02)	(0.01)
Targeted subjects,	0.05***	0.06***	0.06***	0.06***	0.07***
Cohort 2012	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Targeted subjects,	-0.02***	-0.01	-0.00	-0.01	-0.00
Cohort 2013	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
8th-grade KCCT scores					
Mathematics	0.38***	0.25***	0.38***	0.40***	0.53***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Reading	0.13***	0.15***	0.11***	0.10***	0.09***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Social studies	0.20***	0.14***	0.23***	0.21***	0.23***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Writing	0.10***	0.06***	0.09***	0.08***	0.09***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Background characteristics					
Black	-0.02***	-0.07***	-0.12***	-0.05***	-0.07***
	(0.01)	(0.01)	(0.03)	(0.01)	(0.02)
Hispanics	-0.07***	-0.06***	0.07	-0.11***	-0.06*
	(0.01)	(0.02)	(0.08)	(0.02)	(0.03)
Other race	0.01	0.01	-0.27**	0.05	-0.03
	(0.01)	(0.04)	(0.13)	(0.03)	(0.04)
Male	0.04***	0.01	0.09***	0.02*	0.08***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Special education	-0.12***	-0.14***	0.09	-0.06*	0.04
	(0.01)	(0.03)	(0.10)	(0.03)	(0.04)
LEP	0.15***	0.03	0.32	0.01	0.26
	(0.03)	(0.03)	(0.38)	(0.06)	(0.17)
FRPL-eligible	-0.20***				
	(0.00)				
Targeted subjects	-0.01***	-0.05***	-0.02	-0.05***	0.03***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Constant	-0.04***	-0.26***	-0.14***	-0.12***	-0.07***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Observations	401,099	41,621	11,270	40,185	82,758
R-squared	0.52	0.39	0.50	0.48	0.52

Note: The reference cohort took the ACT in the 2010–11 school year. The reference racial group is white. Targeted subjects include English and mathematics, for which the KCAS implemented new, CCSS-aligned curricula since 2011–12. Comparison subjects include science and reading, whose curricula were carried over from the era of "Program of Studies," the old state standards before KCAS.

*** p<0.01, ** p<0.05, * p<0.1

Table 4. Cross-cohort comparisons of 10th-grade PLAN composite scores, by school poverty and student FRPL eligibility

[Standard errors in parentheses]

	(1)	(2)	(3)	(4)	(5)
		High-poverty schools		Low-poverty schools	
VARIABLES	All	FRPL students	Non-FRPL students	FRPL students	Non-FRPL students
Cohort 2012	0.01	-0.02	-0.03	0.02	0.02
	(0.00)	(0.01)	(0.03)	(0.01)	(0.01)
Cohort 2013	0.04***	0.04***	0.05	0.04***	0.05***
	(0.00)	(0.01)	(0.03)	(0.01)	(0.01)
8th-grade KCCT scores					
Mathematics	0.40***	0.28***	0.42***	0.42***	0.55***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Reading	0.15***	0.17***	0.14***	0.12***	0.11***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Social studies	0.22***	0.17***	0.23***	0.22***	0.27***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Writing	0.12***	0.08***	0.13***	0.10***	0.12***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Background characteristics					
Black	-0.09***	-0.16***	-0.18***	-0.09***	-0.11***
	(0.01)	(0.01)	(0.03)	(0.02)	(0.02)
Hispanics	-0.11***	-0.11***	0.11	-0.11***	-0.07*
	(0.01)	(0.03)	(0.09)	(0.03)	(0.04)
Other race	0.00	0.01	-0.06	0.01	-0.03
	(0.02)	(0.05)	(0.16)	(0.04)	(0.04)
Male	-0.02***	-0.05***	0.05*	-0.02*	0.02*
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Special education	-0.16***	-0.08***	-0.00	-0.05	0.01
	(0.01)	(0.03)	(0.09)	(0.03)	(0.04)
LEP	0.11***	-0.02	0.48	0.01	0.15
	(0.03)	(0.04)	(0.34)	(0.07)	(0.24)
FRPL-eligible	-0.16***				
	(0.00)				
Constant	-0.03***	-0.24***	-0.14***	-0.13***	-0.08***
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Observations	100,212	10,381	2,814	10,039	20,679
R-squared	0.63	0.55	0.63	0.60	0.63

Note: The reference cohort took the ACT in the 2010–11 school year, and the PLAN in the 2009–10 school year. The reference racial group is white.

*** p<0.01, ** p<0.05, * p<0.1

Table 5. Cross-subject and cross-cohort comparisons of ACT scores while controlling for PLAN, by school poverty and student FRPL eligibility

	(1)	(2)	(3)	(4)	(5)
		High-poverty schools		Low-poverty schools	
VARIABLES	All	FRPL students	Non-FRPL students	FRPL students	Non-FRPL students
		Cross-cohort models: Outcome=ACT composite scores			
Cohort 2012	0.02***	0.03***	0.06***	0.02*	0.02**
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Cohort 2013	0.01***	0.02*	0.01	0.00	-0.01
	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Observations	100,212	10,381	2,814	10,039	20,679
R-squared	0.81	0.69	0.79	0.77	0.82
		Cross-subject, cross-cohort models: Outcome=ACT subject scores			
Untargeted subjects,	-0.00	0.00	0.03	-0.01	-0.02**
Cohort 2012	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Untargeted subjects,	0.02***	0.03**	0.02	0.01	-0.02***
Cohort 2013	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Targeted subjects,	0.05***	0.05***	0.05**	0.06***	0.08***
Cohort 2012	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Targeted subjects,	0.00	-0.01	0.00	-0.00	0.04***
Cohort 2013	(0.00)	(0.01)	(0.02)	(0.01)	(0.01)
Observations	401,099	41,621	11,270	40,185	82,758
R-squared	0.65	0.50	0.63	0.60	0.65

Note: Standard errors in parentheses in the top panel, and standard errors clustered at the student level in parentheses for the bottom panel. The reference cohort took the ACT in the 2010–11 school year and the PLAN in the 2009–10 school year. The reference racial group is white. Targeted subjects include English and mathematics, for which the KCAS implemented new, CCSS-aligned curricula since 2011–12. Comparison subjects include science and reading, whose curricula were carried over from the era of "Program of Studies," the old state standards before KCAS. Regressions control for student PLAN scores in addition to KCCT scores and the same list of student background characteristics as in earlier tables.

*** p<0.01, ** p<0.05, * p<0.1