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EdWorkingPaper No. 20-269

Online Course-Taking and Expansion of Curricular Options in High Schools

Cassandra M.D. Hart
University of California, Davis

Brian Jacob
University of Michigan

Susanna Loeb
Brown University

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VERSION: August 2020

Suggested citation: Hart, Cassandra M.D., Brian Jacob, and Susanna Loeb. (2020). Online Course-Taking and Expansion of Curricular Options in High Schools. (EdWorkingPaper: 20-269). Retrieved from Annenberg Institute at Brown University: https://doi.org/10.26300/x3d2-7d79

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Cassandra M.D. Hart
Robert Linden
University of California, Davis

Brian Jacob
University of Michigan

Susanna Loeb
Brown University

July 30, 2020

Abstract

A common rationale for offering online courses in K-12 schools is that they allow students to take courses not offered at their schools; however, there has been little research on how online courses are used to expand curricular options when operating at scale. We assess the extent to which students and schools use online courses for this purpose by analyzing statewide, student-course level data from high school students in Florida, which has the largest virtual sector in the nation. We introduce a "novel course" framework to address this question. We define a virtual course as "novel" if it is only available to a student virtually, not face-to-face through their own home high school. We find that 7% of high school students in 2013-14 enroll in novel online courses. Novel courses were more commonly used by higher-achieving students, in rural schools, and in schools with relatively few Advanced Placement/International Baccalaureate offerings.

Keywords: Online learning, curricular access, K-12, descriptive methods

Acknowledgements: Funding for this research was provided by the Institute of Education Sciences (Grant R305A150163), the Walton Family Foundation, and the Spencer Foundation. Data was provided by the Florida Department of Education. The authors thank these agencies for their support. The authors thank seminar participants in the Multidisciplinary Program in Education Sciences at Northwestern University for comments. Results, information, and opinions are the authors' and do not reflect the views or positions of any funding agency or research partner.

Even before the onset of the COVID-19 pandemic, the use of online courses for K-12 students had been climbing dramatically over the last two decades. While there were only about 317,000 online enrollments in the K-12 sector in 2002-03, by 2009-10 nearly 1.8 million K-12 enrollments were taken online. Enrollments have continued to grow since then, and a recent survey of principals found that over 21 percent of public schools reported offering their students access to at least some fully online courses (National Center for Education Statistics, 2016).

There are two common educational rationales provided for how online courses may benefit students.[1] First, advocates argue that some students may be better served by online courses than in face-to-face courses due to the unique instructional environment that online education provides (Bush, n.d.; Archambault et al., 2010). For instance, because courses can be taken at a student's own pace, students may benefit if their preferred pace is either faster or slower than their peers'.

Second, advocates argue that online courses may open up course options for students that are not available at their home institutions (Clark, 2008). For instance, students may be able to enroll in more advanced versions of courses than their home institution offers (e.g., by taking Advanced Placement [AP] US History when only a standard US history course is offered at the home institution), or by taking course subjects that are entirely absent from the home institution (e.g., by taking American Sign Language when no analogous class exists at the home institution).

While there has been a small but growing body of literature conducting large-scale evaluations of the extent to which online courses are associated with student performance for K-12 students (Ahn & McEachin, 2017; Cavalluzzo, Lowther, Mokher, & Fan, 2012; Heissel, 2016; Heinrich, Darling-Aduana, Good, & Cheng, 2019; Heppen, et al., 2017; Hart, Berger,

[1] Other common rationales for online courses—such as the potential to offer courses less expensively—appeal to economic rather than educational advantages (Bush, n.d.).

Jacob, Loeb, & Hill, 2019; Woodworth, et al., 2015), the second justification has received far less attention from researchers looking at large populations of students (but see Darling-Aduana & Heinrich, Forthcoming, looking at a single district). We fill this gap in the literature, using statewide administrative data from Florida to look descriptively at the types of classes that students take online that are not available at their home institutions (which we call "novel" online courses). We also look at school and student characteristics associated with using online classes to supplement existing offerings.

We find that a small but growing share of students enroll in novel online courses each year. We observe roughly 7 percent of Florida high school students taking novel online courses by 2013-14. We distinguish between cases where students take online courses that relatively few other students in their home institutions take—cases where we argue that students maybe strategically using online options to supplement course offerings in their high school—and cases where schools seem to rely on online offerings to potentially outsource courses that might otherwise be offered through the home institution.

We find that students who attend certain types of schools—including rural schools and schools that have fewer AP offerings—are more likely to use online courses to supplement the courses available to them, and that the use of online courses to supplement course offerings is more common among certain student subgroups, including higher-achieving students, Asian students, more affluent students, and girls.

Prior Literature and Context

A number of prior papers show that taking advanced or specialized course enrollments is associated with stronger student outcomes. With respect to advanced course-taking, colleges may view enrollment in such courses as an indicator of student ability (National Research Council, 2002; Santoli, 2002), giving students who take these courses an edge in admissions. Moreover, some (generally observational) evidence suggests that students who take more advanced courses—particularly AP courses—fare better in terms of college outcomes, including enrollment (Speroni, 2011) and graduation (Dougherty, Mellor, & Jian, 2006), although these correlational findings may be substantially attenuated with stronger controls for factors that influence students' access to and likelihood of participation in these courses (Klopfenstein & Thomas, 2009; Geiser & Santelices, 2006).

Some experimental evidence of interventions to increase AP course-taking generally finds benefits in terms of downstream outcomes like college matriculation (Jackson, 2010), while experimental evidence of interventions to increase science AP course-taking specifically suggest benefits to students' science skill and interest in pursuing STEM majors (but negative outcomes on grades, stress, and confidence in ability to succeed in college science; Conger, Kennedy, Long & McGhee, 2019). Other studies looking at participation in rigorous coursework more broadly (encompassing honors and advanced-track courses) find that enrollment in more rigorous courses was associated with an increased likelihood of college enrollment (Long, Conger, & Iatarola, 2012). Taken together, these studies suggest a logical basis for students to expect downstream benefits to taking advanced courses.

Taking unique elective courses may offer similar advantages to students. Conceptually, taking courses that allow students to explore relatively specialized interests—for instance, by taking low-enrollment courses like American Sign Language or Forensic Science—may help them to develop firmer ideas of career or academic pathways they would like to explore in the future. Taking such courses may also demonstrate depth of interest to colleges, which may increase students' chances of admission to more selective schools.

Despite the potential value of access to opportunities for students to take advanced or unique course offerings, students in some schools have systematically poorer access to advanced-track courses or varied course offerings (Theokas & Saaris, 2013; Long, Conger, & Iatarola, 2012; Gagnon & Mattingly, 2015). For instance, a 2013 report found that nearly 30% of high schools nationwide had no students taking AP tests, although because these schools tended to be smaller than average, less than 10% of students attended schools with such sparse offerings (Theokas & Saaris, 2013). Small and rural schools tended to have sparse AP offerings; for instance, less than 60% of rural schools had AP students, compared to nearly 75% (85%) of urban (suburban) schools (Theokas & Saaris, 2013). Long, Conger & Iatarola (2012) find fewer differences across school size using a broader definition of rigorous courses that includes honors and upper level courses, but their results still suggest that students in smaller schools are less likely to have access to rigorous courses in foreign languages and social studies in particular.

In addition to having fewer offerings of advanced courses, smaller high schools may also have less varied elective offerings. Larger high schools are more likely to offer a wide range of course offerings because the larger student population increases the likelihood that a niche course will receive enough enrollments to justify staffing it (Lee, Smerdon, Alfred-Liro, & Brown, 2000; Monk & Haller, 1993).

Online courses may offer a cost-effective way to expand curricular opportunities for students in small or rural schools with more limited course offerings (Barbour, 2007). Survey evidence suggests that educators consider the ability of online courses to expand the existing curriculum to be among the most important potential benefits to virtual education. A set of surveys of K-12 administrators collected in 2005-06 and 2007-08 found that in both years, the largest share of respondents (roughly 75%) reported that the ability of online courses to provide access to courses "not otherwise available at the school" was an important reason for a district to offer online and blended courses (Picciano & Seaman, 2007; Picciano, Seaman, Shea, & Swan, 2012). The ability to offer "Advanced Placement or college-level courses" was likewise endorsed as an important benefit to online courses by roughly two-thirds of respondents in both surveys (Picciano & Seaman, 2007; Picciano, Seaman, Shea, & Swan, 2012). Some districts have developed online course offerings specifically in an attempt to increase access to AP and elective offerings (Darling-Aduana & Heinrich, Forthcoming).

However, although the expansion of course offerings is a benefit generally expected of online education, there has been little prior large-scale work exploring how students use online courses to access expanded course offerings. This paper fills this gap in the literature by providing descriptive evidence of the extent to which students access courses not otherwise available to them in their home institutions, the students most likely to use courses in this way, and the types of courses they take.

We look at students' enrollment in novel courses in the context of Florida public schools. Florida is an ideal context for this study as it is at the forefront of the use of online education in K-12 schools. For instance, Florida is home to the largest state-run virtual school in the nation (Digital Learning Collaborative, 2020). Florida students took over 510,000 virtual course enrollments in 2017-18; the state with the next largest virtual course sector was North Carolina with just over 110,000 virtual enrollments (Digital Learning Collaborative, 2020). Florida is also one of a handful of states that includes online learning as a graduation requirement; in order to receive a standard high school diploma, students are expected to take at least one online class (Florida Department of Education, 2011). The widespread use of virtual course-taking in Florida makes it an ideal setting to explore to what extent a mature virtual sector is used by students to expand their curricular options.

Methods

Data and Sample

We draw on administrative data from the Florida Department of Education (FLDOE), which maintains a rich trove of student and course level data on all students in the state. Importantly, Florida data allows us to distinguish between the institution where students were enrolled while taking the course and the institution that provides instruction for the course. This allows us to observe students taking courses through online providers, but attending traditional brick-and-mortar schools as their primary institutions.

We observe student course enrollments from 2005-06 to 2013-14. Most analyses focus on the 2013-14 school-year to provide the most recent picture of how online courses are used. However, we also use prior years of data to establish trends over time.

Because online course-taking is more prevalent among high school students than among younger students, we limit our sample to students in grades 9-12. We also limit our sample to traditional public schools, excluding such schooling options as Department of Juvenile Justice schools, alternative education programs, and schools serving hospital and homebound students. Importantly, we also exclude students in full-time virtual schools, so that our estimates here represent only the online course-taking patterns that supplement curriculum provided at traditional brick-and-mortar high schools. This yields a sample of 732,408 unique students in the 2013-14 school-year that comprises our main sample.

We draw on additional sources to measure school characteristics. Measures of urbanicity, choice status (charter/magnet vs. traditional public schools), and aggregate school demographics are drawn from the National Center of Education Statistics Common Core of Data. Data on school grades (A-F) assigned to schools by the Florida Department of Education are drawn from the Florida School Indicator Reports.

Measures

Types of Online Course Enrollments

We distinguish between four types of online course enrollments: duplicate, novel, supplemental, and displaced. Each of these course-taking measures captures whether a given student takes at least one online course of the specified type in a given academic year. Below we describe how we classify each type of virtual enrollment. Figure 1 also presents the classification rules visually in a flow chart, taking as an example a student enrolled in a Chinese 1 class through an online course provider.

In some cases, a course that a student take online (e.g., Chinese 1) is also offered face-to-face at her home high school. We classify such cases as "duplicate" enrollments, because the online course offering duplicates an enrollment opportunity already available to the student through face-to-face instruction.

However, this paper focuses on what we call "novel" online enrollments. We classify a course enrollment for a given student attending a given home high school as a novel virtual enrollment when 1) we observe the student taking the class through an online instructional institution and 2) no other students attending the student's home high school took the same course (e.g., Chinese 1) through the home high school in the same academic year. When these conditions are met, we infer that the course was not offered face-to-face in the year that the student takes it, and thus the use of the online course extended the student's options past what was available at her home institution.

We further categorize novel courses as either "supplemental" or "displaced" to identify two separate reasons why virtual courses may not be offered at a given high school. First, courses may not be offered if few students want to take them, either because they are very advanced (e.g., AP Physics) or because they represent relatively niche interests (e.g., Forensic Science). These may be online classes that students use strategically to pursue specialized interests or to differentiate themselves on college applications. Because of the limited density of students interested in these courses, it may not be reasonable for the high school to spend the money to staff sections of these classes face-to-face. We call these "supplemental" online courses since we infer that students use them to extend the curriculum beyond anything the high school would be likely to reasonably offer. We classify a novel course enrollment as supplemental when 1) no other student in their high school took the same course face-to-face in the same academic year, and 2) fewer than 15 students from the same high school took the course virtually.

Second, courses may not be offered face-to-face because schools elect not to staff classes despite healthy student interest in those courses. This may be at least partially due to the availability of online options to serve interested students; in other words, it may represent a strategic decision by schools to concentrate their staff time in other courses by outsourcing instruction to online providers for certain courses. We call these "displaced" online courses because high schools have a density of students interested in taking the course (as revealed by online enrollments), but the high school opts not to offer it despite the demonstrated interest. We classify a novel course enrollment as displaced when 1) no students took the same course face-to-face from the student's home high school in the same academic year, and 2) at least 15 students were enrolled in an online version of the course in the same academic year.

While we use 15 students as the cut-off to distinguish between supplemental and displaced classes, in practice, the number of students from a given high school enrolled in supplemental classes is generally well below the 15-student threshold. For roughly 20 percent of supplemental course enrollments, the student enrolled is the sole person from their school taking that course in that year, while nearly two-thirds of supplemental enrollments represent cases where five or fewer same-school students are enrolled in the same course in the same academic year. This suggests that in most cases, the "supplemental" designation captures cases where schools would be unlikely to offer face-to-face options in the face of relatively light student demand.

School Characteristics

We examine whether several types of school characteristics are associated with the likelihood that students take at least one online novel course. First, we characterize schools according to urbanicity (urban, rural, suburban, or town). To capture school performance, we characterize schools based on the grades they earn from the FLDOE as part of the state's accountability system; D and F grades are combined because few schools earn such low grades. We also capture whether schools are charter or magnet schools vs. traditional public schools. To capture school affluence, we characterize schools based on whether they have a relatively high (>50%) vs. relatively low (≤ 50%) share of students using free or reduced-price lunch (FRPL). Finally, we generate a variable that captures the number of AP or International Baccalaureate (IB) courses offered at each school as a way of distinguishing schools with relatively diverse course offerings from those with more limited course offerings. We distinguish between schools that offer fewer than ten unique AP/IB courses from those that offer ten or more unique AP/IB courses.

Student Characteristics

We distinguish course-taking patterns by student grade (9-12), student sex (male vs. female), race (White, Black, Hispanic, Asian, multi-racial or other race); exceptionality status (gifted, other exceptionality, non-exceptional); and English proficiency status (limited English Proficient vs. English Proficient). We also distinguish students based on their prior standardized test performance; we create averages of students' standardized 8^{th} grade math and reading scores on the FCAT (Florida Comprehensive Assessment Test), and generate categorical variables that split students according to the quartile of FCAT average achievement that they fall into.

Table 1 provides sample descriptive statistics for the 2013-14 school-year, the year we focus on for most analyses, for the overall sample and based on different types of novel virtual course-taking. These descriptive statistics suggest that higher-grade students and girls tend to be particularly over-represented in the sample of novel virtual course-takers (Column 2) compared to the overall sample (Column 1), while students using free and reduced-price lunch, students in special education, and students designed as Limited English Proficient (LEP) are all under-represented. Students taking novel virtual courses also have higher 8^{th} grade standardized test scores compared to the overall sample. Students attending schools that received A ratings in 2013-14 from the FLDOE are somewhat over-represented among novel virtual course-takers, as are magnet school students. In general, groups that are over-represented among the novel virtual course-takers become over-represented to a slightly greater degree when we zero in on supplemental virtual course-takers (Column 3).

Models

Analyses in this paper are primarily descriptive. For instance, we document the classes most commonly taken as novel online courses, and trace trends in novel online course-taking rates over time.

We also examine the student or school characteristics associated with taking novel online courses not available at the home high school. To establish whether student or school characteristics are differentially associated with novel online course-taking, we conduct regressions using 2013-14 data that include a vector of dummy indicators for each set of student or school characteristics in turn. This allow us to estimate and compare the average rates of students from each group who take at least one online course. For instance, we estimate equations of the following form:

(1) $AnyNovelCourse_{is} = \pi \boldsymbol{CharType}_{is} + \varepsilon_{is}$

where $AnyNovelCourse_{is}$ is an indicator for whether student i attending home high school s takes at least one course that we categorize as a novel online course in 2013-14. We also estimate other models of the same form that substitute in outcomes indicating whether students take any supplemental online enrollments or any displaced online enrollments in 2013-14.

Each outcome is related to $\boldsymbol{CharType}_{is}$, which represents a vector that captures a single set of school characteristics of interest (e.g., urbanicity, school grade received from the FLDOE in 2013-14, etc.) or student characteristics of interest (e.g., student grade; sex; race; exceptionality status; English proficiency status; or quartiles capturing students' performance on 8^{th} grade standardized tests). Each set of characteristics is initially entered into the model in isolation, without any additional controls included.

Additional analyses extend this further by including multiple sets of characteristics simultaneously in regressions to determine which school and student characteristics are most predictive of use of novel, supplemental, or displaced online courses, controlling for other factors. To explore school characteristics, we use 2013-14 data to estimate equations of the form:

(2) $AnyNovelCourse_{is} = \beta \boldsymbol{Urbanicity}_s + \omega APScarce_s + \delta \boldsymbol{SchGrade}_s + \gamma HighPctFRL_s + \theta \boldsymbol{Choice_s} + \varepsilon_{is}$

where we estimate whether student *i* in school *s* takes at least one novel course in 2013-14 based on several different vectors of school characteristics, including urbanicity ($\boldsymbol{Urbanicity}_s$, distinguishing urban, rural, and town schools: suburban schools omitted); an indicator for whether a school offered fewer than 10 AP/IB courses ($APScarce_s$); a vector of indicators for FLDOE-assigned grades for the school ($\boldsymbol{SchGrade}_s$, distinguishing A, B, and D/F schools: C schools omitted); an indicator for whether the share of the student body using free or reduced-price lunch is greater than 50% ($HighPctFRL_s$) and a vector of indicators for whether the student's home institution is a school of choice ($\boldsymbol{Choice}_s$, distinguishing magnet and charter schools; traditional public schools omitted). These regressions identify which school-level factors are the most influential on online course-taking patterns when holding other factors constant.

A final set of school fixed effect regressions identifies which student-level characteristics are most influential, holding the high school that each student attends constant. As before, we use 2013-14 data to estimate equations of the following form:

(3) $AnyNoveCourse_{is} = \nu \boldsymbol{Grade}_i + \eta \boldsymbol{Gr8Quartile}_i + \tau \boldsymbol{Excep}_i + \upsilon LEP_{it} + \phi FRPL_i + \varphi Female_i + \kappa \boldsymbol{Race}_i + \theta_s + \varepsilon_{is}$

This equation relates the outcome for student *i* attending home high school *s* to vectors of indicators for student grade ($\boldsymbol{Grade}_i$; grade 9 is omitted); indicators for the quartile placement of students based on averaged math and reading 8th grade standardized test scores (***Gr8Quartile***$_i$: quartile 2 is omitted); student exceptionalities (***Excep***$_i$: indicators for gifted status or other exceptionality; students with no exceptionalities omitted); limited English proficiency status (LEP_i); use of free or reduced price lunch ($FRPL_i$); student sex ($Female_i$); and a vector of indicators for student race (***Race***$_i$: indicators for Black, Hispanic, Asian, multi-racial or other race; White omitted). We include a school fixed effect term θ_s to ensure that comparisons are made in relationship to peers attending the same schools. All regressions run using Equations (2) and (3) include omitted variable dummies to preserve information from observations with missing data. All regressions, including those for Equation (1), use robust standard errors clustered at the school level.

Results

Trends over Time in Virtual Course Enrollment Types

A growing number of Florida students have enrolled in virtual courses over time. Figure 2 traces the growth of the use of these courses. For each year, we document the share of unique students with at least one of each type of virtual enrollment. The solid line represents total virtual enrollments, and shows that nearly 20% of high school students took at least one virtual enrollment during the 2013-14 school-year.[2] Many of these enrollments were "duplicate" enrollments (courses that were also offered face-to-face at their home high school).

However, the total virtual enrollment and duplicate virtual enrollment lines diverge to a growing extent in later years, as novel course enrollments (courses that were not offered face-to-face) make up a larger share of students' online course enrollments. By the 2013-14 school-year,

[2] Note that while Florida requires virtual course-taking experiences in order for students to graduate, this came into effect for the cohort entering 9th grade in the 2010-11 school-year (Florida Department of Education, 2011). Therefore, the older cohorts of students in our sample were not subject to this requirement.

nearly 7% of students took at least one novel virtual enrollment. Within the category of novel enrollments, the share of students taking supplemental enrollments (low total enrollment from student's home institution) and displaced enrollments (high total enrollment from student's home institution) grow at similar rates over time; nearly 3% (over 4%) of students took at least one supplemental (displaced) enrollment in the 2013-14 academic year. Note that students may take multiple types of virtual classes in a given year.

Although only a small share of students take each type of virtual enrollment in a given academic year, students accumulate greater probabilities of having ever taken each type of enrollment over the duration of their entire high school careers. Among the cohort of students who were in 12th grade in the 2013-14 academic year, roughly 13% had taken at least one novel virtual enrollment throughout their high school careers. This included roughly 8% who had taken at least one supplemental virtual enrollment and 7% who had taken at least one displaced virtual enrollment; about 1.5% of students had taken at least one of both types of novel virtual course enrollments.

Courses Taken through Novel, Supplemental, and Displaced Virtual Enrollments

We next explore the types of courses for which students use online options to take novel course offerings not available in their home institutions. Table 2 presents the 20 courses for which online novel course offerings make up the largest share of total enrollments statewide. The first column presents the total, statewide share of students enrolled in each class (including both virtual and face-to-face offerings) who took the course online as a novel virtual course opportunity (i.e., through online instructional providers where no student took the same course face-to-face in the student's home high school). The next three columns respectively provide the total number of unique students taking the course as a novel virtual enrollment (Column 2), as a virtual enrollment generally (i.e., including both novel enrollments and duplicate enrollments; Column 3), and as face-to-face (FtF) enrollments (Column 4).

The table shows that the classes taken as novel online enrollments include a mix of both courses often considered standard for a high school curriculum (e.g., Driver's Education or Physical Education classes such as Health 1), as well as those that serve students with more specialized interests (e.g., Chinese, Latin, Social Media, Forensic Science). There are also a mix of courses that offer opportunities for unique advancement (e.g., Art History and Criticism 1 Honors or Advanced Placement Computer Science A) or remediation (courses for credit recovery).

Columns 5 and 6 delve into the extent to which novel enrollments tend to represent either supplemental enrollments, where students fulfill niche interests, or displaced enrollments, which may represent strategic staffing decisions by schools. These columns document the share of total novel enrollments classified as supplemental or displaced, respectively. We observe two important patterns. First, for most courses on this list (15/20), a majority of novel enrollments represent supplemental, rather than displaced enrollments, although for an additional course (Social Media 1), displaced enrollments make up nearly half (49.7%) of novel enrollments. However, four of the top five courses on the list are dominated by displaced enrollments. This suggests that schools are not supplanting face-to-face instruction with virtual options for many classes, but where they do, the volume in those classes is substantial.

A related question is whether displaced enrollments represent cases where schools scale back face-to-face offerings, or whether they simply represent online courses that have become popular, but not at the expense of existing face-to-face offerings. Table 3 provides evidence on this question for the six courses where displaced enrollments made up over half (or, in the case of Social Media, just under half) of novel enrollments. Columns 1-3 respectively provide the count of unique enrollments in 2013-14 classified as displaced, virtual (including all novel and duplicate virtual enrollments), and face-to-face. To compare the latter column to historical numbers, Column 4 provides the total face-to-face enrollments for each course in 2005, when relatively few students were taking online classes.

Table 3 suggests that both explanations are at play for different classes. For some classes, notably Social Media and Reading for College Success, the “displaced” label may not strictly apply as these classes were created only after 2005 and therefore may not have had the opportunity to gain large face-to-face enrollments before online classes emerged as an option. On the other hand, other classes, such as Parenting Skills seem to have seen significant reductions in face-to-face enrollments between 2005 and 2013, with concomitant increases in virtual enrollments over the same period.

Driver’s Education presents an interesting case. The comparisons between face-to-face enrollments of the classroom-based Driver’s Education/Traffic Safety class in 2005 and 2013 suggests that face-to-face enrollments declined only modestly, even while virtual enrollments grew rapidly: While there were zero virtual enrollments in 2005, there were nearly 30,000 by 2013. However, this is somewhat misleading. A second version of the Driver’s Education class, which included a lab-based component (i.e., driving practice), saw precipitous declines in face-to-face enrollments between 2005 and 2013; this is shown in the final row of Table 3. These two courses are generally substitutes for one another; only about 4% of students in our sample who take at least one of the Driver’s Education classes are observed in both formats. Taken together, these figures suggests that schools decreased their face-to-face driver’s education offerings as online offerings grew in popularity.

These results illuminate variability in the ways that online courses are used to expand the high school curriculum. In some cases, they seem to be used strategically by schools to expand high school offerings by soaking up a level of student demand that could justify staffing a face-to-face version of a course in the absence of a virtual alternative (e.g., for Parenting Skills or Driver's Education). In other cases, online courses seem to be used strategically by students to allow them to take offerings that are relatively specialized and that are unlikely ever to be staffed at many high schools (e.g., Latin 2). Although it still makes up a limited share of overall virtual enrollments, this latter use of online courses is notable because it accords well with the benefits of online courses predicted by virtual education advocates.

School Characteristics Associated with Novel Virtual Course Enrollments

We next conduct a series of regressions to determine whether rates of novel course-taking are different across schools based on different characteristics. We run regressions on one set of school characteristics at a time to tease out whether rates of novel virtual course-taking differ based on each set of school characteristics in turn. Regressions include a saturated set of mutually exclusive categories (e.g., for urbanicity, indicators for urban, rural, suburban and town are all included), and the constant term is suppressed. This means that coefficients can be interpreted as the fraction of unique students in each school type with at least one enrollment for each type of virtual enrollment studied (novel, supplemental, displaced).

We also test whether coefficients are significantly different from each other within each set of characteristics. The results of these tests are given at the bottom of each panel; results indicate which groups differ from each other at $p \leq 0.05$.[3] Within each set of characteristics, the group number for each subgroup is given to the right of the group label.

Table 4 shows that when we consider novel virtual course-taking generally as the outcome (Column 1), rates of course-taking are relatively similar across different school types. For instance, although a higher share of students in rural schools (7.8%) than in urban schools (6.4%) take novel virtual enrollments, the difference between these groups is not statistically significant. There are some exceptions: schools that earned “A” grades on the Florida state accountability system (7.4%) have a significantly higher rate of novel course-taking than do “C” schools (5.8%), more affluent schools (7.5%) have higher rates than do less affluent schools (6.1%), and magnet schools have higher rates (10.8%) than do traditional public schools (6.5%) or charter schools (6.2%). However for the most part, differences across groups are modest. This seems to be largely driven by a lack of differentiation in course-taking rates between school types for displaced courses (Column 3).

However, differences based on school characteristics emerge more clearly when we look at rates of supplemental virtual course-taking as an outcome (Column 2). For instance, supplemental virtual course-taking rates are significantly higher in rural schools (3.8%) than in suburban (2.8%) or urban (2.8%) schools, although the rates of novel course-taking overall and displaced virtual course-taking do not differ by urbanicity. Likewise, students in schools with fewer AP/IB opportunities are more likely (3.8%) to take supplemental enrollments than are their peers in schools with more AP/IB options (2.8%), but we see no difference between these schools on displaced enrollments.

[3] Since we exclude the constant in order to see the means for each group, the tests of significance for coefficients in the regressions implicitly compare each group mean to 0. All group means are statistically significant from 0, but we omit symbols indicating significance for table clarity.

A similar set of patterns remains when we include all different characteristics together in a multivariate regression: For each enrollment type, magnet school students are more likely than their peers in other school settings to take online courses to expand school offerings (Table 5, Columns 1-3), but other characteristics are less consistently predictive. High rates of school poverty (>50% of students on FRPL) are negatively associated with supplemental course-taking, while rural location and AP/IB sparsity are also significant and positive predictors of the likelihood of taking supplemental enrollments (Column 2).

These analyses suggest that, in accordance with predictions, students in schools with sparser elective options seem more likely to avail themselves of online courses that they use to extend the curriculum to take relatively specialized offerings. At the same time, more affluent schools, as well as magnet schools, seem especially disposed to the use of online courses to promote course-taking for options not offered in the home high school.

Student Characteristics Associated with Novel Virtual Course Enrollments

We next explore student characteristics associated with the likelihood of taking different types of virtual enrollments. Similar to Table 4, Table 6 provides results from regressions where mutually exclusive, exhaustive vectors of indicator variables for a single set of characteristics (e.g., exceptionality status) are entered in turn. Like for Table 4, the coefficients represent the fraction of students in each subgroup who take at least one of each type of enrollment indicated in the column headers in 2013-14, and results from tests of whether the group means differ from each other at $p \leq 0.05$ are presented in the bottom row of each panel.

We observe more consistent variation in course-taking patterns based on student academic placement characteristics than across school characteristics (Table 6). For instance, eleventh and twelfth graders are more likely to take novel courses generally (Column 1) than are younger students (Panel A). This is driven both by higher supplemental course-taking for higher-grade students (Column 2), and for 11th graders in particular, by a greater use of displaced courses compared to all other grades (Column 3).

The likelihood of novel virtual course-taking is monotonically higher for students higher in the FCAT quartile distribution (Panel B, Column 1). This monotonicity is driven by the fact that higher achieving students make greater use of supplemental courses (Column 2). However, achievement is associated with use of displaced courses only at the lowest end of the skill distribution. Very low-scoring (quartile 1) students are less likely to be in enrolled in displaced courses than are other students, but there are no significant differences between other groups for these courses.

We see a similar pattern for student exceptionality (Panel C). Gifted students (4.1%) are more likely than students with no exceptionalities (3.0%) to use supplemental virtual courses (Column 2), who are more likely to take supplemental enrollments than students in special education (1.7%). While the distinction between special education students (2.8%) and the other groups remains for displaced enrollments (Column 3), gifted (4.6%) and non-exceptional students (4.2%) take displaced enrollments at similar rates. Finally, students with limited English proficiency are consistently less likely to take each type of virtual enrollment compared to students not designated as limited English proficient (Panel D).

We also observe consistent differences across students of different demographic characteristics (Table 7). Female students are more likely to take each type of virtual enrollment compared to male students (Panel A), and students who use free and reduced price lunch are less likely to take each type of virtual enrollment than are more economically advantaged students (Panel C). With respect to race/ethnicity (Panel B), Asian students have particularly high rates of novel virtual course-taking (8.5%), driven by high rates of supplemental virtual course-taking (5.2%); they are statistically no more likely than any other group to take displaced enrollments. Multi-racial students also have high rates of novel virtual course-taking of all types; this suggests that Asian and multi-racial students may use virtual courses especially strategically to expand their course offerings.

The general trends observed in Tables 6 and 7 are repeated in Table 8 when we enter all student covariates simultaneously into a multivariate regression. Because these regressions include fixed effect terms for the student's home high school, the model compares the likelihood of novel virtual course-taking among students attending the same school. Higher-grade and higher-achieving students are more likely to take novel virtual courses than their peers (Column 1), driven by higher use of supplemental enrollments (Column 2), while lower-achieving students, students enrolled in special education, or limited English proficient students are less likely to use such enrollments. Also similar to the results in Table 7, girls have higher rates of novel virtual course-taking than do boys, while students using subsidized lunch have lower rates compared to their more affluent peers. Patterns of racial differences do not mirror Table 7 as closely; notably, once other covariates are controlled, all other racial groups are more likely to take novel and supplemental courses compared to White students (omitted).

Again, this pattern of results suggests that groups with higher average levels of achievement are particularly likely to use supplemental virtual courses, while there is less differentiation between different types of students in the likelihood of being enrolled in displaced virtual courses. This further suggests that the use of supplemental courses may reflect strategic decisions by students.

Discussion

This paper explores how students use online courses to take courses not available at their home institutions. A growing share of students use online courses this way, with about 7% of students taking courses online that are not available in their home schools by 2013-14. These are split roughly evenly between enrollments that allow students to take courses that are specialized and may attract too few enrollments from same-school peers to justify staffing a course, and enrollments where a sufficient density of same-school peers took the course to potentially justify staffing a face-to-face version of the course. Courses that fell into the former group (supplemental enrollments) tended to represent courses that could allow students to take curriculum at non-standard levels (either more advanced, like AP/IB courses, or credit recovery classes), or in subjects that were relatively specialized (e.g., Chinese, Creative Photography).

Consistent with the relatively specialized nature of many of these courses, students were most likely to take supplemental enrollments in rural schools and schools with limited curriculum as proxied through a relatively small number of available AP/IB courses. Higher-achieving students were also more likely to take supplemental courses.

Our study has some important limitations. Notably, while Florida offers a particularly illustrative setting to explore how students may use online courses to expand curriculum, the results may not generalize well to other settings. Florida's virtual sector is particularly large and mature, and it is possible that students in states that have put fewer resources into virtual learning would see lower take-up of virtual courses to broaden access beyond existing face-to-face curricular offerings.

Nonetheless, observing the use of supplemental enrollment is illustrative because this use of online courses is a common justification for the expansion of virtual offerings. Future research should delve further into this finding. One set of potential studies could explore whether making use of virtual courses for this purpose offers students advantages in college admissions. Future research should also delve further into whether schools are strategically limiting their course offerings due to the availability of online options. Doing so may allow schools to divert staff to other courses that they feel are uniquely well-suited to face-to-face instruction. While more research needs to be done to fully probe this phenomenon, our study offers important initial information on how students and schools use online courses to expand existing, face-to-face curricula.

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Figure 1. Decision Rules for Classifying Student Virtual Enrollments: Example of a Virtual Enrollment in Chinese 1

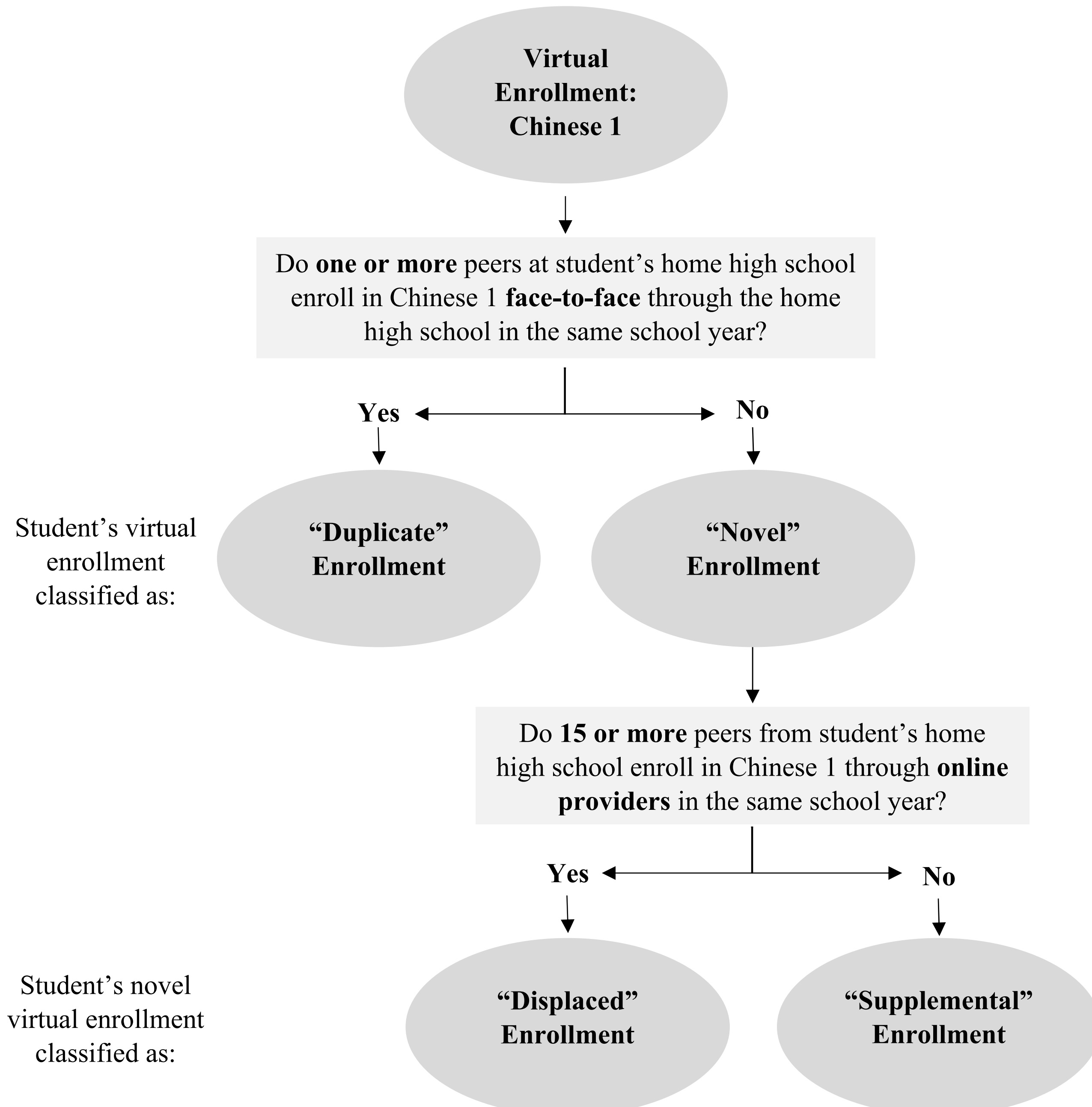

Figure 2. Fraction of Students with Virtual Enrollments by Enrollment Type, Over Time

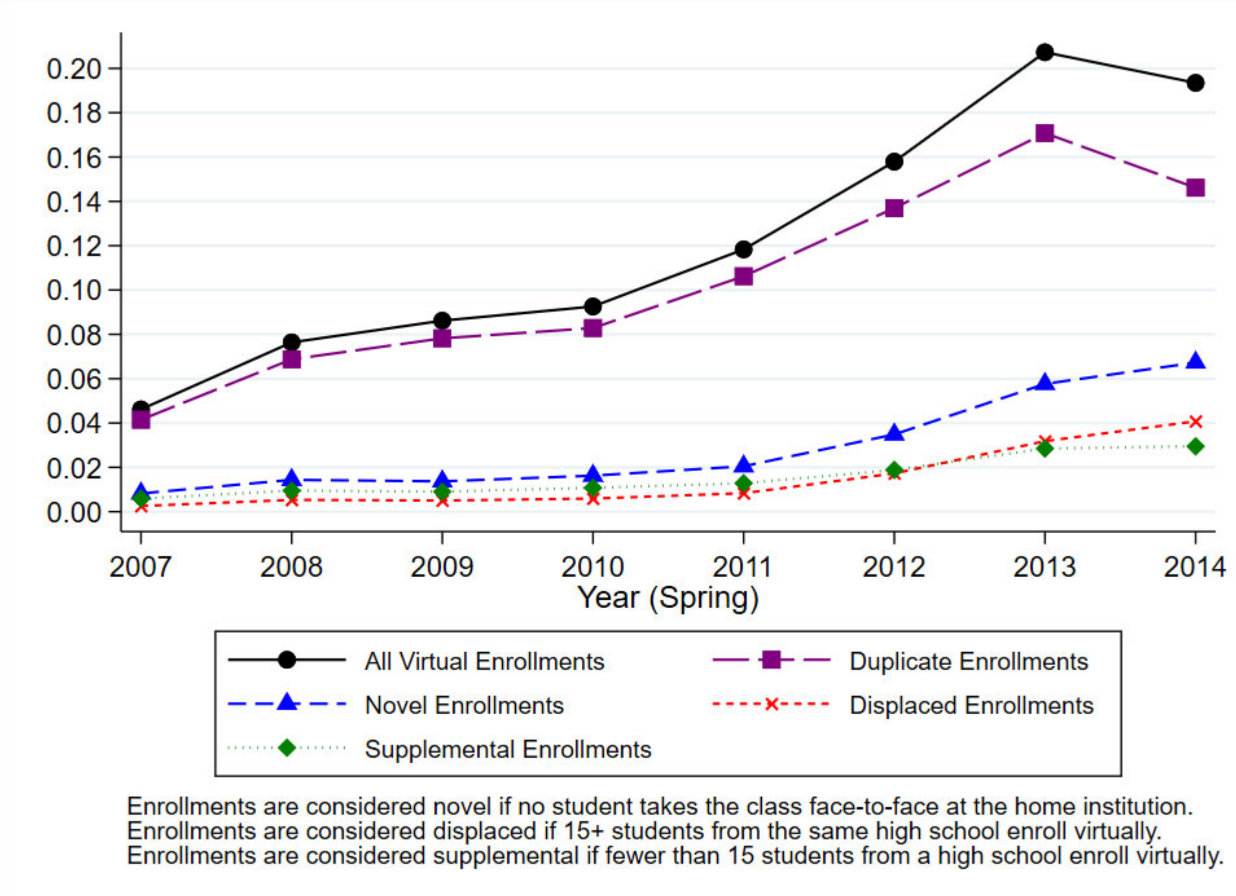

Table 1. Sample Descriptive Statistics, 2013-14 School-Year

		Students with 1+ Enrollments:		
	All Students	Novel Virtual	Supplemental Virtual	Displaced Virtual
	(1)	(2)	(3)	(4)
Student Characteristics				
Grade 9	0.27	0.18	0.11	0.22
Grade 10	0.26	0.23	0.20	0.24
Grade 11	0.24	0.35	0.33	0.36
Grade 12	0.23	0.25	0.36	0.18
Female	0.50	0.60	0.62	0.58
White	0.42	0.44	0.48	0.42
Black	0.20	0.17	0.14	0.19
Hispanic	0.32	0.32	0.29	0.33
Asian	0.03	0.03	0.05	0.02
Multi-racial	0.03	0.03	0.04	0.03
Other race	0.01	0.01	0.01	0.01
FRPL	0.53	0.43	0.37	0.46
Gifted	0.06	0.07	0.08	0.06
Special Education	0.12	0.07	0.07	0.08
Limited English Proficient	0.21	0.13	0.13	0.13
Gr. 8 Std. FCAT Score	0.11	0.31	0.41	0.23
	(0.89)	(0.82)	(0.82)	(0.81)
School Characteristics				
Urban	0.25	0.24	0.24	0.24
Rural	0.11	0.13	0.14	0.12
Town	0.04	0.04	0.05	0.03
School Offers <10 AP/IBs	0.13	0.14	0.17	0.12
School Grade: A	0.38	0.42	0.44	0.42
School Grade: B	0.37	0.36	0.34	0.37
School Grade: C	0.23	0.20	0.21	0.19
School Grade: D/F	0.02	0.02	0.02	0.02
>50% Students FRPL	0.56	0.51	0.48	0.52
Magnet School	0.05	0.08	0.07	0.09
Charter School	0.04	0.04	0.05	0.03
Unique students	732,408	49,268	21,593	29,862

Authors' calculations from FLDOE Data. Each unit represents a unique student. Standard deviations for continuous measures in parentheses. An enrollment is considered Novel if the student takes the class virtually, is enrolled in a different (non-virtual) home institution, and the home institution has 0 face-to-face enrollments in that class. Novel enrollments are considered Supplemental (Displaced) if the home institution has fewer than 15 (15 or more) virtual enrollments and no face-to-face enrollments in the home institution, for that class. Gr. 8 Std. FCAT score refers to students' average standardized scores between the math and reading sections of the Florida Comprehensive Assessment Test (FCAT), Florida's state standardized test. AP: Advanced Placement. IB: International Baccalaureate. FRPL: Free and Reduced Price Lunch.

Table 2. Courses with Highest Share of Total Statewide Enrollments through Novel Online Enrollments, 2013-14

	% Total Enrollments Novel	Frequency of Enrollments of Different Types			% Novel Enrollments Classified as:	
		Novel Virtual	All Virtual	All FtF	Supple-mental	Displaced
	(1)	(2)	(3)	(4)	(5)	(6)
Personal and Family Finance/Level 2	53.8	2,841	3,346	1,937	43.1	56.9
Social Media 1	50.8	1,023	1,087	926	50.3	49.7
Parenting Skills/Level 2	50.7	4,262	5,613	2,790	31.5	68.5
Reading for College Success	44.3	1,824	2,156	1,965	10.6	89.4
Driver Education/Traffic Safety-Classroom	36.3	15,702	29,893	13,357	3.4	96.6
Art History And Criticism 1 Honors	34.2	613	721	1,072	97.6	2.4
Chinese 1	32.0	458	505	927	100.0	-
Health 1-Life Management Skills	22.2	1,555	2,390	4,628	59.0	41.0
Chinese 2	19.9	191	220	741	100.0	-
Latin 1	19.7	924	1,150	3,551	95.9	4.1
Outdoor Education	18.9	1,678	2,197	6,682	48.3	51.7
Forensic Science 1	18.6	1,171	1,483	4,810	80.8	19.2
English 2 for Credit Recovery	14.4	169	217	960	100.0	-
English 1 for Credit Recovery	12.7	163	194	1,092	100.0	-
Creative Photography 1	12.5	1,575	2,356	10,220	63.3	36.7
Latin 2	12.0	342	496	2,354	95.0	5
English 3 for Credit Recovery	10.8	103	126	831	100.0	-
Music Of The World	10.7	940	1,438	7,313	78.4	21.6
Advanced Placement Computer Science A	10.3	169	220	1,420	100.0	-
Algebra 2 for Credit Recovery	7.6	75	101	890	100.0	-

Authors' calculations from FLDOE Data. Sample includes courses with at least 50 Novel enrollments. Ranked by highest percent of total statewide enrollments (total Virtual+total FtF) taken through Novel online enrollments. An enrollment is considered Novel if the student takes the class virtually, is enrolled in a different (non-virtual) home institution, and the home institution has 0 face-to-face enrollments in that class. Novel enrollments are considered supplemental (displaced) if the home institution has fewer than 15 (15 or more) virtual enrollments and no face-to-face enrollments in the home institution, for that class. FtF: face-to-face.

Table 3. Displaced Enrollments

	Frequency of Unique Enrollments			
	Displaced, 2013	Virtual, 2013	FtF, 2013	FtF, 2005
	(1)	(2)	(3)	(4)
Personal and Family Finance/Level 2	1,617	3,346	1,937	344
Social Media 1	508	1,087	926	-
Parenting Skills/Level 2	2,919	5,613	2,790	6,887
Reading for College Success	1,631	2,156	1,965	-
Driver Education/Traffic Safety-Classroom	15,162	29,893	13,357	15,440
Outdoor Education	868	2,197	6,682	4,326
Driver Education/Traffic Safety- Classroom and Laboratory	248	677	24,309	54,308

Authors' calculations from FLDOE Data. An enrollment is considered Novel if the student takes the class virtually, is enrolled in a different (non-virtual) home institution, and the home institution has 0 face-to-face enrollments in that class. Novel enrollments are considered displaced if the home institution has 15 or more virtual enrollments and no face-to-face enrollments in the home institution, for that class. FtF: face-to-face.

Table 4. Rates of Novel Virtual Course-Taking, by School Characteristics 2013-14

	Novel (1)	Supplemental (2)	Displaced (3)
	Panel A. By Urbanicity		
Rural (Grp. 1)	0.078	0.038	0.043
	(0.008)	(0.003)	(0.007)
Suburban (Grp. 2)	0.067	0.028	0.042
	(0.004)	(0.001)	(0.003)
Urban (Grp. 3)	0.064	0.028	0.038
	(0.005)	(0.001)	(0.005)
Town (Grp. 4)	0.063	0.034	0.031
	(0.008)	(0.003)	(0.007)
Group Differences	**n.s.**	**Grp. 1>Grp. 2, Grp. 3**	**n.s**
	Panel B. By AP Variety		
<10 AP/IB Courses (Grp. 1)	0.072	0.038	0.037
	(0.006)	(0.003)	(0.005)
10+ AP/IB Courses (Grp. 2)	0.067	0.028	0.041
	(0.003)	(0.001)	(0.003)
Group Differences	**n.s.**	**Grp. 1> Grp. 2**	**n.s**
	Panel C. By School Grade		
A Schools (Grp. 1)	0.074	0.033	0.044
	(0.005)	(0.001)	(0.004)
B Schools (Grp. 2)	0.065	0.027	0.041
	(0.005)	(0.001)	(0.004)
C Schools (Grp. 3)	0.058	0.027	0.034
	(0.005)	(0.002)	(0.005)
D/F Schools (Grp. 4)	0.062	0.023	0.042
	(0.011)	(0.004)	(0.009)
Group Differences	**Grp. 1> Grp. 3**	**Grp. 1>Grp.2, 3, 4**	**n.s**
	Panel D. By % of Students on Free and Reduced Price Lunch (FRPL)		
<=50% Students FRPL (Grp. 1)	0.075	0.034	0.044
	(0.004)	(0.001)	(0.004)
>50% Students FRPL (Grp. 2)	0.061	0.026	0.038
	(0.004)	(0.001)	(0.003)
Group Differences	**Grp. 1>Grp. 2**	**Grp. 1>Grp. 2**	**n.s.**
	Panel E. By School of Choice Status		
Trad. Pub. School (Grp. 1)	0.065	0.028	0.040
	(0.003)	(0.001)	(0.003)
Magnet (Grp. 2)	0.108	0.041	0.071
	(0.012)	(0.004)	(0.011)
Charter (Grp. 3)	0.062	0.035	0.029
	(0.010)	(0.004)	(0.007)
Group Differences	**Grp. 2>Grp. 1, Grp. 3**	**Grp. 2>Grp. 1**	**Grp. 2>Grp. 1, Grp. 3**
N	729,803	729,803	729,803

Authors' calculations from FLDOE Data. Coefficient (within-school correlation robust SE). Coefficients from regressions estimating Model (1). Each cell represents the share of students in the school type listed in the row label who took at least one virtual course of type listed in column label. No other controls included within each panel. Bolded rows report tests of differences between groups in each panel. For instance, “Grp. 1>Grp. 2” indicates a positive, significant difference between groups 1 and 2. “N.s.”: no significant pairwise differences between groups.

Table 5. Multivariate Regressions with School-Level Variables Predicting Novel Virtual Course-Taking, 2013-14: School Fixed Effects Estimates

	Novel	Supplemental	Displaced
	(1)	(2)	(3)
Urbanicity			
Urban	-0.006	-0.002	-0.005
	(0.006)	(0.002)	(0.006)
Rural	0.011	0.010***	0.002
	(0.009)	(0.003)	(0.008)
Town	-0.004	0.003	-0.008
	(0.009)	(0.004)	(0.008)
School Offers <10 AP/IBs	0.007	0.008***	-0.001
	(0.007)	(0.003)	(0.006)
FLDOE School Grade			
A	0.005	-0.000	0.005
	(0.008)	(0.003)	(0.008)
B	0.004	-0.002	0.005
	(0.007)	(0.002)	(0.007)
D/F	0.002	-0.007	0.009
	(0.013)	(0.005)	(0.010)
>50% Students FRPL	-0.011*	-0.009***	-0.003
	(0.006)	(0.002)	(0.006)
School of Choice			
Magnet School	0.045***	0.014***	0.033***
	(0.013)	(0.004)	(0.012)
Charter School	-0.004	0.004	-0.009
	(0.011)	(0.004)	(0.009)
Constant	0.068***	0.033***	0.039***
	(0.008)	(0.003)	(0.008)
N	732,408	732,408	732,408

Authors' calculations from FLDOE Data. Coefficient (within-school correlation robust SE). Significance: *0.10 **0.05 ***0.01. Coefficients from regressions estimating Model (2), with all school-level covariates entered simultaneously and missing data dummy variables included. Each column represents a separate regression with a dependent variable indicating whether each student took at least one of the virtual course type indicated in the column header.

Table 6. Rates of Novel Virtual Course-Taking, by Student Academic Characteristics 2013-14

	Novel (1)	Supplemental (2)	Displaced (3)
Panel A. By Student Grade			
Gr 9 (Grp. 1)	0.044	0.012	0.034
	(0.003)	(0.001)	(0.003)
Gr. 10 (Grp. 2)	0.058	0.022	0.038
	(0.003)	(0.001)	(0.002)
Gr. 11 (Grp. 3)	0.098	0.041	0.060
	(0.005)	(0.001)	(0.005)
Gr. 12 (Grp. 4)	0.073	0.047	0.032
	(0.003)	(0.002)	(0.002)
Group Differences	**Grp. 3>Grp. 4>Grp. 2>Grp. 1**	**Grp. 4>Grp. 3> Grp. 2>Grp. 1**	**Grp. 3> Grp2> Grp. 1, Grp. 4**
Panel B. By Student Quartile, 8th Grade Average of Math/Reading FCAT			
Quartile 1 (Lowest) (Grp. 1)	0.046	0.016	0.032
	(0.003)	(0.001)	(0.002)
Quartile 2 (Grp. 2)	0.068	0.026	0.044
	(0.003)	(0.001)	(0.003)
Quartile 3 (Grp. 3)	0.076	0.034	0.046
	(0.003)	(0.001)	(0.003)
Quartile 4 (Highest) (Grp. 4)	0.084	0.042	0.046
	(0.004)	(0.001)	(0.003)
Group Differences	**Grp. 4>Grp. 3>Grp. 2>Grp. 1**	**Grp. 4>Grp. 3>Grp. 2>Grp. 1**	**Grp. 4, 3, 2> Grp. 1**
Panel C. By Student Exceptionality Status			
Gifted (Grp. 1)	0.083	0.041	0.046
	(0.005)	(0.002)	(0.004)
No Exceptionality (Grp. 2)	0.070	0.030	0.042
	(0.003)	(0.001)	(0.003)
Special Education (Grp. 3)	0.042	0.017	0.028
	(0.002)	(0.001)	(0.002)
Group Differences	**Grp. 1>Grp. 2>Grp3.**	**Grp. 1>Grp. 2>Grp3.**	**Grp 1, 2>Grp. 3**
Panel D. Limited English Proficiency (LEP) Status			
Not LEP (Grp. 1)	0.074	0.032	0.045
	(0.003)	(0.001)	(0.003)
LEP (Grp. 2)	0.042	0.018	0.025
	(0.003)	(0.001)	(0.002)
Group Differences	**Grp. 1>Grp. 2**	**Grp. 1>Grp. 2**	**Grp. 1>Grp. 2**
N	732,408	732,408	732,408

Authors' calculations from FLDOE Data. Coefficient (within-school correlation robust SE). Coefficients from regressions estimating Model (1). Each cell represents the share of students in the school type listed in the row label who took at least one virtual course of type listed in column label. No other controls included within each panel. Bolded rows report tests of differences between groups in each panel. For instance, “Grp. 1>Grp. 2” indicates a positive, significant difference between groups 1 and 2. “N.s.”: no significant pairwise differences between groups.

Table 7. Rates of Novel Virtual Course-Taking, by Student Demographic Characteristics 2013-14

	Novel	Supplemental	Displaced
	(1)	(2)	(3)
	Panel A. By Sex		
Female (Grp. 1)	0.081	0.037	0.048
	(0.003)	(0.001)	(0.003)
Male (Grp. 2)	0.054	0.022	0.034
	(0.002)	(0.001)	(0.002)
Group Differences	**Grp. 1>Grp. 2**	**Grp. 1>Grp. 2**	**Grp. 1>Grp. 2**
	Panel B. By Race		
Asian (Grp. 1)	0.085	0.052	0.036
	(0.005)	(0.003)	(0.003)
White (Grp. 2)	0.071	0.034	0.041
	(0.003)	(0.001)	(0.003)
Hispanic (Grp. 3)	0.066	0.027	0.042
	(0.004)	(0.001)	(0.003)
Black (Grp. 4)	0.056	0.020	0.038
	(0.003)	(0.001)	(0.003)
Multi-racial (Grp. 5)	0.079	0.038	0.045
	(0.004)	(0.002)	(0.003)
Group Differences	**Grp 1, Grp. 5> Grp. 2, Grp. 3> Grp. 4;**	**Grp. 1>Grp. 5> Grp. 2>Grp. 3>Grp. 4**	**Grp. 5>Grp. 1, Grp. 2, Grp. 3., Grp. 4**
	Panel C. By Free or Reduced-Price Lunch (FRPL) Status		
Not FRPL (Grp. 1)	0.082	0.040	0.047
	(0.003)	(0.001)	(0.003)
FRPL (Grp. 2)	0.054	0.021	0.036
	(0.003)	(0.001)	(0.003)
Group Differences	**Grp. 1>Grp. 2**	**Grp. 1>Grp. 2**	**Grp. 1>Grp. 2**
N	732,408	732,408	732,408

Authors' calculations from FLDOE Data. Coefficient (within-school correlation robust SE). Coefficients from regressions estimating Model (1). Each cell represents the share of students in the school type listed in the row label who took at least one virtual course of type listed in column label. No other controls included within each panel. Bolded rows report tests of differences between groups in each panel. For instance, "Grp. 1>Grp. 2" indicates a positive, significant difference between groups 1 and 2. "N.s.": no significant pairwise differences between groups.

Table 8. Multivariate Regressions with Student-Level Variables Predicting Novel Virtual Course-Taking, 2013-14: School Fixed Effects Estimates

	Novel (1)	Supplemental (2)	Displaced (3)
Student Grade Level			
Grade 10	0.014***	0.011***	0.004*
	(0.002)	(0.001)	(0.002)
Grade 11	0.052***	0.028***	0.026***
	(0.005)	(0.001)	(0.005)
Grade 12	0.029***	0.034***	-0.002
	(0.003)	(0.001)	(0.003)
8th Grade FCAT Quartile			
Quartile 1 (Lowest)	-0.010***	-0.005***	-0.006***
	(0.001)	(0.001)	(0.001)
Quartile 3	0.003***	0.004***	-0.002
	(0.001)	(0.001)	(0.001)
Quartile 4 (Highest)	0.007***	0.010***	-0.003**
	(0.002)	(0.001)	(0.002)
Educational Placements			
Gifted	0.005**	0.006***	0.000
	(0.002)	(0.001)	(0.002)
Special Ed	-0.013***	-0.006***	-0.008***
	(0.001)	(0.001)	(0.001)
LEP	-0.020***	-0.007***	-0.014***
	(0.002)	(0.001)	(0.001)
Demographics			
FRPL	-0.018***	-0.013***	-0.006***
	(0.001)	(0.001)	(0.001)
Female	0.024***	0.013***	0.012***
	(0.001)	(0.001)	(0.001)
Black	0.006***	0.001*	0.005***
	(0.001)	(0.001)	(0.001)
Hispanic	0.030***	0.010***	0.022***
	(0.002)	(0.001)	(0.002)
Asian	0.023***	0.023***	-0.000
	(0.003)	(0.002)	(0.002)
Multi-racial	0.011***	0.008***	0.003**
	(0.002)	(0.001)	(0.002)
Other race	0.024***	0.009***	0.016***
	(0.005)	(0.003)	(0.004)
Constant	0.036***	0.008***	0.030***
	(0.002)	(0.001)	(0.002)
N	732,408	732,408	732,408

Authors' calculations from FLDOE Data. Coefficient (within-school correlation robust SE). Significance: *0.10 **0.05 ***0.01. Coefficients from regressions estimating Model (3), including all controls, missing variable dummies, and school fixed effects. Each column represents a separate regression with a dependent variable indicating whether each student took at least one of the virtual course type indicated in the column header.