What's Happening

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Characteristics and postsecondary pathways of students who participate in acceleration programs in Minnesota

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In collaboration with the Midwest College and Career Success Research Alliance

Key findings

- Forty-eight percent of 2011 Minnesota high school graduates participated in at least one acceleration program, such as Advanced Placement courses, dual-enrollment courses, International Baccalaureate courses, and others. About half of participants in acceleration programs who enrolled in a Minnesota college within two years of high school graduation were awarded at least one dual credit at the college level.
- Eighty percent of participants in acceleration programs who were awarded dual credit received it from a selective or very selective four-year college.
- Racial/ethnic minority students and students eligible for the federal school lunch program participated in acceleration programs and were awarded dual credit by the college in which they enrolled at lower rates than their peers.
- Participation in acceleration programs was associated with higher rates of enrollment in Minnesota colleges, and regardless of the number of credits awarded by colleges, participation was also associated with college readiness and persistence.

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Summary

Acceleration programs are academically challenging courses in which high school students can simultaneously earn credit toward a high school diploma and a postsecondary degree (dual credit). These programs include Advanced Placement courses, concurrent-enrollment courses, Postsecondary Enrollment Options courses (a dual-enrollment program in Minnesota), International Baccalaureate courses, and others. Since the Postsecondary Enrollment Options Act of 1985 (Postsecondary Enrollment Options Act, 2015), policymakers and practitioners in Minnesota have used acceleration programs as a strategy to improve students' college readiness and college success.

Despite the widespread use of acceleration programs, little information exists on the types of students and schools that access these programs and on participants' postsecondary pathways, such as whether and where they enroll in college. Members of the Midwest College and Career Success Research Alliance collaborated with Regional Educational Laboratory Midwest to conduct a study that provides a broad description of acceleration programs in Minnesota, including rates of participation, descriptions of student participants, and participants' postsecondary outcomes.

The study team obtained and analyzed data from the Minnesota State Longitudinal Education Data System provided by the Minnesota Office of Higher Education. The study examined student participation rates and success in acceleration programs available to Minnesota high school students and compared college pathways and outcomes between participants and nonparticipants among the 2011 cohort of high school graduates.

Analysis of the 2011 cohort of Minnesota high school graduates revealed six main findings related to participation and success in acceleration programs, the types of colleges that award dual credit, and college outcomes:

- Almost half of 2011 Minnesota high school graduates participated in at least one acceleration program during high school.
- About half of participants in acceleration programs who enrolled in a Minnesota college within two years of high school graduation were awarded at least one dual credit at the college level.
- Racial/ethnic minority students, students eligible for the federal school lunch program (a proxy for economic disadvantage), and students with lower academic achievement participated in acceleration programs at a lower rate than their peers.
- Racial/ethnic minority students and students eligible for the federal school lunch program who participated in acceleration programs were awarded dual credit by the college in which they enrolled at lower rates than their peers.
- The majority of Minnesota colleges in which participants in acceleration programs enrolled and were awarded dual credit were selective or very selective four-year colleges.
- Participation in acceleration programs was associated with higher rates of enrollment in Minnesota colleges. Further, even when participants were not awarded credit by the college in which they enrolled, program participation was associated with higher rates of college readiness as measured by students taking only nonremedial coursework, and persisting to the second year of college.

The results of this study might point to the contribution of these programs to student outcomes, but more rigorous research is needed to draw a causal inference about the impact

of acceleration programs on these outcomes. In addition, these results raise several considerations for educators and policymakers, including the potential importance of expanding opportunities for underrepresented students to enroll in acceleration programs and re-examining state procedures for collecting data in order to classify acceleration programs more comprehensively and document differences between types of programs.

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Why this study?

In Minnesota and other states many high school students have the opportunity to take advanced courses that allow them to simultaneously earn high school and college credit (dual credit). Previous research indicates that enrolling in acceleration programs—which include Advanced Placement courses, concurrent-enrollment courses, Postsecondary Enrollment Options courses (a dual-enrollment program in Minnesota), International Baccalaureate courses, and others (see box 1 for definitions)—during high school is associated with multiple measures related to postsecondary success (Speroni, 2011; Tierney, Bailey, Constantine, Finkelstien, & Hurd, 2009) and that enrolling high school students in dual-enrollment programs may help identify student academic weaknesses early on, which can reduce the need for remedial courses in college (Rennie Center for Education Research and Policy, 2015). Further, recent experimental research shows that participation in dual-enrollment courses during high school significantly increases the likelihood of college enrollment and degree completion (Berger, Turk-Bicakci, Garet, Knudson, & Hoshen, 2014). This study contributes to the literature by describing the characteristics of students, high schools, and colleges that participated in acceleration programs and the college outcomes of students who participated in acceleration programs in Minnesota.

Acceleration programs are popular among Minnesota high school students. During the 2010/11 school year 35,000 Minnesota high school students sat for at least one Advanced Placement examination, more than 20,000 participated in concurrent-enrollment courses, and more than 8,000 participated in Postsecondary Enrollment Options courses (Minnesota Office of Higher Education, n.d. a). Nine percent of 2010 Minnesota high school graduates who enrolled in a Minnesota college in fall 2010 had earned enough credits (about 30) to have a college class standing of sophomore or higher upon admission (Minnesota Office of Higher Education, n.d. a).[1]

This study describes the characteristics of students, high schools, and colleges that participated in acceleration programs and the college outcomes of students who participated in acceleration programs in Minnesota

Of the approximately 133 postsecondary institutions in Minnesota, more than 100 offer Postsecondary Enrollment Options courses, including community and technical colleges, state universities, and private four-year colleges (Minnesota Department of Education, n.d. a). Individual postsecondary institutions may establish their own eligibility requirements for their dual-enrollment courses, such as a minimum level of preparation or other entry requirements. The Minnesota State Colleges and Universities Board of Trustees has established eligibility requirements for dual-enrollment courses for its 34 community and technical colleges and state universities:

- Grade 12 students must be ranked in the top half of their class or score in the 50th percentile on college admissions examinations.
- Grade 11 students must be ranked in the upper third of their class or score in the 70th percentile on college admissions examinations.

More-selective colleges may have other criteria. For example, University of Minnesota–Twin Cities requires a minimum grade point average of 3.3 and two writing samples and considers other advanced coursework in addition to scores on college entrance examinations (University of Minnesota, n.d.).

Although acceleration programs are a central part of Minnesota's strategy for improving college readiness, little information exists on the characteristics of students who participate in these programs or on the postsecondary pathways of participants. Studies that

Box 1. Acceleration programs in Minnesota

Minnesota high school students have the opportunity to participate in several types of acceleration programs that offer the opportunity to earn high school and college credit simultaneously (dual credit; Minnesota Office of Higher Education, 2012). The current study examines participation in five categories:

Advanced Placement. A program created by the College Board that is available to students in 232 of approximately 430 high schools in Minnesota. Students take college-level courses and can earn college credit while still in high school by taking an end-of-course examination; however, the award of college credit is contingent on individual postsecondary institutions' policies.

Concurrent enrollment. College-level courses that academically eligible high school students take at their high school and that allow the student to earn both high school and college credit. These courses are offered through partnerships with a two- or four-year Minnesota college or university and are usually taught by a high school teacher who has been trained to teach college-level coursework.

Postsecondary Enrollment Options. A Minnesota program in which students in grades 10–12 can earn both high school and college credit while still in high school by successfully completing college-level courses at a Minnesota college. Postsecondary Enrollment Options courses are available at a wide variety of Minnesota two- and four-year colleges. Participating colleges set their own eligibility requirements for high school students; students who qualify enroll at the college and take courses either on the college's campus or online.

International Baccalaureate. Courses designed by the International Baccalaureate Organization to prepare students for the academic rigor of postsecondary institutions and incorporate and encourage thinking from an international perspective. Students can take either an entire program of study for an International Baccalaureate diploma or individual coursework for certificates in specific subjects, which are recognized at most postsecondary institutions. As with Advanced Placement, the award of college credit is contingent on individual postsecondary institutions' policies.

Other/unknown programs. Some students are recorded in the Minnesota State Longitudinal Education Data System as having enrolled in or been awarded credit for participation in an acceleration program, but the program is not specifically classified. The other/unknown category appears on data system forms due to two possible reporting gaps. First, high schools may not report (or may underreport) the number of students participating in acceleration programs. Second, postsecondary institutions may not report specific articulation agreements with high schools or districts. Such programs include private college high school vouchers, which is the for-profit college version of the Postsecondary Enrollment Options program, and one-to-one articulation agreements between certain high schools or districts and colleges that may not be subsidized by the state.

have been done in this area are often based on national data or on data from other states (see appendix A for a review of the literature on acceleration programs). Consequently, members of the Midwest College and Career Success Research Alliance collaborated with Regional Educational Laboratory Midwest to conduct a study that documents the proportion and types of students who participate in acceleration programs, the types of students who are awarded college credit for completing these programs, the Minnesota two- or four-year college in which participants enroll, and participants' postsecondary outcomes.

What the study examined

The study explored five research questions focused on the 2011 graduates of Minnesota public high schools:

1. What proportion of 2011 high school graduates participated in acceleration programs and were awarded credits by the Minnesota two- or four-year college in which they enrolled?

2. What were the characteristics of the students and schools that participated in acceleration programs and of the students who were awarded credit in these programs?

3. What were the characteristics of colleges that awarded credit to participants in acceleration programs who enrolled in their institutions?

4. Was participation in acceleration programs associated with college enrollment, college readiness, or persistence to the second year of college?

5. Do the associations between participation in acceleration programs and college enrollment, college readiness, and college persistence remain the same after student- and school-level characteristics are controlled for?

Data used in the study are from the Minnesota State Longitudinal Education Data System and provided by the Minnesota Office of Higher Education. Descriptive statistics and correlational statistical models were used in the analysis.

The study examined participation in five acceleration programs: Advanced Placement courses, concurrent-enrollment courses, Postsecondary Enrollment Options courses, International Baccalaureate courses, and other/unknown programs

Box 2. Data and methods

Population

The study team collected deidentified student data from the Minnesota State Longitudinal Education Data System. The population for this study consisted of all Minnesota public high school students who graduated in 2011 (n = 59,499). This cohort could be followed in the state longitudinal data system for two years after high school graduation (through spring 2013).

Data types

The study examined participation in five acceleration programs: Advanced Placement courses (measured by whether students sat for an Advanced Placement examination), concurrent-enrollment courses, Postsecondary Enrollment Options courses, International Baccalaureate courses (measured by whether students sat for an International Baccalaureate examination), and other/unknown programs. Because dual credits are not awarded by colleges until students enroll, data for dual credits awarded at the college level were available only for students who enrolled in a Minnesota college within two years of high school graduation.

In addition to student participation and credits awarded at the college level, the study team collected and analyzed the following variables:

- *Student characteristics.* Data included gender, race/ethnicity, eligibility for the federal school lunch program (a proxy for economic disadvantage), ACT scores, and math and reading scores on the Minnesota Comprehensive Assessment.

(continued)

Box 2. Data and methods *(continued)*

- *High school characteristics.* Data included school urbanicity (rural or nonrural) and school size (small, medium, or large, defined by splitting the distribution of total school enrollment into thirds).
- *Characteristics of dual credit–awarding colleges.* Data included two categories of college type (less-than-two- and two-year colleges and four-year colleges) and selectivity ranking (nonselective two-year colleges and less selective, selective, and very selective four-year colleges; on the basis of rankings in Barron's Educational Series, 2010).
- *Postsecondary measures.* Data included student-level measures of enrollment in a Minnesota college (all certificate- and degree-granting institutions offering less-than-two-year, two-year, and four-year programs) in fall 2011, enrollment in only a four-year Minnesota college in fall 2011, enrollment in a Minnesota college within two years of high school graduation, taking only nonremedial courses in a student's first semester, and persistence to the second year of college. Minnesota State Longitudinal Education Data System data were supplemented by data from the National Student Clearinghouse to capture students who transferred out of Minnesota for their second year of college.

Methods

The study team calculated descriptive statistics and developed and analyzed hierarchical logistic regression models. The models controlled for student and high school characteristics. For a more detailed account of data collection and the methods used to answer the research questions, and analytic samples, see appendix B.

While associations in the research questions may suggest a potential contribution of these programs to student outcomes, the analysis is correlational in nature; more rigorous research would be needed to make a causal inference about the impact of acceleration programs. The data, analytic samples, and methodological approach to answering the research questions are summarized in box 2 and detailed in appendix B.

What the study found

Forty-eight percent of 2011 Minnesota high school graduates participated in acceleration programs; participation rates varied by program type and student characteristics. Among participants, enrollment in selective and very selective colleges was overrepresented, and enrollment in two-year colleges was underrepresented. Participation was positively associated with college enrollment, college readiness, and persistence to the second year of college.

Advanced Placement courses had the highest participation rate among all graduates (26 percent), followed by concurrent-enrollment courses, Postsecondary Enrollment Options courses, other/unknown programs, and International Baccalaureate courses

Almost half of 2011 Minnesota high school graduates participated in at least one acceleration program during high school

Forty-eight percent of 2011 Minnesota high school graduates participated in at least one acceleration program during high school. Advanced Placement courses had the highest participation rate among all graduates (26 percent), followed by concurrent-enrollment courses (19 percent), Postsecondary Enrollment Options courses (7 percent), other/unknown programs (6 percent), and International Baccalaureate courses (2 percent; table 1). In addition, 24 percent of participants participated in more than one program during high school.

Table 1. Number and percentage of 2011 Minnesota high school graduates and those who enrolled in a Minnesota college within two years of high school graduation who had participated in acceleration programs, by program

	All 2011 Minnesota high school graduates (n = 59,499)		Graduates who enrolled in a Minnesota college within two years (n = 33,298)	
Acceleration program	Number	Percent	Number	Percent
Any program	28,636	48	18,287	55
Advanced Placement	15,347	26	9,450	28
Concurrent-enrollment	11,342	19	7,602	23
Postsecondary Enrollment Options	4,420	7	3,060	9
Other/unknown program[a]	3,423	6	2,075	6
International Baccalaureate	1,428	2	891	3
More than one program	6,769	11	4,435	13

a. Programs such as private college high school vouchers and one-to-one articulation agreements between districts and colleges, many of which are not regulated by the state or reported in the State Longitudinal Education Data System by participating high schools.

Source: Authors' calculations based on data from the Minnesota State Longitudinal Education Data System.

Fifty-six percent of all 2011 Minnesota high school graduates enrolled in a Minnesota college within two years of high school graduation. Fifty-five percent of these college enrollees had participated in acceleration programs during high school (see table 1).

About half of participants in acceleration programs who enrolled in a Minnesota college within two years of high school graduation were awarded at least one dual credit, but the rate varied by program

Fifty-one percent of participants in acceleration programs who enrolled in a Minnesota college within two years of high school graduation were awarded at least one dual credit by their college. The percentage varied across the program types. Credits from concurrent-enrollment courses, Postsecondary Enrollment Options courses, and Advanced Placement courses were accepted at a rate of 55–58 percent (figure 1). Credits from International Baccalaureate courses were accepted at a lower rate (42 percent), and other/unknown programs were accepted at the lowest rate (35 percent). Possible reasons for not being awarded credit include students being unable to pass the courses or examinations required to earn the credit and colleges of enrollment not recognizing the credits obtained from the college hosting the acceleration program.

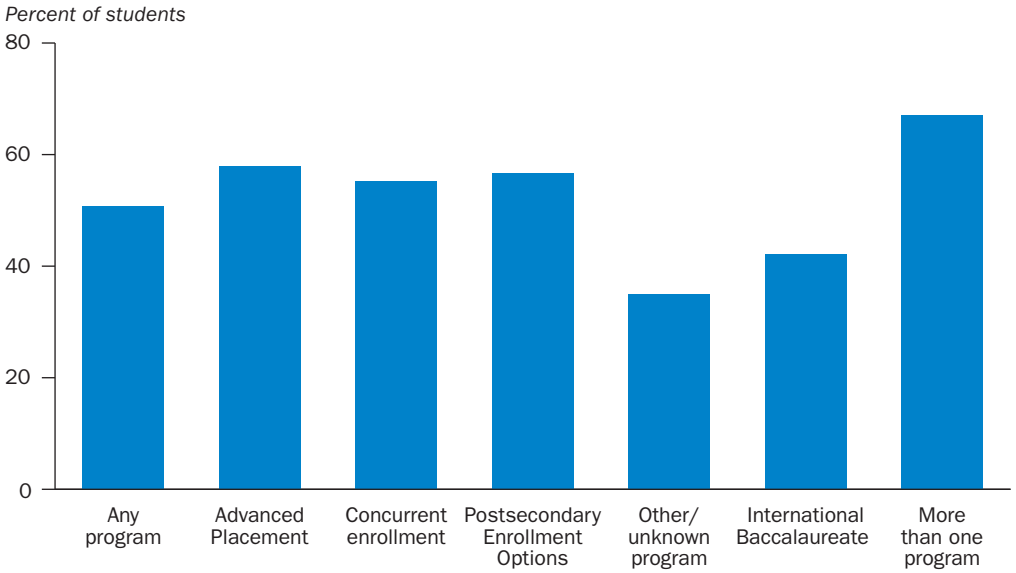
Credits from concurrent-enrollment courses, Postsecondary Enrollment Options courses, and Advanced Placement courses were accepted at a rate of 55–58 percent. Credits from International Baccalaureate courses and other/unknown programs were accepted at lower rates

Rates of participation in acceleration programs and dual credits awarded at the college level varied by student and school characteristics

Male students, racial/ethnic minority students, students eligible for the federal school lunch program, and academically lower achieving students participated in acceleration programs and were awarded dual credit by their college of enrollment at a lower rate than their peers.

Participation in acceleration programs. Compared with all 2011 Minnesota high school graduates, students who participated in acceleration programs were more likely to be female (57 percent versus 50 percent), White (87 percent versus 82 percent), and not eligible for the federal school lunch program (73 percent versus 62 percent; figure 2). Participants were

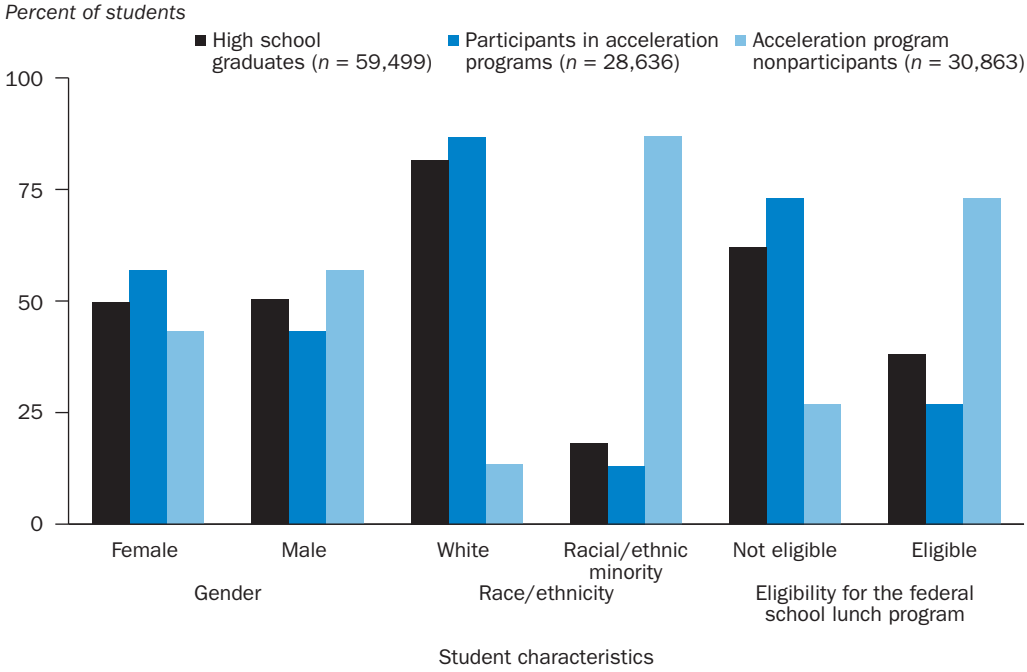
Figure 1. The percentage of 2011 Minnesota high school graduates who participated in an acceleration program, enrolled in a Minnesota college, and were awarded dual credit varied by program



Note. Includes only dual credits awarded to program participants who enrolled in a Minnesota college. High school graduates who enrolled in an out-of-state college may have been awarded dual credit at their college of enrollment.

Source: Authors' calculations based on data from the Minnesota State Longitudinal Education Data System.

Figure 2. Compared with all 2011 Minnesota high school graduates, participants in acceleration programs were more likely to be female, White, and not economically disadvantaged



Note: Comparison is based only on students who graduated from high school and excludes dropouts, students who did not graduate with their cohort, and students in other grades.

Source: Authors' calculations based on data from the Minnesota State Longitudinal Education Data System.

also more likely to have an ACT score in the upper third of the achievement distribution (41 percent versus 22 percent in the full population) and Minnesota Comprehensive Assessment math and reading scores in the upper third of the achievement distribution (46 percent versus 27 percent) and to have graduated from a large high school (43 percent versus 33 percent; see table C1 in appendix C).

The distribution of student- and school-level characteristics of participants in International Baccalaureate courses and other/unknown programs differed from that of participants in other types of programs

The distribution of student- and school-level characteristics of participants in International Baccalaureate courses and other/unknown programs differed from that of participants in other types of programs (see table C1 in appendix C). Compared with all 2011 Minnesota high school graduates, students who participated in International Baccalaureate courses were more likely to be Black (11 percent versus 7 percent) or Hispanic students (6 percent versus 4 percent) and to have graduated from a nonrural high school (96 percent versus 66 percent). Compared with all 2011 Minnesota high school graduates, students who participated in other/unknown acceleration programs were more likely to be eligible for the federal school lunch program (42 percent versus 38 percent) and to have graduated from a smaller high school (64 percent versus 33 percent) and less likely to have Minnesota Comprehensive Assessment scores in the upper third of the achievement distribution (22 percent for math and 23 percent for reading versus 27 percent for both math and reading).

The percentages of graduates of rural and of nonrural high schools among participants in acceleration programs (35 percent and 65 percent) were similar to the percentages among all 2011 Minnesota high school graduates (34 percent and 66 percent). However, differences in participation rates between graduates of rural and of nonrural schools existed for acceleration programs: rural high school graduates accounted for 43 percent of participants in concurrent-enrollment courses, 43 percent of participants in other/unknown programs, 34 percent of participants in Postsecondary Enrollment Options courses, 27 percent of participants in Advanced Placement courses, and 4 percent of participants in International Baccalaureate courses (see table C1 in appendix C).

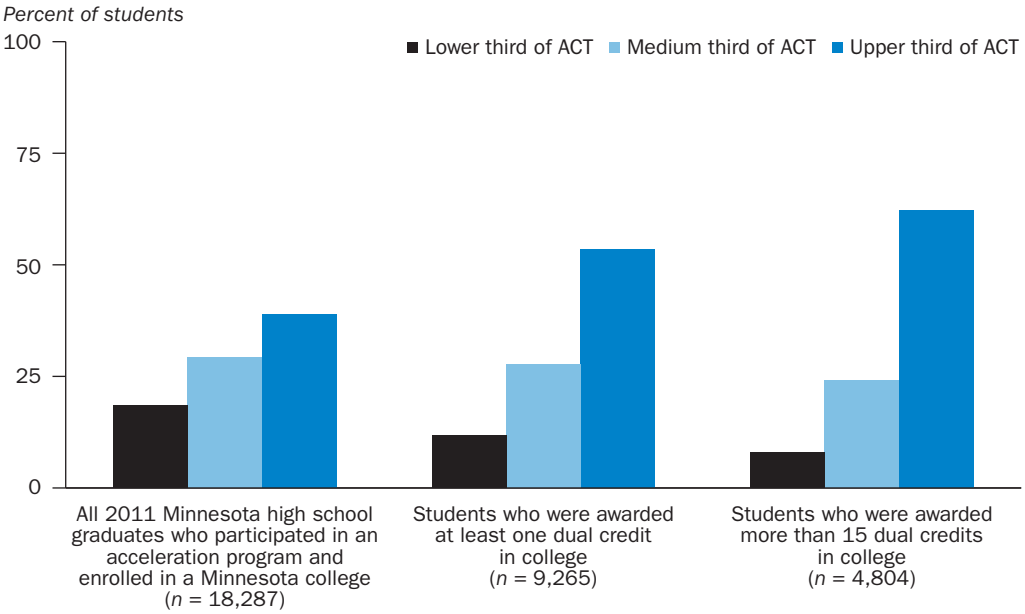
Dual credits awarded. The percentage of participants in acceleration programs who were awarded dual credit by the college in which they enrolled differed by student characteristics. Compared with all participants in acceleration programs who enrolled in a Minnesota two- or four-year college, participants who were awarded at least one dual credit were more likely to be White (88 percent versus 85 percent) and not eligible for the federal school lunch program (78 percent versus 72 percent; see table C2 in appendix C).

As might be expected from most acceleration programs' requirements for strong academic credentials, 53 percent of students who were awarded at least one dual credit in college had an ACT score in the upper third of the achievement distribution, compared with 39 percent of all 2011 Minnesota high school graduates who participated in an acceleration program and enrolled in a Minnesota college (figure 3). Sixty-two percent of students who were awarded more than 15 dual credits in college had an ACT score in the upper third of the achievement distribution (see table C2 in appendix C).

The majority of Minnesota colleges in which participants in acceleration programs enrolled and were awarded dual credit were selective or very selective four-year colleges

Acceleration program participants who were awarded dual credit by their Minnesota college of enrollment were more likely to enroll in a selective or very selective college

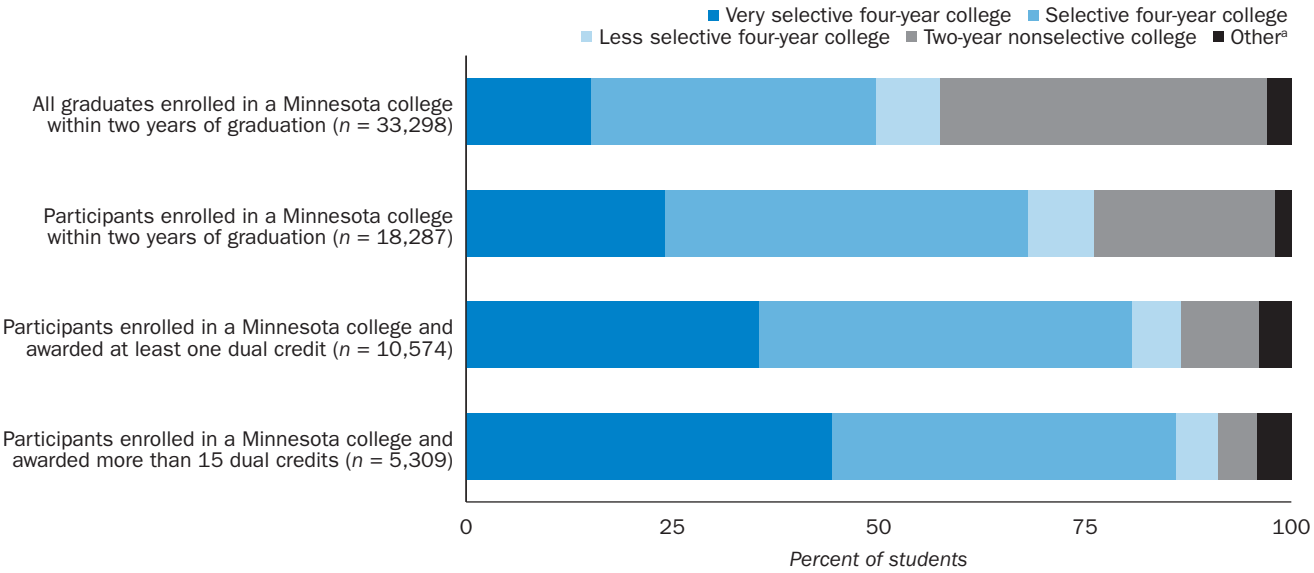
Figure 3. Among participants in acceleration programs, students who were awarded dual credits had higher ACT scores compared with all 2011 Minnesota high school graduates



Note: ACT score groupings are based on all students in the population of 2011 Minnesota high school graduates with valid ACT scores (*n* = 37,171).

Source: Authors' calculations based on data from the Minnesota State Longitudinal Education Data System.

Figure 4. The percentage of students who enrolled in a selective or very selective Minnesota college was higher among participants in acceleration programs who were awarded dual credits than among all 2011 Minnesota high school graduates



Note: Includes only students who graduated from high school and excludes dropouts, students who did not graduate with their cohort, and students in other grades.

a. Includes four-year colleges that are not rated by Barron's and colleges with less-than-two-year certificate programs, such as cosmetology schools.

Source: Authors' calculations based on data from the Minnesota Statewide Longitudinal Education Data System and Barron's Educational Series (2010).

(on the basis of Barron's Educational Series, 2010; see appendix B). This finding suggests that the types of colleges that awarded dual credit to participants in acceleration programs tended to be more selective. The majority of 2011 Minnesota high school graduates who enrolled in a Minnesota college enrolled in a selective (35 percent) or two-year nonselective (40 percent) college; 15 percent enrolled in a very selective college, and 8 percent enrolled in a less selective four-year college (figure 4).

Compared with all 2011 Minnesota high school graduates who enrolled in a Minnesota college within two years of graduation, participants in acceleration programs tended to enroll in selective and very selective Minnesota colleges

Compared with all 2011 Minnesota high school graduates who enrolled in a Minnesota college within two years of graduation, participants in acceleration programs tended to enroll in selective (44 percent versus 35 percent of all who enrolled) and very selective (24 percent versus 15 percent of all who enrolled) Minnesota colleges. Participants also were less likely to enroll in two-year nonselective colleges (22 percent versus 40 percent of all who enrolled). Differences in the selectivity of college enrollment were even more pronounced between students who were awarded at least one dual credit and students who were awarded more than 15 dual credits. The percentage of participants in acceleration programs who enrolled in a very selective college was 35 percent among participants who were awarded at least one dual credit and 44 percent among participants who were awarded more than 15 dual credits, compared with 15 percent of all 2011 Minnesota high school graduates (see figure 4).

The higher the selectivity of the college, the more likely participants in acceleration programs were to have been awarded at least one dual credit by the college in which they enrolled. The percentage of participants who were awarded at least one dual credit was 74 percent in very selective four-year colleges, 40 percent in selective four-year colleges, 25 percent in less selective four-year colleges, and 7 percent in two-year nonselective colleges (table 2).

Minnesota high school graduates who participated in acceleration programs had higher rates of college enrollment, readiness, and persistence than did those who did not participate

Previous research has shown that participation in acceleration programs during high school is associated with enrollment in college and college persistence (An, 2013; Karp, Calcagno, Hughes, Jeong, & Bailey, 2008; Oregon University System, 2010; Speroni, 2011; Swanson, 2008). A similar pattern was found among Minnesota participants in acceleration programs. While the pattern does not suggest a causal relationship (these findings may be due in part to selection effects—that is, most acceleration programs attract higher

Table 2. Number and percentage of 2011 Minnesota high school graduates who participated in acceleration programs and were awarded dual credits by the college in which they enrolled, by college selectivity

	Total	Awarded at least one dual credit		Awarded more than 15 dual credits	
College selectivity	Number	Number	Percent	Number	Percent
Very selective four-year college	5,069	3,743	74	2,352	46
Selective four-year college	11,933	4,777	40	2,216	19
Less selective four-year college	2,591	635	25	268	10
Two-year nonselective college	14,107	1,005	7	248	2

Source: Authors' calculations based on data obtained from the Minnesota State Longitudinal Education Data System and Barron's Educational Series (2010).

performing students), the findings point to potential beneficial effects on participants in acceleration programs.

Enrollment in a Minnesota college in fall 2011. High school graduates who participated in an acceleration program during high school were more likely to be enrolled in a Minnesota college in fall 2011 than were nonparticipants (58 percent versus 41 percent). The enrollment rate in a Minnesota college in fall 2011 ranged from 56 percent among participants in International Baccalaureate courses to 63 percent among participants in Postsecondary Enrollment Options courses (table 3). Participants in other/unknown programs had a slightly lower enrollment rate (53 percent).

Most of the associations between participation in an acceleration program and enrollment in a Minnesota college persisted even after student- and school-level characteristics were controlled for; however, this was not the case for all types of programs.[2] Relative to students who did not participate in an acceleration program, students who participated in a concurrent-enrollment course were 11 percentage points more likely to enroll in a Minnesota college in fall 2011. Similarly, the likelihood of enrolling in a Minnesota college in fall 2011 was 10 percentage points higher among participants in Postsecondary Enrollment Options courses and 9 percentage points higher among participants in other/unknown programs relative to those who did not participate in acceleration programs (all were statistically significant at $p < 0.001$; figure 5; see also table C3 in appendix C). Participation in Advanced Placement or International Baccalaureate courses was not associated with the likelihood of enrolling in a Minnesota college in fall 2011 after other variables were controlled for.

After student- and school-level characteristics were controlled for, students who participated in a concurrent-enrollment course were 11 percentage points more likely to enroll in a Minnesota college in fall 2011 relative to students who did not participate in an acceleration program

Enrollment in a four-year Minnesota college in fall 2011. Participants in acceleration programs were more than twice as likely as nonparticipants to enroll in a four-year Minnesota college in fall 2011 (46 percent versus 17 percent; see table 3). Enrollment in a

Table 3. Rates of college enrollment, nonremedial coursetaking, and persistence to the second year of college by participation in acceleration programs and number of credits earned, among 2011 Minnesota high school graduates

Acceleration program	Total number of participants	Enrolled in a Minnesota college in fall 2011[a]		Enrolled in a four year Minnesota college in fall 2011[a]		Enrolled in a Minnesota college in fall 2011 or 2012[a]		Enrolled in only nonremedial courses in the first semester of college[b]		Persisted to the second year of college[b]	
		Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Any program	28,636	16,627	58	13,274	46	18,287	64	16,210	89	15,245	83
Advanced Placement	15,347	8,700	57	7,759	51	9,450	62	8,835	94	8,321	88
Concurrent enrollment	11,342	7,009	62	5,603	49	7,602	67	6,732	89	6,437	85
Postsecondary Enrollment Options	4,420	2,783	63	2,209	50	3,060	69	2,809	92	2,532	83
Other/unknown program	3,423	1,802	53	1,044	31	2,075	61	1,639	79	1,433	69
International Baccalaureate	1,428	795	56	656	46	891	62	758	85	740	83
Multiple programs	6,769	4,130	61	3,691	55	4,435	66	4,218	95	3,907	88
No participation	30,863	12,575	41	5,323	17	15,011	49	8,756	58	4,323	29

na is not applicable.

a. Based on all 2011 Minnesota high school graduates (N = 59,499).

b. Based on graduates who enrolled in a Minnesota college in fall 2011 or fall 2012 (n = 33,298).

Source: Authors' calculations based on data from the Minnesota Statewide Longitudinal Education Data System.

four-year Minnesota college ranged from 46 percent among participants in International Baccalaureate courses to 55 percent among participants in multiple acceleration programs. Participants in other/unknown programs had a lower enrollment rate in a four-year Minnesota college (31 percent), though the rate was almost twice that of nonparticipants (17 percent; see table 3).

Most of the associations between participation in an acceleration program and enrollment in a four-year Minnesota college in fall 2011 persisted even after student- and school-level characteristics were controlled for; however, this was not the case for all programs. Relative to students who did not participate in an acceleration program, students who participated in a concurrent-enrollment course were 13 percentage points more likely to enroll in a four-year Minnesota college in fall 2011. Similarly, the likelihood of enrolling in a four-year Minnesota college in fall 2011 was 9 percentage points higher among participants in Postsecondary Enrollment Options courses, 9 percentage points higher among participants in other/unknown programs, and 8 percentage points higher among participants in Advanced Placement courses (all were statistically significant at $p < 0.001$; see figure 5 and table C3 in appendix C). Participation in International Baccalaureate courses was not associated with the likelihood of enrolling in a four-year Minnesota college in fall 2011 after other variables were controlled for.

Enrollment in a Minnesota college in fall 2011 or 2012. When fall 2012 enrollments were included, more of the cohort of 2011 Minnesota high school graduates had enrolled in a Minnesota college, regardless of whether they participated in an acceleration program. Although the gap in enrollment between participants and nonparticipants shrank when the timeline was expanded (indicating that more of the graduates who enrolled in 2011 were nonparticipants), a 15 percentage point gap remained between participants (64 percent) and nonparticipants (49 percent). The same pattern occurred with specific acceleration programs; enrollment rates in a Minnesota college within two years of high school graduation ranged from 62 percent among participants in Advanced Placement and International Baccalaureate courses to 69 percent among participants in Postsecondary Enrollment Options courses (see table 3). Participants in other/unknown programs had slightly lower rates of enrollment within two years (61 percent).

After student- and school-level characteristics were controlled for, students who participated in a concurrent enrollment course were 10 percentage points more likely to enroll in a Minnesota college in fall 2011 or 2012 relative to students who did not participate in an acceleration program

Most of the associations between participation in an acceleration program and enrollment in a Minnesota college in fall 2011 or 2012 persisted even after student- and school-level characteristics were controlled for; however, this was not the case for all program types. Relative to students who did not participate in an acceleration program, students who participated in a concurrent-enrollment course were 10 percentage points more likely to enroll in a Minnesota college in fall 2011 or 2012. Similarly, the likelihood of enrolling in a Minnesota college in fall 2011 or 2012 was 11 percentage points higher among participants in Postsecondary Enrollment Options courses, and 10 percentage points higher among participants in other/unknown programs (all were statistically significant at $p < 0.001$; see figure 5 and table C3 in appendix C). Participation in Advanced Placement and International Baccalaureate courses was not associated with the likelihood of enrolling in a Minnesota college within two years of high school graduation after other variables were controlled for.

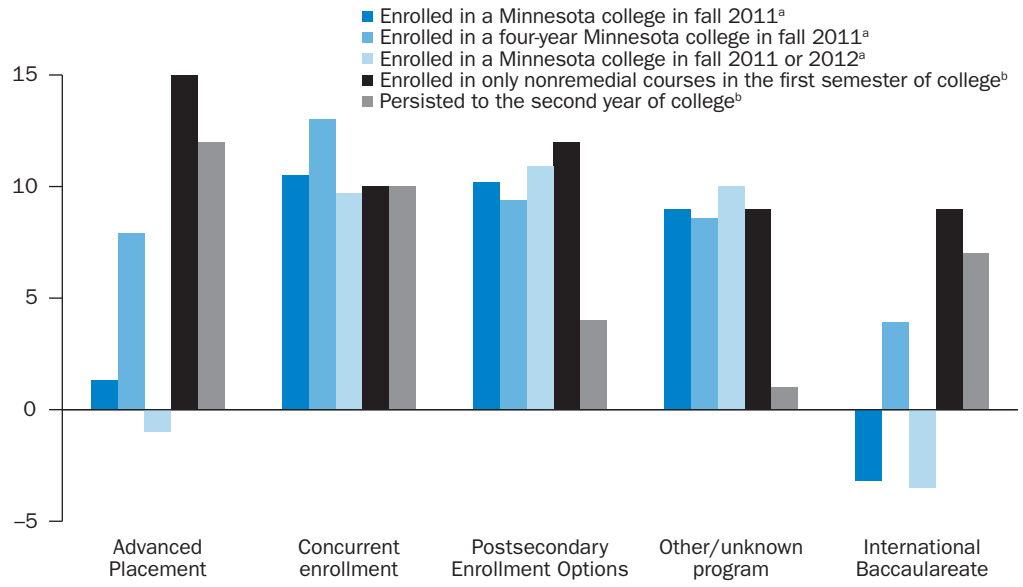
College readiness. High school graduates who participated in acceleration programs were more likely than nonparticipants to have taken only nonremedial courses in their first semester of college (89 percent versus 58 percent; see table 3). Among specific programs,

rates of taking only nonremedial courses ranged from 85 percent among participants in International Baccalaureate courses to 95 percent among participants in more than one acceleration program (see table 3). Participants in other/unknown programs had a lower rate of taking only nonremedial courses (79 percent), though the rate was higher than that of nonparticipants (58 percent).

All of the associations between participation in an acceleration program and enrolling in only nonremedial coursework in the first semester of college persisted even after student- and school-level characteristics were controlled for. Relative to students who did not participate in an acceleration program, students who participated in an acceleration program were 9–15 percentage points more likely to enroll in only nonremedial coursework, depending on the type of acceleration program in which they participated (all were statistically significant at $p < 0.001$; see figure 5 and table C4 in appendix C). This finding is consistent with that of Rennie Center for Education Research and Policy (2015), which found that college-level coursework taken during high school can help identify weaknesses early on, which can reduce the need for remedial coursework after high school graduation. In addition, participants in acceleration programs are more likely than nonparticipants to enroll in four-year colleges, which are less likely to offer or place students in remedial courses.

After student- and school-level characteristics were controlled for, students who participated in an acceleration program were 9–15 percentage points more likely to enroll in only nonremedial coursework relative to students who did not participate in an acceleration program, depending on the type of acceleration program in which they participated

Figure 5. The association between participation in acceleration programs and college outcomes among 2011 Minnesota high school graduates was generally positive but varied for some programs



Note: Predicted probabilities are based on the typical high school graduate, or a graduate from a high school with average academic and sociodemographic characteristics. Comparison is based only on students who graduated from high school, and excludes dropouts, students who did not graduate with their cohort, and students in other grades.

a. Based on all 2011 Minnesota high school graduates (N = 59,499).

b. Based on 2011 Minnesota high school graduates who enrolled in a Minnesota college within two years of high school graduation (n = 33,298).

Source: Authors' calculations based on regression models using data from the Minnesota Statewide Longitudinal Education Data System.

Persistence. Participants in acceleration programs were almost three times as likely as nonparticipants to have persisted to the second year of college (83 percent versus 29 percent; see table 3). One explanation for this gap may be that participants in acceleration programs were more likely than nonparticipants to enroll in four-year colleges, where persistence rates are generally higher than in two-year colleges. Persistence rates ranged from 83 percent among participants in International Baccalaureate courses and Postsecondary Enrollment Options courses to 88 percent among participants in Advanced Placement courses and participants in more than one acceleration program. Participants in other/unknown acceleration programs had a lower persistence rate (69 percent), though the rate was more than twice that of nonparticipants (29 percent; see table 3).

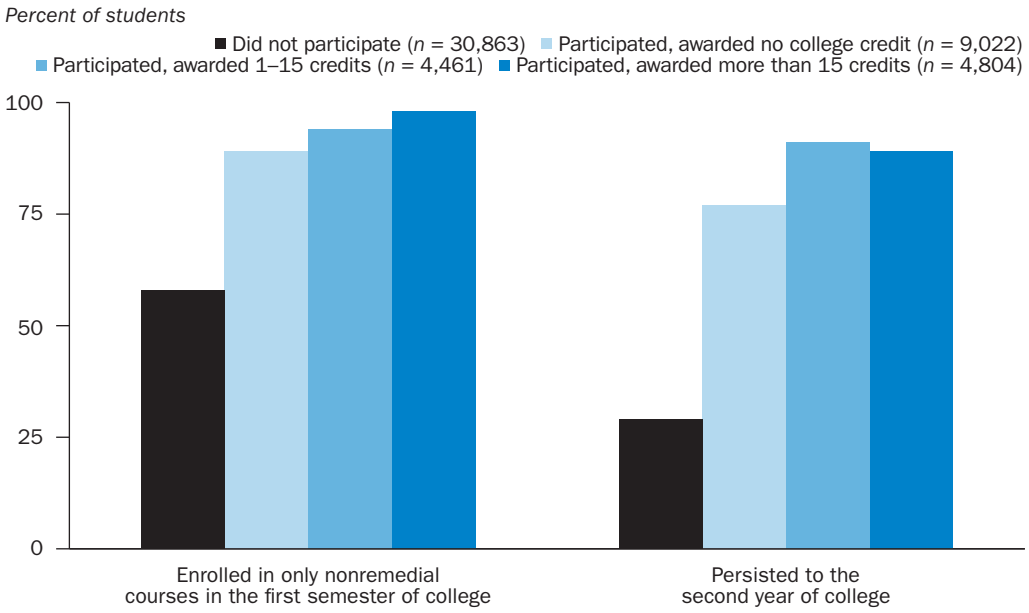
Most of the associations between participation in an acceleration program and returning for a second year of college persisted after student- and school-level characteristics were controlled for; however, this was not the case for all programs. Relative to students who did not participate in an acceleration program, students who participated in an Advanced Placement course were 12 percentage points more likely to return for a second year of college ($p < 0.001$). Similarly, the likelihood of returning for a second year of college was 10 percentage points higher among participants in concurrent-enrollment courses ($p < 0.001$), 7 percentage points higher among participants in International Baccalaureate courses ($p = 0.003$), and 4 percentage points higher among participants in Postsecondary Enrollment Options courses ($p = 0.004$; see figure 5 and table C4 in appendix C). Participation in other/unknown programs was not associated with persistence to the second year of college after other variables were controlled for.

After student- and school-level characteristics were controlled for, students who participated in an Advanced Placement course were 12 percentage points more likely to return for a second year of college relative to students who did not participate in an acceleration program

Participants in acceleration programs who enrolled in a Minnesota college within two years of graduation had higher rates of college readiness and persistence than did nonparticipants, regardless of whether the college in which they enrolled awarded them any credits. The percentage of students who enrolled in only nonremedial courses in the first semester of college was 89 percent among participants in acceleration programs who were awarded no credit by the college in which they enrolled, 94 percent among participants who were awarded 1–15 credits, and 98 percent among participants who were awarded more than 15 credits, compared with 58 percent of nonparticipants (figure 6).

Similarly, the percentage of students who persisted to the second year of college was 77 percent among participants who were awarded no college credit, 91 percent among participants who were awarded 1–15 credits, and 89 percent among participants who were awarded more than 15 credits, compared with 29 percent of nonparticipants (see figure 6). The size of the differences may be due partly to program eligibility requirements; most acceleration programs likely attracted highly academically qualified students who would have performed well in college regardless of whether they participated in acceleration coursework.

Figure 6. Among 2011 Minnesota high school graduates, participants in acceleration programs were more likely than nonparticipants to enroll in only nonremedial courses in the first semester of college and to persist to the second year of college, regardless of whether or how many credits were awarded



Note: Percentages are based on 2011 Minnesota high school graduates who enrolled in a Minnesota college within two years of high school graduation (n = 33,298). Percentages are unadjusted and do not account for student- and school-level characteristics.

Source: Authors' calculations based on regression models using data from the Minnesota Statewide Longitudinal Education Data System.

The percentage of students who enrolled in only nonremedial courses in the first semester of college was 89 percent among participants in acceleration programs who were awarded no credit by the college in which they enrolled, 94 percent among participants who were awarded 1–15 credits, and 98 percent among participants who were awarded more than 15 credits, compared with 58 percent of nonparticipants

Implications of the study findings

The results of this study raise several implications for educators and policymakers to consider regarding acceleration programs in Minnesota.

High schools and colleges might explore ways to expand acceleration program opportunities for racial/ethnic minority students, students eligible for the federal school lunch program, and students with lower academic achievement

Historically, racial/ethnic minority and low-income students have been less likely than their peers to enroll in college (Kena et al., 2015). Acceleration programs in Minnesota aim to improve college readiness among high school students. Despite this aim and the fact that nearly half of graduates in the current study participated in acceleration programs, racial/ethnic minority students and students eligible for the federal school lunch program were less likely than their peers to have participated or to have been awarded credit when they participated. These findings are consistent with prior research conducted in Texas and Pennsylvania (Appleby et al., 2011; Museus, Lutovsky, & Colbeck, 2007).

Previous national research has found that participation in dual-enrollment programs has a stronger impact on degree attainment for students who are eligible for the federal school lunch program than for students who are not eligible (An, 2013; Edmunds, 2010). This

research also suggests that expanding dual-credit opportunities for racial/ethnic minority students and students with lower academic achievement can improve their outcomes and reduce the attainment gap between these students and their more advantaged peers. Acceleration programs such as the Early College High School Initiative that target underserved students and provide them with opportunities to earn college credits and receive exposure to the college culture during high school have been shown to significantly improve high school graduation, college enrollment, and degree completion rates among these students (Berger, et al., 2014). Future research could examine whether the relationship between participation in acceleration programs and postsecondary outcomes differs among various types of acceleration programs or by students' race/ethnicity, economic status, or achievement.

Policymakers might explore whether eligibility requirements for acceleration programs could be relaxed without undermining program efficacy

Policymakers might explore whether eligibility requirements for acceleration programs could be relaxed without undermining program efficacy. Although Minnesota colleges set their own requirements for participation in acceleration programs, several two- and four-year colleges have common eligibility requirements that focus on students who achieve higher class ranks. More-selective colleges can have even stricter academic requirements. One exception to this finding was among programs classified as other/unknown acceleration programs, which include private college high school vouchers and one-to-one articulation agreements between specific colleges and high schools or districts. These programs appear to serve slightly different student populations and have different rates of awarding dual credits. The programs are also associated with less positive postsecondary outcomes than are other types of acceleration programs but with more positive postsecondary outcomes than is nonparticipation. Given these findings, the Minnesota Department of Education and the Minnesota Office of Higher Education may benefit from a deeper examination of other/unknown programs, which may provide an opportunity for students who do not meet the more stringent eligibility requirements of other types of programs.

Expanding access to acceleration programs in rural areas may pose a distinct set of issues. Zinth (2015) found that, nationally, high schools in rural areas are more likely than high schools in nonrural areas to report that participants in dual enrollment take courses at their high school rather than on a college campus. Results from the current study support this finding; students in rural high schools participated in concurrent-enrollment courses (where courses are taught at the high school) at a higher rate than did students in nonrural schools. Zinth (2015) also found that offering courses on college campuses (as the Postsecondary Enrollment Options program in Minnesota does) presents logistical challenges for rural students. The current study found that rural and nonrural high school students in Minnesota participated in Postsecondary Enrollment Options courses (most of which are taught on a college campus or online) at a rate comparable to the full population of graduates. Future research could examine how students access these programs, including the extent to which students take advantage of online course offerings.

Researchers could explore the extent to which the positive outcomes of participants are attributable to the impact of acceleration programs as opposed to the types of students who participate in the programs

Although only half of participants in acceleration programs who enrolled in a Minnesota college were awarded credit by the college in which they enrolled, graduates who participated in acceleration programs during high school and were not awarded credit had more

positive college outcomes than did nonparticipants. Participants were more likely to enroll in a Minnesota college, take only nonremedial courses in their first semester, and persist to the second year of college—regardless of whether or how many dual credits they were awarded.

The starkest contrast among these outcomes was the finding that participants in acceleration programs were three times as likely to continue to the second year of college as nonparticipants and that this relationship remained strong for most types of programs after student- and school-level characteristics such as race/ethnicity, eligibility for the federal school lunch program, and academic achievement (characteristics associated with college persistence rates; Kena et al., 2015; Stephan, Davis, Lindsay, & Miller, 2015) were controlled for. While the relationships are promising, more rigorous research will be required to understand their direct impacts on students, beyond the selection effects of most programs attracting high-achieving students.

The positive association between participation in an acceleration program and the college outcomes of taking only nonremedial courses and persistence remained even when participants had not been awarded any credit through acceleration coursework

While participants in acceleration programs who were awarded credits by the college in which they enrolled had slightly better college readiness and persistence outcomes than did participants who were awarded no credit, the most notable difference was between participants awarded no credit and nonparticipants; the positive association between participation and the college outcomes of taking only nonremedial courses and persistence remained even when participants had not been awarded any credit through acceleration coursework. This finding is consistent with previous research that has found that students who take Advanced Placement examinations but do not pass them (in other words, they participated in Advanced Placement courses but would not be awarded college credit) still have more positive college outcomes than do those who do not take the examination (Indiana Commission for Higher Education, 2013; Mattern, Shaw, & Xiong, 2009; Stephan et al., 2015).

High schools could explore ways to increase the likelihood that colleges accept the dual credits that students earn

Beyond better preparing high school students for college and careers, one benefit of acceleration programs is the cost savings associated with the reduction in the number of college courses required to earn a degree (Radunzel, Noble, & Wheeler, 2014). Participation in concurrent-enrollment and Postsecondary Enrollment Options courses does not cost a student anything because it is subsidized by the state (Minnesota Department of Education, 2015). Despite the opportunity to earn college credit at no cost to the student, only about half the high school graduates who participated in an acceleration program and enrolled in a Minnesota college were awarded any credit. In addition, students eligible for the federal school lunch program (who may benefit more from subsidized tuition and fees) in the current study who participated in acceleration programs and enrolled in a Minnesota college were found to have been awarded credits by the college in which they enrolled at a lower rate than were other students.

There are a few possible reasons that high school graduates who participate in acceleration programs and enroll in a Minnesota college were not awarded credits. First, some students may not be passing the examinations or the courses needed to earn the credit. Advanced Placement and International Baccalaureate courses require students to pass a content-based examination that indicates proficiency in a subject area in order to be considered for credit

at the college level. Second, if a student takes acceleration coursework affiliated with one college but enrolls in a different college, whether the credits transfer depends on the rules of the college in which the student enrolls (Minnesota Department of Education, 2015). In other words, dual credits earned at one college are not guaranteed to transfer to another college.

Legislation enacted in Minnesota in July 2015, four years after the 2011 cohort graduated from high school, introduced regulations on the award of dual credit (Postsecondary Enrollment Options Act, 2015; Subd. 12). Students who successfully complete Postsecondary Enrollment Options courses in high school must now be awarded credit if they enroll in an institution in the Minnesota State Colleges and Universities System. The law provides a first step toward guaranteeing the transfer of earned credit from acceleration programs. Guaranteeing college credit for students who successfully complete dual-enrollment courses could reduce students' total cost of attending college, potentially minimizing students' need to finance their postsecondary education through additional work or student loans, especially among economically disadvantaged students.

Guaranteeing college credit for students who successfully complete dual-enrollment courses could reduce students' total cost of attending college

Limitations of the study

There are seven main limitations to this study.

First, the data on which the findings are based are for graduates of Minnesota high schools who enrolled in postsecondary institutions within the state and exclude students who attend an out-of-state college. Thus the results may not be generalizable to students in acceleration programs in other states or Minnesota participants in acceleration programs who enrolled in an out-of-state college. However, 70 percent of Minnesota students enroll in an in-state college (Minnesota Office of Higher Education, n.d. e).[3]

Second, the generalizability of the descriptive results that compared subgroups of students (for example, demographic and achievement differences between participants in acceleration programs and nonparticipants) is limited in two ways:

- The analytic samples are limited to students who graduated from high school on time. Eighteen percent of the 2011 grade 12 cohort of Minnesota public high school students either dropped out before graduating or did not earn enough credits to graduate and continued their high school education beyond 2011 (Minnesota Department of Education, n.d. b). The analytic samples exclude these students and students from other cohorts who participated in acceleration programs during the same time period. Because students eligible for the federal school lunch program and students with lower academic achievement are less likely to graduate from high school (Stark & Noel, 2015), the analysis likely underestimates the differences between participants in acceleration programs and the full population of high school enrollees.
- Many factors could account for differences in measures of postsecondary success between students who participate in acceleration programs and those who do not, but only student gender, race/ethnicity, eligibility for the federal school lunch program, academic achievement, and high school characteristics were examined. Many other commonly studied predictors of college enrollment—for example, completion of the *Free Application for Federal Student Aid* and completion of college placement tests—were unavailable (Advisory Committee on Student

Financial Assistance, 2005; Belfield & Crosta, 2012; Dynarski & Scott-Clayton, 2006; Kantrowitz, 2011; King, 2006; Roderick, Nagaoka, Coca, and Moeller, 2008; Stephan & Rosenbaum, 2013). Including these other commonly studied predictors in statistical models may have provided more accurate estimates of the differences in college outcomes between participants and nonparticipants.

Third, if a student has no record of postsecondary enrollment (either in Minnesota or National Student Clearinghouse data), the study team assumed that the student did not enroll in a postsecondary institution after high school and did not include the student in the analysis of postsecondary outcomes. As a result, postsecondary enrollment may be undercounted. Such undercounting can occur if students enrolled in college after high school after their college's enrollment census date or if students earned enough college credit during high school to graduate with an associate's degree[4] and subsequently did not enroll in college after high school graduation. Because of this possibility, findings associated with postsecondary outcome measures cannot be generalized to students who earn an associate's degree through dual-credit programs in high school and do not continue on to a postsecondary institution after high school graduation. Nevertheless, because the majority of students who participate in concurrent-enrollment and postsecondary enrollment options courses do so through a four-year college and continue on to a four-year college (only 22 percent of participants in concurrent-enrollment courses and 23 percent of participants in Postsecondary Enrollment Options courses who enrolled in a Minnesota college within two years of high school graduation enrolled in a two-year college), the number of students who earn enough credits for an associate's degree and do not continue on to a four-year college likely is very low.

Fourth, students who participated in Advanced Placement or International Baccalaureate courses may be underrepresented in the Minnesota State Longitudinal Education Data System database. The records of participation in Advanced Placement and International Baccalaureate courses in the database are determined by whether a student sat for an examination in one of the programs. If a student completed the coursework in either program but did not sit for an examination, that student's participation would not appear in the database. Although this is considered a limitation, sitting for an examination is a common method for reporting participation in Advanced Placement courses among the College Board and several state education agencies,[5] and the number of students excluded by the decision is likely very low.

Finally, this study is descriptive and cannot support causal conclusions. However, it provides information about Minnesota students that can be useful to policymakers in understanding who participates in acceleration programs and whether and to what extent participation is associated with postsecondary success measured by college choice, enrollment, readiness, and persistence as well as how access to these programs may vary by student- and school-level characteristics. Such information can benefit the Midwest College and Career Success Research Alliance by providing useful information requested by policymakers on the accessibility of dual credit programs and the postsecondary pathways of students who participate in them.

This study is descriptive and cannot support causal conclusions. However, it provides information about Minnesota students that can be useful in understanding who participates in acceleration programs and whether and to what extent participation is associated with postsecondary success

Appendix A. Literature review

Despite the large proportion of students nationwide planning to attend college (97 percent), just 66 percent enroll in college immediately after high school graduation (Aud et al., 2013), and less than 60 percent of those who enroll attain a certificate or degree (Snyder & Dillow, 2012).[6] Programs that offer acceleration across secondary and postsecondary education are one strategy that districts and states have adopted in an effort to increase students' college readiness and reduce the gap between college plans and completion (Minnesota Department of Education, n.d. a).

Acceleration programs take multiple forms. Advanced Placement and International Baccalaureate courses use a standardized curriculum, require an end-of-course examination, and traditionally have focused on high achievers (College & Career Readiness & Success Center at American Institutes for Research, 2013). Dual- and concurrent-enrollment programs allow high school students to enroll in college courses and earn college credit. There is no standardized curriculum or format, and these programs differ in their location (that is, on a college campus, online, or at a high school), staff (that is, high school or college instructor), admission requirements, class composition (that is, high school students only or high school and college students), and funding (Allen, 2010). Recent data indicate that 11 percent of dual-enrollment courses are taught by postsecondary faculty. Most dual-enrollment courses are held on secondary school campuses and taught by certified high school faculty (Zinth, 2015), possibly because such locations are more convenient for participants, who need not travel to the nearest college campus.

Early College High Schools is another option for acceleration. Early College High Schools partner with colleges to offer mostly underserved high school students the opportunity to take dual-enrollment college courses while still in high school at little cost to the student (Berger et al., 2014). These schools are usually small and located on college campuses (Edmunds, 2010). Currently, there is one Early College High School in Minnesota (http://www.earlycolleges.org/schools.html).

Acceleration programs and postsecondary success

By providing students with the opportunity to take college-level courses, districts and states aim to increase students' motivation, knowledge of college requirements, and academic preparation (Minnesota Office of Higher Education, n.d. b). Correlational research indicates that enrolling in acceleration programs during high school predicts multiple measures related to postsecondary success. Nathan, Accomando, and Fitzpatrick (2005) found that the number of students taking Advanced Placement examinations rose 988 percent between 1986 and 2004 as a result of Minnesota's dual-enrollment program (Krueger, 2006). Advanced Placement courses are positively correlated with college readiness (Speroni, 2011; Tierney et al., 2009), and participation in dual- and concurrent-enrollment programs predicts enrollment in college, college persistence, and degree completion (An, 2013; Karp, Calcagno, Highes, Jeong, & Bailey, 2008; Oregon University System, 2010; Speroni, 2011; Swanson, 2008).

A recent study by the Rennie Center for Education Research and Policy (2015) in Massachusetts found that enrolling in dual-enrollment programs helps identify students' academic weaknesses early on and can remove the need for remedial courses after graduation from

high school. The Texas-ACT College Success Research Consortium recently found that incoming college students who had taken dual-enrollment courses in high school were more likely to complete a bachelors' degree in a timely manner than those who had not (Radunzel, et al., 2014). Furthermore, recent experimental research on Early College High Schools suggests that participation in college courses through Early College High Schools significantly increases the likelihood of college enrollment and degree completion (Bailey, Hughes, & Karp; 2002; Berger et al., 2014; Karp et al., 2008).

The relationship between participation in acceleration programs and postsecondary outcomes may depend on the number of credits earned. Community College Research Center (2012) found that students who earn two or more dual credits have better college outcomes than do students who earn only one. However, other research suggests that participation in Advanced Placement courses might be associated with positive outcomes even if no college credits are earned (Stephan et al., 2015). Two reports show that students who took an Advanced Placement examination and scored below a 3 (on a scale of 1 to 5) had higher college enrollment and persistence rates, attended more-selective colleges, and had lower remediation rates than did students who did not take an Advanced Placement examination (Indiana Commission for Higher Education, 2013; Mattern et al., 2009);[7] however, these studies did not account for differences between the types of students who take an Advanced Placement examination and those who do not. On the whole, U.S. high school students attempted 167,050 concurrent-enrollment credits, an average of 8 credits per student, during the 2013/14 school year (Bautsch, 2015).

Access to acceleration programs

Proponents suggest that acceleration programs can reduce equity gaps in postsecondary achievement (see the discussion in An, 2013), and recent research suggests that acceleration programs can benefit disadvantaged students (An, 2013; Community College Research Center, 2012). For instance, analysis of data from the National Longitudinal Study of 1988 showed that participation in dual-enrollment courses was associated with higher rates of college degree attainment for low-income high school students (An, 2013). Participation in dual-enrollment courses was also found to have a weaker effect for high school students from affluent backgrounds than for their low-income peers (An, 2013). Another study found that dual-enrollment and acceleration programs were associated with higher college and high school completion rates, particularly among underserved, racial/ethnic minority, and low-income students (Zinth, 2014). An experimental study examining early outcomes of the Early College High Schools Initiative in North Carolina similarly found that performance gaps in the successful completion of Algebra I in grade 9 between racial/ethnic minority students and other students were significantly smaller than in a control group and had completely closed with completion of English I (Edmunds, 2010). Berger et al. (2014) also found a stronger Early College High Schools impact on college degree attainment for racial/ethnic minority students than for other students.

Studies in Texas and Pennsylvania found that racial/ethnic minority students or students from economically disadvantaged backgrounds participated in acceleration programs at lower rates than did White students or those from more advantaged economic backgrounds (Appleby et al., 2011; Museus et al., 2007). Nationally, the College Board found that 60 percent of students identified as having Advanced Placement math potential, defined as the likelihood that they would excel in an Advanced Placement math course

as predicted by their scores on the PSAT, did not participate in an Advanced Placement math course (College Board, 2013). The greatest Advanced Placement potential was lost among Hispanic, Black, and American Indian/Alaska Native students (College Board, 2013).

Not all high school students have equal access to acceleration programs. Survey data collected in 2010/11 by the National Center for Education Statistics show that students in 82 percent of U.S. public high schools participate in dual-credit programs, but students at smaller high schools, urban and suburban high schools, and high schools with a high proportion of racial/minority students were less likely to be enrolled at a high school with a dual-credit program available (Thomas, Marken, Gray, & Lewis, 2013; Zinth, 2015). Taylor and Lichtenberger (2013) found that differences in students' access to dual-credit programs in Illinois high schools depended on the characteristics of the high school in which they were enrolled. Students were more likely to have access to a dual-credit program if their high school was located in a town or rural area, was in a small or medium-sized public school district, had a larger proportion of White students and a smaller proportion of low-income students, had high graduation and attendance rates, and met adequate yearly progress goals.

Acceleration programs in Minnesota

Members of the Midwest College and Career Success Research Alliance needed state-specific information about the accessibility of acceleration programs across secondary and postsecondary education for Minnesota students. Although a growing body of literature examines the postsecondary outcomes of students who participate in acceleration programs, no recent studies specific to Minnesota examined the relationship between type of acceleration programs and postsecondary measures.

The Postsecondary Enrollment Options program was established in 1985 by Minnesota state statute (Postsecondary Enrollment Options Act, 2015) to allow high school students to earn both secondary and postsecondary credit for college or university courses completed on a college or university campus (Borden, Taylor, Park, & Seiler, 2013). It was the first state dual-enrollment policy in the United States (Education Commission of the States, 2013). Colleges that participate in the program are reimbursed by the state for dual-enrollment courses taught at the college (Minnesota Department of Education, 2015).

In addition to the Postsecondary Enrollment Options program, high school students in Minnesota have the opportunity to earn both secondary and postsecondary credit though concurrent-enrollment programs in which college courses are taught during the school day at the high school, usually by a specially trained high school teacher (Minnesota Department of Education, n.d. a). Concurrent enrollment is funded through the school district (Minnesota Department of Education, 2015), with additional state aid available (Minnesota Network of Concurrent Enrollment Programs, 2011). During the 2010/11 school year 24 two- and four-year colleges with concurrent-enrollment programs worked with 352 public and private high schools, and more than 21,000 high school students participated in concurrent-enrollment courses (Minnesota Network of Concurrent Enrollment Programs, n.d., 2011).

Appendix B. Data sources and methodology

The following section details the data sources, data processing, and methods of data analysis for the report.

Data sources

The study team worked directly with the Minnesota Office of Higher Education, which is represented on the Midwest College and Career Success Research Alliance, to acquire the student data from the Minnesota Statewide Longitudinal Education Data System. The data consisted of deidentified K–12 student-level information (enrollment and assessment data, managed by the Minnesota Department of Education) and postsecondary student-level information (enrollment and National Student Clearinghouse data, managed by the Minnesota Office of Higher Education). Urban-centric locale codes and high school enrollment values for Minnesota high schools were downloaded from the National Center for Education Statistics Elementary and Secondary Information System website (http://nces.ed.gov/ccd/elsi/; U.S. Department of Education, n.d.). Minnesota Office of Higher Education postsecondary data were supplemented with data from two sources: publicly available data accessed through the Integrated Postsecondary Education Data System Data Center website (http://nces.ed.gov/ipeds/datacenter/) and selectivity rankings from Barron's Profiles of American Colleges (Barron's Educational Series, 2010).

Data processing

This section details the creation of the population and analytic samples, variable creation, and the extent to which data were missing from the variables in the analysis.

Creation of the population and analytic samples. The study team received data on all 2011 Minnesota high school graduates (59,499 students), with each student identified by an anonymous identification number. Because the study examined several subsections of the population of 2011 Minnesota high school graduates, the study team relied on several analytic samples to accurately answer the study's five research questions (table B1). Characteristics of the full population and the analytic samples are outlined in table B2.

Variable creation. This section describes variables that were created from the raw data. Variables that did not require extensive manipulation (for example, gender and race/ethnicity) are not described.

Minnesota Comprehensive Assessment scores. For the cohort in this study the Minnesota Comprehensive Assessment in math was administered in grades 8 and 11 (in spring 2007 and 2010, respectively), and the Minnesota Comprehensive Assessment in reading was administered in grades 8 and 10 (in spring 2007 and 2009, respectively). Composite test scores were calculated by separately standardizing each raw score (grade 8 math and reading, grade 10 reading, and grade 11 math), adding scores together by subject area (grade 8 and 11 math and grade 8 and 10 reading), and then standardizing the sum of each. Standardization was based on the test scores of all 2011 high school graduates in the full population.

Table B1. Analytic samples for the research questions

Research question	Analytic sample	Description of analytic sample	Sample size
1 (proportion of 2011 graduates who participated in acceleration programs and were awarded credits) 4 (whether participation in acceleration programs was associated with college enrollment) 5 (whether the association between participation in acceleration programs and college enrollment was the same after student- and school-level characteristics were controlled for)	High school graduates	All 2011 graduates of Minnesota high schools regardless of postsecondary plans	59,499
2 (characteristics of the students and schools that participated in acceleration programs and of the students who were awarded credit in the programs)	Participants in acceleration programs	All 2011 graduates of Minnesota high schools who participated in at least one acceleration program during high school	28,636
3 (characteristics of colleges that awarded credit to participants in acceleration programs who enrolled in their institutions) 4 (whether participation in acceleration programs was associated with college readiness and college persistence) 5 (whether the association between participation in acceleration programs and college readiness and college persistence was the same after student- and school-level characteristics were controlled for)	Graduates enrolling in a Minnesota college within two years of high school graduation	All 2011 graduates of Minnesota high schools who enrolled in a Minnesota college within two years of high school graduation	33,298

Source: Authors' creation based on data from the Minnesota Statewide Longitudinal Education Data System.

Advanced Placement and International Baccalaureate program participation. Indicators for these acceleration program types were measured by whether a student sat for an examination in their respective program. While this method may miss a small number of students who participated in coursework but subsequently did not sit for an examination, it is a common method for measuring participation in both of these programs (Minnesota Office of Higher Education, n.d. a).

Unknown participation in acceleration program. For some students, participation in acceleration programs was flagged in the postsecondary data, but no participation indicator was given in the K–12 data. After speaking with Minnesota state data experts, the study team identified this as a potential source of reporting errors and flagged these students as participating in an "unknown dual-credit program." Thus, the study can track their postsecondary outcomes, compare them with other acceleration programs, and aid in resolving the reporting error.

Reported dual credit. Although data on participation in acceleration programs were provided, there is no indication of what dual credit was earned from those programs. The study team thus worked with the Minnesota Office of Higher Education to identify a proxy variable for dual credit earned in the postsecondary data provided by the state. To this end, the variable for reported dual credit was constructed using one or both of the high school graduate's first semester transfer credit value and accumulated credit value, with the selection depending on the institution attended (because institutions differed in their data reporting). Specifically, for students whose first college term was at a public institution in

Table B2. Characteristics of the population and analytic samples

Characteristic	2011 Minnesota high school graduates (*N* = 59,499)		Participants in acceleration programs (*N* = 28,636)		Graduates enrolling in a Minnesota college within two years of high school graduation (*N* = 33,298)	
	Number	Percent	Number	Percent	Number	Percent
Student characteristic						
Gender						
Male	29,954	50.3	12,379	43.2	15,800	47.5
Female	29,545	49.7	16,257	56.8	17,498	52.5
Race/ethnicity						
White	48,547	81.6	24,808	86.6	27,264	81.9
Black	4,261	7.2	1,183	4.1	2,350	7.1
Asian/Pacific Islander	3,579	6.0	1,710	6.0	2,284	6.9
Hispanic (any race)	2,309	3.9	691	2.4	1,035	3.1
American Indian/Alaskan Native	803	1.4	244	0.9	365	1.1
Eligibility for the federal school lunch program						
Eligible	22,585	38.0	7,696	26.9	11,384	34.2
Not eligible	36,914	62.0	20,940	73.1	21,914	65.8
ACT composite score						
Lower third	11,739	31.6	4,538	15.8	8,353	25.1
Middle third	12,062	32.5	7,797	27.2	8,218	24.7
Upper third	13,370	36.0	11,770	41.1	8,115	24.4
MCA-II standardized math score						
Lower third	16,078	33.2	3,653	12.8	8,769	26.3
Middle third	16,182	33.4	8,358	29.2	10,436	31.3
Upper third	16,135	33.3	13,278	46.4	9,968	29.9
MCA-II standardized reading score						
Lower third	16,199	33.3	3,753	13.1	8,869	26.6
Middle third	16,154	33.2	8,423	29.4	10,367	31.1
Upper third	16,251	33.4	13,216	46.2	10,018	30.1
High school characteristic						
Urbanicity						
Rural	20,032	33.7	10,070	35.2	11,103	33.3
Nonrural	39,467	66.3	18,566	64.8	22,195	66.7
Size						
Small	19,697	33.1	6,671	23.3	9,245	27.8
Medium	19,804	33.3	9,773	34.1	12,039	36.2
Large	19,914	33.5	12,188	42.6	11,993	36.0

MCA is Minnesota Comprehensive Assessment.

Note: ACT scores were divided into thirds on the basis of available data from 37,171 students, MCA-II math scores were divided into thirds on the basis of available data from 48,395 students, MCA-II reading scores were divided into thirds on the basis of available data from 48,604 students, and school sizes were divided into thirds on the basis of available data from 59,415 students. Percentages may not sum to 100 because of rounding.

Source: Authors' calculations based on data from the Minnesota Statewide Longitudinal Education Data System, U.S. Department of Education (n.d.), and Barron's Educational Series (2010).

the University of Minnesota system, their reported dual credit was equivalent to the value of their first-term accumulated credits. If students attended any other institution (any non-public institution or one not in the University of Minnesota system), their reported dual credit was calculated by adding the values of their transfer credits and accumulated credits reported in their first term.

College enrollment. Minnesota-specific college enrollment indicators were constructed using postsecondary enrollment data. The Minnesota Office of Higher Education collects data on all postsecondary institutions in the state for the fall term, including private colleges, two-year colleges and less-than-two-year institutions. For graduates who enrolled in an out-of-state college, supplemental college enrollment data were provided by the National Student Clearinghouse collection. A small subset of students may not appear in the college enrollment data if there are no records of enrollment (such as students who did not enroll in a college) or if enrollment occurred in an out-of-state postsecondary institution that does not participate in the National Student Clearinghouse.

A student was considered enrolled in fall 2011 if that student was registered at a Minnesota college during the fall 2011 term. A student was considered to have enrolled within two years of high school graduation if that student was registered at a Minnesota college during either the fall 2011 or fall 2012 term. Students enrolled in an out-of-state college (according to the National Student Clearinghouse) were used to supplement the calculation of student persistence—if the student started in a Minnesota college (found in the data provided by the Minnesota Office of Higher Education) in the first year and was seen to have transferred out of state for the second year (found in the National Student Clearinghouse data), that student was counted as persisting to the second year of college. When National Student Clearinghouse data were used, the term of student enrollment was chosen according to the term and year observed in the specific record, which is provided by the institution. When contradictions arose between National Student Clearinghouse and Office of Higher Education data, the study team assumed that the Minnesota Office of Higher Education's data were more accurate.

College selectivity. Four-year colleges were classified into three categories on the basis of the Barron's selectivity ranking (Barron's Educational Series, 2010). Barron's classifies colleges into categories according to the academic qualifications of students enrolled in the college (SAT or ACT scores, class rank, and high school grade point average) and the percentage of applicants accepted. The Barron's index has been used in many studies of college outcomes (Dale & Krueger, 2011; Hoxby, 2001; Roderick et al., 2008), and the National Center for Education Statistics makes it available to users with a restricted data license for merging with many of its longitudinal datasets. For this analysis, the Barron's categories were collapsed to three: 5 colleges were classified as less selective (corresponding to Barron's categories of competitive, less competitive, and special), 20 colleges were classified as selective (corresponding to the Barron's very competitive plus, very competitive, and competitive plus categories), and 5 colleges were classified as very selective (corresponding to the Barron's categories of most competitive, highly competitive plus, and highly competitive; box B1). For the small number of students enrolled in more than one college during any given term, the institution with the higher selectivity was chosen as the student's primary institution.

Box B1. Minnesota four-year public and private colleges by selectivity level

Very selective four-year colleges

- Carleton College
- Macalester College
- Saint Olaf College
- Gustavus Adolphus College
- University of Minnesota–Twin Cities

Selective four-year colleges

- Bethel University
- College of Saint Benedict
- Hamline University
- Saint John's University
- University of Minnesota–Morris
- Concordia College, Moorhead
- University of Minnesota–Duluth
- Augsburg College
- Bemidji State University
- College of Saint Scholastica
- Concordia University Saint Paul
- Minnesota State University–Moorhead
- North Central University
- Northwestern College
- Saint Cloud State University
- Saint Mary's University of Minnesota
- Southwest Minnesota State University
- St. Catherine University
- University of Saint Thomas
- Winona State University

Less selective four-year colleges

- Minnesota State University–Mankato
- University of Minnesota–Crookston
- College of Visual Arts
- Metropolitan State University
- Minneapolis College of Art and Design

Source: Barron's Educational Series, 2010.

Taking only nonremedial courses in the first year. One of the postsecondary outcomes of interest was to observe what association, if any, participation in acceleration programs had with the incidence of remedial coursework in students' first year of college. The study team used remedial credit values found in the postsecondary data to build an indicator of whether a student took any remedial courses.

Missing data. Overall, rates of missing data were low (table B3). Missing data cannot be distinguished from indicators of nonparticipation for ACT and of nonparticipation in acceleration programs. If a student did not have an ACT score, the study team assumed

Table B3. Rates of missing data for student, high school, and college variables by analytic sample

Variable	2011 Minnesota high school graduates (*N* = 59,499)		Acceleration program participants (*N* = 28,636)		Enrolled in Minnesota college within two years of high school graduation (*N* = 33,298)	
	Number of valid cases	Percent missing	Number of valid cases	Percent missing	Number of valid cases	Percent missing
Student variables						
Gender	59,499	0.0	28,636	0.0	33,298	0.0
Race/ethnicity	59,499	0.0	28,636	0.0	33,298	0.0
Eligibility for the federal school lunch program	59,499	0.0	28,636	0.0	33,298	0.0
MCA-II standardized math score	48,395	18.7	25,289	11.7	29,173	12.4
MCA-II standardized reading score	48,604	18.3	25,392	11.3	29,254	12.1
ACT score	37,171	37.5	24,105	15.8	24,686	25.9
High school variables						
School urbanicity	59,499	0.0	28,636	0.0	33,298	0.0
School enrollment	59,415	0.1	28,632	0.0	33,277	0.1
College variables						
College type	34,935	41.3	18,939	33.9	33,298	0.0
College selectivity	19,593	67.1	14,060	50.9	19,140	42.5

MCA is Minnesota Comprehensive Assessment.

Source: Authors' calculations based on data from the Minnesota Statewide Longitudinal Education Data System, U.S. Department of Education (n.d.), and Barron's Educational Series (2010).

that the student did not take the ACT, and if a student did not have a record of participation in Advanced Placement, concurrent-enrollment, Postsecondary Enrollment Options, or International Baccalaureate courses, the study team inferred that the student did not participate. For hierarchical linear models, which require complete cases, missing values for Minnesota Comprehensive Assessment (MCA)-II scores were replaced with the population mean, and a missing data indicator was created.

Methods of data analysis

Descriptive and correlational methods were used to analyze the data for the study. The following sections describe the methods used for each research question.

Research question 1. To answer research question 1 on the proportion of 2011 graduates who participated in acceleration programs and were awarded credits by the Minnesota two- or four-year college in which they enrolled, the study team used cross-tabular descriptive statistics to describe the percentage of high school graduates who participated in each type of acceleration program (that is, Advanced Placement courses, concurrent-enrollment courses, Postsecondary Enrollment Options courses, International Baccalaureate courses, or other/unknown programs), participated in more than one type of acceleration program, had at least one dual credit from any acceleration program recorded by the Minnesota college in which they enrolled, and had more than 15 dual credits from any acceleration program recorded by the Minnesota college in which they enrolled.

Research question 2. To answer research question 2 on the characteristics of the students and schools that participated in acceleration programs and of the students who were awarded credit in these programs, the study team examined the extent to which participation in acceleration programs and having dual credit recorded varied by student- and school-level characteristics. This analysis provides state-specific information to policymakers on gaps in accessibility and differences in the rate of earning dual credits for the examined subgroups. Cross-tabular descriptive statistics were used to describe the percentage of students participating in each type of acceleration program by the student characteristics of gender, race/ethnicity, eligibility for the federal school lunch program, and state standardized test scores, and the school characteristics of urbanicity (rural and nonrural), and school size (small, medium, or large, on the basis of the number of students). Cross-tabular descriptive statistics were also used to describe differential rates of having dual credit recorded by the Minnesota college in which a graduate enrolled by student and school characteristics.

Research question 3. To answer research question 3 on the characteristics of colleges that awarded credit to participants in acceleration programs who enrolled in their institutions, the study team examined differences in the percentage and type of credits awarded to students by college type and selectivity. This information can be used for understanding the extent to which various colleges participate in acceleration programs. To address this question, the analysis included Minnesota high school graduates who enrolled in a college in Minnesota. Differences were examined in terms of credits from any acceleration program awarded by colleges. (In Minnesota, credits are awarded by the college in which students enroll and are not distinguished by acceleration program type.)

Research question 4. To answer research question 4 on whether participation in acceleration programs was associated with college enrollment, college readiness, or persistence to the second year of college, the study team examined the extent to which students who participated in acceleration programs differed from those who did not on the postsecondary measures of college enrollment, college readiness, and college persistence as well as the extent to which participants in acceleration programs who were awarded credit by the college in which they enrolled and those who were not awarded credit differed on measures of college readiness and college persistence. Descriptive analysis examined differences between students who participated in acceleration programs and those who did not in the postsecondary measures of college enrollment (enrolled in a Minnesota college in fall 2011, enrolled in a Minnesota four-year college in fall 2011, or enrolled in a Minnesota college in fall 2011 or 2012), college readiness (enrolled in only nonremedial courses in the first semester), and college persistence (enrolled in a Minnesota college in fall 2011 or 2012 and returned for the second year of college).

Research question 5. To answer research question 5 on whether the associations between participation in acceleration programs and college enrollment, college readiness, and college persistence remain the same after other student and school variables are controlled for, the study team estimated two-level hierarchical models to examine the association between participation in acceleration programs and each postsecondary measure, with student and school characteristics (identified in research question 2) controlled for.

The study team estimated five two-level hierarchical linear models, one for each of the postsecondary outcomes associated with college enrollment, college readiness, and college

persistence. A statistical adjustment for multiple comparisons was included using the Benjamini–Hochberg correction (Benjamini & Hochberg, 1995), the method recommended by the What Works Clearinghouse for studies examining multiple outcomes in the same domain using a single comparison group (What Works Clearinghouse, 2014). For all outcomes, hierarchical generalized linear models were estimated using hierarchical linear model software to account for the binary outcome and nested nature of the data in which students are nested within high schools. Specifically, to model the binary outcome, the probability of achieving the outcome, for student i in high school j, is transformed using the logit link, which is the log of the odds, where the odds is the probability of the event (that is, enrolling in a Minnesota college in fall 2011; enrolling in only nonremedial courses the first semester of college) divided by 1 minus the probability of the event:

$$\eta_{ij} = \log\left(\frac{u_{ij}}{1-u_{ij}}\right).$$

The transformed variable is then modeled as the outcome in the following two-level model:

Level 1 model for binary outcomes: students-within-schools

$$\eta_{ij} = \beta_{0j} + \sum_{p=1}^{P} \beta_{1j} a_{pij} + e_{ij}$$

where i is the number of students ($i = 1, \ldots, n_j$) in school j, j is the number of high schools ($j = 1, \ldots, j$), a_{pij} is the pth student characteristic for student i in high school j ($p = 1, \ldots, P$), and e_{ij} is the random error term for student i in high school j.

Level 2 model: schools

$$\beta_{0j} = \gamma_{00} + \sum_{r=1}^{R} \gamma_{0r} W_{0rj} + u_j$$

$$\beta_{pj} = \gamma_p \text{ for } p > 0$$

where W_{0rj} is the rth characteristic for high school j ($r = 1, \ldots, R$) and u_j is the random error for high school j.

Each model included level 1 (student) and level 2 (school) variables to control for student and school characteristics. Student characteristics include gender, race/ethnicity, eligibility for the federal school lunch program, and composite standardized MCA-II math and reading test scores. School characteristics included urbanicity and size. The models also included several binary predictors reflective of students taking advantage of acceleration programs in high school and dual credits earned in college. These included whether a student participated in an Advanced Placement course, whether a student participated in a concurrent-enrollment course, whether a student participated in a Postsecondary Enrollment Options (PSEO) course, whether a student participated in an other/unknown program, and whether a student participated in an International Baccalaureate course. For the models estimating the likelihood of taking only nonremedial courses in the first

semester and persisting to the second year of college, the models also included whether a student was awarded 1–15 dual credits and whether a student was awarded more than 15 dual credits recorded.

The results from these models are shown in tables C3 and C4 in appendix C, which present the odds ratios, 95 percent confidence intervals, and *p*-values.

Predicted probability. The "What this study found" section describes output from the regression models in terms of predicted probabilities rather than log odds or odds ratios. For example, to calculate the change in predicted probability in enrolling in a Minnesota college in fall 2011 associated with participation in a PSEO course, the following steps were taken. First, the linear predictor of the log odds of enrolling versus not enrolling in a Minnesota college in fall 2011 was calculated for students who participated in a PSEO course. This linear predictor was calculated as the sum of the estimated coefficient of participating in a PSEO courses multiplied by 1 minus the grand mean of participating in a PSEO course, plus the intercept. Second, the probability of enrolling in a Minnesota college in fall 2011 for students who participated in a PSEO course was calculated as a transformation of the linear predictor: this probability equals 1/[1+exp(–1**linear_predictor*)]. Third, the corresponding linear predictor and probability of enrolling in a Minnesota college in fall 2011 was calculated for students who did not participate in a PSEO course. Finally, the difference between the two predicted probabilities was calculated. This value indicates the difference in predicted probabilities associated with participation in a PSEO course for a "typical" student, where typical means a student whose values for all variables except participation in a PSEO course are at the grand mean values among students in the model, and the random student and high school effects are equal to zero.

Appendix C. Additional results

This appendix presents additional and more detailed results from the analysis.

Demographic and academic characteristics of students

Research question 2 asked about the demographic and academic characteristics of graduates who participated in acceleration programs overall and within each type of acceleration programs and who continued on to a Minnesota college and were awarded dual credit by the college in which they enrolled. Student- and school-level demographic characteristics of the population of 2011 Minnesota high school graduates, along with the student- and school-level characteristics of participants in acceleration programs overall and for each type of acceleration program are presented in table C1.

Student and school characteristics of participants in acceleration programs who enrolled in a Minnesota college within two years of high school graduation, participants who reported being awarded at least one dual credit, and participants who reported being awarded more than 15 dual credits from the college in which they enrolled are provided in table C2.

Controlling for student and school characteristics

Research question 5 asked whether the associations between participation in acceleration programs and college enrollment, college readiness, and college persistence remained the same after student- and school-level characteristics were controlled for.

Results of the regression analyses examining the association between participation in acceleration programs and the three college enrollment measures (enrolling in a Minnesota college in fall 2011, enrolling in a four-year Minnesota college in fall 2011, and enrolling in a Minnesota college in fall 2011 or fall 2012) after student- and school-level characteristics were controlled for are presented in table C3.

Results of the analysis examining the relationship between participation in acceleration programs and college readiness (as measured by taking only nonremedial courses in the first semester) and college persistence, as well as the extent to which the award of dual credit was associated with college readiness and persistence among participants in acceleration programs who enrolled in a Minnesota college within two years of high school graduation, after student- and school-level characteristics were controlled for are presented in table C4.

Table C1. Number and percentage of 2011 Minnesota high school graduates who participated in acceleration programs by student and school characteristics

Characteristic	Total population (*N* = 59,499)		Acceleration program: Any program (*N* = 28,636)		Advanced Placement (*N* = 15,347)		Concurrent enrollment (*N* = 11,342)		Postsecondary Enrollment Options (*N* = 4,420)		Other/unknown program (*N* = 3,423)		International Baccalaureate (*N* = 1,428)	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Student characteristic														
Gender														
Male	29,954	50	12,379	43	6,915	45	4,724	42	1,474	33	1,469	43	607	43
Female	29,545	50	16,257	57	8,432	55	6,618	58	2,946	67	1,954	57	821	58
Race/ethnicity														
White	48,547	82	24,808	87	13,414	87	10,166	90	3,736	85	2,902	85	895	63
Black	4,261	7	1,183	4	559	4	304	3	224	5	224	7	150	11
Asian/Pacific Islander	3,579	6	1,710	6	1,006	7	486	4	336	8	137	4	286	20
Hispanic	2,309	4	691	2	288	2	286	3	95	2	101	3	84	6
American Indian/ Alaskan Native	803	1	244	1	80	1	100	1	29	1	59	2	13	1
Eligibility for the federal school lunch program														
Eligible	22,585	38	7,696	27	2,830	18	3,204	28	1,276	29	1,421	42	571	40
Not eligible	36,914	62	20,940	73	12,517	82	8,138	72	3,144	71	2,002	58	857	60
ACT composite score[a]														
Lower third	11,739	20	4,538	16	1,415	9	2,003	18	609	14	822	24	313	22
Middle third	12,062	20	7,797	27	3,826	25	3,418	30	1,239	28	823	24	318	22
Upper third	13,370	22	11,770	41	8,841	58	4,309	38	1,748	40	529	15	626	44
MCA-II math score[a]														
Lower third	16,078	27	3,653	13	980	6	1,613	14	469	11	814	24	182	13
Middle third	16,182	27	8,358	29	3,611	24	3,614	32	1,299	29	1,083	32	375	26
Upper third	16,135	27	13,278	46	9,250	60	5,190	46	2,015	46	755	22	703	49
MCA-II reading score[a]														
Lower third	16,199	27	3,753	13	1,014	7	1,682	15	443	10	838	24	209	15
Middle third	16,154	27	8,423	29	3,783	25	3,606	32	1,328	30	1,032	30	387	27
Upper third	16,251	27	13,216	46	9,071	59	5,153	45	2,053	46	794	23	665	47
School characteristic														
Urbanicity														
Rural	20,032	34	10,070	35	4143	27	4915	43	1516	34	1,462	43	62	4
Nonrural	39,467	66	18,566	65	11204	73	6427	57	2904	66	1,961	57	1366	96

(continued)

Table C1. Number and percentage of 2011 Minnesota high school graduates who participated in acceleration programs by student and school characteristics *(continued)*

			Acceleration program											
	Total population (*N* = 59,499)		Any program (*N* = 28,636)		Advanced Placement (*N* = 15,347)		Concurrent enrollment (*N* = 11,342)		Postsecondary Enrollment Options (*N* = 4,420)		Other/unknown program (*N* = 3,423)		International Baccalaureate (*N* = 1,428)	
Characteristic	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Enrollment														
Small	19,697	33	6,671	23	2,164	14	1,811	16	1,094	25	2,201	64	245	17
Medium	19,804	33	9,773	34	5,219	34	4,191	37	1,954	44	767	22	499	35
Large	19,914	33	12,188	43	7,964	52	5,339	47	1,372	31	452	13	684	48

PSEO is postsecondary enrollment options. MCA is Minnesota Comprehensive Assessment.

Note: ACT scores were divided into thirds on the basis of available data from 37,171 students, MCA-II math scores were divided into thirds on the basis of available data from 48,395 students, MCA-II reading scores were divided into thirds on the basis of available data from 48,604 students, and school sizes were divided into thirds on the basis of available data from 59,415 students. Percentages may not sum to 100 because of rounding.

a. Data for some students were unavailable. Percentages use the *N* values in the column header as the denominator.

Source: Authors' calculations based on data from the Minnesota Statewide Longitudinal Education Data System and U.S. Department of Education (n.d.).

Table C2. Student and school characteristics of participants in acceleration programs who enrolled in a Minnesota college within two years of high school graduation, those who reported being awarded at least one dual credit, and those who reported being awarded more than 15 dual credits

	Participants enrolled in Minnesota college (*N* = 18,287)		Reported being awarded at least one dual credit (*N* = 9,265)		Reported being awarded more than 15 dual credits (*N* = 4,804)	
Characteristic	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Student characteristic						
Gender						
Male	7,754	42	3,829	41	1,903	40
Female	10,533	58	5,436	59	2,901	60
Race/ethnicity						
White	15,629	85	8,173	88	4,288	89
Black	804	4	254	3	100	2
Asian/Pacific Islander	1,283	7	608	7	314	7
Hispanic	409	2	161	2	68	1
American Indian/Alaskan Native	162	1	69	1	34	1
Eligibility for the federal school lunch program						
Eligible	5,147	28	2,005	22	956	20
Not eligible	13,140	72	7,260	78	3,848	80
ACT composite score[a]						
Lower third	3,374	18	1,089	12	386	8
Middle third	5,361	29	2,565	28	1,157	24
Upper third	7,119	39	4,956	53	2,982	62
MCA-II standardized math score[a]						
Lower third	2,474	14	647	7	207	4
Middle third	5,726	31	2,439	26	1,022	21
Upper third	8,235	45	5,380	58	3,155	66
MCA-II standardized reading score[a]						
Lower third	2,551	14	707	8	228	5
Middle third	5,733	31	2,507	27	1,051	22
Upper third	8,205	45	5,279	57	3,135	65
School characteristic						
Urbanicity						
Rural	6,365	35	3,296	36	1,773	37
Nonrural	11,922	65	5,969	64	3,031	63
Size						
Small	4,155	23	1,916	21	1,013	21
Medium	6,467	35	3,209	35	1,664	35
Large	7,665	42	4,140	45	2,127	44

MCA is Minnesota Comprehensive Assessment.

Note: ACT scores were divided into thirds on the basis of available data from 37,171 students in the analytic sample of 2011 Minnesota high school graduates, MCA-II math scores were divided into thirds on the basis of available data from 48,395 students, MCA-II reading scores were divided into thirds on the basis of available data from 48,604 students, and school sizes were divided into thirds on the basis of available data from 59,415 students.

a. Data for some students were unavailable. Percentages use the *N* values in the column header as the denominator.

Source: Authors' calculations based on data from the Minnesota Statewide Longitudinal Education Data System and U.S. Department of Education (2012).

Table C3. Regression results predicting enrollment in a Minnesota college in fall 2011, enrollment in a four-year Minnesota college in fall 2011, and enrollment in a Minnesota college in fall 2011 or fall 2012 among 2011 Minnesota high school graduates

	Enrolled in a Minnesota college in fall 2011		Enrolled in a four year Minnesota college in fall 2011		Enrolled in a Minnesota college in fall 2011 or fall 2012	
Characteristic	Odds ratio	95 percent confidence interval	Odds ratio	95 percent confidence interval	Odds ratio	95 percent confidence interval
Student characteristic						
Female	1.21***	(1.16, 1.26)	1.34***	(1.28, 1.41)	1.21***	(1.16, 1.26)
Black	1.25***	(1.15,1.36)	1.25***	(1.12, 1.39)	1.34***	(1.22, 1.46)
Hispanic	0.79***	(0.71, 0.89)	0.69***	(0.61, 0.78)	0.82***	(0.73, 0.91)
Eligible for the federal school lunch program	0.82***	(0.78, 0.87)	0.69***	(0.66, 0.73)	0.85***	(0.81, 0.90)
Standardized MCA-II math composite score	1.13***	(1.10, 1.17)	1.63***	(1.56, 1.71)	1.10***	(1.06, 1.14)
Indicator of missing MCA-II math score	0.55***	(0.51, 0.59)	0.59***	(0.54, 0.64)	0.53***	(0.49, 0.57)
Participated in Advanced Placement	1.06	(0.99, 1.13)	1.58***	(1.46, 1.71)	0.96	(0.90, 1.04)
Participated in concurrent enrollment	1.53***	(1.40, 1.68)	2.03***	(1.80, 2.29)	1.48***	(1.34, 1.63)
Participated in Postsecondary Enrollment Options	1.51***	(1.39, 1.65)	1.67***	(1.52, 1.84)	1.55***	(1.42, 1.69)
Participated in other/unknown program	1.44***	(1.31, 1.58)	1.60***	(1.41, 1.82)	1.49***	(1.36, 1.64)
Participated in International Baccalaureate	0.88	(0.65, 1.19)	1.25	(0.80, 1.95)	0.87	(0.66, 1.15)
High school characteristic						
Rural high school	1.31***	(1.19, 1.45)	1.40***	(1.24, 1.58)	1.21***	(1.90, 1.33)
Enrollment between 579 and 1,599 students	1.85***	(1.66, 2.05)	2.09***	(1.85, 2.37)	1.84***	(1.66, 2.04)
Enrollment 1,600 students or larger	1.95***	(1.73, 2.19)	2.31***	(2.02, 2.65)	1.96***	(1.75, 2.19)

** Significant at $p < .01$; *** significant at $p < .001$.

MCA is Minnesota Comprehensive Assessment. PSEO is Postsecondary Enrollment Options program.

Note: Regressions were run on the entire population of 2011 Minnesota high school graduates, which had 59,499 students in 797 schools. Critical *p*-values were adjusted using the Benjamini–Hochberg method (Benjamini & Hochberg, 1995); however, the adjustments had no influence on the statistical significance of the predictors.

Source: Authors' calculations based on data from the Minnesota Statewide Longitudinal Education Data System.

Table C4. Regression results predicting enrolling in only nonremedial courses in the first semester of college and persistence to the second year of college for 2011 Minnesota high school graduates who enrolled in a Minnesota college within two years of high school graduation

Characteristic	Took only nonremedial courses in the first semester of college		Persisted to a second year of college	
	Odds ratio	95 percent confidence interval	Odds ratio	95 percent confidence interval
Student characteristic				
Female	0.99	(0.93, 1.06)	1.29***	(1.23, 1.36)
Black	0.72***	(0.64, 0.81)	0.96	(0.86, 1.08)
Hispanic	0.78**	(0.67, 0.91)	0.89	(0.77, 1.04)
Eligible for the federal school lunch program	0.73***	(0.68, 0.77)	0.63***	(0.59, 0.67)
Standardized MCA-II math composite score	3.28***	(3.07, 3.49)	1.54***	(1.48, 1.60)
Indicator of missing MCA-II math score	0.57***	(0.52, 0.62)	0.68***	(0.62, 0.74)
Participated in Advanced Placement	3.25***	(2.91, 3.62)	2.00***	(1.84, 2.18)
Participated in concurrent enrollment	2.11***	(1.91, 2.34)	1.72***	(1.58, 1.86)
Participated in Postsecondary Enrollment Options	2.91***	(2.51, 3.37)	1.24**	(1.11, 1.40)
Participated in other/unknown program	2.05***	(1.79, 2.34)	1.03	(0.90, 1.18)
Participated in International Baccalaureate	2.12***	(1.58, 2.84)	1.47**	(1.18, 1.82)
Up to 15 dual credits awarded[a]	2.34***	(1.97, 2.78)	1.94***	(1.76, 2.13)
More than 15 dual credits awarded[a]	6.09***	(4.85, 7.66)	1.26**	(1.10, 1.44)
High school characteristic				
Rural high school	1.21**	(1.09, 1.35)	1.26***	(1.15, 1.37)
Enrollment between 579 and 1,599 students	1.10	(0.97, 1.25)	1.29***	(1.18, 1.42)
Enrollment of 1,600 students or higher	1.20**	(1.06, 1.36)	1.45***	(1.31, 1.61)

** Significant at $p < .01$; *** significant at $p < .001$.

MCA is Minnesota Comprehensive Assessment.

a. Includes only participants in acceleration programs who enrolled in a Minnesota college within two years of high school graduation (n = 18,247).

Note: Regressions were run on the sample of high school graduates who entered a Minnesota college within two years of graduation, which had 33,298 students in 689 high schools. Critical p-values were adjusted using the Benjamini–Hochberg method (Benjamini & Hochberg, 1995); however, the adjustments had no influence on the statistical significance of the predictors.

Source: Authors' calculations based on data obtained from the Minnesota Statewide Longitudinal Education Data System.

Notes

1. The minimum standards in Minnesota are 60 semester credits for an associate's degree (Minnesota Office of Higher Education, n.d. b) and 120 semester credits for a bachelor's degrees (Minnesota Office of Higher Education, n.d. c).
2. Regression models controlled for gender, race/ethnicity, eligibility for the federal school lunch program, standardized math test scores at the student level and for high school urbanicity and size at the school level. The models did not control for variables not available through the Minnesota State Longitudinal Education Data System, such as grade point average, parent education, and postsecondary aspirations.
3. In fall 2011 there were 248,903 undergraduates enrolled in Minnesota public postsecondary institutions and 91,725 undergraduates enrolled in Minnesota private postsecondary institutions (Aud et al., 2013).
4. Full-time Postsecondary Enrollment Options program students who begin these courses in grade 11 have the opportunity to earn enough credits for an associate's degree (Minnesota Department of Education, n.d. c).
5. For examples of this reporting method, see Indiana Department of Education (n.d.) and Minnesota Office of Higher Education (n.d. d).
6. Fifty-seven percent of 2001 first-time full-time bachelor's degree-seekers completed a bachelor's degree, and 28 percent of 2005 two-year college students completed a certificate or associate's degree within 150 percent of the normal time (Snyder & Dillow, 2011).
7. For example, in Indiana, 90 percent of 2011 high school graduates who took and passed an Advanced Placement test enrolled in college, compared with 87 percent of 2011 graduates who took but did not pass an Advanced Placement test and 53 percent of 2011 graduates who did not take an Advanced Placement test (Indiana Commission for Higher Education, 2013).

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