What's Happening

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What predicts participation in developmental education among recent high school graduates at community college? Lessons from Oregon

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Education Northwest

Key findings

- Nearly 75 percent of recent high school graduates who enrolled in an Oregon community college took at least one developmental education (that is, non-credit-bearing prerequisite) course.
- Recent high school graduates who started at a lower level of developmental education at community college were less likely than their peers who started at a higher level to stay in college and earn a degree.
- For recent high school graduates, individual academic achievement in high school influences participation in developmental education at community college more than sociodemographic characteristics and school-level factors.
- Students who took dual-credit courses in high school in certain subject areas were less likely to participate in developmental education at community college.

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Summary

Nationwide, about two-thirds of community college students are considered academically underprepared for postsecondary coursework and must enroll in at least one developmental education (that is, non-credit-bearing prerequisite) course in math, reading, or writing (Bailey, Jeong, & Cho, 2010; Radford & Horn, 2012). Thus far, research on developmental education has focused mainly on the general community college population, a diverse population that includes a large number of individuals who have returned to college after a gap in their education. Less is known—both nationally and in specific contexts—about the extent of participation in developmental education among students enrolling in community college directly from high school and the relationship between high school experiences and subsequent participation in developmental education.

Using student-level administrative data from the Oregon Department of Education, Oregon community colleges, and National Student Clearinghouse, this study examines the rates of participation in developmental education among four groups of Oregon public high school graduates who enrolled in an Oregon community college within six years after high school graduation:

- *Recent high school graduates.* Students who enrolled in an Oregon community college in the academic year following graduation.
- *Graduates who attended four-year college first.* Students who enrolled in a four-year college first and then, one to six years after high school graduation, enrolled in an Oregon community college.
- *Graduates who attended another two-year college first.* Students who enrolled in a private or out-of-state public two-year college first and then, one to six years after high school graduation, enrolled in an Oregon community college.
- *Graduates who delayed entry with no prior college experience.* Students who enrolled in an Oregon community college within six years after high school graduation but not in the year immediately following graduation and without enrolling in any other college in the intervening years.

This study also examined the postsecondary outcomes of recent high school graduates who enrolled in community college and how high school experiences predicted participation in developmental education at community college among all four groups.

This study found that nearly 75 percent of recent high school graduates who enrolled in an Oregon community college and graduates who delayed entry with no prior college experience took at least one developmental education course. In contrast, a much smaller share of graduates who attended a four-year college or another two-year college first took a developmental course. This study also found that recent high school graduates who started at a lower level of developmental education were less likely than their counterparts who started at a higher level to stay in college and earn a degree, which is consistent with findings from other research across the country.

A third finding is that individual academic achievement in high school influences participation in developmental education at community college more than sociodemographic characteristics and school-level factors do, particularly among recent high school graduates. School-level factors were more important for influencing participation among graduates who delayed entry with no prior college experience and who attended a four-year

college or another two-year college first. This suggests that the influence of school-level quality and other school characteristics on college readiness persists over time and continues to influence academic preparedness. Finally, the study also found that high school students who took dual-credit courses in certain subjects were less likely to participate in developmental education at community college.

The findings suggest a foundational, actionable direction for improving students' college readiness and success: targeting academic underpreparedness at the high school level, well before students graduate and enroll in college. Efforts to improve academic preparation that are shaped by high schools and postsecondary institutions working together, such as dual credit, may be particularly promising strategies for improving college readiness. Cross-sector efforts to address college readiness may also strengthen the impact of reforms in developmental education at community colleges in Oregon and across the country.

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Why this study?

In 2011 the Oregon legislature established the goal of having 80 percent of Oregon adults earn a postsecondary degree by 2025. Specifically, the legislation calls for 40 percent of adults to earn at least a bachelor's degree, 40 percent to earn an associate's degree or postsecondary certificate, and the remaining 20 percent to earn a high school diploma or equivalent (Senate Bill 253, 2011). This is commonly referred to as the "40–40–20" goal. The state monitors progress toward this goal through an achievement compact—a partnership agreement between the state and a school district or postsecondary institution that defines key measures of student success and sets targets for achievement, as defined by the district or institution (Oregon Education Investment Board, 2011).

The Regional Educational Laboratory Northwest formed the Oregon College and Career Readiness Research Alliance to support the state as it works toward achieving the 40–40–20 goal. Alliance members include leaders from school districts, postsecondary institutions, and the state secondary and postsecondary education agencies, including the Oregon Department of Education, Oregon Department of Community Colleges and Workforce Development, Oregon University System, and Oregon Education Investment Board (the task force appointed by Oregon Governor John Kitzhaber to support student success from cradle to career).

This study is intended to inform decisions on how to improve the transition from high school to college for recent high school graduates who attend community college

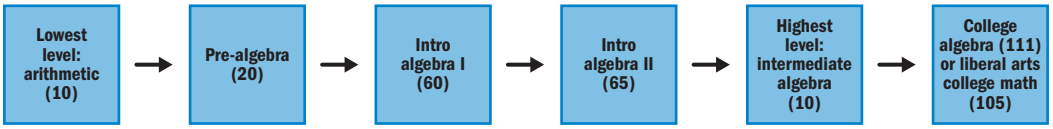
This study addresses two priorities of the Oregon College and Career Readiness Research Alliance. First, the alliance identified developmental education (that is, non-credit-bearing prerequisite courses in math, reading, and writing) as a priority area after determining that more research was needed to identify gaps in the education pipeline, particularly at the transition from high school to college. This study focuses on developmental education at the 17 Oregon community colleges (box 1) because participation in developmental education is much more pervasive at two-year colleges than at four-year colleges (Radford & Horn, 2012). As a result, this study draws on multiple data sources to identify the rates of participation in developmental education among Oregon high school graduates who enrolled in an Oregon community college within six years of high school graduation; the postsecondary outcomes of recent high school graduates who started their postsecondary career at community college; and individual characteristics, experiences, and school-level factors that predict participation in developmental education at community college. This study is intended to inform decisions on how to improve the transition from high school to college for recent high school graduates who attend community college.

Second, the alliance requested more information on the relationship between dual-credit courses and college readiness and success because such courses are viewed as a key strategy to improve the transition from high school to college and academic preparedness of Oregon students (Oregon Department of Education, 2011).[1] As a result, this study examines the relationship between a key experience of Oregon students—participation in dual credit in high school—-and subsequent participation in developmental education or college-level coursework at community college, thus providing the first Oregon-specific evidence on the topic.

Box 1. Developmental education at Oregon community colleges

Students at Oregon community colleges who are assigned to developmental education take one course in the developmental education sequence per term until they complete their developmental education requirements and can enroll in entry-level college math or English, as well as other college courses with math or English prerequisites. Although the community colleges operate as independent institutions, many have similar developmental education sequences. Figure 1 illustrates a common course sequence in math at the Oregon community colleges, and figure 2 illustrates a common course sequence in writing. All developmental education courses are below the 100 level except Writing 115, which many community colleges consider a preparatory course for College English Composition and which does not count toward degree program requirements. A common course not illustrated is a one-term Introduction to Algebra course (70) that covers content drawn from Introduction to Algebra I and Introduction to Algebra II (Math 60 and 65) and that provides an alternative to the two-term Intro Algebra sequence. The Oregon community colleges use a quarter system (fall, winter, spring, and summer terms). A student who places into pre-algebra (Math 20) and grammar (Writing 80) and enrolls every term needs about one academic year (four terms) to complete his or her developmental education requirements.

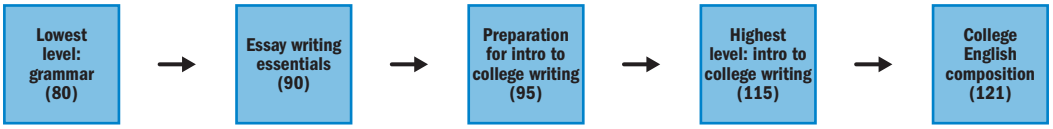
Figure 1. Common course sequence in developmental education in math at the Oregon community colleges



Note: Course names reflect the course content rather than the names used by the Oregon community colleges. Numbers in parentheses are course numbers.

Source: Author's analysis of community college course catalogs.

Figure 2. Common course sequence in developmental education in writing at the Oregon community colleges



Note: Course names reflect the course content rather than the names used by the Oregon community colleges. Numbers in parentheses are course numbers.

Source: Author's analysis of community college course catalogs.

Framing the national problem

A lack of academic preparedness for college-level coursework is a major challenge facing students pursuing a postsecondary degree. Each year, large numbers of college students, particularly at community colleges, are required to take and pass at least one developmental education course in math, reading, or writing before they are considered "college ready" or academically qualified for college-level coursework (Adelman, 2005; Bailey et al., 2010; Horn & Berger, 2004). For example, among students who started college in 2003/04, 68 percent of public two-year college students, 39 percent of public four-year college students, and 32 percent of private four-year college students took at least one developmental education course (Radford & Horn, 2012).

Nationally, enrollment in developmental education is high for several reasons. First, high school graduation requirements may not align with the necessary skills and knowledge required to be ready for college-level coursework (Conley, 2007; Grubb, 2013; Hodara, Jaggars, & Karp, 2012; Kurlaender & Larsen, 2013; Venezia, Bracco, & Nodine, 2010). As a result, many students who fulfill the curricular requirements to earn a high school diploma are still not academically prepared for college and must enroll in developmental education at community college.

Second, there are gaps in rigorous high school coursetaking, particularly in math, between Black and White students, Hispanic and White students, and higher and lower income students (Domina & Saldana, 2012; Dondero & Muller, 2012; Iatarola, Conger, & Long, 2011; Kelly, 2009; Riegle-Crumb & Grodsky, 2010). These gaps in advanced coursetaking in high school may partly explain both high rates of participation in developmental education and why participation tends to be much higher among traditionally disadvantaged students, such as students from low-income backgrounds (Long, Iatarola, & Conger, 2009).

Many students who earn a high school diploma are still not academically prepared for college and must enroll in developmental education at community college

Third, participation in developmental education may be high due to how students are referred to this coursework. Typically, community colleges administer placement exams to incoming students to determine whether they are ready for college-level coursework or need further preparation in math, reading, or writing (Hodara et al., 2012). However, these exams provide a limited measure of students' readiness for college-level coursework because they cannot assess other skills students may have—such as critical thinking and academic tenacity—that are also related to college readiness and success. Further, most students are unaware of the purpose and consequences of the placement exams and consequently do not prepare for them (Fay, Bickerstaff, & Hodara, 2013; Grubb, 2013; Venezia et al., 2010). These students may have the potential to do well in a college-level course but perform poorly on the relevant placement exam and thus end up in developmental education.

High rates of participation in developmental education are a concern for several reasons. While developmental education courses may improve the academic skills of those who complete them (Attewell, Lavin, Domina, & Levey, 2006; Bahr, 2010), on average, few students finish their developmental education course requirements, and they have lower credit accrual and college graduation rates than their counterparts who started college in college-level coursework (Attewell et al., 2006; Bailey et al., 2010; Jaggars & Hodara, 2011; Roksa, Jenkins, Jaggars, Zeidenberg, & Cho, 2009).[2]

Additionally, developmental education is costly: students spend an estimated $6.7 billion per year on such courses at community colleges (Scott-Clayton, Crosta, & Belfield, 2012). Across Oregon's 17 community colleges, the approximate cost of developmental education in 2010/11 was nearly $41.5 million (Oregon Department of Community Colleges and Workforce Development, 2011). Yet, for large numbers of community college students, the investment of time and money on developmental coursework yields little progress toward a college degree.

Because of the increasing financial and education costs of developmental education, postsecondary institutions across the country are working to improve the effectiveness of these courses (see examples of reforms in Edgecombe, Cormier, Bickerstaff, & Barragan, 2013; Hodara et al., 2012; Quint, Jaggars, Byndloss, & Magazinnik, 2013). These efforts are complemented by secondary school reforms intended to improve students' college readiness

and reduce their need for developmental education. Most notably, states have revised their own standards or adopted the Common Core State Standards in math and in English language arts and literacy to ensure that all students graduate from high school with the skills and knowledge necessary to succeed in college, career, and life (Barnett & Fay, 2013). At the same time, states are aligning assessments to new standards to better understand whether students have gained college- and career-ready skills (Barnett, Fay, Trimble, & Pheatt, 2013).

High schools, including those in Oregon, are also aligning secondary and postsecondary education expectations by expanding accelerated learning opportunities for all students. Courses such as dual credit, Advanced Placement, and International Baccalaureate are intended to provide high school students with more rigorous, college-level coursework, improve their college readiness, and ease their transition to college (Lerner & Brand, 2006). Improvements to curriculum, assessment, and course offerings may eventually decrease the demand for developmental education by ensuring more students leave high school prepared for college-level coursework.

Research on developmental education has focused mainly on the general community college population, which includes individuals who have returned to college after a gap; less is known about developmental education among students who enroll in community college directly from high school or who have a relatively short gap between high school graduation and college entry

Research questions

Thus far, research on developmental education has focused mainly on the general community college population (see, for example, Bettinger & Long, 2005; Boatman & Long, 2010; Calcagno & Long, 2008; Dadgar, 2012; Hodara, 2012; Martorell & McFarlin, 2011; Scott-Clayton & Rodriguez, 2012; Xu, 2013), a diverse population that includes a large number of individuals who have returned to college after a gap in their education. Less is known—both nationally and in specific contexts—about the extent of participation in developmental education and the relationship between high school experiences and subsequent participation in developmental education among students who enroll in community college directly from high school or who have a relatively short gap between high school graduation and college entry. As a result, the study population includes four groups:

- *Recent high school graduates.* Students who enrolled in an Oregon community college in the academic year following graduation.
- *Graduates who attended four-year college first.* Students who enrolled in a four-year college first and then, one to six years after high school graduation, enrolled in an Oregon community college.
- *Graduates who attended another two-year college first.* Students who enrolled in a private or out-of-state public two-year college first and then, one to six years after high school graduation, enrolled in an Oregon community college.
- *Graduates who delayed entry with no prior college experience.* Students who enrolled in an Oregon community college within six years after high school graduation but not in the year immediately following graduation and without enrolling in any other college in the intervening years.

This study addresses three research questions:

- What are the rates of participation in developmental education among high school graduates who enrolled in an Oregon community college within six years after high school graduation?
- What are the course progression, persistence, and degree attainment outcomes of recent high school graduates who enrolled in an Oregon community college by course starting level?

- What demographic characteristics, high school academic experiences, and institutional factors predict participation in developmental education among high school graduates who enrolled in an Oregon community college within six years after high school graduation?

Box 2 provides a summary of the data and methodology behind the study; appendix A provides more detail on the data, and appendix B provides more detail on the methodology.

Box 2. Data and methods

Data

This study uses a longitudinal dataset that links secondary and postsecondary data on students who attended an Oregon public high school from 2004/05 to 2010/11 and subsequently enrolled in an Oregon community college from 2005/06 to 2011/12 (*N* = 101,812). The sample includes only Oregon high school students with a graduation status who attended an Oregon community college after their high school graduation year.

The data were from three sources:

- The Oregon Department of Education (student gender, race/ethnicity, academic information, state assessment scores, high school graduation status, and high school and district of attendance, covering Oregon public high school students for 2004/05–2010/11).
- The National Student Clearinghouse (college type, term-by-term enrollment, degree completion, and degree type, covering attendees at colleges that participate in the National Student Clearinghouse for 2005/06–2011/12).
- The Oregon Department of Community Colleges and Workforce Development (full course transcript data, including term-by-term course name, number, and grade; demographics; major; financial aid indicators; and degree completion status and type, covering high school graduates at 17 Oregon community college for 2005/06–2011/12).

See appendix A for more detail on data sources.

Methodology

A different methodology was used to analyze each research question.

Research question 1. To calculate rates of participation in developmental education, the study team identified developmental education math, reading, and writing courses in the community college course transcript data based on course names and numbers. Rates are based on the number of students who enrolled in any of these courses. See table B1 in appendix B for a list of courses identified as developmental education.

Research question 2. To examine long-term education outcomes by course starting level in common developmental math and writing sequences, the study team calculated course progression rates through math and writing course sequences at Oregon community colleges and persistence and degree attainment rates for recent high school graduates who enrolled in an Oregon community college (including those who received a credential at a postsecondary institution outside Oregon).[1] The analysis included recent high school graduates only, for two reasons. First, this analysis provides insight into the possible impact of secondary-postsecondary misalignment—represented by recent high school graduates starting college in developmental education—on long-term postsecondary outcomes. Second, capturing accurate

(continued)

Box 2. Data and methods *(continued)*

rates of course progression, persistence, and degree attainment requires a long follow-up period because many students, particularly community college students, tend to enroll part time or temporarily leave college (Crosta, 2014; Horn & Nevill, 2006). Therefore, to accurately identify students' course progression, persistence, and degree attainment, the sample includes only the first three cohorts of recent high school graduates, followed for five years (for 2006/07 graduates who enrolled in 2007/08), six years (for 2005/06 graduates who enrolled in 2006/07), or seven years (for 2004/05 graduates who enrolled in 2005/06). Further details on the outcomes analysis are presented in appendix C.

Research question 3. To investigate the relationship between participation in developmental education and various variables, the study team used regression analysis, conducted separately for each of the four groups of the study population. The variables tested were:

- *Demographics*. Gender, race/ethnicity, age at college entry.
- *Socioeconomic status*. Free or reduced-price lunch status, Pell grant (federal aid to low-income students) status.
- *High school academic experiences.* Individualized Education Program status, English learner student status, dual-credit course status, number of days absent, grade repetition.
- *Oregon Assessment of Knowledge and Skills performance on grade 10 math, reading, and science tests.* Low or very low, nearly meets proficiency, meets proficiency, exceeds proficiency.
- *High school characteristics.* School location (rural, urban, suburban, town); percentage of students who are White, who are English learner students, who were eligible for free or reduced-price lunch, who had an Individualized Education Program; average Oregon Assessment of Knowledge and Skills scores in math, reading, and science.
- *School attended*. High school graduated from, community college attended.

Two analyses were conducted. To understand the extent to which groups of variables explain student enrollment in developmental education, the first analysis estimated a series of linear regression models, each with a different group of independent variables. The most important estimate from this regression analysis is the *R*-squared—a statistical measure of how well the group of variables in the model predicts the outcome. To identify the precise relationship between specific variables and developmental education enrollment, the second analysis estimated a logistic regression model with all the independent variables listed above. Here, the most important estimates are the marginal effects—the percentage point differences in the predicted probability of enrolling in developmental education versus college-level coursework only.

See appendix B for more detail on methodology.

Note

1. Developmental reading results are not discussed in the main text but are included in appendix C because only a small proportion of students enrolled in developmental reading, and almost all developmental reading students also took developmental writing.

What the study found

Findings vary across the four groups of high school graduates who enrolled in community college. This section highlights four key findings.

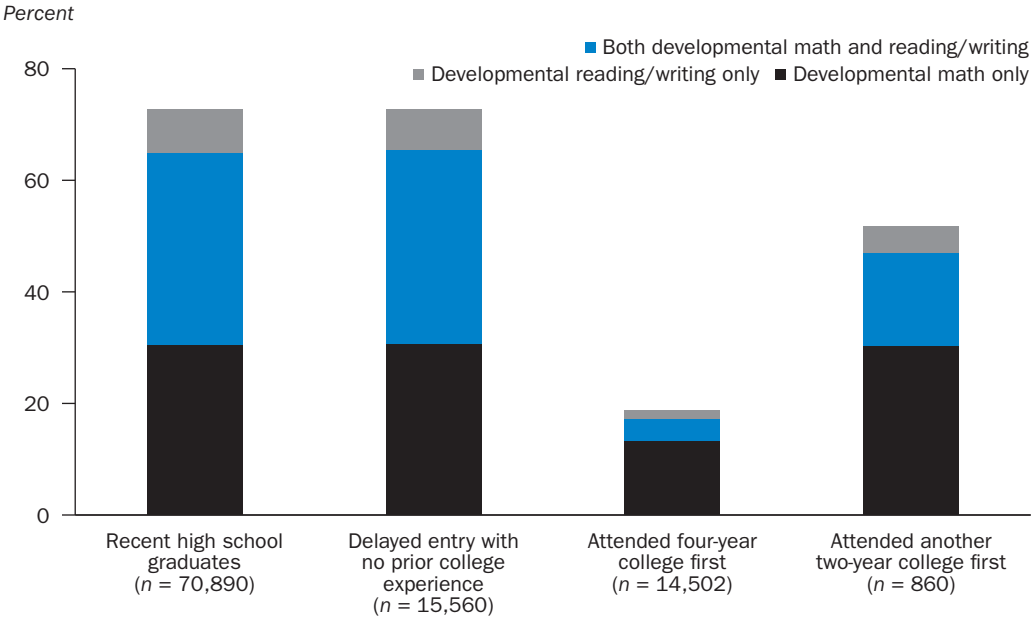
Nearly 75 percent of recent high school graduates who enrolled in an Oregon community college and graduates who delayed entry with no prior college experience took at least one developmental education course; a much smaller share of graduates who attended a four-year college or another two-year college first did

Overall, 65 percent of high school graduates took a developmental education course; however, participation in developmental education varied substantially across the four groups of high school graduates. The proportion of students who took a developmental education course was higher among recent high school graduates (73 percent) and graduates who delayed entry with no prior college experience (73 percent) than among graduates who attended a four-year college (52 percent) or another two-year college first (19 percent; figure 1). The rates of participation in developmental education may have been lower for the latter two groups because they were more likely to graduate from high school and enter a four-year or another two-year college academically prepared or because they improved their academic skills at their first college and thus were more likely to start in college-level coursework at community college.

The proportion of students who took a developmental education course was higher among recent high school graduates and graduates who delayed entry with no prior college experience than among graduates who attended a four-year college or another two-year college first

Among all groups, participation was more prevalent in developmental math than in developmental reading or writing, and the most common developmental course overall was Introduction to Algebra I. Participation in developmental math was highest among graduates who

Figure 1. Nearly 75 percent of recent high school graduates and graduates who delayed entry with no prior college experience who enrolled in an Oregon community college took at least one developmental education course



Note: Sample includes Oregon public high school graduates from 2004/05 to 2010/11 who enrolled in an Oregon community college from 2005/06 to 2011/12.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

delayed entry with no prior college experience (66 percent took developmental math), with only a small difference for recent high school graduates (64 percent took developmental math).

Recent high school graduates who started at a lower level of developmental education were less likely than their counterparts who started at a higher level to stay in college and earn a degree

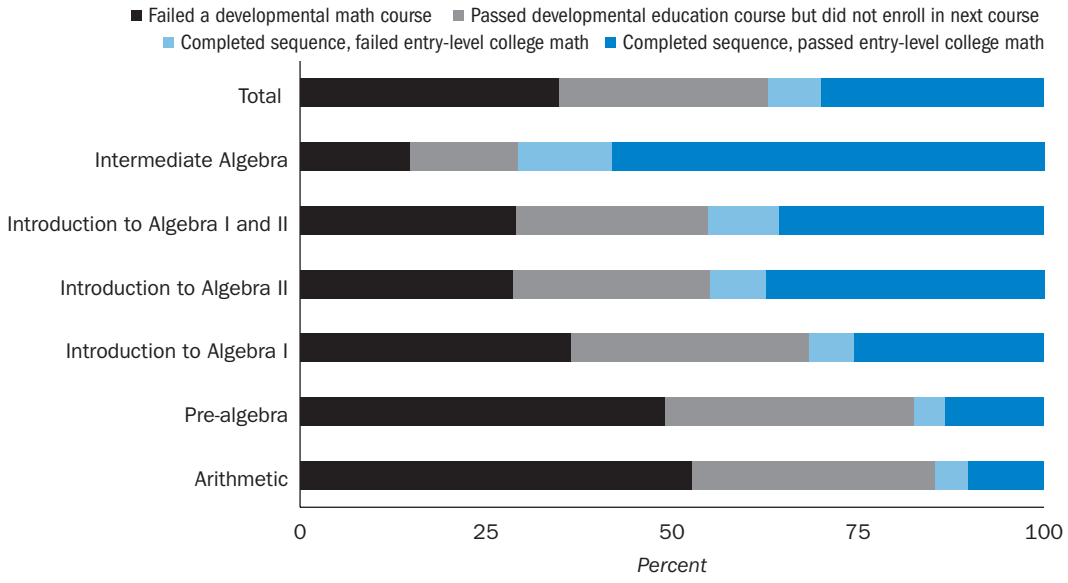
The lower that recent high school graduates started in the developmental education sequence, the lower their education outcomes. Over five to seven years, 30 percent of all recent high school graduates who took a course in the most common developmental math sequence persisted and eventually passed an entry-level college math course (figure 2).[3] Of students who started at the highest level of the sequence (Intermediate Algebra), 58 percent passed entry-level college math, compared with 10 percent who started at the lowest level (Arithmetic). Outcomes in developmental writing students were better: 54 percent of all recent high school graduates who took a course in developmental writing persisted and eventually passed an entry-level college English composition course (figure 3). Of students who started at the highest level of the sequence (Introduction to College Writing), 62 percent passed entry-level college English composition, compared with 38 percent who started at the lowest level (Grammar).

Over five to seven years, 30 percent of all recent high school graduates who took a course in the most common developmental math sequence persisted and eventually passed an entry-level college math course

The results for developmental reading follow a pattern similar to the results for developmental math and writing (see figures C1 and C2 in appendix C).

Students did not complete an entry-level college course in math or English for a variety of reasons. The most common was receiving a failing grade (D or lower) in a developmental

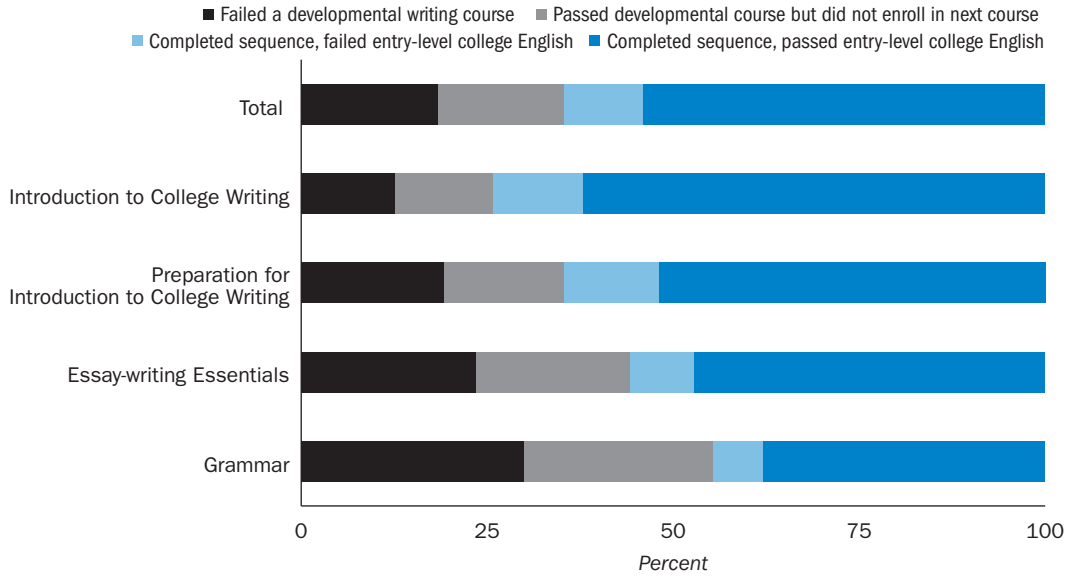
Figure 2. Nearly 60 percent of students who started at the highest level of the developmental math sequence passed entry-level college math, compared with 10 percent who started at the lowest level



Note: Sample includes Oregon public high school graduates from 2004/05 to 2006/07 who immediately enrolled in an Oregon community college from 2005/06 to 2007/08.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Figure 3. Over 60 percent of students who started at the highest level of the developmental writing sequence passed entry-level college English, compared with nearly 40 percent who started at the lowest level



Note: Sample includes Oregon public high school graduates from 2004/05 to 2006/07 who immediately enrolled in an Oregon community college from 2005/06 to 2007/08.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

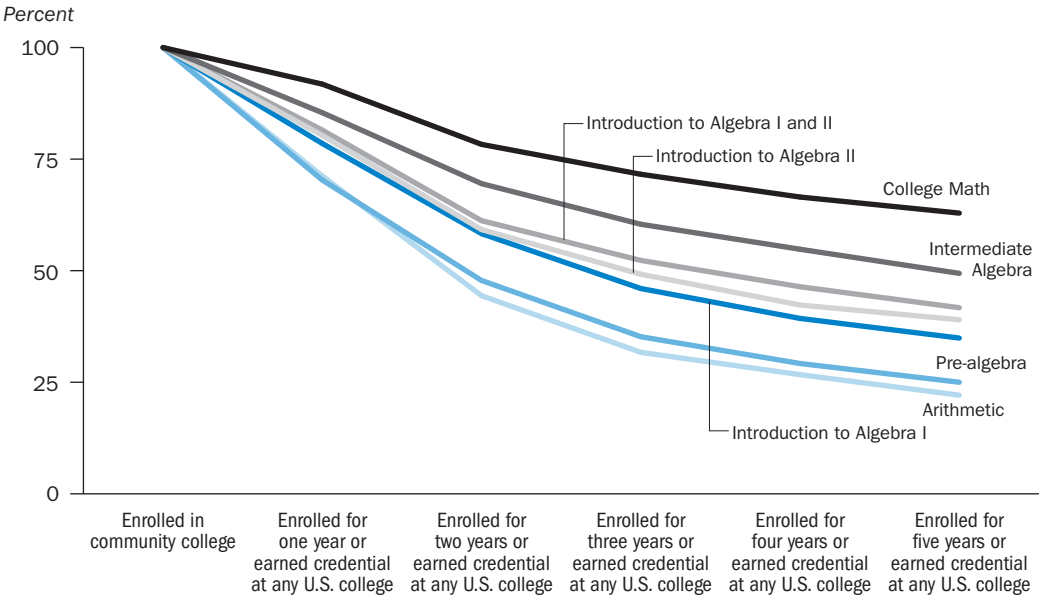
Over five to seven years, 54 percent of all recent high school graduates who took a course in developmental writing persisted and eventually passed an entry-level college English composition course

course and not repeating the course, followed by passing every developmental course but not enrolling in the next course in the sequence. A small proportion of students completed the developmental course sequence but failed the entry-level college course.

Persistence and degree attainment outcomes for recent high school graduates follow the same pattern. After five years 63 percent of students who started in a college-level math course were still in college or had earned a credential (a certificate or a two- or four-year degree), while persistence and degree attainment ranged from 22 percent for those who started in arithmetic to 49 percent for those who started in Intermediate Algebra (figure 4). And after five years 49 percent of students who started in a college-level English writing course were still in college or had earned a credential, while persistence and degree attainment ranged from 27 percent for those who started in grammar to 36 percent for those who started in Introduction to College Writing (figure 5).

Across all course-starting levels, a small percentage of students (2–5 percent) earned certificates (table 1). However, the percentage of students who earned a two-year degree, transferred to a four-year college, and earned a four-year degree decreases substantially the lower students started in the developmental education sequence. More than half of students who started in college-level math earned any type of credential (sometimes from a postsecondary institution outside Oregon), compared with 15 percent of students who started in arithmetic. And about 40 percent of students who started in college-level English earned any type of credential from a postsecondary institution, compared with 18 percent of students who started in grammar.

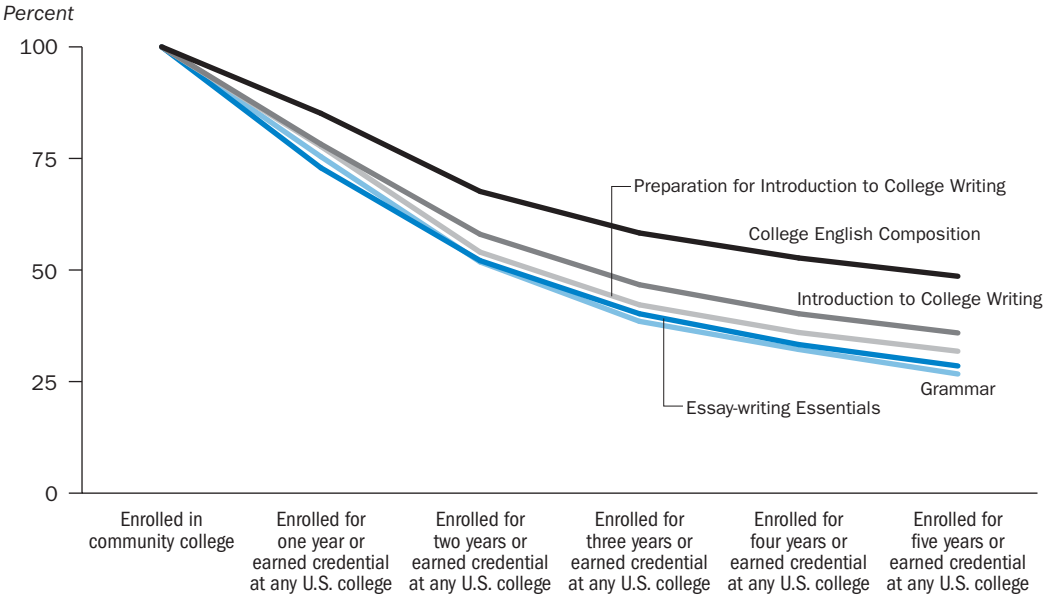
Figure 4. Nearly two-thirds of students who started in college-level math persisted in postsecondary education or earned a credential, compared with 22 percent of students who started at the lowest level of the developmental math sequence



Note: Sample includes Oregon public high school graduates from 2004/05 to 2006/07 who immediately enrolled in an Oregon community college from 2005/06 to 2007/08.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Figure 5. Nearly half of students who started in college-level English persisted in postsecondary education or earned a credential, compared with 27 percent of students who started at the lowest level of the developmental writing sequence



Note: Sample includes Oregon public high school graduates from 2004/05 to 2006/07 who immediately entered Oregon community college from 2005/06 to 2007/08.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Table 1. Degree and transfer outcomes over a five to seven year period, by course starting level (percent)

Course	Earned a certificate	Earned a two year degree	Transferred to a four year college	Earned a four year degree	Any credential[a]
Full sample (*n* = 27,526)	3.2	16.4	37.0	21.1	30.3
Math					
College math	2.4	29.2	65.5	43.8	53.8
Intermediate algebra	3.4	25.1	48.6	27.6	39.7
Intro algebra I & II	3.0	20.8	34.4	18.1	30.4
Intro algebra II	4.4	21.8	36.9	19.1	32.8
Intro algebra I	3.2	16.8	29.7	13.9	25.6
Pre-algebra	3.6	10.2	21.0	8.6	17.4
Arithmetic	3.9	9.5	16.1	6.2	15.0
Writing					
College English composition	2.8	22.3	49.6	29.2	39.8
Intro to college writing	3.5	17.7	30.9	15.2	27.4
Preparation for intro to college writing	4.2	15.1	26.1	11.9	23.7
Essay writing essentials	3.4	11.7	22.7	10.3	19.4
Grammar	3.0	12.1	20.0	8.6	17.6
Reading					
College reading	3.6	17.1	32.4	16.2	26.7
Intro to college reading	4.0	13.3	22.7	10.7	21.4
Preparation for intro to college reading	5.1	11.1	16.4	7.6	17.9

a. Includes a certificate (less than a two-year degree), a two-year degree (that is, Associate of Arts, Associate of Science, Associate of Applied Science, and Associate of General Studies), and a four-year degree from any college in the United States.

Note: Sample includes Oregon public high school graduates from 2004/05 to 2006/07 who immediately entered Oregon community college from 2005/06 to 2007/08.

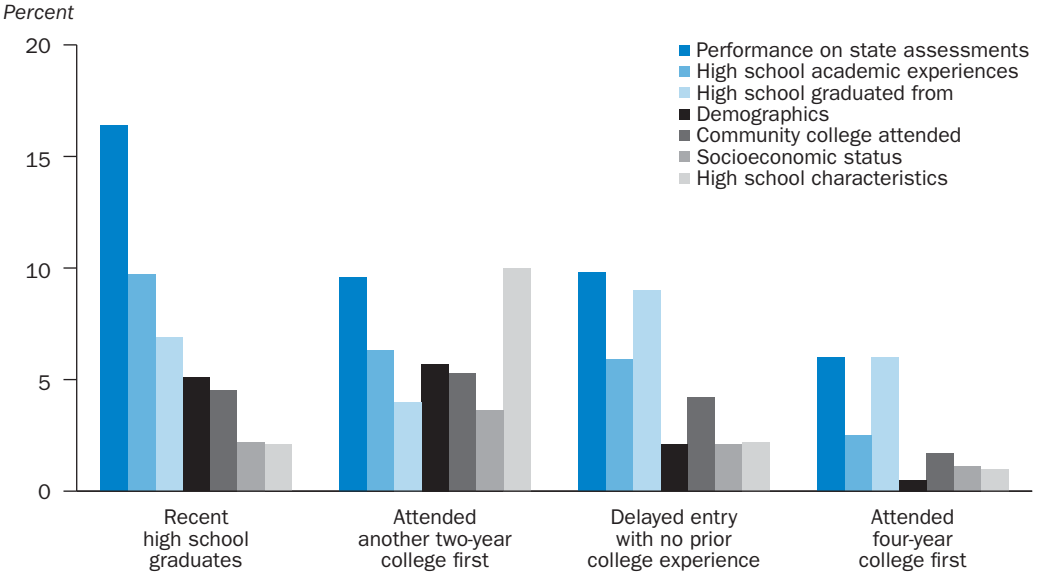
Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse (students who transferred to a four-year college and students who earned a four-year degree), and the Oregon Department of Community Colleges and Workforce Development (students who earned a certificate and students who earned a two-year degree).

Particularly for recent high school graduates, individual academic achievement in high school influences participation in developmental education more than sociodemographic characteristics and school-level factors do

Oregon Assessment of Knowledge and Skills performance explained 16 percent of the differences in rates of participation in developmental education among recent high school graduates, and high school academic experiences explained 10 percent

This study sought to identify the factors that were most important in influencing, or predicting, participation in developmental education among different groups of students. Particularly for recent high school graduates, the most important factor was individual academic achievement, represented by math, reading, and science proficiency levels on the Oregon Assessment of Knowledge and Skills (OAKS), followed by individual high school academic experiences. OAKS performance explained 16 percent of the differences in rates of participation in developmental education among recent high school graduates, and high school academic experiences explained 10 percent (figure 6). OAKS performance was less predictive of participation in developmental education among students who attended a four-year college or another two-year college first or who delayed entry with no prior college experience, explaining 6–10 percent of the differences in their rates of enrollment in development education. Perhaps, as time passed, high school state assessment scores became less representative of their current academic proficiency or overall college readiness.

Figure 6. For all groups of students, performance on state assessments was one of the most important factors influencing participation in developmental education



Notes: Sample includes Oregon public high school graduates from 2004/05 to 2010/11 who enrolled in an Oregon community college from 2005/06 to 2011/12. The figure reports *R*-squared from regression models, a measure of how well the statistical model explains the outcome—for example, 16 percent of the difference in the rate of participation in developmental education among recent high school graduates can be explained by differences in performance on the math, reading, and science state assessment, and 2 percent can be explained by differences in the characteristics of their high school.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

The high school that students graduated from explained 7 percent of the variation in rates of participation in developmental education among recent high school graduates, which is less than the variation explained by individual academic achievement and experiences

In particular, for students who attended another college first, their college coursetaking experiences may have overshadowed any influence of their state assessment performance. However, OAKS performance was still among the most important factors.

The high school that students graduated from or specific characteristics of it ("High school characteristics" in figure 6) were also important in influencing participation in developmental education, particularly for students who attended another two-year college or a four-year college first or delayed entry with no prior college experience. The high school that students graduated from explained 7 percent of the variation in rates of participation in developmental education among recent high school graduates, which is less than the variation explained by individual academic achievement and experiences. However, among students who attended a four-year college first (9 percent) or delayed entry with no prior college experience (6 percent), the high school that students graduated from explained an amount of variation in rates of participation in developmental education similar to that of OAKS performance. Among students who attended another two-year college first, the high school they graduated from explained 4 percent of the variation, but specific school-level factors ("High school characteristics" in figure 6) explained 10 percent—as much as OAKS performance did.

The school factor that had the largest influence on increasing rates of participation in developmental education among students who attended another two-year college first was the percentage of students in their high school who had an Individualized Education

Program. And the factor that had the largest influence on decreasing participation in developmental education was the percentage of students in their high school who were English learner students (see table C3 in appendix C). Overall, the finding that school-level factors are important suggests that they may persist over time and continue to influence academic preparedness.

Finally, for all groups except students who attended another two-year college first, demographic and socioeconomic status characteristics were some of the least influential factors in predicting subsequent participation in developmental education at community college. Together, demographic and socioeconomic status characteristics explained 10 percent of differences in rates of participation in developmental education among students who attended another two-year college first, 7 percent among recent high school graduates, 4 percent among students who delayed entry with no prior college experience, and 2 percent among students who attended a four-year college first.

Together, demographic and socioeconomic status characteristics explained 10 percent of differences in rates of participation in developmental education among students who attended another two-year college first, 7 percent among recent high school graduates, 4 percent among students who delayed entry with no prior college experience, and 2 percent among students who attended a four-year college first

These findings do not discount the importance of sociodemographic characteristics in predicting participation in developmental education. Indeed, even among recent high school graduates with the same education achievement characteristics, high school graduation and college entrance years, and high school graduated from and college attended, American Indian/Alaska Native and Hispanic students were more likely than White students to participate in developmental math and reading or writing (see tables C5 and C6 in appendix C). Recent female high school graduates were more likely than their male counterparts to participate in developmental math but less likely to participate in developmental reading or writing. By contrast, Asian and Black recent high school graduates were more likely than their White counterparts to participate in developmental reading or writing but less likely to participate in developmental math. Disparities in participation in developmental education based on sociodemographic characteristics are important to address. However, in general, the malleable factors of students' academic achievement, high school experiences, and school-level factors influence their developmental education enrollment more than sociodemographic characteristics do.

High school students who took dual-credit courses in certain subjects were less likely to participate in developmental education at community college

High school students who took dual-credit courses were less likely than students who did not to participate in developmental education and more likely to enroll directly in college-level math and English at community college. The most common dual-credit courses are college-level algebra and English composition. Taking dual-credit math or English courses decreased the likelihood of participating in developmental education in the same subject because the students had already earned college credits in those subjects. Recent high school graduates who took dual-credit math were 33 percentage points less likely to participate in developmental math than their counterparts who did not take dual-credit math (see table C5 in appendix C for specific results for other student groups). Students who took dual-credit English were 15 percentage points less likely to participate in developmental reading or writing than their counterparts who did not take dual-credit English (see table C6 in appendix C for results for other student groups).

Taking dual-credit courses in other subjects also decreased the likelihood of taking developmental math and English. Specifically, recent high school graduates who took a

dual-credit course in college-level English, social science, history, world languages, science, and three career and technical education areas (information, communications, and technology; health sciences; and industrial and engineering systems) were 2–8 percentage points less likely than their counterparts who did not take such a course to participate in developmental math (see table C5 in appendix C for results for other student groups). Recent high school graduates who took a dual-credit course in college-level math, social science, history, world languages, and the career and technical education area of business and management were 2–7 percentage points less likely than their counterparts who did not take such a course to participate in developmental reading and writing (see table C6 in appendix C for results for other student groups). Appendix D lists the most popular courses in each dual-credit subject area. Courses in subject areas that are associated with lower participation in developmental education enrollment may offer students an introduction to the type of rigorous coursework that they will encounter in college-level math and English.

Implications of the study

The findings presented in this report have implications for researchers, higher education practitioners, and high school practitioners.

Implications for researchers

Overall participation rates may mask key differences in the rate of participation between students who enter college immediately after high school and those who have a gap between high school graduation and community college entry

The community college population is extremely diverse, but research rarely examines participation in developmental education for different groups of students, particularly students entering community college directly from high school. As a result, overall participation rates may mask key differences in the rate of participation between students who enter college immediately after high school and those who have a gap between high school graduation and community college entry. In Oregon about 75 percent of graduates bound for community college in the academic year following high school were considered academically underprepared and required to enroll in college-level math or English. This rate is higher than that for students who delayed entry and attended another two-year or four-year college first but is the same as the rate for students who delayed entry with no prior college experience. Further research should consider disaggregating results for the community college population and examining how results may differ between students who begin their postsecondary career at community college and students who have a gap between high school exit and community college entry.

Implications for higher education practitioners

Course progression findings in this study follow a pattern similar to those in other studies (for example, Bailey et al., 2010), which have provided the impetus for redesigning developmental education across the country. One reform implemented by many community colleges is acceleration (Edgecombe et al., 2013). Acceleration models can vary: some allow students who place into developmental education to enroll directly in college-level coursework and take a developmental/support course concurrently, while others shorten the developmental education sequence by combining two or more sequential courses into a single-term course or by aligning curriculum to college-level math or English content and discarding competencies that are unnecessary for success in college coursework.

For higher education practitioners interested in acceleration, the math findings provide an approximate idea of how outcomes can improve in shorter or accelerated developmental education sequences. Students who started in Intro Algebra I & II, which combines two separate Intro Algebra courses into a single-term course, have outcomes that are similar to those of students in the second term of the Intro Algebra sequence and that are much higher than those of students in the first term of the Intro Algebra sequence (see figures 4 and 6). Differences in outcomes could be due to differences in students (for example, differences in motivation or ability) who took the single-term course versus two terms of Intro Algebra. They could also be due to eliminating opportunities for attrition from the sequence: Shorter sequences provide fewer opportunities for students to fail a course or choose not to enroll in the next course and have been found to increase the likelihood of enrolling in and passing entry-level college courses (Hodara & Jaggars, 2014).

Implications for high school practitioners

Helping students enroll in and succeed in dual-credit courses may present a promising strategy for expanding opportunities for students to engage with challenging, college-level material in high school and for secondary and postsecondary institutions to work together to align expectations

This study emphasizes a foundational, actionable direction for reducing rates of participation in developmental education—targeting academic underpreparedness at the high school level, well before students graduate and enter college. Furthermore, this study finds that other academic experiences—particularly taking a dual-credit course in academic subjects—are associated with lower participation in developmental education. In addition to college algebra and English composition, some of the most popular dual-credit courses associated with a lower likelihood of participating in developmental math and reading or writing include U.S. history, Spanish, and introduction to economics. Helping students enroll in and succeed in these dual-credit courses may present a promising strategy for expanding opportunities for students to engage with challenging, college-level material in high school and for secondary and postsecondary institutions to work together to align expectations. The combination of collaborative efforts between secondary and postsecondary institutions to improve college readiness through dual-credit and other partnerships and developmental education reforms at community colleges in Oregon and across the country has the potential to further improve the transition from high school to college.

Limitations of this study

This study is limited in the following ways. First, Oregon Department of Community Colleges and Workforce Development data do not include college placement exam scores, so the study team cannot estimate who was referred to developmental education because placement score data are unavailable. Based on course transcript score data, the study team knows only who participated in developmental education. The number of students referred to developmental education is higher than the number of students who participate in those courses because students can avoid their developmental requirements while they take college-level courses that do not have math and English prerequisites. These students are not in the developmental education sample, and thus the sample may be a conservative estimate of the number of incoming students considered academically underprepared for college coursework.

A second limitation concerns the research design and the types of recommendations that can be made based on the findings. This study is purely descriptive and reports primarily rates. Only the examination of the predictors of participation in developmental education used statistical models. The models included a rich set of variables, such as indicators of

college and high school of attendance. But the estimates do not reveal anything about the impact or effect of specific factors, characteristics, and experiences on participation in developmental education. They provide insight only into the relationship between student and institutional characteristics and participation in developmental education.

Finally, this study lacks a key set of variables that would have strengthened understanding of this student population: high school course transcript data. Data on the courses students took in high school or their high school grade point average—important variables that not only capture students' academic achievement but are also signals of "motivation and perseverance"—are unavailable (Bowen, Chingos, & McPherson, 2009, p. 124). High school grade point average is an especially strong predictor of college readiness and success. Estimates of the predicted probability of participating in developmental education may be misleading because high school coursetaking and grade point average cannot be accounted for. In addition, differences in high school coursetaking and grade point average may help explain why and how sociodemographic characteristics predict participation in developmental education. Despite these limitations, however, every effort has been made to provide comprehensive data on participation in developmental education and postsecondary outcomes of Oregon high school graduates at Oregon community colleges.

Appendix A. About the data

This appendix describes the data sources, how the data were linked across the sources, how the data were cleaned, limits of the data, and characteristics of the data sample.

Data sources

This study uses data on students who graduated from an Oregon high school between 2004/05 and 2010/11 and enrolled at one of the 17 Oregon community colleges between 2005/06 and 2011/12. The data are from three sources:

- The Oregon Department of Education (ODE), which provided student-level data from 2004/05 to 2011/12. The full ODE data set includes 425,417 students and was used to create high school average characteristics. The analytic sample does not include ODE students with a dropout status (N = 40,796); students who exited in 2004/05–2010/11 but had a missing withdrawal code, perhaps because they moved out of state (N = 95,696); and students who were still enrolled in high school (N = 43,931). ODE data include school enrollment and attendance data, graduation/dropout/withdrawal status, demographic data (such as age, gender, race/ethnicity, eligibility for free or reduced-price lunch, special education status, and English learner student status), and students' Oregon Assessment of Knowledge and Skills (OAKS) scores.

  OAKS is the state assessment administered in grades 3–8 and grade 10.[4] It includes tests in math, reading, writing, science, and social science. The test content is aligned with grade-level state academic content standards in these subject areas, and performance standards identify the score requirements to meet or exceed grade-level standards in each subject. Additionally, test scores are reported for specific objectives so that teachers, parents, and students can identify specific curriculum objectives that students need to improve. All tests are standardized assessments, except for the writing test, which comprises a written essay scored by two different raters.
- The National Student Clearinghouse (NSC), which provided information on the type of college that students enrolled in (public or private, two year or four year, and in state or out of state), semesters in which they were enrolled, degree completion date, and degree type for fall 2005 to spring 2013. The NSC verifies student enrollment for 96 percent of domestic colleges and universities (National Student Clearinghouse, 2014), which allowed the study team to track student persistence and degree completion in postsecondary institutions nationally. Some students in the sample may have attended an institution not included in the NSC. See http://www.studentclearinghouse.org/colleges/enrollment_reporting/participating_schools.php for a list of schools that participate in the NSC.
- The Oregon Department of Community Colleges and Workforce Development (CCWD), which provided data on students who attended an Oregon community college between 2005/06 and 2010/11. The data include demographic characteristics; last high school attended and high school completion date; last college attended and degree earned; term-by-term courses taken, grades in those courses, and credits attempted and earned; financial aid information; degree completion date; and type of degree or program. This statewide dataset does not include placement test scores, so it could not be determined who was referred to developmental education; the study team only observes participation in developmental education from the course transcript data.

The Regional Educational Laboratory (REL) Northwest signed a data-sharing agreement with the ODE and the CCWD; the ODE also provided the NSC data that are linked to the ODE student-level data.

Data linking

The study team used student gender, first and last name, and birth date to match ODE records on public high school students to CCWD records on community college students. The study sample was then constructed as described below.

First, the sample includes only high school students with a graduation status: 66 percent of students (*N* = 244,994) who exited in 2004/05–2010/11 have a high school graduation status.

Second, the sample includes only graduates who attended an Oregon community college after their high school graduation year. (Oregon public high school students show up in the Oregon community college data for two reasons: because they've taken dual-credit courses articulated with the community colleges while in high school and because they have attended an Oregon community college after graduation.) Some 42 percent of students (*N* = 101,812) who graduated from an Oregon public high school from 2004/05 to 2010/11 enrolled in an Oregon community college after high school from 2005/06 to 2011/12.

Data cleaning

This section identifies issues that emerged while preparing data for use in this study and how the study team resolved them.

Conflicting demographic information between ODE and CCWD. The study team considered data reported to ODE for accountability purposes to be the most accurate because ODE is held accountable under the No Child Left Behind Act of 2001 to report accurate student achievement scores on the OAKS tests to the federal government.

Different values for time-invariant variables. If a time-invariant variable such as race/ethnicity varied for the same student in the ODE dataset, the student was assigned the modal race/ethnicity across all observations of that student in the combined ODE and CCWD longitudinal datasets. If there was no modal value, the student was categorized as more than one race/ethnicity.

Multiple OAKS scores in the same school year. If a student had more than one test score in the same subject in the same school year, the first score was used. A possible reason for multiple scores for the same test in the same year is that some students may have been allowed to retake the test. Students' first score was used because it allows for a fairer comparison to the scores of other students who took the test only once. If multiple tests in the same subject and same test date were reported, the scores were averaged.

Missing OAKS scores. About 85 percent of students who graduated in 2004/05 and 63 percent of those who graduated in 2005/06 had missing OAKS scores because they took OAKS prior to 2004. As a result, these cohorts were excluded from the regression analyses, and the descriptive tables report OAKS scores for the 2006/07–2010/11 graduating cohorts.

Approximately 5 percent of students in the 2006/07–2010/11 cohorts had missing OAKS scores. The study team created dichotomous indicators to identify students with missing OAKS scores, which are included in the regression equations. Missing scores were not imputed.

Missing high school withdrawal code. Withdrawal codes are sometimes missing when students withdraw at the end of a school year and are not recorded as enrolled the following school year. Since the study team worked with a statewide database, they were able to confirm whether a student transferred to another school within the state. Some 95,696 students were missing withdrawal codes, did not have a high school diploma, and did not re-enroll at another high school in the state. These students, who could have finished high school in another state or dropped out, are excluded from the study sample.

Missing data. Other than OAKS scores, minimal data were missing because two data sources were used. Longitudinal data were used to fill in missing values for two variables: school-level average OAKS scores, since approximately 5 percent of students in the 2006/07–2010/11 cohorts had missing OAKS scores, and high school location, since 163 students had a missing National Center for Education Statistics location code for their high school. For these variables the grand mean of the sample was imputed, and an indicator that identifies cases in which values have been imputed was created. That indicator was included in two regression models to observe whether students who had missing values had different outcomes from those who did not have missing values. Imputed data are included in only two regression models that include school average characteristics (models 5 and 6).

Multiple community college records for one student. Individual students in the ODE data had up to five unique records in the CCWD data because they attended more than one college or had noncontinuous enrollment periods. All multiple records were resolved by combining information across the unique records for each student. Across all records, the study team identified students' first and last terms and all community colleges attended, degrees earned, courses taken, credits attempted and earned, and grades earned.

Data limitations

Though the study population reflects different types of graduates who attended community college, it represents only a small proportion of the overall community college population. In particular, the study population does not include older students who are entering community college after a gap of more than five years in their education, students who do not have a high school diploma who attend community college, or students who attend community college but did not attend an Oregon public high school. Table A1 compares characteristics of the study population and the state's community college population.

Sample characteristics

Community college students. Community colleges are open-door institutions that are often more convenient and less expensive than four-year institutions and thus are credited with improving higher education access, especially among low-income students, racial/ethnic minority students, and first generation college students (Cohen & Brawer, 2003). Characteristics of all Oregon high school graduates confirm that Oregon community

Table A1. Differences between the study population and the state's community college population

Study population	Community college population
• Approximately 30 percent of Oregon public high school graduates entered an Oregon community college in the academic year following high school graduation.	• Approximately 9 percent of community college students include Oregon public high school graduates who entered an Oregon community college in the academic year following high school graduation.
• Nearly 100 percent of the study population were younger than 25 when they entered an Oregon community college	• About 33 percent of community college students are younger than 25 when they enter an Oregon community college

Source: Data on study population are from author's analysis from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development; data on community college population are from the community college profile by the Oregon Department of Community Colleges and Workforce Development (2011).

colleges seem to educate a higher proportion of high school graduates from historically disadvantaged groups than four-year colleges do (table A2). For example, compared with Oregon high school graduates who attended any four-year college in the United States, a lower percentage of graduates who ever attended an Oregon community college are White (78 percent compared with 82 percent) and a higher percentage were eligible for free or reduced-price lunch (37 percent compared with 22 percent). Academic characteristics also vary. For example, compared with four-year college students, fewer community college students exceeded OAKS proficiency levels in math (12 percent compared with 36 percent) and reading (13 percent compared with 36 percent).

Differences among four groups of community college students. Students who attended a four-year college first were more academically and economically advantaged than the other three groups of students. For example, higher proportions met or exceeded OAKS proficiency levels in reading and math, and lower proportions were eligible for free or reduced-price lunch and Pell grants (table A3).

Recent high school graduates seem more academically prepared in high school than students who attended another two-year college first or delayed entry with no prior college experience. For example, higher proportions of recent high school graduates participated in dual credit and met or exceeded OAKS proficiency levels than students who attended another two-year college first or delayed entry with no prior college experience. But recent high school graduates also had the highest number of absences in high school. There are also some key demographic differences among the groups. For example, recent high school graduates were much more likely to be female and slightly more likely to be an English learner student than students who attended another two-year college first or delayed entry with no prior college experience. Students who attended another two-year college first were more likely than all other student groups to be male and Black, and students who delayed entry with no prior college experience had the highest rates of eligibility for free or reduced-price lunch and Pell grants.

Another key difference is student mobility, which the NSC defines as attending multiple institutions concurrently or transferring from one institution to another (National Student Clearinghouse Research Center, 2014). Nationally, 9 percent of students who started college in 2012/13 attended more than one institution. Student mobility almost always

Table A2. Characteristics of full sample of Oregon public high school students who graduated from 2004/05 to 2010/11 (percent, unless otherwise noted)

Characteristic	Ever attended Oregon community college (*N* = 101,812)	First college attended for graduates who never attended Oregon community college		
		Four year college (*N* = 59,174)	Private or out of state two year college (*N* = 18,937)	No college attendance in data (*N* = 65,071)
Gender				
Male	47	45	50	55
Female	53	55	50	44
Race/ethnicity				
American Indian/Alaska Native	2	1	2	2
Asian	5	7	4	3
Black	3	2	4	2
Hispanic	10	5	14	18
White	78	82	73	70
More than one race/ethnicity or other	3	2	3	3
High school academics				
Had an Individualized Education Program	10	4	18	21
English learner student status	7	3	10	14
Absences (average number of days)	21	17	22	28
Repeated a grade	4	<1	8	12
Took dual-credit course	25	32	10	12
OAKS math level[a]				
No rating	4	3	9	10
Low or very low	19	4	30	34
Nearly meets	19	8	20	19
Meets	46	48	34	30
Exceeds	12	37	6	7
OAKS reading level[a]				
No rating	5	3	10	11
Low or very low	12	3	21	24
Nearly meets	17	6	19	19
Meets	53	52	42	38
Exceeds	13	36	7	7
Socioeconomic status indicators				
Eligible for free or reduced-price lunch	37	22	51	55
Received federal Pell at community college	35	na	na	na
College entry after high school				
Enrolled in the fall or spring after high school graduation	70	93	66	0
Delayed enrollment one or more years	30	7	34	0

na is not applicable

OAKS is Oregon Assessment of Knowledge and Skills.

a. Performance levels are for 2006/07–2010/11 graduates only because 2005 and 2006 graduates have a large number of missing OAKS scores.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Table A3. Characteristics of Oregon public high school students who graduated from 2004/05 to 2010/11 and attended an Oregon community college (percent, unless otherwise noted)

Characteristic	Recent high school graduates (*N* = 70,890)	Attended four year college first (*N* = 14,502)	Attended another two year college first (*N* = 860)	Delayed entry with no prior college experience (*N* = 15,560)
First college type				
Oregon community college	100	0	0	100
Public four-year in-state	0	71	0	0
Public four -year out-of-state	0	7	0	0
Private four -year in-state	0	12	0	0
Private four -year out-of-state	0	10	0	0
Public two-year out-of-state	0	0	93	0
Private two -year in-state	0	0	5	0
Private two -year out-of-state	0	0	2	0
Gender				
Male	47	43	54	52
Female	53	57	46	48
Race/ethnicity				
American Indian/Alaska Native	2	1	3	3
Asian	5	8	5	3
Black	3	2	9	3
Hispanic	11	5	8	12
White	77	81	73	75
More than one race/ethnicity or other	3	2	2	3
High school academics				
Had an Individualized Education Plan	11	3	8	13
English learner student status	9	3	4	7
Absences (average number of days)	23	12	16	19
Repeated a grade	4	<1	2	7
Took dual-credit course	28	26	17	13
OAKS math level[a]				
No rating	4	3	6	7
Low or very low	17	5	20	26
Nearly meets	20	12	23	22
Meets	46	55	43	37
Exceeds	11	26	9	7
OAKS reading level[a]				
No rating	4	2	6	8
Low or very low	12	3	15	17
Nearly meets	17	9	22	21
Meets	54	60	47	45
Exceeds	12	25	10	9
Socioeconomic status indicators				
Eligible for free or reduced-price lunch	39	18	35	45
Received federal Pell grant	38	14	35	44

(continued)

Table A3. Characteristics of Oregon public high school students who graduated from 2004/05 to 2010/11 and attended an Oregon community college (percent, unless otherwise noted) *(continued)*

Characteristic	Recent high school graduates (*N* = 70,890)	Attended four year college first (*N* = 14,502)	Attended another two year college first (*N* = 860)	Delayed entry with no prior college experience (*N* = 15,560)
Enrollment characteristics				
Age at community college entry	19	21	21	21
Attended one community college	86	83	87	88
Attended more than one community college	14	17	13	12
Full-time only	12	8	17	15
Part-time only	23	53	39	43
Mix of full-time and part-time	64	39	44	42
Course enrollment				
Took college courses only	27	81	48	27
Took developmental education	73	19	52	73
Developmental math only	30	13	30	31
Developmental reading or writing only	8	2	5	7
Developmental math and reading or writing	34	4	17	33

OAKS is Oregon Assessment of Knowledge and Skills.

a. Performance levels are for 2006/07–2010/11 graduates only because 2005 and 2006 graduates have a large number of missing OAKS scores.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

involves attending a two-year public college at some point. Nationally, nearly 40 percent of mobile students who started college in 2012/13 attended both a two-year and a four-year public college, 20 percent attended more than one two-year public college, 13 percent attended both a two-year public and a four-year private college, and the remaining students attended a different combination of sectors.

The four groups of community college students in this study were mobile in different ways. For example, graduates who attended a four-year college first were mobile in two primary ways: reverse transfer, in which graduates started at a four-year college and then transferred to an Oregon community college (this was most common), and reverse transfer combined with concurrent enrollment in both an in-state public four-year and a two-year college. In other words, some graduates started at an Oregon public four-year college and then concurrently enrolled in a four-year college and an Oregon community college. Graduates who attended another two-year college generally had one type of postsecondary mobility; this group is composed mainly of Oregon graduates who attended an out-of-state public two-year college and then returned to Oregon and attended an Oregon community college. Recent high school graduates and graduates who delayed entry with no prior college experience had one main type of postsecondary mobility: some students transferred from an Oregon community college to a four-year college. This postsecondary outcome is discussed in more detail in the "What the study found" section. Finally, across all four groups, 12–17 percent of students attended more than one Oregon community college, sometimes concurrently.

Appendix B. Methodology

This appendix explains the methodology used to answer each of the three research questions. It also includes tables that list all developmental education courses, defines the sample for question 2, and describes the variables used in the regression models.

Methodology for research question 1

Participation rates are based on the number of students who took any developmental education course at community college after high school graduation. Developmental math, reading, and writing courses in the community college course transcript data were identified based on course names, course department names, and course numbers. Courses below the 100 level that signify registering for a writing or reading center (such as WR 59 and RD 59), tutoring session, or lab attached to a course were not included, but adult basic education courses and other basic skills courses that are considered below the lowest levels of the developmental math, reading, and writing course sequences were. A very small proportion of students (around 1 percent) participated in only these types of courses.

Out of the full sample of 101,812 students, 65 percent took at least one developmental education course after high school graduation. About 1 percent of students in the sample took a developmental education course while in high school; any participation during high school was excluded from the participation rates reported in this study. Table B1 lists the course number and names of developmental math, reading, and writing courses. It reports the most common courses first: 62 percent of students participated in a common set of courses, and the remaining 3 percent took a variety of other developmental education courses.

Methodology for research question 2

The sample for this question includes only students who graduated from 2004/05 to 2006/07 and enrolled directly in college from 2005/06 to 2007/08, in order to track their postsecondary outcomes for five years (for the 2007/08 entrants), six years (for the 2006/07 entrants), or seven years (for the 2005/06 entrants). This sample selection provided a long enough timeframe to track outcomes that take a long time to achieve, such as transfer to a four-year college and completion of a four-year degree. The study team examined progression through the developmental sequences, college persistence, and degree attainment by students' course starting level in the most common course sequences and analyzed course transcript data to identify the math, reading, and writing course students took first (their course starting level). Tables B2–B4 show the courses and the number and proportion of students from the 2004/05–2006/07 graduating cohorts who directly enrolled in college in the fall or spring after graduating from high school and took those courses.

To examine progression through the developmental math, reading, and writing sequences, the study team tracked student enrollment and course performance in each course level of a sequence. Course performance is measured by passing the course, or earning a "C" or higher. For students starting in each course level, the study team used categories from Jaggars and Hodara (2011), a Community College Research Center study on developmental

Table B1. Developmental education courses

Subject	Course number	Course name
62 percent of students enrolled in at least one of these developmental education courses:		
Developmental math	MTH 95	Intermediate algebra
	MTH 70	Intro algebra I and II
	MTH 65	Intro algebra II
	MTH 60	Intro algebra I
	MTH 20	Pre-algebra
	MTH 10	Arithmetic
Developmental writing	WR 115	Intro to college writing
	WR 95	Preparation for intro to college writing
	WR 90	Essay writing essentials
	WR 80	Grammar
Developmental reading	RD 90	Intro to college reading
	RD 80	Preparation for intro to college reading
Another 3 percent of students enrolled in a variety of other developmental education courses:		
Developmental math	MTH 97	Geometry
	MTH 94	Intermediate algebra II
	MTH 93	Intermediate algebra I
	MTH 85	Technical math II
	MTH 80	Technical math I
	MTH 75	Applied geometry
	MTH 63	Intro algebra II
	MTH 61	Intro algebra I
	MTH 50	Technical math
	MTH 45	Technical math
	MTH 35	Technical math
	MTH 33	Technical math
	MTH 31	Health care math
	MTH 30	Applied math
	MTH 25	Applied math
	SK 8	Introduction to math
	ABE math	Adult basic education (various course numbers)
Developmental writing	LGS 80	Introductory writing skills
	WR 65	Critical thinking II
	WR 60	Critical thinking I
	WR 0525	English fundamentals
	WR 40	English fundamentals
	WR 30	Fundamentals of composition II
	WR 20	Fundamentals of composition I
	WR 10	Basic writing
	ABE writing	Adult basic education (various course numbers)
Developmental reading	RD 89	Reading for ELL students
	RD 80	Fundamentals of reading
	RD 075X	Reading skills
	RD 30	Reading skills
	RD 20	Reading skills
	ABE reading	Adult basic education (various course numbers)

Source: Author's analysis of community college course catalogs and course transcript data.

Table B2. Math course starting level for recent high school graduates who started college in 2005/06, 2006/07, or 2007/08

Math course starting level	Course number	Students who started at this level	
		Number	Percent
College math	MTH 105+	4,297	15.6
Intermediate algebra	MTH 95	3,011	10.9
Intro algebra I & II	MTH 70	1,780	6.5
Intro algebra II	MTH 65	1,999	7.3
Intro algebra I	MTH 60	6,302	22.9
Pre-algebra	MTH 20	3,882	14.1
Arithmetic	MTH 10	892	3.2
Other math	Various	356	1.3
None		5,007	18.2
Total		27,526	100.0

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Table B3. Writing course starting level for recent high school graduates who started college in 2005/06, 2006/07, or 2007/08

Writing course starting level	Course number	Students who started at this level	
		Number	Percent
College English composition	WR 121+	10,772	39.1
Intro to college writing	WR 115	4,056	14.7
Preparation for intro to college writing	WR 95	856	3.1
Essay writing essentials	WR 90	2,507	9.1
Grammar	WR 80	836	3.0
Other writing	Various	3,216	11.7
No developmental writing, developmental reading only		1,307	4.8
No writing, reading, English		3,976	14.5
Total		27,526	100.0

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Table B4. Reading course starting level for recent high school graduates who started college in 2005/06, 2006/07, or 2007/08

Reading course starting level	Course number	Students who started at this level	
		Number	Percent
College English composition	WR 121+	10,772	39.1
College reading	RD 115	1,684	6.1
Intro to college reading	RD 90	2,323	8.5
Preparation for intro to college reading	RD 80	1,326	4.8
Other reading	Various	177	0.6
No developmental reading, developmental writing only		7,268	26.4
No writing, reading, English		3,976	14.5
Total		27,526	100.0

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

education at the City University of New York community colleges. The study team estimated the proportion of students who:

- Did not complete the entry-level college math or English course because they failed a developmental education course in the sequence.
- Did not complete the entry-level college math or English course because they passed every course they took but chose not to enroll in the next course in the sequence.
- Completed the sequence and enrolled in the entry-level college course but failed the course.
- Completed the sequence and enrolled and passed the entry-level college course.

To examine persistence, the study team plotted the proportion of students who persisted in postsecondary education year-to-year over a five-year period using Oregon Department of Community Colleges and Workforce Development (CCWD) and National Student Clearinghouse (NSC) data. Students who earned a credential (certificate, two-year, or four-year degree) and left postsecondary education were counted as persisters.

To examine degree attainment and transfer, CCWD and NSC data were used to calculate the proportion of students who earned a certificate, two-year degree, transferred to a four-year college (based on NSC data only), or earned a four-year degree at a four-year college (based on NSC data only). The study team used both CCWD and NSC data to calculate the proportion of students who earned any credential (certificate, two-year degree, four-year degree) at any college in the United States.

Methodology for research question 3

The study team conducted two different regression analyses using STATA, which is a statistical software program.

The first analysis uses logistic regression to understand the precise relationship between specific variables and participation in developmental education:

$$(B1) \quad \Pr(DE)_{iyesc} = \alpha + \beta Demo_i + \beta SES_i + \beta HSacad_i + \beta OAKS_i + \beta GradYr_y + \beta EntryYr_e + \beta CC_c + \beta HS_s + \varepsilon_{iyesc}$$

The model was estimated separately for math and English. In the math model, the dichotomous dependent variable *DE* equals 1 if the student ever took a developmental math course and 0 if the student took only college math, and in the English model, *DE* equals 1 if the student ever took a developmental reading or writing course and 0 if the student took only college English. The dependent variable *DE* is a function of a set of basic demographic characteristics *Demo*; two indicators of socioeconomic status *SES*; a set of variables that represent student's high school academic experiences, *HSacad*; indicators of performance on the *OAKS*; cohort fixed effects (year of high school graduation, *GradYr*, and year of college entry, *EntryYr*); school fixed effects (high school graduated from, *HS*, and community college attended, CC); and the residual term ε_i, which captures the effect of random noise. The model is also estimated with indicators of dual-credit subject areas to assess the relationship between different dual-credit courses and participation in developmental education.

Fixed effects are represented by parameters for each high school graduation year (5 indicators for five years), college entry year (5), community college (17), and high school (1,749). These parameters are set to 0 when they do not apply to that student and 1 when they do. For example, only indicators for the year the student graduated, year the student entered college, community college the student attended, and high school the student graduated from are set to 1—all other indicators are equal to 0. Each parameter has a fixed intercept, and the overall intercept α is the average value for the excluded reference group. The cohort and school fixed effects variables control for variation in the outcome that occurs due to graduating class, college entry year, high school graduated from, and community college attended. The school fixed effects account for school quality and other institutional factors that are correlated with the percentage of developmental education courses students take. The cohort fixed effects account for changes that are connected to a particular cohort of students and are correlated with the percentage of developmental education courses students take. For example, cohort fixed effects may be able to account for changes that occurred during or after the recession that are correlated with education outcomes or for changes to state-level policies that impact education outcomes.

The coefficient estimates in the model are odds ratios. To ease the interpretation of the coefficient estimates, the study team ran a command in STATA "mfx compute" after the regression model, which translates the odds ratios into marginal effects. The marginal effect is the difference in the predicted probability of achieving the outcome associated with a given predictor. This study reports the marginal effect estimates, not the odds ratios.

The second analysis uses a series of linear regression models to understand the relative contribution of groups of independent variables. Following the methods used by Kurlaender and Larsen (2013) in their analysis of the influence of high school achievement on college coursetaking, the dependent variable is a continuous variable that represents the proportion of courses the student took that are developmental education courses. The mean is 0.168 (that is, on average, 17 percent of students' courses at community college were developmental education courses), and the standard deviation is 0.209. Each model includes a different set of independent variables:

- Demographic characteristics.
- Socioeconomic status indicators.
- High school academic experiences.
- Performance on the Oregon Assessment of Knowledge and Skills.
- Average high school characteristics of the high school the student graduated from.
- Indicator of community college attended.
- Indicator of high school graduated from.

All models have a residual term, ε_i, which captures the effect of random noise. The study team estimated the seven models separately for the four different groups of students (see table 1 in the main report) and then compared the *R*-squared across each of the seven models for all four groups. Table B5 describes the variables included in the regression models.

Table B5. Description of independent variables in regression models

Variable	Comments
Demographics	
Male* Female	From ODE and CCWD data. See notes in section on data cleaning.
American Indian/Alaska Native Asian Black Hispanic More than one race/ethnicity or other Unknown White*	From ODE and CCWD data. See notes in section on data cleaning.
Age upon college entry	Calculated using birth date from ODE and CCWD entry term.
Socioeconomic status indicators	
Eligible for free or reduced-price lunch Not eligible for free or reduced-price lunch*	From ODE data. If student is ever marked as having been eligible for free or reduced-price lunch in high school, this indicator equals 1.
Received federal Pell grant Did not receive federal Pell grant*	From CCWD data. If a student received a federal Pell grant during any term in college, this indicator equals 1.
High school academic experiences	
Total days absent in high school	From ODE data.
Ever repeated a grade in high school Did not repeat a grade in high school*	From ODE data. If a student ever repeated a high school grade, this indicator equals 1.
Had an Individualized Education Program in high school Did not have an Individualized Education Program in high school*	From ODE data. If student is ever marked as having an Individualized Education Program in high school, this indicator equals 1.
English learner student Not an English learner student*	From ODE data. If student is ever marked as having been an English learner student in high school, this indicator equals 1.
Took a dual-credit course Did not take a dual-credit course*	CCWD course transcript data flags dual-credit courses. If student took a dual-credit course while in high school, this indicator equals 1. This variable is removed when indicators of taking specific dual-credit subjects are included. See appendix D for dual-credit subject areas and examples of specific dual-credit courses in each of these subject areas.
OAKS performance	
No OAKS grade 10 math score OAKS grade 10 math score is very low or low OAKS grade 10 math score nearly meets OAKS grade 10 math score meets OAKS grade 10 math score exceeds*	In each subject, ODE designates the OAKS score that indicates the student has met the achievement standard (or proficiency level) in that subject and score ranges that indicate the student is very low or low from, nearly meets, meets, or exceeds the achievement standard. The cutoff score indicating the achievement standard and score ranges for each performance level vary each year, so it is more accurate to use performance levels to indicate proficiency levels than the actual score. For this study, the very low and low performance levels were combined.
No OAKS grade 10 reading score OAKS grade 10 reading score is very low or low OAKS grade 10 reading score nearly meets OAKS grade 10 reading score meets OAKS grade 10 reading score exceeds*	
No OAKS grade 10 science score OAKS grade 10 science score is very low or low OAKS grade 10 science score nearly meets OAKS grade 10 science score meets OAKS grade 10 science score exceeds*	

(continued)

Table B5. Description of independent variables in regression models *(continued)*

Variable	Comments
High school characteristics (of high school student graduated from)	
Percentage of students who are White	Aggregated full sample of students in ODE data (that is, full sample of 424,417 students includes graduates, nongraduates, and students still enrolled) to the school level and calculated the percentage of students who are White for each high school.
Percentage of students who are eligible for free or reduced-price lunch	Aggregated full sample of students in ODE data to the school level and calculated the percentage of students who were eligible for free or reduced-price lunch for each high school.
Percentage of students who are in special education	Aggregated full sample of students in ODE data to the school level and calculated the percentage of students in special education (that is, had an Individualized Education Program) for each high school.
Percentage of students who are English learner students	Aggregated full sample of students in ODE data to the school level and calculated the percentage of students who were English learner students for each high school.
High school is in urban area* High school is in rural area High school is in suburban area High school is in a town High school locale code is missing	Based on National Center for Education Statistics locale code in ODE data. Locations were categorized into four different categories (urban, rural, suburban, town). Urban includes large city, midsize city, and small city. Rural includes rural fringe, rural distant, rural remote, rural outside core based statistical area (CBSA) or metropolitan statistical area (MSA), and rural inside CBSA or MSA. Suburban includes urban fringe, large suburb, midsize suburb, and small suburb. Town includes large town, small town, town fringe, town distant, and town remote.
Average OAKS math	Standardized grade 10 OAKS scores with a mean of 0 and a standard deviation of 1 within test and school year. Students with missing scores received average of sample. Aggregated full sample of students in ODE data to the school level and calculated average OAKS scores for each high school.
Average OAKS reading	
Average OAKS science	
School attended	
17 indicators of community college of attendance (1 excluded as the reference group)	This is the community college each student attended. Some 14 percent attended more than one college and were assigned to the college where they took developmental education.
1,749 indicators of high school of attendance (1 excluded as the reference group)	This is the school ID for the high school each student graduated from.
Cohort	
Graduated in academic year 2006/07* Graduated in academic year 2007/08 Graduated in academic year 2008/09 Graduated in academic year 2009/10 Graduated in academic year 2010/11	Official graduation year in ODE data.
Entered in academic year 2007/08* Entered in academic year 2008/09 Entered in academic year 2009/10 Entered in academic year 2010/11 Entered in academic year 2011/12	CCWD entry year in raw data is ignored because many students dual enrolled during high school and have an entry year before they graduated. A new entry year was calculated based on first academic year after high school graduation year that student attempted credits at an Oregon community college. High school graduation year and college entry year are used to determine if the student enrolled in fall or spring after high school graduation or delayed entry one to six years.

* The reference group in the regression model.

ODE is Oregon Department of Education. CCWD is Oregon Department of Community Colleges and Workforce Development. OAKS is Oregon Assessment of Knowledge and Skills.

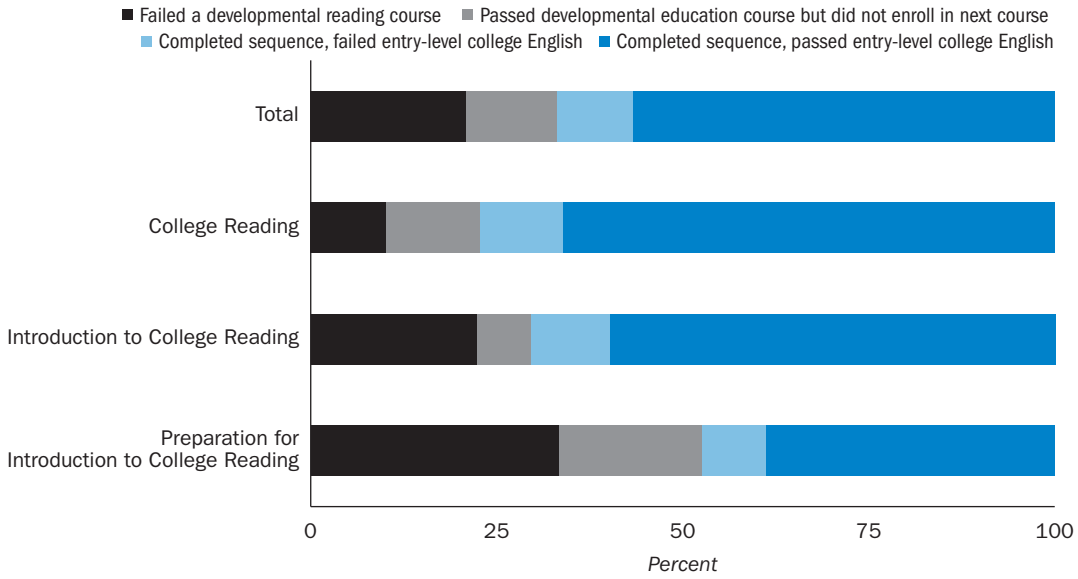
Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Appendix C. Detailed results

This appendix has two sets of detailed results: the developmental reading results for research question 2 and the regression results for research question 3.

Developmental reading results

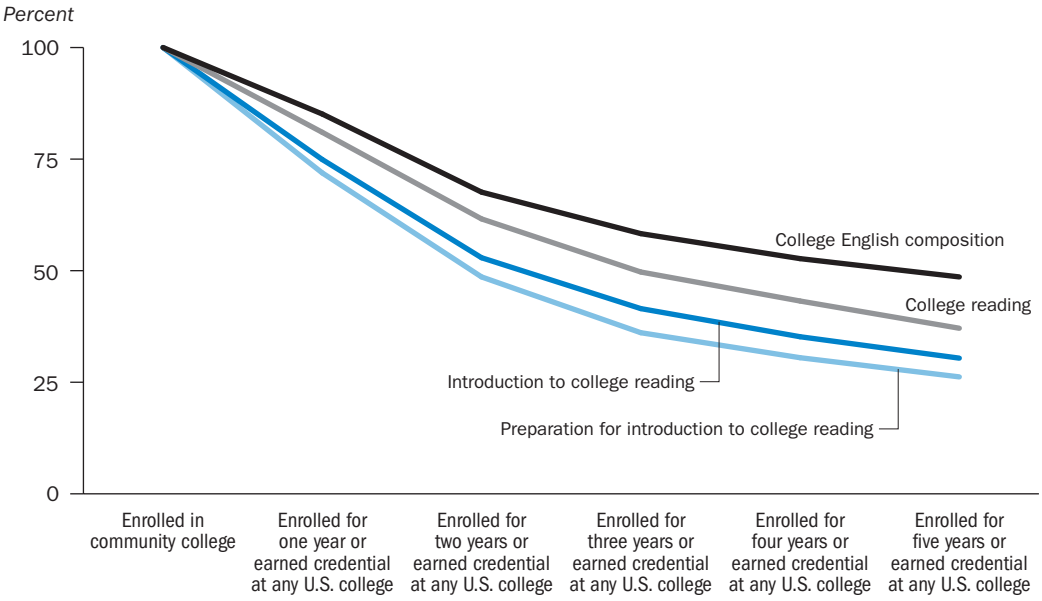
Figure C1. Two-thirds of students who started at the highest level of the developmental reading sequence passed entry-level college English, compared with nearly 40 percent who started at the lowest level



Note: Sample includes Oregon public high school graduates from 2004/05 to 2006/07 who immediately enrolled in an Oregon community college from 2005/06 to 2007/08.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Figure C2. Nearly half of students who started in college-level English persisted in postsecondary education or earned a credential, compared with 26 percent of students who started at the lowest level of the developmental reading sequence



Note: Sample includes Oregon public high school graduates from 2004/05 to 2006/07 who immediately entered Oregon community college from 2005/06 to 2007/08.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Regression results

Table C1. Proportion of variation in rates of participation in developmental education explained, by characteristic, recent high school graduates

Characteristic	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Regression 6	Regression 7
Female	0.005**						
	(0.002)						
American Indian/Alaska Native	0.056**						
	(0.007)						
Asian	0.027**						
	(0.004)						
Black	0.124**						
	(0.007)						
Hispanic	0.088**						
	(0.003)						
More than one race/ethnicity or other	0.024**						
	(0.007)						
Unknown race/ethnicity	–0.018*						
	(0.010)						
Age at first community college entry after high school graduation	–0.024**						
	(0.001)						
Ever eligible for free or reduced-price lunch in high school		0.065**					
		(0.002)					

(continued)

Table C1. Proportion of variation in rates of participation in developmental education explained, by characteristic, recent high school graduates *(continued)*

Characteristic	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Regression 6	Regression 7
Ever awarded Pell grant		–0.008** (0.002)					
OAKS math: no rating			0.091** (0.007)				
OAKS math: very low or low rating			0.145** (0.003)				
OAKS math: nearly meets rating			0.107** (0.003)				
OAKS math: meets rating			0.058** (0.002)				
OAKS read: no rating			0.058** (0.007)				
OAKS reading: very low or low rating			0.105** (0.004)				
OAKS reading: nearly meets rating			0.078** (0.003)				
OAKS reading: meets rating			0.038** (0.002)				
OAKS science: no rating			0.031** (0.003)				
OAKS science: very low or low rating			0.082** (0.004)				
OAKS science: nearly meets rating			0.058** (0.003)				
OAKS science: meets rating			0.018** (0.002)				
Ever had an Individualized Education Program in high school				0.085** (0.003)			
Ever classified as an English learner student in high school				0.080** (0.003)			
Total days absent in high school				0.001** (0.000)			
Ever repeated a grade in high school				–0.002 (0.004)			
Ever enrolled in a dual-credit course				–0.092** (0.002)			
Rural high school					–0.010** (0.003)		
Suburban high school					–0.010** (0.003)		
Town high school					–0.024** (0.003)		
Missing high school locale code					0.040 (0.032)		
Percentage of students in high school who were White					–0.154** (0.014)		
Percentage of students of in high school who were eligible for free or reduced-price lunch					–0.010 (0.011)		

(continued)

Table C1. Proportion of variation in rates of participation in developmental education explained, by characteristic, recent high school graduates *(continued)*

Characteristic	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Regression 6	Regression 7
Percentage of students who had an Individualized Education Program in high school					0.098**		
					(0.026)		
Percentage of students in high school who were classified as an English learner student					–0.071**		
					(0.015)		
Average OAKS math score in high school					–0.025**		
					(0.008)		
Average OAKS reading score in high school					0.004		
					(0.011)		
Average OAKS science score in high school					–0.028**		
					(0.008)		
Indicator for no rating math score					0.345**		
					(0.063)		
Indicator for no rating reading score					–0.159**		
					(0.017)		
Indicator for no rating science score					–0.337**		
					(0.039)		
Community college attended						✔	
High school graduated from							✔
Constant	0.631**	0.160**	0.023**	0.181**	0.311**	0.162**	0.150**
	(0.013)	(0.001)	(0.002)	(0.001)	(0.013)	(0.004)	(0.014)
Observations	52,853	52,853	52,853	52,853	52,853	52,853	52,853
R-squared	0.051	0.022	0.164	0.097	0.021	0.045	0.069

** is significant at $p < 0.01$. * is significant at $p < 0.05$.

OAKS is Oregon Assessment of Knowledge and Skills.

Note: The sample is restricted to Oregon public high school graduates from 2006/07 to 2010/11 because graduates from 2005/06 and 2006/07 have a large number of missing OAKS scores. Values reported are coefficient estimates from linear regression models; numbers in parentheses are robust standard errors. Due to space limitations, coefficient estimates on school fixed effects are not included.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Table C2. Proportion of variation in rates of participation in developmental education explained, by characteristic, graduates who attended a four-year college first

Characteristic	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Regression 6	Regression 7
Female	0.008**						
	(0.003)						
American Indian/Alaska Native	0.018						
	(0.014)						
Asian	–0.014**						
	(0.004)						
Black	0.032*						
	(0.013)						
Hispanic	0.022**						
	(0.007)						
More than one race/ethnicity or other	0.009						
	(0.008)						
Unknown race/ethnicity	0.014						
	(0.021)						
Age at first community college entry after high school graduation	–0.002						
	(0.001)						
Ever eligible for free or reduced-price lunch in high school		0.020**					
		(0.004)					
Ever awarded Pell grant		0.024**					
		(0.004)					
OAKS math: no rating			0.032*				
			(0.016)				
OAKS math: very low or low rating			0.101**				
			(0.011)				
OAKS math: nearly meets rating			0.056**				
			(0.006)				
OAKS math: meets rating			0.018**				
			(0.003)				
OAKS read: no rating			0.005				
			(0.016)				
OAKS reading: very low or low rating			0.048**				
			(0.013)				
OAKS reading: nearly meets rating			0.012*				
			(0.006)				
OAKS reading: meets rating			0.004				
			(0.003)				
OAKS science: no rating			0.014*				
			(0.006)				
OAKS science: very low or low rating			0.025**				
			(0.009)				
OAKS science: nearly meets rating			0.015*				
			(0.007)				
OAKS science: meets rating			0.005				
			(0.003)				
Ever had an Individualized Education Program in high school				0.047**			
				(0.012)			
Ever classified as an English learner student in high school				0.017*			
				(0.009)			

(continued)

Table C2. Proportion of variation in rates of participation in developmental education explained, by characteristic, graduates who attended a four-year college first *(continued)*

Characteristic	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Regression 6	Regression 7
Total days absent in high school				0.000**			
				(0.000)			
Ever repeated a grade in high school				0.066**			
				(0.022)			
Ever enrolled in a dual-credit course				–0.029**			
				(0.003)			
Rural high school					0.001		
					(0.005)		
Suburban high school					–0.001		
					(0.004)		
Town high school					–0.005		
					(0.005)		
Missing high school locale code					0.137*		
					(0.074)		
Percentage of students in high school who were White					–0.003		
					(0.023)		
Percentage of students of in high school who were eligible for free or reduced-price lunch					0.028		
					(0.020)		
Percentage of students who had an Individualized Education Program in high school					0.172**		
					(0.056)		
Percentage of students in high school who were classified as an English learner student					–0.024		
					(0.027)		
Average OAKS math score in high school					–0.016		
					(0.013)		
Average OAKS reading score in high school					0.024		
					(0.017)		
Average OAKS science score in high school					–0.023*		
					(0.014)		
Indicator for no rating math score					0.001		
					(0.005)		
Indicator for no rating reading score					–0.001		
					(0.004)		
Indicator for no rating science score					–0.005		
					(0.005)		
Community college attended						✔	
High school graduated from							✔
Constant	0.083**	0.039**	0.013**	0.049**	0.023	0.067**	0.039*
	(0.026)	(0.002)	(0.002)	(0.002)	(0.023)	(0.011)	(0.019)
Observations	8,602	8,602	8,602	8,602	8,602	8,602	8,602
R-squared	0.005	0.011	0.060	0.025	0.010	0.017	0.061

** is significant at $p < 0.01$. * is significant at $p < 0.05$.

OAKS is Oregon Assessment of Knowledge and Skills.

Note: The sample is restricted to Oregon public high school graduates from 2006/07 to 2010/11 because graduates from 2005/06 and 2006/07 have a large number of missing OAKS scores. Values reported are coefficient estimates from linear regression models; numbers in parentheses are robust standard errors. Due to space limitations, coefficient estimates on school fixed effects are not included.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Table C3. Proportion of variation in rates of participation in developmental education explained, by characteristic, graduates who attended another two-year college first

Characteristic	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Regression 6	Regression 7
Female	0.017 (0.020)						
American Indian/Alaska Native	0.070 (0.070)						
Asian	–0.004 (0.063)						
Black	0.164** (0.046)						
Hispanic	0.104** (0.039)						
More than one race/ethnicity or other	0.046 (0.088)						
Unknown race/ethnicity	0.062 (0.105)						
Age at first community college entry after high school graduation	–0.009 (0.008)						
Ever eligible for free or reduced-price lunch in high school		0.083** (0.025)					
Ever awarded Pell grant		0.013 (0.023)					
OAKS math: no rating			0.087 (0.068)				
OAKS math: very low or low rating			0.106** (0.036)				
OAKS math: nearly meets rating			0.078** (0.027)				
OAKS math: meets rating			0.051* (0.022)				
OAKS read: no rating			0.009 (0.061)				
OAKS reading: very low or low rating			0.120** (0.043)				
OAKS reading: nearly meets rating			0.073* (0.034)				
OAKS reading: meets rating			0.031 (0.024)				
OAKS science: no rating			0.077* (0.043)				
OAKS science: very low or low rating			0.021 (0.045)				
OAKS science: nearly meets rating			0.056 (0.046)				
OAKS science: meets rating			–0.011 (0.033)				
Ever had an Individualized Education Program in high school				0.115* (0.045)			
Ever classified as an English learner student in high school				0.016 (0.057)			

(continued)

Table C3. Proportion of variation in rates of participation in developmental education explained, by characteristic, graduates who attended another two-year college first *(continued)*

Characteristic	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Regression 6	Regression 7
Total days absent in high school				0.000 (0.000)			
Ever repeated a grade in high school				0.102 (0.079)			
Ever enrolled in a dual-credit course				–0.096** (0.016)			
Rural high school					–0.059* (0.030)		
Suburban high school					–0.048* (0.028)		
Town high school					–0.052* (0.026)		
Missing high school locale code					0.104 (0.148)		
Percentage of students in high school who were White					–0.169 (0.153)		
Percentage of students of in high school who were eligible for free or reduced-price lunch					–0.108 (0.102)		
Percentage of students who had an Individualized Education Program in high school					0.557** (0.191)		
Percentage of students in high school who were classified as an English learner student					–0.356* (0.155)		
Average OAKS math score in high school					0.051 (0.072)		
Average OAKS reading score in high school					–0.092 (0.112)		
Average OAKS science score in high school					–0.125 (0.102)		
Indicator for no rating math score					–0.059* (0.030)		
Indicator for no rating reading score					–0.048* (0.028)		
Indicator for no rating science score					–0.052* (0.026)		
Community college attended						✔	
High school graduated from							✔
Constant	0.314* (0.175)	0.128** (0.011)	0.032* (0.019)	0.169** (0.014)	0.343* (0.141)	0.141** (0.026)	0.180** (0.061)
Observations	542	542	542	542	542	542	542
R-squared	0.057	0.036	0.096	0.063	0.100	0.053	0.044

** is significant at $p < 0.01$. * is significant at $p < 0.05$.

OAKS is Oregon Assessment of Knowledge and Skills.

Note: The sample is restricted to Oregon public high school graduates from 2006/07 to 2010/11 because graduates from 2005/06 and 2006/07 have a large number of missing OAKS scores. Values reported are coefficient estimates from linear regression models; numbers in parentheses are robust standard errors. Due to space limitations, coefficient estimates on school fixed effects are not included.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Table C4. Proportion of variation in rates of participation in developmental education enrollment explained, by different characteristic, graduates who delayed entry with no prior college experience

Characteristics	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Regression 6	Regression 7
Female	0.017** (0.005)						
American Indian/Alaska Native	0.070** (0.017)						
Asian	0.039* (0.017)						
Black	0.110** (0.017)						
Hispanic	0.080** (0.008)						
More than one race/ethnicity or other	0.036* (0.017)						
Unknown race/ethnicity	–0.008 (0.026)						
Age at first community college entry after high school graduation	–0.010** (0.002)						
Ever eligible for free or reduced-price lunch in high school		0.064** (0.006)					
Ever awarded Pell grant		0.022** (0.006)					
OAKS math: no rating			0.056** (0.017)				
OAKS math: very low or low rating			0.131** (0.010)				
OAKS math: nearly meets rating			0.115** (0.009)				
OAKS math: meets rating			0.069** (0.007)				
OAKS read: no rating			0.089** (0.017)				
OAKS reading: very low or low rating			0.100** (0.011)				
OAKS reading: nearly meets rating			0.089** (0.010)				
OAKS reading: meets rating			0.042** (0.007)				
OAKS science: no rating			0.056** (0.010)				
OAKS science: very low or low rating			0.094** (0.011)				
OAKS science: nearly meets rating			0.073** (0.010)				
OAKS science: meets rating			0.026** (0.007)				
Ever had an Individualized Education Program in high school				0.067** (0.008)			
Ever classified as an English learner student in high school				0.078** (0.010)			

(continued)

Table C4. Proportion of variation in rates of participation in developmental education enrollment explained, by different characteristic, graduates who delayed entry with no prior college experience *(continued)*

Characteristics	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5	Regression 6	Regression 7
Total days absent in high school				0.001**			
				(0.000)			
Ever repeated a grade in high school				0.028**			
				(0.009)			
Ever enrolled in a dual-credit course				–0.110**			
				(0.005)			
Rural high school					–0.020*		
					(0.008)		
Suburban high school					–0.025**		
					(0.008)		
Town high school					–0.034**		
					(0.007)		
Missing high school locale code					–0.084*		
					(0.039)		
Percentage of students in high school who were White					–0.064*		
					(0.038)		
Percentage of students of in high school who were eligible for free or reduced-price lunch					–0.055*		
					(0.029)		
Percentage of students who had an Individualized Education Program in high school					–0.121*		
					(0.050)		
Percentage of students in high school who were classified as an English learner student					0.035		
					(0.042)		
Average OAKS math score in high school					–0.048*		
					(0.023)		
Average OAKS reading score in high school					–0.010		
					(0.030)		
Average OAKS science score in high school					–0.055*		
					(0.023)		
Indicator for no rating math score					–0.187**		
					(0.053)		
Indicator for no rating reading score					–0.020*		
					(0.008)		
Indicator for no rating science score					–0.025**		
					(0.008)		
Community college attended						✔	
High school graduated from							✔
Constant	0.418**	0.201**	0.044**	0.229**	0.347**	0.181**	0.189**
	(0.042)	(0.004)	(0.007)	(0.004)	(0.035)	(0.010)	(0.031)
Observations	9,468	9,468	9,468	9,468	9,468	9,468	9,468
R-squared	0.021	0.021	0.098	0.059	0.022	0.042	0.090

** is significant at $p < 0.01$. * is significant at $p < 0.05$.

OAKS is Oregon Assessment of Knowledge and Skills.

Note: The sample is restricted to Oregon public high school graduates from 2006/07 to 2010/11 because graduates from 2005/06 and 2006/07 have a large number of missing OAKS scores. Values reported are coefficient estimates from linear regression models; numbers in parentheses are robust standard errors. Due to space limitations, coefficient estimates on school fixed effects are not included.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Table C5. Differences in predicted probability of participating in developmental math versus not participating, by characteristic and type of graduate

Characteristics	Recent high school graduates	Attended four-year college first	Attended another two-year college first	Delayed college entry with no prior college experience
Female	0.040**	0.024**	–0.057	0.048**
	(0.004)	(0.008)	(0.069)	(0.010)
American Indian/Alaska Native	0.022**	0.017	–0.146	0.035
	(0.001)	(0.049)	(0.156)	(0.028)
Asian	–0.055**	–0.043**	–0.171	–0.067*
	(0.010)	(0.013)	(0.146)	(0.027)
Black	–0.039**	–0.066*	–0.094	–0.046
	(0.012)	(0.030)	(0.134)	(0.032)
Hispanic	0.036**	0.018	0.126	0.036*
	(0.007)	(0.021)	(0.126)	(0.017)
More than one race/ethnicity or other	–0.003	0.106**	0.021	–0.011
	(0.013)	(0.035)	(0.307)	(0.032)
Unknown race/ethnicity	–0.048*	0.021	0.417	–0.059
	(0.024)	(0.051)	(0.358)	(0.054)
Age at first community college entry after high school graduation	0.059**	0.051**	0.072*	0.062**
	(0.002)	(0.005)	(0.036)	(0.005)
Ever eligible for free or reduced-price lunch in high school	–0.030**	–0.011	0.033	–0.009
	(0.005)	(0.012)	(0.077)	(0.011)
Ever awarded Pell grant	0.105**	0.140**	0.134*	0.226**
	(0.004)	(0.015)	(0.071)	(0.011)
Ever had an Individualized Education Program in high school	–0.006	0.026	–0.060	–0.029*
	(0.006)	(0.026)	(0.108)	(0.015)
Ever classified as an English learner student in high school	–0.061**	–0.057*	–0.172	–0.054*
	(0.008)	(0.023)	(0.166)	(0.021)
Total days absent in high school	–0.000	0.001**	–0.001	0.000*
	(0.000)	(0.000)	(0.001)	(0.000)
Ever repeated a grade in high school	–0.039**	0.153*	–0.036	–0.027
	(0.011)	(0.074)	(0.253)	(0.020)
Ever enrolled in a dual-credit math course	–0.329**	–0.052**	–0.159	–0.232**
	(0.008)	(0.013)	(0.178)	(0.030)
Ever enrolled in a dual-credit English course	–0.075**	–0.038**	–0.268*	–0.062*
	(0.008)	(0.013)	(0.147)	(0.027)
Ever enrolled in a dual-credit world language course	–0.017*	–0.030*	–0.106	–0.043
	(0.010)	(0.016)	(0.142)	(0.037)
Ever enrolled in a dual-credit science course	–0.023*	–0.027	–0.022	–0.028
	(0.010)	(0.017)	(0.214)	(0.037)
Ever enrolled in a dual-credit history course	–0.040**	–0.031	0.116	0.040
	(0.013)	(0.020)	(0.222)	(0.050)
Ever enrolled in a dual-credit social science course	–0.054**	–0.001	–0.079	–0.027
	(0.013)	(0.027)	(0.204)	(0.039)
Ever enrolled in a dual-credit information, communications, and technology course	–0.020*	0.003	–0.034	0.008
	(0.008)	(0.021)	(0.170)	(0.026)
Ever enrolled in a dual-credit health sciences course	0.007	–0.021	0.014	–0.045
	(0.009)	(0.017)	(0.135)	(0.031)
Ever enrolled in a dual-credit business and management course	0.005	–0.027	–0.160	0.014
	(0.009)	(0.022)	(0.172)	(0.029)
Ever enrolled in a dual-credit industrial and engineering systems course	–0.033**	–0.053*	–0.048	–0.050
	(0.011)	(0.023)	(0.177)	(0.032)

(continued)

Table C5. Differences in predicted probability of participating in developmental math versus not participating, by characteristic and type of graduate *(continued)*

Characteristics	Recent high school graduates	Attended four-year college first	Attended another two-year college first	Delayed college entry with no prior college experience
Ever enrolled in a dual-credit human resources course	0.023* (0.010)	0.062* (0.030)	–0.072 (0.212)	0.025 (0.034)
Ever enrolled in a dual-credit arts, information, and communication course	–0.008 (0.016)	0.040 (0.036)	–0.003 (0.254)	–0.090 (0.060)
Ever enrolled in a dual-credit agriculture, food, and natural resource systems course	0.003 (0.015)	–0.056 (0.035)	0.197 (0.271)	0.026 (0.055)
OAKS math: no rating	0.208** (0.016)	0.027 (0.035)	0.004 (0.285)	0.111** (0.034)
OAKS math: very low or low rating	0.274** (0.009)	0.235** (0.027)	0.056 (0.128)	0.166** (0.024)
OAKS math: nearly meets rating	0.305** (0.008)	0.178** (0.018)	0.104 (0.120)	0.197** (0.023)
OAKS math: meets rating	0.215** (0.007)	0.068** (0.009)	0.013 (0.102)	0.164** (0.021)
OAKS reading: no rating	0.029* (0.015)	0.093* (0.041)	–0.082 (0.294)	0.018 (0.032)
OAKS reading: very low or low rating	0.041** (0.009)	0.068* (0.030)	0.053 (0.143)	0.012 (0.024)
OAKS reading: nearly meets rating	0.081** (0.008)	0.049** (0.019)	0.101 (0.130)	0.052* (0.022)
OAKS reading: meets rating	0.061** (0.007)	0.019* (0.009)	0.061 (0.112)	0.038* (0.019)
OAKS science: no rating	0.081** (0.009)	0.020 (0.020)	0.182 (0.152)	0.056* (0.025)
OAKS science: very low or low rating	0.087** (0.008)	0.037 (0.024)	0.103 (0.153)	0.068** (0.023)
OAKS science: nearly meets rating	0.106** (0.008)	0.008 (0.020)	0.080 (0.154)	0.081** (0.023)
OAKS science: meets rating	0.062** (0.007)	0.006 (0.010)	0.072 (0.120)	0.049* (0.019)
Constant	–0.744** (0.046)	–0.746** (0.117)	–0.369 (0.675)	–0.942** (0.133)
High school graduation year	✔	✔	✔	✔
College entry year	✔	✔	✔	✔
Indicator of community college attended	✔	✔	✔	✔
Indicator of high school graduated from	✔	✔	✔	✔
Observations	52,853	8,602	542	9,468
R-squared	0.201	0.183	0.524	0.195

** is significant at $p < 0.01$. * is significant at $p < 0.05$.

OAKS is Oregon Assessment of Knowledge and Skills.

Note: The sample is restricted to Oregon public high school graduates from 2006/07 to 2010/11 because graduates from 2005/06 and 2006/07 have a large number of missing OAKS scores. Values reported are marginal effects from the logistic regression model; numbers in parentheses are robust standard errors. Due to space limitations, coefficient estimates on cohort and school fixed effects are not included.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Table C6. Differences in predicted probability of participating in developmental reading or writing versus not participating, by characteristic and type of graduate

Characteristics	Recent high school graduates	Attended four-year college first	Attended another two-year college first	Delayed college entry with no prior college experience
Female	–0.009* (0.004)	–0.008 (0.006)	0.029 (0.059)	0.019* (0.010)
American Indian/Alaska Native	0.035* (0.015)	0.009 (0.031)	0.139 (0.182)	0.102** (0.031)
Asian	0.060** (0.010)	0.010 (0.010)	0.043 (0.111)	0.089** (0.027)
Black	0.064** (0.013)	–0.021 (0.021)	0.111 (0.122)	0.052* (0.031)
Hispanic	0.042** (0.008)	0.001 (0.015)	0.015 (0.112)	0.056** (0.018)
More than one race/ethnicity or other	–0.011 (0.014)	–0.007 (0.017)	–0.001 (0.191)	0.014 (0.033)
Unknown race/ethnicity	0.009 (0.025)	0.015 (0.032)	0.001 (0.376)	–0.032 (0.055)
Age at first community college entry after high school graduation	0.033** (0.002)	0.011** (0.003)	0.019 (0.032)	0.036** (0.005)
Ever eligible for free or reduced-price lunch in high school	0.004 (0.005)	0.008 (0.008)	0.078 (0.066)	0.020* (0.011)
Ever awarded Pell grant	0.075** (0.005)	0.068** (0.010)	0.065 (0.059)	0.173** (0.011)
Ever had an Individualized Education Program in high school	0.080** (0.007)	0.017 (0.019)	0.002 (0.098)	0.059** (0.015)
Ever classified as an English learner student in high school	0.042** (0.009)	0.007 (0.020)	–0.294* (0.149)	0.025 (0.023)
Total days absent in high school	–0.000** (0.000)	–0.000 (0.000)	–0.001 (0.001)	–0.000 (0.000)
Ever repeated a grade in high school	–0.038** (0.012)	0.189** (0.068)	0.068 (0.199)	–0.028 (0.021)
Ever enrolled in a dual-credit math course	–0.037** (0.008)	–0.013 (0.009)	–0.281 (0.171)	–0.086** (0.026)
Ever enrolled in a dual-credit English course	–0.152** (0.007)	–0.018* (0.009)	–0.192 (0.153)	–0.048* (0.024)
Ever enrolled in a dual-credit world language course	–0.025** (0.009)	–0.026** (0.010)	–0.085 (0.202)	–0.016 (0.031)
Ever enrolled in a dual-credit science course	–0.013 (0.010)	–0.045** (0.013)	–0.150 (0.157)	–0.029 (0.036)
Ever enrolled in a dual-credit history course	–0.062** (0.013)	–0.013 (0.012)	–0.002 (0.145)	–0.042 (0.044)
Ever enrolled in a dual-credit social science course	–0.069** (0.013)	–0.013 (0.018)	–0.117 (0.145)	–0.104** (0.039)
Ever enrolled in a dual-credit information, communications, and technology course	0.018* (0.008)	–0.014 (0.012)	0.103 (0.123)	0.008 (0.025)
Ever enrolled in a dual-credit health sciences course	–0.013 (0.010)	–0.045** (0.013)	–0.150 (0.157)	–0.029 (0.036)
Ever enrolled in a dual-credit business and management course	–0.020* (0.009)	–0.034* (0.013)	–0.152 (0.118)	–0.057* (0.029)
Ever enrolled in a dual-credit industrial and engineering systems course	0.011 (0.011)	0.030 (0.020)	0.142 (0.180)	–0.039 (0.032)

(continued)

Table C6. Differences in predicted probability of participating in developmental reading or writing versus not participating, by characteristic and type of graduate *(continued)*

Characteristics	Recent high school graduates	Attended four-year college first	Attended another two-year college first	Delayed college entry with no prior college experience
Ever enrolled in a dual-credit human resources course	0.014 (0.011)	0.008 (0.018)	0.313 (0.207)	–0.012 (0.038)
Ever enrolled in a dual-credit arts, information, and communication course	0.005 (0.016)	–0.004 (0.022)	–0.153 (0.240)	0.040 (0.057)
Ever enrolled in a dual-credit agriculture, food, and natural resource systems course	0.011 (0.016)	–0.024 (0.018)	0.030 (0.236)	0.055 (0.059)
OAKS math: no rating	0.105** (0.017)	–0.026 (0.024)	0.069 (0.189)	0.018 (0.033)
OAKS math: very low or low rating	0.179** (0.009)	0.077** (0.020)	0.234* (0.114)	0.144** (0.022)
OAKS math: nearly meets rating	0.152** (0.008)	0.023* (0.011)	0.009 (0.094)	0.126** (0.020)
OAKS math: meets rating	0.068** (0.006)	0.011* (0.005)	0.046 (0.082)	0.051** (0.017)
OAKS reading: no rating	0.141** (0.016)	0.059* (0.030)	0.156 (0.174)	0.210** (0.031)
OAKS reading: very low or low rating	0.275** (0.009)	0.101** (0.024)	0.116 (0.118)	0.233** (0.022)
OAKS reading: nearly meets rating	0.300** (0.008)	0.068** (0.013)	0.183* (0.102)	0.256** (0.020)
OAKS reading: meets rating	0.146** (0.006)	0.018** (0.005)	0.075 (0.076)	0.131** (0.016)
OAKS science: no rating	0.089** (0.009)	0.036** (0.012)	0.115 (0.133)	0.094** (0.022)
OAKS science: very low or low rating	0.169** (0.009)	0.013 (0.017)	–0.093 (0.116)	0.145** (0.022)
OAKS science: nearly meets rating	0.142** (0.008)	0.010 (0.013)	–0.023 (0.121)	0.131** (0.021)
OAKS science: meets rating	0.062** (0.006)	0.007 (0.006)	0.056 (0.089)	0.057** (0.017)
Constant	0.105** (0.017)	–0.026 (0.024)	0.069 (0.189)	0.018 (0.033)
High school graduation year	✔	✔	✔	✔
College entry year	✔	✔	✔	✔
Indicator of community college attended	✔	✔	✔	✔
Indicator of high school graduated from	✔	✔	✔	✔
Observations	52,853	8,602	542	9,468
R-squared	0.218	0.150	0.513	0.229

** is significant at $p < 0.01$. * is significant at $p < 0.05$.

OAKS is Oregon Assessment of Knowledge and Skills.

Note: The sample is restricted to Oregon public high school graduates from 2006/07 to 2010/11 because graduates from 2005/06 and 2006/07 have a large number of missing OAKS scores. Values reported are marginal effects from the logistic regression model; numbers in parentheses are robust standard errors. Due to space limitations, coefficient estimates on cohort and school fixed effects are not included.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Appendix D. Dual-credit courses by subject

This appendix describes how the dual-credit courses were categorized into different subjects and lists the highest enrollment courses in each subject area.

Oregon Department of Community Colleges and Workforce Development data flag courses that are dual credit. To understand differences in the relationship between participation in dual credit and participation in developmental education, dual-credit courses were categorized into different academic subjects and career and technical education subjects (called career learning areas in Oregon). Courses were categorized into each subject based on the course names and names of the departments in which the dual-credit courses are housed at each community college. Each subject has 25–250 courses with different course numbers but similar names and departments. Table D1 indicates the three most popular (by enrollment) courses in each subject and the percentage of students who took a course in that subject area.

Table D1. Three most popular dual-credit courses in each subject

Subject	Share of dual-credit participants who took course in subject area (percent)	Course name and number of the top three courses with the highest enrollment by subject area[a]
All (*N* = 53,539)	100	English composition I (121) College algebra (111) Trigonometry/elementary functions (112)
Academic		
Math	26	College algebra (111) Trigonometry/elementary functions (112) Calculus I (251)
English	26	English composition I (121) English composition II (122) Introduction to literature: Fiction (104)
World languages	15	First year Spanish, term 1 (101) First year Spanish, term 3 (103) First year Spanish, term 2 (102)
Science	14	General biology I (101) General biology II (102) General biology III (103)
Social science	9	Introduction to economics (115) American government & politics I (201) American government & politics II (202)
History	9	History of the United States I (201) History of the United States II (202) History of the United States III (203)
Career and technical education[b]		
Information and communications technology cluster[c]	17	Keyboarding (120 and 121) Computer fundamentals (101) Beginning Word (216)
Health sciences	15	Emergency first aid (167) CPR (261) Introduction to health occupations (100)

(continued)

Table D1. Three most popular dual-credit courses in each subject *(continued)*

Subject	Share of dual-credit participants who took course in subject area (percent)	Course name and number of the top three courses with the highest enrollment by subject area[a]
Business and management	13	Personal finance (218) Introduction to business (101) Introduction to business computing (131)
Industrial and engineering systems	9	Basic drafting (DRF 142) Introduction to AutoCAD (DRF 130) Welding I (WLD 121)
Human resources	8	Introduction to early childhood education & family studies (120) Early childhood development (125) Introduction & observation in early childhood education (150)
Arts, information, and communication	5	Photoshop (130) Introduction to drawing (131) Fundamentals of acting (141)
Agriculture, food, and natural resource systems	4	Animal science (121) Computers in agriculture (111) Introduction to animal science operation (122)

a. Listed in order of highest enrollment to lowest enrollment.

b. Called "Career learning areas" in Oregon; an organizational chart is available at http://www.ode.state.or.us/teachlearn/subjects/oregonskillsets/oss_colorchart.pdf.

c. This is not a career learning area. It is a cluster or career focus area in three different career learning areas.

Note: Sample includes Oregon public high school graduates from 2006/07 to 2010/11 who participated in dual credit, regardless of where or whether they attended college after graduation.

Source: Author's analysis of data from the Oregon Department of Education, the National Student Clearinghouse, and the Oregon Department of Community Colleges and Workforce Development.

Notes

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1. In this report, dual credit means lower division collegiate or career and technical education courses articulated with an Oregon community college, offered in a high school during regular school hours, and taught by approved high school instructors for the purpose of awarding students secondary and postsecondary credit (Oregon Department of Community Colleges and Workforce Development, 2012).
2. Research on the causal impact of developmental education has sought to identify whether observed outcomes of students in developmental education are due to developmental education itself or to other factors that contribute to education outcomes (Bettinger & Long, 2005, 2009; Boatman & Long, 2010; Calcagno & Long, 2008; Dadgar, 2012; Hodara, 2012; Martorell & McFarlin, 2011; Scott-Clayton & Rodriguez, 2012; Xu, 2013). Most findings across these studies reveal either no difference in college outcomes (such as college course performance, college persistence, transfer, and degree completion) or worse outcomes for students in developmental education than for those in college coursework and for students in lower levels of developmental coursework than for those in higher levels. These studies took place in six different states, suggesting that they are applicable to a large number of higher education contexts (Jaggars & Stacey, 2014). Because college systems define college readiness differently and, as a result, have different placement exam score cutoffs that assign students to college-level courses or developmental education, these studies also represent students with different levels of incoming ability (Bailey, Jaggars, & Scott-Clayton, 2013). For these reasons, causal research suggests that, on average, traditional sequences of developmental education do not improve the college outcomes of community college students.
3. Low college math completion could be due, in part, to different math requirements for certificate programs since Intro Algebra II is the highest math course required by many certificate programs. However, we cannot identify students pursuing certificates in the data, so we do not know how many students did not need a college math course. Data on degree attainment suggest that certificate seekers are a small proportion of the sample since only 3 percent of students earned a certificate (table 1).
4. Beginning in 2011, the state administered OAKS in grade 11 instead of grade 10; however, during the time period of this study OAKS was administered in grade 10.

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