Community College Review
2018, Vol. 46(2) 176–196

DOI: 10.1177/0091552118759419
journals.sagepub.com/home/crw
SAGE

How High School Coursework Predicts Introductory College-Level Course Success

Chenoa S. Woods[1], Toby Park[1], Shouping Hu[1], and Tamara Betrand Jones[1]

Abstract

Objective: In recent years, developmental education (DE) reform has led to a restructuring of the placement process, redesigning of course instructional modalities, or implementing student support services to supplement developmental coursework. In Florida, recent legislative changes allowed students to opt out of placement testing and enroll directly in college-level courses regardless of academic ability. The purpose of this study is to understand how students' high school transcript information can be used in the academic advising process when students are no longer required to take standardized placement tests. **Method:** We used a combination of high school courses from statewide student-level data and conducted logistic regression analyses to understand how these courses help predict success in English Composition I and Intermediate Algebra. We also developed student profiles and presented predicted probabilities to illustrate how students with different combinations of high school coursework were predicted to pass their courses. **Results:** The results indicated that, generally, when students enrolled in introductory college-level courses, those with higher levels of high school preparation were predicted to pass at higher rates. However, even students whose coursework designated them as college-ready had predicted passing rates of 69.5% in English and 47.6% in Intermediate Algebra. **Contributions:** We recommend that college academic advisors use high school coursework, in addition to other factors, when advising students into courses and that advisors support students' success by referring them to appropriate support services. We call for additional research to further understand how high school coursework can be used for flexible placement policies.

[1]Florida State University, Tallahassee, USA

Corresponding Author:
Chenoa S. Woods, Florida State University, 1114 W. Call Street, Stone Building 1208G, Tallahassee, FL 32306, USA.
Email: cwoods@fsu.edu

Keywords
course placement, academic advising, education reform, student success, student outcomes

In recent years, developmental education (DE) reform has led to a restructuring of the placement process, redesigning of course instructional modalities, or implementation of student support services to supplement developmental coursework (Belfield, Jenkins, & Lahr, 2016; Bickerstaff, Fay, & Trimble, 2016; Complete College America, 2016; Melguizo, Bos, Ngo, Mills, & Prather, 2016; Scrivener et al., 2015). For example, advisors may use high school transcript information instead of or in addition to course placement tests during course registration, or developmental courses may be paired with college-level courses or additional tutoring as a means of supporting students' mastery of basic skills. Specifically in Florida, recent legislative changes have introduced a new scenario where placement tests are optional and students may enroll directly in college-level courses regardless of academic ability (S. 1720, 2013). The legislation also required that DE courses be taught with new instructional modalities designed to better suit students' needs and more quickly move students to college credit-bearing courses. These instructional modalities include modularized, compressed, contextualized, and corequisite courses. Due to the changing placement policies and multiple DE course options under the legislation, advisors' roles have become increasingly complex regarding students' registration process (Woods, Richard et al., 2017). In the case of altering placement policies or instructional practices, advisors may be faced with an increased workload. In particular, when colleges modify placement policies for developmental courses, advisors have the task of guiding students into the most appropriate courses, sometimes by using multiple measures, such as high school coursework, instead of relying solely on placement tests.

The purpose of this study is to understand how students' high school transcript information can be used in the academic advising process when students are no longer required to take standardized placement tests. We focused on English and math pathways and modeled how high school coursework could predict students' readiness for the first college-level classes in English (English Composition 1) or math (Intermediate Algebra). English Composition 1 (ENC 1101) is the standard entry-level college credit-bearing course across the state of Florida. Although Intermediate Algebra (MAT 1033) is the most common entry-level math course and offers college-level credits, it does not fulfill the math course requirement; the credits can be used as electives. All institutions in the Florida College System (FCS) have common course numbering. We used a combination of English, foreign language courses, math, and science courses and asked, "What measures of high school coursework are associated with the likelihood of success in introductory college-level English and math courses?" By addressing this question, we hope to provide helpful information to high school counselors who assist their students in course registration. Understanding how high school courses can prepare students to be successful in their first college credit-bearing course may lead to more high school students entering community college with advanced

coursework. Likewise, college academic advisors who are required to guide students' registration process using a flexible placement policy may also make use of the findings from this study. Although situated in the context of Florida's redesign, these findings can provide guidance for advisors in multiple contexts, particularly when students do not have placement exam scores.

This study uniquely contributes to the college readiness literature in that we model relationships between high school coursework and students' college-level course success by drawing from a pool of students prepared at different levels. Due to broadened enrollment choices made possible through the DE redesign in Florida, our sample includes students who enrolled in a college-level course with a range of levels of preparation. Because traditional, more common placement practices would not allow underprepared students to enroll in college-level courses, this study provides a novel examination of how high school coursework can predict college-level course success for students, who, under previous placement policies, would not be enrolled in the course.

Background and Relevant Literature

The Context of DE Redesign

As placement policies have begun to move away from relying solely on placement tests, high school transcript data such as specific courses, course grades, and overall grade point average (GPA) have become increasingly popular placement alternatives. The rationale for implementing new placement policies is threefold: (a) standardized tests have been found to be mediocre placement tools (Hughes & Scott-Clayton, 2011; Scott-Clayton, 2012); (b) high school coursework is an indicator that students have relevant college knowledge (Conley, 2005); and (c) transcript information has been shown to be a useful placement tool (Scott-Clayton, Crosta, & Belfield, 2014). Some states have implemented hierarchical placement policies (Kalamkarian, Raufman, & Edgecombe, 2015) or decision-tree style placement policies (Willett et al., 2015) as means of redesigning their placement policies.

Even more drastic, the state of Florida passed Senate Bill 1720 (2013), legislation that eliminated mandatory placement testing and mandatory DE coursework for certain students. Beginning in fall 2014, students who entered a public Florida high school in the 2003-2004 academic year and subsequently earned a standard high school diploma in 2007-2008 or later, and active duty military personnel, were exempt from these requirements. Colleges were also required to redesign their DE courses to be taught in innovative instructional modalities, including modularized, compressed, corequisite, and contextualized courses. Thus, in the context of Florida's DE redesign, academic advisors must embrace their role in helping students select their courses (see National Academic Advising Association, 2006) and to develop and implement effective guidance practices that forego traditional standardized testing. Although students may not be required to follow their college advisor's guidance, advisors remain influential in students' enrollment experiences (Woods, Richard et al., 2017). The majority

of high school counselors report that 80% or more of their time is spent on course scheduling (Radford, Ifill, & Lew, n.d.), and it may behoove high school students and counselors alike to consider courses that are predicted to increase success in introductory college-level courses.

College Readiness and Academic Rigor

College readiness includes earning a standard high school diploma and successfully passing first-year college-level courses to continue in the course sequence without remediation (Chait & Venezia, 2009; Greene & Forster, 2003; Porter & Polikoff, 2012). Cognitive strategies such as reasoning and critical thinking skills and the academic rigor of the high school courses students take (e.g., higher-level math and writing-intensive English courses) are especially important (Conley, 2005). Rigorous core courses can provide students with the cognitive strategies necessary for college success; however, college readiness is not consistently defined in the literature, and there are debates about whether completing minimum college admissions requirements deems students truly college-ready (Porter & Polikoff, 2012).

The disconnection between the K-12 sector and higher education creates issues of defining college readiness, determining who is college-ready, and predicting who is prepared to succeed in college-level courses. There appears to be misalignment between the important skills and knowledge needed in college as compared with high school. Furthermore, high school students take a series of assessments that may capture only a portion of those necessary for college success. The American College Test (ACT; 2007) found that high school math teachers emphasized higher order content whereas college instructors emphasized a solid understanding of basic skills. Similarly, high school and college English instructors disagreed on curricular priorities; college instructors placed more emphasis on grammar. In science, college instructors emphasized understanding the scientific method but high school teachers stressed the importance of basic facts. These differences stem from limited coordination between the two sectors' separate governmental leadership, jurisdiction, and organizational structures (Chait & Venezia, 2009).

There have been some statewide efforts to better link these two sectors. The Early Assessment Program (EAP) in California implemented a college readiness assessment in high school, when students have the senior year to remediate prior to college entry, if necessary (Howell, Kurlaender, & Grodsky, 2010). EAP was designed to identify students who needed additional assistance before their senior year of high school, provide all stakeholders with opportunities to increase the quality of college preparation, and motivate students to prepare for college-level work. States use a variety of exams including high school exit exams, the PSAT, SAT, and/or ACT as a college readiness tools, but Florida, like California, developed its own college readiness assessment (McIntosh, 2011). Although a mandated test for designated students beginning in 2011, Florida's Postsecondary Education Readiness Test (PERT) remains available but is no longer required to be administered in high schools (Florida Department of Education, 2015).

High school coursework and grades in particular classes predict college success broadly (Adelman, 2006; Horn, Kojaku, & Carroll, 2001; Long, Conger, & Iatarola, 2012; Warburton, Bugarin, & Nunez, 2001). A nationally representative study that grouped students into three levels of preparation based on high school coursework indicated that students who were most prepared had higher rates of transferring either laterally or to a more selective institution; however, these were students who initially enrolled in a 4-year institution (Horn et al., 2001). Higher levels of high school preparation were also associated with maintaining enrollment at the students' first institution and staying on track to obtain a bachelor's degree. In another study, academic rigor of high school courses was associated with college GPA, the number of DE courses taken, persistence, and attainment (Warburton et al., 2001). Furthermore, community college students with fewer years of math coursework had higher rates of remediation, compared with students who were more prepared (Schak, Metzger, Bass, McCann, & English, 2017).

Math coursework, and Algebra 2 in particular, appears to be important in college attendance and success. Byun, Irvin, and Bell (2015) clearly argued that "mathematics is a gatekeeper" to future educational success (p. 439). They found that advanced math course-taking was positively predictive of math achievement and college enrollment, even after employing the rigorous method of propensity score matching. Similarly, when comparing the rigor of Algebra 1 to Algebra 2, scoring higher on Algebra 2 was related to a stronger higher probability of passing the college-level math course for community college students (Jonas et al., 2012). Interestingly, the same study found that writing was a stronger predictor of success in college-level English than reading. In another study, students with Algebra 2 coursework were more likely to attend community college, as compared with not attending (Kim, Kim, DesJardins, & McCall, 2015). However, it is worth noting that without an experimental design, it is difficult to determine whether students who succeed in college do so because of taking more advanced courses (Porter & Polikoff, 2012).

Some have stated that high school rank and GPA may be inconsistent measures across institutions (Porter & Polikoff, 2012). Another issue related to academic rigor is that of weighted high school GPA for Advanced Placement (AP), International Baccalaureate (IB), and honors courses. These classes weight GPAs heavily, particularly for students who participated in many advanced courses, yet high school GPAs with full weight explain less variance in first- and second-year college GPA than unweighted high school GPAs (Geiser & Santelices, 2004). Nevertheless, honors and AP coursework have been associated with benefits for students. For example, the total number of honors courses taken is positively related to college GPA and credits earned, even after controlling for high school GPA (Belfield & Crosta, 2012). Likewise, students with AP credits earned higher first-semester college GPAs than similarly prepared students without AP credit (Scott, Tolson, & Lee, 2010). However, others have shown that the number of honors or AP courses a student enrolled in during high school has no statistically significant relationship with first- or second-year college GPA or persistence (Geiser & Santelices, 2004). Deaton (2014) also found that when comparing students with and without AP English credit, there were no differences in

first-semester GPAs. Thus, evidence on the effectiveness of AP and honors course participation is somewhat mixed and may warrant further investigation. Indeed, some argue that in regard to college admissions, AP coursework is used as a signal to imply motivation, but once other experiences are accounted for, AP students perform similarly to non-AP students (Klopfenstein & Thomas, 2009). It is not clear if this signaling works beyond the admissions process, once the student is in class or in other settings. Furthermore, little is known about community college students with honors and AP coursework.

Other evidence states that grades and proficiency levels are associated with student success. That is, in Virginia, 83% of students who were advanced proficient on their statewide standardized test in Algebra 2 subsequently passed their introductory math course in college compared with just 54% of students who passed Algebra 2 with proficiency; just 19% of those who failed Algebra 2 passed the introductory college course (Jonas et al., 2012). More students scoring advanced proficient in writing passed their college-level English course compared with students who passed with proficiency (84% compared with 58%); just 11% of those who failed their writing assessment passed their English course (Jonas et al., 2012).

The Problem With Standardized Tests

Standardized tests have long been used for college admissions for more selective institutions and placement mechanisms for students who potentially need remediation in one or more subjects. Proponents of standardized tests argue that they have increased standards and expectations but may reveal that lower performing students are receiving inadequate education; opponents argue that high-stakes tests narrow the curriculum without improving student learning or achievement (McIntosh, 2011). Much of the research using high school grades as predictors of success in colleges juxtaposes the predictive power of grades (often a cumulative GPA) with standardized tests scores (Camara & Echternacht, 2000; Geiser & Santelices, 2007; Zwick & Sklar, 2005). For many years, standardized tests were viewed as a more appropriate measure than high school grades because grading can be subjective and may not be systematic (see Geiser & Santelices, 2007). However, some studies have claimed that both SAT scores and high school grades should be used to predict first-year college GPA (Kobrin, Patterson, Shaw, Mattern, & Barbuti, 2008). For example, high school grades, after controlling for SAT scores, were predictive of first- or second-year college GPA, with larger effects for high school grades (Geiser & Santelices, 2004; Zwick & Sklar, 2005). In another study, Komarraju, Ramsey, and Rinella (2013) found that once controlling for ACT scores, high school GPA accounted for an additional 11% of variance in college GPA. It is also worth noting that many students do not take the SAT or ACT in high school, particularly if they are planning to attend a community college; these tests may be more useful for predicting success within 4-year institutions (see Kobrin et al., 2008).

Standardized tests have often been used as DE placement tools, but there has been mixed evidence that placement tests are accurate predictors of success. In contrast,

much of the research has shown that high school transcript variables such as credit in specific courses, grades, and overall GPA more accurately place students into appropriate courses (Scott-Clayton et al., 2014). In one study, Belfield and Crosta (2012) found that once controlling for high school GPA and transcript information, the positive effect of placement scores (specifically from the ACCUPLACER and COMPASS) on college GPA disappeared; however, placement tests positively predicted college credits earned, even after controlling for GPA and other high school transcript information. Indeed, placement based on test score cut points results in severe course misplacement; evidence suggests that in both math and English, using high school GPA alone reduces the occurrence of misplacements compared with using test scores from the COMPASS and ACCUPLACER alone (Scott-Clayton et al., 2014). Furthermore, placement tests may be more predictive of success (as compared with failure) in college-level math courses, than in English. Scott-Clayton and Rodríguez (2015) also found evidence that students who were placed into developmental English using scores from the COMPASS exam could have been successful in the college-level course.

The established research informs our work to include relevant high school variables to predict students' likelihood of passing their first college-level courses. There is a lack of evidence that relates high school course credit to success in specific college courses, and prior research has not investigated success in introductory college-level courses when students have *not* been remediated. Furthermore, the unique context of optional DE, a policy context specific to the state of Florida, lends additional importance to this study. That is, community colleges in other states that have implemented changes to their DE placement system and course offerings such as Virginia, North Carolina, and California but have not made DE optional. Given the recent shift in practice and policy to rely on multiple measures and additional factors in the placement process, a study where placement test scores are not accounted for aligns with the way in which Florida and many other state college systems are moving (see Kalamkarian et al., 2015).

Method

Data and Sample

The data for this study came from the Florida Department of Education Data Warehouse and included statewide K-20 student-level data. The current study relied on data from first-time-in-college (FTIC) students who were enrolled in one of the 28 institutions in the FCS in fall 2014. We limited our sample to include only those students who were no longer required to take a placement test or enroll in developmental courses (those exempt under SB 1720), students who enrolled directly into college-level English or math, and students who did not take a developmental course in either pathway. We also limited our sample to those who had complete high school records, given that we relied heavily on these data in our models. Our final sample consisted of 27,702 FCS students, 40.6% of the FTIC cohort entering the FCS in 2014.

Table 1. Sample Descriptive Statistics.

Student characteristics and high school coursework	*n*	%
Race/ethnicity		
Black	5,489	19.81
Hispanic	9,854	35.50
Other	1,659	5.99
White	10,700	38.63
Female	14,506	52.36
Low-income	13,755	49.65
High school preparation		
English honors	17,325	62.54
AP English	3,842	13.87
LOTE (<2 years)	6,126	22.11
LOTE (2 years)	13,885	50.12
LOTE (>2 years)	7,691	27.76
Algebra 2	23,917	86.34
Advanced math	6,466	23.34
Science honors	12,940	46.71
AP science	1,005	3.63
Total	27,702	

Note. High school preparation courses are dummy variables indicating having earned high school credit in the course. LOTE is measured as student having taken less than 2 years, 2 years, or more than 2 years of a LOTE. Advanced math includes trigonometry, precalculus, calculus, statistics, and probability. Science classes include biology, chemistry, and physics. AP = advanced placement; LOTE = language other than English.

We conduced *t* tests to determine if our study sample differed from the overall FCS FTIC 2014 cohort. There were fewer Black students and more Hispanic and low-income students in our sample as compared with the overall incoming cohort. There were similar proportions of White students, students of another race/ethnicity, and females in each group. However, students in our sample were significantly more prepared. On average, more students in our sample had earned high school credit in English honors or AP English, Algebra 2, another advanced math course, honors science, and AP science, and earned two credits of language other than English (LOTE; that is, foreign language). Nevertheless, many of these group differences are because we dropped students who had taken developmental courses, which restricted the number of students in our sample who would have limited high school preparation. Thus, our sample is not representative of the overall incoming 2014 cohort. These students are nevertheless important to study because this group represents students who have the option to enroll in developmental or introductory courses, and chose to enroll in the college-level course without remediation. That is, the findings from this sample of students will be helpful to advisors who meet with exempt students that are looking to enroll directly into college-level courses. Students who chose to enroll in a

developmental course may be different from students who enrolled in college-level courses directly in terms of academic goals, external obligations or priorities, or other characteristics.

In our analytic sample, nearly 36% of the students were Hispanic, 19.8% were Black, 38.6% were White, and 6.0% were of another race/ethnicity. About half of the students in the sample were low-income, and 52.4% were female (Table 1). In terms of high school preparation, 62.5% had earned honors English credit and 13.9% of students had earned at least some AP English credit. Whereas 22.1% of the sample had fewer than 2 years of LOTE, 50.1% had 2 years, and 27.8% had more than 2 years. The majority of students (86.3%) earned Algebra 2 credit, and 23.3% earned credit in another advanced math course. Over 46% of the sample had earned science honors credit, and 3.6% had earned credit in AP science. These descriptive statistics include students who took either the college-level English course *or* math course. Of our sample, 91.5% enrolled in English Composition 1 and 54.8% enrolled in Intermediate Algebra. The low math course-taking rate aligns with previous research that given the option, students may choose to enroll in developmental math or delay enrollment in any math course (Park, Woods, Hu, Bertrand Jones, & Tandberg, 2017; Park et al., 2016; Woods, Park, Hu, & Bertrand Jones, 2017).

Variables

Our outcome variables of interest include passing the introductory English course, English Composition 1 (ENC 1101) in the first semester, and passing the most common introductory college-level math course, Intermediate Algebra (MAT 1033) in the first semester. To address our research question, we used high school coursework in English, LOTE, math, and science to understand how these high school courses contributed to success in college-level English and math courses separately (see Table 2). We frame our approach with the understanding that students who take courses beyond those required for high school graduation (e.g., honors courses) may be better prepared for college-level work, and students in the highest level of preparation completed even more advanced relevant coursework (e.g., AP courses or additional years) and may indeed have an even higher likelihood of success. In part, we based our indicators of preparation on Florida's high school graduation requirements. Requirements for earning a standard high school diploma include four years of English, four credits in math (including Algebra 1 and Geometry), and three credits in science (one of which must be Biology 1), among other coursework. However, LOTE, Algebra 2, advanced math, and honors and AP courses were not required.

In our models, we specifically included measures of whether students had earned credit in honors English, AP English, and LOTE (less than 2 years, 2 years, and more than 2 years). Our decision to include those specific increments of LOTE was based on the fact that the state university system requires 2 years of a LOTE for admission. We also included indicator variables for completing Algebra 2 and another advanced math course (including trigonometry, precalculus, calculus, and statistics). In addition, we included indicators for students who had completed honors or AP science classes (biology, chemistry, and physics). Each of these types of classes are treated as dummy variables in the inferential analyses.

Table 2. Introductory College-Level English and Math Course Pass Rates by High School Preparation.

	Pass ENC 1101		Pass MAT 1033	
High school preparation	*n*	%	*n*	%
Overall	17,976	70.89	7,760	51.13
High school preparation				
English honors	11,954	74.94	5,215	55.84
AP English	2,696	79.34	1,236	61.28
LOTE (<2 years)	3,207	58.00	1,161	35.80
LOTE (2 years)	9,379	73.60	4,183	53.52
LOTE (>2 years)	5,390	76.09	2,416	58.66
Algebra 2	16,059	73.31	7,258	54.40
Advanced math	4,746	79.64	2,121	66.72
Science honors	9,088	76.32	4,086	59.82
AP science	755	81.62	291	69.12

Note. LOTE is measured as student having taken less than 2 years, 2 years, or more than 2 years of a LOTE. Advanced math includes trigonometry, precalculus, calculus, statistics, and probability. Science classes include biology, chemistry, and physics. AP = advanced placement; LOTE = language other than English.

In addition to these key variables, we included in our full models indicator variables for Black, Hispanic, and students of another race/ethnicity, with White as the reference category. We also included an indicator for gender (with males as the reference category), and we used students' eligibility for free- or reduced-priced lunch in high school as a proxy for low-income status.

Analytic Approach

We began by examining descriptive statistics of course passing rates for English and math separately, disaggregated by each high school course indicator. Then, we utilized logistic regression equations with the key indicators of coursework to estimate their relationships with passing the introductory courses (y_{ij}):

$$\text{logit}\left(\text{CourseSuccess}_{ij}\right) = \beta_0 + \beta_1\left(\text{HonEng}_{ij}\right) + \beta_2\left(\text{APEng}_{ij}\right) + \beta_3\left(\text{2-3LOTE}_{ij}\right) + \beta_4\left(\text{4LOTE}_{ij}\right) + \beta_5\left(\text{Algebra2}_{ij}\right) + \beta_6\left(\text{AdvMath}_{ij}\right) + \beta_7\left(\text{HonSci}_{ij}\right) + \beta_8\left(\text{APSci}_{ij}\right) + \beta_9\left(\text{S}_{ij}\right) + \beta_{10}\left(\text{C}_j\right).$$

We included the dummy variables for each course for student *i* in FCS institution *j*, with standard preparation as the reference category, student-level controls *(S)*, and college-level fixed effects *(C)*.[1]

To ease interpretation, we present our results in the form of odds ratios (ORs), then turn to predicted probabilities based on the models above. We do so holding the remaining variables at the mean. We conducted predicted probabilities for several combinations of courses to understand how different student preparation profiles were related to success in the introductory college-level course.

Limitations

Our analyses do not account for availability of high school courses offered, participation in a dual enrollment program or other college preparatory high school, or access to AP courses or other opportunities to develop higher order skills. Although somewhat limited by the data available, we also made these decisions intentionally. The current study is designed to be useful for academic advisors within the FCS institutions as well as those in other settings, and we focused our analyses on variables that would be readily available to advisors via a student transcript or student self-report.

Perhaps students who earn grades of A and B retain more information and are better prepared for college coursework than students who earn a C but still pass the course. A limitation of the current study is that we cannot account for specific grades earned in the courses included in our analyses, nor overall high school GPA. Nevertheless, taking just one rigorous high school course in ninth or 10th grade has been shown to be associated with higher math scores and increased odds of high school graduation and attending a 4-year college; for those who entered a 4-year institution, students with rigorous courses also earned more college credits, had a higher college GPA, and were more likely to earn a bachelor's degree (Long et al., 2012). Similar to our study, Long and colleagues (2012) did not consider high school GPA. Other work shows that even after accounting for a number of background characteristics and high school performance, advanced coursework in math is related to college attendance (Aughinbaugh, 2012; Byun et al., 2015). Furthermore, taking into account previous coursework may help college advisors to direct students into a program of study, meta-major, or guided pathway to a degree. For instance, college students without advanced high school math courses may be guided into a math pathway for liberal arts majors (see Rodríguez, 2014). These course indicators are not all-inclusive nor exhaustive; other combinations of coursework and other measures such as noncognitive factors may also predict success in the college-level courses.

Results

Descriptive Portrait

Overall, 70.9% of students passed the English course (see Table 2). Generally, passing rates were higher for students with more advanced preparation. For example, 79.3% of students with AP English credit passed compared with 74.5% of students with honors English credit. Likewise, whereas 59.5% of students with less than 2 years of LOTE

passed their English course, 77.5% of students with 4 or more years passed the course. Similar patterns are true for math and science coursework.

In math, 51.1% of students passed Intermediate Algebra. As with English, students with higher-level coursework passed the math course at higher rates. That is, 54.4% of students who earned Algebra 2 credit passed Intermediate Algebra, but 66.7% of students with advanced math coursework passed the course. Similarly, pass rates for students with AP science credit were 69.1%, compared with 59.8% for students with science honors credit. In both subjects, there are differences in pass rates between types of high school preparation. We use predictive models below to test whether these differences are significant.

Predicting Success in College-Level English

Table 3 presents the findings from our logistic regression analyses estimating the effects of different high school coursework on the likelihood of passing the English course. After controlling for student demographics and college-level fixed effects, we found that students with honors and AP English credit have higher odds of passing ENC 1101 (OR = 1.160, $p < .001$ and OR = 1.15, $p < .001$, respectively). Similarly, compared with students with less than 2 years of LOTE, students with 2 years, or more than 2 years had higher odds of passing English (OR = 1.545, $p < .001$ and OR = 1.591, $p < .001$, respectively). Algebra, advanced math, and higher-level science coursework also are positively related to passing English (ORs range from 1.204 to 1.590, $p < .05$). Indeed, the ORs for both math courses are larger than the ORs for either English course.

Whereas ORs indicated that in general, students with more advanced coursework are more likely to pass the course, to make these results more useful for advisors, we relied on predicted probabilities of pass rates for students of different preparation profiles. For example, a student with standard preparation, or no advanced coursework as measured by our indicators, had a 48.2% passing rate of English Composition 1, whereas a college-ready student who completed 2 years of a LOTE and Algebra 2 had a 69.5% passing rate (see Table 4). Furthermore, the college-ready student who also earned high school credit in English honors had a passing rate of 72.6%. Thus, these profiles indicate that as students add difficult or higher-level courses to their high school experience, they may be better prepared to pass their introductory English course.

Predicting Success in Introductory College-Level Math

Net of student-level controls and community college fixed effects, credit in Algebra 2 (OR = 2.284, $p < .001$), advanced math (OR = 1.810, $p < .001$), science honors (OR = 1.361, $p < .001$), and AP science (OR = 1.392, $p < .001$) were associated with higher odds of passing Intermediate Algebra (see Table 3). Although neither Honors nor AP English were significantly related to success in math, students with 2 or more than 2 years of LOTE were significantly more likely to pass the course, compared with

Table 3. High School Preparation Predicting Passing Introductory College-Level English and Math.

High school coursework and student characteristics	ENC 1101	MAT 1033
English honors	1.160***	1.022
	(0.039)	(0.041)
AP English	1.153**	1.041
	(0.056)	(0.056)
LOTE (2 years)	1.545***	1.525***
	(0.056)	(0.070)
LOTE (>2 years)	1.591***	1.740***
	(0.067)	(0.090)
Algebra 2	1.590***	2.284***
	(0.065)	(0.133)
Advanced math	1.460***	1.810***
	(0.056)	(0.080)
Science honors	1.132***	1.361***
	(0.039)	(0.054)
AP science	1.204*	1.392**
	(0.108)	(0.156)
Black	0.728***	0.758***
	(0.029)	(0.037)
Hispanic	1.107**	1.021
	(0.039)	(0.043)
Other	0.902	1.087
	(0.056)	(0.084)
Female	1.479***	1.234***
	(0.043)	(0.042)
Low-income	0.872***	0.891**
	(0.027)	(0.033)
College fixed effects	Yes	Yes
Constant	0.894	0.265***
	(0.064)	(0.024)
n	25,356	15,178
Pseudo-R^2	.046	.059

Note. Odds ratios presented, standard errors are in parentheses. LOTE is measured as student having taken less than 2 years, 2 years, or more than 2 years of a LOTE. Advanced math includes trigonometry, precalculus, calculus, statistics, and probability. Science classes include biology, chemistry, and physics. AP = advanced placement; LOTE = language other than English.
*$p < .05$. **$p < .01$. ***$p < .001$.

students with less than 2 years (OR = 1.525, $p < .001$ and OR = 1.740, $p < .001$, respectively).

We again turn to predicted probabilities of passing rates for students of different preparation profiles. These predicted probabilities can help advisors understand how

Table 4. Predicted Probabilities and Marginal Effects of Passing College-Level English and Math by Type of Preparation.

Student profiles	Coursework	*n*	College-level English (%)	College-level math (%)
Standard student	No advanced coursework of any kind	1,288	48.18	20.71
Moderate preparation: College-ready student	Standard student + 2 LOTE + Algebra 2	2,716	69.54	47.62
Moderate preparation: College-ready student with science honors	College-ready student + Science honors	525	72.11	55.31
Moderate preparation: College-ready student with English honors	College-ready student + English honors	1,942	72.60	48.16
Moderate preparation: College-ready student with honors	College-ready student + English honors + Science honors	2,867	74.99	55.84
Moderate preparation: College-ready student with honors and advanced English preparation	College-ready student with honors + AP English + >2 LOTE	434	78.08	60.04
Moderate preparation: College-ready student with advanced math and science preparation	College-ready student with honors + AP science + Advanced math	143	84.05	76.11
Highly prepared student	College-ready student with honors + > 2 LOTE + Advanced math + AP English + AP science	131	86.23	79.10

Note. LOTE is measured as student having taken less than 2 years, 2 years, or more than 2 years of a LOTE. Advanced math includes trigonometry, precalculus, calculus, statistics, and probability. Science classes include biology, chemistry, and physics. These profiles are meant to be illustrative but not exhaustive. AP = advanced placement; LOTE = language other than English.

likely students with different high school transcripts are to pass their course. The student with standard preparation had a MAT 1033 passing rate of just 20.7%, but a college-ready student (one with 2 years of LOTE and Algebra 2 credit) had a passing rate of 47.6% (see Table 4). A college-ready student who also earned English and science honors, AP science, and advanced math credit had a passing rate of 76.1%. These predicted probabilities illustrate how students with more advanced coursework are better

prepared to pass Intermediate Algebra, particularly when given the option to bypass DE coursework.

Discussion and Conclusion

In this study, we analyzed how high school academic preparation is related to success in introductory college-level English and math courses, which may aid academic advisors when directing students how to enroll in their first-semester courses. We used statewide student-level data and found that students with standard preparation had the lowest likelihood of success in their college-level English (48.2%) and math (20.7%) courses. Using predicted probabilities to illustrate different profiles of preparation can provide useful estimates of students' likelihood of success when high school transcripts indicate different course-taking patterns. We propose the student preparation profiles presented here as a guide for high school counselors and college advisors to reference with their students. In an era where placement techniques that do not rely solely on standardized test scores are being expanded and DE is being reduced and accelerated, proactive high school counseling to enroll students in courses shown to promote success in key introductory courses may facilitate student success once in college. We believe this study provides a tool that advisors can use to help students understand their strengths, but we agree with other scholars and recommend the use of multiple indicators, including course grades and noncognitive factors to predict students' success (Belfield & Crosta, 2012; Scott-Clayton et al., 2014). We also make a call for additional research to explore other placement practices and mechanisms.

The large differences in predicted pass rates between student profiles indicate that in some cases, completing an honors course is associated with an increase in the likelihood that a student will pass their college-level math course. On average, the predicted probability of a college-ready student to pass his or her math course is 47.6%; however, completing an honors course is associated with increasing this probability to 55.4%. These low to moderate passing rates are somewhat concerning, because by our operational definition, college-ready students have already completed some advanced coursework in addition to minimal high school graduation requirements; presumably, these students should be ready to pass introductory college courses. This finding may be indicative of a mismatch of standards between high school and college math and science (ACT, 2007), grade inflation (Butcher, McEwan, & Weerapana, 2014; Woodruff & Ziomek, 2004), or other means of inadequate preparation. Regardless, this study demonstrates that in our sample, basic high school coursework is not sufficient preparation for passing introductory courses at the community college.

Although there is some prior evidence that taking foreign language coursework in high school is related to positive postsecondary outcomes (particularly a third-level foreign language course; see Long et al., 2012), we found that 2 years or more than 2 years of LOTE were related to passing college-level courses in both English and math. Indeed, in both subjects the ORs for these variables were sizable (OR = 1.525-1.740).

In practice, it may behoove advisors to consider 2 or more years of LOTE as one indicator of potential success in both entry-level courses.

Practical Recommendations

The finding that the most prepared students only have an 86.2% likelihood of passing the college-level English course illustrates that even some of the most highly prepared students will struggle. Thus, advisors should discuss with students their level of commitment to studying, their availability to attend class regularly and utilize resources such as tutoring centers, and their self-assessments of their ability in the subject. If students communicate uncertainty in their ability or pressing outside obligations, advisors may want to consider recommending a refresher course or supplemental help such as a corequisite course to further support these students.

Indeed, in both subjects, advisors should ensure that students have the necessary support systems in place to help students succeed. As some have argued that college-level course placement should be the default placement for most students, our findings lend support to others' claims that students with lower levels of preparation, particularly those in math, may benefit from the additional support found in corequisite courses or other support systems which provide basic skill development (Complete College America, 2016). For example, Statway is a 1-year course sequence that couples basic skill development with college-level statistics. Recent findings indicated that students who enrolled in the Statway program were more likely to earn college-level math credits than nonparticipants (Yamada & Bryk, 2016).

When students do enroll in college-level courses, advisors should inform their students of tools that can support their success. Such tools include corequisite courses or other in-class support, tutoring centers, online tutoring, additional practice questions in cocurricular materials, meetings with faculty members or other mentors, and follow-up advising sessions. Connecting students to advisors, faculty, and academic support systems remains crucial, particularly for students who enrolled in college-level courses without advanced high school coursework. Although support services such as tutoring have helped students earn better grades or develop necessary skills, when learning assistance is optional, the majority of students choose not to participate (Salem, 2016; Vick, Robles-Piña, Martirosyan, & Kite, 2015). Course instructors may choose to require the use of support services as part of their course curriculum to increase students' uptake of the supplementary programs.

It is important that advisors consider all possible points of evidence that indicate students' college readiness. In this study, we limited our sample to those students where we had complete high school records. However, some community college students may not have high school transcripts, particularly if they are returning to school after many years. Scott-Clayton (2012) noted that for these students, a placement test may be the best mechanism to determine appropriate courses, perhaps in combination with students' self-reported high school background. In support of this claim, correlations between high school graded achievement and tested achievement have been shown to be moderate in size (.4-.7), but grades may capture additional learning

outcomes as compared with traditional tests (Brookhart, 2015). In the case of Florida, many older and returning students would not be exempt under SB 1720, so placement tests may be an effective placement tool to be used for this population of students.

Future Research

As definitions of college readiness continue to evolve based on educational standards, college admissions, and career growth within certain fields, continued research should explore how students' high school coursework is related to preparation for college-level work. Particularly in the growing fields of engineering and computer science, high school math and science preparation may be particularly influential in students' ability to succeed in these majors and become gainfully employed following degree attainment. Furthermore, we plan to continue to map student success as meta-majors become fully integrated into the advising process and the overall student experience. Additional research to understand the advising processes in the context of optional DE and optional placement tests is crucial for student success. In particular, capturing advisors' enrollment recommendations and whether students complied or took an alternate path would provide insight on the role of student agency in an era of increased choice.

Authors' Note

The opinions expressed are those of the authors and do not represent views of the Institute of Education Sciences, the U.S. Department of Education, or the Bill & Melinda Gates Foundation.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305A160166 to Florida State University, and in part by a grant from the Bill & Melinda Gates Foundation.

Note

1. We also ran models that clustered students within their high schools. These models did not substantially change our findings, but because these models limited our sample due to some students missing the high school indicator, we present findings without this specification.

References

Adelman, C. (2006). *The toolbox revisited: Paths to degree completion from high school through college*. Washington, DC: U.S. Department of Education.

American College Test. (2007). *ACT National Curriculum Survey 2005–2006*. Iowa City, IA: Author.

Aughinbaugh, A. (2012). The effects of high school math curriculum on college attendance: Evidence from the NLSY97. *Economics of Education Review*, *31*, 861-870. doi:10.1016/j.econedurev.2012.06.004

Belfield, C., Jenkins, P. D., & Lahr, H. E. (2016). *Is corequisite remediation cost-effective? Early findings from Tennessee* (CCRC Research Brief No. 62). New York, NY: Teachers College, Community College Research Center, Columbia University. doi:10.7916/D8HX1CNF

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

Bickerstaff, S., Fay, M. P., & Trimble, M. J. (2016). *Modularization in developmental mathematics in two states: Implementation and early outcomes* (CCRC Working Paper No. 87). New York, NY: Teachers College, Community College Research Center, Columbia University.

Brookhart, S. M. (2015). Graded achievement, tested achievement, and validity. *Educational Assessment*, *20*, 268-296. doi:10.1080/10627197.2015.1093928

Butcher, K. F., McEwan, P. J., & Weerapana, A. (2014). The effects of an anti-grade-inflation policy at Wellesley College. *The Journal of Economic Perspectives*, *28*, 189-204. doi:10.1257/jep.28.3.189

Byun, S., Irvin, M. J., & Bell, B. A. (2015). Advanced math course taking: Effects on math achievement and college enrollment. *Journal of Experimental Education*, *83*, 439-468. doi:10.1080/00220973.2014.919570

Camara, W. J., & Echternacht, G. (2000). *The SAT I and high school grades: Utility in predicting success in college* (Research Note 10). New York, NY: Office of Research and Development, The College Board.

Chait, R., & Venezia, A. (2009). *Improving academic preparation for college: What we know and how state and federal policy can help*. Washington, DC: Center for American Progress.

Complete College America. (2016). *Corequisite remediation: Spanning the completion divide*. Retrieved from http://completecollege.org/spanningthedivide/

Conley, D. T. (2005). *College knowledge: What it really takes for students to succeed and what we can do to get them ready*. San Francisco, CA: Jossey-Bass.

Deaton, S. (2014). Impact of the English advanced placement (AP) program on college grade point average among rural Appalachian students. *The Rural Educator*, *35*, 1-11.

Florida Department of Education. (2015, May). *Information on House Bill 7069*. Presented at the Florida Organization of Instructional Leaders Spring Conference, Howey-in-the-Hills, FL.

Geiser, S., & Santelices, M. V. (2004). *The role of Advanced Placement and honors courses in college admissions* (Research & Occasional Paper Series: CSHE 4.04). Berkeley: Center for Studies in Higher Education, University of California, Berkeley.

Geiser, S., & Santelices, M. V. (2007). *Validity of high-school grades in predicting student success beyond the freshman year: High-school record vs. standardized tests as indicators of four-year college outcomes* (Research & Occasional Paper Series: CSHE. 6.07). Berkeley: Center for Studies in Higher Education, University of California, Berkeley.

Greene, J. P., & Forster, G. (2003). *Public high school graduation and college readiness rates in the United States*. New York, NY: Center for Civic Innovation, Manhattan Institute.

Horn, L., Kojaku, L. K., & Carroll, C. D. (2001, August). *High school academic curriculum and the persistence path through college: Persistence and transfer behavior of undergraduates 3*

years after entering 4-year institutions (NCES2001-163). Retrieved from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2001163

Howell, J. S., Kurlaender, M., & Grodsky, E. (2010). Postsecondary preparation and remediation: Examining the effect of the Early Assessment Program at California State University. *Journal of Policy Analysis and Management*, *29*, 726-748. doi:10.1002/pam.20526

Hughes, K. L., & Scott-Clayton, J. (2011). Assessing developmental assessment in community colleges. *Community College Review*, *39*, 327-351. doi:10.1177/0091552111426898

Jonas, D., Dougherty, C., Herrera, A. W., LaTurner, J., Garland, M., & Ware, A. (2012). *High school predictors of college readiness: Determinants of high school graduates' enrollment and successful completion of first-year mathematics and English college courses in Virginia*. Richmond: Virginia Department of Education.

Kalamkarian, H. S., Raufman, J., & Edgecombe, N. (2015). *Statewide developmental education reform: Early implementation in Virginia and North Carolina*. New York, NY: Teachers College, Community College Research Center, Columbia University.

Kim, J., Kim, J., DesJardins, S. L., & McCall, B. P. (2015). Completing algebra II in high school: Does it increase college access and success? *The Journal of Higher Education*, *86*, 628-662. doi:10.1080/00221546.2015.11777377

Klopfenstein, K., & Thomas, M. K. (2009). The link between advanced placement experience and early college success. *Southern Economic Journal*, *75*, 873-891.

Kobrin, J. L., Patterson, B. F., Shaw, E. J., Mattern, K. D., & Barbuti, S. M. (2008). *Validity of the SAT for predicting first-year college grade point average* (Research Report No. 2008-5). New York, NY: The College Board.

Komarraju, M., Ramsey, A., & Rinella, V. (2013). Cognitive and non-cognitive predictors of college readiness and performance: Role of academic discipline. *Learning and Individual Differences*, *24*, 103-109. doi:10.1016/j.lindif.2012.12.007

Long, M. C., Conger, D., & Iatarola, P. (2012). Effects of high school course-taking on secondary and postsecondary success. *American Educational Research Journal*, *49*, 285-322. doi:10.3102/0002831211431952

McIntosh, S. (2011). *State high school tests: Changes in state policies and the impact of the college and career readiness movement*. Washington, DC: Center on Education Policy.

Melguizo, T., Bos, J. M., Ngo, F., Mills, N., & Prather, G. (2016). Using a regression discontinuity design to estimate the impact of placement decisions in developmental math. *Research in Higher Education*, *57*, 123-151. doi:10.1007/s11162-015-9382-y

National Academic Advising Association. (2006). *Concept of academic advising*. Retrieved from https://www.nacada.ksu.edu/Resources/Pillars/Concept.aspx

Park, T., Woods, C. S., Hu, S., Bertrand Jones, T., & Tandberg, D. (2017). What happens to underprepared first-time-in-college students when developmental education is optional? The case of developmental math and Intermediate Algebra in the first semester. *The Journal of Higher Education*. Advance online publication. doi:10.1080/00221546.2017.1390970

Park, T., Woods, C. S., Tandberg, D., Hu, S., Bertrand Jones, T., & Richard, K. (2016). When developmental education is optional, what will students do? Analysis of survey data on student course enrollment decisions in an environment of increased choice. *Innovative Higher Education*, *41*, 221-236.

Porter, A. C., & Polikoff, M. S. (2012). Measuring academic readiness for college. *Educational Policy*, *26*, 394-417. doi:10.1177/0895904811400410

Radford, A. W., Ifill, N., & Lew, T. (n.d.). *A national look at the high school counseling office: What is it doing and what role can it play in facilitating students' paths to college?*

Retrieved from https://www.nacacnet.org/news–publications/Research/nationallookh-scounselingoffice/

Rodríguez, O. (2014). *Increasing access to college-level math: Early outcomes using the Virginia Placement Test* (Issue Brief No. 58, S. 1720. FLA. STAT. §1008-30 (2013)). New York, NY: Teachers College, Community College Research Center, Columbia University.

Salem, L. (2016). Decisions . . . decisions: Who chooses to use the writing center? *The Writing Center Journal*, *35*, 147-171.

Schak, O., Metzger, I., Bass, J., McCann, C., & English, J. (2017). *Developmental education challenges and strategies for reform*. Washington, DC: U.S. Department of Education Office of Planning, Evaluation and Policy Development Policy and Program Studies Service.

Scott, T. P., Tolson, H., & Lee, Y. H. (2010). Assessment of Advanced Placement participation and university academic success in the first semester: Controlling for selected high school academic abilities. *Journal of College Admission*, *208*, 26-30.

Scott-Clayton, J. (2012). *Do high-stakes placement exams predict college success?* (Working Paper No. 41.). New York, NY: Teachers College, Community College Research Center, Columbia University.

Scott-Clayton, J., Crosta, P. M., & Belfield, C. R. (2014). Improving the targeting of treatment: Evidence from college remediation. *Educational Evaluation and Policy Analysis*, *36*, 371-393. doi:10.3102/0162373713517935

Scott-Clayton, J., & Rodríguez, O. (2015). Development, discouragement, or diversion? New evidence on the effects of college remediation policy. *Education Finance and Policy*, *10*, 4-45. doi:10.1162/EDFP_a_00150

Scrivener, S., Weiss, M. J., Ratledge, A., Rudd, T., Sommo, C., & Fresques, H. (2015). *Doubling graduation rates: Three-year effects of CUNY's Accelerated Study in Associate Programs (ASAP) for developmental education students*. New York, NY: Manpower Demonstration Reserach Corporation.

Vick, N., Robles-Piña, R. A., Martirosyan, N. M., & Kite, V. (2015). The effectiveness of tutoring on developmental English grades. *The Community College Enterprise*, *21*, 11-26.

Warburton, E. C., Bugarin, R., & Nunez, A. M. (2001). *Bridging the gap: Academic preparation and postsecondary success of first-generation students* (NCES Report 2001-153). Retrieved from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2001153

Willett, T., Hayward, C., Nguyen, A., Newell, M., Bahr, P., Hetts, J., . . . Duran, D. (2015). *Multiple Measures Assessment Project (MMAP) spring 2015 technical report*. Sacramento: Research and Planning Group for California Community Colleges.

Woodruff, D. J., & Ziomek, R. L. (2004). *High school grade inflation from 1991 to 2003* (Research Report Series 2004-04). Iowa City, IA: American College Test.

Woods, C. S., Park, T., Hu, S., & Bertrand Jones, T. (2017). Reading, writing, and English course pathways when developmental education is optional: Course enrollment and success for underprepared first-time-in-college students. *Community College Journal of Research and Practice*. Advance online publication. doi:10.1080/10668926.2017.1391144

Woods, C. S., Richard, K., Park, T., Tandberg, D., Hu, S., & Jones, T. B. (2017). Academic advising, remedial courses, and legislative mandates: An exploration of academic advising in Florida community colleges with optional developmental education. *Innovative Higher Education*, *42*, 289-303. doi:10.1007/s10755-016-9385-4

Yamada, H., & Bryk, A. S. (2016). Assessing the first two years' effectiveness of Statway®: A multilevel model with propensity score matching. *Community College Review*, *44*, 179-204. doi:10.1177/0091552116643162

Zwick, R., & Sklar, J. G. (2005). Predicting college grades and degree completion using high school grades and SAT scores: The role of student ethnicity and first language. *American Educational Research Journal*, *42*, 439-464. doi:10.3102/00028312042003439

Author Biographies

Chenoa S. Woods is a research faculty member for the Center for Postsecondary Success at Florida State University. She earned her PhD in Education Policy and Social Context from the University of California, Irvine. Her primary research interests include college access, choice, and success with an emphasis on precollege counseling and preparation.

Toby Park is an associate director of the Center for Postsecondary Success and Assistant Professor of Education Policy at Florida State University. He earned his PhD from Vanderbilt University in Education Policy, and his primary research utilizes quasi-experimental techniques to investigate student outcomes in postsecondary education and policy initiatives that improve student success.

Shouping Hu is the Louis W. and Elizabeth N. Bender endowed Professor of Higher Education at Florida State University and the founding director of the Center for Postsecondary Success. He earned his PhD in Higher Education from Indiana University; and his research interests include student postsecondary readiness, outcomes, and success and public policy.

Tamara Bertrand Jones is an associate professor of Higher Education at Florida State University and associate director of the Center for Postsecondary Success. Her research uses culturally responsive frameworks to examine the sociocultural contexts of evaluation and education for underrepresented populations in academia. She earned her PhD from Florida State University in Research and Evaluation Methods.