

2019

# Student Participation and Postsecondary Outcomes

## Specialized Courses in Science, Technology, Engineering and Mathematics



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## ABOUT THE ERDC

The research presented here uses data from the Education Research and Data Center, located in the Washington Office of Financial Management. ERDC works with partner agencies to conduct powerful analyses of learning that can help inform the decisionmaking of Washington legislators, parents, and education providers. ERDC's data system is a statewide longitudinal data system that includes de-identified data about people's preschool, educational and workforce experiences.

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## Background

Project Lead the Way is a national organization that provides “real-world, applied learning experiences” in science, technology, engineering and mathematics, or STEM. Individual Washington high schools offered PLTW curricula as early as 1999.<sup>1</sup> In recent years, the Office of Superintendent of Public Instruction has awarded grants to enhance high school offerings of PLTW curricula. These awards may be used for the purchase of the lab equipment and professional development to integrate these advanced courses in the schools.<sup>2</sup>

In 2014, two PLTW curricula were offered in participating Washington high schools:

- The Engineering curriculum, which consists of two foundation courses: Introduction to Engineering Design and Principles of Engineering. Specialization courses offered through 2014 were Aerospace Engineering, Biotechnical Engineering, Civil Engineering and Architecture, Computer Integrated Manufacturing and Digital Electronics. The capstone course for Engineering is Engineering Design and Development.
- The Biomedical Science curriculum, which consists of Principles of Biomedical Science, Human Body Systems, Medical Interventions and the capstone course, Biomedical Innovation.

Participating high schools most often offer a subset of available courses in a curriculum.

School participation in PLTW requires an agreement signed by the superintendent or school board president. There is also a participation fee that covers access to all program features for which a school has a trained teacher. In 2013, the annual participation fees were \$3,000 for Engineering and \$2,000 for Biomedical Science.

This report integrates information from K-12 education, postsecondary education and employment sectors to provide detailed enrollment, course-taking and employment information for the approximately 2,500 PLTW participants who graduated from high school in 2014.<sup>3</sup>

## The 2014 PLTW high school graduate cohort

Students may enroll in PLTW courses throughout high school, so identification of PLTW participants involves (1) identifying high schools offering PLTW courses, (2) identifying PLTW courses at the high-school level and (3) examining course-specific

1 Project Lead the Way <[www.pltw.org/](http://www.pltw.org/)>

2 OSPI Budget Provisos 2011–13 Biennium: Project Lead the Way [[www.k12.wa.us/Finance/Agency-FinancialServices/Provisos/2013/EACodeQN2ProjectLeadtheWay.docx](http://www.k12.wa.us/Finance/Agency-FinancialServices/Provisos/2013/EACodeQN2ProjectLeadtheWay.docx)]

3 RCW 28A.188.070 directs the Education Research and Data Center in the Office of Financial Management to study postsecondary enrollment; mathematics and science course-taking patterns; and employment of students completing PLTW in a series of annual reports running from 2015 through 2018.

student enrollment over a period of four years for students in each high school graduation year cohort.

Students graduating in 2014 who completed at least one PLTW course in school years 2011 through 2014 are the focus of this report. OSPI's Comprehensive Education Data and Research System<sup>4</sup> — specifically the student grade history file — was used to identify students completing PLTW courses.

## Characteristics of program participants<sup>5</sup>

Male students accounted for approximately two-thirds of 2014 high school graduates completing PLTW courses in high school. Schools offering PLTW courses have race/ethnic distributions among their graduates similar to high schools in general.

Table 1: Characteristics of 2014 PLTW Graduates<sup>6</sup>

Student Characteristics	PLTW Graduates	All Graduates from PLTW Schools	All Washington Graduates
Male	63%	50%	49%
Female	37%	50%	51%
Programs and Services			
FRPL-eligible	38%	38%	38%
Special education	5%	9%	9%
Bilingual education	3%	3%	2%
Race/Ethnicity			
American Indian or Alaska Native	1%	1%	1%
Asian	11%	8%	8%
Black/African American	6%	5%	4%
Hispanic	15%	16%	16%
Native Hawaiian or other Pacific Islander	1%	1%	1%
Two or More Races	6%	6%	5%
White	60%	64%	64%

Note: Shares may not add to 100% due to rounding.

4 See the OSPI CEDARS website <<http://www.k12.wa.us/CEDARS/>> for information.

5 Conventions to protect personally identifying information suggested by the U.S. Department of Education are adhered to in the following series of tables when cell sizes represent populations too small to report. Counts shown in tables are rounded to the nearest 10 students. See "Statistical Methods for Protecting Personally Identifiable Information in Aggregate Reporting" (NCES SLDS Technical Brief #3) <[nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2011603](https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2011603)>.

6 FRPL-eligible students are those eligible for free or reduced-price lunch based on family income.

Breaking the PLTW students into subgroups based on subject area sheds light on additional patterns of enrollment. Male students participate to a greater degree than females in the Engineering programs, while female students participate at higher levels in the Biomedical Science programs. Table 2 illustrates this and also categorizes the PLTW graduates by the share participating in foundational level and advanced level PLTW courses.

Table 2: PLTW Graduates by Program, Gender and Level (Foundation or Advanced)

PLTW Curriculum	Graduates	Male	Female
All PLTW programs	2,520	63%	37%
PLTW Engineering	1,640	79%	21%
Foundation courses only	1,230	78%	22%
Advanced courses	420	81%	19%
PLTW Biomedical Science	960	34%	66%
Foundation courses only	780	34%	66%
Advanced courses	180	32%	68%

Note: Some students completed both Engineering and Biomedical Science courses and are represented in both categories. Counts are rounded to the nearest 10 students.

Table 3 shows the high school GPA for 2014 PLTW graduates overall, by PLTW program and for students completing two or more units in a PLTW program.

Table 3: GPA Distribution of PLTW Graduates, 2014

PLTW Curriculum	Percentage in GPA Category				
	3.50-4.00	3.00-3.49	2.50-2.99	2.00-2.49	<2.00
All PLTW programs	28%	26%	21%	17%	8%
Advanced	31%	28%	18%	15%	7%
PLTW Engineering	28%	25%	20%	18%	9%
Advanced	30%	27%	19%	15%	9%
PLTW Biomedical Science	28%	27%	21%	17%	6%
Advanced	34%	30%	17%	*	*

Note: Some students completed both Engineering and Biomedical Science courses and are represented in both categories. Totals in programs may not add to 100% due to rounding. An asterisk (\*) indicates that data is not reported to protect subgroups with fewer than 10 individuals. Totals in programs may not add to 100% due to rounding.

## Postsecondary enrollment follow-up<sup>7</sup>

Table 4 summarizes one year of postsecondary education follow-up for 2014 PLTW graduates. Included in the postsecondary enrollment data are four types of enrollment: Washington public four-year institutions; the state's community and technical colleges, or CTCs; Washington private institutions; and out-of-state institutions.<sup>8</sup> Overall, 69 percent of PLTW graduates enrolled in postsecondary education in 2015. Postsecondary enrollment rates, as well as enrollment rates by type of institution, are related to high school GPA.

Typically, high school graduates with the highest GPA have the highest rates of postsecondary enrollment and the greatest tendency to enroll in either Washington public four-year institutions or in private or out-of-state institutions.<sup>9</sup> This holds true for the PLTW graduates. More than 85 percent of PLTW graduates with a GPA of 3.50 or above participated in postsecondary education in the year after high school graduation. Of those, 76 percent attended either a Washington public four-year institution or a private and/or out-of-state institution.

Table 4: One-Year Postsecondary Enrollment Follow-Up by High School GPA

High School GPA	Any Institution	Washington Public		Private or Out-of-State Institution
		CTC	Four-Year	
3.50-4.00	86%	13%	48%	28%
3.00-3.49	78%	29%	32%	19%
2.50-2.99	65%	37%	21%	10%
<2.50	46%	34%	4%	9%
Total	69%	27%	27%	17%

Note: Shares may not add to 100% because some students enrolled in more than one type of postsecondary institution in 2015.

7 Postsecondary enrollment rates for the 2014 PLTW high school graduates have been updated from previous reports based on current data available to the Education Research and Data Center. Academic years used in this report are expressed using the last year of the academic term, so "2013" refers to the academic year 2012–13. The two years of follow-up for the 2013 graduates are 2014 (i.e., 2013–14) and 2015 (i.e., 2014–15).

8 Enrollment data for the ERDC data warehouse is provided by the State Board for Community and Technical Colleges and the six public baccalaureate higher education institutions of the state (University of Washington, Washington State University, Central Washington University, Eastern Washington University, The Evergreen State College and Western Washington University). Additionally, the National Student Clearinghouse is the source of information about enrollment in Washington private higher education institutions and out-of-state institutions.

9 See the ERDC High School Graduate Outcomes (<https://erdc.wa.gov/data-dashboards/high-school-graduate-outcomes>).

Table 5 shows a full two-year postsecondary enrollment follow-up (through 2016) for the 2014 high school graduates. Individuals were considered enrolled if, at any time during the two years after high school graduation, they were enrolled in a postsecondary institution.

- PLTW high school graduates with lower high school GPAs are more likely to defer college enrollment by a year than those with higher GPAs. At the end of one year, 46 percent of graduates with high school GPAs lower than 2.50 had enrolled in postsecondary education. After two years, 54 percent had enrolled. Comparable rates for those in the 3.50–4.00 GPA range were 86 percent after one year to 92 percent after two.
- PLTW graduates who defer postsecondary enrollment until the second year after high school graduation were more likely to enroll in a CTC. In the first year after graduation, 27 percent of the graduates enrolled in a CTC. After the second year, 35 percent of those enrolling in postsecondary institutions had enrolled in a CTC.

Table 5: Two-Year Postsecondary Enrollment Rate Follow-up by High School GPA

High School GPA	Any Institution	Washington Public		Private or Out-of-State Institution
		CTC	Four-Year	
3.50-4.00	92%	20%	50%	34%
3.00-3.49	83%	38%	33%	23%
2.50-2.99	71%	44%	23%	12%
<2.50	54%	40%	5%	11%
Total	76%	35%	29%	21%

Note: Shares may not add to 100% because some students enrolled in more than one type of postsecondary institution in 2015 and 2016.

Table 6 shows a follow-up by PLTW curriculum and gender for the two-year period after graduation from high school.

By the second postsecondary year, 75 percent of PLTW graduates had enrolled in postsecondary education. While participation in PLTW programs is higher for male students than for female students (see Table 1), women enroll in postsecondary institutions in the two years following high school graduation at a rate higher than men.



Table 6: Two-Year Postsecondary Enrollment Rate Follow-up by PLTW Program and Gender

PLTW Curriculum	Any Institution	Washington Public		Private & Out-of-State Institution
		CTC	Four-Year	
All PLTW	75%	35%	28%	21%
Engineering	76%	35%	28%	22%
Biomedical Science	74%	34%	29%	19%
Male	73%	34%	27%	19%
Engineering	74%	34%	27%	20%
Biomedical Science	67%	29%	26%	17%
Female	79%	36%	31%	23%
Engineering	82%	35%	29%	29%
Biomedical Science	77%	37%	31%	20%

Note: Some students enrolled in more than one type of postsecondary institution in 2015 and 2016.

## Postsecondary mathematics

Postsecondary mathematics and science credit-earning patterns for the 2014 PLTW graduates were assessed for students enrolled in Washington public institutions.<sup>10</sup>

Mathematics courses were classified as:

- pre-college mathematics
- general college-level mathematics
- pre-calculus
- calculus and higher-level mathematics

Pre-calculus, calculus and higher-level mathematics courses serve as foundational courses for further work in STEM fields.

Table 7 shows successful completion of mathematics courses for one and two years after high school graduation.

<sup>10</sup> Course-taking details are not available for institutions other than Washington public colleges and universities.



Table 7: Postsecondary Mathematics Course Completions by PLTW Graduates

PLTW Curriculum	Mathematics Credits			
	One-Year Follow-Up		Two-Year Follow-Up	
	Any	Percentage College-Level	Any	Percentage College-Level
All PLTW	69%	78%	81%	82%
Engineering	74%	80%	83%	84%
Advanced	79%	80%	87%	86%
Biomedical Science	63%	73%	77%	78%
Advanced	70%	78%	78%	78%

Overall, 69 percent of PLTW graduates who enrolled in Washington public institutions in the year after graduation earned credit in at least one mathematics course.

Approximately 78 percent of those earning college-level mathematics credit earned credit in a college-level mathematics course. After two years, 81 percent of those enrolled in public postsecondary institutions had enrolled in college-level mathematics and 82 percent of those had earned credit in college-level mathematics.

Table 8 shows the percentage of students earning mathematics credits by the highest level of credits earned. Mathematics credit-earning rates are calculated as a share of students earning mathematics credits.

Table 8: Highest Level Mathematics Credits

PLTW Curriculum	Highest Level Mathematics Course							
	One-Year Follow-up				Two-Year Follow-up			
	Pre-College	General Math	Pre-Calculus	Calculus & Higher	Pre-College	General Math	Pre-Calculus	Calculus & Higher
All	22%	24%	23%	31%	18%	29%	19%	34%
Engineering	20%	18%	25%	37%	16%	23%	19%	42%
Advanced	20%	19%	27%	34%	14%	26%	23%	37%
Biomedical	27%	34%	21%	18%	22%	41%	19%	19%
Advanced	25%	39%	18%	17%	22%	39%	22%	18%

Note: Some students completed both Engineering and Biomedical Science courses.

- By two years after high school graduation, approximately one-third of the 2014 PLTW graduates who earned mathematics credits had earned credits in calculus or higher level mathematics.
- Not unexpectedly, students who completed PLTW Engineering coursework in high school earned credits in calculus or higher-level mathematics at rates higher than those who took PLTW Biomedical Science coursework, where advanced study is less mathematics-intensive.

- After the second postsecondary year, 18 percent of the PLTW students earned credits in pre-college mathematics as their highest-level mathematics. The rate was lower for PLTW Engineering students (16 percent) than for PLTW Biomedical Science students (22 percent).

Some students need to strengthen their math skills before progressing to college-level mathematics. Table 9 takes the approximately 230 PLTW graduates who enrolled in pre-college mathematics in 2015 and shows the highest level of mathematics credits earned over the two postsecondary follow-up years.

Table 9: Highest-Level Mathematics Credits, Students Earning Credit in Pre-College Mathematics, 2015

PLTW Curriculum	Highest Level Mathematics Course					
	One-Year Follow-up			Two-Year Follow-up		
	Pre-College	General Math	Pre-calculus & Higher	Pre-College	General Math	Pre-calculus & Higher
All	68%	17%	15%	47%	28%	25%
Engineering	67%	13%	20%	47%	23%	30%
Biomedical	*	*	*	49%	34%	17%

Note: An asterisk (\*) indicates that data is not reported to protect subgroups with fewer than 10 individuals.

Of the students who enrolled in pre-college mathematics in the first year after high school graduation, 32 percent had completed college-level mathematics by the end of that same year — 17 percent in general mathematics and 15 percent in pre-calculus or higher-level mathematics. By the end of the second year, more than half had completed a college-level mathematics course and 25 percent had completed a pre-calculus or higher mathematics course.

## Postsecondary Science

Science courses, including computer science, offered by Washington public postsecondary institutions were classified into two categories: those foundational for further study in STEM fields and those designed for nonscience majors.

Table 11 shows enrollment in foundational science courses in the following categories:

- Physics, Engineering, Engineering Technology
- Chemistry
- Biology and Medical
- Computer Science (including programming courses, but excluding courses that cover the use of software)

Table 10: Postsecondary Science Courses Completed by PLTW Graduates, One- and Two-Year Follow-up

PLTW Curriculum	Physics, Engineering		Chemistry		Biology, Medical		Computer Science	
	1 Year	2 Years	1 Year	2 Years	1 Year	2 Years	1 Year	2 Years
All PLTW Students	16%	23%	23%	31%	14%	24%	11%	17%
Engineering	23%	30%	26%	32%	8%	16%	15%	24%
Advanced	29%	37%	29%	35%	7%	14%	14%	23%
Biomedical Science	5%	9%	19%	30%	24%	39%	4%	5%
Advanced	*	10%	23%	37%	27%	48%	*	*

Note: An asterisk (\*) indicates that data is not reported to protect subgroups with fewer than 10 individuals.

Table 11 shows that:

- PLTW Engineering students completed Physics/Engineering and Computer Science foundational courses at relatively high levels.
- PLTW Biomedical Science students completed Biology/Medical foundational courses at relatively high levels.
- All PLTW students completed foundational chemistry courses at relatively high rates.
- Computer science courses were almost exclusively in the domain of the PLTW Engineering students.

## Employment

Approximately 2,000 PLTW high school graduates were employed in Washington in 2015 or 2016, roughly 1,800 in each year.<sup>11</sup> Table 11 shows the median earnings of the graduates by postsecondary enrollment status and by the number of calendar quarters in which they were employed. Individuals earning at least \$100 in a quarter are considered employed. Table 11 shows that the median earnings of all employed PLTW graduates in 2015 was approximately \$7,200.

<sup>11</sup> Employment and earnings information is available for individuals matched with unemployment insurance wage records collected by the Washington State Employment Security Department. Employment information for self-employed individuals, federal employees and those employed exclusively outside Washington is not included.

Table 11: Earnings of PLTW Graduates by Employment Status

	2015			2016		
	Employed	Share	Median Earnings	Employed	Share	Median Earnings
Employed	1,830	100%	\$7,200	1,820	100%	\$10,300
Employed 4 quarters	780	43%	\$14,900	990	54%	\$17,200
Not enrolled	450	25%	\$13,500	670	37%	\$16,300
Employed 4 quarters	260	14%	\$18,500	440	24%	\$21,800
Enrolled	1,370	75%	\$6,200	1,150	63%	\$8,200
Employed 4 quarters	520	28%	\$13,000	550	30%	\$13,900

Note: Numbers of graduates are rounded to the nearest 10. Earnings are rounded to the nearest \$100. Totals may not add due to rounding. Earnings are inflation-adjusted to 2016 dollars using the implicit price deflator for personal consumption.

Many factors are in play in assessing employment outcomes, particularly for a group wherein many members are combining work with postsecondary enrollment. For those not enrolled in postsecondary education, median earnings were \$13,500 more than twice the median of \$6,200 for those enrolled. Adding the number of quarters worked into the equation illustrates the obvious: Those working all four quarters in 2015 had significantly higher earnings (\$14,900) than those working fewer quarters.

There are significant differences across industries in the potential earnings for recent high school graduates. Table 12 shows earnings by industry group for all employed graduates and for those who had earnings in four quarters. For those working in more than one industry, the industry associated with the highest earnings for that year is selected for display.

When employment and earnings are broken out by industry group, several things stand out:

- The two industry groups employing the greatest numbers in the PLTW graduates are trade, which includes retail trade employment, and leisure and hospitality, which includes employment in restaurants.
- Highest median earnings for those employed four quarters were in manufacturing and construction sectors.

Table 12: Earnings by Industry Group and Employment Status

Industry Group	All Employed Graduates				Employed 4 Quarters			
	2015		2016		2015		2016	
	Count	Median	Count	Median	Count	Median	Count	Median
Construction	70	\$12,400	70	\$14,400	30	\$23,700	30	\$27,700
Manufacturing	90	\$14,300	100	\$17,900	50	\$21,300	60	\$23,000
Trade	460	\$9,900	520	\$11,500	240	\$14,900	310	\$17,300
Transportation & Utilities	60	\$9,200	60	\$14,300	30	\$15,100	40	\$20,300
Information, Financial	70	\$6,300	80	\$9,900	30	\$16,300	40	\$21,000
Professional & Business Services	170	\$6,300	200	\$9,100	60	\$16,500	90	\$15,900
Education, Health Services	180	\$6,500	220	\$7,900	80	\$15,000	110	\$17,900
Leisure & Hospitality	370	\$8,100	410	\$9,200	200	\$12,300	230	\$14,200
Other industries	140	\$7,100	160	\$8,100	50	\$13,400	70	\$16,500

Note: Numbers of graduates are rounded to the nearest 10. Earnings are rounded to the nearest \$100. Totals may not add due to rounding. Earnings are inflation adjusted to 2016 dollars using the implicit price deflator for personal consumption.



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