What's Happening

April 2015

Early identification of high school graduation outcomes in Oregon Leadership Network schools

Arthur Burke
Education Northwest

Key findings

This study examined data from the 2007/08 grade 9 cohort in four Oregon districts to find early warning indicators of students who may drop out or fail to graduate from high school on time. The study identified four indicators that provided valuable early warning signals about students who did not graduate on time, particularly about students who dropped out of high school:

- Grade 8 attendance rate below 80 percent.
- Grade 9 attendance rate below 80 percent.
- Grade 8 grade point average (GPA) below 2.0.
- Grade 9 GPA below 2.0.

When the influence of demographic, achievement, and behavioral characteristics and differences in the schools that students attended were considered at the same time, only gender, English learner student status, and attendance and GPA in grades 8 and 9 were associated with graduation outcomes.

ies NATIONAL CENTER FOR EDUCATION EVALUATION AND REGIONAL ASSISTANCE
Institute of Education Sciences
U.S. Department of Education

REL NORTHWEST
Regional Educational Laboratory
At Education Northwest

U.S. Department of Education
Arne Duncan, *Secretary*

Institute of Education Sciences
Sue Betka, *Acting Director*

National Center for Education Evaluation and Regional Assistance
Ruth Curran Neild, *Commissioner*
Joy Lesnick, *Associate Commissioner*
Amy Johnson, *Action Editor*
OK-Choon Park, *Project Officer*

REL 2015–079

The National Center for Education Evaluation and Regional Assistance (NCEE) conducts unbiased large-scale evaluations of education programs and practices supported by federal funds; provides research-based technical assistance to educators and policymakers; and supports the synthesis and the widespread dissemination of the results of research and evaluation throughout the United States.

April 2015

This report was prepared for the Institute of Education Sciences (IES) under Contract ED-IES-12-C-003 by Regional Educational Laboratory Northwest administered by Education Northwest. The content of the publication does not necessarily reflect the views or policies of IES or the U.S. Department of Education, nor does mention of trade names, commercial products, or organizations imply endorsement by the U.S. Government.

Burke, A. (2015). *Early identification of high school graduation outcomes in Oregon Leadership Network schools* (REL 2015–079). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Northwest. Retrieved from http://ies.ed.gov/ncee/edlabs.

This report is available on the Regional Educational Laboratory website at http://ies.ed.gov/ncee/edlabs.

Summary

A substantial body of recent research has attempted to identify the characteristics of students who graduate from high school on time and of those who do not. One motivation for this research has been the desire to develop indicators that can provide early identification of students who might not complete high school on time so that educators can design interventions to get these students back on track for graduation.

This study looked at the graduation outcomes of a cohort of students who began grade 9 in the 2007/08 school year in four Oregon districts. It analyzed factors related to three key graduation outcomes: dropping out within four years of entering grade 9, staying in school but not graduating on time (within four years), and graduating on time.

The results call particular attention to male students and to English learner students because these students had lower on-time graduation rates than other students. In addition, the study confirms findings from previous research that high attendance and grade point average (GPA) in grades 8 and 9 are significantly associated with graduating on time. After other factors were accounted for, race/ethnicity and achievement on standardized tests were less predictive of graduating on time. Unlike previous studies, this one did not find that, after accounting for other factors, discipline in grade 9 was substantially associated with graduating on time.

The study has three key findings:

- Four indicators—grade 8 attendance rate below 80 percent, grade 9 attendance rate below 80 percent, grade 8 GPA below 2.0, and grade 9 GPA below 2.0—provided valuable early warning signals about students who did not graduate on time.
- When other factors were not accounted for, students' high school graduation outcomes differed according to their demographic characteristics, special education status, English learner student status, attendance and achievement in grades 8 and 9, and behavior (suspension or expulsion) in grade 9.
- However, when the influence of demographic, achievement, and behavioral characteristics and differences in the schools that students attended were considered at the same time, only gender, English learner student status, and attendance and GPA in grades 8 and 9 were associated with graduation outcomes. In addition, differences in graduation outcome by gender and English learner student status diminished for students with higher GPAs in grade 9.

In this study, attendance and GPA in grades 8 and 9 were the most predictive indicators of graduation outcome. And unlike gender or English learner student status, they can be influenced by teachers and parents to help keep students on track for graduation.

Contents

Tables

Why this study?

Regional Educational Laboratory (REL) Northwest undertook this study for two reasons: to add to the growing body of research about characteristics of students who fail to complete high school on time and to provide information to the Oregon Leadership Network concerning students who graduated from high school on time and those who did not. The Oregon Leadership Network is an alliance of 16 districts, two education service districts, and several community groups that have worked together for more than a decade to promote successful outcomes for all students (Education Northwest, 2011). Improving graduation rates is a high priority for the alliance districts. This study informs work under way in the alliance districts about developing early warning systems that can identify students who are likely to need additional support to graduate on time.

Dropout and on-time graduation rates in Oregon

Dropout rates for Oregon students vary substantially for students of different races/ethnicities

Overall, dropout rates for Oregon students have declined in recent years. However, the dropout rate varies substantially for students of different races/ethnicities. In 2010/11, 3.3 percent of Oregon's high school students dropped out (Oregon Department of Education, 2012).[1] Statewide, the dropout rate for Black students and American Indian students was twice the rate for White students, while the dropout rate for Hispanic students was 1.6 times the rate for White students (Oregon Department of Education, 2012).

Across the four study districts, 7 percent of students who began grade 9 in 2007/08 dropped out. The overall dropout rate for racial/ethnic minority students was 1.7 times higher than the rate for White students. Within districts, dropout rates ranged from 4 percent to 10 percent for White students and from 6 percent to 15 percent for racial/ethnic minority students (see table A2 in appendix A).

Across all Oregon districts, 68 percent of students who began grade 9 in 2007/08 graduated on time (within four years; Oregon Department of Education, 2013). This included 52 percent of American Indian students, 54 percent of Black students, 58 percent of Hispanic students, 70 percent of White students, and 78 percent of Asian students.

Across the study districts, 73 percent of students who began grade 9 in 2007/08 graduated on time. Within the study districts, on-time graduation rates ranged from 59 percent to 77 percent. Overall, 77 percent of White students and 67 percent of racial/ethnic minority students graduated on time. By individual district, on-time graduation rates ranged from 68 percent to 81 percent for White students and from 50 percent to 72 percent for racial/ethnic minority students.

Students who drop out of high school often suffer severe economic consequences. For example, compared with individuals with a high school diploma, dropouts are less likely to be employed, and when employed, they work fewer weeks per year. In addition, dropouts earn half as much as individuals with a diploma and are half as likely to be covered by a health plan provided through a union or an employer (Rouse, 2007). Recent studies show that the earnings gap between high school dropouts and high school graduates is growing. Overall, the economic consequences of dropping out are increasingly grim (Heckman, Humphries, & Mader, 2011). Furthermore, dropping out is associated with disadvantages in areas of life beyond employment and wages. For example, dropouts commit more crimes,

suffer poorer health, and are less likely to vote and engage constructively in their communities than people who finish high school (Pleis, Ward, & Lucas, 2010; Rumberger, 2011).

The individual costs of dropping out are mirrored by the substantial costs to society, including approximately $240,000 in lost tax revenue over the lifetime of an average dropout and higher expenses associated with increased crime, welfare, and health care (Chapman, Laird, Ifill, & KewalRamani, 2011; Rumberger, 2011). Some dropouts go on to earn a General Educational Development certificate (GED). However, evidence suggests that the GED is not a satisfactory substitute for completing high school. More specifically, the GED does not improve economic outcomes for most of those who attain it, and holding a GED does little to improve chances for success in postsecondary institutions (Heckman et al., 2011).

Oregon Leadership Network districts, like many other districts across the country, are investigating ways to identify early those students who may not graduate from high school on time. This study addresses this need by examining how high school graduation outcomes are associated with gender, race/ethnicity, special education status, English learner student status, attendance and achievement in grades 8 and 9, and suspension or expulsion in grade 9, after controlling for each of the remaining variables.[2] Finding out which variables are predictive of dropping out or failing to graduate within four years can help educators develop better early warning indicators to monitor and intervene on behalf of students who need assistance.

Finding out which variables are predictive of dropping out or failing to graduate within four years can help educators develop better early warning indicators to monitor and intervene on behalf of students who need assistance

Connections to previous research

Research on student motivation (Usher & Kober, 2012) and the engagement of high school students with their schools (National Research Council, 2004) suggests that students' persistence in school is determined by a complex interplay of behavioral, cognitive, social, and emotional factors that operate within students, families, classrooms, and schools, as well as at other levels. At the same time, a substantial body of research has investigated characteristics of middle school students and students in grade 9 that provided early warning of students who eventually dropped out of high school. Key points from this research are summarized in box 1. Findings from representative studies are summarized in appendix B.

Box 1. Previous research findings about students who did not graduate from high school on time

Students' attendance, achievement, and behavior have stronger relationships with graduating than do their race/ethnicity and their achievement on state tests in reading and math.

Students who drop out of high school can be identified by examining their attendance, achievement, and behavior in grade 9.

Attendance and achievement in the middle grades are associated with high school graduation outcomes, and these factors can be used to identify students who are likely to drop out of high school.

Source: Summarized from sources described in appendix B and table B1.

This study is similar to previous research in two ways. First, analyses include student demographic characteristics, attendance, and behavior along with course grades and results of standardized tests, which previous research has found to be related to graduation outcomes. Second, the study examined thresholds of attendance and achievement in grades 8 and 9 that identified students who did not graduate from high school on time.

What the study examined

This study examined three types of graduation outcomes: dropping out within four years of entering grade 9, staying in school but not graduating on time (within four years of entering grade 9), and graduating on time. Each outcome was addressed by a research question:

1. ***Characterizing students with different graduation outcomes.*** Did students' high school graduation outcomes differ by their gender, race/ethnicity, special education status, English learner student status, attendance and achievement in grades 8 and 9, and behavior (suspension or expulsion) in grade 9?

2. ***Examining statistical relationships among the predictors.*** How were high school graduation outcomes associated with each of the above variables, after the study controlled for the other variables and for characteristics (both observed and unobserved) of the schools that students attended?

3. ***Identifying indicators of failing to graduate on time.*** What levels of attendance and achievement in grades 8 and 9 and suspension and expulsion in grade 9 could provide early identification of students who might not graduate on time?

A brief description of the study sample and analytic methods is given in box 2. Additional information about the outcomes and analytic methods is provided in table A1 in appendix A and in appendix C.

Box 2. Data and methods

The study sample is a cohort of 6,118 students who entered grade 9 in four Oregon school districts in 2007/08. All data for the study came from state and district databases. The Oregon Department of Education provided data for enrollment, demographics, suspension or expulsion, participation in special programs, and graduation and dropout status. The four districts provided grade point average (GPA) data. In the database, 276 students in the four districts who earned a General Educational Development certificate were recorded as nondropouts and nongraduates and thus were not included in the study. Students who graduated after making up credits after their senior year ended were treated as on-time graduates if they were recorded as graduates in the database for the 2010/11 school year (September 1, 2010, to August 31, 2011).

The high school graduation outcomes examined in the study are "dropped out," "stayed in school but did not graduate on time," and "graduated on time." "Dropped out" refers to students who dropped out within four years of entering grade 9. "Stayed in school but did not graduate on time" refers to students who did not drop out within four years of entering grade 9 but did not graduate within four years. "Graduated on time" refers to students who graduated

(continued)

Box 2. Data and methods *(continued)*

within four years of entering grade 9. Additional information about the variables used in the study is given in table A1 in appendix A.

Percentages of students who dropped out, stayed in school but did not graduate on time, and graduated on time were calculated and reported by gender, race/ethnicity, special education status, and English learner student status. Average levels of attendance, GPA, achievement on state tests in reading and math, and suspensions or expulsions were calculated and reported for students with each graduation outcome. In addition, percentages of students with each graduation outcome were calculated and reported for students with different levels of attendance, GPA, achievement on state tests, and suspension or expulsion.

Regression analysis was used to describe how gender, race/ethnicity, special education status, English learner student status, attendance in grades 8 and 9, GPA in grades 8 and 9, achievement on state tests in grade 8, and suspension or expulsion in grade 9 together were associated with graduation outcomes. These variables were chosen because research shows that student attendance, achievement, and behavior in grades 8 and 9 are associated with graduating and dropping out and because the districts requested an analysis of how these variables were associated with graduation outcomes for their population of students.

Attendance in grade 8 or 9 of less than 80 percent and a GPA in grade 8 or 9 of less than 2.0 provided early identification of students who did not graduate on time

The study controlled for differences in the schools that students attended by including fixed effects for schools in the regression model. Models without school fixed effects produce estimates that combine what is happening both within and between schools. Including fixed effects produces estimates based only on students' experiences within their school. Using fixed effects to control for school characteristics (both observed and unobserved) makes the results more relevant for school staff members who are deciding which of their students will get dropout prevention services. Decisions at this level require school staff members to think about what is going on within their school rather than think about whether some of their students might benefit from attending other schools.

Additional information about the analytic methods is provided in appendix C.

What the study found

Achievement and attendance in grades 8 and 9 provide strong early warning signals about students who may need additional support to graduate on time. More specifically, the study found that attendance in grade 8 or 9 of less than 80 percent and a GPA in grade 8 or 9 of less than 2.0 provided early identification of students who did not graduate on time. The study also identified differences in rates of graduating within four years of entering grade 9 by students' gender, race/ethnicity, special education status, and English learner student status. However, when the influence of demographic, achievement, and behavioral characteristics and differences in the schools that students attended were considered at the same time, only gender, English learner student status, and attendance and GPA in grades 8 and 9 were associated with graduation outcomes.

These results are consistent with other research, which has found that on-time graduation rates differ for students with different characteristics and that attendance and achievement in grades 8 and 9 have stronger associations with graduation outcomes than do race/ethnicity, special education status, English learner students status, and results of standardized tests of achievement in reading and math. The study differs from other research in finding that discipline in grade 9 was not substantially associated with graduating on time after accounting for other factors.

When other factors were not accounted for, students' high school graduation outcomes differed according to their demographic characteristics, special education status, English learner student status, attendance and achievement in grades 8 and 9, and behavior in grade 9

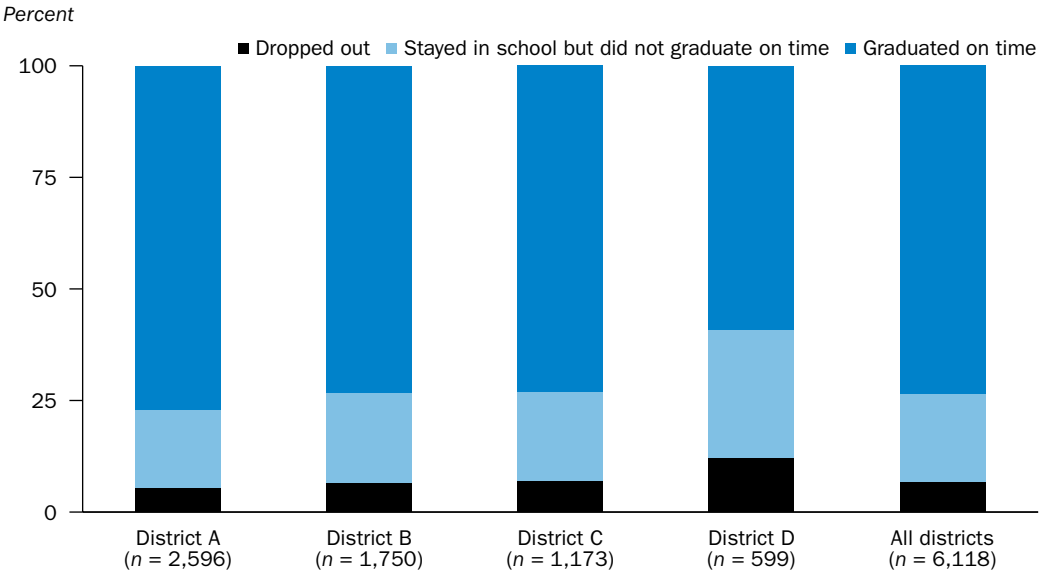
Overall, 7 percent of the students who entered grade 9 in the four study districts in 2007/08 dropped out within four years, 20 percent stayed in school but did not graduate on time, and 73 percent graduated on time. Dropout rates ranged from 5 to 12 percent across the districts, while on-time graduation rates ranged from 59 to 77 percent (figure 1).

High school outcomes varied across the cohort by student gender, race/ethnicity, special education status, and English learner student status (table 1).

- Male students dropped out at a rate 1.6 times higher than female students and stayed in school but did not graduate on time at a rate 1.4 times higher than female students did.
- Except for Asian students, racial/ethnic minority students dropped out and stayed in school but did not graduate on time at higher rates than White students did.
- Students in special education dropped out or stayed in school but did not graduate on time at rates approximately twice as high as those for students not in special education.
- English learner students dropped out at rates more than twice as high as those for non–English learner students and stayed in school but did not graduate on time at rates 1.5 times higher.

Overall, 7 percent of the students who entered grade 9 in the four study districts in 2007/08 dropped out within four years, 20 percent stayed in school but did not graduate on time, and 73 percent graduated on time

Figure 1. In the 2007/08 grade 9 cohort in four Oregon districts, 7 percent of students dropped out, 20 percent did not graduate on time, and 73 percent graduated on time, with some variation among districts



Note: *Dropped out* refers to students who dropped out within four years of entering grade 9. *Stayed in school but did not graduate on time* refers to students who did not drop out within four years of entering grade 9 but did not graduate within four years. *Graduated on time* refers to students who graduated within four years of entering grade 9.

Source: Author's analysis of data from Oregon state and district databases; see box 2 for details.

Table 1. High school outcomes by student demographic characteristics, program participation, and behavior, grade 9 cohort of 2007/08

Characteristic	Number	Dropped out		Stayed in school but did not graduate on time		Graduated on time	
		Percent	Rate ratio[a]	Percent	Rate ratio[a]	Percent	Rate ratio[a]
Total	6,118	7	na	20	na	73	na
Gender							
Male	3,159	8	1.6	23	1.4	69	0.9
Female	2,959	5	na	17	na	78	na
Race/ethnicity							
American Indian	60	15	3.0	30	1.7	55	0.7
Asian	685	3	0.6	12	0.7	86	1.1
Black	325	8	1.6	33	1.8	59	0.8
Hispanic	908	14	2.8	32	1.8	55	0.7
More than one race/other	226	10	2.0	20	1.1	70	0.9
White	3,914	5	na	18	na	77	na
Special education status							
In special education	178	10	2.0	36	1.9	54	0.7
Not in special education	5,940	5	na	19	na	74	na
English learner student status							
English learner student	614	14	2.3	29	1.5	57	0.8
Non–English learner student	5,504	6	na	19	na	75	na
Behavior							
Suspended or expelled grade 9	564	21	4.2	46	2.7	33	0.4
Not suspended or expelled in grade 9	5,554	5	na	17	na	78	na

na is not applicable because the group is the reference group.

Note: *Dropped out* refers to students who dropped out within four years of entering grade 9. *Stayed in school but did not graduate on time* refers to students who did not drop out within four years of entering grade 9 but did not graduate within four years. *Graduated on time* refers to students who graduated within four years of entering grade 9. The combined percentages of the three outcomes—dropped out, stayed in school but did not graduate on time, and graduated on time—may not sum to 100 because of rounding.

a. Compares percentages for a target group, for example, male students, against percentages for a reference group, for example, female students. Reference groups are the last group in each section. For example, the rate ratio of 1.6 for male students under the percent dropped out column indicates that the percentage of male students (target group) who dropped out was 1.6 times higher than the percentage of female students (reference group) who dropped out.

Source: Author's analysis of data from Oregon state and district databases; see box 2 for details.

Graduation outcomes by student demographic characteristics and program participation are presented by district in table A2 in appendix A.

For the whole cohort of students and within each district, average levels of attendance, achievement, and behavior were substantially different among students who dropped out, stayed in school but did not graduate on time, and graduated on time (table 2; see also table A3 in appendix A). Students who dropped out had the lowest average attendance and GPA, lowest rates of scoring proficient on state tests in reading and math, and highest rates of suspension and expulsion. Students who graduated on time had the highest average attendance rates, GPA, and rates of scoring proficient on state tests in reading and math and the lowest rates of suspension and expulsion. Students who stayed in school but did not graduate on time had attendance rates, GPAs, rates of scoring proficient on state tests, and suspension and expulsion between the levels for dropouts and on-time graduates.

Table 2. Average attendance, achievement, and suspension or expulsion in grades 8 and 9 by graduation outcome, grade 9 cohort of 2007/08

Grade and variable	Dropped out (*n* = 403)	Stayed in school but did not graduate on time (*n* = 1,216)	Graduated on time (*n* = 4,499)
Grade 8			
Attendance (percent)	87	91	95
Grade point average	2.0	2.3	3.2
Proficient on state reading test (percent)	45	60	81
Proficient on state math test (percent)	51	64	85
Grade 9			
Attendance (percent)	80	87	95
Grade point average	1.3	1.7	3.1
Suspended or expelled (percent)	29	21	4

Note: *Dropped out* refers to students who dropped out within four years of entering grade 9. *Stayed in school but did not graduate on time* refers to students who did not drop out within four years of entering grade 9 but did not graduate within four years. *Graduated on time* refers to students who graduated within four years of entering grade 9. State tests in reading and math were only at grade 8. Percent proficient includes students meeting or exceeding the standard for proficiency. Suspension and expulsion data were not available for grade 8.

Source: Author's analysis of data from Oregon state and district databases; see box 2 for details.

After other factors were accounted for, students' graduation outcomes four years after entering grade 9 were associated with their gender, English learner student status, attendance in grade 8, attendance in grade 9, GPA in grade 8, and GPA in grade 9

When the influence of demographic, achievement, and behavioral characteristics and differences in the schools that students attended were considered at the same time, only gender, English learner student status, and attendance and grade point average in grades 8 and 9 were associated with graduation outcomes

The second research question addresses how students' graduation status four years after entering grade 9 was associated with their gender, race/ethnicity, special education status, English learner student status, attendance and achievement in grades 8 and 9, and suspension or expulsion in grade 9 when all these factors were considered at the same time. This was done through regression modeling. Details of the modeling are given in appendix C.

After other factors were accounted for, students' graduation outcomes four years after entering grade 9 were associated with their gender, English learner student status, attendance in grade 8, attendance in grade 9, GPA in grade 8, and GPA in grade 9. To illustrate the association of these variables with graduating four years after entering grade 9, probabilities of graduating four years after entering grade 9 were calculated from the model for values of each of these variables (table 3).

At higher grade 9 GPAs, differences in on-time graduation rates by gender shrank (figure 2).

Similarly, differences in on-time graduation rates between English learner students and other students shrank at higher grade 9 GPAs (figure 3).

In contrast to the reduced differences in on-time graduation rates between male and female students and between English learner and non–English learner students observed at higher grade 9 GPAs (see figures 2 and 3), differences between these groups of students remained constant across attendance in grades 8 and 9 and grade 8 GPAs.

Table 3. Estimated probabilities of graduating within four years of entering grade 9, by attendance and grade point average in grades 8 and 9 and gender and English learner student status, grade 9 cohort of 2007/08

Variable and value	Estimated probability of graduating on time	Rate ratio
Grade 8 attendance		
95 percent	.74	1.12
85 percent	.71	1.08
75 percent	.69	1.05
65 percent	.66	na
Grade 9 attendance		
95 percent	.75	1.21
85 percent	.71	1.15
75 percent	.67	1.08
65 percent	.62	na
Grade 8 grade point average		
4.0	.78	1.13
3.0	.75	1.09
2.0	.72	1.04
1.0	.69	na
Grade 9 grade point average		
4.0	.92	2.00
3.0	.83	1.80
2.0	.67	1.46
1.0	.46	na
Female	.76	1.06
Male	.72	na
Non–English learner student	.74	1.07
English learner student	.69	na

na is not applicable because the group is the reference group.

Note: Estimated probabilities were calculated from the regression model described in appendix C.

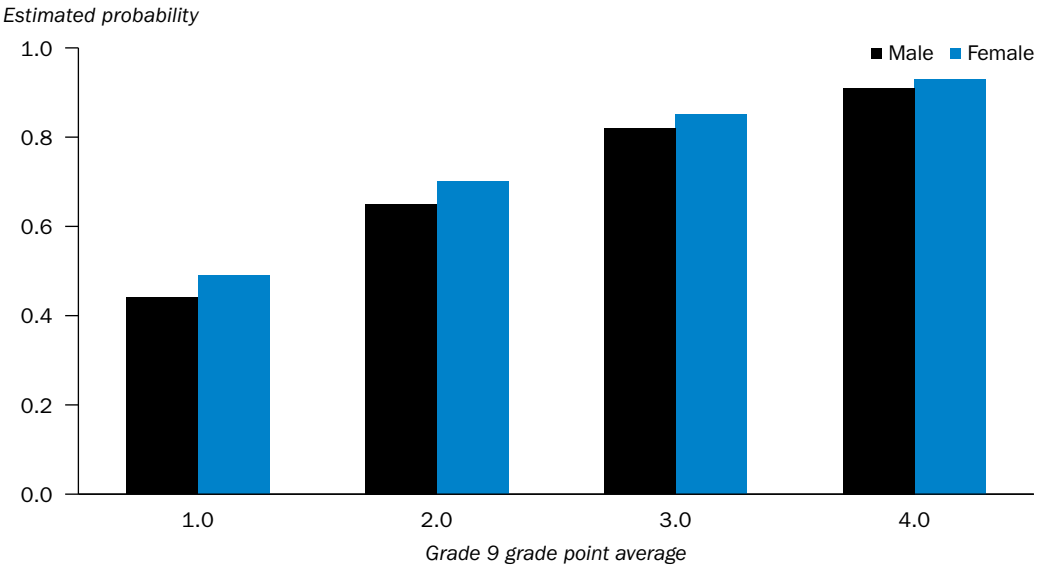
Source: Author's analysis of data from Oregon state and district databases; see box 2 for details.

Four indicators—grade 8 attendance rate below 80 percent, grade 9 attendance rate below 80 percent, grade 8 GPA below 2.0, and grade 9 GPA below 2.0—provided valuable early warning signals about students who did not graduate on time, particularly about students who dropped out

The third research question addresses whether indicators could be developed to provide early identification of students who might not graduate on time. Students identified by such indicators could be provided with programs and resources to improve their attendance and achievement and thus increase their likelihood of graduating on time. Regression modeling showed that when students' gender, race/ethnicity, and program participation were considered together with their attendance, achievement, and behavior in grades 8 and 9, the following indicators were not related to graduation outcomes in a statistically significant way: race/ethnicity, special education status, meeting standards on state tests in reading and math, and suspension or expulsion in grade 9 (see table C1 in appendix C).

The following variables were associated with graduation outcomes: gender, English learner student status, attendance in grade 8, attendance in grade 9, GPA in grade 8, and GPA in

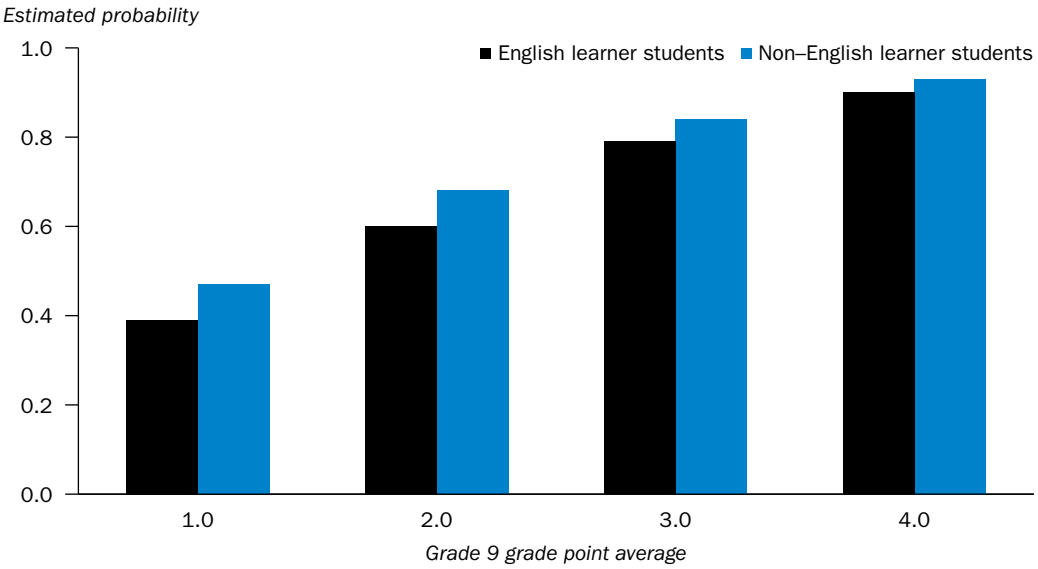
Figure 2. At higher grade point averages, differences in on-time graduation rates shrank between male and female students, grade 9 cohort of 2007/08



Note: Estimated probabilities were calculated from the regression model described in appendix C.

Source: Author's analysis of data from Oregon state and district databases; see box 2 for details.

Figure 3. At higher grade point averages, differences in on-time graduation rates shrank between English learner students and other students, grade 9 cohort of 2007/08



Note: Estimated probabilities were calculated from the regression model described in appendix C.

Source: Author's analysis of data from Oregon state and district databases; see box 2 for details.

grade 9 (see table C1 in appendix C). While gender and English learner student status were associated with graduation outcomes, these variables were not considered as early warning indicators for two reasons. First, students, parents, and teachers cannot control these variables in the way they can control students' attendance and achievement. Second, using gender and English learner student status in an early warning system might encourage stereotyping of certain groups of students. In contrast, attendance and GPA in grades 8 and 9 are directly influenced by students, parents, and teachers. As a result, these four variables were selected as indicators. The approach used in this study follows Allensworth and Easton (2005, 2007) in focusing on academic variables as early warning indicators.

Proportions of students who graduated or did not graduate within four years of entering grade 9 at different rates of attendance and levels of GPA are displayed in table 4. For brevity, data are aggregated for attendance below 80 percent and GPA below 2.0.

To be useful, early warning indicators must meet two criteria. First, they must identify substantial proportions of students who failed to graduate on time. Second, they must identify relatively few students who graduated on time (Pepe, 2003). In this sample, attendance of

Table 4. High school outcomes at different rates of attendance and levels of GPA in grades 8 and 9, grade 9 cohort of 2007/08

Attendance and GPA by grade	Cutpoint	Number of students	Percent who dropped out	Percent who stayed in school but did not graduate on time	Percent who graduated on time
Attendance					
Grade 8	Attend ≥ 90 percent	5,116	4	17	79
	Attend < 90 percent	1,002	18	37	45
	Attend < 80 percent	231	33	44	23
Grade 9	Attend ≥ 90 percent	4,853	3	14	83
	Attend < 90 percent	1,265	20	42	38
	Attend < 80 percent	473	32	51	17
GPA					
Grade 8	GPA ≥ 3.5	2,340	1	7	92
	GPA < 3.0	2,642	13	34	53
	GPA < 2.0	961	21	45	34
Grade 9	GPA ≥ 3.5	1,904	1	5	94
	GPA < 3.0	3,170	12	33	55
	GPA < 2.0	1,569	19	46	35

GPA is grade point average.

Note: *Dropped out* refers to students who dropped out within four years of entering grade 9. *Stayed in school but did not graduate on time* refers to students who did not drop out within four years of entering grade 9 but did not graduate within four years. *Graduated on time* refers to students who graduated within four years of entering grade 9.

Source: Author's analysis of data from Oregon state and district databases; see box 2 for details.

less than 80 percent and a GPA of less than 2.0 identified large proportions of students who did not graduate on time (see table 4). More specifically:

- 77 percent of students with grade 8 attendance of less than 80 percent did not graduate on time.
- 83 percent of students with grade 9 attendance of less than 80 percent did not graduate on time.
- 66 percent of students with grade 8 GPA less than 2.0 did not graduate on time.
- 65 percent of students with grade 9 GPA less than 2.0 did not graduate on time.

Meanwhile, only 1–12 percent of students with attendance of less than 80 percent and a GPA of less than 2.0 graduated on time (table 5).

In general, students identified by more indicators had lower on-time graduation rates than did students identified by fewer indicators. This means that students identified by more indicators had higher rates of dropping out or staying in school but not of graduating on time (table 6).

Table 5. Percentages of students who dropped out, stayed in school but did not graduate on time, and graduated on time, identified by each indicator, grade 9 cohort of 2007/08

	Percent of students identified by the indicator among students who…		
Indicator	Dropped out (*n* = 403)	Stayed in school but did not graduate on time (*n* = 1,216)	Graduated on time (*n* = 4,499)
Grade 8 attendance less than 80 percent	19	8	1
Grade 9 attendance less than 80 percent	37	20	2
Grade 8 grade point average less than 2.0	51	35	7
Grade 9 grade point average less than 2.0	75	60	12

Note: *Dropped out* refers to students who dropped out within four years of entering grade 9. *Stayed in school but did not graduate on time* refers to students who did not drop out within four years of entering grade 9 but also did not graduate within four years. *Graduated on time* refers to students who graduated within four years of entering grade 9.

Source: Author's analysis of data from Oregon state and district databases; see box 2 for details.

Table 6. Students identified by multiple indicators had higher rates of dropping out or not graduating on time, grade 9 cohort of 2007/08

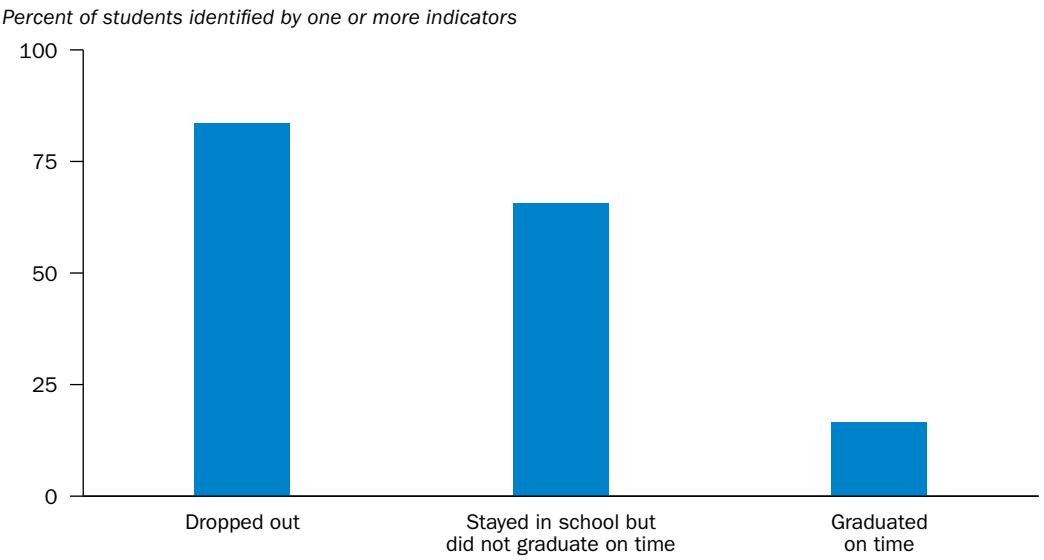
Number of indicators	Number of students	Percent dropped out	Rate ratio[a]	Percent stayed in school but did not graduate on time	Rate ratio[a]	Percent graduated on time	Rate ratio[a]
4	101	46.5	29.9	46.5	4.7	6.9	0.08
3	206	37.4	24.0	51.9	5.3	10.7	0.12
2	643	15.9	10.2	54.0	5.5	30.2	0.34
1	926	12.0	7.7	31.7	3.2	56.0	0.63
0	4,242	1.6	1.0	9.9	1.0	88.6	1.00

Note: *Dropped out* refers to students who dropped out within four years of entering grade 9. *Stayed in school but did not graduate on time* refers to students who did not drop out within four years of entering grade 9 but did not graduate within four years. *Graduated on time* refers to students who graduated within four years of entering grade 9.

a. Compares the percentages in each row within each column to the percentage in the last row (students identified by zero indicators).

Source: Author's analysis of data from Oregon state and district databases; see box 2 for details.

Figure 4. More than 70 percent of students identified by one or more indicators did not graduate on time, grade 9 cohort of 2007/08



Note: Figure displays the percent of students identified by one or more indicators for students with each graduation outcome. *Dropped out* refers to students who dropped out within four years of entering grade 9. *Stayed in school but did not graduate on time* refers to students who did not drop out within four years of entering grade 9 but did not graduate within four years. *Graduated on time* refers to students who graduated within four years of entering grade 9.

Source: Author's analysis of data from Oregon state and district databases; see box 2 for details.

Overall, more than 70 percent of students who did not graduate on time were identified by one or more of the indicators, including 84 percent of students who dropped out and 66 percent of students who stayed in school but did not graduate on time

Overall, more than 70 percent of students who did not graduate on time were identified by one or more of the indicators, including 84 percent of students who dropped out and 66 percent of students who stayed in school but did not graduate on time; 16 percent of students who graduated on time were identified by one or more indicators (figure 4).

Implications of the study findings

The study results have four implications for districts or others currently implementing or planning to implement an early warning system.

First, the results suggest, as others have, that an early warning system might be based on students' attendance and course achievement in grades 8 and 9—information that is collected as part of normal recordkeeping and reporting.

Second, the results call attention to weaker graduation outcomes for male students and for English learner students and a potential need for districts to explore interventions and strategies for these students to improve on-time graduation rates.

Third, the thresholds of 80 percent attendance and a 2.0 GPA in grades 8 and 9 for identifying students who did not graduate on time were developed specifically from a cohort of students in four Oregon Leadership Network districts, and they are a useful metric for those districts. Other districts may want to explore whether different thresholds are appropriate for their context.

Finally, the four early warning indicators identified can focus the attention of parents, students, and community organizations in the four districts—and in other districts in the Northwest Region and nationally—on strategies for improving students' attendance and course achievement in grades 8 and 9 to help ensure their on-time graduation from high school.

Limitations of the study

The study examined dropping out, staying in school but not graduating on time, and graduating on time for one cohort of students in four districts using demographic and program participation data together with a limited set of variables describing their attendance, achievement, and behavior in grades 8 and 9. The study did not examine the complete range of education experiences to which students were exposed within and outside school. Other factors at the student, school, or other levels that may improve predictions of students' dropping out or graduating were not considered in the analysis. Furthermore, in this study proficiency on standardized tests did not predict dropout status after other variables were controlled for. However, Oregon students do not have to pass a graduation test to earn a diploma. The predictive value of such tests could be different in states that require students to pass them to graduate.

The results call attention to weaker graduation outcomes for male students and for English learner students and a potential need for districts to explore interventions and strategies for these students to improve on-time graduation rates

Districts participating in the study were not a random sample of Oregon districts. Consequently, the results may not generalize to other districts in the state. Furthermore, the study identified indicators that were strongly associated with not graduating within four years of entering grade 9, but the results do not support claims that low attendance or low achievement in grade 8 or 9 caused students not to graduate with their grade 9 cohort.

Students who transferred out of the study districts and whose graduation outcomes were subsequently not reported to the Oregon Department of Education were not included in the analyses. In addition, some students were missing test scores, attendance data, or GPAs and consequently were not included. Finally, an unknown number of students dropped out but were not identified as dropouts because of incomplete reporting of dropout status by districts to the state. This problem was more prevalent in Oregon for the grade 9 cohort of 2007/08 than for later cohorts because the Oregon Department of Education required more detailed reporting of dropout status for later cohorts of students. Whatever the sources of missing data, results of the study would be biased to the degree that the associations between variables in the study and students' high school outcomes were different for students with missing data than they were for students included in the study.

Finally, the model was calibrated and implications were derived from the model based on one cohort of students in four districts. It is important to evaluate how well the relationships identified by the study hold for other cohorts in the same districts and for cohorts of students in other districts.

Appendix A. Study variables and characteristics of the student cohort in each district

This appendix includes descriptions of the variables used in the study; information about the demographic characteristics, program participation, attendance, and achievement in grades 8 and 9; and history of suspension or expulsion in grade 9 for the student cohort in each district.

Table A1. Variables used in the study

Variable	Description
Graduation outcomes	
Dropped out	This outcome refers to students who left school without earning a diploma or equivalent certificate and were not enrolled in a high school program in the United States, a postsecondary degree program, or a district-sponsored adult high school diploma program. Not counted as dropouts are students who left school early but earned a General Educational Development certificate (GED) or students who are deceased, schooled at home, placed in special facilities, or living outside the United States. Rules for identifying students as dropouts are identified in the *Oregon Graduates and Dropouts Reporting Manual,* published by the Oregon Department of Education (2009). Students who drop out are identified in the cumulative average daily membership collection that districts submit to the department (see table source below). The study identified students as dropouts if they were identified as dropouts in the Oregon Department of Education database within four years after they entered grade 9.
Stayed in school but did not graduate on time	This outcome refers to students who did not drop out within four years of entering grade 9 but did not graduate within four years.
Graduated on time	This outcome refers to students who received a diploma within four years of entering grade 9. Students earning a diploma are identified in the cumulative average daily membership collection that districts submit to the Oregon Department of Education.
Demographic characteristics and program participation	
Gender	Male or female as reported in the state enrollment file.
Race/ethnicity	This study reported race/ethnicity following Oregon Department of Education practice for statewide reporting. Categories are: American Indian/Alaskan Native, Asian/Pacific Islander, Black, Hispanic/Latino, White, Multiracial/Multiethnic. Students identified with more than one race are reported as multiracial/multiethnic unless they were identified as Hispanic/Latino or the only two races were Asian and Pacific Islander. Asian or Pacific Islander students are reported as Asian/Pacific Islander. Students identified as Hispanic are reported as Hispanic/Latino even if multiple races were identified.
Special education status	Students eligible for Oregon special education with an individualized education program.
English learner student status	Students identified as having limited proficiency in English. English learner student status does not require that a student be enrolled in a program for English as a second language.
Attendance, achievement, and behavior in grades 8 and 9	
Attendance rate	The number of days a student was reported present divided by the number of school days. Attendance rate was calculated separately for grades 8 and 9.
Grade point average	Two grade point average measures were used: cumulative grade point average across all grade 8 courses and cumulative grade point average across all grade 9 courses.
Achievement on state test	Meeting or not meeting the standard for proficiency on the state tests in reading and math at grade 8.
Behavior	Whether a student was suspended or expelled in grade 9.

Note: Sources of missing data are discussed in the *Limitations of the study* section. Results in the report are based on cases with complete information.

Source: Adapted by the author from Oregon Department of Education (2010).

Table A2. High school outcomes by district, student demographic characteristics, and program participation, grade 9 cohort of 2007/08

District and characteristic	Number	Percent of district total	Percent dropped out	Percent stayed in school but did not graduate on time	Percent graduated on time
District A	1,173	100	7	20	73
Male	618	53	9	23	68
Female	555	47	4	17	78
American Indian	[a]	[a]	[a]	[a]	[a]
Asian	106	9	0	10	90
Black	[a]	[a]	[a]	[a]	71
Hispanic	129	11	12	31	57
More than one race/other	41	4	[a]	[a]	76
White	864	74	7	20	73
In special education	82	7	12	33	55
Not in special education	1,091	93	6	19	74
English learner student	144	12	13	27	60
Non–English learner student	1,029	88	6	19	75
Suspended or expelled in grade 9	127	11	19	45	36
Not suspended or expelled in grade 9	1046	89	5	17	78
District B	1,750	100	6	20	73
Male	889	51	9	23	68
Female	861	49	4	17	79
American Indian	36	2	22	25	53
Asian	185	11	4	12	84
Black	186	11	10	36	54
Hispanic	186	11	15	24	62
White	1,127	64	4	18	78
In special education	36	2	[a]	[a]	47
Not in special education	1,714	98	6	20	74
English learner student	110	6	10	23	67
Non–English learner student	1,640	94	6	20	74
Suspended or expelled in grade 9	135	8	22	49	29
Not suspended or expelled in grade 9	1615	92	5	18	77
District C	599	100	12	29	59
Male	329	55	12	34	54
Female	270	45	12	23	65
American Indian	[a]	[a]	[a]	[a]	[a]
Asian	54	9	[a]	[a]	74
Black	45	8	[a]	[a]	60
Hispanic	186	31	19	40	41
More than one race/other	[a]	[a]	[a]	[a]	[a]
White	302	50	10	23	68
In special education	18	3	[a]	[a]	[a]
Not special education	581	97	12	29	59
English learner student	100	17	27	37	36
Non–English learner student	499	83	9	27	64
Suspended or expelled in grade 9	121	20	26	51	22
Not suspended or expelled in grade 9	478	80	9	23	68

(continued)

Table A2. Demographic characteristics, program participation, and high school outcomes of students in the grade 9 cohort of 2007/08, by district *(continued)*

District and characteristic	Number	Percent of district total	Percent dropped out	Percent stayed in school but did not graduate on time	Percent graduated on time
District D	2,596	100	5	17	77
Male	1,323	51	6	20	74
Female	1,273	49	4	15	80
American Indian	10	<1	[a]	[a]	[a]
Asian	340	13	[a]	[a]	87
Black	70	3	[a]	[a]	67
Hispanic	407	16	11	31	58
More than one race/other	148	6	10	16	74
White	1,621	62	4	15	81
In special education	42	2	[a]	[a]	62
Not special education	2,554	98	5	17	77
English learner student	260	10	12	29	60
Non–English learner student	2,336	90	5	16	79
Suspended or expelled in grade 9	181	7	18	41	41
Not suspended or expelled in grade 9	2,415	93	4	16	80

Note: *Dropped out* refers to students who dropped out within four years of entering grade 9. *Stayed in school but did not graduate on time* refers to students who did not drop out within four years of entering grade 9 but did not graduate within four years. *Graduated on time* refers to students who graduated within four years of entering grade 9. Percentages may not sum to 100 because of rounding.

a. Values are not shown when data refer to fewer than 10 students.

Source: Author's analysis of data from Oregon state and district databases; see box 2 for details.

Table A3. Average attendance, achievement, and behavior in grades 8 and 9 by graduation outcome and district, grade 9 cohort of 2007/08 (percent unless otherwise indicated)

District, grade, and indicator	Dropped out	Stayed in school but did not graduate on time	Graduated on time
District A (number)	80	236	857
Grade 8			
Attendance	88	89	95
Grade point average	2.0	2.2	3.2
Proficient on state reading test	35	53	78
Proficient on state math test	59	57	81
Grade 9			
Attendance	84	88	95
Grade point average	1.3	1.7	2.9
Suspended or expelled	30	24	5
District B (number)	112	355	1,283
Grade 8			
Attendance	87	91	95
Grade point average	2.0	2.4	3.3
Proficient on state reading test	58	67	87
Proficient on state math test	52	67	89
Grade 9			
Attendance	77	85	95
Grade point average	1.3	1.7	3.1
Suspended or expelled	27	19	3
District C (number)	73	173	353
Grade 8			
Attendance	90	94	96
Grade point average	2.2	2.5	3.3
Proficient on state reading test	27	46	72
Proficient on state math test	33	53	72
Grade 9			
Attendance	84	90	96
Grade point average	1.5	1.8	3.1
Suspended or expelled	44	36	8
District D (number)	138	452	2,006
Grade 8			
Attendance	86	91	95
Grade point average	1.8	2.3	3.2
Proficient on state reading test	51	63	80
Proficient on state math test	54	68	87
Grade 9			
Attendance	78	88	95
Grade point average	1.3	1.8	3.1
Suspended or expelled	23	16	4

Note: *Dropped out* refers to students who dropped out within four years of entering grade 9. *Stayed in school but did not graduate on time* refers to students who did not drop out within four years of entering grade 9 but did not graduate within four years. *Graduated on time* refers to students who graduated within four years of entering grade 9. State tests in reading and math were only at grade 8. Suspension and expulsion data were not available for grade 8.

Source: Author's analysis of data from Oregon state and district databases; see box 2 for details.

Appendix B. Connections to previous research

A large body of research has investigated characteristics of middle school students and students in grade 9 that provided early warning of students who eventually dropped out of high school. Findings from representative studies are summarized in this appendix.

Characteristics of high school students associated with graduating or dropping out

A 2005 study of Chicago students showed that students who had not accumulated five credits by the end of grade 9 and had received two or more Fs in a core subject graduated on time at lower rates than grade 9 students who achieved at higher levels (Allensworth & Easton, 2005). Chicago students characterized by one or both of these factors were considered to be "off track" and thus at risk of dropping out. Off-track rates varied greatly across schools, from 30 percent to 90 percent, which suggests the importance of monitoring and reporting students' status as on track or off track by school. A later study of Chicago students found that grade 9 grade point average (GPA), whether a student was on track in grade 9, and the number of semester courses failed in grade 9 correctly identified graduates and nongraduates, while the number of absences was slightly less predictive of students who graduated (Allensworth & Easton, 2007).

In Chicago, students' achievement in grade 9 courses explained greater variance in their predicted graduation status than did their race/ethnicity, gender, economic status, or scores on a standardized test at grade 8 (Allensworth & Easton, 2007). The relative inefficiency of scores on standardized tests in predicting graduation implies that the transition to high school places more demands on students than simply acquiring academic skills (Allensworth & Easton, 2005). Other studies also demonstrate the relative inefficiency of scores on standardized tests compared with course performance and attendance in predicting graduation (Rumberger & Lim, 2008).

Neild and Balfanz (2006) studied the progress of first-time grade 9 students in six graduating classes of Philadelphia students from 2000 through 2005. Indicators and thresholds for attendance and achievement in grades 8 and 9 were identified that accurately predicted students who did not graduate from high school on time. Building on this research, a 2010 study in seven Tennessee school districts with high dropout rates identified attendance, course failure, and suspension or expulsion in grade 9 as key factors associated with students graduating or not graduating (Balfanz, Wang, & Byrnes, 2010). These factors proved to be stronger predictors of dropping out than students' demographic characteristics and test scores. In the seven districts, half the students who dropped out had less than 85 percent attendance and two or more course failures, and a third had two or more suspensions. These factors were not highly correlated, meaning their ability to predict whether a student would graduate or drop out was higher in combination than in isolation: 24 percent of students with one indicator dropped out, while 43 percent of students with three indicators dropped out.

Similarly, a 2010 study that used statewide data for Delaware students in grades 9–12 during the 2006/07 and 2007/08 school years identified attendance and achievement indicators and thresholds that were highly predictive of whether a student would graduate on time (Uekawa, Merola, Fernandez, & Porowski, 2010).

Characteristics of middle school students associated with dropping out of high school

A study of Philadelphia public school students yielded predictors of graduation similar to those identified with Chicago high school students, but for younger students (Balfanz, Herzog, & Mac Iver, 2007). For students in Philadelphia middle schools, poor attendance, poor behavior, or failing math or English in grade 6 was strongly associated with failing to graduate. Similar to the results in Chicago, scores on standardized tests were less predictive of graduation status than grades, attendance, and behavior were.

Balfanz (2009) showed that the findings from Philadelphia were largely consistent with those from five other districts but noted differences among districts in the thresholds for signaling danger of not graduating. For example, in some districts missing a month or more of classes in middle school signaled that a student was in danger of not graduating, while in other districts missing at least two months of school signaled that a student was in danger of not graduating. Similarly, in some districts failing middle school math or English predicted being off track to graduate from high school, while in other districts failing any course predicted being off track. Balfanz also noted that on-time graduation rates varied across middle schools in the five districts (as low as 50 percent in some). In addition, schools with demographically similar students had different graduation rates, suggesting that schools can make a difference in keeping students on track toward graduation.

Overall, the research literature highlights a number of potential early indicators of graduation and thresholds that trigger identification of students at risk of not graduating. These are summarized in table B1.

Table B1. Grade 8 and 9 indicators and thresholds from previous research identifying students who dropped out of high school

Study	Indicators	Thresholds
Allensworth & Easton (2005)	Number of (full-year) credits earned	Fewer than five
	Number of (semester) Fs in core subjects	At most one
Allensworth & Easton (2007)[a]	Attendance	10 days per semester
	Grade point average and course Fs	More than one F and grade point average in passed courses below 2.0
Balfanz et al. (2010)[b]	Attendance	Less than 85 percent
	Course failures	Two or more
	Suspensions	Two or more
Neild & Balfanz (2006)[c]	Attendance, grade 8	Less than 80 percent
	Grades in math and English, grade 8	F in English and/or math
	Attendance	Less than 70 percent
	Grades in math and English	Fewer than two credits
	Promotion to grade 10	Not promoted on time
Uekawa et al. (2010)[d]	Attendance	Less than 88 percent
	Current grade in math	Less than –0.47
	Current grade in English language arts	Less than –0.63

Note: Indicators and thresholds are for grade 9 except where identified for grade 8 and for Uekawa et al. (2010).

a. Results extended from Allensworth and Easton (2005). Allensworth and Easton (2007) combined the two indicators and thresholds to form an "on-track" indicator: 78 percent of students identified as not on track failed to graduate in four years. Thresholds for grade point average for Allensworth and Easton (2005) were the values in figure 9 of their paper at which approximately 50 percent of students failed to graduate. Thresholds for attendance were the number of missed days in figure 12 of their paper at which students accumulated two Fs.

b. Indicators and thresholds were selected to balance the need for accuracy (as shown by the large fraction of students above the threshold who dropped out) and yield (as shown by the threshold identifying a large fraction of all students who dropped out).

c. Grade 8 indicators and thresholds were selected to identify students who dropped out at a rate of 85 percent or greater, and grade 9 indicators and thresholds were selected to identify students with a 75 percent dropout rate.

d. Thresholds for grades in math and English language arts are *z*-scores created by transforming course grades to a scale with mean 0 and standard deviation 1.

Source: Author's summary of cited studies.

Appendix C. Modeling graduation outcomes with logistic regression

Logistic regression has been employed in a number of education studies similar to this one. For example, Gleason and Dynarski (2002) used logistic regression to examine whether widely used indicators of risk are effective predictors of students likely to drop out. Hierarchical generalized linear modeling was applied in groundbreaking studies at the University of Chicago Consortium on Chicago School Research (Allensworth & Easton, 2007) on early identification of students likely to drop out of Chicago schools. Fong, Huang, and Goel (2008) used generalized linear modeling to examine links between math coursework in grade 12 and remediation in math for students entering higher education in Nevada. As a final example, Balfanz et al. (2010) applied generalized linear modeling to develop early warning indicators of students dropping out of Tennessee schools for the Tennessee Department of Education.

Model-building strategy

Previous research identified a number of variables concerning students' experiences in grades 8 and 9 that identified students who later dropped out of high school (see table B1 in appendix B). These include attendance in grades 8 and 9, suspensions in grade 9, and measures of achievement in grades 8 and 9 (grade point average [GPA] in grade 9, credits earned in grade 9, Fs in grade 9 core courses, and poor grades in English and math in grade 8).

The base model for this study included students' gender, race/ethnicity, special education status, English learner student status, and suspension or expulsion in grade 9. It also included some—but not all—of the variables identified in other studies as early warning indicators of students who dropped out. More specifically, the model included attendance in grades 8 and 9 and GPA in grades 8 and 9. It also included achievement on state reading and math tests at grade 8 to test the contribution from this source after controlling for other variables, including GPA. Credits earned and Fs in core subjects were not included because the districts reported these variables on different schedules (such as semester or trimester). Furthermore, for the cohort studied, districts did not report GPA and course achievement data directly to the Oregon Department of Education in a standard format. This meant that the study team had to use GPA data derived from the districts. Because these data were not reported in a consistent way, it was difficult to develop a measure of credits earned and Fs in core courses that was consistent across the districts. For this reason, these variables were not included in the base model. It is, of course, unclear whether—even if reported in a standard format—statewide credits earned and number of Fs in core courses would have added anything to explaining high school outcomes that was not already accounted for by GPA.

The relationship of the predictors with students' high school outcome was analyzed using ordered logistic regression. "Ordered" refers to the fact that the three graduation outcomes—dropping out within four years of entering grade 9, staying in school but not graduating within four years of entering grade 9, and graduating within four years of entering grade 9—have an intuitive "worse-to-better" ordering. Dropping out is the least desirable outcome, staying in school but not graduating on time is more desirable than dropping out, and graduating on time is the most desirable outcome. The scale is ordinal and not interval because the amount of "desirability" may differ between the outcomes.

The model tests the association between students' high school graduation outcomes and their gender, race/ethnicity, special education status, English learner student status, attendance, course achievement, scores on state tests, and suspension or expulsion. The model tests the strength of the association of each of these variables with graduation outcomes after controlling for the other variables. The model used in this study is the most popular model for ordinal responses and is based on logits of cumulative probabilities. For a response variable Y with J categories and a set of predictors X with corresponding coefficients β, the model has the form:

$$\text{logit}[P(Y \leq = j \mid X)] = \alpha_j - \beta X, j = 1 \ldots J - 1.$$

The parameters $[\alpha_j]$ are called cutpoints; these quantities are estimated from the data to define the changes among the outcome categories but are rarely independently interpretable. The model assumes that the odds ratios for the effects of the predictors on the response variable are the same for each of the possible ways of collapsing a J-category response to a binary variable. This model, which assumes that the effect β is the same for j, is thus referred to as the "proportional odds model" (Liu & Agresti, 2005).

The regression software estimates the coefficients β together with the cutpoints k_1, k_2, …, k_{k-1}. The coefficient estimates quantify the strength and direction of the association of each variable with the outcome after controlling for the effects of the other variables. Logistic regression coefficients are on the log odds scale. When they are exponentiated, the coefficients have greater intuitive meaning as odds ratios. For example, for a coefficient β_1 of 2.1 for variable X_1, $\exp(\beta_1) = 2.1$ means that the odds that an outcome occurs become 2.1 times more likely when the value of X_1 increases by one unit.

The model accounts for the clustering of students within schools by including fixed effects for schools. A fixed effect for a school is simply a variable coded 1 if a student attended the school and 0 otherwise. This simple construction has profound implications for estimates produced by the model. Models without school fixed effects produce estimates that combine what is happening both within and between schools. Including fixed effects for schools in the model produces estimates based only on students' experiences within their school.

Regression results

Regression results are presented in table C1. The strength and direction of the association of each variable with graduating on time compared with dropping out or not graduating on time after controlling for the other variables are summarized in the odds ratio for the variable. Odds ratios greater than 1.0 indicate that higher levels of the variable are associated with graduating on time rather than dropping out or staying in school but not graduating on time, while odds ratios below 1.0 indicate that a higher level of the variable is associated less with graduating on time and more with dropping out or staying in school but not graduating on time. For example, the odds ratio of 0.77 for gender indicates that after the other variables are adjusted for, male students (coded 1) were less likely to graduate on time than female students (coded 0). The *p*-value indicates the level of statistical significance associated with each odds ratio. The level conventionally chosen for deciding whether an effect is statistically significant is 0.05. The *p*-value for gender indicates that lower rate of graduating on time for male students compared with female students is statistically significant beyond the .05 level; in fact, it is significant beyond .001. Finally, for

Table C1. Results of regression analysis of graduation outcome, grade 9 cohort of 2009/08

Variable	Odds ratio	$p > \|Z\|$	95 percent confidence interval	
Demographic characteristics				
Gender (male)	0.77	.000	0.67	0.89
Race[a]				
American Indian	0.85	.576	0.48	1.50
Asian	0.89	.411	0.68	1.17
Black	0.84	.233	0.64	1.12
Hispanic	1.00	.984	0.82	1.23
More than one race/other	0.77	.128	0.54	1.08
Special education status				
In special education	0.89	.522	0.64	1.26
English learner student status				
English learner student	0.68	.001	0.54	0.86
Attendance				
Grade 8	1.02	.001	1.01	1.03
Grade 9	1.03	.000	1.02	1.03
Grade point average				
Grade 8	1.24	.000	1.11	1.37
Grade 9	2.65	.000	2.39	2.93
Achievement on state test[b]				
Met reading standard	1.13	.142	0.96	1.33
Met math standard	1.04	.663	0.88	1.23
Behavior				
Suspended or expelled in grade 9[c]	0.89	.276	0.73	1.09

Note: Number of observations = 6,114. Likelihood ratio chi-square (56) = 2,499.2. Prob > chi-square = 0.0000. Pseudo R^2 (McKelvey–Zavoina) = 0.46. Long (1997) recommends McKelvey–Zavoina as the most appropriate pseudo R^2 for ordinal models. The outcome variable for each student has three categories: dropped out, stayed in school but did not graduate on time, and graduated on time. *Dropped out* refers to students who dropped out within four years of entering grade 9. *Stayed in school but did not graduate on time* refers to students who did not drop out within four years of entering grade 9 but did not graduate within four years. *Graduated on time* refers to students who graduated within four years of entering grade 9. The model estimates rates of graduating on time relative to the other outcomes.

a. White students are the base for the coefficients for the racial/ethnic categories. A joint significance test for the race variables was not statistically significant (likelihood ratio chi-square = 4.22 on 5 degrees of freedom, with $p > .52$).

b. State test was only at grade 8. When the 0/1 proficiency indicators were replaced with scale scores, the resulting variables were not statistically significant and the fit of the model was unchanged.

c. Data were not available for grade 8.

Source: Author's analysis of data from Oregon state and district databases; see box 2 for details.

each variable the confidence interval for the estimated coefficient gives the range of values that is likely to capture the true—but unknown—size of the effect of the variable with 95 percent confidence. The 95 percent confidence level corresponds to testing hypotheses using the conventional cutoff of p less than .05.

Estimating the contribution of indicators to prediction

The base model included gender, race/ethnicity, special education status, English learner student status, attendance in grade 9, GPA in grade 9, and suspension or expulsion in

grade 9. This served as the grade 9 "main effects" model. These variables were chosen because the alliance requested an investigation of how students' background characteristics are associated with graduating and dropping out and because research shows that students' attendance, achievement, and behavior in grade 9 significantly predict graduating and dropping out. Research also suggests that students' experiences in middle school may be associated with their graduation outcomes. The alliance requested an exploration of this association in its data, thus students' grade 8 scores on the state test and their attendance and behavior in grade 8 were included as candidate predictors.

Collinearity was examined among the quantitative predictors: attendance in grade 8, attendance in grade 9, GPA in grade 8, and GPA in grade 9. Collinearity occurs when two or more predictors in a model are approximately determined by a combination of other independent predictors in the model. In severe cases of collinearity, the information carried by the collinear variables is largely redundant; very large standard errors can be a sign of this. No unusually large standard errors were identified. Nevertheless, two statistics —the tolerance and the variance inflation factor—were examined for each of the quantitative predictors. For each predictor the tolerance was close to 0 and the variance inflation factor was small. In short, no evidence of collinearity was found among the attendance and GPA variables.

Assessing model fit

The fit of the model was evaluated in three ways. First, the likelihood ratio chi-square test (see table C1) was statistically significant, which indicates that at least one of the estimated coefficients was not zero. Second, the McKelvey–Zavoina pseudo R^2 of 0.46 was relatively large (McKelvey–Zavoina pseudo R^2 is perhaps the closest analogue to the familiar ordinary least squares R^2 among the various formulations of pseudo R^2). Third, ordinal regression assumes that the relationship between the predictors and the logits is the same across all outcomes (the proportional odds assumption described above). This assumption was tested by estimating coefficients for the predictors separately for each outcome and then testing whether the resulting estimates were equal. The overall chi-square test for equality across outcomes was statistically significant, which indicates a departure from the proportionality assumption. This situation frequently occurs with models based on logistic regression. However, the differences were confined to 3 of the 10 predictors (the fixed effects for schools were not counted as predictors). As a result, no modifications were made to the model.

Notes

1. Single-year dropout rates have been declining in Oregon for a number of years. The dropout rate in 1994/95 was 7.4 percent. Nationally, status dropout rates (that is, the percentage of individuals ages 16–24 who are not in school and have not earned a high school diploma or General Education Development certificate) declined between 1990 and 2010 for White, Black, and Hispanic students (Aud et al., 2012).
2. The statistical model also controlled for the schools that students attended. See appendix C for more information about the modeling used in the study.

References

Allensworth, E. M., & Easton, J. Q. (2005). *The on-track indicator as a predictor of high school graduation*. Chicago, IL: University of Chicago, Consortium on Chicago School Research.

Allensworth, E. M., & Easton, J. Q. (2007). *What matters for staying on-track and graduating in Chicago public high schools: A close look at course grades, failures, and attendance in the freshman year*. Chicago, IL: University of Chicago, Consortium on Chicago School Research. http://eric.ed.gov/?id=ED498350

Aud, S., Hussar, W., Johnson, F., Kena, G., Roth, E., Manning, E., et al. (2012). *The condition of education 2012* (NCES No. 2012–045). Washington, DC: U.S. Department of Education, National Center for Education Statistics. http://eric.ed.gov/?id=ED532315

Balfanz, R. (2009). *Putting middle grades students on the graduation path: A policy and practice brief*. Westerville, OH: National Middle School Association.

Balfanz, R., Herzog, L., & Mac Iver, D. J. (2007). Preventing student disengagement and keeping students on the graduation path in urban middle-grades schools: Early identification and effective interventions. *Educational Psychologist*, *42*(4), 223–235. http://eric.ed.gov/?id=EJ780922

Balfanz, R., Wang, A., & Byrnes, V. (2010). *Early warning indicator analysis: Tennessee*. Baltimore, MD: Johns Hopkins University, School of Education, Everyone Graduates Center. Retrieved March 6, 2014, from http://www.tn.gov/education/safe_schls/dropout/doc/EarlyWarningIndicatorAnalysisTN.pdf

Chapman, C., Laird, J., Ifill, N., & KewalRamani, A. (2011). *Trends in high school dropout and completion rates in the United States: 1972–2009* (Compendium Report, NCES No. 2012–006). Washington, DC: U.S. Department of Education, National Center for Education Statistics. http://eric.ed.gov/?id=ED524955

Education Northwest, Oregon Leadership Network. (2011). *What is the Oregon Leadership Network?* Retrieved March 6, 2014, from http://educationnorthwest.orgzoln/about

Fong, A. B., Huang, M., & Goel, A. M. (2008). *Examining the links between grade 12 mathematics coursework and mathematics remediation in Nevada public colleges and universities: Summary* (Issues & Answers Report, REL 2008–058). Washington, DC: U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory West. http://eric.ed.gov/?id=ED502238

Gleason, P., & Dynarski, M. (2002). Do we know whom to serve? Issues in using risk factors to identify dropouts. *Journal of Education for Students Placed at Risk, 7*(1), 25–41. http://eric.ed.gov/?id=EJ640277

Heckman, J. J., Humphries, J. E., & Mader, N. S. (2011). The GED. In E. A. Hanushek, S. Machin, & L. Woessmann (Eds.), *Handbook of the economics of education* (Vol. 3, pp. 423–483). San Diego, CA: North-Holland. http://eric.ed.gov/?id=ED527055

Liu, I., & Agresti, A. (2005). The analysis of ordered categorical data: An overview and a survey of recent development. *Test, 14*(1), 1–73. Retrieved June 26, 2014, from http://www.stat.ufl.edu/~aa/articles/liu_agresti_2005.pdf

Long, J. S. (1997). *Regression models for categorical and limited dependent variables*. Thousand Oaks, CA: Sage.

National Research Council, Committee on Increasing High School Students' Engagement and Motivation to Learn. (2004). *Engaging schools: Fostering high school students' motivation to learn*. Washington, DC: National Academies Press.

Neild, R., & Balfanz, R. (2006). *Unfulfilled promise: The dimensions and characteristics of Philadelphia's dropout crisis, 2000–2005*. Baltimore, MD: Johns Hopkins University Center for Social Organization of Schools. http://eric.ed.gov/?id=ED538314

Oregon Department of Education. (2009). *Oregon graduates & dropouts reporting manual*. Salem, OR: Author.

Oregon Department of Education. (2010). *Oregon cumulative ADM manual for the 2010–11 school year*. Salem, OR: Author.

Oregon Department of Education. (2012). *Dropout file 2010–2011*. Retrieved February 8, 2012, from http://www.ode.state.or.us/wma/data/schoolanddistrict/students/dropout/dropouttables2010–2011_01262012.xls

Oregon Department of Education. (2013). *Trends in cohort graduation rates 2011–12*. Retrieved April 21, 2014, from http://www.ode.state.or.us/wma/data/schoolanddistrict/students/docs/trendscohortgrad1112.pdf

Pepe, M. (2003). *The statistical evaluation of medical tests for classification and prediction*. New York: Oxford University Press.

Pleis, J. R., Ward, B. W., & Lucas, J. W. (2010). *Summary health statistics for U.S. adults: National Health Interview Survey, 2009* (Vital and Health Statistics Series 10, No. 249). Washington, DC: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. Retrieved March 6, 2014, from http://www.cdc.gov/nchs/data/series/sr_10/sr10_249.pdf

Rouse, C. E. (2007). Quantifying the costs of inadequate education: Consequences of the labor market. In C. R. Belfield & H. M. Levin (Eds.), *The price we pay: Economic and social consequences of inadequate education* (pp. 99–124). Washington, DC: Brookings Institution Press.

Rumberger, R. W. (2011). *Dropping out: Why students drop out of high school and what can be done about it*. Cambridge, MA: Harvard University Press.

Rumberger, R. W., & Lim, S. A. (2008). *Why students drop out of school: A review of 25 years of research* (CDRP Report No. 15). Santa Barbara, CA: University of California, Santa Barbara, Gevirtz Graduate School of Education, California Dropout Research

Project. Retrieved March 6, 2014, from http://www.cdrp.ucsb.edu/download.php?file=researchreport15.pdf

Uekawa, K., Merola, S., Fernandez, F., & Porowski, A. (2010). *Creating an early warning system: Predictors of dropout in Delaware*. Dover, DE: Delaware Department of Education. Retrieved April 25, 2014, from http://www.doe.k12.de.us/infosuites/ddoe/p20council/docs/MA1275TAFINAL508.pdf

Usher, A., & Kober, N. (2012). *Student motivation: An overlooked piece of school reform. Summary*. Washington, DC: George Washington University, Graduate School of Education and Human Development, Center on Education Policy. http://eric.ed.gov/?id=ED532666

The Regional Educational Laboratory Program produces 7 types of reports

Making Connections
Studies of correlational relationships

Making an Impact
Studies of cause and effect

What's Happening
Descriptions of policies, programs, implementation status, or data trends

What's Known
Summaries of previous research

Stated Briefly
Summaries of research findings for specific audiences

Applied Research Methods
Research methods for educational settings

Tools
Help for planning, gathering, analyzing, or reporting data or research