Student Participation and Postsecondary Outcomes: Specialized Courses in Science, Technology, Engineering and Mathematics

Report prepared by the Washington State Office of Financial Management as directed by RCW 28A.188.070
(Specialized courses in science, technology, engineering and mathematics)

2015 Annual Report

Forecasting and Research Division
Office of Financial Management
August 2015

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Background

Project Lead the Way (PLTW) is a national organization that provides a science, technology, engineering and mathematics (STEM) curriculum for elementary through high school. Individual Washington high schools offered PLTW curricula as early as 1999.[1] In recent years, the Office of Superintendent of Public Instruction (OSPI) has awarded grants to enhance high school offerings of PLTW curricula. These one-time awards may be used for the purchase of the lab equipment and professional development to integrate the advanced courses in the schools.[2] Districts receiving funding for these activities are shown in the Appendix.

Currently, two curricula are offered in participating Washington high schools. The Engineering curriculum consists of two foundation courses: introduction to engineering design and principles of engineering. Specialization courses are aerospace engineering, biotechnical engineering, civil engineering and architecture, computer integrated manufacturing, computer science and software engineering, and digital electronics. The capstone course for engineering is engineering design and development.

Foundation courses for the Biomedical Science curriculum are principles of biomedical science, human body systems and medical interventions. The capstone course is biomedical innovation. Participating high schools most often offer only a subset of all available courses in a curriculum. School participation in PLTW requires an agreement signed by the local superintendent or school board president. A participation fee covers access to all program features for which a school has a trained teacher. The participation fee is assessed annually: $3,000 for Engineering and $2,000 for Biomedical Science.

RCW 28A.188.070 directs the Education Research and Data Center (ERDC) in the Office of Financial Management to:

- study mathematics and science course-taking patterns of students completing specialized STEM courses, including the extent to which completion of PLTW courses reduces mathematics remediation of students; and
- follow the students to employment or further training and education in the two years following high school.

ERDC is to report the findings "to the governor, appropriate state agencies, and the appropriate education and fiscal committees of the legislature" in a series of annual reports running from 2015 through 2018.

Identifying the PLTW Cohort

Students may participate in PLTW courses throughout their high school career, so identification of PLTW participants involves (1) identifying PLTW courses at the high-school level, and (2)

[1] Project Lead the Way <www.pltw.org/>
[2] OSPI Budget Provisos 2011–13 Biennium: Project Lead the Way [www.k12.wa.us/Finance/AgencyFinancialServices/Provisos/2013/EACodeQN2ProjectLeadtheWay.docx]

examining course-specific student enrollment over a period of four years for students in each high school graduation year cohort.[3]

The first PLTW study cohort is students graduating in 2012–13 who completed at least one PLTW course between 2009–10 and 2012–13. OSPI's Comprehensive Education Data and Research System — specifically the student grade history file — was used to identify students completing PLTW courses.

Reporting Schedule

The first reporting cohort (Cohort 1) is composed of 2012–13 high school graduates who at any point in high school completed a PLTW course. Cohort 2 will consist of 2013–14 high school graduates. Because of the timing of data availability for postsecondary follow-up into enrollment and employment, these are the only cohorts for which complete two-year follow-up reporting will be possible by 2018 in the final report.

Table 1 shows availability of data for three reporting topics: K-12 participation and student characteristics, postsecondary enrollment and employment. The first complete two-year follow-up of postsecondary enrollment and employment for Cohort 1 will be available in the 2017 report.

Table 1: Schedule for Postsecondary Education and Employment Follow-Up

Report Year	K-12 Participation and Student Characteristics	Postsecondary Enrollment (High School Graduates)	Employment (High School Graduates)
2014	Cohort 1 (preliminary)	Follow-up data not available.	Full year of data not available.
2015	Cohort 1	One-year follow-up for 2013 K-12 completers (Cohort 1).	Full year of data not available.
2016	Cohorts 1-2	Two-year follow-up for Cohort 1 (2013). One-year follow-up for Cohort 2 (2014).	One-year follow-up for Cohort 1 (2013).
2017	Cohorts 1-3	Two-year follow-up for Cohorts 1 (2013) and 2 (2014). One-year follow-up for Cohort 3 (2015).	Two-year follow-up for Cohort 1 (2013).
2018	Cohorts 1-4	Two-year follow-up for Cohorts 1 (2013), 2 (2014) and 3 (2015). One-year follow-up for Cohort 4 (2016).	Two-year follow-up for Cohorts 1 (2013) and 2 (2014).

Cohort 1 = PLTW students graduating in 2012–13 (2013); Cohort 2 = PLTW students graduating in 2013–14 (2014);
Cohort 3 = PLTW students graduating in 2014–15 (2015); Cohort 4 = PLTW students graduating in 2015–16 (2016)

Characteristics of Program Participants

The following tables describe the characteristics of the 1,690 PLTW participants who graduated in 2012–13 (Cohort 1). Conventions to protect personally identifying information suggested by the U.S. Department of Education are followed in the following series of tables when cell sizes

[3] OSPI staff assisted ERDC in identifying PLTW courses.

represent populations too small to report.[4] Counts shown in tables are rounded to the nearest 10 students. As shown in Table 2, approximately twice as many male students completed PLTW courses as females.

Table 2: Characteristics of 2013 PLTW Graduates (1,690 High School Graduates)

Student Characteristic	Share	Student Characteristic	Share
Gender		*Race/ethnicity*	
Male	68%	American Indian or Alaska Native	≤1%
Female	32%	Asian	14%
		Black/African-American	6%
Program characteristics		Hispanic	17%
Low income	43%	Native Hawaiian or Other Pacific Islander	≤1%
Special education	≤5%	Two or more races	5%
Bilingual education	≤5%	White	57%

Males participate to a greater degree than women in the Engineering programs. Table 3 illustrates this and also categorizes the PLTW graduates by the number of units of credit earned in each curriculum area.

Table 3: PLTW Course Completions by Program, Gender and PLTW Units Completed

PLTW Course-Completion Category	High School Graduates (rounded to nearest 10)	Male	Female
All PLTW Students	1,690	68%	32%
PLTW Engineering	1,320	79%	21%
<1 unit	370	75%	25%
1 unit	690	80%	20%
2 or more units	260	83%	17%
PLTW Biomedical	450	37%	63%
<1 unit	100	40%	60%
1 unit	290	36%	64%
2 or more units	50	35%	65%

Note: Some students completed both Engineering and Biomedical courses. Totals in programs may not add due to rounding.

Table 4 shows the high school grade point average (GPA) for 2012–13 PLTW graduates: overall, by PLTW program and for students completing two or more units in a PLTW program.

[4] "Statistical Methods for Protecting Personally Identifiable Information in Aggregate Reporting" (NCES SLDS Technical Brief #3) <nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2011603>

Table 4: GPA Distribution of PLTW Graduates, 2012-13

PLTW Curriculum	Percentage in GPA Category				Total
	3.50 - 4.00	3.00 - 3.49	2.50 - 2.99	Below 2.50	
All PLTW Students	26%	27%	22%	25%	100%
2 or more units	29%	23%	22%	27%	100%
PLTW Engineering	26%	27%	21%	26%	100%
2 or more units	29%	23%	22%	27%	100%
PLTW Biomedical	26%	27%	25%	23%	100%
2 or more units	31%	33%	25%	12%	100%

Note: Totals in programs may not add due to rounding.

Preliminary Postsecondary Enrollment Follow-Up

Table 5 summarizes one year of postsecondary education follow-up for 2012–13 PLTW graduates. Included in the postsecondary enrollment data are enrollments in Washington public four-year institutions, the state's community and technical colleges (CTCs) and private and out-of-state institutions. Overall, 60 percent of the graduates enrolled in postsecondary education in 2013–14. Overall college-going rates, as well as college-going rates by type of institution, are related to high school GPA. PLTW graduates with GPAs in the 3.50 to 4.00 range attended mainly Washington public four-year institutions (46 percent) and private or out-of-state institutions (39 percent).

Table 5: One-Year Postsecondary Follow-Up for 2012-13 PLTW High School Graduates by High School GPA

GPA Category	College-Going Rate (2013–14)	Share of College Enrollment (For Students Enrolled in 2013-14)		
		Washington CTC	Washington Public Four-Year	Private and/or Out-of-State Institution
3.50-4.00	88%	19%	46%	39%
3.00-3.49	72%	37%	42%	22%
2.50-2.99	50%	59%	26%	18%
<2.50	27%	79%	4%	17%
Total	60%	39%	36%	27%

*Suppressed because of small cell size

Note: Shares may not add to 100% because some students enrolled in more than one type of institution in 2013–14.

Table 6 shows college-going rates by PLTW program and gender. In general, postsecondary enrollment rates are greater for women than for men.

Table 6: One-Year Postsecondary Follow-Up by PLTW Program and Gender

PLTW Curriculum	High School Graduates (rounded)	Postsecondary Enrollment Rate			
		Any College	Washington CTC	Washington Public Four-Year	Private and/or Out-of-State
All graduates	66,100	62%	27%	20%	14%
All PLTW students	1,690	60%	23%	22%	16%
Male	1,150	58%	22%	21%	16%
PLTW Engineering	1,050	58%	21%	22%	16%
PLTW Biomedical	160	58%	26%	16%	18%
Female	540	64%	26%	23%	17%
PLTW Engineering	280	67%	27%	26%	15%
PLTW Biomedical	280	61%	24%	21%	19%

Note: Some students completed both Engineering and Biomedical courses. Some students attended more than one type of institution in 2013–14. Totals in programs may not add due to rounding

Table 7 shows college-going rates by PLTW program and number of units completed.

Table 7: One-Year Postsecondary Follow-Up by PLTW Units Completed

PLTW Curriculum	High School Graduates (rounded)	Postsecondary Enrollment Rate			
		Any College	Washington CTC	Washington Public Four-Year	Private and/or Out-of-State
All PLTW Students	1,690	60%	23%	22%	16%
PLTW Engineering	1,320	60%	23%	23%	16%
<1 unit	370	58%	25%	20%	14%
1 unit	690	58%	22%	23%	15%
2 or more units	260	65%	20%	26%	20%
PLTW Biomedical	450	60%	25%	19%	19%
<1 unit	100	52%	27%	13%	14%
1 unit	290	61%	25%	20%	19%
2 or more units	50	71%	19%	29%	25%

Note: Some students completed both Engineering and Biomedical courses. Some students attended more than one type of institution in 2013–14. Totals in programs may not add due to rounding.

Postsecondary Mathematics Course-Taking

The 2013–14 postsecondary mathematics and science course-taking patterns for the 2012–13 PLTW graduates were assessed for students enrolled in Washington public institutions. 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 are foundational courses for further work in STEM fields.

Table 8 shows enrollment in mathematics courses. Overall, 85 percent of PLTW graduates who enrolled in Washington public institutions in the year after graduation enrolled in at least one mathematics course and 72 percent of those students enrolled in a college-level mathematics course.

Table 8: Postsecondary Mathematics Course-Taking by 2012–13 PLTW Graduates, One-Year Follow-Up

PLTW Course-Completion Category	Enrolled in Public Institution (rounded)	Enrolled in Mathematics Course(s)	Enrolled in College-Level Mathematics Course(s)
All PLTW students	750	85%	72%
PLTW Engineering	590	86%	75%
<1 unit	160	85%	78%
1 unit	310	84%	75%
2 or more units	120	89%	73%
PLTW Biomedical	190	82%	62%
<1 unit	*	*	*
1 unit	130	79%	59%
2 or more units	*	*	*

Note: Some students completed both Engineering and Biomedical Science courses in high school. Totals in programs may not add due to rounding. An asterisk (*) indicates that detail has been suppressed due to small cell size.

Table 9 shows the highest level mathematics courses taken by the 2013 PLTW graduates during 2013–14 postsecondary enrollment.

Table 9: Highest Level Mathematics Course in 2013–14 for Those Enrolled in Mathematics Courses

PLTW Course-Completion Category	Highest Level Mathematics Course (for those enrolled in mathematics)			
	Pre-College	General Mathematics	Pre-Calculus	Calculus or Higher
All PLTW Students	28%	24%	19%	29%
PLTW Engineering	25%	24%	18%	34%
<1 unit	22%	28%	14%	36%
1 unit	25%	24%	20%	31%
2 or more units	27%	20%	16%	37%
PLTW Biomedical	38%	25%	25%	11%
<1 unit	*	*	*	*
1 unit	41%	25%	24%	9%
2 or more units	*	*	*	*

Note: Some students completed both Engineering and Biomedical courses. Row totals may not add to 100% due to rounding. An asterisk (*) indicates that detail has been suppressed due to small cell size.

This table introduces a new way of looking at mathematics course-taking by examining the highest level of mathematics attained during the follow-up period. Students who enroll in pre-college

mathematics followed by enrollment in a college-level mathematics course are included in the higher level category. Also, in both Tables 8 and Table 9, pre-college mathematics course-taking rates are calculated relative to students enrolled in mathematics courses rather than as a percentage of all students enrolled.

Postsecondary Science Course-Taking

Postsecondary course-taking data in science and engineering for 2012–13 PLTW high school graduates enrolled in Washington public institutions in 2013–14 was developed for the PLTW graduates in the following categories:

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

Courses in these categories were those judged as foundational for further work in STEM fields. These categories do not reflect total postsecondary science course-taking since some college-level science (e.g., geology, meteorology and zoology) does not fall into any of these four categories.

In Table 10, "Enrolled in Science" means enrolled in a course in at least one of the four areas listed.

Table 10: Postsecondary Science Course-Taking by 2012–13 PLTW Graduates, One-Year Follow-Up

PLTW Course-Completion Category	Enrolled in Public Institution (rounded)	Enrolled in Science	Physics, Engineering	Computer Science	Biology, Medical	Chemistry
All PLTW Students	750	55%	20%	13%	18%	30%
PLTW Engineering	590	56%	23%	16%	14%	31%
<1 unit	160	54%	21%	14%	16%	32%
1 unit	310	54%	22%	14%	15%	29%
2 or more units	120	66%	31%	26%	9%	35%
PLTW Biomedical	190	53%	7%	5%	31%	27%
<1 unit	40	43%	*	*	*	*
1 unit	130	53%	*	*	*	*
2 or more units	20	72%	*	*	*	*

Note: Some students completed both Engineering and Biomedical courses. Totals in programs may not add due to rounding. An asterisk (*) indicates that detail has been suppressed due to small cell size.

Science course-taking rates for high school graduates earning at least two PLTW units in high school were higher than the overall PLTW rate.

2016 Annual Report

For the program participants in 2012–13, the 2016 Annual Report will include:

- A full two-year postsecondary education follow-up and a one-year employment follow-up.

- Updates of mathematics and science course-taking to cover the two years after high school graduation.
- A characterization and one-year postsecondary education follow-up for those who exited high school in 2013–14. (These students had access to PLTW courses for one additional year and may have taken additional program coursework.)

Appendix

Districts receiving PLTW Funding

	iGrant 658 PLTW Professional Development		iGrant 669 PLTW Advanced Level STEM Courses		
	2013–14	2014–15	2012–13	2013–14	2014–15
Asotin-Anatone					$25,000
Bellevue	$1,250				
Bethel	2,500		$25,000	$25,000	25,000
Burlington-Edison			25,000		
Central Valley				25,000	
Deer Park		$1,450			
East Valley (Spokane)				25,000	
Edmonds			25,000		
Enumclaw	2,500				
Evergreen		5,800			
Federal Way			25,000		
Franklin Pierce	2,500		25,000	25,000	
Goldendale	1,250	2,900			
Grand Coulee					25,000
Highline					25,000
Lake Chelan	1,250				
Lake Stevens			25,000		
Lake Washington	2,500	2,250			25,000
Longview	2,500				
Mead	2,500		25,000		
Newport				25,000	
Puyallup			25,000		
Riverside					25,000
Royal	2,500				
Seattle	1,250	5,800	25,000	25,000	25,000
Spokane	2,500	5,800		25,000	
Sumner			25,000		
Sunnyside		2,900			
Toppenish			$25,000		
Tumwater		5,800			
University Place					25,000
Vancouver	1,250			25,000	
Wahluke	2,500	$5,800			
West Valley (Spokane)	$1,250			$25,000	$25,000

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