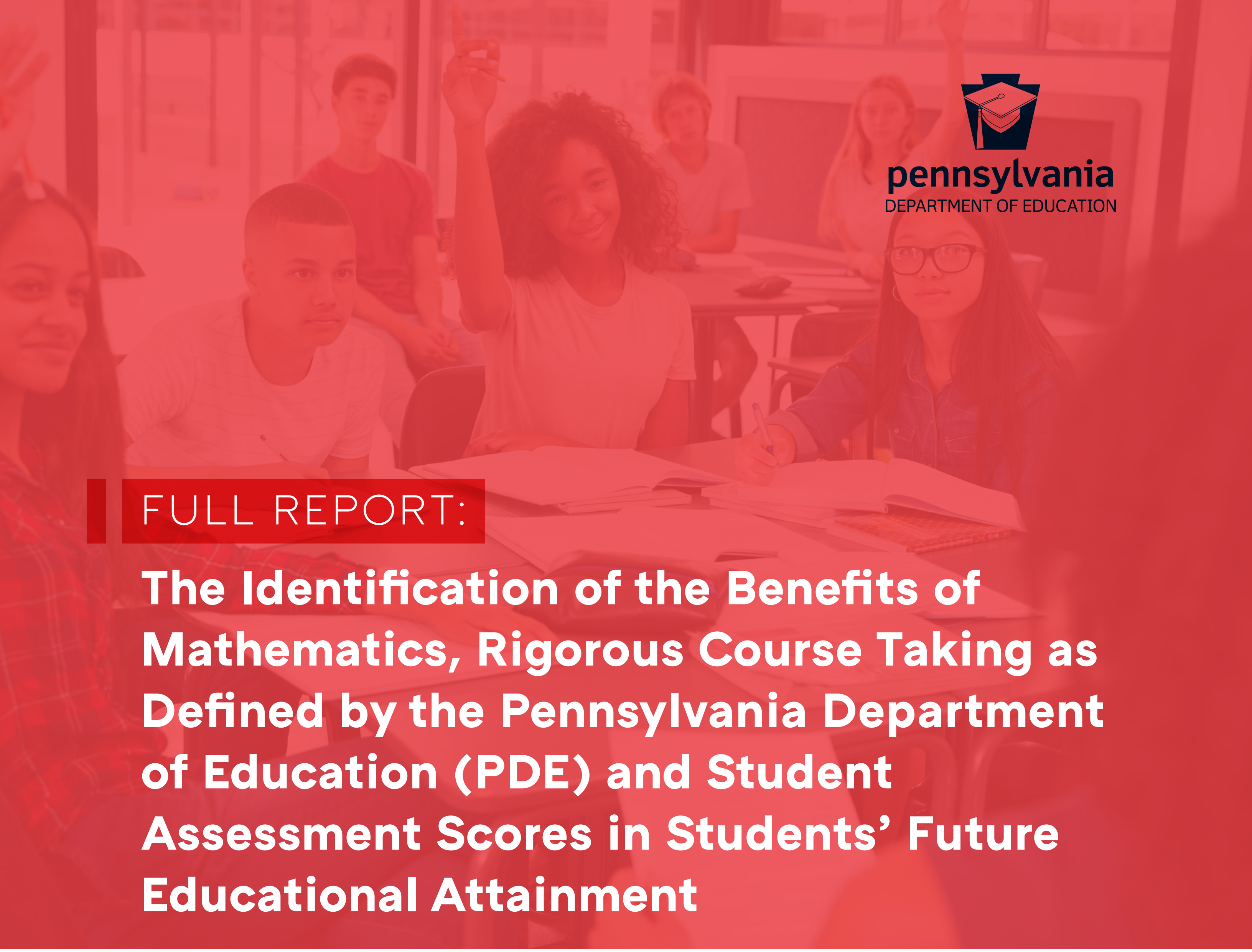

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FULL REPORT:

The Identification of the Benefits of Mathematics, Rigorous Course Taking as Defined by the Pennsylvania Department of Education (PDE) and Student Assessment Scores in Students' Future Educational Attainment

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Research and Evaluation

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Abstract

The success of students in Pennsylvania (PA) has been deemed a top priority in the Governor's commitment to strengthen the education system, which can lead to improved opportunities for PA students and make the path to a postsecondary education more accessible. The research questions addressed in this report are directly aligned with the Governor's Strategic Plan Priority Goals and answer priority research questions within two of PDE's major Research Agenda areas – P–20 Policy and Postsecondary Education. Three cohorts of Pennsylvania students were followed from Grade 9 entry and two from Grade 7 entry to various points in postsecondary study depending on the cohort. Analysis of data over time for students who graduated from PA high schools showed a large effect and significant association between rigorous and advanced course taking in high school and postsecondary enrollment and success. These findings indicate that early college credit opportunities for students through AP or IB programs and dual credit enrollment opportunities are making a difference for students graduating from high schools in PA in terms of defining students' postsecondary path and success. Additionally, taking an advanced algebra course during high school, the timing of Algebra I, and Grade 8 PSSA and Keystone performance were all found to be significantly associated with an increase in odds of on-time high school graduation, postsecondary enrollment, and persistence and retention, even after controlling for other significant explanatory variables.

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The Pennsylvania Department of Education (PDE) Evaluation and Research project is an effort that was established through a State Longitudinal Data System (SLDS) Grant from the Institute of Education Sciences (IES), National Center for Education Statistics (NCES), awarded in October 2015. The Research and Evaluation project is an initiative to make full use of the P-16+ system data and other data sources to answer priority questions from the PDE research agenda, to form collaborative research partnerships, and to increase PDE's capacity to conduct research. Our mission is to evaluate and analyze data to provide insight that can be used to positively impact policy, inform decision making and lead to improved student outcomes.

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The mission of the Department of Education is to ensure that every learner has access to a world-class education system that academically prepares children and adults to succeed as productive citizens. Further, the Department seeks to establish a culture that is committed to improving opportunities throughout the commonwealth by ensuring that technical support, resources, and optimal learning environments are available for all students, whether children or adults.

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Introduction

The success of students in Pennsylvania (PA) has been deemed a top priority in the Governor's commitment to strengthen the education system, which can lead to improved opportunities for PA students and make the path to a postsecondary education more accessible.

The research questions addressed in this report can aid policymakers in making informed decisions that will better prepare PA students for the transition to postsecondary education and lead to higher rates of degree attainment. The research questions addressed in this report are directly aligned with the following Governor's Strategic Plan Priority Goals:

- **Priority Goal #2** - ESSA: To prepare all students to graduate high school college ready and career-ready and to be engaged citizens of the commonwealth.
- **Priority Goal #5** – Higher Education: To promote access, affordability and performance in higher education through strategies to expand opportunity for students and align with employer needs and to support the commonwealth's public institutions of higher education in achieving these goals.

Literature Review

There continues to be a need for research that will increase postsecondary degree attainment with strategies and policies focused on improving the P-20 education pipeline (Blankenberger & Phillips, 2016). With a continually growing demand for employees with college degrees, it is imperative that students are successful in high school and go on to attend, persist and graduate from postsecondary education. The National Student Clearinghouse (NSC) Research Center reported that 74 percent of all students who began college in the fall of 2017 persisted into the fall of 2018. Of these same students only 61.7 percent were reported to have been retained at their starting institution (NSC, 2019). A comparison to percentages reported from 2009 shows no significant changes in persistence and retention rates overall. Factors including high school algebra enrollment (Gaertner, Kim, Desjardins & McClarty, 2013), rigorous high school course taking patterns (Long, Conger & Iatarola, 2012), and standardized test scores (Westrick, Le, Robbins, Radunzel & Schmidt, 2015) have all been found to be associated with postsecondary outcomes, including educational attainment.

High School Course Taking Patterns

Algebra enrollment in high school has long been researched in association with postsecondary outcomes. Kim et al. (2015) found that while completion of Algebra II in high school is associated with the probability of attending 2-year colleges, there was no significant association with college completion and degree attainment. Additionally, Aughinbaugh (2012) found that students completing an advanced math course in high school were more likely to attend college and enroll in a 4-year college compared to students who only completed Algebra I or geometry.

> Factors including high school algebra enrollment, rigorous high school course taking patterns, and standardized test scores have all been found to be associated with postsecondary outcomes, including educational attainment.

Similar to high school algebra enrollment, research has shown an association between rigorous course taking patterns in high school and college enrollment. Chajewski, Mattern, & Shaw (2019) found that participation in Advanced Placement (AP) courses is positively associated with the likelihood of college enrollment, when compared to students who take no AP courses. Interestingly, they found a positive association regardless of the amount of participation. Long, Conger & Iatarola (2012) found that taking any rigorous course in the first two years of high school is associated with more positive outcomes for students. They found large effects and a positive association between taking at least one rigorous course early in high school (versus none) and Grade 10 math test scores, graduation from high school, and going on to a 4-year postsecondary institution. They also found that the largest effect was between taking a rigorous course in the first two years of high school and the probability of on-time high school graduation and enrollment in predominantly 4-year institutions. Their findings showed no significant variation based on racial, socioeconomic and gender student groups.

Other research conducted by Ackerman, Kanfer & Calderwood (2013) showed that the completion of AP exams by students is positively associated with postsecondary performance and completion. After high school GPA, the average AP exam score was found to be the best predictor of academic success. The completion of AP-based courses was correlated with higher college performance (GPA) for first-year college students and beyond. Additionally, students with higher levels of AP-based course credits were found to have completed more higher-level courses and fewer lower-level courses and graduate at a significantly higher rate within fewer semesters. Similar to the findings by Long et al. (2012), the effect of participation in AP courses in high school on postsecondary outcomes was found to be consistent regardless of gender and ethnicity.

Further, rigorous course taking, through enrollment in dual enrollment courses, has been found to be associated with postsecondary success by reducing the time to degree; this form of rigorous course taking allows students to earn college credits before entering college and is associated with an increase in the number of college courses students take once they are enrolled in college (Allen & Dadgar, 2012). Similar to other research, enrolling in one or more rigorous courses was found to be associated with positive and substantial gains for students and the effects were found to be the same for all student groups. Other studies have found taking dual enrollment courses to be associated with the improved likelihood of postsecondary enrollment and graduation, particularly for low-income and male students (Karp et al, 2007; Lichtenberger et al, 2014), and improved time to degree completion (An, 2013; 2015; Geise, 2011).

Similar studies have been conducted on data from other states. For instance, a study of public-school census data in the state of Florida also examined the association between students' high school course taking in various subjects and high school graduation, entry into postsecondary institutions, and postsecondary performance. (Long, Conger & Iatarola, 2012). This study found significant differences in outcomes based on rigorous course taking and found larger effects for disadvantaged students and students attending disadvantaged schools. Similarly, a study that included the analysis of data from a 2003 Illinois high school graduating class attending 4-year institutions found that dual credit and AP course taking were among the significant factors related to improved likelihood of baccalaureate completion (Blankenberger et al., 2017).

The courses students take during high school are expected to improve their skills and knowledge and prepare them for their postsecondary careers. The combination of all courses taken throughout a high school can significantly determine, in part, the paths that a student follows after high school (Plank, DeLuca, and Estacion, 2008)

Postsecondary Success

Persistence and retention rates are another prominently studied aspect of higher education (Seidman, 2005; Tinto, 2006), given increasing economic demands that require a highly educated and skilled workforce (Carey, 2004; Lotkowski, Robbins & Noeth, 2004; U.S. Department of Labor, 2015). Although the number of students pursuing higher education may have increased in recent years, completion rates remain a concern. Knapp, Kelly-Reid & Ginder (2011) reported that only 36.7 and 57.4 percent of students who entered postsecondary at that time obtained a bachelor's degree after four years and six years, respectively. Similarly, the U.S. Department of Education (2015) reported that 59 percent of students who enter four-year colleges completed their degrees within five years.

A focus on research that can inform strategies to improve students' successful transition into postsecondary can lead to better outcomes for students. This includes successful completion and degree attainment in order to meet developing workforce demands and guide policies aimed at improving the pipeline between secondary and postsecondary education (Blankenberger & Phillips, 2016).

Methodology and Sample

The Conceptual Framework that was the basis of our research and analyses can be seen in Appendix A. It includes the primary constructs of our research questions and the link between questions of interest, variables of interest, and the key outcomes of interest, high school and subsequent postsecondary success. This research had the following major objectives:

- Identification of the association between mathematics (specifically algebra), courses of rigor, as defined by the Pennsylvania Department of Education (PDE), and student assessment scores, and high school graduation, postsecondary educational access, and success.
- Connecting high school student learning outcomes to postsecondary preparation and success.
- Identification of significant factors that could potentially affect the achievement gap for at risk student groups in Pennsylvania schools and postsecondary access and success.
- Improvement in the selection and identification of students at risk for attrition.
- improved completion rates for all Pennsylvania students and specific student groups.

The goal was to utilize existing data available through PDE's longitudinal data system to achieve our major objectives while also answering the following priority research questions within two of PDE's major Research Agenda areas:

P-20 Policy:

- Do Grade 7 PSSA math scores predict a student's ability to graduate from high school and continue with postsecondary education?
- Does enrollment in algebra in Grade 8 or 11 predict postsecondary enrollment?
- Are some racial/ethnic or geographic populations (rural/urban comparison) doing better or worse than others in terms of educational attainment (B.A., A.A., 2-year certificate, 1-year certificate, industry credential)?

Postsecondary Education:

- Does math course taking, PSSA score or Keystone passage increase the likelihood of enrolling, persisting and graduating from a postsecondary institution?
- Does enrollment in honors or AP courses or participation in dual enrollment increase the likelihood of postsecondary enrollment and are there demographic differences? Postsecondary access? Postsecondary success?
- What are the retention rates for students attending Pennsylvania colleges? Are there differences by sector (public, private, 2-year, etc.)?

The following additional sub-questions were also of interest and addressed:

- What is the description and breakdown of student cohort populations by year and grade?
- What are the effects of taking a rigorous course early in high school versus later in high school?
- Do early college credit opportunities through dual enrollment, participation in AP or the International Baccalaureate (IB) program make a difference?
- To what extent does rigorous high school course taking (i.e. algebra, AP, IB, dual enrollment) and the timing of course taking define students' postsecondary path and success?
- Using exploratory analyses, what factors are most highly associated with high school graduation, postsecondary enrollment, persistence, retention, and bachelor's degree completion within four years?

Procedures and Data File Preparation

Research questions were addressed through the analysis of linked Pennsylvania Information Management System (PIMS) and National Student Clearinghouse (NSC) data. PIMS serves as the primary source of data for PDE's required reporting and provides education stakeholders– the governor, agency leadership, legislators, school district personnel, taxpayers, parents and the community – with the essential unit-level and aggregate data needed to make sound decisions about education in the Commonwealth. PIMS data was obtained for school years 2010-2011 through 2016-2017 for three cohorts of Grade 9 students and two cohorts of Grade 7 students. NSC records were obtained through 2017/2018 for PA high school graduates from school years 2014, 2015, 2016, and 2017.

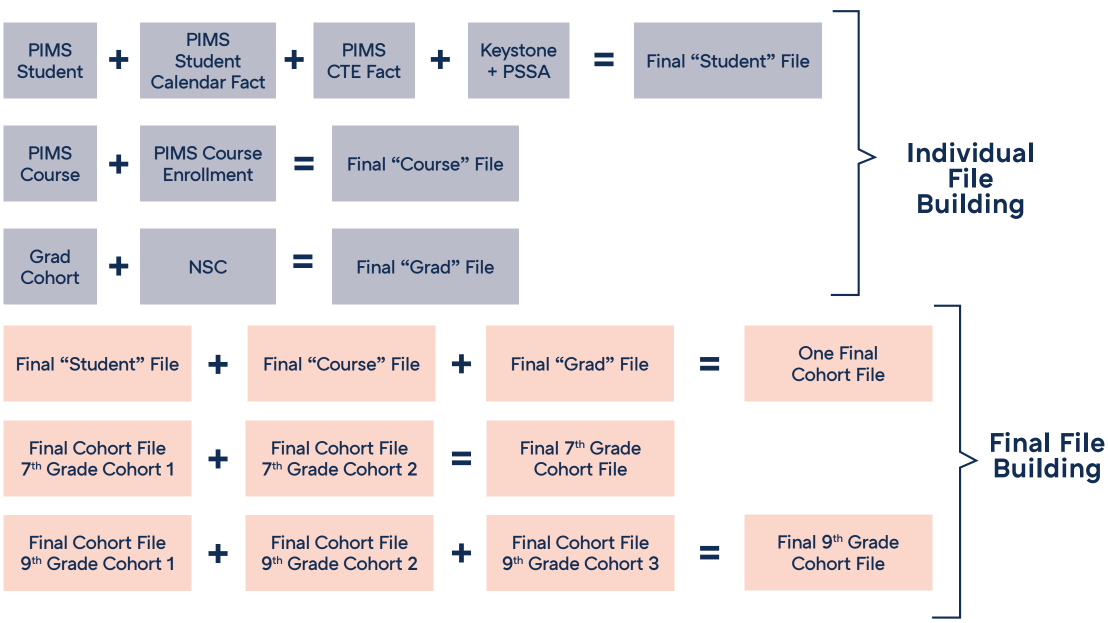
Data from five PIMS templates was used to gather demographic and descriptive information of the sample. The PIMS Student files provided student-level demographic data, including gender, race/ethnicity, special education status, English learner (EL) status, and other data. The Student Calendar Fact files provided student enrollment information, such as days enrolled in a district and days present in school. The CTE Student Fact Template provided information specific to Career and Technology Education students, such as gender, race/ethnicity, status as a rigorous CTE student, and indicators describing a CTE student's internships or work experiences. Lastly, Grad Cohort data files compiled by PDE described the status of each year's graduating high school class, based on 9th grade entry date, including demographic information.

To analyze course taking patterns in high school, the PIMS Course data was linked to Student Course Enrollment data to gather detailed information on each course offered across LEAs in PA, including the course's code and numerical designation, subject area, rigorous/advanced status, student course taking details across years, and other important information. To track this information, algebraic indicators and an honors, rigorous (AP, IB, and Dual Credit), and advanced (rigorous, honors, or gifted) designation process was implemented for each course. Information on the definitions of these categories and processes can be found in Appendix B.

After indicators were developed for each course, grand totals for each student were created to assess how many courses of each category students enrolled in during high school. Dichotomous variables were also created to indicate whether a student participated in at least one course of a particular category (Algebra I, advanced algebra, honors, rigor, advanced, etc.) as well as an indicator of the timing of each course. For the 7th grade cohorts used in the present study, a student was considered to have early timing for a class if they enrolled during middle school and late timing if they enrolled during high school. For the 9th grade cohorts, a student was considered to have early timing for a class if they were enrolled during their Grade 9 or 10 year; subsequently, late timing included enrollment during a student's Grade 11 or 12 year. Two additional dichotomous indicators for Algebra I enrollment were established based on whether a student had Algebra I for the first time in Grade 8 or 11. To supplement course enrollment data, performance scores from the Pennsylvania Keystone standardized exams were also obtained for the purpose of this study. The PDE (2019) describes the Keystone tests as end-of-course exams which measure ability in various subject areas, including algebra, literature and English, life sciences, and others. For the purpose of this study a dichotomous indicator of overall achievement level reflective of proficient/advanced and basic/below basic was used.

Two main data sources were used to determine high school graduation status and postsecondary trajectory. Grad Cohort data files compiled by PDE provided high school graduation records for each 9th grade cohort in our study, including an indicator for whether a student graduated at four or five-years. National Student Clearinghouse (NSC) data was used to track students' postsecondary trajectories after high school graduation. The NSC data reported student records for college enrollment, institution type (2-year versus 4-year), institution sector (public/private), enrollment status (part versus full-time) graduation status, the major and degree type a student graduated with, and other information related to a student's postsecondary tenure. NSC files were matched with Grad Cohort data files based on the high school graduation year of students in each cohort. Figure 1 shows how data files were joined to form final cohort files for analysis.

FIGURE 1. Linking Process for all Data Files



The goal was to utilize the data available for analysis on Pennsylvania students across time to examine the association between courses of rigor as defined by PDE and assessment performance, and high school completion, college enrollment, persistence, retention, and graduation within four years. Utilizing statistical models that include a variety of potential indicators of high school and postsecondary outcomes, we provide estimates of the effects and explore variation in the estimated effects based on student demographics.

These data were analyzed using varied analytic methods, that included descriptive statistics, Analysis of Variance (ANOVA), Chi-Square (Pearson), and Logistic Regression analysis. Results are disaggregated and differentiated by student groups that are of interest to state policymakers and that include ethnicity, economically disadvantaged status, gender, EL, Special Education, and historically underperforming.

Our analyses were exploratory in nature, which allowed us to examine several individual variables that could be potential significant predictors of high school and postsecondary outcomes. In our first phase of analysis we examined our student population characteristics descriptively to explore patterns, variable distributions, and examine the raw differences in outcomes associated with each independent variable individually.

In our second phase of analysis, logistic regression was used to explore the cumulative effects of variables associated with the highest amount of explained variance in our final statistically significant models. This additional analysis allowed for the examination of differences of each potential significant variable in isolation, but also in the context of additional explanatory variables. Our exploration of academic outcomes at both the high school and postsecondary level included several variables. A detailed description of the final variables that were tested in our analyses can be found in Appendix C.

Sample

Our design allowed us to track multiple cohorts of students and examine whether year-to-year differences in student cohorts exist. Table 1 provides a detailed description and breakdown of our student cohort populations.

Three cohorts of Pennsylvania students were followed from Grade 9 entry in school years 2010-2011, 2011-2012, and 2012-2013 and two 7th grade cohorts were followed from entry in school years 2010-2011 and 2011-2012 to various points in postsecondary study depending on the cohort. Table 1 shows how each cohort could be tracked through postsecondary enrollment and completion.

TABLE 1. Postsecondary Outcomes Examined by Cohort

Outcome	9th Grade Cohort 1 (2010-2011)	9th Grade Cohort 2 (2011-2012)	9th Grade Cohort 3* (2012-2013)	7th Grade Cohort 2 (2011-2012)
On-time High School Graduation	x	x	x	x
College Entry	x	x	x	x
Persistence & Retention to Year 2	x	x	x	
Persistence & Retention to Year 3	x	x		
College Graduation Within 4 Years	x			
Retention to College Graduation	x			
Degree Type at Graduation	x			

**This 9th grade cohort subsumes the first 7th grade cohort who was enrolled in Grade 7 in 2010-2011.*

Our analyses included a substantially high number of students across multiple years of data collection. We had sufficiently high numbers of students for our methods, even given the complexity of our logistic regression analytical models. Since our analyses were exploratory in nature and included the total population of students available for all cohorts, no sampling technique was used.

For our analytic purposes, two different files were used. One included all students in our 9th grade cohorts linked to NSC data. This file was used to provide all postsecondary descriptive analysis for PA high school graduates. Because course level data was not needed for this descriptive analysis, the full student population files were used.

A reduced data file was also created to address questions related to student course enrollment; this file contained only students who had records found for all years of middle school (7th grade cohorts) and high school (9th grade cohorts) enrollment. This was to minimize measurement error and prevent between group comparisons for students who had all four years of course data with students who may have only had enrollment records for two or three years. However, for research questions unrelated to course enrollment, the full file was used.

Tables 2 and 3 provide a full demographic breakdown of our student population characteristics by cohort overall and by demographic student groups for both the full and reduced cohort files. Additionally, detailed descriptive statistics on course enrollment based on the percentage of students who enrolled in at least one or more courses versus none can be found in Appendix D. All students in each cohort attended a public Pennsylvania local educational agency (LEA), Intermediate Unit (IU), public charter school, or public cyber charter school.

TABLE 2. Student Population Demographics by Cohort at Time of High School Graduation

	9th 2010-11	9th 2011-12	9th 2012-13* (Includes 7th 2010-11)	7th 2011-12
Overall				
Total	*N*=140299	*N*=139071	*N*=138971	*N*=139702
Gender				
Male	51.4 (72115)	50.8 (70672)	51.3 (71225)	51.2 (71586)
Female	48.6 (68184)	49.2 (68399)	48.7 (67746)	48.8 (68116)
Ethnicity				
American Indian/Alaskan Native	0.1 (202)	0.1 (191)	0.2 (212)	0.2 (215)
Black or African American	15.1 (21147)	15.4 (21379)	15.2 (21190)	15.2 (21199)
Hispanic	8.2 (11501)	8.8 (12171)	9.2 (12836)	9.7 (13573)
White	72. (100986)	70.7 (98310)	70.0 (97278)	69.4 (96999)
Multi-Racial	1.3 (1825)	1.5 (2150)	1.8 (2496)	2.0 (2752)
Asian	3.2 (4543)	3.4 (4765)	3.5 (4868)	3.5 (4846)
Native Hawaiian/Other Pacific Islander	0.1 (95)	0.1 (105)	0.1 (91)	0.1 (118)
Historically Underperforming				
Yes	44.8 (62833)	46.4 (64558)	46.6 (65015)	48.7 (67995)
No	55.2 (77466)	53.6 (74513)	53.2 (73956)	51.3 (71707)
EL Status				
Yes	2.1 (3003)	2.2 (3071)	2.4 (3308)	2.8 (3877)
No	97.9 (137296)	97.8 (136000)	97.6 (135663)	97.2 (135825)
Special Education Status				
Yes	14.3 (20059)	15.0 (20871)	15.4 (21356)	16.5 (23043)
No	85.7 (120240)	85.0 (118200)	84.6 (117615)	83.5 (116659)
Economically Disadvantaged				
Yes	37.7 (52836)	39.3 (54696)	39.6 (55052)	41.3 (57656)
No	62.3 (87463)	60.7 (84375)	60.4 (83919)	58.7 (82046)

**This 9th grade cohort subsumes the first 7th grade cohort who was enrolled in Grade 7in 2010-2011.*

TABLE 3. Demographics for Reduced Student File for Students with All Years Course Data

	7th Grade Cohorts			9th Grade Cohorts			
	Cohort 1	Cohort 2	Overall	Cohort 1	Cohort 2	Cohort 3	Overall
Overall							
Total	*n*=103755	*n*=100729	*n*=204484	*n*=115068	*n*=113170	*n*=112520	*n*=340758
Gender							
Male	50.7 (52565)	50.1 (50512)	50.4 (103077)	50. 7 (58354)	50.2 (56822)	50.8 (57171)	50.6 (172347)
Female	49.3 (51190)	49.9 (50217)	49.6 (101407)	49.3 (56714)	49.8 (56348)	49.2 (55349)	49.4 (168411)
Ethnicity							
American Indian/ Alaskan Native	0.1 (121)	00.1 (114)	0.1 (235)	0.1 (146)	0.1 (131)	0.1 (133)	0.1 (410)
Black or African American	11.5 (11890)	10.8 (10904)	11.1 (22794)	12.4 (14268)	12.3 (13919)	12.1 (13564)	12.3 (41751)
Hispanic	6.9 (7116)	6.9 (6921)	6.9 (14037)	6.5 (7469)	7.1 (8035)	7.3 (8239)	7.0 (23743)
White	76.8 (79650)	77.2 (77727)	77.0 (157377)	76.6 (88172)	75.8 (85770)	75.4 (84819)	75.9 (258761)
Multi-Racial	1.5 (1593)	1.6 (1619)	1.6 (3212)	1.1 (1319)	1.4 (1537)	1.6 (1817)	1.4 (4673)
Asian	3.2 (3332)	3.3 (3372)	3.3 (6704)	3.2 (3629)	3.3 (3701)	3.5 (3886)	3.3 (11218)
Native Hawaiian or Other Pacific Islander	0.1 (53)	0.1 (72)	0.1 (125)	0.1 (65)	0.1 (75)	0.1 (62)	0.1 (202)
Historically Underperforming							
Yes	41.2 (42718)	41.9 (42208)	41.5 (84926)	40.3 (46382)	41.6 (47073)	41.8 (47067)	41.2 (140522)
No	58.8 (61037)	58.1 (58521)	58.5 (119558)	59.7 (68686)	58.4 (66097)	58.2 (65453)	58.8 (200236)
EL Status							
Yes	0.7 (777)	0.8 (792)	0.8 (1569)	1.1 (1232)	1.1 (1235)	1.1 (1290)	1.1 (3757)
No	99.3 (102978)	99.2 (99937)	99.2 (202915)	98.9 (113836)	98.9 (111935)	98.9 (111230)	98.9 (337001)
Special Education Status							
Yes	13.5 (14017)	13.7 (13843)	13.6 (27860)	12.7 (14585)	13.3 (15041)	13.5 (15191)	13.2 (44817)
No	86.5 (89738)	86.3 (86886)	86.4 (176624)	87.3 (100483)	86.7 (98129)	86.5 (97329)	86.8 (295941)
Economically Disadvantaged							
Yes	34.9 (36249)	35.7 (35929)	35.3 (72178)	33.9 (39058)	35.3 (39911)	35.6 (40081)	34.9 (119050)
No	65.1 (67506)	64.3 (64800)	64.7 (132306)	66.1 (76010)	64.7 (73259)	64.4 (72439)	65.1 (221708)

What is the description and breakdown of student cohort populations by year?

Tables 2 and 3 show that student group population percentages were similar across all cohorts. Demographics are based on student population characteristics for each cohort at the time of high school graduation.

There were 140,299 total students in the first 9th grade cohort; 51.4 percent were male, and 48.6 percent were female. Fifteen percent identified as Black or African American, 8.2 percent were Hispanic, 72 percent were White, 1.3 percent were multi-racial, 3.2 percent were Asian, and a combined .2 percent identified as American Indian/Alaskan Native or Native Hawaiian or Pacific Islander. Further, 44.8 percent of students were considered historically underperforming, meaning they were a special education student, an EL, or economically disadvantaged. Just over 2 percent of students were EL, 14.3 percent were special education students, and 37.7 percent were economically disadvantaged.

In total, 139,071 students comprised the second 9th grade cohort. Of these students, 50.8 percent were male, and 49.2 percent were female. Ethnic and racial composition showed Black or African American students were 15.4 percent of the cohort, Hispanic students were 8.8 percent, White students were 70.7 percent, multi-racial students were 1.5 percent, and American Indian/Alaskan Native and Native Hawaiian or Pacific Islander students were .2 percent of the sample. Lastly, a total of 46.4 percent of students were considered historically underperforming, breaking down to 2.2 percent as EL, 15 percent as special education, and 39.3 percent as economically disadvantaged.

The third 9th grade cohort (also first 7th grade cohort based on year of high school graduation and Grade 9 entry status) was composed of 138,971 students, 51.3 percent of whom were male and 48.7 percent female. The racial/ethnic group breakdown was similar to the previous cohorts, with 15.2 percent identifying as African American or Black, 9.2 percent as Hispanic, 70 percent as White, 1.8 percent as multi-racial, 3.5 percent as Asian and .3 percent as either American Indian/Alaskan Native or Native Hawaiian or Pacific Islander. Among these students, 46.6 percent were historically underperforming, 2.4 percent were EL, 15.4 percent were special education students, and 39.6 percent were economically disadvantaged.

The second 7th grade cohort was composed of 139,702 students, 51.2 percent of whom were male and 48.8 percent female. The racial/ethnic group breakdown was similar to the previous cohorts, with 15.2 percent identifying as African American, or Black 9.7 percent as Hispanic, 69.4 percent as White, 2.0 percent as multi-racial, 3.5 percent as Asian and .3 percent as either American Indian/Alaskan Native or Native Hawaiian or Pacific Islander. Among these students, 48.7 percent were historically underperforming, 2.8 percent were EL, 16.5 percent were special education students, and 41.3 percent were economically disadvantaged.

For variables related to course taking patterns, only students with all four years of found course records were included in analyses. This was to prevent between groups comparisons for students who had all four years of course records to students who may have only had two or three years of information. When students without all four years of course data were excluded, a total of 115,068 students remained in the first 9th grade cohort, 113,170 for the second 9th grade cohort, 112,520 for the third 9th grade cohort, 103,755 for the first 7th grade cohort and 100,729 for the second 7th grade cohort. Table 3 provides a descriptive breakdown of student demographic characteristics after this file reduction. As a comparison of Tables 2 and 3 shows, the student group percentages in the reduced file are similar to those reported for all cohorts for the full population of students. However, comparisons between full and reduced cohorts showed a small difference in representation for African American students (from over 15% to over 12% representation) and for Hispanic students (from 8-9% to 6-7%). However, the ethnic/racial breakdown in the reduced file closely mirrors PA census information from 2010 which found that roughly 12 percent of PA citizens are African American or Black and 7.6 percent identify as Hispanic (United States Census Bureau, 2010.)

Results

Cohort Differences

Initial cohort differences based on outcomes were examined for the full population of students across cohorts. As Figures 2 through 4 show, differences between cohorts were consistently minimal for on-time high school graduation, and all our postsecondary outcomes. Pearson chi-square analysis showed no significant differences between cohorts.

FIGURE 2. On-Time High School Graduation and Postsecondary Enrollment by Cohort

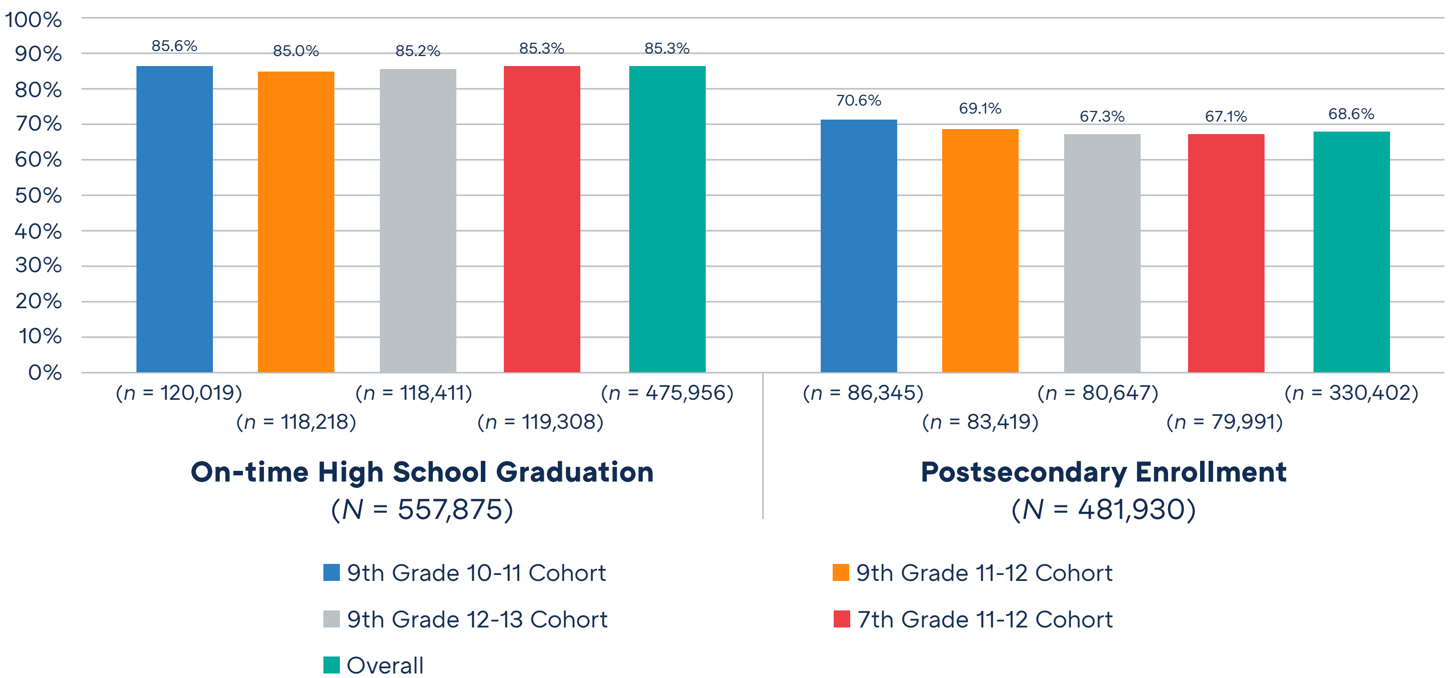
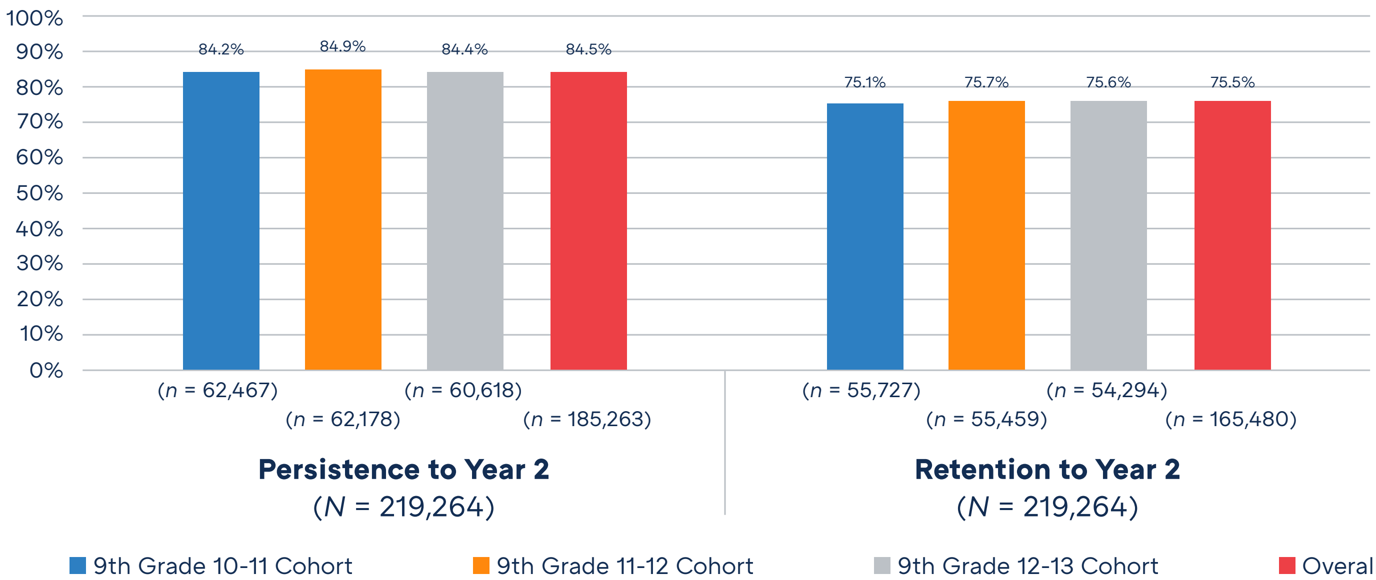
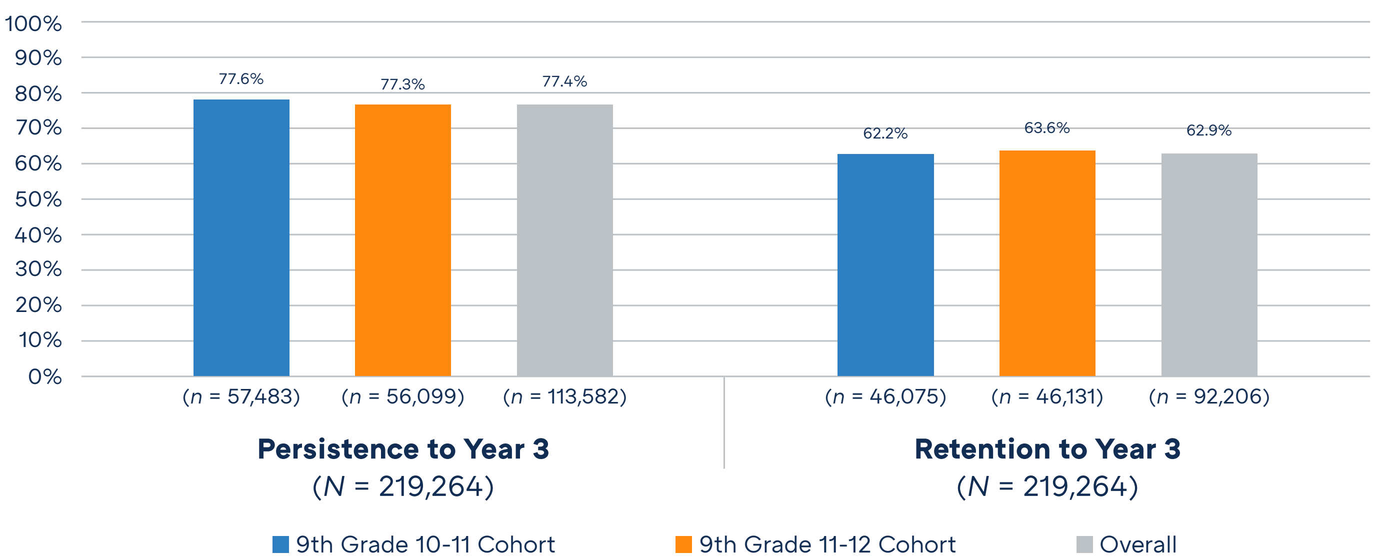


FIGURE 3. Persistence and Retention to Year 2 by Cohort



Note: This graph contains 9th grade cohorts only.

FIGURE 4. Persistence and Retention to Year 3 by Cohort



Postsecondary Outcomes by Demographics

(Note: Ethnicity is not discussed here because it is discussed beginning on page 64)

Gender

Figures 5 through 8 show that the rates of on-time high school graduation at 4-years and all postsecondary outcomes were slightly higher for female students than male students with the largest difference (10%) found in the percentage of students that enrolled in postsecondary education after high school completion. For every outcome, the difference in proportions was statistically significant, however, the effect was small.

FIGURE 5. On-Time High School Graduation and Postsecondary Enrollment by Gender

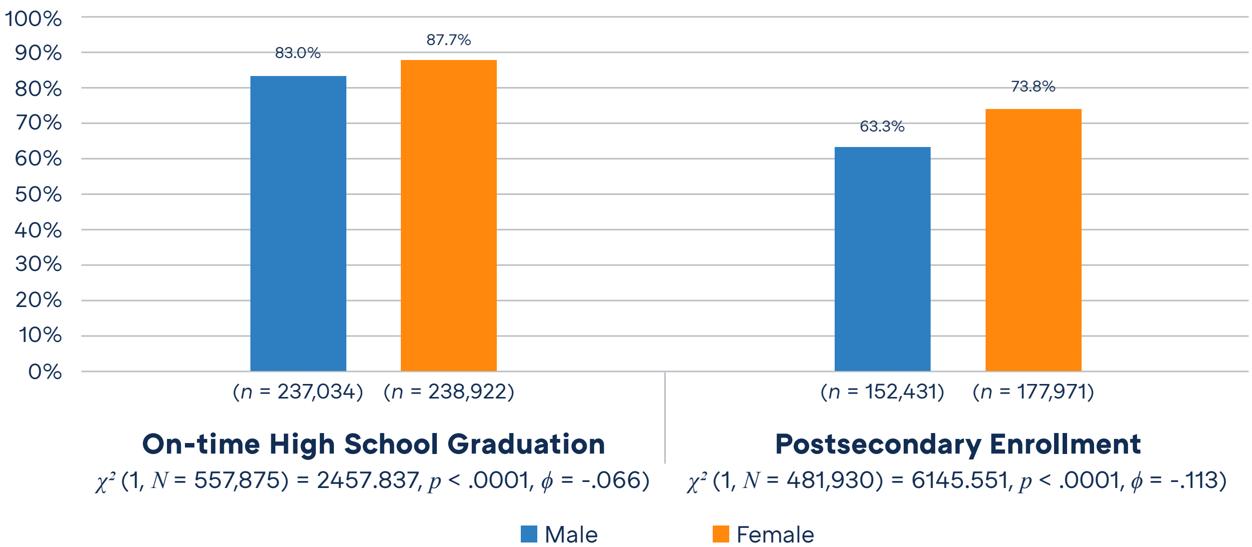
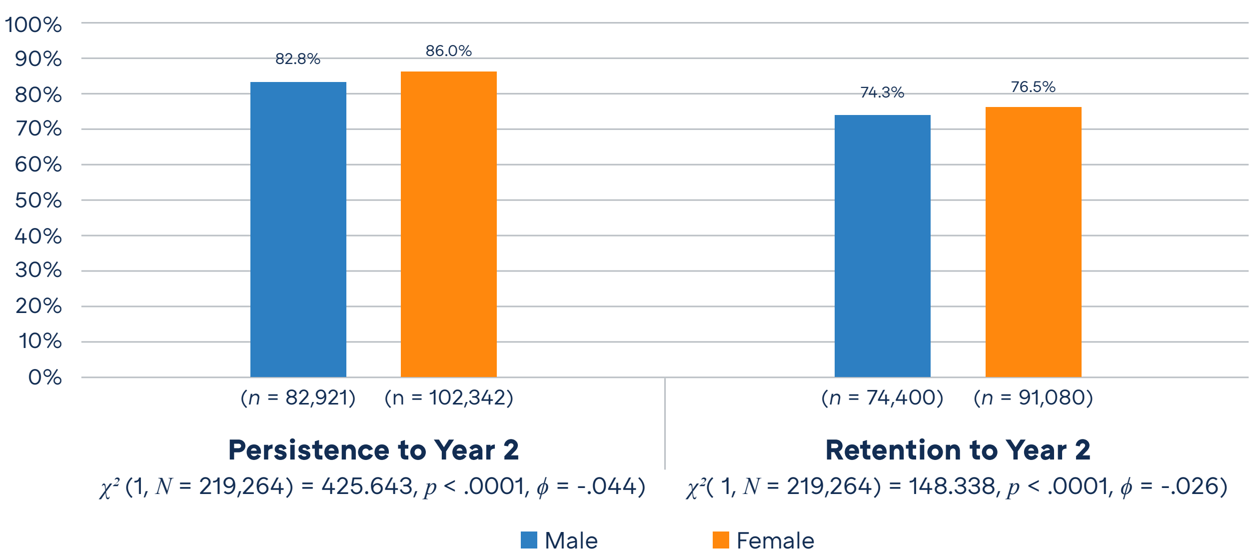
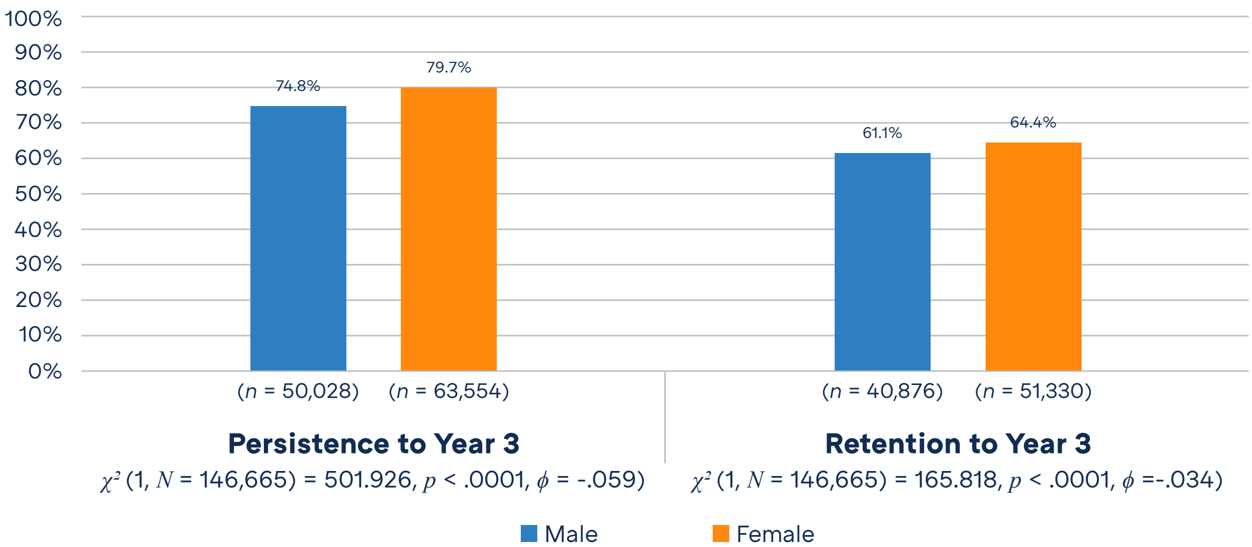


FIGURE 6. Persistence and Retention to Year 2 by Gender



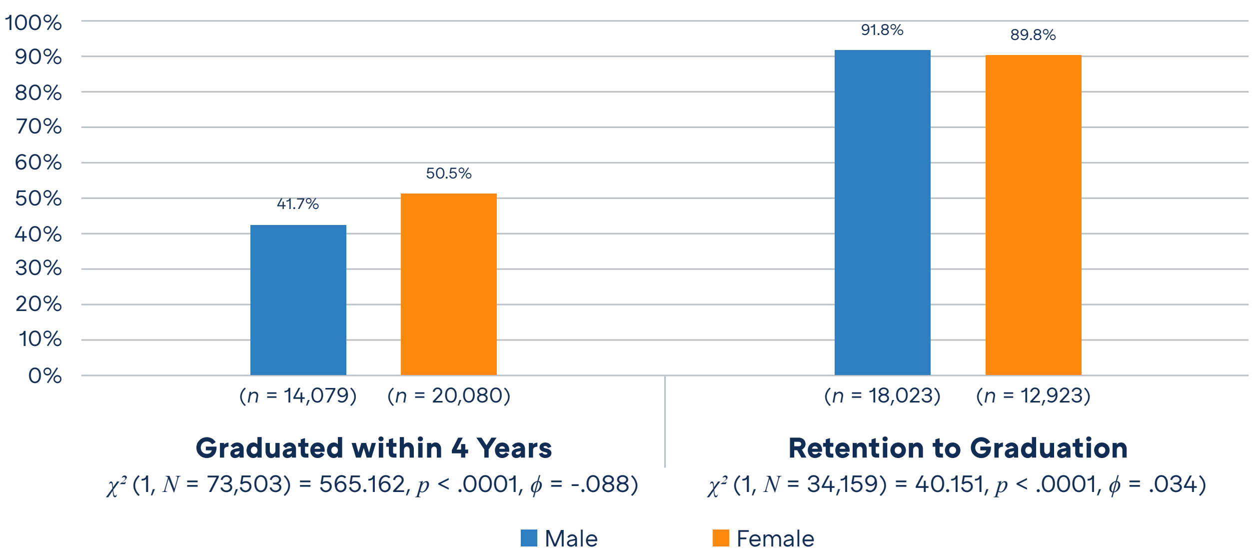
Note: This graph contains 9th grade cohorts only.

FIGURE 7. Persistence and Retention to Year 3 by Gender



Note: This graph contains the 9th grade 2010/11 & 9th grade 2011/12 cohorts only.

FIGURE 8. Persistence and Retention to Graduation by Gender



Note: This graph represents only those from the 9th grade 2010/11 cohort who entered college in the fall immediately following their HS graduation.

Special Education Status

Figures 9 through 12 show that small to moderate effects based on special education status were found for on-time high school graduation and all postsecondary outcomes. Although there was only a 16.8 percentage point difference between special education status students versus others in rates of on-time high school graduation (χ^2 (1, N = 557,875) = 16136.240, $p < .0001$, ϕ= -.170), the gap between the two groups grew as students continued in postsecondary education. Among 419,153 non-special education status students, 73.1 percent enrolled in a postsecondary institution compared to 38.3 percent (n=24,032) of special education students. The difference between the groups was statistically significant (χ^2 (1, N = 481,930) = 30694.260, p < .000), and the effect was moderate (ϕ = -.252). Among the 4,590 special education status students followed through entrance into postsecondary, 25.6 percent (n=1,173) persisted to graduation within four years of high school completion, compared to 47.9 percent of non-special education status students. This difference was significant (χ^2 (1, N = 73,503) = 861.108, p < .0001), but this effect was small (ϕ = .108).

FIGURE 9. On-Time High School Graduation and Postsecondary Enrollment based on Special Education Status

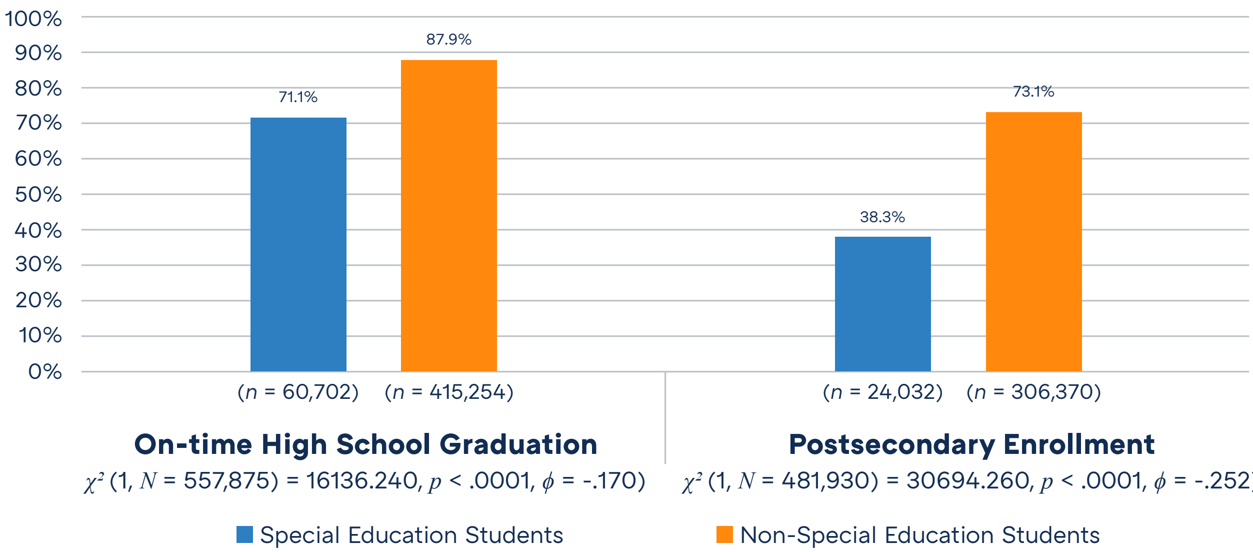
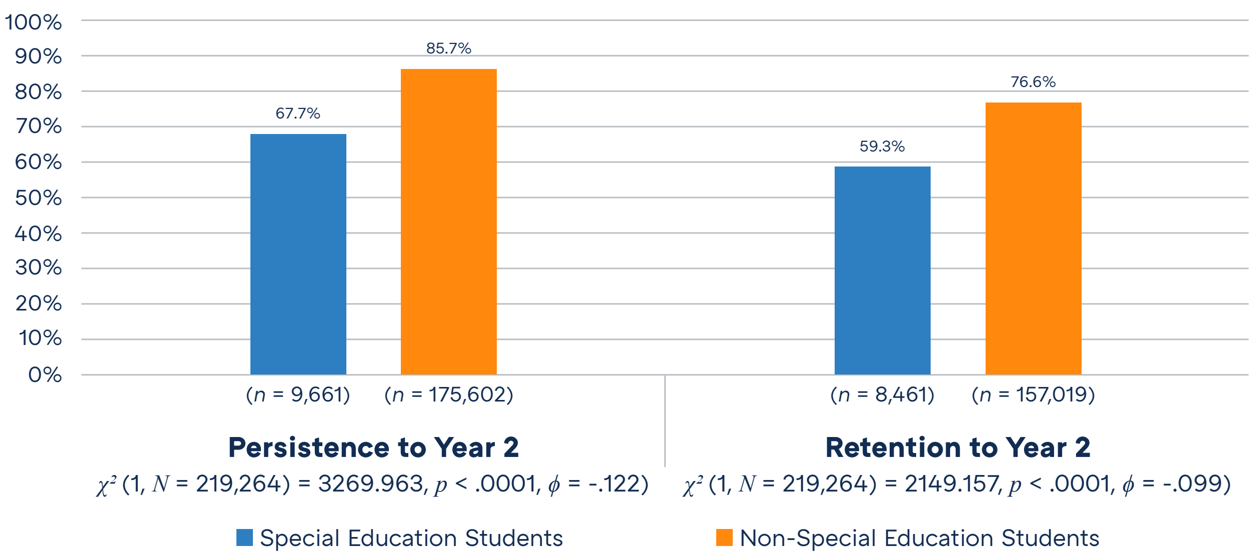
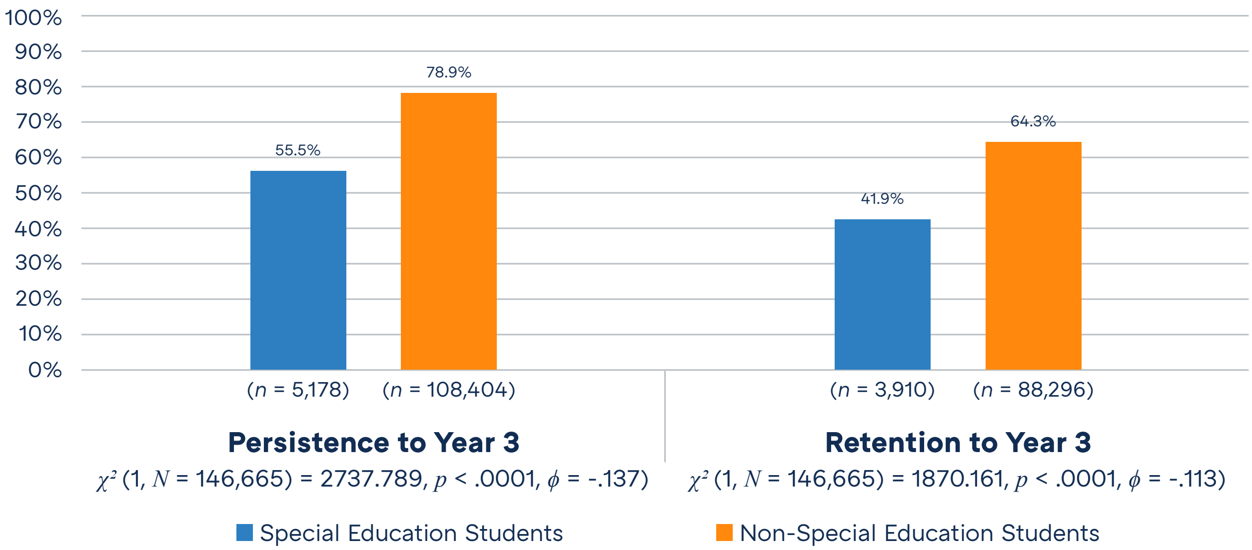


FIGURE 10. Persistence and Retention to Year 2 based on Special Education Status



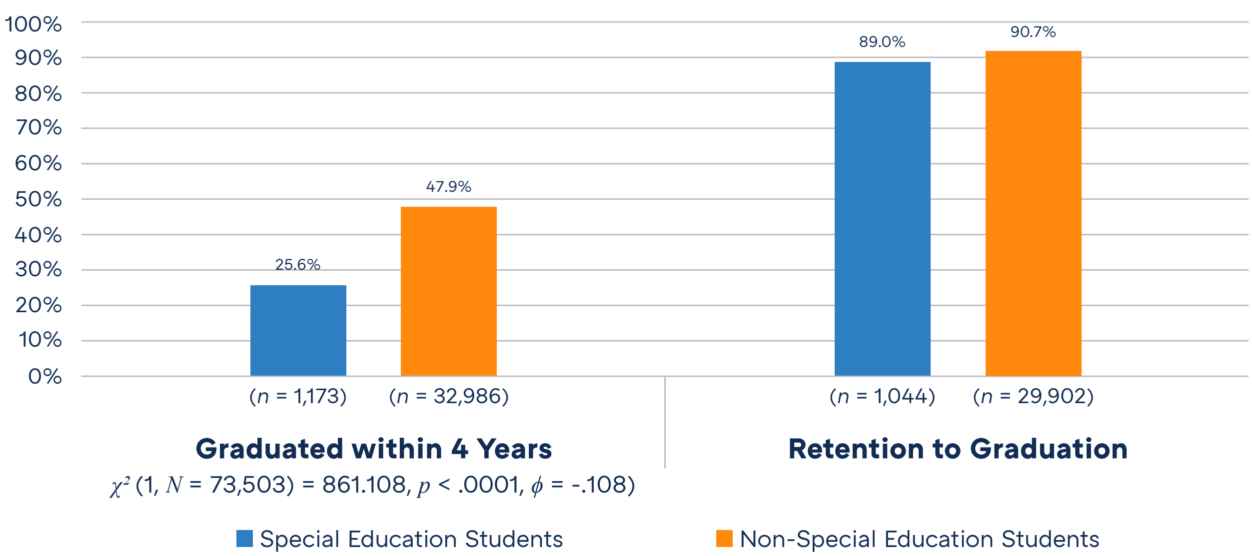
Note: This graph contains 9th grade cohorts only.

FIGURE 11. Persistence and Retention to Year 3 based on Special Education Status



Note: This graph contains the 9th grade 2010/11 & 9th grade 2011/12 cohorts only.

FIGURE 12. Persistence and Retention to Graduation based on Special Education Status



Note: This graph represents only those from the 9th grade 2010/11 cohort who entered college in the fall immediately following their HS graduation.

EL Status

Figures 13 through 16 show significant differences in on-time high school graduation and postsecondary outcomes based on EL status. There was a 22.3 percentage point difference between EL status students and other students in rates of on-time 4-year high school graduation, and a similar percentage point difference (22.5%) in postsecondary enrollment. Both differences in proportions were statistically significant but given the small number of students represented in the EL group, the effects were small (ϕ = -.096 and ϕ = -.066). There are large differences in persistence, retention, and graduation at four years as well; however, there are a very small number of EL student represented for these outcomes. Although statistical significance was found, again, the effect is small given the size of this student group.

FIGURE 13. On-Time High School Graduation and Post-secondary Enrollment based on EL Status

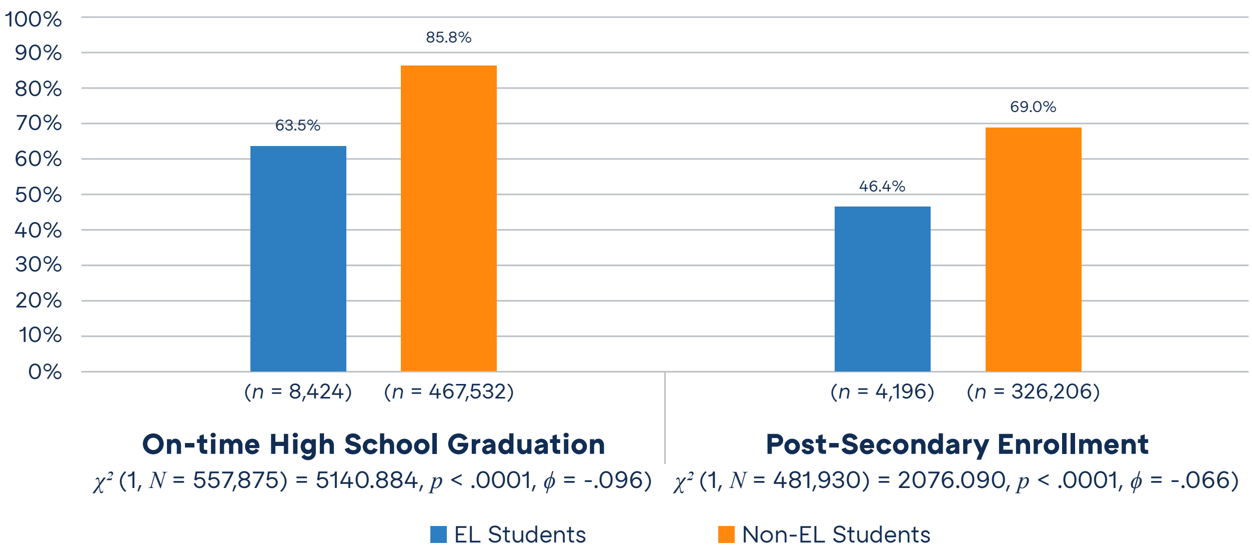
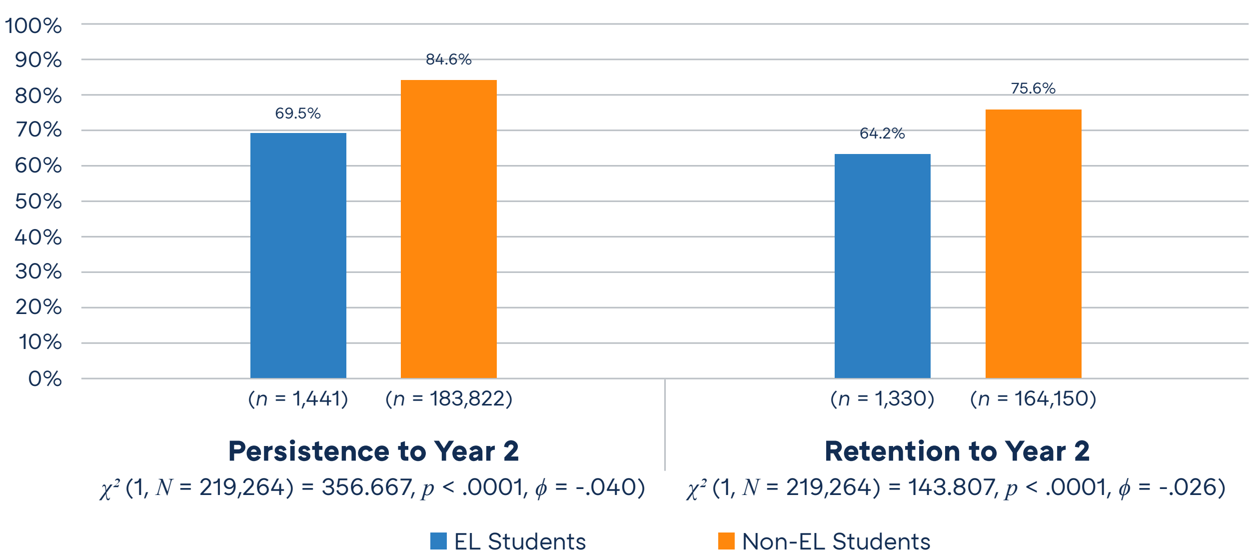
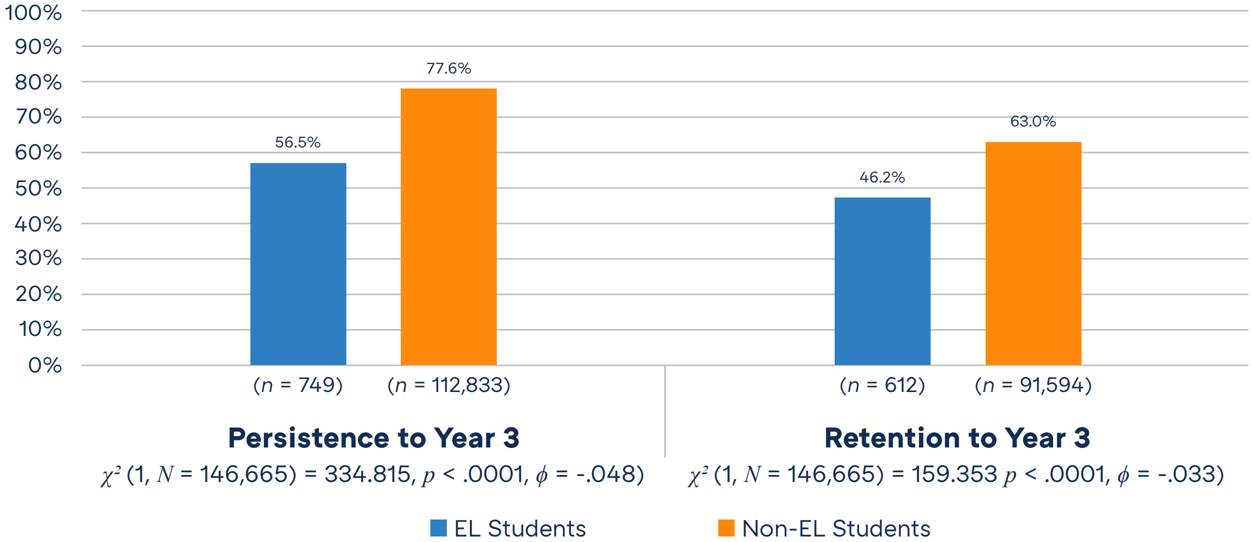


FIGURE 14. Persistence and Retention to Year 2 based on EL Status



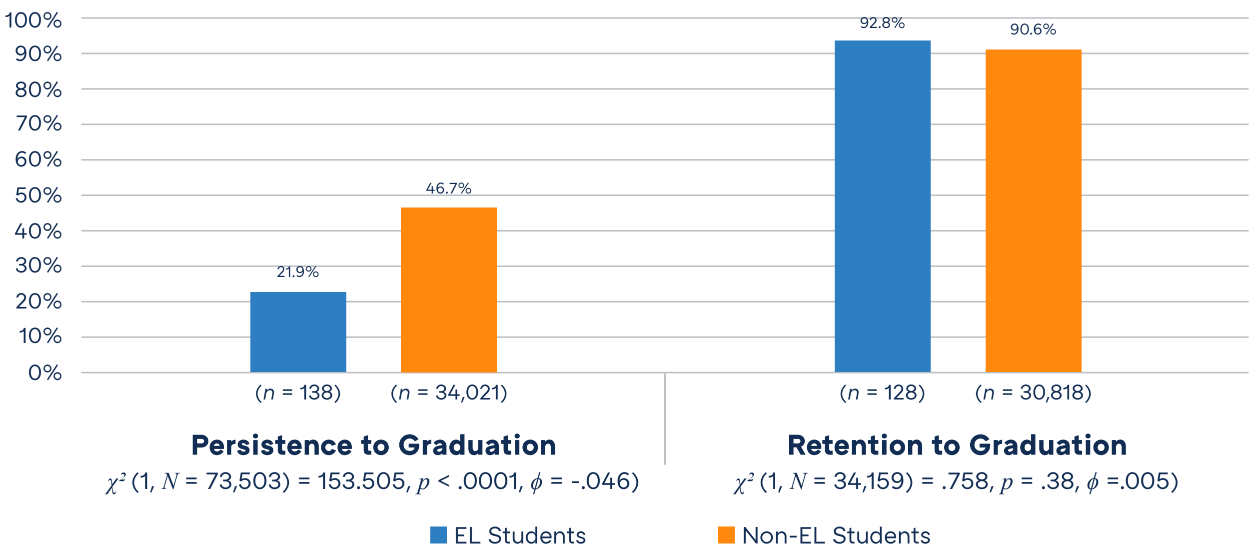
Note: This graph contains 9th grade cohorts only.

FIGURE 15. Persistence and Retention to Year 3 based on EL Status



Note: This graph contains the 9th grade 2010/11 & 9th grade 2011/12 cohorts only.

FIGURE 16. Persistence and Retention to Graduation based on EL Status



Note: This graph represents only those from the 9th grade 2010/11 cohort who entered college in the fall immediately following their HS graduation.

Historically Underperforming Status

Figures 17 through 20 show the statistically significant differences in on-time high school graduation, postsecondary enrollment, persistence, retention, and graduation within four years of high school completion between students in the historically underperforming group versus students who are not. All differences, except retention to year two, had moderate effect sizes. Although there was only a 15.8 percentage point difference between the historically underperforming group and others in rates of high school graduation (χ^2 (1, N = 557,875) = 27896.881, p < .0001), the effect was moderate (ϕ = -.224) and the gap between the two groups widened as students continued in postsecondary. Among 276,547 non-historically underperforming students, 220,684 (79.8%) enrolled in a postsecondary institution. However, of the 205,383 historically underperforming students, only 109,718 (53.4%) enrolled. The difference between the groups was significant, χ^2 (1, N=481,930) =38044.064, p < .0001, and the effect was moderate (ϕ = -.281). Among historically underperforming students followed through entrance into postsecondary, 29 percent (n=6,173) graduated within four years of high school graduation compared to 53.6 percent of non-historically underperforming students. This difference was statistically significant, χ^2 (1, N = 73,503) = 3656.926, p < .0001), and the effect was moderate (ϕ = -.223).

FIGURE 17. On-Time High School Graduation and Postsecondary Enrollment based on Historically Underperforming Status

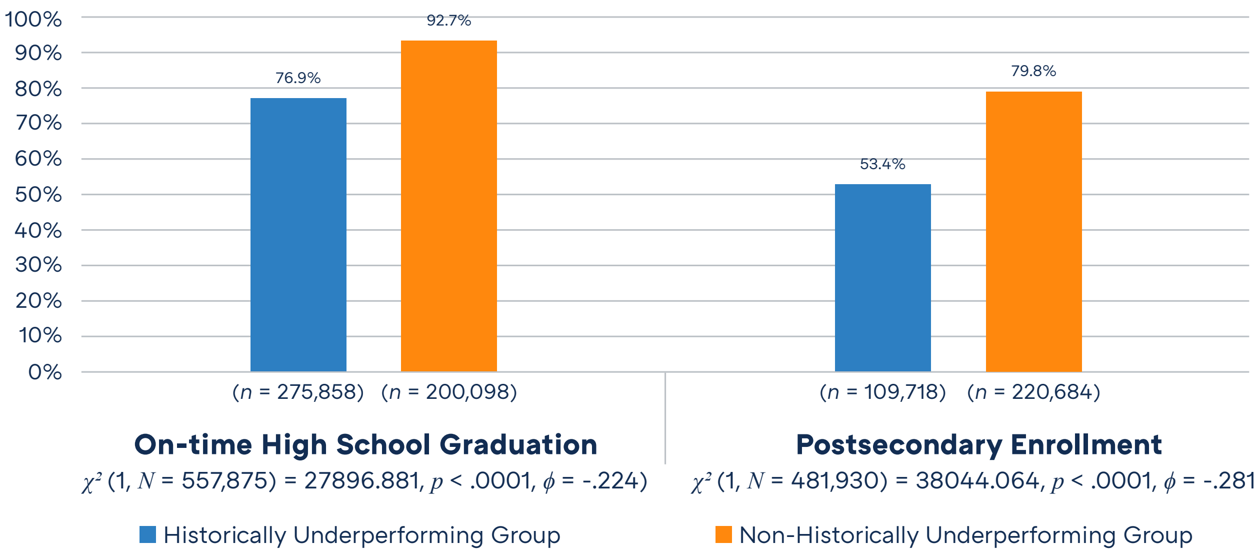
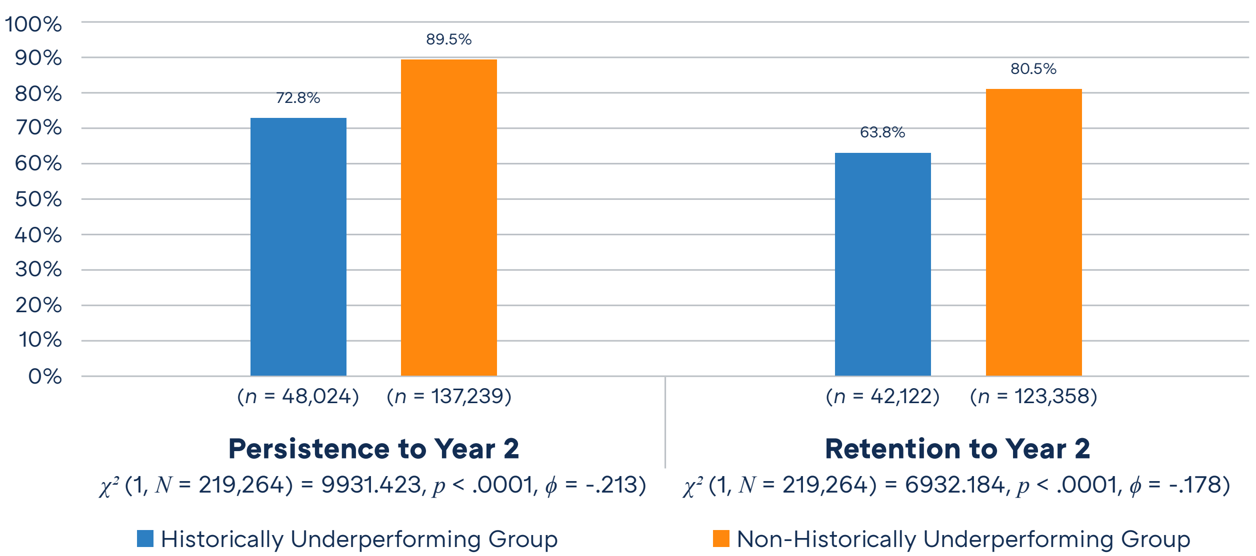
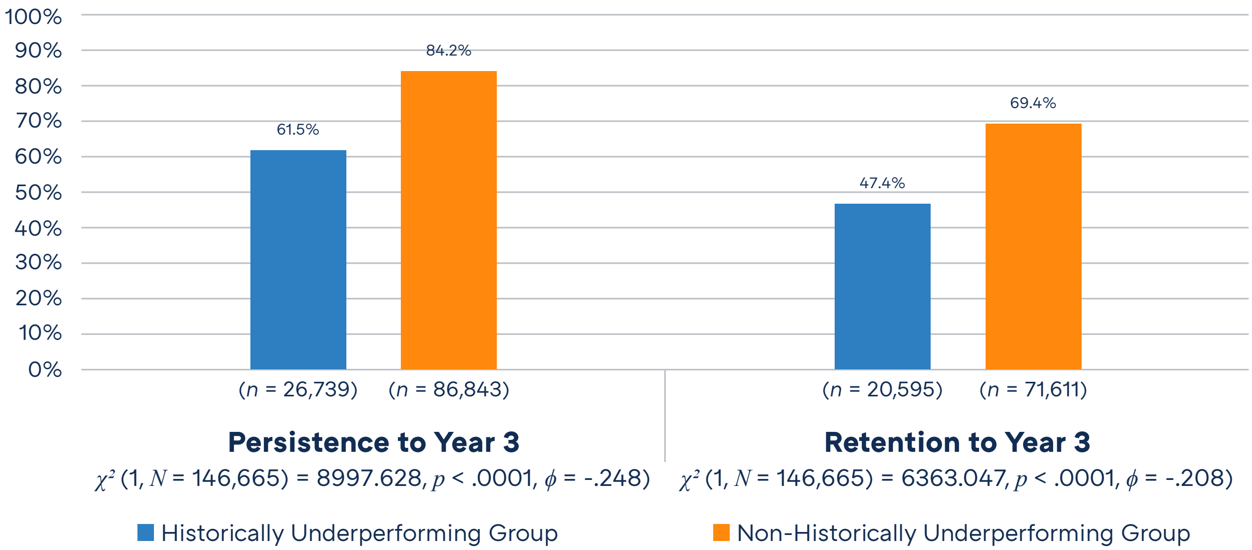


FIGURE 18. Persistence and Retention to Year 2 based on Historically Underperforming Status



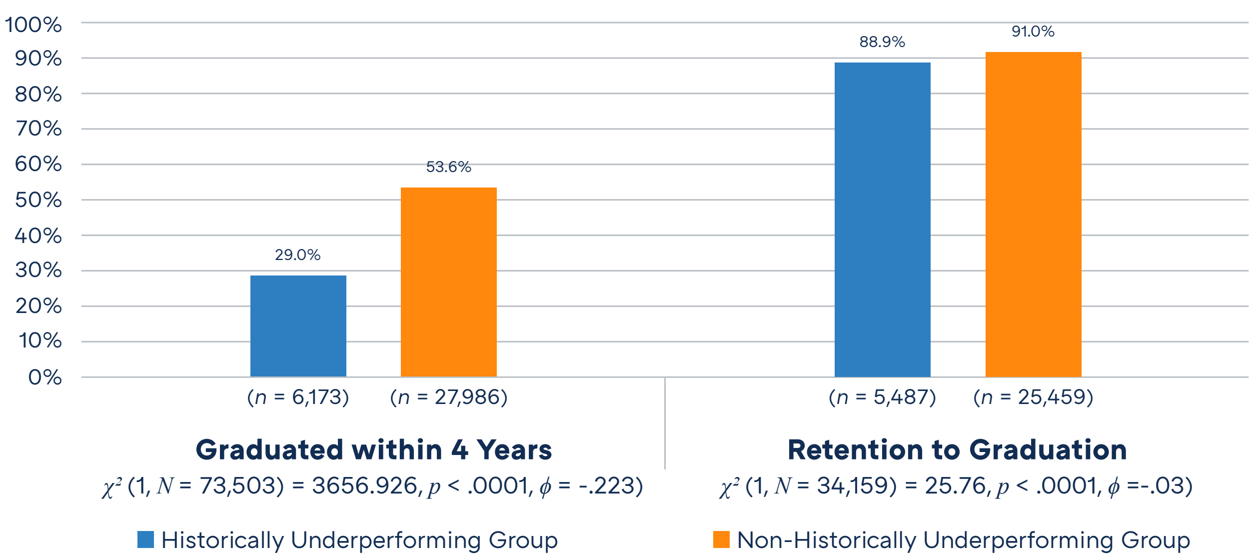
Note: This graph contains 9th grade cohorts only.

FIGURE 19. Persistence and Retention to Year 3 based on Historically Underperforming Status



Note: This graph contains the 9th grade 2010/11 & 9th grade 2011/12 cohorts only.

FIGURE 20. Persistence and Retention to Graduation based on Historically Underperforming Status



Note: This graph represents only students from the 9th grade 2010/11 cohort who entered college in the fall immediately following their HS graduation.

Economically Disadvantaged Status

Figures 21 through 24 show the rates of on-time high graduation, postsecondary enrollment, persistence, retention and graduation within four years of high school graduation for students in the economically disadvantaged student group versus students who are not. For each outcome there is a statistically significant difference between groups with a moderate effect. Although there was only a 13.1 percentage point difference between economically disadvantaged students and others in rates of on-time high school graduation (χ^2 (1, N = 557,875) = 18153.961, p < .0001, ϕ = -.180), the gap between the two groups gradually widened as students continued in postsecondary. Among non-economically disadvantaged students, 235,039 (76.6%) enrolled in a postsecondary institution compared to only 95,363 (54.5%) of students in the economically disadvantaged group. This difference in proportions was statistically significant (χ^2 (1, N = 481,930) = 25305.571, p < .0001) and the effect was moderate (ϕ = -.229). Among the economically disadvantaged students followed through entrance into postsecondary, 5,286 (29.0%) graduated with a postsecondary degree within four years of high school completion compared to 52.2 percent of non-economically disadvantaged students. This difference was significant, χ^2 (1, N = 73,503) = 2982.723, p < .0001), and the effect was also moderate (ϕ = -.201).

FIGURE 21. On-Time High School Graduation and Postsecondary Enrollment based on Economically Disadvantaged Status

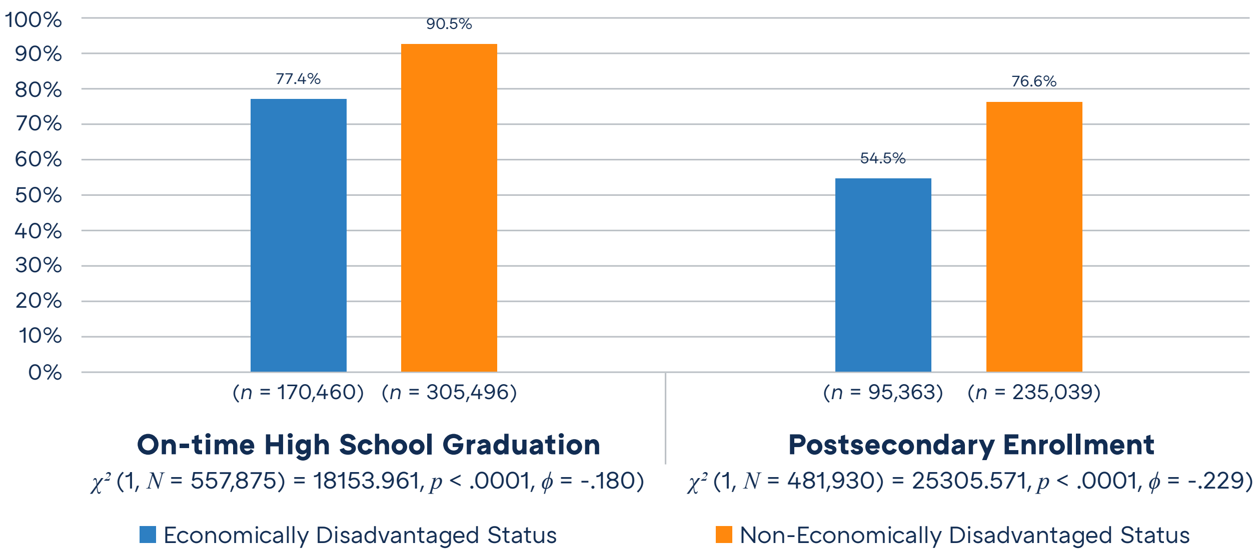
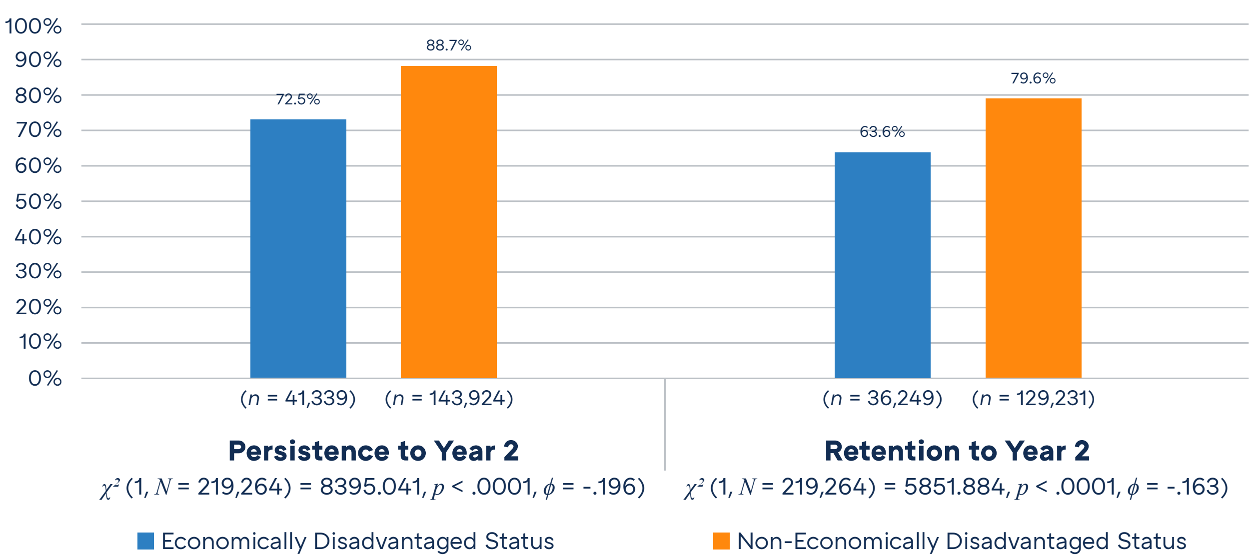
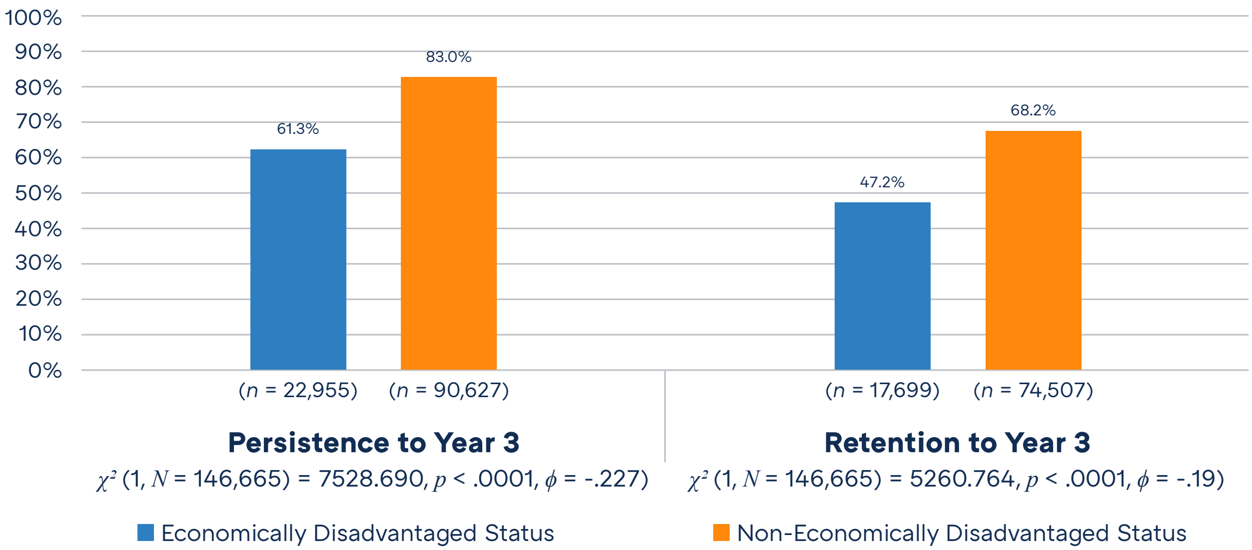


FIGURE 22. Persistence and Retention to Year 2 based on Economically Disadvantaged Status



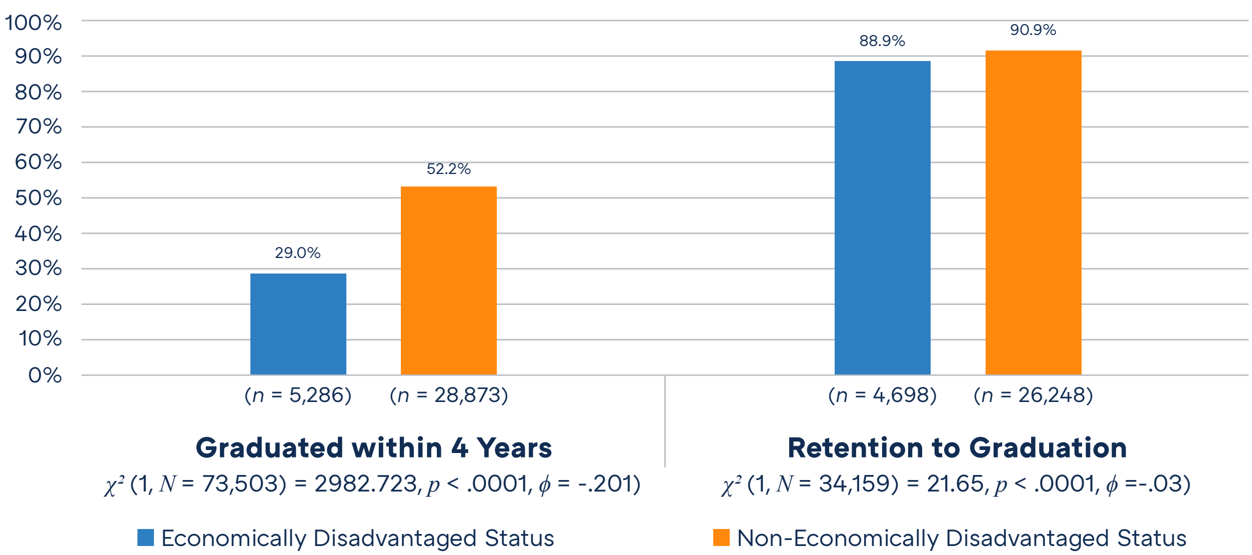
Note: This graph contains 9th grade cohorts only.

FIGURE 23. Persistence and Retention to Year 3 based on Economically Disadvantaged Status



Note: This graph contains the 9th grade 2010/11 & 9th grade 2011/12 cohorts only.

FIGURE 24. Persistence and Retention to Graduation based on Economically Disadvantaged Status



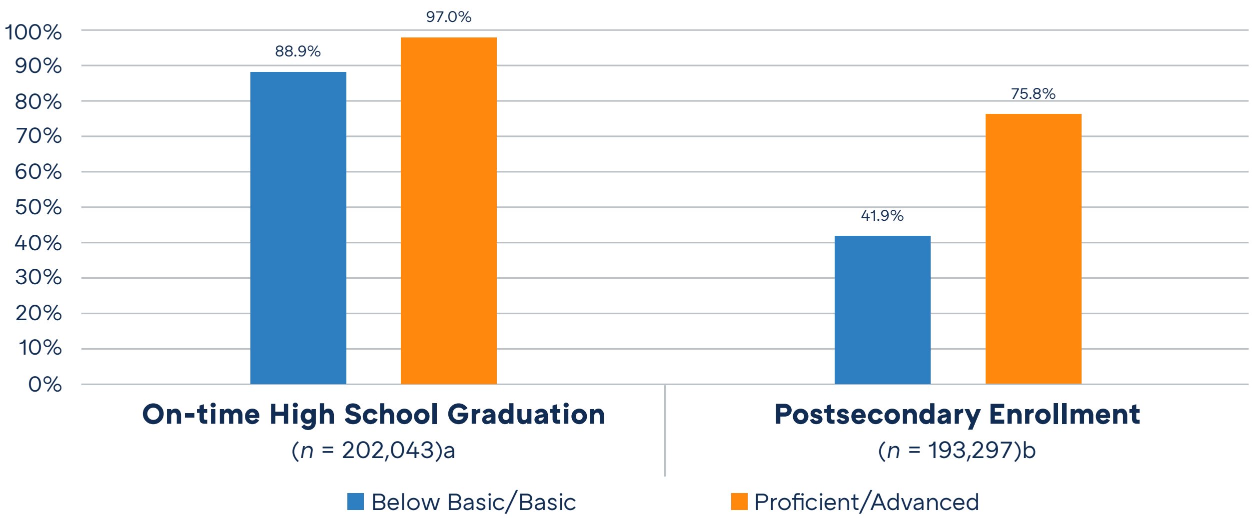
Note: This graph represents only those from the 9th grade 2010/11 cohort who entered college in the fall immediately following their HS graduation.

Are Grade 7 PSSA math scores associated with a student's ability to graduate from high school and continue with postsecondary education?

Figure 25 shows the differences in on-time high school graduation and postsecondary enrollment based on Grade 7 PSSA math performance. Pearson chi-square analysis showed a significant association between Grade 7 PSSA math scores with on-time high school graduation at four years and postsecondary enrollment. The size of the effect is larger, however, for postsecondary enrollment. Among

168,578 students in our cohorts who tested as Proficient/Advanced on the PSSA math exam, 163,506 (97%) graduated on-time. Comparably, of the 33,465 students in our cohorts who performed Below Basic/Basic on the PSSA math exam, 29,739 (88.9%) graduated on-time. The ten-percentage point difference between the Proficient/Advanced and Below Basic/Basic groups for on-time high school graduation was significant, $\chi^2(1, N = 202{,}043) = 4{,}426.14$, $p < .01$, with a small effect ($\phi = .15$).

FIGURE 25. Association between Grade 7 PSSA Math Scores with On-Time High School Graduation and Postsecondary Enrollment



a: $\chi^2(1, N = 202{,}043) = 4{,}426.14$, $p < .01$; $\phi = .15$, $p < .01$
b: $\chi^2(1, N = 193{,}297) = 14{,}043.8$, $p < .0001$; $\phi = .27$, $p < .01$

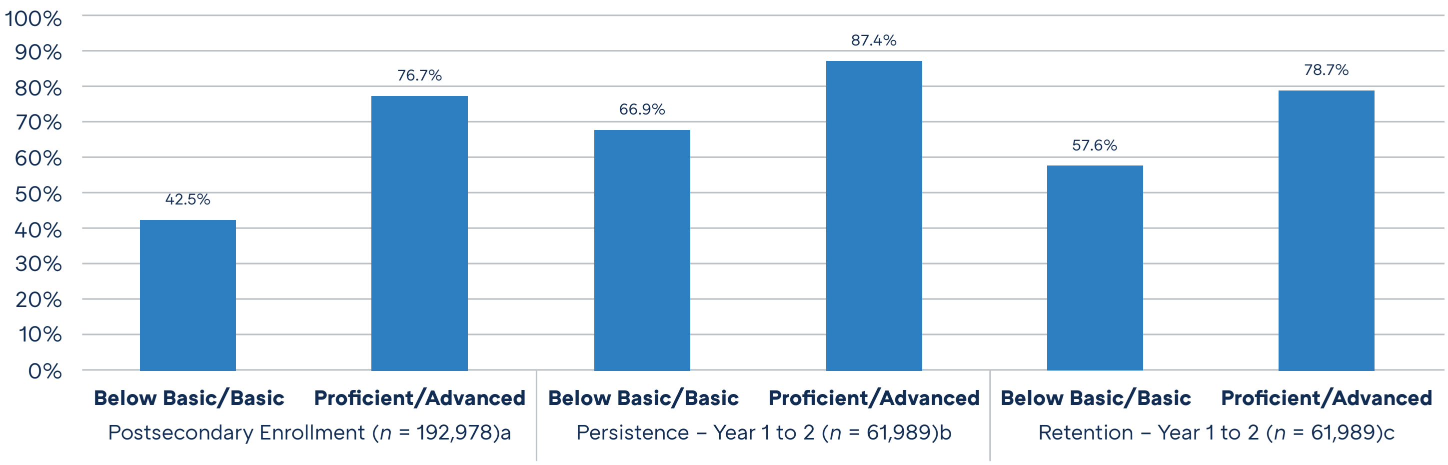
There is also a significant and moderate association between Grade 7 PSSA math performance and postsecondary enrollment. Only students who graduated from high school on-time at four years were followed into postsecondary. Among those 163,177 students who tested as Proficient/Advanced, 123,678 (75.8%) enrolled in postsecondary, yet only 12,622 (41.9%) of the 30,120 students who tested Below Basic/Basic enrolled in postsecondary education. The difference in proportions was significant, $\chi^2(1, N = 193{,}297) = 14{,}043.8$, $p < .0001$, and the effect of Grade 7 math PSSA scores on postsecondary enrollment was moderate ($\phi = .27$).

Are Grade 8 PSSA math scores associated with the likelihood of enrolling in and persisting at a postsecondary institution?

Pearson Chi-square analysis showed a significant moderate effect of Grade 8 PSSA math performance on postsecondary enrollment and a significant, but small effect for persistence and retention to year two. Although the difference in proportions for all outcomes were statistically significant, as Figure 26 shows, the difference between groups in postsecondary enrollment is larger than persistence and retention to year two. For students with a Proficient/Advanced achievement level, 76.7 percent (n=121,371) enrolled in a postsecondary institution compared to only 42.5 percent of students with a Below Basic/Basic achievement level. The difference in proportions was statistically significant ($\chi^2(1, N = 192{,}978) = 15{,}990.42$, $p < .0001$) and the association was moderate ($\phi = .29$).

A higher proportion of students with a Proficient/Advanced achievement level on their Grade 8 PSSA math test also persisted to their second year of postsecondary and remained at the same postsecondary institution from their first to second year. Specifically, 87.4 percent (*n*=56,049) of students who scored as Proficient/Advanced persisted to their second year compared to only 66.9 percent (*n*=3,974) of students, who scored Below Basic/Basic. Similarly, a higher percentage of students with a Proficient/Advanced achievement level (78.7%) remained at the same postsecondary institution from their first to their second year. Among students who scored Below Basic/Below, only 57.6 percent (*n*=5,940) remained at the same institution from their first year to second year. The differences in proportions for both persistence to year 2 (χ^2 (1, N = 61,989) = 1,803.50, p < .0001) and retention to year two (χ^2 (1, N = 61,989) = 1,334.31, p < .0001) were statistically significant, but both effects were small (ϕ = .17 & ϕ = .15)

FIGURE 26. Association between Grade 8 PSSA Math Scores and Postsecondary Outcomes



a: χ^2 (1, N = 192,978) = 15,990.42, p < .0001; ϕ = .29, p < .0001
b: χ^2 (1, N = 61,989) = 1,803.50, p < .0001; ϕ = .17, p < .0001
c: χ^2 (1, N = 61,989) = 1,334.31, p < .0001; ϕ = .15, p < .0001

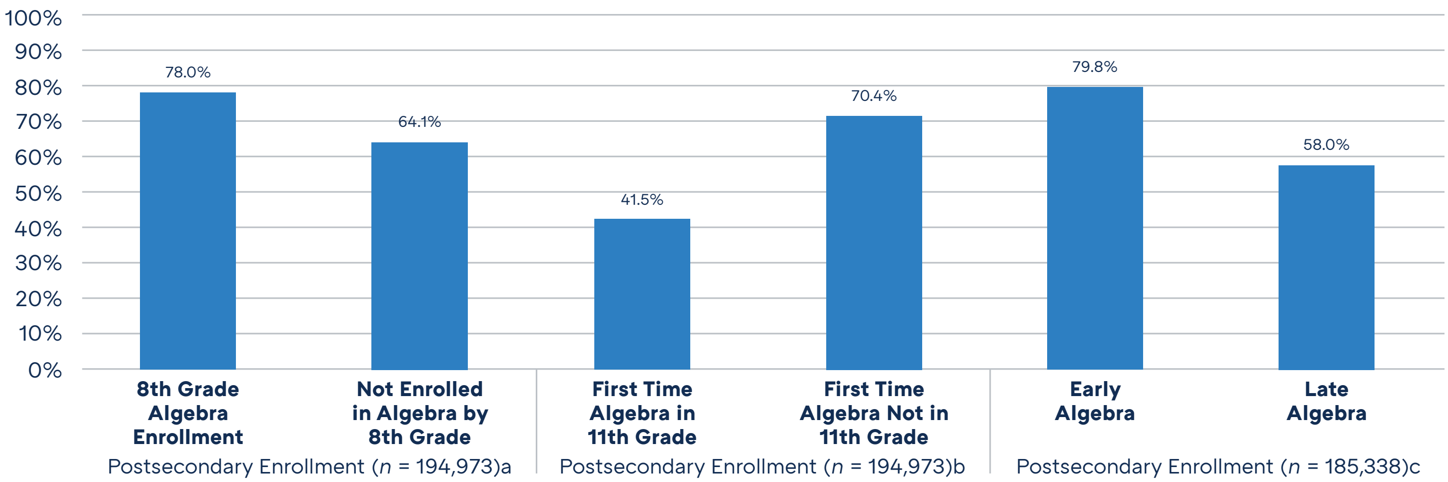
Is the timing (8th versus 11th and early versus late) of enrollment in Algebra I associated with postsecondary enrollment?

This question was addressed by testing three different dichotomous measures (dummy variables) of Algebra I timing for both 7th grade cohorts and two for 9th grade cohorts. For 7th grade cohort analyses, the first dummy variable was an indicator of whether a student enrolled in Algebra I for the first time in Grade 8, the second described first time enrollment in Grade 11, and the third measured enrollment in Algebra I for the first time, early (middle school) versus late (high school). For 9th grade cohort analyses, the first dummy variable was an indicator of first-time enrollment in Grade 11 while the second measured enrollment in Algebra I for the first time, early (9th or 10th) versus late (11th or 12th).

As Figure 27 shows, 78 percent of the students who enrolled in Algebra I for the first time in Grade 8 were found to have enrolled in a postsecondary institution following high school graduation compared to 64 percent of students who did not take algebra for the first time in Grade 8. The difference in proportions was statistically significant (χ^2 (1, N = 194,973) = 4,4663.87, p < .0001), but the association was small (ϕ = .15, p < .001). For students who enrolled in Algebra I for the first time in Grade 11, 601 (41.5%) enrolled in a postsecondary institution compared to 70.4 percent (*n*=193,525) of students who did not take Algebra I for the first time in Grade 11. This difference in proportions was also statistically significant (χ^2 (1, N = 194,973) = 575.65, p < .01), but the effect was very small (ϕ = .05, p < .01). Although the difference in percentages is very large, there was a very small number of students who were reported as having taken Algebra I for the first time in Grade 11.

Although the association between Grade 8 Algebra I and Grade 11 Algebra I enrollment and postsecondary enrollment was statistically significant with a small effect, the association based on early versus late timing was statistically significant with a moderate effect (ϕ = .24, p < .01). Of the 105,162 students who enrolled in algebra early (middle school for 7th grade cohorts), 79.8 percent (*n*=83,893) enrolled in a postsecondary institution following high school graduation compared to only 58 percent (*n*=46,526) of the 80,176 students who were reported as enrolling in Algebra I in high school (late timing for 7th grade cohorts). The difference in proportions was statistically significant (χ^2 (1, N = 185,338) = 10,316.45, p < .01).

FIGURE 27. Association between Algebra I Timing and Postsecondary Enrollment among 7th Grade Cohorts



a: χ^2 (1, N = 194,973) = 44,663.87, p < .0001; ϕ = .15, p < .0001
b: χ^2 (1, N = 194,973) = 575.65, p < .01; ϕ = .05, p < .0001
c: χ^2 (1, N = 185,338) = 10,316.45, p < .0001; ϕ = .24, p < .0001

Algebra I Timing for 9th Grade Cohorts

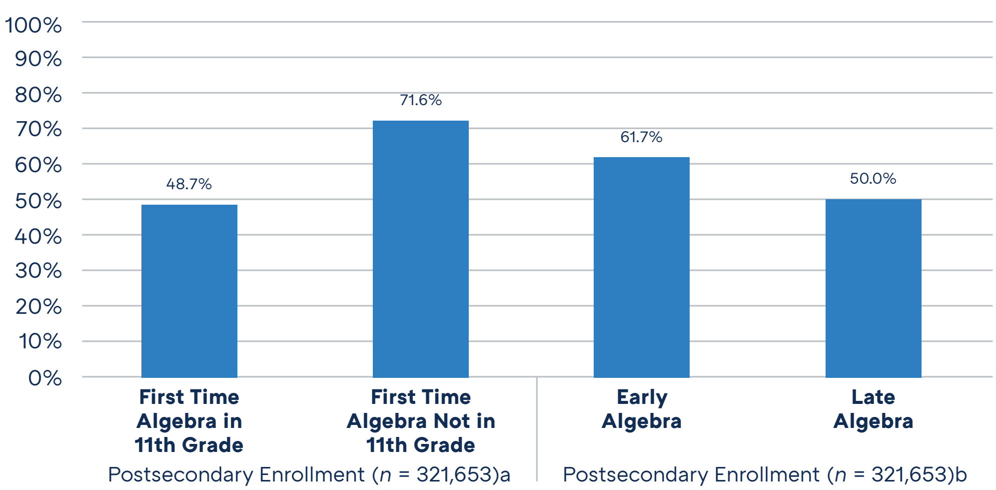
For the 9th grade cohorts, this question was addressed by testing two different dichotomous measures (dummy variables) of Algebra I timing. The first was an indicator of whether a student enrolled in Algebra I for the first time in Grade 11, and the second described enrollment in Algebra I for the first time, early (Grade 9 or 10) versus late (Grade 11 or 12) in high school.

Although chi-square analysis showed a statistically significant association between Algebra I timing and postsecondary enrollment for the 9th grade cohorts, the effects for both Algebra for the first time in Grade 11 and early versus late timing were very small (ϕ = .06, p < .01 & ϕ = .06, p < .01). The percentage difference in postsecondary enrollment between those who took Algebra I for the first time in Grade 11 and those who did not is large, but the number of students in the Grade 11 Algebra category is small. As Figure 28 shows, 71.6 percent of the 316,926 students who did not take algebra for the first time in Grade 11 were reported to have enrolled in postsecondary education. This is compared to 49 percent (n=2,301) of the 4,727 students who took Algebra I for the first time in Grade 11 and enrolled in a postsecondary institution following high school graduation. The difference between the groups was significant, χ^2 (1, N = 321,653) = 1,194.50, p < .01, despite the small effect (ϕ = .06, p < .01).

Similar to the 7th grade cohorts, a higher proportion of students enrolled in postsecondary when they took Algebra I early. Of the 177,833 students who enrolled in algebra early, 61.7% later enrolled in postsecondary education. However, only 50.0% of the 6,362 students who took algebra late went on to enroll in postsecondary. The difference in proportions was statistically significant ($\chi 2$ (1, N = 184,195) = 355.66, p < .01), but the association between algebra timing and postsecondary enrollment for the 9th grade cohorts was negligible (ϕ = .04, p < .01).

These results, when compared to the 7th grade cohort analysis, indicate that the timing of enrollment in Algebra I is significantly associated with and a very important precursor to the probability of a student enrolling in a postsecondary institution following high school graduation. However, defining early versus late timing for enrollment is important as these results suggest that early timing, defined as enrollment in Algebra I in "middle school," when compared to late timing (high school), has the largest effect with a moderate positive association (ϕ = .24, p < .0001).

FIGURE 28. Association between Algebra Timing and Postsecondary Enrollment among 9th Grade Cohorts



a: χ^2 (1, N = 321,653) = 1,194.50, p < .01; ϕ = .06, p < .01
b: χ^2 (1, N = 184,195) = 355.66, p < .01; ϕ = .04, p < .01

Is enrollment in honors AP courses or participation in dual enrollment associated with the likelihood of postsecondary enrollment and success and are there demographic differences?

- What are the effects of taking a rigorous course early in high school versus later in high school?
- To what extent does rigorous high school course taking (i.e. algebra, AP, IB, dual enrollment) and the timing of course taking define students' postsecondary path and success? Do early college credit opportunities through dual enrollment, participation in AP or the IB program make a difference?

AP Course Taking & Postsecondary Outcomes

An examination of the association between AP course taking in high school and postsecondary outcomes showed a large effect for postsecondary enrollment and a moderate effect for all other postsecondary outcomes. As Figure 29 shows, students who had taken at least one AP class had a much higher rate of postsecondary enrollment than those students who had not taken any AP courses. Among the 131,160 students who had taken at least one or more AP course, 90.1 percent (*n*=118,188) were reported as having enrolled in a postsecondary institution, compared to only 58.3 percent of students who had not taken any AP courses during high school. The difference in proportions was statistically significant (χ^2 (1, N = 321,653) = 38424.89, $p < .0001$) and the effect was large ($\phi = .35$).

Although the percentage differences between groups for all other postsecondary outcomes (persistence, retention, graduation within four years, and graduating from the same college they began) is not as large as for postsecondary enrollment, they are still statistically significant with moderate effect sizes.

IB and Dual Credit Course Taking & Postsecondary Outcomes

Although statistically significant differences were found for all outcomes based on whether a student took IB or dual enrollment courses or not, the differences are small compared to the effect of AP course enrollment. As Figures 30 and 31 show, the largest difference in outcomes between the two groups was in rates of postsecondary enrollment for both outcomes. For IB course enrollment during high school, 81.4 percent (*n*=3,195) of students who had taken at least one IB course enrolled in postsecondary education, compared to 71.1 percent of those who did not take an IB course. This difference in proportions between the two groups was statistically significant (χ^2 (1, N = 321,653) = 199.56, $p < .0001$), but the effect was small ($\phi = .03$). For dual credit course enrollment during high school, 84.6 percent (*n*=33,279) of students who had taken at least one dual enrollment course enrolled in a postsecondary institution following high school graduation compared to only 69.4 percent of students who had not taken any dual enrollment courses. This difference in proportions between the two groups was also found to be statistically significant (χ^2 (1, N = 321,653) = 3868.24, $p < .0001$), but the effect was small ($\phi =.11$). Similarly, the effects of IB and dual enrollment course taking for all other postsecondary outcomes is very small. It should be noted that the number of students who participated in IB and dual enrollment courses was small.

Rigorous Course Taking & Postsecondary Outcomes

A dichotomous measure was developed to examine the effect of taking at least one or more rigorous course (AP, IB, and Dual Credit) versus no rigorous courses during high school.

Figure 32 shows that students who had taken at least one rigorous course had better outcomes than those who did not. Similar to the effects of each individually, the largest difference in outcomes between the two groups was in rates of postsecondary enrollment. Among the 150,929 students who had taken at least one rigorous course, 88.1 percent (132,931) were reported to have enrolled in a postsecondary institution, compared to only 56.4 percent enrollment for students who had not taken a rigorous course during high school. This difference in proportions was statistically significant (χ^2 (1, N = 321,653) = 39261.07, $p < .0001$), with a large effect of rigorous course taking ($\phi = .35$). Rates of persistence, retention, and graduation within four years following high school completion also varied significantly ($p < .0001$) based on rigorous course taking during high school, all with moderate effects ($\phi = .21$ to $\phi = .27$).

Advanced Course Taking & Postsecondary Outcomes

To examine the effect of high school course taking further, a dichotomous measure was developed of whether a student took one or more rigorous (AP, IB, and Dual Credit) or honors courses versus no rigorous enrollment throughout high school. As Figure 33 shows, students who were reported as having taken at least one advanced course had more positive outcomes related to postsecondary education than those who had not. Similar to the findings for all rigorous courses individually, the largest difference was in rates of postsecondary enrollment. Among the 212,850 students who had taken at least one advanced course, 83.5 percent (*n*=177,739) enrolled in a postsecondary institution following high school graduation, compared to only 47.3% of those who had not taken an advanced course during high school. The difference in proportions between groups was significant (χ^2 (1, N = 321,653) = 46067.65, p < .0001), and the effect was large (ϕ = .38). As Figure 33 shows, there is also a statistically significant difference in rates of persistence, retention, and graduation within four years of high school completion, all with moderate effect sizes ranging from ϕ = .20 to ϕ = .26.

Honors Course Taking & Postsecondary Outcomes

As Figure 34 shows, across all outcomes, students who had taken at least one honors course had better outcomes than those who had not. The largest difference in outcomes between the two groups was in rates of postsecondary enrollment. Among the 184,425 students who had taken at least one honors course, 84.9 percent (*n*=156,541) enrolled in a postsecondary institution, while only 53 percent of those who had not taken an honors course enrolled. The difference between the two groups was statistically significant ($\chi 2$ (1, N = 321,653) = 39161.18, p < .0001), and the effect was large (ϕ = .35). Rates of persistence also varied by honors course taking. Among the 95,829 students who had taken at least one honors course, 84.8 percent (*n*=81,304) persisted to year three of college, while 63.8 percent of those who had not taken an honors course persisted. The difference between the groups was significant (χ^2 (1, N =135,954) = 7440.61, p < .0001), and the effect was also moderate (ϕ = .23). Among the 47,772 students who had taken at least one honors course, 53.4 percent (*n*=25,492) persisted to graduation while only 33.9 percent of those who had not taken an honors course graduated. The difference between the groups was also statistically significant (χ^2 (1, N = 68,497) = 2193.06, p < .0001), but the effect was small (ϕ = .18).

Overview of Effect of Early College Credit Opportunities for PA High School Students

Overall, students in PA who had taken one or more of any course identified as honors, rigorous (AP, IB, or Dual Credit), or advanced (honors, gifted, or rigorous) had significantly higher rates of postsecondary enrollment, persistence, retention, and graduation within four years following high school completion. Across all course taking measures, the largest between-group differences with large effects was seen in the rates of postsecondary enrollment for students who had taken at least one of these courses, showing consistently higher rates of postsecondary enrollment. For those followed through postsecondary to graduation within four years, the between-group differences in outcomes remains statistically significant with moderate effects related to these measures of course taking in high school. These findings indicate that early college credit opportunities for students through AP or IB programs and dual credit enrollment opportunities are making a difference for students graduating from high schools in PA in terms of defining students' postsecondary path and success. It should be noted that the effect of late timing for enrollment mirrored the effect of taking these courses overall. This is because most of the rigorous classes in which students enrolled were later, rather than early, in high school.

FIGURE 29. Association between AP Course Taking and Postsecondary Outcomes

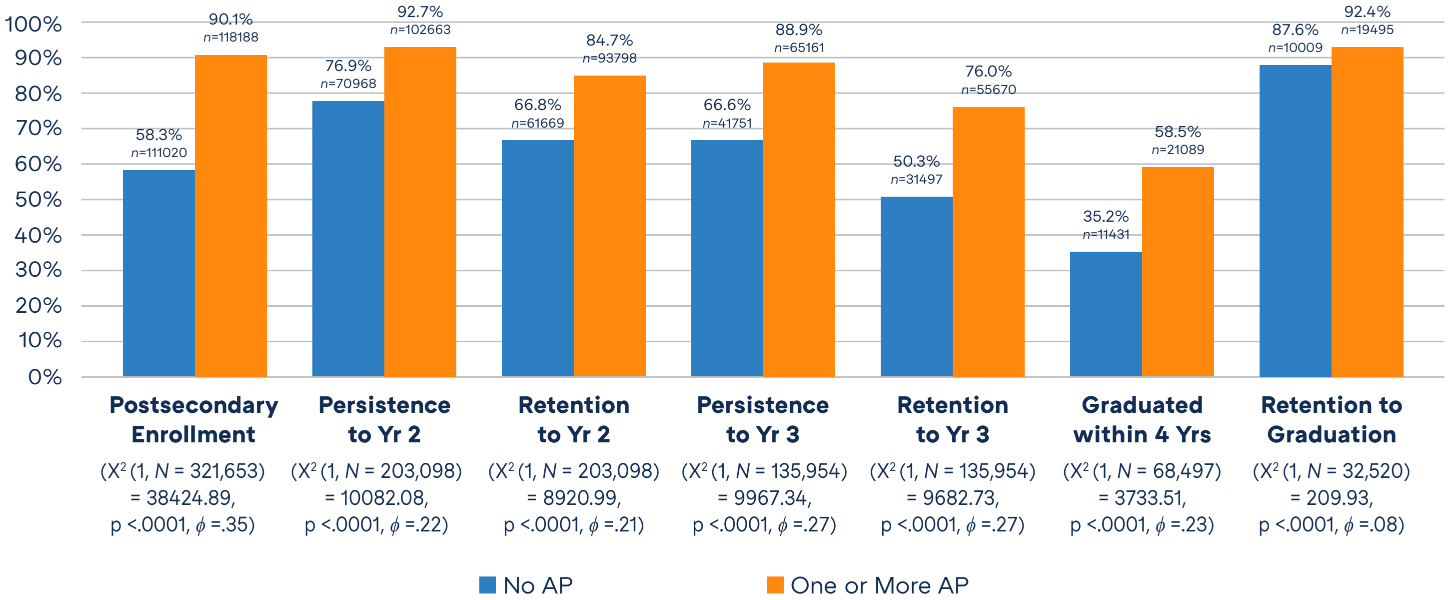


FIGURE 30. Association between IB Course Taking and Postsecondary Outcomes

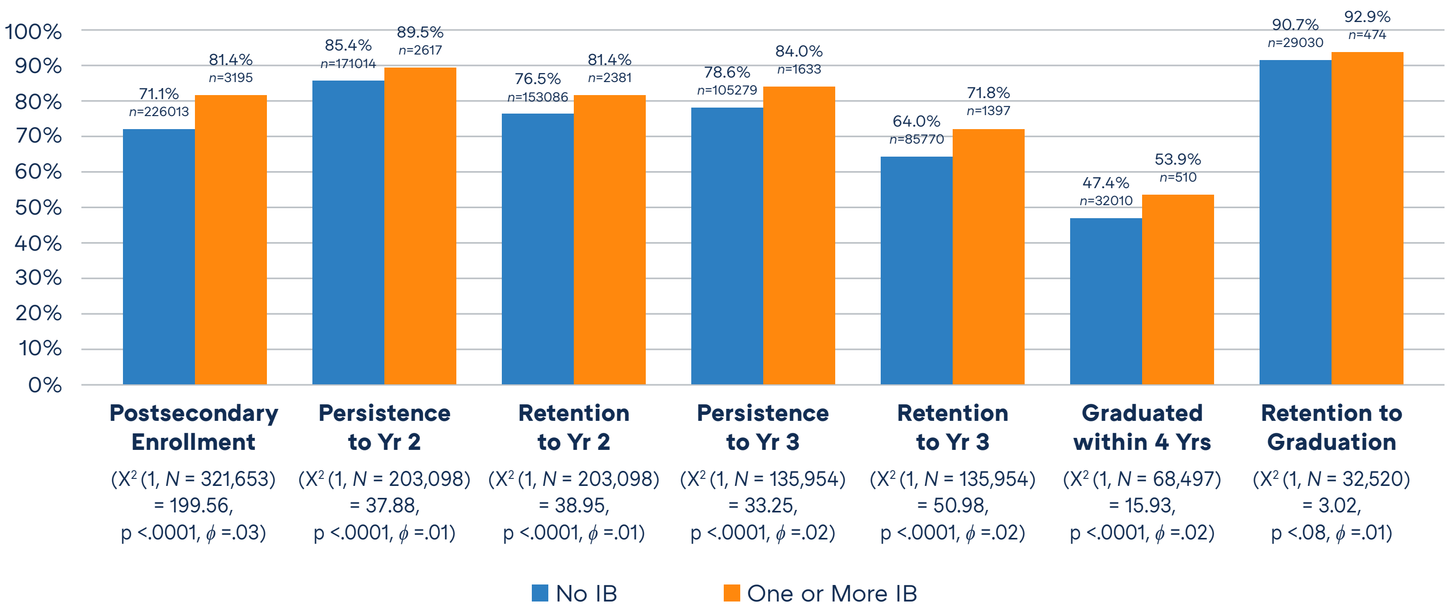


FIGURE 31. Association between Dual Credit Course Taking and Postsecondary Outcomes

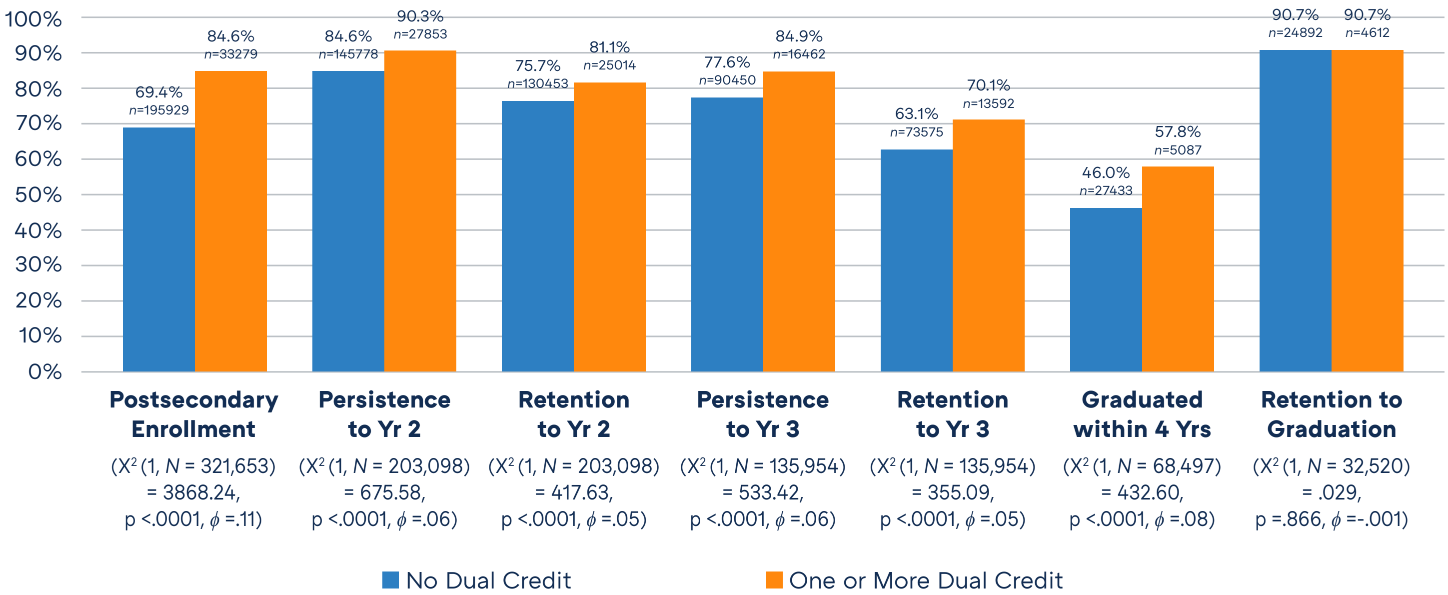


FIGURE 32. Association between Courses of Rigor and Postsecondary Outcomes

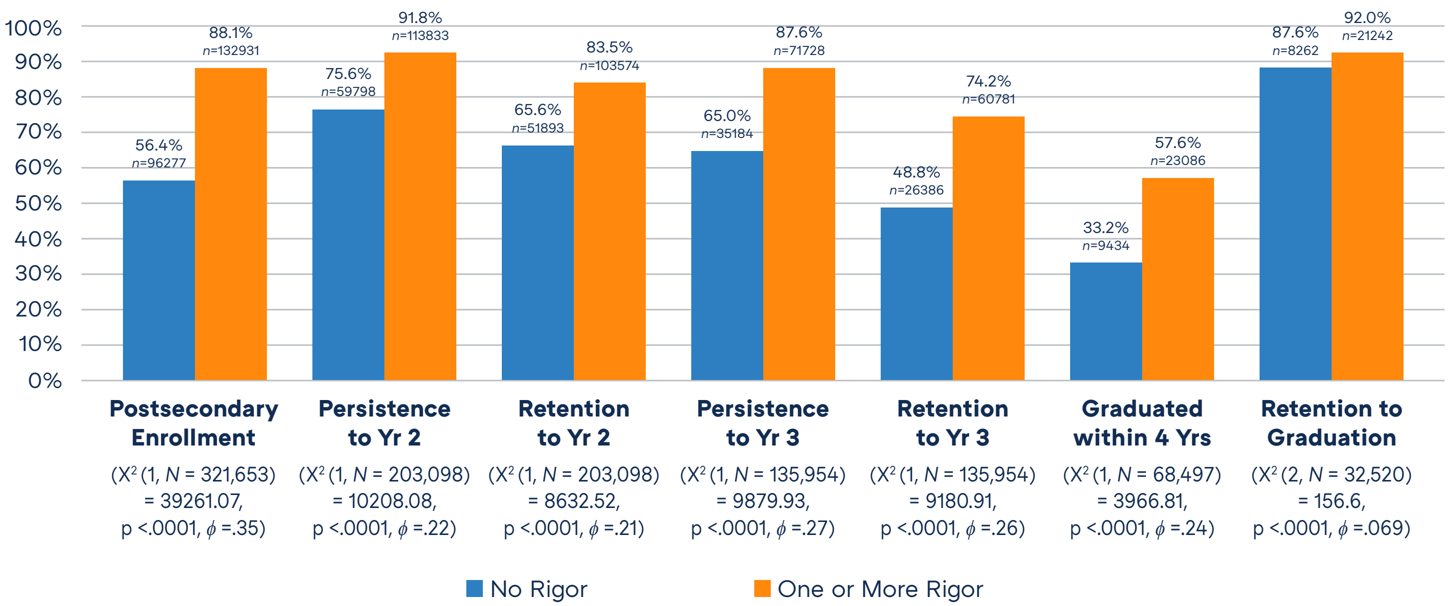


FIGURE 33. Association between Advanced Course Taking and Postsecondary Outcomes

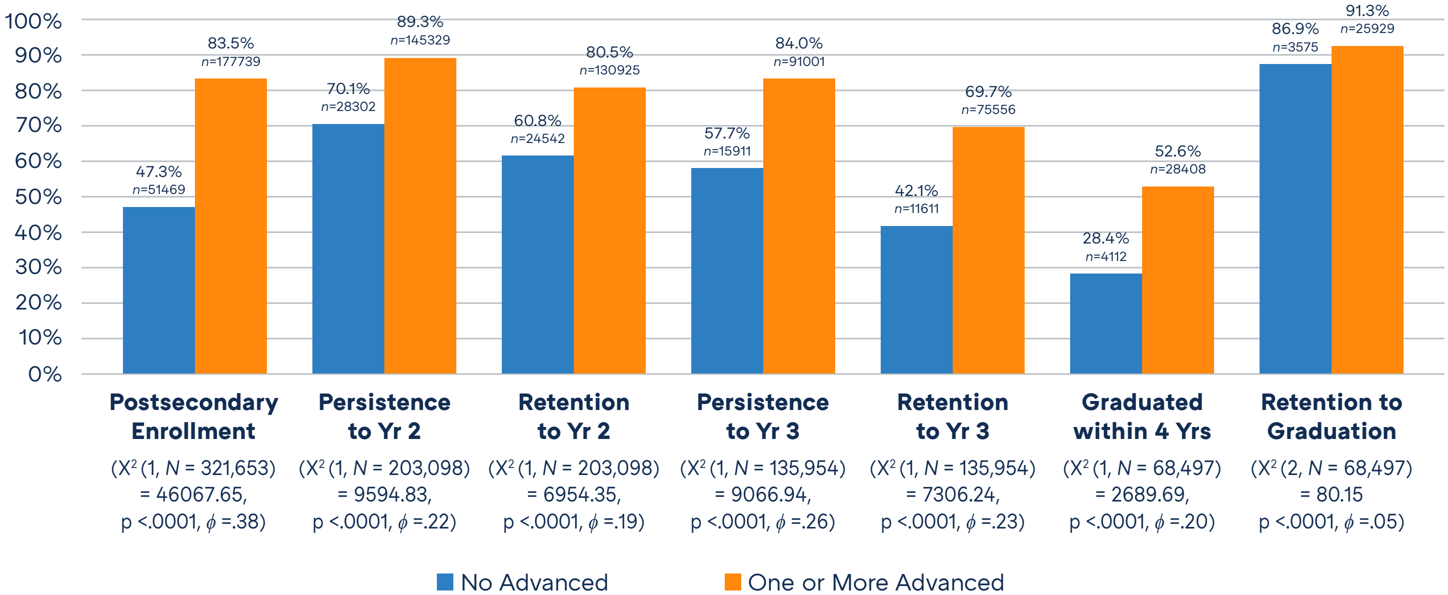
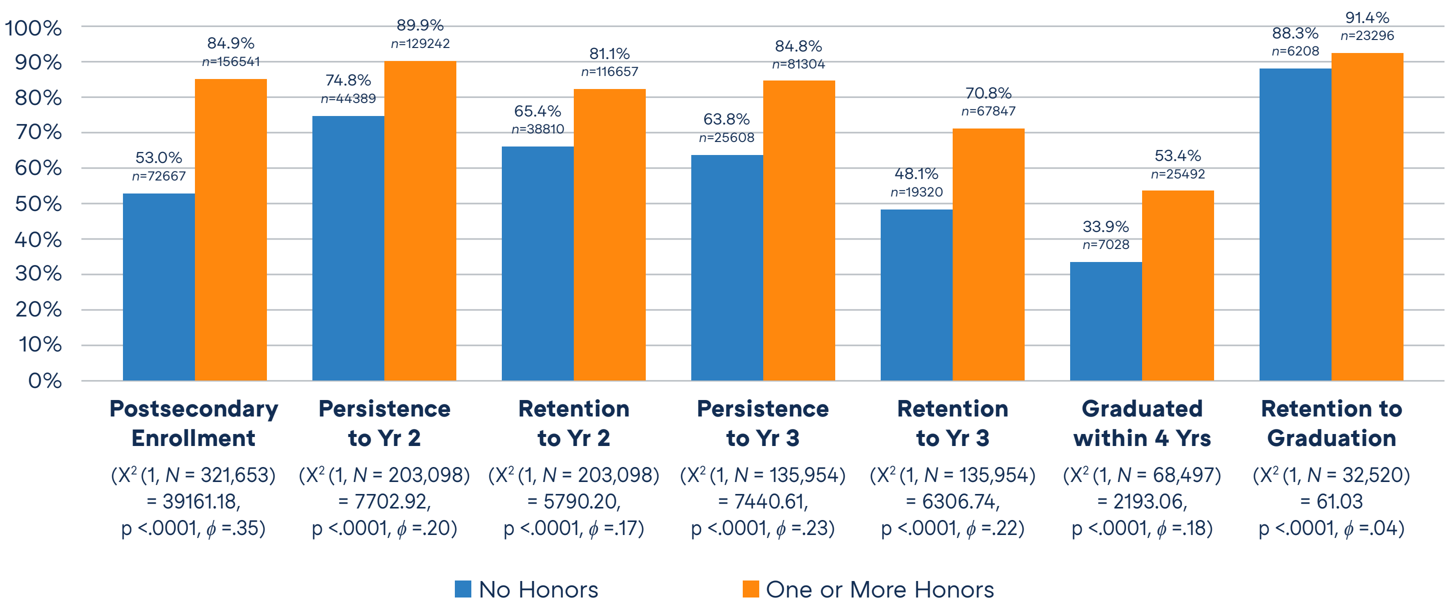


FIGURE 34. Association between Honors Course Taking and Postsecondary Outcomes



Is math course taking or Keystone passage in high school associated with the likelihood of enrolling in, persisting and graduating from a postsecondary institution?

Keystone data was only available for two PA 9th grade cohorts who were followed through postsecondary enrollment and for only one cohort followed through persistence and retention to year two. A dichotomous measure was used to examine differences for students who had Below Basic or Basic Keystone achievement levels versus students with Proficient or Advanced. For the effects of math course taking, please see the findings discussed previously on Algebra I enrollment beginning on page 36 and logistic regression results beginning on page 54.

Keystone Achievement Levels & Postsecondary Enrollment

An examination of the association between performance on Keystone subtests and postsecondary outcomes showed a large effect for postsecondary enrollment, a moderate effect for persistence to year two and a small bordering moderate effect for retention to year two (see Figures 35 - 37). As Figure 35 shows, students who tested as Proficient/Advanced in any subject area of the Keystone exam had significantly higher rates of postsecondary enrollment following high school completion when compared to the students in the Basic/Below Basic group. The smallest difference in enrollment rates, but still with a moderate to large effect, was a 30.8 percentage point difference between groups on the Biology exam (81.8% versus 51.0%, respectively). Among the 72,394 students who tested as Proficient/Advanced on the Algebra exam, 80.7 percent (n=58,449) enrolled in a postsecondary institution, compared to only 46.8 percent of the 31,153 students in the Basic/Below Basic group. For Algebra, the difference in proportions was statistically significant, (χ^2 (1, N = 103,547) = 12089.94, p < .0001) and the effect was large (ϕ = .34). The largest effect in enrollment rates was found between those who tested Proficient/Advanced and those who tested Basic/Below Basic on the Literature exam. Among the 80,273 students who tested as Proficient/Advanced, 79.4 percent (n=63,723) enrolled in a postsecondary institution following high school completion, compared to only 40.2 percent (n=9,318) of the 23,178 students who tested as Basic/Below Basic. This difference in proportions is also statistically significant (χ^2 (1, N = 103,451) = 13302.91, p < .0001), and with a large effect (ϕ = .36).

Although the percentage differences between groups for persistence and retention rates to year two based on all Keystone subtests are not as large as for postsecondary enrollment, the differences in proportions is still statistically significant with moderate effects for persistence and small, bordering moderate effects, for retention.

FIGURE 35. Association between Keystone Achievement Levels and Postsecondary Enrollment

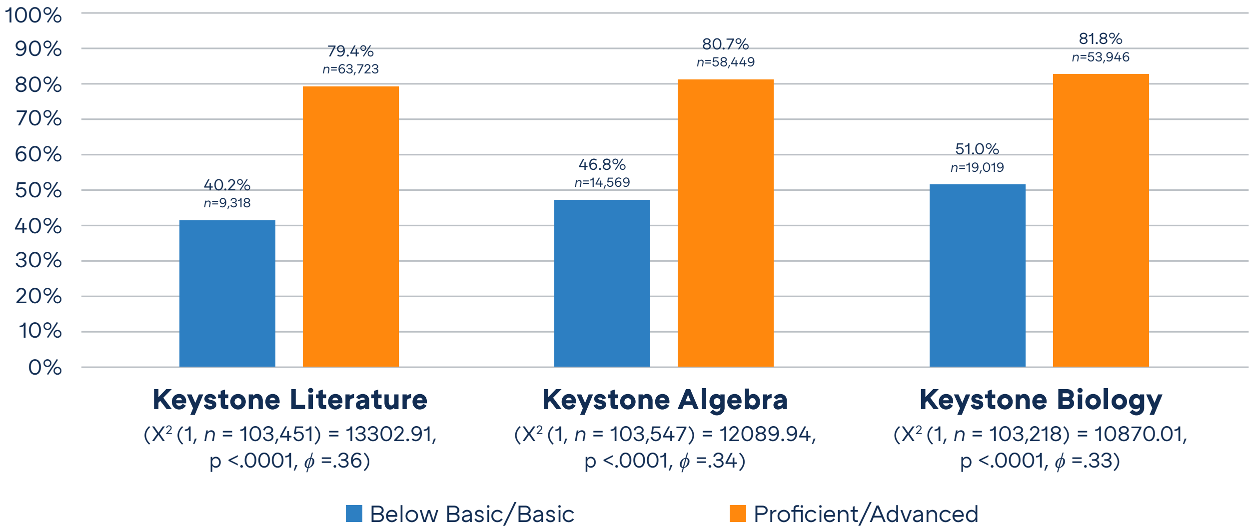


FIGURE 36. Association between Keystone Achievement Levels and Postsecondary Persistence to 2-Years

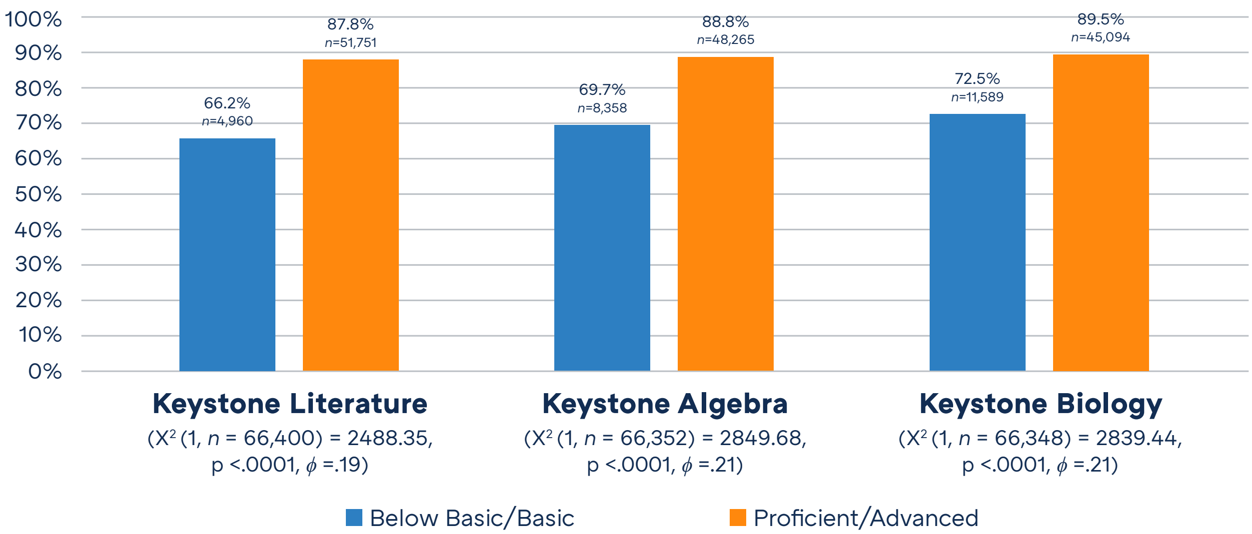
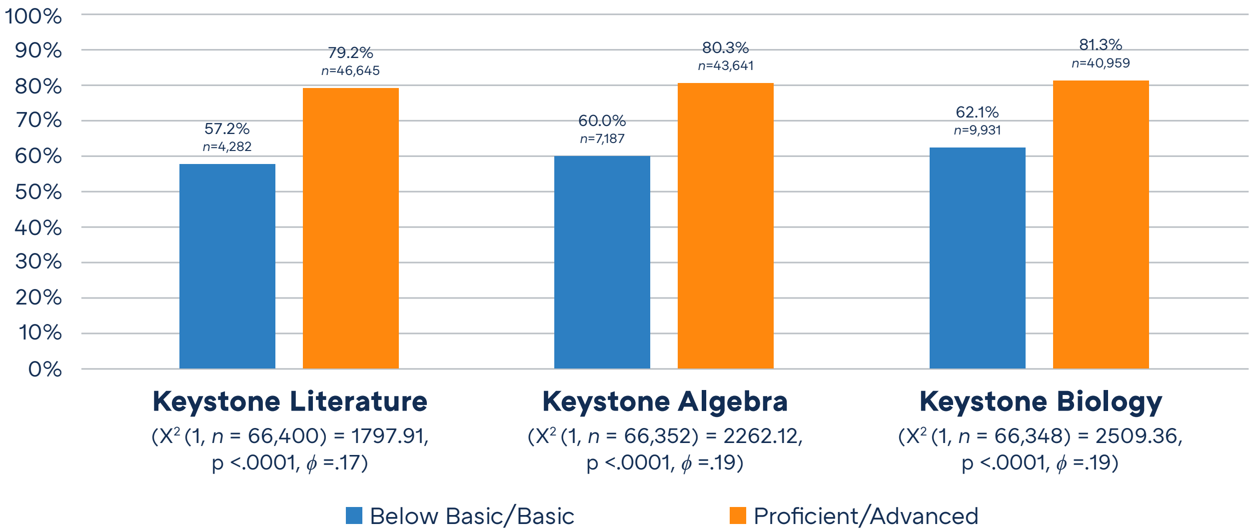


FIGURE 37. Association between Keystone Achievement Levels and Postsecondary Retention to 2-Years



Overview of the Association between Keystone Achievement Levels & Postsecondary Outcomes

For all postsecondary outcomes, students who tested as Proficient/Advanced in any subject area of the Keystone Exam had higher rates of postsecondary enrollment, persistence, and retention to year two when compared to students who tested Basic/Below Basic. Across all Keystone subject areas, the largest difference between the Proficient/Advanced and Below Basic groups was in rates of postsecondary enrollment.

For two Grade 7 PA student cohorts, what factors are most highly associated with high school graduation, postsecondary enrollment and persistence and retention to year two? For three Grade 9 PA student cohorts, what factors are most highly associated with high school graduation, postsecondary enrollment, retention, persistence, and on-time bachelor's degree completion?

Logistic regression was used to measure the effect of course taking patterns on on-time high school graduation (within four years) and postsecondary outcomes, such as enrollment, persistence, retention, and postsecondary degree attainment within four years after high school graduation. Appendix C shows the independent variables and covariates that were tested individually for significance. Logistic regression was used because all outcomes were binary. The analyses were exploratory in nature, which allowed for the examination of several individual variables and their association with high school and postsecondary outcomes. In this phase of analysis, logistic regression was used to examine the differences in effects of the individual significant independent variables in isolation and in the context of additional explanatory variables, as well as the cumulative effects of variables associated with the highest amount of explained variance in the final statistically significant models.

Tables 1 through 11 found in Appendix E show the statistically significant variables when tested individually and the final models associated with the highest amount of explained variance for each outcome. In all models, both the number of rigorous courses and the number of advanced courses are statistically significant independent variables; however, in most cases the number of advanced courses taken is associated with a slightly higher amount of variance in outcomes. Given that the definition of advanced courses includes rigorous courses (see definitions in Appendix B) the number of advanced courses taken was the variable used in our final models. Further, in addition to testing the effects of economically disadvantaged status, EL, and special education status, an independent variable called historically underperforming was included. Historically underperforming includes students within the special education, EL, and economically disadvantaged student groups. As the final models in Tables 1–11 show, in all cases, both historically underperforming and economically disadvantaged were statistically significant. Given this, in cases where the amount of variance associated with each variable is similar, two final models are included: one that includes historically underperforming and one that includes economically disadvantaged. There are a few instances where the amount of variance associated with historically underperforming status is much higher than economically disadvantaged. In this case, historically underperforming was included in the final models only. In all cases the difference in association when comparing final models with economically disadvantaged versus historically underperforming is very small or there is no difference. The effects of two interactions for historically underperforming and economically disadvantaged status and number of advanced courses were tested. None of the interactions tested were found to be statistically significant.

Further, for the 7th grade cohort analyses, in many cases both performance on the Grade 7 PSSA and Grade 8 PSSA math test were significantly associated with the dependent variable. Given that these two independent variables are highly correlated, only one was included in the final models. Performance on the Grade 8 PSSA math test was included in the final models because in most cases the amount of variance associated with this variable was larger.

Lastly, for the 9th grade cohort analyses, Keystone Algebra or Literature achievement was found to be significantly associated with most outcomes. Given that Keystone data was only available for one 9th grade cohort, in cases where it was significant, two models are provided: one model that does not include Keystone as an independent variable and one model where it is included.

7th Grade Cohort Logistic Regression Results

For the two 7th grade cohorts in this study, logistic regression analysis results indicate that there is a statistically significant association between the number of rigorous and number of advanced courses a student in PA takes and on-time high school graduation and all postsecondary outcomes. As the final models show, the effect of taking rigorous or advanced courses remains significant even after holding all other explanatory variables constant. A comparison of the odds ratio (Exp(β)) for the effect of the number of advanced courses on outcomes individually, versus after holding all other significant explanatory variables constant, shows a significant increase in odds regardless.

Whether or not a student was enrolled in an advanced algebra course, Keystone Algebra or Literature subtest performance, Grade 8 PSSA performance and the timing of Algebra I are all significantly associated with on-time high school graduation, postsecondary enrollment, persistence and retention to year two. As a comparison of the odds ratios in the final model tables show (see Table 1–4 in Appendix E), the effect of these variables remains significant even after holding all other explanatory variables constant.

The probability of on-time high school graduation (Table 1, Appendix E) and postsecondary enrollment (Table 2, Appendix E) was found to have a statistically significant association with the number of advanced courses taken in high school, enrollment in advanced algebra during high school, Grade 8 math PSSA performance, Keystone Algebra subtest performance, timing of Algebra I, and whether a student is economically disadvantaged or part of the historically underperforming student group. For on-time high school graduation, the amount of variance associated with these variables is small at 16 percent (R^2 = .16). However, for postsecondary enrollment, 27 (Models 1 & 2) to 29 (Models 3 & 4) percent of the variance (R^2 = .27 & .29) in postsecondary enrollment is associated with variables in the final models.

The odds of a student graduating on-time from high school increases by at least a factor of 1.17 (Model 1) and the odds of a student enrolling in a postsecondary institution increases by a factor of 1.15 (Model 3 & 4) to 1.17 (Model 1) when the number of advanced courses increases by one. The odds of a student graduating from high school on-time are 1.795 (Model 1) to 1.86 times higher if a student has taken an advanced algebra course and 2.25 times higher if a student has scored proficient or advanced on the Keystone Algebra subtest. The odds of a student enrolling in a postsecondary institution after high school graduation are also two times higher if a student has taken an advanced algebra course and 1.3 to 1.6 times higher if a student has scored proficient or advanced on the 8th grade Math PSSA subtest.

The timing of algebra, when measured as both enrollment for the first time in Grade 8 and early (middle school) versus late (high school), was found to also have a significant association with on-time high school graduation and postsecondary enrollment. The odds of a student graduating on-time and enrolling in postsecondary increase if a student had Algebra I for the first time in Grade 8. Similarly, the odds increase if a student had Algebra I early (middle school) and decrease if a student had Algebra I late (high school).

For persistence and retention to year two (Tables 2 & 3, Appendix E), enrollment status at entry (part versus full-time) and institution type at entry (2 versus 4-year institution) were both found have a very large effect. Additionally, institution sector (public versus private) was also found to be significantly associated with persistence and retention to year two. The probability of a student persisting to year two was found to be significantly associated with the number of advanced courses a student had taken in high school, enrollment status at entry (part-time/full-time), the type of institution (2 versus 4-year), institution sector (public/private), whether or not a student took an advanced algebra course in high school, the timing of Algebra I, Keystone Algebra subtest performance, and whether a student was part of the historically underperforming student group during their year of high school graduation. Twenty-one percent of the variation in persistence to year two is associated with variation in these variables (R^2 = .21). The probability of a student remaining at the same school to year two was also found to be significantly associated with the same variables, except advanced algebra, with 14 percent of the variation associated with variables in this model (R^2 = .14).

The odds for persistence to year two are 2.7 times higher for students who had a full-time status at entry, 2.25 times higher respectively for students who enrolled in 4-year institutions at entry, 1.29 times higher if a student enrolled in a private versus public institution at entry, 1.239 times higher if a student took advanced algebra, and 1.204 times higher if a student scored proficient or advanced on the Keystone Algebra subtest. Holding all other significant explanatory variables constant, the odds of a student persisting to year two increases by a factor of 1.076 when the number of advanced courses increases by one. For the final model, the odds ratio and effects of advanced courses decreases slightly when other explanatory variables are included in the model. Additionally, the timing of Algebra I (early versus late) remained significant when included in a model with other explanatory variables and enrollment in Grade 8 algebra alone did not.

Similar effects of significant independent variables for persistence exist for retention to year two with odds that are slightly lower. The odds for retention to year two are 1.649 times higher for students who enroll in 4-year institutions at entry, the odds are 2.375 times higher for students who enrolled full-time at entry versus part-time, and the odds are 1.236 times higher if a student scored proficient or advanced on the Keystone Algebra subtest. Although taking an advanced algebra course in high school is significantly associated with persistence to year two, it was not found to be significantly associated with retention to year two for 7th grade cohorts.

For all final models, students in the historically underperforming student group had a lower probability ($p<.0001$) of on-time high school graduation, postsecondary enrollment, persistence, and retention when compared to other students. Additionally, no significant individual effects based on ethnicity, EL, or special education status were found when controlling for other explanatory variables. However, when EL, special education status, and economically disadvantaged student groups were combined (Historically Underperforming) they did result in significant associations.

The prediction accuracy for a favorable outcome (on-time high school graduation, postsecondary enrollment, persistence, and retention) based on the final models varied, however, all final models had a prediction accuracy over 92 percent for a favorable outcome indicating a high level of sensitivity.

These findings indicate that there is a statistically significant effect of advanced course taking for students in our cohorts and graduates from PA high schools. Additionally, taking an advanced algebra course during high school, the timing of Algebra I, Grade 8 PSSA and Keystone performance are all significantly associated with an increase in odds of on-time high school graduation, postsecondary enrollment, persistence and retention, even after controlling for other significant explanatory variables.

9th Grade Cohort Logistic Regression Results

For 9th grade cohorts, logistic regression analysis results indicate that there is a statistically significant association between the number of rigorous and number of advanced courses a student in PA takes throughout high school and on-time graduation and all postsecondary outcomes. As the final models show (Tables 5–11, Appendix E), the effect of taking rigorous or advanced courses in high school remains significant even after holding all other explanatory variables constant. A comparison of the odds ratio ($Exp(\beta)$) for the effect of the number of advanced courses on outcomes individually, versus after holding all other significant explanatory variables constant, shows a significant increase in odds regardless.

The probability of on-time high school graduation (Table 5, Appendix E) and postsecondary enrollment (Table 6, Appendix E) was found to have a statistically significant association with the number of advanced courses taken in high school, whether or not a student took an advanced algebra course in high school, Keystone subtest performance, and whether a student is part of the historically underperforming student group. The odds of a student graduating on-time from high school increases by a factor of 1.28 (Model 1) to 1.219 (Model 2) and the odds of a student enrolling in a postsecondary institution increases by a factor of 1.165 (Model 2) to 1.19 (Model 1) when the number of advanced courses increases by one. The odds for on-time high school graduation are also 2.065 (Model 2) to 2.712 (Model 1) times higher if a student has taken an advanced algebra course in high school and 2.4 times higher if a student has scored proficient or advanced on the Keystone Algebra subtest. There is a decrease in odds of on-time high school graduation for students in the historically underperforming student group. Eighteen percent of the variation in on-time high school graduation ($R^2 = .18$) and 27 to 30 percent of the variation in postsecondary enrollment ($R^2 = .27$ to $.30$) is associated with variance in the variables in these models.

The odds of a student enrolling in postsecondary education after high school completion increases by a factor of 1.17 to 1.19 when the number of advanced courses increases by one. The odds are also 1.92 (Model 2) to 2.25 (Model 1) times higher if a student has taken an advanced algebra course in high school and 2.24 times higher if a student has scored proficient or advanced on the Keystone Literature subtest. Male students and students in the historically underperforming student group had slightly lower odds of postsecondary enrollment. Additionally, students who graduated from high school in suburban areas had odds that are 1.4 times higher than other regions for postsecondary enrollment.

For persistence to year two and three (Tables 7 & 9, Appendix E), retention to year two and three (Tables 8 & 10, Appendix E), and graduation within four years following high school completion (Table 11, Appendix E), enrollment status at entry (part versus full-time) and institution type at entry (2 versus 4-year) were both found to have a very large effect. Additionally, institution sector (public versus private) was found to be significantly associated with postsecondary graduation within four years. The odds for persistence to year two and year three are 2.8 and 2.3 times higher respectively for students who had a full-time status at entry and 2.4–2.5 (year two) and 3.1 (year three) times higher respectively for students who enrolled in 4-year institutions at entry. Holding all other significant explanatory variables constant, the odds of a student persisting to year two and year three increases by a factor of 1.1 when the number of advanced courses increases by one. The odds for persistence to year two are 1.13 to 1.3 times higher for students who took an advanced algebra course in high school. Taking an advanced algebra course in high school was not statistically significant when included in a model with other explanatory variables for persistence to year three and in fact the effect of this variable diminished after a student's entry into their second year of postsecondary education. Twenty-one percent of the variance in persistence to year two (R^2 = .21) and 26 percent of the variance in persistence to year three (R^2 = .26) is associated with variance in the variables in these models.

The effect of advanced course taking in high school is similar for retention to year two and three. However, the number of rigorous courses was used in the final model for retention to year three since the amount of variance associated with this variable was the same as for advanced courses. The effect of enrolling in a 2-year versus 4-year institution at entry is smaller for retention to year two and much larger for retention to year three. The odds for retention to year three are 3.7 times higher for students who enroll in 4-year institutions at entry versus 1.8 times higher for retention to year two. Although it could seem logical to conclude that students enrolled in a 2-year institution could exit postsecondary after the completion of a 2-year degree or potentially transfer to a 4-year institution to continue their education, this was not observed among students in these cohorts. Only a small percentage of students (27%) who began at a 2-year institution at entry into postsecondary earned a degree (any degree) within four years after high school graduation. Lastly, students in the economically disadvantaged student group had lower odds of persistence to year two and three and retention to year two and three. Fourteen percent of the variation in retention to year two (R^2 = .14) and 22 percent of the variance in retention to year three (R^2 = .22) is associated with variance in the variables in these final models.

The probability of graduating within four years of high school graduation (any degree) was found to be significantly associated with the number of advanced courses taken in high school, enrollment status at entry (part-time/full-time), the type of institution (2- versus 4-year), institution sector (public versus private), and whether a student is part of the historically underperforming student group. Holding other significant explanatory variables constant, the odds for postsecondary graduation within four years of high school completion are 3.16 times higher for students who had an initial full-time entry status and 1.22 times higher for students who enrolled in 4-year institutions at entry. The odds of graduation within four years are 1.7 times higher for students who attended a private institution compared to a public institution. For postsecondary graduation within four years, holding all other significant explanatory variables constant, the significant effect of the number of advanced courses taken in high school remains. The odds of a student graduating within four years of high school graduation increases by a factor of 1.1 when the number of advanced courses increases by one. Seventeen percent of the variation in graduation within four years is associated with variation in the variables in this model (R^2 = .17).

For all final models, students in the historically underperforming and economically disadvantaged student groups had a lower probability ($p < .0001$) of on-time high school graduation, postsecondary enrollment, persistence, retention, and postsecondary graduation within four years of high school completion when compared to other students. There were no significant effects found based on ethnicity when controlling for other explanatory variables. There were a few significant differences based on geographical region. For postsecondary enrollment, students from suburban regions had higher odds of postsecondary enrollment when compared to students from other regions. For persistence to year two and year three, and graduation within four years of high school completion, students from urban regions had lower odds of persistence and graduation within four years of high school completion.

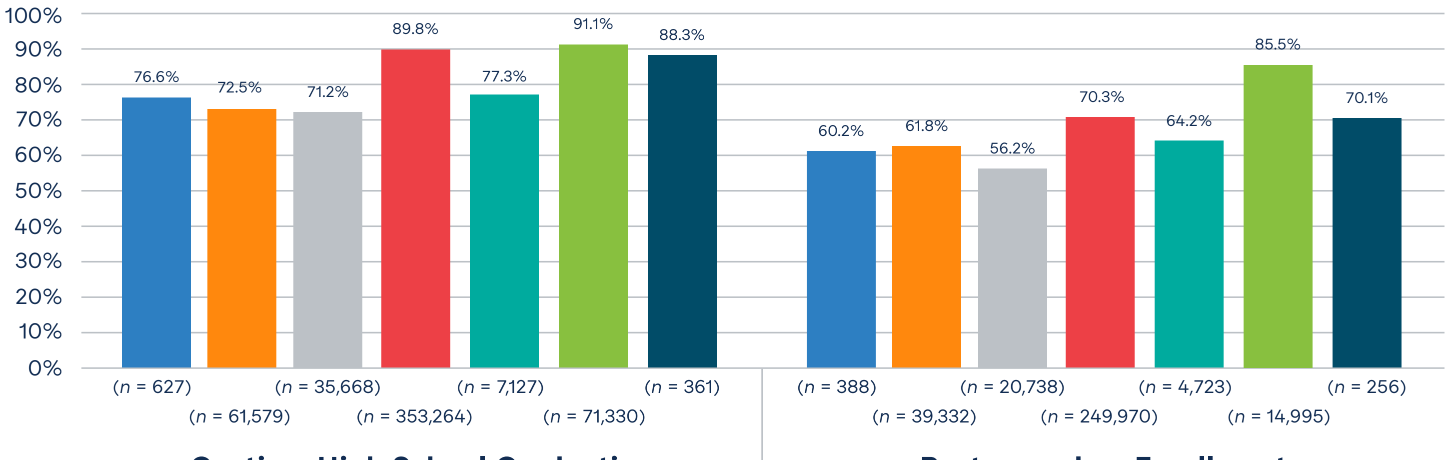
The prediction accuracy for a favorable outcome (on-time high school graduation, postsecondary enrollment, persistence, retention, and graduation within four years) based on the final models for the 9th grade cohorts varied, but all had a prediction accuracy of over 90 percent for a favorable outcome. All models had a reasonably high or high level of sensitivity, predicting a favorable outcome for students.

Are there some racial/ethnic or geographic populations (rural/urban) doing better or worse than others in terms of educational attainment?

Racial/ethnic Student Group Differences in Education Attainment

Chi-square analyses indicate a significant difference in rates of on-time, 4-year high school graduation and postsecondary outcomes based on Race/Ethnicity. As Figures 38–41 show, the largest effects (moderate associations) were found for on-time high school graduation and postsecondary graduation within four years of high school completion. The differences between racial/ethnic student groups were also statistically significant for postsecondary enrollment, persistence, and retention, however the effects were small. Asian students, closely followed by White and Native Hawaiian/Other Pacific Islander students, had the highest rates of on-time high school graduation (91.1%, 89.9%, and 88.3%, respectively), while Hispanic students (71.2%) and Black or African American students (72.5%) had the lowest on-time graduation rates. The difference between the groups was statistically significant (χ^2 (6, N = 557,875) = 26366.145, $p < .001$), with a moderate effect (ϕ = .217). Comparably, Asian, White, and Native Hawaiian/Other Pacific Islander students also had the highest rates of postsecondary enrollment (85.5%, 70.3%, and 70.1%, respectively), while Hispanic students (56.2%) and Black or African American students (61.8%) again were among the lowest postsecondary enrollment rates along with students in the Multi-racial (60.2%) ethnic category. Again, the difference between the groups was statistically significant (χ^2 (6, N = 481,930) = 6866.896, $p < .001$), but the effect for postsecondary enrollment was small (ϕ = .119). Among students who persisted to year two and year three of college, Asian, White, and Native Hawaiian/Other Pacific Islander students again had the highest rates, while Black or African American students had the lowest rates of persistence. The differences in rates between racial/ethnic student groups gradually but consistently widened. Among those who graduated within four years of high school completion, White and Asian students had the highest rates (51.2%, and 50.1%, respectively), while Black/African American and Hispanic students had the lowest rates (20.3% and 28.2%, respectively). The difference between the groups for graduation within four years following high school graduation was statistically significant (χ^2 (6, N = 73,503) = 3292.464, $p < .001$), and the effect was moderate (ϕ = .21).

FIGURE 38. On-Time High School Graduation and Postsecondary Enrollment by Race/Ethnicity

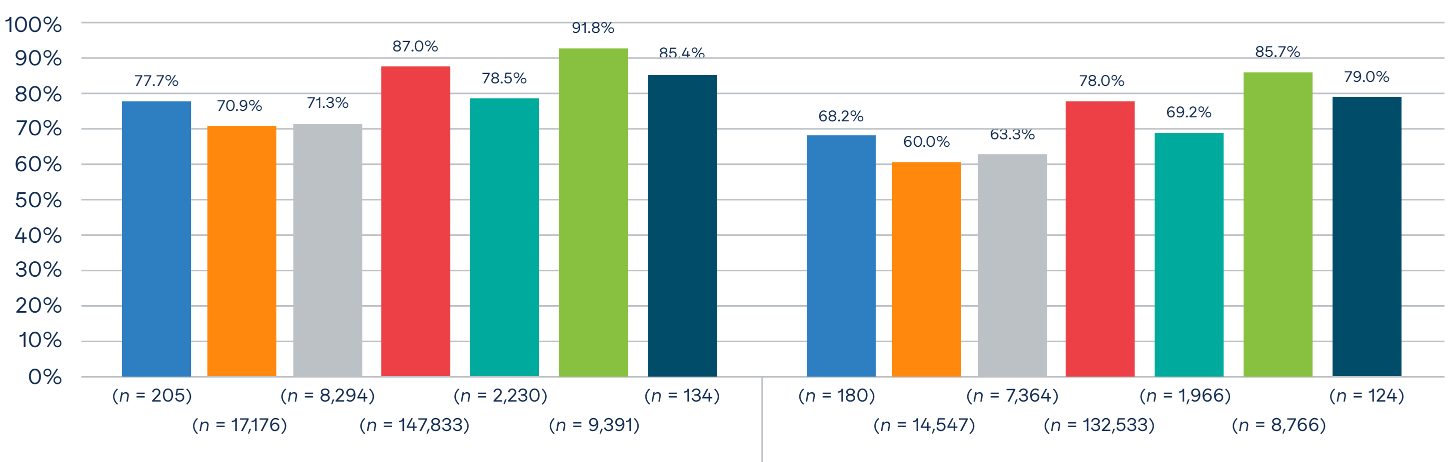


On-time High School Graduation
X^2 (6, *N* = 557,875) = 26366.145, $p < .001$, ϕ =.217)

Postsecondary Enrollment
X^2 (6, *N* = 481,930) = 6866.896, $p < .001$, ϕ =.119)

- American Indian/Alaskan Native
- Black or African American
- Hispanic (any race)
- White
- Multi-Racial (not Hispanic)
- Asian
- Native Hawaiian or Other Pacific Islander

FIGURE 39. Persistence and Retention to Year 2 by Race/Ethnicity



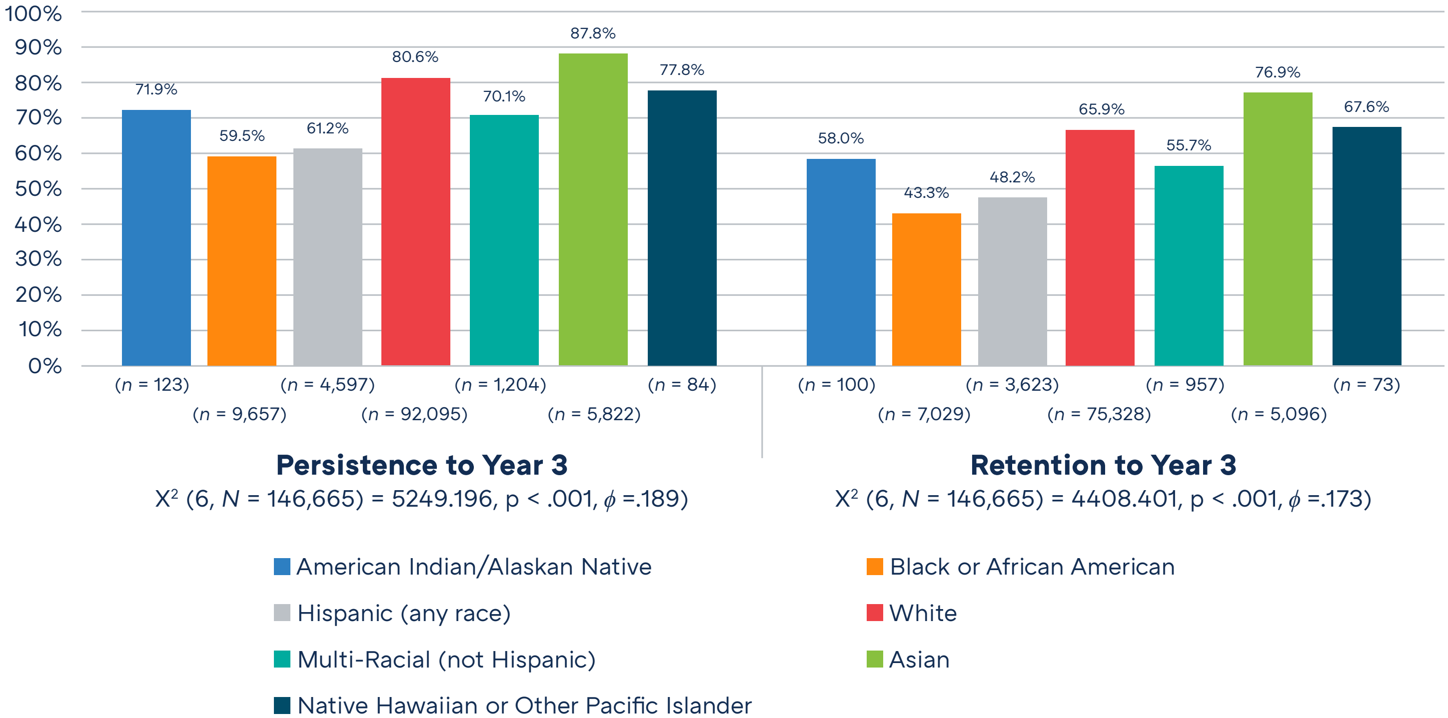
Persistence to Year 2
X^2 (6, *N* = 219,264) = 26366.145, $p < .001$, ϕ =.170)

Retention to Year 2
X^2 (6, *N* = 219,264) = 5290.520, $p < .001$, ϕ =.155)

- American Indian/Alaskan Native
- Black or African American
- Hispanic (any race)
- White
- Multi-Racial (not Hispanic)
- Asian
- Native Hawaiian or Other Pacific Islander

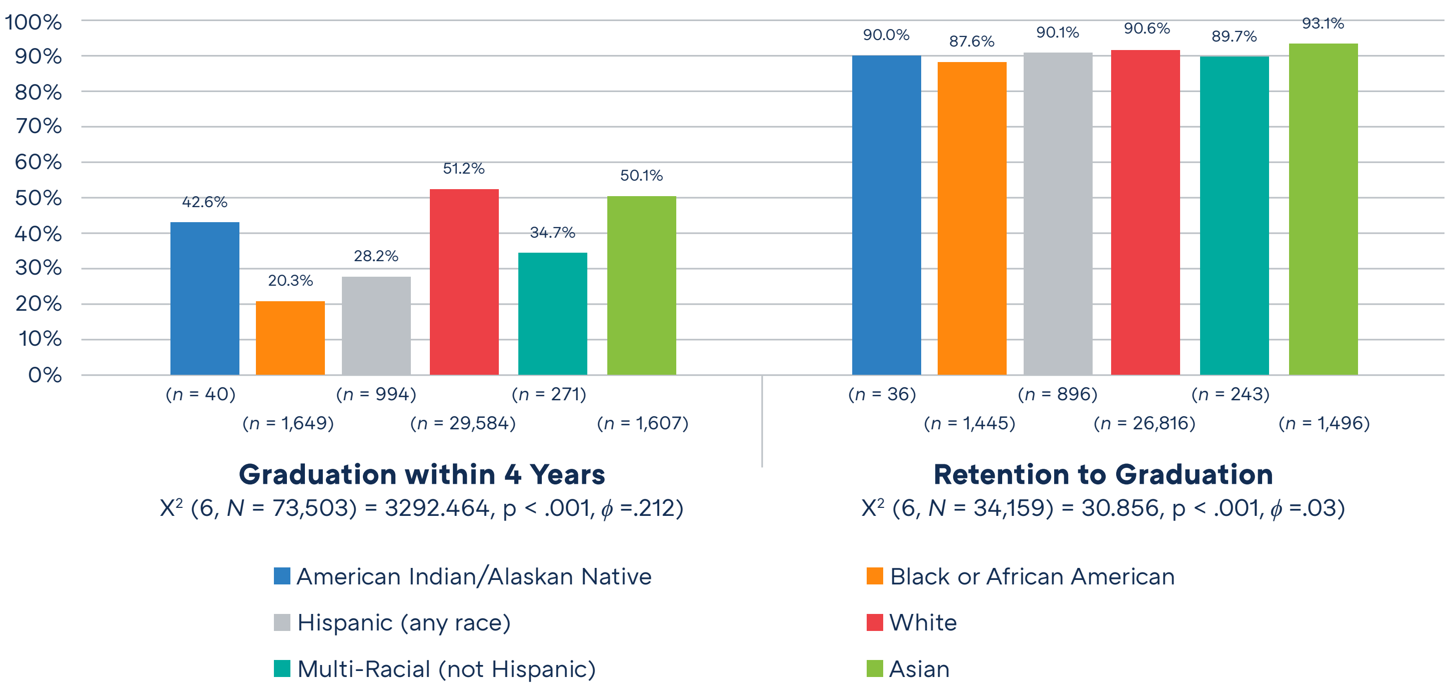
Note: This graph contains 9th grade cohorts only.

FIGURE 40. Persistence and Retention to Year 3 by Race/Ethnicity



Note: This graph contains the 9th grade 2010/11 & 9th grade 2011/12 cohorts only.

FIGURE 41. Persistence and Retention to Graduation by Race/Ethnicity



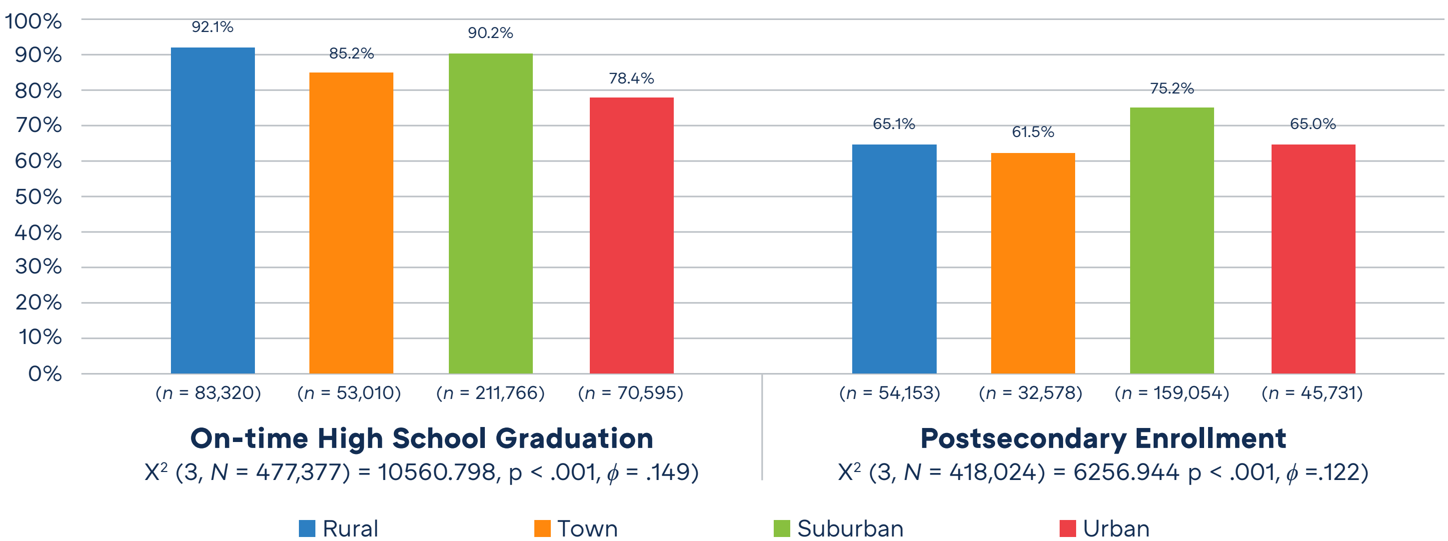
**This graph represents only those from the 9th grade 2010/11 cohort who entered college in the fall immediately following their HS graduation and could be followed to postsecondary graduation within four years.*
Note: Percentage for Native Hawaiian/Other Pacific Islander could not be provided (n < 20).

Differences in Educational Attainment based on Geographical Region

A small effect was found for differences in educational attainment based on geographical region (see Figures 42–43). For on-time high school graduation, students from high schools in urban (city) regions had a significantly lower on-time graduation rate when compared to students from other regions in the state with 78.4 percent graduating on-time versus 92.1 percent for students from rural regions, 90.2 percent for students from suburban regions, and 85.2 percent for students from towns. This difference between geographic regions was statistically significant, χ^2(3, N = 477,377) =10560.798, p < .001, but the effect was small (ϕ = .149).

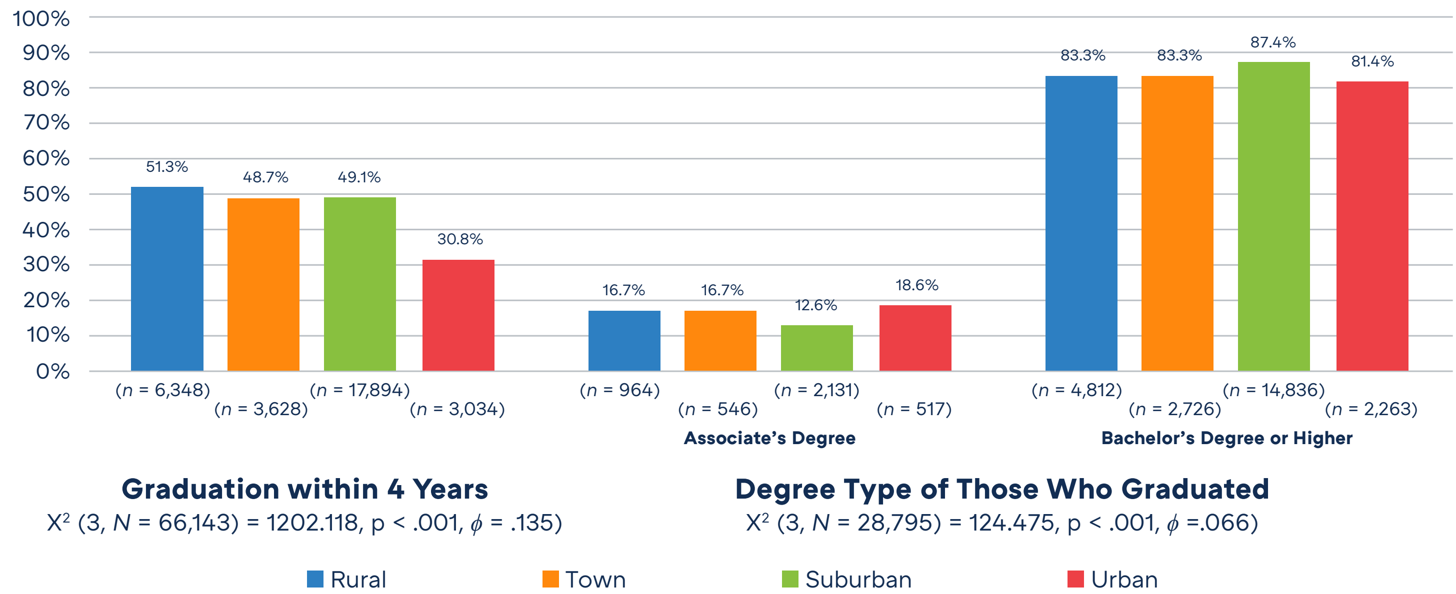
For postsecondary enrollment, students graduating from suburban high schools had significantly higher rates of postsecondary enrollment when compared to students from other regions in the state. Among the 211,552 students in suburban regions, 75.2 percent (*n*=159,054) enrolled in a postsecondary institution following high school graduation, compared to 65.1 percent from rural regions, 65 percent from urban regions, and 61.5 percent from towns. This difference in proportions was also found to be statistically significant (χ^2(3, N = 418,024) = 6256.944, p < .001), but also with a small effect (ϕ = .122).

FIGURE 42. On-Time High School Graduation & Postsecondary Attainment based on Geographical Region



As Figure 43 shows, similar to regional differences for on-time high school graduation, students who graduated from high schools in urban regions had much lower rates of postsecondary graduation within four years (30.8%) when compared to students who graduated from high schools in other geographic regions in the state. The difference between geographic regions was statistically significant (χ^2 (3, N = 66,143) = 1202.118, p < .001), but the effect was small (ϕ = .135). The differences between geographical regions in degree type at graduation within four years are not large (small effect ϕ=.066), with students from suburban high schools graduating with a slightly higher percentage of bachelor's degree.

FIGURE 43. Educational Attainment based on Geographical Region



Overview of Differences by Geographical Region

Across all regions, rates of on-time high school graduation were high, but the highest for students from rural regions and significantly lower for students from high schools in urban regions. The rate of postsecondary enrollment for students graduating from high schools in suburban regions was significantly higher than students from all other geographical regions.

Across all outcomes, students from rural and suburban regions consistently had the highest rates of success. However, students of urban regions consistently had lower rates on measures of educational attainment in this study. The rate of postsecondary enrollment for students from urban regions was comparable to those of students of rural regions and towns, however, the rate of postsecondary graduation within four years was much lower than students from other regions, with rates of graduation within four years that were similar.

What are the retention rates for students attending Pennsylvania colleges? Are there differences by sector (public/private; 2-year/4-year)?

We do not have access to data for all students who attend postsecondary institutions in Pennsylvania. Therefore, analysis of data for these questions was limited to PA high school graduates only who enrolled in postsecondary education following high school graduation.

Persistence and Retention: 2-Year and 4-Year Institutions

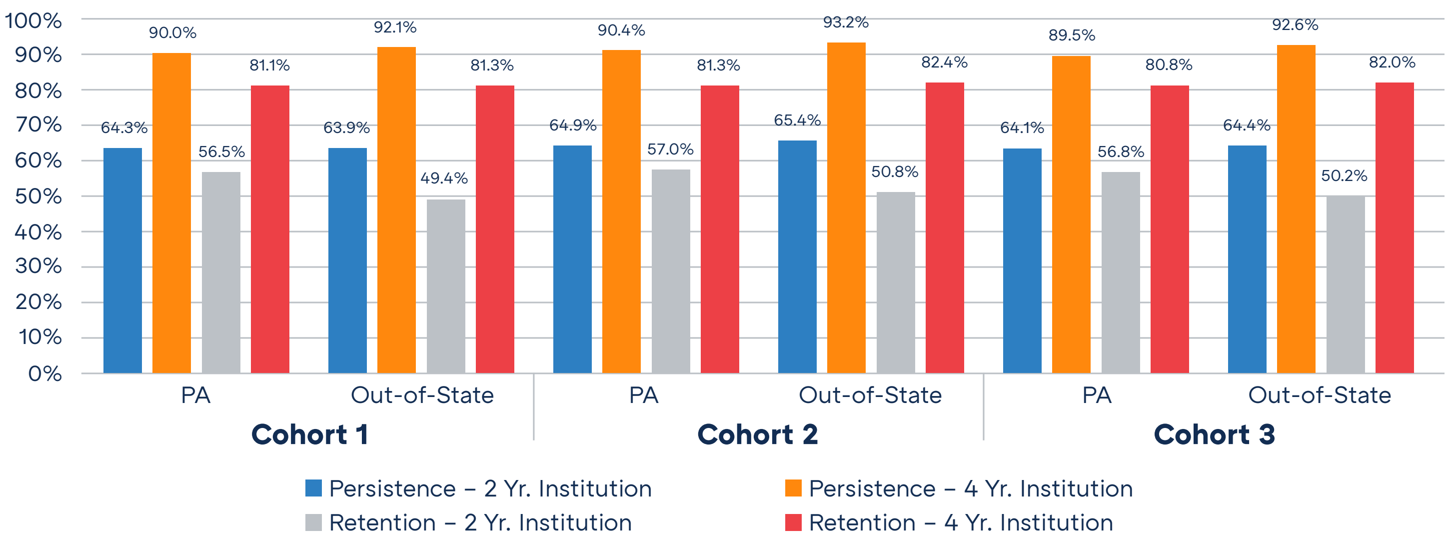
Descriptive analyses were conducted to assess postsecondary retention and persistence rates to year two, year three, and graduation among Pennsylvania high school graduates who attended postsecondary 2- and 4-year institutions. Additionally, data were analyzed to allow for comparisons between students who attended Pennsylvania institutions versus those who attended out-of-state institutions.

Figure 44 shows that the overall rates of persistence to year two were comparable for students who attended in-state and out-of-state 2-year institutions. Across all student cohorts, the percentage of students who persisted to their second year at a 2-year institution ranged from 63.9 percent to 65.4 percent. Students attending 4-year institutions persisted from year one to year two at a slightly higher rate when they attended out-of-state institutions.

In-state students who attended 4-year institutions returned for a second year between 89.5 percent to 90.4 percent of the time, whereas out-of-state students returned 92.1 percent to 93.2 percent of the time, although this varied slightly by cohort. For retention to year two, trend-level data indicates students at 2-year Pennsylvania institutions returned for year two more often than students who attended out-of-state institutions. Conversely, retention rates for 4-year institutions were comparable for students who attended Pennsylvania institutions and out-of-state institutions; these values ranged from 80.8 percent–82.0 percent, varying slightly by cohort.

Across all cohorts, the rates of persistence to year two for students attending PA 2- and 4-year institutions are much higher than the rates for retention to year two for these students. Further, the persistence and retention rates for PA high school graduates attending 4-year institutions in PA are much higher than the rates for students attending 2-year institutions.

FIGURE 44. Postsecondary Persistence and Retention to Year 2 for 2- and 4-Year Institutions: PA vs. Out-of-State



Postsecondary Persistence and Retention to Year Three for 2- and 4-Year Institutions: PA vs. Out-of-State

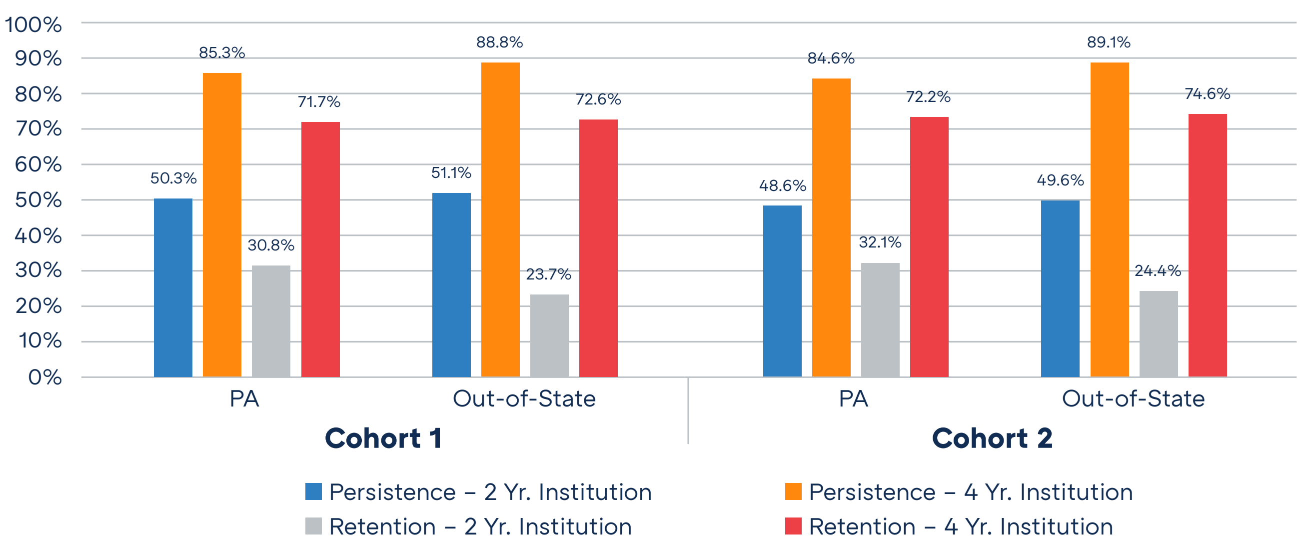
Only two 9th grade cohorts could be followed through entry into their third year of postsecondary education to provide information for persistence and retention to year three. Although it may not seem logical to examine differences in persistence and retention to year three for students who enrolled in 2-year institutions at entry because one might conclude that students who enrolled in a 2-year institution should exit postsecondary after the completion of a 2-year degree (after year two potentially) or transfer to a 4-year institution to continue their education, this was not observed among students in these cohorts. Only a small percentage of students (26%) who began at a 2-year institution at entry into postsecondary earned a degree (any degree) within four years after high school graduation. Therefore, descriptive analysis to examine differences in persistence and retention to year three between students who initially enrolled in 2 versus 4-year institutions at entry are described here.

Similar to descriptive statistics for persistence and retention to year two, across all cohorts, the rates of persistence to year three for students attending PA 2- and 4-year institutions are much higher than the rates for retention to year three for these students (see Figure 45). Further, the persistence and retention rates for PA high school graduates attending 4-year institutions in PA are much higher than the rates for students attending 2-year institutions.

Year three persistence rates at 2-year institutions ranged from 48.6 percent - 51.1 percent. Like year two persistence rates, there were not notable differences in persistence to year three between students who attended Pennsylvania institutions and those who attended out-of-state institutions. In-state and out-of-state persistence rates were less comparable among students who attended 4-year institutions. Students in the first cohort who attended Pennsylvania institutions returned for a third-year 85.3 percent of the time, whereas out-of-state students returned 88.8 percent of the time. Similarly, in-state students in the second cohort returned 84.6 percent of the time, while their out-of-state peers returned 89.1 percent of the time. While differences in rates of persistence were more visible among students who attended 4-year institutions, it is worth noting that even these differences were small.

There was a more noticeable difference for in-state and out-of-state retention among students who attended 2-year institutions. Specifically, retention rates were higher for students who attended 2-year Pennsylvania institutions versus out-of-state. Students from cohort 1 and cohort 2 returned to the same postsecondary Pennsylvania institution 30.8 percent and 32.1 percent of the time, respectively, whereas only 23.7 percent (cohort 1) and 24.4 percent (cohort 2) of students from out-of-state institutions returned. While retention rates were much higher at 4-year institutions than 2-year institutions, there was less variation between in-state and out-of-state institutions.

FIGURE 45. Postsecondary Persistence and Retention to Year 3 for 2- and 4-Year Institutions: PA vs. Out-of-State

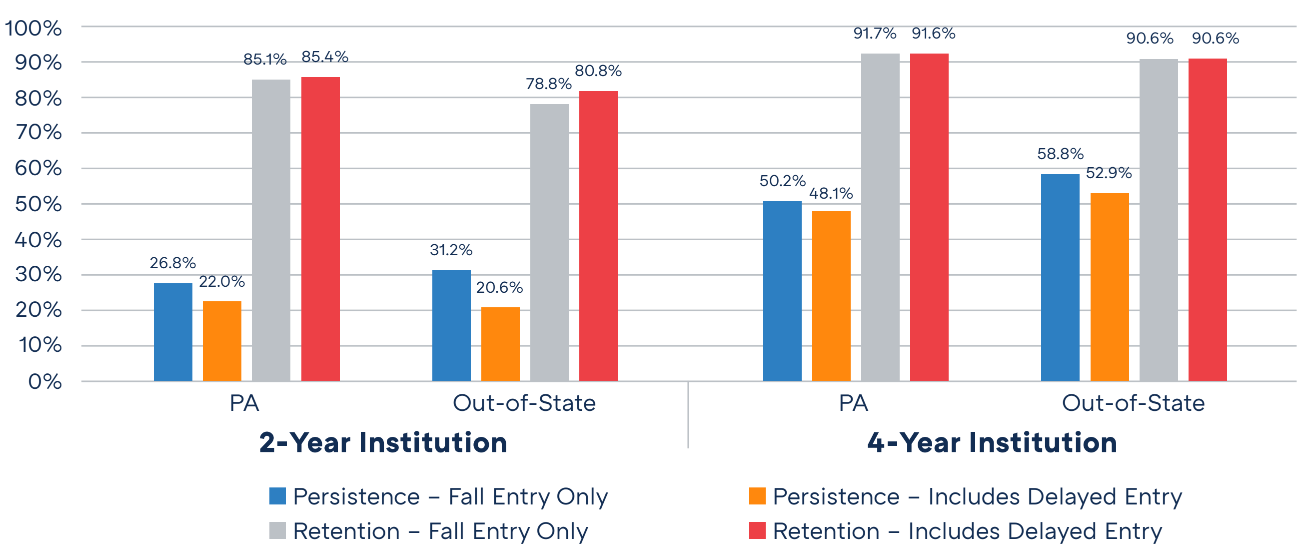


Postsecondary Persistence and Retention to Graduation within four years of high school completion for 2- and 4-Year Institutions: PA vs. Out-of-State

Only one 9th grade cohort could be followed from on-time high school graduation through postsecondary graduation within four years. Figure 46 shows that among students who entered a 2-year Pennsylvania postsecondary institution in the fall following their high school graduation, 26.8 percent graduated with a degree (any degree) within four years of high school completion, compared to 31.2 percent of students who attended 2-year out-of-state, postsecondary institutions. When students who delayed entry into postsecondary were included in the descriptive analysis, this trend was reversed. Specifically, a slightly higher percentage of Pennsylvania students graduated within four years than out-of-state students. At 4-year institutions the percentage of students who graduated within four years was higher among students who attended out-of-state institutions, regardless of whether they delayed postsecondary entry. Half of Pennsylvania students (50.2%) who entered a 4-year postsecondary institution in the fall following high school graduated within four years, compared to 59 percent of students who attended out-of-state institutions. When students who delayed entry to postsecondary were included in the analysis, the difference between in-state and out-of-state is slightly smaller with 48.1 percent of students who attended 4-year Pennsylvania institutions graduating within four years of high school completion compared to 52.9 percent of students who attended out-of-state institutions.

Regarding whether students graduated from the same institution they began (retention to graduation), the number of students who returned to the same institution through graduation was notably higher at 2-year Pennsylvania institutions than 2-year out-of-state institutions. This trend was especially evident when comparing students who entered postsecondary in the fall and attended a 2-year Pennsylvania postsecondary institution (85.1%) to students who entered an out-of-state 2-year postsecondary institution in the fall (78.8%). A similar trend was evident when students who delayed entry were included in the analysis. Specifically, 85.4% of students who attended Pennsylvania institutions returned to the same 2-year university to graduation, whereas 80.8% of students who attended out-of-state 2-year institutions returned to the same university and graduated. Despite the trends identified at 2-year institutions, retention to graduation rates were comparable at 4-year institutions, regardless of when students entered or whether they attended a Pennsylvania or out-of-state institution.

FIGURE 46. Postsecondary Persistence and Retention to Graduation for 2- and 4-Year Institutions: PA vs. Out-of-State



Persistence and Retention: Public and Private Institutions

Descriptive analyses were conducted to assess retention and persistence to year two, year three, and graduation within four years for Pennsylvania students who attended private and public postsecondary institutions. Data were analyzed to also allow for comparisons between students who attended Pennsylvania institutions and those who attended out-of-state institutions.

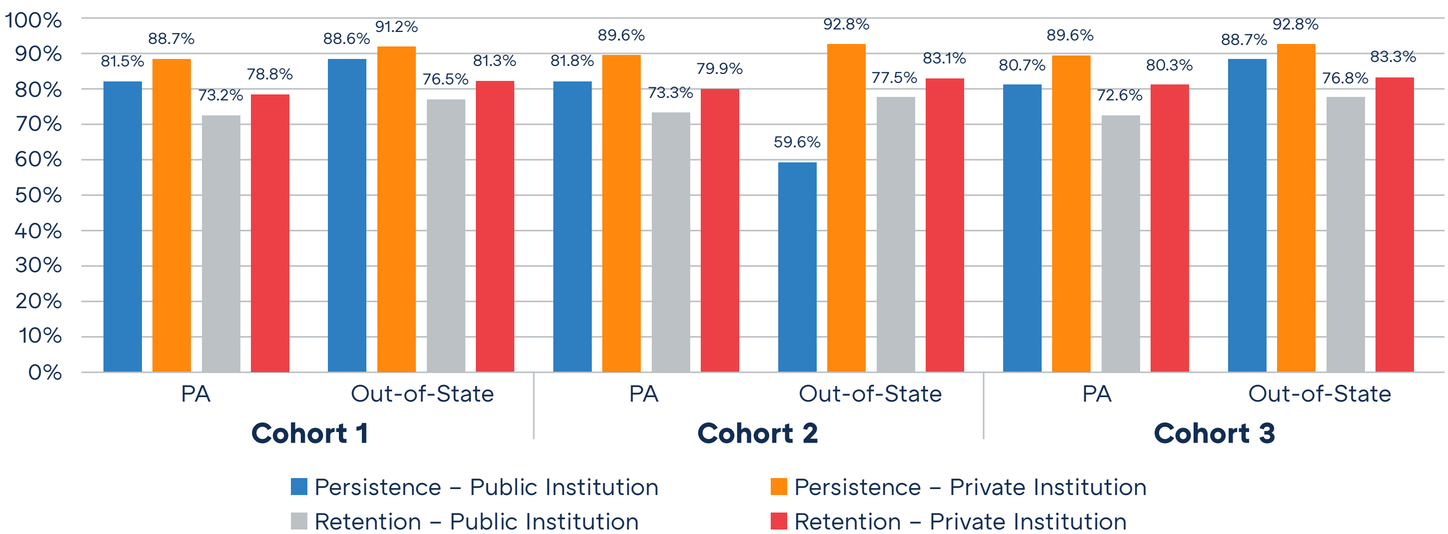
Postsecondary Persistence and Retention to Year 2 for Public and Private Institutions: PA vs. Out-of-State

Overall, descriptive results indicate persistence to year two was slightly higher at private institutions and out-of-state institutions (see Figure 47). A closer look at the data reveals that students who attended public, out-of-state institutions had higher rates of persistence than students who attended public institutions in Pennsylvania. Across cohorts, 88.6 percent to 89.6 percent of students at public, out-of-state institutions persisted to year two, compared to 80.7 percent to 81.8 percent of students who attended public, Pennsylvania institutions. Students at private, out-of-state institutions also persisted to year two at slightly higher rates (91.2% - 92.8%) than students at private, in-state institutions (88.7% - 89.6%).

Similar to the trends identified for persistence, retention rates to year two were higher among students who attended private out-of-state institutions. Across cohorts, students who attended public out-of-state institutions returned to the same institution for year two at slightly higher rates than students who attended public institutions in Pennsylvania. Retention rates at public out-of-state institutions ranged from 76.5 percent - 77.5 percent compared to rates of 72.6 percent to 73.3 percent for students attending public Pennsylvania institutions.

Overall, and across all cohorts, the persistence and retention rates to year two were slightly higher for PA high school graduates attending private postsecondary institutions in PA than for students attending public postsecondary institutions in PA. Further, the rates for persistence are higher than the rates for retention for students attending postsecondary institutions in PA.

FIGURE 47. Postsecondary Persistence and Retention to Year 2 for Public and Private Institutions: PA vs. Out-of-State



Postsecondary Persistence and Retention to Year Three for Public and Private Institutions: PA vs. Out-of-State

Similar to persistence and retention to year two, and across all cohorts, the persistence and retention rates to year three were slightly higher for PA high school graduates attending private postsecondary institutions in PA than for students attending public postsecondary institutions in PA. Further, the rates for persistence are higher than the rates for retention for students attending postsecondary institutions in PA (see Figure 48).

In general, persistence and retention rates to year three were higher among students who attended out-of-state institutions and private institutions. Across cohorts 1 and 2 a higher percentage of students who attended out-of-state institutions returned for their third year at the same postsecondary institution they began. The difference in retention rates between in-state and out-of-state institutions was more pronounced for public institutions. Students in the first and second cohorts who attended public PA institutions returned for their third year in postsecondary 74.1 percent and 72.6 percent of the time, respectively. Comparatively, 84.3 percent (first cohort) and 84.4 percent of students (second cohort) who attended public, out-of-state institutions returned for their third year. Though the difference between Pennsylvania and out-of-state persistence rates was less pronounced, a similar trend was evident for private institutions.

Retention rates were higher among students who attended out-of-state institutions and private institutions, regardless of cohort. Within cohort 1 approximately 59% of students who attended public Pennsylvania institutions returned to their postsecondary institution for year three, while 65.6% of students who attended public, out-of-state institutions returned for year three. The difference in retention rates was similar for cohort 2. For private institutions, out-of-state retention rates were also slightly higher than retention rates at Pennsylvania institutions. At Pennsylvania institutions, 67.7 percent and 69.5 percent (cohort 1 and cohort 2, respectively), of the students returned for year three compared to 72.2 percent and 74.9 percent (cohort 1 and cohort 2, respectively) of students who attended out-of-state postsecondary institutions. Overall, retention rates were higher at private institutions than public institutions for both students attending PA institutions of higher education and students attending out-of-state institutions.

Postsecondary Persistence and Retention to Graduation for Public and Private Institutions: PA vs. Out-of-State

As Figure 49 shows, PA high school graduates, regardless of time of entry, attending private institutions in PA had higher rates of persistence than those attending public institutions. The retention rates for PA students attending postsecondary institutions in PA were similar regardless of time of entry and institution sector. Overall, however, rates of postsecondary graduation within four years of high school completion were higher when students who delayed entry into postsecondary are excluded.

Among PA high school graduates who entered postsecondary in the fall immediately following high school completion, a higher percentage of students graduated within four years of high school completion when they attended public, out-of-state institutions (51.6%) than public Pennsylvania institutions (39.7%). However, compared to public institutions, a higher percentage of students graduated within four years of high school graduation when they attended private in-state (58.0%) or out-of-state (62.1%) postsecondary institutions.

Regardless of whether the institution was public or private, results indicate a high percentage of students, between 88.3 percent to 91.9 percent, graduated from the same institution where they began. While there was virtually no difference between private in-state and out-of-state institutions, retention rates were slightly higher at public, in-state institutions (90.2%) than public, out-of-state institutions (88.3%).

FIGURE 48. Postsecondary Persistence and Retention to Year 3 for Public and Private Institutions: PA vs. Out-of-State

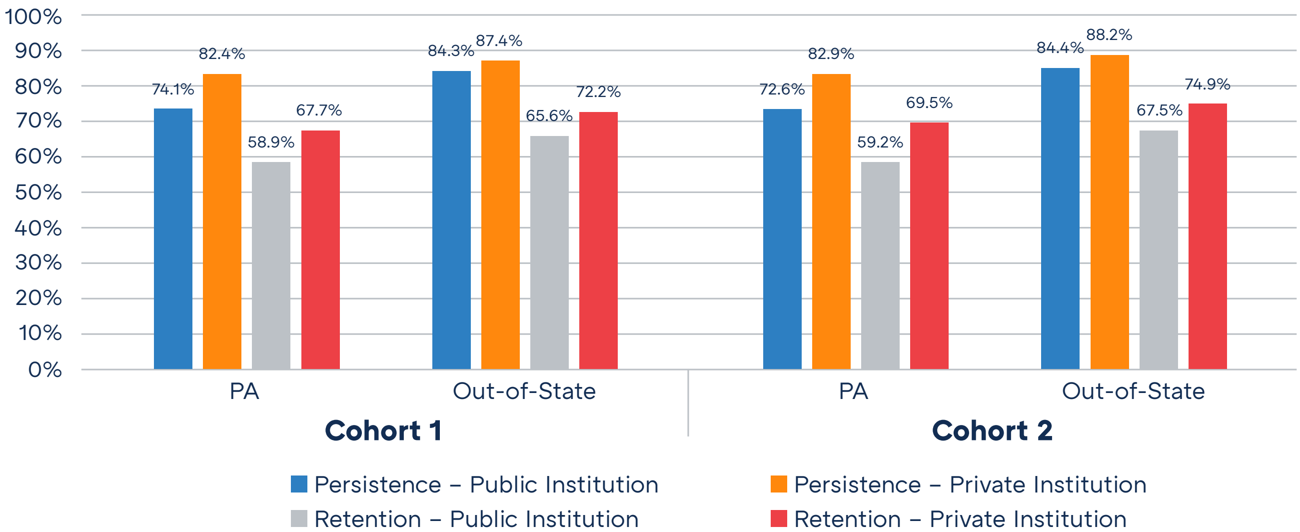
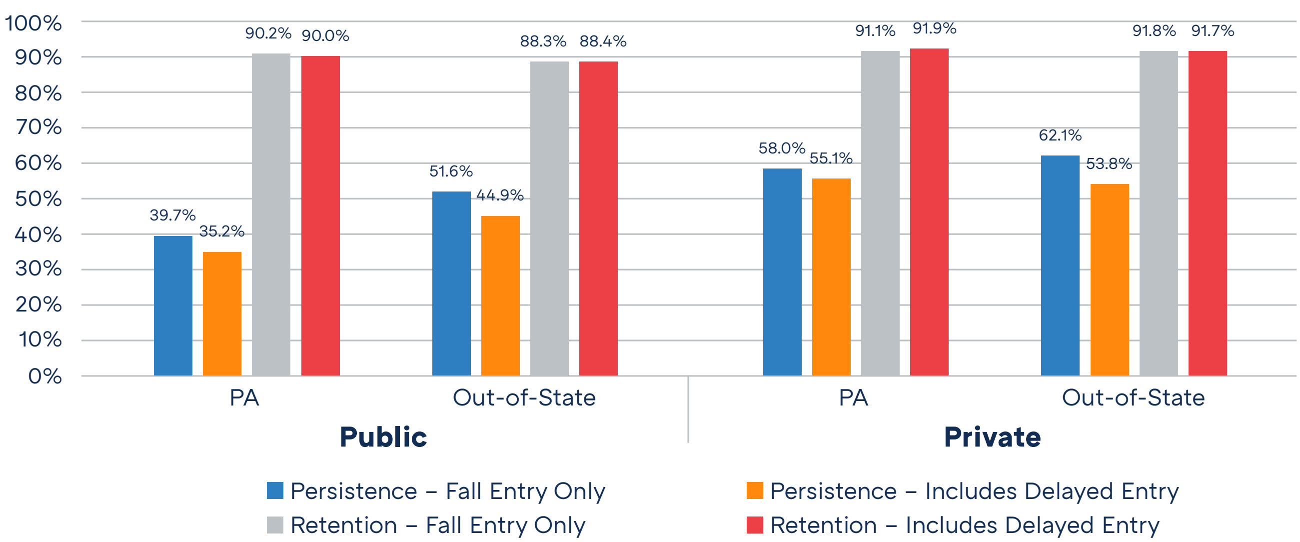


FIGURE 49. Postsecondary Persistence and Retention to Graduation for Public and Private Institutions: PA vs. Out-of-State



Note: Retention to graduation is the percentage of students who graduated from the same college they began for those students who graduated within four years of high school graduation.

Persistence and Retention Overall Differences: Year two, year three and graduation within four years of high school completion (no state comparisons)

Chi-square analyses were used to investigate differences in persistence and retention rates between institution types and enrollment status. Specifically, persistence and retention rates were compared for 2- and 4-year institutions, public and private institutions, and part-time and full-time enrollment status at entry into postsecondary.

Postsecondary Persistence and Retention to Year Two Based on Institution Type and Enrollment Status

A comparison of postsecondary persistence to year two showed statistically significant differences between students who attended 2-year institutions at entry versus students who attended 4-year institutions (χ^2 (1, N = 217,589) = 19,773.89, p < .001) with moderate effects (ϕ = .30). Approximately 91 percent of students who began at 4-year institutions persisted to year two, compared to only 64.5 percent of students who began at 2-year institutions. Retention to year two was significantly higher, with a moderate effect, among students who began enrollment at 4-year institutions (χ^2 (1, N = 217,589) = 12,623.40, p < .001; ϕ = .24, p < .001). Eighty-one percent of students who attended 4-year institutions at entry returned to the same institution for year two, yet only 56.4 percent of students attending 2-year institutions returned to their same institution.

A comparison of students based on institution sector at entry revealed that students who began at private institutions (90.2%) had slightly higher rates of persistence to year two than students at public institutions (82.5%). Though the difference in proportions was statistically significant (χ^2 (1, N = 217,589) = 2,058.33, p < .001), the effect was small (ϕ = .10). Retention rates to year two were also significantly different between students who attended public and private institutions (χ^2 (1, N = 217,589) = 1,130.22, p < .001), however the effect was small (ϕ = .07). Specifically, a slightly larger percentage of students who began at private institutions (80.5%) returned for their second year than students who began at public institutions (73.7%).

Students who enrolled in postsecondary full-time had higher rates of persistence and retention to year two than students who had an initial part-time enrollment status. Eighty-nine percent of students persisted to year two when they were enrolled full-time, compared to only 55 percent of students who enrolled part-time initially. The difference in proportions is statistically significant (χ^2 (1, N = 204,632) = 16,998.27, p < .001) and the strength of the relationship between enrollment status at entry and persistence to year two was moderate (ϕ = .29). A significantly higher percentage of students who enrolled full-time (80.5%) initially also returned to the same institution for year two when compared to students who enrolled part-time (47.0%) initially. The difference in proportions was statistically significant (χ^2 (1, N = 204,632) = 10,713.12, p < .001) and with a moderate effect (ϕ = .23).

Postsecondary Persistence and Retention to Year Three Based on Institution Type and Enrollment Status

The chi-square analysis examining persistence to year three revealed that 85.8 percent of students (n = 97,195) enrolled in 4-year institutions initially persisted to year three, compared to only 49.5 percent (n

= 16,128) of students who enrolled in 2-year institutions initially. The difference between these groups was significant (χ^2 (1, N = 145,878) = 191,182.09, p < .001) and the association between the variables was large (ϕ = .36). Retention to year three was also higher among students who enrolled initially at 4-year institutions than students who enrolled at 2-year institutions. Specifically, retention to year three for students who enrolled at 4-year institutions initially was 72.3 percent (n = 81,923), compared to only 31 percent (n = 10,094) for 2-year institutions. The difference in retention to year three was statistically significant (χ^2 (1, N = 145,878) = 18,532.70, p < .001) and the strength of the association was large (ϕ = .36).

Although the difference between initial enrollment in a 2-year versus 4-year institution was large, the difference for private and public enrollment is small comparatively. Approximately 84 percent of students who enrolled in private institutions initially persisted to year three compared to 75 percent of students who enrolled in public institutions initially. While the difference in persistence to year three was statistically significant (χ^2 (1, N = 145,878) = 1,469.84, p < .001), the strength of the association was small (ϕ = .10). For retention to year three, there was also a statistically significant difference between students who enrolled initially at public versus private institutions (χ^2 (1, N = 145,878) = 1,257.91, p < .001). The retention rate to year three was 70 percent for students who initially enrolled at private institutions versus 60.2 percent for public institutions. The strength of the association was small (ϕ = .09).

The relationship between persistence to year three and enrollment status was significant (χ^2 (1, N = 137,284) = 11,330.68, p < .001) and the effect was moderate (ϕ = .29). Close to 83 percent of PA high school graduates who entered postsecondary at full-time status (n = 103,228) persisted to year three, while only 42.2 percent (n = 5,301) of students who enrolled with a part-time status initially persisted to year three. Retention rates to year three were also significantly higher among students who entered at full-time status than part-time students. Among full-time students, 67.9 percent returned to their same institution for year three compared to only 30.5 percent of students who entered initially part-time. This association was statistically significant (χ^2 (1, N = 137,284) = 6,989.45, p < .001) and the strength of the association was moderate (ϕ = .23, p < .001).

Postsecondary Persistence and Retention to Graduation Based on Institution Type and Enrollment Status

Similar to results for persistence and retention, moderate effects for 2- versus 4-year institution type at entry and enrollment status at entry were found for graduation within four years after high school completion. A larger percentage of students who enrolled at 4-year institutions initially were reported to have graduated when compared to students who enrolled at 2-year institutions at entry (χ^2 (1, N = 73,389) = 3,200.55, p < .001). Graduation rates within four years of high school graduation for students who enrolled at 4-year institutions at entry was 52 percent (n = 29,606), compared to only 27 percent (n = 4,472) among students who enrolled at 2-year institutions at entry into postsecondary. The strength of the association was moderate (ϕ = .21). A larger proportion of students with full-time status (50.5%) at entry graduated within four years compared to part-time status (14.7%) at enrollment. This difference was also statistically significant with a moderate effect (χ^2 (1, N = 69,178) = 3,019.36, p < .00; ϕ = .21).

Similar to graduation within four years, a significantly higher percentage of students who enrolled at a 4-year institution initially (91.5%) graduated from the same college they began compared to students who began at a 2-year institution (84.7%), χ^2 (1, N = 34,159) = 211.55, p < .001. The strength of the association was small (ϕ = .08).

For graduation from the same college, the effect was also statistically significant for enrollment status at entry (χ^2 (1, N = 69,253) = 133.78, p < .0001). Ninety-one percent of students who enrolled full-time at entry graduated from the same institution they began compared to 76.2 percent of students who enrolled part-time at entry. The strength of this association was small (ϕ = .064).

Lastly, graduation rates within four years of high school graduation and the percentage of students who remained at the same institution from entry to graduation were also higher for students who enrolled in private institutions versus public institutions initially (59.2% versus 41.2% and 91.5% versus 89% respectively). Although the difference in graduation within four years of high school completion is large enough to be statistically significant (χ^2 (1, N = 73,389) = 1,980.69, p < .001, the effect was small (ϕ = .16).

Conclusions

Brown & Conley (2007) define “College Readiness” as the level of preparation a student needs in order to enroll and succeed, without remediation, in credit-bearing, general education courses at a postsecondary institution that offers baccalaureate degree program(s) or transfer to a baccalaureate program. For students in PA, the level of preparation from middle through high school in terms of course taking patterns and the resulting degree of preparedness can have huge implications as a measure of positive student outcomes and postsecondary enrollment and success. A student’s high school course taking pattern can define their postsecondary path (Plank, DeLuca, & Estacion, 2008) and advanced high school courses provide curricula that are more challenging academically (Long et al., 2012). Similar to prior research, analysis of data over time for students who graduated from PA high schools showed a large effect and significant association between rigorous and advanced course taking in high school, including advanced algebra, and postsecondary enrollment and success.

The findings from this report indicate that there is a statistically significant effect of rigorous and advanced course taking for students in all cohorts and graduates from PA high schools. The odds of on-time graduation from high school, postsecondary enrollment, persisting to year two and three, remaining at the same college, and graduating within four years of high school completion, increases with each additional rigorous or advanced course taken. Consistent with prior research (Allen & Dadger, 1012; Chajewski, Mattern & Shaw, 2019; Long, Conger & Iatarola, 2012), analysis results showed that enrolling in just one rigorous or advanced course during high school (versus none) has huge implications for educational attainment and is associated with positive outcomes for students. These findings indicate that early college credit opportunities for students through AP or IB programs and dual credit enrollment opportunities are making a difference for students graduating from high schools in PA in terms of defining students’ postsecondary path and success.

Additionally, taking an advanced algebra course during high school, the timing of Algebra I, and Grade 8 PSSA and Keystone performance are all significantly associated with an increase in odds of on-time high school graduation, postsecondary enrollment, persistence and retention, even after controlling for other significant explanatory variables. A significant effect of advanced course taking, advanced algebra enrollment, and Keystone performance for students in our 9th grade cohorts and graduates from PA high schools, remains even after controlling for other significant explanatory variables.

The timing of enrollment in Algebra I was also found to be significantly associated with, and a very important precursor to, the probability of a student enrolling in a postsecondary institution following high school graduation. However, defining early versus late timing for enrollment is important as analysis results suggest that early timing, defined as enrollment in Algebra I in “middle school,” when compared to late timing (high school) has the largest effect with a moderate positive association (ϕ = .24, p < .0001).

Although enrollment in an advanced algebra course, including Algebra II was not originally one of the research questions to be addressed through this study, a dichotomous indicator was developed and tested to determine the effects of enrollment in high school for PA students and examine the extent of the association in comparison to Algebra I. Logistic regression analyses confirmed a significant association between taking an advanced algebra course and postsecondary outcomes. These results are similar to other studies that found that enrollment in Algebra II can influence college outcomes, including persistence and graduation (Gaertner et al., 2013). The effects of taking an advanced algebra course in high school decreased after entry into the second year of postsecondary. Although advanced algebra was found to increase the odds of on-time high school graduation, postsecondary enrollment, and persistence to year two, it had no significant association with persistence to year three, retention to year two and three, or postsecondary graduation within four years of high school completion. Interestingly, although the effect of taking an advanced algebra course in high school diminished over time for the PA students in these cohorts, the significant effect of the number of advanced courses taken in high school remained for all postsecondary outcomes, including graduation within four years of high school completion.

The odds for persistence to both year two and three are significantly higher for students who enroll initially at a full-time status and at 4-year institutions. However, the odds of a student continuing into year three are over three times higher for students who enroll initially at a 4-year institution.

There were a few significant differences based on geographical region. For postsecondary enrollment, students from suburban regions had higher odds of postsecondary enrollment when compared to students from other regions. For persistence to year two and year three, and graduation within four years of high school completion, students from urban regions had lower odds of persistence and graduation with four years of high school completion.

Further, some previous research has found SES to be a weak predictor of academic performance and retention (Westrick, Le, Robbins, Radunzel & Schmidt, 2015). However, our analysis on data for PA students showed that students from the economically disadvantaged student group, as well as students within the historically underperforming student group, had a lower probability of on-time high school graduation, postsecondary enrollment, persistence, retention, and postsecondary graduation within four years of high school completion when compared to other students.

Given the focus on educational improvements that can facilitate the successful transition to postsecondary education, these results can inform state and local policy initiatives that aim to increase the number of students taking advanced and rigorous courses in PA high schools. These factors could lead to a potential increase in the number of students who enroll in postsecondary institutions and persist through degree attainment.

Caveats

Although the magnitude of most of the effects were found to be moderate to large and consistent with prior research, there is still a lot of variance left to explain when predicting on-time high school graduation, postsecondary enrollment, success, and degree attainment within four years of high school graduation. Although the data obtained for this study allowed us to track students longitudinally, the data available to us did not include any information on additional student level or familial characteristics outside of socioeconomic status. Additionally, prior research has shown a strong association between high school GPA and postsecondary outcomes. GPA is not collected as part of the PIMS, therefore could not be tested in our analyses. Further, teacher and school level variables were not included in our analyses but could potentially be examined in the future as part of a secondary analysis of data.

The initial variables considered for inclusion in analytic models included a measure of postsecondary institution selectivity. That data could not be obtained in time for use in this study but may be obtained at a later date for secondary analyses.

Lastly, although course enrollment information is available through PIMS for students in PA schools, information on successful course completion and performance is not available. The inclusion of measures of performance would improve the predictive models and provide a better estimate of the true effects of course taking patterns. Additionally, previous research has shown that rigorous courses taken in different subject areas may have varying effects (Long et al, 2012). Although specific subject areas of rigorous and advanced courses were not a focus of this study, it could be examined in the future.

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Appendix A

Identification of the association between mathematics (specifically Algebra), courses of rigor, as defined by PDE, and student assessment scores, and high school graduation, postsecondary educational access, and success.

Connecting high school student learning outcomes to postsecondary preparation and success.

Identification of significant factors that could potentially affect the achievement gap for student group populations at risk in Pennsylvania schools and postsecondary access and success.

Improvement in the selection and identification of students at risk for attrition.

Direction for future research to guide policy decisions geared toward narrowing the achievement gap and improved completion rates for Pennsylvania students overall and student groups.

Standardized Test Scores
- Grade 7 PSSA Scores
- Grade 8 PSSA Scores
- Keystone

Rigorous Course Taking
- Enrollment in Algebra
- Timing of Algebra
- Enrollment in AP Courses
- IB Course Enrollment
- Dual Enrollment Courses
- Math Course Taking

Postsecondary Factors
- Postsecondary institution type

Additional Variables
- Postsecondary enrollment status
- Special Education Status
- Gender
- Historically Underperforming
- SES
- Ethnicity
- EL

Graduation from High School

Postsecondary Enrollment

Postsecondary Retention
- First-to-second year
- Second-to-third year

Postsecondary Persistence/ Graduation
- Returning to college for 2nd year
- Returning to college for 3rd year
- Graduation status at 4 years

Appendix B

List of Operational Definitions

1. A **Rigorous course** refers to any course defined as such by the Pennsylvania Department of Education (PDE). This includes any course that meets the Pennsylvania reporting standards for Advanced Placement (AP), Dual Credit, or International Baccalaureate (IB). Additionally, a CTE student who has completed 50% or more of their CTE program is included in PDE's definition of rigorous course-taking students.

2. An **Advanced course** refers to any class that meets the listed requirements for a rigorous course or is designated by a PA Local Educational Agency (LEA) as honors or gifted. Because PA LEAs are not required to report honors or gifted courses, totals of such across geographical regions would be incomplete. However, honors and gifted courses that are reported, in addition to rigorous courses, paint a more complete picture of advanced course taking in PA.

3. Postsecondary **persistence** is defined as continued enrollment (or degree completion) at any higher education institution in the fall semesters of a student's first and second year (NSC, 2018).

4. Postsecondary **retention** is defined as continued enrollment (or degree completion) within the same higher education institution in the fall semesters of a student's first and second year (NSC, 2018).

5. **Persistence to Graduation** for the purpose of our study is defined as having graduated within four years from high school completion.

6. **Retention to Graduation** is defined as having graduated from the same higher education institution where a student began.

7. An **Advanced Algebra** course is any algebra course taken beyond the Algebra I (or equivalent) course prerequisite.

Appendix C

Description of Variables for Analytic Models

Variable Type	Description	Data Source
Outcome (Dependent) Variables		
Graduation from High School	• Graduation on time at 4-Years versus Not.	PIMS
Postsecondary Enrollment	• Enrollment versus Not Enrolled. • If enrolled, 2-Year versus 4-Year Institution;	PIMS/NSC
Postsecondary Retention	• First- to second year. • Second- to third year.	PIMS/NSC
Postsecondary Persistence/Graduation	• Returning to college for 2nd year and 3rd year. • Graduation status (Dichotomous variable indicating graduated within four years after high school).	PIMS/NSC
Predictors (Independent Variables)		
Grade 7 PSSA Scores	• Mathematics, and English Language Arts (Scale Score and Performance Levels – Advanced/Proficient versus Not).	PIMS
Grade 8 PSSA Scores	• Mathematics, English Language Arts, and Science (Scale Score and Performance Levels – Advanced/Proficient versus Not).	PIMS
Enrollment in Algebra	• Timing of enrollment: 1) Early versus Late. 2) First enrollment in Grade 8 or not. 3) First enrollment in Grade 11 or not. 4) Enrollment in an advanced algebra course.	PIMS
Enrollment in AP Courses	• Dichotomous variable representing student enrollment in one or more AP courses versus none. • Continuous variable representing the total number of AP courses in which a student enrolled.	PIMS
IB Course Enrollment	• Dichotomous variable representing student enrollment in one or more IB courses versus None. • Total number of IB courses.	PIMS
Participation in Dual Enrollment	• Participated or Not and Total number of dual enrollment courses.	PIMS
Rigorous Course Taking in High School	• The cumulative effects of rigorous course taking in High School based on level of courses: 1) Enrollment in one or more. 2) Total number of AP, IB and Dual Enrollment courses in which a student enrolled.	PIMS
Keystone Passage	• Best as of Grade 11: Algebra I, Literature, and Biology (Scale Score and Performance Levels – Advanced/Proficient versus Not)	PIMS
Postsecondary Institution Type	• Public versus Private.	NSC
Covariates		
Postsecondary Enrollment Status	• Full-time versus Part-time.	NSC
Gender	• Dichotomous measure of male versus female.	PIMS
Socioeconomic Status	• Economically Disadvantaged Status (Yes/No) at time of high school graduation.	PIMS
Ethnicity	• Categorical variable that includes the following: American Indian/Alaskan Native, Black or African American, Hispanic, White, Multi-racial, Asian, Native Hawaiian or other Pacific Islander. • Dummy variables of each representing categories were tested in Logistic Regression models.	PIMS
EL Status	• Dichotomous variable (Not EL vs. Currently EL) of status at time of high school graduation.	PIMS
Special Education Status	• Dichotomous variable (Not SpecEd vs. SpecEd.) of status at time of high school graduation.	PIMS
Geographical Region	• Rural, Town, Suburban, and Urban: Dummy variables representing each region.	PIMS & Other

Appendix D

Courses of Rigor (AP, Dual, and IB)

	9th Grade Cohort 1 (2010/2011)		9th Grade Cohort 2 (2011/2012)		9th Grade Cohort 3 (2012/2013)		7th Grade Cohort 1 (2010/2011)		7th Grade Cohort 2 (2011/2012)	
	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Overall										
Total	43.4 (49957)	56.6 (65111)	34.1 (38627)	65.9 (74543)	46.2 (52034)	53.8 (60486)	47.0 (48814)	53.0 (54941)	49.8 (50179)	50.2 (50550)
Gender										
Male	39.2 (22880)	60.8 (35474)	40.8 (23155)	59.2 (33667)	41.0 (23428)	59.0 (33743)	41.9 (22010)	58.1 (30555)	44.2 (22323)	55.8 (28189)
Female	47.7 (27077)	52.3 (29637)	50.7 (28573)	49.3 (27775)	51.7 (28606)	48.3 (26743)	52.4 (26804)	47.6 (24386)	55.5 (27856)	44.5 (22361)
Ethnicity										
American Indian/Alaskan Native	39.0 (57)	61.0 (89)	42.4 (56)	57.6 (76)	40.6 (54)	59.4 (79)	43.0 (52)	57.0 (69)	43.0 (49)	57.0 (65)
Black or African American	26.1 (3727)	73.9 (10541)	28.2 (3924)	71.8 (5687)	28.9 (3915)	71.1 (9650)	29.4 (3498)	70.6 (8392)	34.7 (3782)	65.3 (7122)
Hispanic	28.6 (2139)	71.4 (5330)	29.2 (2347)	70.8 (5687)	28.3 (2336)	71.7 (5905)	29.4 (3498)	70.8 (5035)	33.1 (2289)	66.9 (4632)
White	46.5 (40986)	53.5 (47186)	49.0 (42062)	51.0 (43708)	49.7 (42149)	50.3 (42668)	50.2 (40022)	49.8 (39628)	52.3 (40668)	47.7 (37059)
Multi-Racial	34.4 (454)	65.6 (865)	38.4 (590)	61.6 (948)	37.8 (686)	62.2 (1130)	37.5 (597)	62.5 (996)	43.9 (710)	56.1 (909)
Asian	70.6 (2563)	29.4 (1066)	73.0 (2704)	27.0 (999)	73.5 (2857)	26.5 (1029)	75.9 (2530)	24.1 (802)	78.2 (2638)	21.8 (734)
Native Hawaiian or other Pacific Islander	47.7 (31)	52.3 (34)	60.0 (45)	40.0 (30)	59.7 (37)	40.3 (25)	*	*	59.7 (43)	40.3 (29)
Historically Underperforming										
Yes	25.9 (12035)	74.1 (343747)	27.7 (13019)	72.3 (34052)	27.6 (13002)	72.4 (34071)	28.3 (12091)	71.7 (30627)	31.7 (13381)	68.3 (28827)
No	55.2 (37922)	44.8 (30764)	58.6 (38709)	41.4 (27390)	59.6 (39032)	40.4 (26415)	60.2 (36723)	39.8 (24314)	62.9 (36798)	37.1 (21723)
EL Status										
Yes	11.1 (137)	88.9 (1095)	11.2 (138)	88.8 (1097)	10.0 (129)	90.0 (1162)	9.4 (73)	90.6 (704)	12.2 (97)	87.8 (695)
No	43.8 (49820)	56.2 (64016)	46.1 (51590)	53.9 (60345)	46.7 (51905)	53.3 (59324)	47.3 (48741)	52.7 (54237)	50.1 (50082)	49.9 (49855)
Special Education Status										
Yes	12.8 (1868)	87.2 (12717)	12.5 (1880)	87.5 (13164)	11.1 (1684)	88.9 (13508)	11.7 (1636)	88.3 (12381)	11.6 (1599)	88.4 (12244)
No	47.9 (48089)	52.1 (52394)	50.8 (49848)	49.2 (48278)	51.7 (50350)	48.3 (46978)	52.6 (47178)	47.4 (42560)	55.9 (48580)	44.1 (38306)
Economic Disadvantaged										
Yes	27.8 (10866)	72.2 (28192)	29.9 (11928)	70.1 (27979)	29.9 (12000)	70.1 (28088)	30.7 (1119)	69.3 (25130)	34.7 (12450)	65.3 (23479)
No	51.4 (39091)	48.6 (36919)	54.3 (39800)	45.7 (33463)	55.3 (40034)	44.7 (32398)	55.8 (37695)	44.3 (29811)	58.2 (37729)	41.8 (27071)

**Number of students too low to report (n < 20).*

Advanced Courses

	9th Grade Cohort 1 (2010/2011)		9th Grade Cohort 2 (2011/2012)		9th Grade Cohort 3 (2012/2013)		7th Grade Cohort 1 (2010/2011)		7th Grade Cohort 2 (2011/2012)	
	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Overall										
Total	63.5 (73038)	36.5 (42030)	64.5 (72984)	35.5 (40186)	64.9 (73017)	35.1 (39503)	66.7 (69225)	33.3 (34530)	69.0 (69458)	31.0 (31271)
Gender										
Male	58.8 (34300)	41.2 (24054)	59.2 (33633)	40.8 (23189)	59.5 (33989)	40.5 (23182)	61.6 (32396)	38.4 (20169)	63.6 (32123)	36.4 (18389)
Female	68.3 (38738)	31.7 (17976)	69.8 (39351)	30.2 (16997)	70.5 (39028)	29.5 (16321)	71.9 (36829)	28.1 (14361)	74.3 (37335)	25.7 (12882)
Ethnicity										
American Indian/Alaskan Native	64.4 (94)	35.6 (52)	53.0 (70)	47.0 (62)	61.7 (82)	38.3 (51)	65.3 (79)	34.7 (42)	61.4 (70)	38.6 (44)
Black or African American	51.5 (7344)	48.5 (6924)	50.9 (7086)	49.1 (6832)	51.8 (7030)	48.2 (6535)	53.5 (6367)	46.5 (5523)	59.2 (6459)	40.8 (4445)
Hispanic	53.1 (7344)	46.9 (3503)	52.9 (4254)	47.1 (3780)	53.7 (4424)	46.3 (3817)	55.6 (3958)	4.4 (3158)	59.2 (4097)	40.8 (2824)
White	65.5 (57774)	34.5 (30398)	67.0 (57428)	33.0 (28342)	67.3 (57075)	32.7 (27742)	69.0 (54920)	31.0 (24730)	70.4 (54693)	29.6 (23034)
Multi-Racial	59.1 (779)	40.9 (540)	59.1 (909)	40.9 (629)	58.5 (1062)	41.5 (754)	59.6 (949)	40.4 (644)	66.3 (1073)	33.7 (546)
Asian	83.7 (3038)	16.3 (591)	85.9 (3181)	14.1 (522)	85.0 (3303)	15.0 (583)	87.5 (2914)	12.5 (418)	89.4 (3013)	10.6 (1359)
Native Hawaiian or other Pacific Islander	66.2 (43)	33.8 (22)	*	*	66.1 (41)	33.9 (21)	*	*	*	*
Historically Underperforming										
Yes	46.6 (21623)	53.4 (24759)	47.0 (22138)	53.0 (24933)	47.0 (22125)	53.0 (24948)	49.1 (20955)	50.9 (21763)	52.0 (21954)	48.0 (20254)
No	74.9 (51415)	25.1 (17271)	76.9 (50846)	23.1 (15253)	77.8 (50892)	22.2 (14555)	79.1 (48270)	20.9 (12767)	81.2 (47504)	18.8 (11017)
EL Status										
Yes	25.7 (317)	74.3 (915)	29.0 (358)	71.0 (877)	27.3 (353)	72.7 (938)	24.8 (193)	75.2 (584)	30.4 (241)	69.6 (551)
No	63.9 (72721)	36.1 (41115)	64.9 (72626)	35.1 (39309)	65.3 (72664)	34.7 (38565)	67.0 (69032)	33.0 (33946)	69.3 (69217)	30.7 (30720)
Special Education Status										
Yes	23.9 (3491)	76.1 (11094)	23.9 (3590)	76.1 (11454)	22.6 (3431)	77.4 (11761)	24.9 (3496)	75.1 (10521)	25.0 (3462)	75.0 (10381)
No	69.2 (69547)	30.8 (30936)	70.7 (69394)	29.3 (28732)	71.5 (69586)	28.5 (27742)	73.2 (65729)	26.8 (24009)	76.0 (65996)	24.0 (20890)
Economic Disadvantaged										
Yes	50.0 (19535)	50.0 (19523)	50.5 (20148)	49.5 (19759)	50.4 (20224)	49.6 (19846)	52.5 (19037)	47.5 (17212)	55.8 (20058)	44.2 (15871)
No	70.4 (76010)	29.6 (22507)	72.1 (52836)	27.9 (20427)	72.9 (52793)	27.1 (19639)	74.3 (50188)	25.7 (17318)	76.2 (49400)	23.8 (15400)

Number of students too low to report (n < 20).

Advanced Course Timing - 9th Grade Cohorts

	9th Grade Cohort 1 (2010/2011)				9th Grade Cohort 2 (2011/2012)				9th Grade Cohort 3 (2012/2013)			
	Early % (n)		Late % (n)		Early % (n)		Late % (n)		Early % (n)		Late % (n)	
	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)
Overall												
Total	45.7 (52413)	54.3 (62361)	57.3 (65775)	42.7 (48999)	47.7 (53785)	52.3 (59052)	57.9 (65384)	42.1 (47453)	48.0 (53843)	52.0 (58406)	58.7 (65928)	41.3 (46321)
Gender												
Male	41.9 (24377)	58.1 (33803)	52.2 (30368)	47.8 (27812)	43.5 (24659)	56.5 (31993)	52.3 (29603)	47.7 (27049)	43.6 (24854)	56.4 (32180)	53.0 (30202)	47.0 (26832)
Female	49.5 (28036)	50.5 (28558)	62.6 (35407)	37.4 (21187)	51.8 (29126)	48.2 (27059)	63.7 (35781)	36.3 (20404)	52.5 (28989)	47.5 (26226)	64.7 (35726)	35.3 (19489)
Ethnicity												
American Indian/ Alaskan Native	37.2 (54)	62.8 (91)	59.3 (86)	40.7 (59)	40.9 (54)	59.1 (78)	48.5 (64)	51.5 (68)	45.9 (61)	54.1 (72)	54.1 (72)	45.9 (61)
Black or African American	34.6 (4890)	65.4 (9263)	40.2 (5684)	59.8 (8469)	33.6 (4641)	66.4 (9175)	41.3 (5710)	58.7 (8106)	35.0 (4715)	65.0 (8774)	42.8 (5770)	57.2 (7719)
Hispanic	35.1 (2607)	64.9 (4828)	43.7 (3247)	56.3 (4188)	36.8 (2942)	63.2 (5051)	43.9 (3511)	56.1 (4482)	36.8 (3020)	63.2 (5189)	45.3 (3717)	54.7 (4492)
White	47.5 (41804)	52.5 (46238)	60.4 (53161)	39.6 (34881)	50.1 (42846)	49.9 (42755)	61.0 (52202)	39.0 (33399)	50.3 (42551)	49.7 (42122)	61.7 (52247)	38.3 (32426)
Multi-Racial	41.2 (539)	58.8 (770)	51.4 (674)	48.5 (635)	43.1 (659)	56.9 (870)	52.8 (807)	47.2 (722)	42.7 (771)	57.3 (1036)	50.4 (911)	49.6 (896)
Asian	68.6 (2486)	31.4 (1139)	79.5 (2882)	20.5 (743)	70.5 (2602)	29.5 (1089)	82.3 (3037)	17.7 (654)	69.4 (2691)	30.6 (1185)	81.8 (3172)	18.2 (704)
Native Hawaiian or other Pacific Islander	50.8 (33)	49.2 (32)	63.1 (41)	36.9 (24)	54.7 (41)	45.3 (34)	70.7 (53)	29.3 (22)	54.8 (34)	45.2 (28)	62.9 (39)	37.1 (23)
Historically Underperforming												
Yes	29.6 (13666)	70.4 (32505)	38.7 (17859)	61.3 (28312)	30.8 (14408)	69.2 (32445)	38.7 (18141)	61.3 (28712)	30.5 (14300)	69.5 (32587)	39.5 (18534)	60.5 (28353)
No	56.5 (38747)	43.5 (29856)	69.8 (47916)	30.2 (20687)	59.7 (39377)	40.3 (26607)	71.6 (47243)	28.4 (18741)	60.5 (39543)	39.5 (25819)	72.5 (47394)	27.5 (17968)
EL Status												
Yes	10.4 (128)	89.6 (1102)	20.2 (249)	79.8 (981)	13.1 (162)	86.9 (1070)	21.8 (268)	78.2 (964)	12.9 (166)	87.1 (1122)	20.4 (263)	79.6 (1025
No	46.0 (52285)	54.0 (61259)	57.7 (65526)	42.3 (48018)	48.0 (53623)	52.0 (57982)	58.3 (65116)	41.7 (46489)	48.4 (53677)	51.6 (57284)	59.2 (65665)	40.8 (45296)
Special Education Status												
Yes	12.2 (1778)	87.8 (12781)	19.3 (2809)	80.7 (11750)	13.6 (2043)	86.4 (12973)	17.6 (2643)	82.4 (12373)	12.3 (1871)	87.7 (13294)	17.3 (2618)	82.7 (12547)
No	50.5 (50635)	49.5 (49580)	62.8 (62966)	37.2 (37249)	52.9 (51742)	47.1 (46079)	64.1 (62741)	35.9 (35080)	53.5 (51972)	46.5 (45112)	65.2 (63310)	34.8 (33774)
Economic Disadvantaged												
Yes	32.4 (12598)	67.6 (26256)	41.4 (16076)	58.6 (22778)	33.4 (13270)	66.6 (26428)	41.8 (16601)	58.2 (23097)	33.2 (13263)	66.8 (26650)	42.6 (17020)	57.4 (22893)
No	52.4 (39815)	47.6 (36105)	65.5 (49699)	34.5 (26221)	55.4 (40515)	44.6 (32624)	66.7 (48783)	33.3 (24356)	56.1 (40580)	43.9 (31756)	67.6 (48908)	32.4 (23428)

**Number of students too low to report*

Advanced Course Timing - 7th Grade Cohorts

	7th Grade Cohort 1 (2010/2011)							
	Middle School				High School			
	Early % (n)		Late % (n)		Early % (n)		Late % (n)	
	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)
Overall								
Total	45.7 (52413)	54.3 (62361)	57.3 (65775)	42.7 (48999)	47.7 (53785)	52.3 (59052)	57.9 (65384)	42.1 (47453)
Gender								
Male	41.9 (24377)	58.1 (33803)	52.2 (30368)	47.8 (27812)	43.5 (24659)	56.5 (31993)	52.3 (29603)	47.7 (27049)
Female	49.5 (28036)	50.5 (28558)	62.6 (35407)	37.4 (21187)	51.8 (29126)	48.2 (27059)	63.7 (35781)	36.3 (20404)
Ethnicity								
American Indian/ Alaskan Native	37.2 (54)	62.8 (91)	59.3 (86)	40.7 (59)	40.9 (54)	59.1 (78)	48.5 (64)	51.5 (68)
Black or African American	34.6 (4890)	65.4 (9263)	40.2 (5684)	59.8 (8469)	33.6 (4641)	66.4 (9175)	41.3 (5710)	58.7 (8106)
Hispanic	35.1 (2607)	64.9 (4828)	43.7 (3247)	56.3 (4188)	36.8 (2942)	63.2 (5051)	43.9 (3511)	56.1 (4482)
White	47.5 (41804)	52.5 (46238)	60.4 (53161)	39.6 (34881)	50.1 (42846)	49.9 (42755)	61.0 (52202)	39.0 (33399)
Multi-Racial	41.2 (539)	58.8 (770)	51.4 (674)	48.5 (635)	43.1 (659)	56.9 (870)	52.8 (807)	47.2 (722)
Asian	68.6 (2486)	31.4 (1139)	79.5 (2882)	20.5 (743)	70.5 (2602)	29.5 (1089)	82.3 (3037)	17.7 (654)
Native Hawaiian or other Pacific Islander	50.8 (33)	49.2 (32)	63.1 (41)	36.9 (24)	54.7 (41)	45.3 (34)	70.7 (53)	29.3 (22)
Historically Underperforming								
Yes	29.6 (13666)	70.4 (32505)	38.7 (17859)	61.3 (28312)	30.8 (14408)	69.2 (32445)	38.7 (18141)	61.3 (28712)
No	56.5 (38747)	43.5 (29856)	69.8 (47916)	30.2 (20687)	59.7 (39377)	40.3 (26607)	71.6 (47243)	28.4 (18741)
EL Status								
Yes	10.4 (128)	89.6 (1102)	20.2 (249)	79.8 (981)	13.1 (162)	86.9 (1070)	21.8 (268)	78.2 (964)
No	46.0 (52285)	54.0 (61259)	57.7 (65526)	42.3 (48018)	48.0 (53623)	52.0 (57982)	58.3 (65116)	41.7 (46489)
Special Education Status								
Yes	12.2 (1778)	87.8 (12781)	19.3 (2809)	80.7 (11750)	13.6 (2043)	86.4 (12973)	17.6 (2643)	82.4 (12373)
No	50.5 (50635)	49.5 (49580)	62.8 (62966)	37.2 (37249)	52.9 (51742)	47.1 (46079)	64.1 (62741)	35.9 (35080)
Economic Disadvantaged								
Yes	32.4 (12598)	67.6 (26256)	41.4 (16076)	58.6 (22778)	33.4 (13270)	66.6 (26428)	41.8 (16601)	58.2 (23097)
No	52.4 (39815)	47.6 (36105)	65.5 (49699)	34.5 (26221)	55.4 (40515)	44.6 (32624)	66.7 (48783)	33.3 (24356)

7th Grade Cohort 2 (2011/2012)							
Middle School				High School			
Early % (n)		Late % (n)		Early % (n)		Late % (n)	
Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)
42.1 (47453)	42.1 (47453)	42.1 (47453)	42.1 (47453)	42.1 (47453)	42.1 (47453)	42.1 (47453)	42.1 (47453)
47.7 (27049)	47.7 (27049)	47.7 (27049)	47.7 (27049)	47.7 (27049)	47.7 (27049)	47.7 (27049)	47.7 (27049)
36.3 (20404)	36.3 (20404)	36.3 (20404)	36.3 (20404)	36.3 (20404)	36.3 (20404)	36.3 (20404)	36.3 (20404)
51.5 (68)	51.5 (68)	51.5 (68)	51.5 (68)	51.5 (68)	51.5 (68)	51.5 (68)	51.5 (68)
58.7 (8106)	58.7 (8106)	58.7 (8106)	58.7 (8106)	58.7 (8106)	58.7 (8106)	58.7 (8106)	58.7 (8106)
56.1 (4482)	56.1 (4482)	56.1 (4482)	56.1 (4482)	56.1 (4482)	56.1 (4482)	56.1 (4482)	56.1 (4482)
39.0 (33399)	39.0 (33399)	39.0 (33399)	39.0 (33399)	39.0 (33399)	39.0 (33399)	39.0 (33399)	39.0 (33399)
47.2 (722)	47.2 (722)	47.2 (722)	47.2 (722)	47.2 (722)	47.2 (722)	47.2 (722)	47.2 (722)
17.7 (654)	17.7 (654)	17.7 (654)	17.7 (654)	17.7 (654)	17.7 (654)	17.7 (654)	17.7 (654)
29.3 (22)	29.3 (22)	29.3 (22)	29.3 (22)	29.3 (22)	29.3 (22)	29.3 (22)	29.3 (22)
61.3 (28712)	61.3 (28712)	61.3 (28712)	61.3 (28712)	61.3 (28712)	61.3 (28712)	61.3 (28712)	61.3 (28712)
28.4 (18741)	28.4 (18741)	28.4 (18741)	28.4 (18741)	28.4 (18741)	28.4 (18741)	28.4 (18741)	28.4 (18741)
78.2 (964)	78.2 (964)	78.2 (964)	78.2 (964)	78.2 (964)	78.2 (964)	78.2 (964)	78.2 (964)
41.7 (46489)	41.7 (46489)	41.7 (46489)	41.7 (46489)	41.7 (46489)	41.7 (46489)	41.7 (46489)	41.7 (46489)
82.4 (12373)	82.4 (12373)	82.4 (12373)	82.4 (12373)	82.4 (12373)	82.4 (12373)	82.4 (12373)	82.4 (12373)
35.9 (35080)	35.9 (35080)	35.9 (35080)	35.9 (35080)	35.9 (35080)	35.9 (35080)	35.9 (35080)	35.9 (35080)
58.2 (23097)	58.2 (23097)	58.2 (23097)	58.2 (23097)	58.2 (23097)	58.2 (23097)	58.2 (23097)	58.2 (23097)
33.3 (24356)	33.3 (24356)	33.3 (24356)	33.3 (24356)	33.3 (24356)	33.3 (24356)	33.3 (24356)	33.3 (24356)

**Number of students too low to report*

CTE

	9th Grade Cohort 1 (2010/2011)		9th Grade Cohort 2 (2011/2012)		9th Grade Cohort 3 (2 012/2013)		7th Grade Cohort 1 (2010/2011)		7th Grade Cohort 2 (2011/2012)	
	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Overall										
Total	21.5 (24720)	78.5 (90348)	17.8 (20170)	82.2 (93000)	13.5 (15240)	86.5 (97280)	14.8 (15353)	85.2 (88402)	12.7 (12760)	87.3 (87969)
Gender										
Male	24.1 (14069)	75.9 (44285)	20.3 (11553)	79.7 (45269)	15.3 (8755)	84.7 (48416)	16.5 (8685)	83.5 (43880)	14.0 (7066)	86.0 (43446)
Female	18.8 (10651)	81.2 (46063)	15.3 (8617)	84.7 (47731)	11.7 (6485)	88.36 (48864)	13.0 (668)	87.0 (44522)	11.3 (5694)	88.7 (44523)
Ethnicity										
American Indian/Alaskan Native	22.6 (33)	77.4 (113)	*	*	*	*	*	*	*	*
Black or African American	24.2 (3458)	75.8 (10810)	18.1 (2515)	81.9 (11403)	15.3 (2078)	84.7 (11487)	16.5 (1957)	83.5 (9933)	15.1 (1651)	84.9 (9253)
Hispanic	29.7 (2219)	70.3 (5250)	22.9 (1840)	77.1 (6194)	14.8 (11407)	85.2 (7018)	15.6 (1111)	84.4 (6005)	12.4 (861)	87.6 (6060)
White	20.8 (18365)	79.2 (69807)	18.4 (283)	82.2 (70507)	13.4 (11407)	86.6 (73410)	14.8 (11759)	85.2 (67891)	12.6 (9777)	87.4 (67950)
Multi-Racial	20.5 (271)	79.5 (1048)	18.4 (283)	81.6 (1255)	14.6 (265)	85.4 (1551)	17.5 (278)	82.5 (67891)	15.5 (251)	84.5 (1368)
Asian	9.9 (361)	90.1 (3268)	6.4 (236)	93.6 (3467)	6.1 (238)	93.9 (3648)	6.6 (220)	93.4 (3312)	5.9 (200)	94.1 (3172)
Native Hawaiian or other Pacific Islander	20.0 (65)	80.0 (52)	*	*	*	*	*	*	*	*
Historically Underperforming										
Yes	31.2 (14483)	68.8 (31899)	25.8 (12139)	74.2 (34932)	18.7 (8816)	81.3 (38257)	20.0 (8542)	80.0 (34176)	17.0 (7162)	83.0 (35046)
No	14.9 (10237)	85.1 (58449)	12.1 (8031)	87.9 (58068)	9.8 (6424)	90.2 (59023)	11.2 (6811)	88.8 (54226)	9.6 (5598)	90.4 (52923)
EL Status										
Yes	30.3 (373)	69.7 (859)	23.7 (293)	76.3 (942)	18.5 (239)	81.5 (1052)	19.2 (149)	80.0 (628)	21.5 (170)	78.5 (622)
No	21.4 (24347)	78.6 (89489)	17.8 (19877)	82.2 (92058)	13.5 (15001)	86.5 (96228)	14.8 (15204)	85.2 (87774)	12.6 (12590)	87.4 (87347)
Special Education Status										
Yes	37.3 (5441)	62.7 (9144)	30.9 (4645)	69.1 (10399)	19.9 (3030)	80.1 (12162)	21.1 (2964)	78.9 (11053)	18.4 (2551)	81.6 (11292)
No	19.2 (19279)	80.8 (81204)	15.8 (15525)	84.2 (82601)	12.5 (12210)	87.5 (85118)	13.8 (12389)	86.2 (77349)	11.7 (10209)	88.3 (76677)
Economic Disadvantaged										
Yes	30.8 (12032)	69.2 (27026)	25.3 (10107)	74.7 (29800)	19.0 (7604)	81.0 (32484)	20.3 (7350)	79.7 (28899)	17.1 (6151)	82.9 (29778)
No	16.7 (12688)	83.3 (63322)	13.7 (10063)	86.3 (63200)	10.5 (7636)	89.5 (64796)	11.9 (8003)	88.1 (59503)	10.2 (6609)	89.8 (58191)

**Number of students too low to report (n < 20).*

Advanced Algebra Enrollment

	9th Grade Cohort 1 (2010/2011)		9th Grade Cohort 2 (2011/2012)		9th Grade Cohort 3 (2012/2013)		7th Grade Cohort 1 (2010/2011)		7th Grade Cohort 2 (2011/2012)	
	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)	Participated (1 or more)	Did Not Participate (No Classes)
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Overall										
Total	86.3 (99305)	13.7 (15763)	86.8 (98222)	13.2 (14948)	84.5 (48281)	13.8 (15527)	87.9 (91229)	12.1 (12526)	87.3 (87947)	12.7 (12782)
Gender										
Male	84.7 (49436)	15.3 (8918)	85.1 (48347)	14.9 (8475)	84.5 (48281)	15.5 (8890)	86.4 (45419)	13.6 (7146)	85.7 (43267)	14.3 (7245)
Female	87.9 (49869)	12.1 (6845)	88.5 (49875)	11.5 (6473)	88.0 (48712)	12.0 (6637)	89.5 (45810)	10.5 (5380)	89.0 (44680)	11.0 (5537)
Ethnicity										
American Indian/Alaskan Native	84.2 (123)	15.8 (23)	83.3 (110)	16.7 (22)	*	*	*	*	78.8 (91)	20.2 (23)
Black or African American	86.3 (12317)	13.7 (1951)	87.3 (12150)	12.7 (1768)	85.1 (11541)	14.9 (2024)	86.0 (10226)	14.0 (1664)	86.1 (9391)	13.9 (1513)
Hispanic	85.3 (6370)	14.7 (1099)	84.7 (6808)	15.3 (1226)	84.6 (6973)	15.4 (1268)	86.2 (6134)	13.8 (982)	86.4 (5978)	13.6 (943)
White	86.3 (76115)	13.7 (12057)	86.8 (74475)	13.2 (11295)	86.5 (73334)	13.5 (11483)	88.2 (70230)	11.8 (9420)	87.4 (67926)	12.6 (9801)
Multi-Racial	82.9 (1094)	17.1 (225)	83.6 (74475)	16.6 (256)	82.6 (1500)	17.4 (316)	83.6 (1331)	16.4 (262)	87.4 (1415)	12.6 (204)
Asian	88.9 (3227)	11.1 (402)	89.8 (3326)	10.2 (377)	89.4 (3476)	10.6 (410)	94.7 (3156)	5.3 (176)	91.4 (3083)	8.6 (289)
Native Hawaiian or other Pacific Islander	*	*	*	*	*	*	*	*	*	*
Historically Underperforming										
Yes	79.5 (36888)	20.5 (9595)	80.4 (37829)	19.6 (9242)	79.1 (37241)	20.9 (9832)	79.8 (34103)	20.2 (8615)	79.5 (33557)	20.5 (8651)
No	90.9 (62417)	9.1 (6269)	91.4 (60393)	8.6 (5706)	91.3 (59752)	8.7 (5695)	93.6 (57126)	6.4 (3911)	92.9 (54390)	7.1 (4131)
EL Status										
Yes	74.4 (916)	25.6 (316)	75.5 (932)	24.5 (303)	73.8 (953)	26.2 (338)	71.6 (556)	28.4 (221)	72.7 (576)	27.3 (216)
No	86.4 (98389)	13.6 (15447)	86.9 (97290)	13.1 (14645)	86.3 (96040)	13.7 (15189)	88.1 (90673)	11.9 (12305)	87.4 (87371)	12.6 (12566)
Special Education Status										
Yes	61.9 (9021)	38.1 (5564)	62.9 (9463)	37.1 (5581)	61.8 (9395)	38.2 (5797)	62.9 (8810)	37.1 (5207)	59.3 (8214)	40.7 (5629)
No	89.9 (90284)	10.1 (10199)	90.5 (88759)	9.5 (9367)	90.0 (87598)	10.0 (9730)	91.8 (82419)	8.2 (7319)	91.8 (79733)	8.2 (7153)
Economic Disadvantaged										
Yes	82.1 (32078)	17.9 (6980)	82.9 (33097)	17.1 (6810)	81.5 (32685)	18.5 (7403)	82.3 (29822)	17.7 (6427)	82.1 (29497)	17.9 (6432)
No	88.4 (67227)	11.6 (8783)	88.9 (65125)	11.1 (8138)	88.8 (64308)	11.2 (8124)	91.0 (61407)	9.0 (6099)	90.2 (58450)	9.8 (6350)

**Number of students too low to report (n < 20).*

First Algebra Enrollment

	9th Grade Cohort 1 (2010/2011)	9th Grade Cohort 2 (2011/2012)	9th Grade Cohort 3 (2012/2013)	7th Grade Cohort 1 (2010/2011)		7th Grade Cohort 2 (2011/2012)	
	11th Grade	11th Grade	11th Grade	8th Grade	11th Grade	8th Grade	11th Grade
	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)	% (n)
Overall							
Total	1.3 (1538)	2.0 (2310)	1.2 (1390)	42.0 (43597)	0.8 (868)	44.6 (44901)	0.8 (794)
Gender							
Male	1.5 (868)	2.1 (1197)	1.3 (764)	40.4 (21229)	0.9 (467)	43.1 (21774)	0.9 (453)
Female	1.2 (670)	2.0 (1113)	1.1 (626)	43.7 (22368)	0.8 (401)	46.1 (23127)	0.7 (341)
Ethnicity							
American Indian/ Alaskan Native	*	*	*	*	*	*	*
Black or African American	0.9 (133)	2.2 (311)	1.6 (213)	25.5 (3031)	1.9 (222)	27.4 (2993)	1.0 (106)
Hispanic	1.6 (116)	1.8 (143)	1.8 (151)	27.8 (1981)	1.0 (73)	31.8 (2204)	0.8 (57)
White	1.4 (1247)	2.1 (1770)	1.1 (966)	45.8 (36481)	0.7 (73)	48.3 (3751)	0.8 (607)
Multi-Racial	*	2.9 (45)	1.7 (30)	*	*	*	*
Asian	0.7 (24)	1.1 (41)	0.7 (28)	*	*	*	*
Native Hawaiian or other Pacific Islander	*	*	*	*	*	*	*
Historically Underperforming							
Yes	2.2 (1012)	3.0 (1411)	0.7 (453)	30.4 (12978)	1.7 (709)	33.2 (14014)	1.4 (604)
No	0.8 (526)	1.4 (899)	2.0 (937)	50.2 (30619)	0.3 (159)	52.8 (30887)	0.3 (190)
EL Status							
Yes	3.5 (43)	3.3 (41)	2.8 (36)	*	*	*	*
No	1.3 (1495)	2.0 (2269)	1.2 (1354)	42.3 (43512)	0.8 (850)	44.8 (44814)	0.8 (780)
Special Education Status							
Yes	4.4 (636)	5.9 (890)	4.1 (623)	20.5 (2868)	3.7 (516)	48.2 (41847)	3.5 (485)
No	0.9 (902)	1.4 (1420)	0.8 (767)	45.4 (40729)	0.4 (352)	22.1 (3054)	0.4 (309)
Economic Disadvantaged							
Yes	1.8 (717)	2.6 (1042)	1.7 (666)	31.5 (11433)	1.4 (510)	34.5 (12383)	1.2 (416)
No	1.1 (821)	1.7 (1268)	1.0 (724	47.6 (32164)	0.5 (358)	50.2 (32518)	0.6 (378)

**Number of students too low to report (n < 20).*

Appendix E

Logistic Regression Analysis Result Tables

For coefficient and direction of effects interpretation, the coding of variables in logistic regression models is as follows:

Keystone Algebra Achievement Level (Below Basic/Basic=0; Proficient/Adv=1)

Enrollment Status at Entry (Part-time=0; Full-time =1)

Institution Sector (Public=0; Private=1)

Enrollment State (Out-of-state=0; PA=1)

Years (2-year Institution=0; 4-Year Institution=1)

Grade 7 Math PSSA Achievement Level (Below Basic/Basic=0; Proficient/Adv=1)

Grade 8 Math PSSA Achievement Level (Below Basic/Basic=0; Proficient/Adv=1)

Advanced Algebra (No=0; Yes=1)

Early or Late Timing (Early=0; Late=1)

First Algebra Enrollment in 8th Grade (No=0; Yes=1)

Historically Underperforming Status (No=0; Yes=1)

Economically Disadvantaged (No=0; Yes=1)

Rigorous/Advanced Course Dummy (Took no courses=0; Took at least 1 or more courses=1)

First Algebra Enrollment 8th Grade (No=0; Yes=1)

First Algebra Enrollment 11th Grade (No=0; Yes=1)

Suburban (Not Suburban=0; Suburban=1)

City (Not Urban/City=0; Urban/City=1)

Gender (Female=0; Male=1)

For All Models:

*Final Models include all independent variables that were significant when tested individually and remained significant.

**Advanced Courses includes Rigorous Courses and was included in the final model when both were significant individually, but it was associated with a higher amount of variation.

***Does not include Keystone Literature Achievement Levels in the model since Keystone data was only available for one of our 9th grade cohorts, we provide a final model with and without this independent variable.

7th Grade Cohort Logistic Regression Analysis Result Tables

TABLE 1. Logistic Regression Analysis of On-time High School Graduation for 7th Grade Cohorts

Individual Independent Variables	β	Se β	Wald's X^2	*df*	*p*	Exp(β) Odds Ratio	Model X^2 (*p*)	Pseudo R^2	*n*
Rigorous Courses (Dummy)	2.258	.035	4166.6	1	.0001	9.566	7047.06 (.0001)	.11	204484
Total # Rigorous Courses (Total)	0.944	.019	2418.1	1	.0001	2.571	7154.04 (.0001)	.11	204484
Advanced Courses (Dummy)	1.813	.023	5996.1	1	.0001	6.129	6931.47 (.0001)	.11	204484
Total # Advanced Courses (Total)	0.289	.005	3082.6	1	.0001	1.335	7735.86 (.0001)	.12	204484
Grade 7 PSSA Math Achievement Level	1.396	.022	3856.8	1	.0001	4.039	3442.09 (.0001)	.06	202043
Grade 8 PSSA Math Achievement Level	1.511	.022	4621.5	1	.0001	4.531	4291.62 (.0001)	.07	201665
First Algebra Enrollment Grade 8	0.987	.025	1591.1	1	.0001	2.682	1831.81 (.0001)	.03	204484
First Algebra Enrollment Grade 11	-1.323	.069	368.8	1	.0001	0.266	274.15 (.0001)	.00	204484
Advanced Algebra (Dummy)	1.644	.022	5522.3	1	.0001	5.177	4719.84 (.0001)	.07	204484
Algebra I Timing (Early or Late Enrollment)	-1.172	.024	2310.4	1	.0001	0.310	2571.93 (.0001)	.04	193718
Historically Underperforming Status	-1.453	.024	3753.0	1	.0001	0.234	4360.46 (.0001)	.07	204484
Economically Disadvantaged	-1.087	.021	2573.2	1	.0001	0.337	2645.13 (.0001)	.04	204484
Keystone Algebra Achievement Level	1.832	.025	5382.9	1	.0001	6.246	5964.39 (.0001)	.10	199180
Final Models*									
Final Model 1							**8881.17 (.0001)**	**.16**	**197525**
Constant	2.026	.034	3454.9	1	.0001	7.584			
Total # Advanced Courses	0.159	.005	974.6	1	.0001	1.172			
Keystone Algebra Achievement Level	0.813	.032	629.4	1	.0001	2.254			
First Algebra Enrollment Grade 8	0.119	.029	17.2	1	.0001	1.127			
Grade 8 PSSA Math Achievement Level	0.131	.029	19.8	1	.0001	1.140			
Advanced Algebra (Dummy)	0.585	.028	441.0	1	.0001	1.795			
Historically Underperforming Status	-0.495	.028	310.8	1	.0001	0.609			
Final Model 2							**8304.10 (.0001)**	**.16**	**188299**
Constant	2.102	.042	2471.8	1	.0001	8.179			
Total # Advanced Courses	0.160	.005	903.9	1	.0001	1.173			
Algebra I Timing (Early or Late Enrollment)	-0.90	.029	9.7	1	.002	0.914			
Grade 8 PSSA Math Achievement Level	0.119	.030	15.5	1	.0001	1.126			
Advanced Algebra (Dummy)	0.622	.029	471.5	1	.0001	1.862			
Historically Underperforming Status	-0.490	.029	292.8	1	.0001	0.612			
Keystone Algebra Achievement Level	0.810	.033	598.5	1	.0001	2.247			

TABLE 2. Logistic Regression Analysis of Postsecondary Enrollment for 7th Grade Cohorts

Statistically Significant Individual Independent Variables	β	Se β	Wald's X^2	*df*	*p*	Exp(β) Odds Ratio	Model X^2 (*p*)	Pseudo R^2	*n*
Total # Advanced Courses	.199	.001	18911.9	1	.0001	1.220	33047.89 (.0001)	.22	193149
Total # Rigorous Courses	.525	.004	14685.8	1	.0001	1.690	27193.82 (.0001)	.19	193149
First Algebra Enrollment Grade 8	.678	.010	4204.2	1	.0001	1.970	4347.83 (.0001)	.03	193149
Grade 7 Math PSSA Achievement Level	1.457	.013	12247.8	1	.0001	4.294	12364.74 (.0001)	.09	191532
Grade 8 Math PSSA Achievement Level	1.481	.013	14024.5	1	.0001	4.396	14169.16 (.0001)	.10	191226
Historically Underperforming Status	-1.219	.010	13749.0	1	.0001	0.296	14229.79 (.0001)	.10	193149
Economically Disadvantaged	-1.004	.010	9360.2	1	.0001	0.366	9403.02 (.0001)	.07	193149
Advanced Algebra (Dummy)	1.405	.015	8789.5	1	.0001	4.077	8887.18 (.0001)	.06	193149
Algebra I Timing (Early or Late Enrollment)	-1.040	.011	9654.6	1	.0001	0.354	9950.62 (.0001)	.08	183633
Keystone Literature Achievement Level	1.754	.012	19784.3	1	.0001	5.778	20513.62 (.0001)	.15	189581
Keystone Algebra Achievement Level	1.573	.011	19650.2	1	.0001	4.820	20110.45 (.0001)	.14	189627
Final Models*									
Final Model 1							**40763.95 (.0001)**	**.27**	**191226**
Constant	-.557	.020	806.0	1	.0001	0.573			
Total # Advanced Courses	.153	.001	10999.0	1	.0001	1.165			
Advanced Algebra (Dummy)	.729	.017	1792.4	1	.0001	2.073			
First Algebra Enrollment in Grade 8	.088	.012	53.4	1	.0001	1.092			
Grade 8 Math PSSA Achievement Level	.53	.014	1359.6	1	.0001	1.692			
Historically Underperforming Status	-.570	.012	2329.7	1	.0001	0.565			
Historically Underperforming Status	-0.495	.028	310.8	1	.0001	0.609			
Final Model 2							**38211.63 (.0001)**	**.27**	**182164**
Constant	-.456	.023	402.6	1	.0001	0.634			
Total # Advanced Courses	.152	.002	9807.3	1	.0001	1.164			
Advanced Algebra (Dummy)	.743	.018	1737.6	1	.0001	2.101			
Algebra I Timing (Early or Late Enrollment)	-.108	.013	74.7	1	.0001	0.897			
Grade 8 Math PSSA Achievement Level	.500	.015	1168.1	1	.0001	1.648			
Historically Underperforming Status	-.568	.012	2208.1	1	.0001	0.567			
Keystone Algebra Achievement Level	0.810	.033	598.5	1	.0001	2.247			
Final Model 3							**39313.06 (.0001)**	**.28**	**179361**
Constant	-.773	.024	998.8	1	.0001	0.461			
Total # Advanced Courses	.139	.002	8179.4	1	.0001	1.149			
Grade 8 Math PSSA Achievement Level	.237	.016	220.1	1	.0001	1.267			
Advanced Algebra (Dummy)	.666	.018	1298.4	1	.0001	1.946			
Algebra I Timing (Early or Late Enrollment)	-.068	.013	28.4	1	.0001	0.934			
Keystone Literature Achievement Level	.760	.015	2457.0	1	.0001	2.138			
Historically Underperforming Status	-.470	.012	1419.4	1	.0001	0.625			
Final Model 4							**41776.41 (.0001)**	**.29**	**188173**
Constant	-.831	.021	1534.9	1	.0001	0.436			
Total # Advanced Courses	.139	.001	9064.1	1	.0001	1.149			
Keystone Literature Achievement Level	.771	.015	2631.5	1	.0001	2.161			
Advanced Algebra (Dummy)	.645	.018	1301.4	1	.0001	1.907			
First Algebra Enrollment in Grade 8	.049	.012	15.8	1	.0001	1.050			
Grade 8 Math PSSA Achievement Level	.253	.016	262.4	1	.0001	1.288			
Historically Underperforming Status	-.470	.012	1479.9	1	.0001	0.625			

TABLE 3. Logistic Regression Analysis of Postsecondary Enrollment for 7th Grade Cohorts

Statistically Significant Individual Independent Variables	β	Se β	Wald's X^2	*df*	*p*	Exp(β) Odds Ratio	Model X^2 (*p*)	Pseudo R^2	*n*
Total # Advanced Courses	.135	.002	2946.9	1	.0001	1.145	4228.55 (.0001)	.12	62321
Total # Rigorous Courses	.367	.008	2397.1	1	.0001	1.444	3722.99 (.0001)	.10	62321
Keystone Algebra Achievement Level	1.243	.025	2416.0	1	.0001	3.465	2232.95 (.0001)	.06	61624
Enrollment Status at Entry (Part/ Full-time)	1.902	.033	3339.5	1	.0001	6.701	2973.79 (.0001)	.09	58655
Institution Sector (Public/ Private)	.746	.029	676.8	1	.0001	2.108	759.21 (.0001)	.02	62321
Enrollment State (Out-of-state/ PA)	-.728	.036	413.2	1	.0001	0.483	479.98 (.0001)	.01	62320
Years (2-year/4-year)	1.642	.024	4597.3	1	.0001	5.164	4418.87 (.0001)	.12	62211
Grade 7 Math PSSA Achievement Level	1.152	.031	1346.5	1	.0001	3.164	1194.52 (.0001)	.03	62032
Grade 8 Math PSSA Achievement Level	1.230	.030	1640.1	1	.0001	3.420	1458.02 (.0001)	.04	61989
Advanced Algebra	.845	.040	443.9	1	.0001	2.328	393.92 (.0001)	.01	62321
Algebra I Timing (Early or Late Enrollment)	-.890	.024	1434.5	1	.0001	0.410	1431.58 (.0001)	.04	59174
First Algebra Enrollment in Grade 8	.493	.023	452.3	1	.0001	1.638	462.16 (.0001)	.01	62321
Historically Underperforming Status	-1.123	.023	2340.5	1	.0001	0.325	2296.04 (.0001)	.06	62321
Economically Disadvantaged	-1.037	.024	1930.1	1	.0001	0.355	1846.94 (.0001)	.05	62321
Final Models*							**6508.27 (.0001)**	**.21**	**55080**
Constant	-.098	.068	2.1	1	.0149	0.907			
Total # Advanced Courses	.073	.003	608.2	1	.0001	1.076			
Enrollment Status at Entry (Part/Full-time)	.993	.039	639.3	1	.0001	2.701			
Years (2-year/4-year)	.809	.033	607.7	1	.0001	2.245			
Institution Sector (Public/ Private)	.255	.037	47.6	1	.0001	1.290			
Advanced Algebra	.214	.053	16.3	1	.0001	1.239			
Algebra I Timing (Early or Late Enrollment)	-.077	.030	6.4	1	.011	0.926			
Keystone Algebra Achievement Level	.186	.034	30.1	1	.0001	1.204			

TABLE 4. Logistic Regression Analysis of Retention to Year 2 for 7th Grade Cohorts

Statistically Significant Individual Independent Variables	β	Se β	Wald's X^2	*df*	*p*	Exp(β) Odds Ratio	Model X^2 (*p*)	Pseudo R^2	*n*
Enrollment Status at Entry (Part vs. Full-time)	1.525	.032	2332.8	1	.0001	4.597	2231.70 (.0001)	.06	58655
Years (2-year/4-year)	1.189	.021	3094.8	1	.0001	3.285	2990.56 (.0001)	.07	62211
Total # Advanced Courses	0.093	.002	2957.0	1	.0001	1.097	3653.85 (.0001)	.09	62321
Advanced Algebra (Dummy)	0.585	.037	247.4	1	.0001	1.796	232.75 (.0001)	.01	62321
Advanced Courses (Dummy)	1.001	.022	2018.3	1	.0001	2.721	1929.12 (.0001)	.05	62321
Total # Rigorous Courses	0.983	.019	2579.3	1	.0001	2.673	2600.92 (.0001)	.06	62321
Algebra I Timing (Early or Late Enrollment)	-0.709	.020	1285.6	1	.0001	0.492	1275.32 (.0001)	.03	59174
First Algebra Enrollment in Grade 8	0.348	.019	330.8	1	.0001	1.416	333.53 (.0001)	.01	62321
Grade 8 PSSA Math Achievement Level	1.000	.028	1255.6	1	.0001	2.717	1181.68 (.0001)	.03	61989
Institution Sector (Public/Private)	0.437	.022	396.8	1	.0001	1.548	414.64 (.0001)	.01	62321
Historically Underperforming Status	-0.845	.020	1815.4	1	.0001	0.430	1777.88 (.0001)	.04	62321
Economically Disadvantaged	-0.794	.020	1499.7	1	.0001	0.452	1453.27 (.0001)	.04	62321
Keystone Algebra Achievement Level	1.009	.023	1986.2	1	.0001	2.742	1895.50 (.0001)	.05	61624
Economically Disadvantaged	-1.037	.024	1930.1	1	.0001	0.355	1846.94 (.0001)	.05	62321
Keystone Algebra Achievement Level	1.009	.023	1986.2	1	.0001	2.742	1895.50 (.0001)	.05	61624
Final Models*							**5087.67 (.0001)**	**.14**	**55080**
Constant	-.224	.043	27.6	1	.0001	0.799			
Enrollment Status at Entry (Part/ Full-time)	.865	.037	548.2	1	.0001	2.375			
Institution Sector (Public/Private)	.105	.027	15.1	1	.0001	1.110			
Begin Year (2-year/4-year)	.500	.028	315.4	1	.0001	1.649			
Total # Advanced Courses	.053	.002	665.3	1	.0001	1.055			
Keystone Algebra Achievement Level	.212	.029	53.7	1	.0001	1.236			
Algebra I Timing (Early or Late Enrollment)	-.092	.025	13.9	1	.0001	0.912			
Historically Underperforming Status	-.391	.024	264.3	1	.0001	0.676			

9th Grade Cohort Logistic Regression Analysis Result Tables

TABLE 5. Logistic Regression Analysis of On-time High School Graduation for 9th Grade Cohorts

Individual Independent Variables	β	Se β	Wald's X^2	*df*	*p*	Exp(β) Odds Ratio	Model X^2 (*p*)	Pseudo R^2	*n*
Total # Rigorous Courses	.963	.013	5173.67	1	.0001	2.619	14864.1 (.0001)	.11	340738
Total # Advanced Courses	.328	.004	6658.2	1	.0001	1.389	17290.2 (.0001)	.13	340738
Historically Underperforming Status	-1.445	.016	8614.6	1	.0001	0.236	9875.4 (.0001)	.08	340738
Economically Disadvantaged	-1.166	.014	6650.9	1	.0001	0.312	6871.0 (.0001)	.05	340738
Advanced Algebra (Dummy)	1.494	.015	10042.8	1	.0001	4.454	8745.1 (.0001)	.06	340738
Algebra Timing	-.330	.037	79.3	1	.0001	0.719	73.5 (.0001)	.001	199524
Keystone Algebra Achievement Level	1.872	.031	3649.9	1	.0001	6.501	4246.5 (.0001)	.12	109054
First Algebra Enrollment Grade 11	-1.323	.069	368.8	1	.0001	0.266	274.15 (.0001)	.00	204484
Advanced Algebra (Dummy)	1.644	.022	5522.3	1	.0001	5.177	4719.84 (.0001)	.07	204484
Algebra I Timing (Early or Late Enrollment)	-1.172	.024	2310.4	1	.0001	0.310	2571.93 (.0001)	.04	193718
Historically Underperforming Status	-1.453	.024	3753.0	1	.0001	0.234	4360.46 (.0001)	.07	204484
Economically Disadvantaged	-1.087	.021	2573.2	1	.0001	0.337	2645.13 (.0001)	.04	204484
Keystone Algebra Achievement Level	1.832	.025	5382.9	1	.0001	6.246	5964.39 (.0001)	.10	199180
Final Models*									
Model 1***							**24791.8 (.0001)**	**.18**	**340738**
Constant	1.822	.019	9692.3	1	.0001	6.186			
Total # Advanced Courses**	.248	.004	4307.3	1	.0001	1.281			
Advanced Algebra (Dummy)	.998	.016	4022.3	1	.0001	2.712			
Historically Underperforming Status	-.807	.016	2427.9	1	.0001	0.446			
Model 2							**6850.3 (.0001)**	**.18**	**109054**
Constant	1.804	.038	2224.7	1	.0001	6.076			
Total # Advanced Courses	0.198	.007	747.5	1	.0001	1.219			
Advanced Algebra (Dummy)	0.725	.032	520.1	1	.0001	2.065			
Historically Underperforming Status	-.566	.033	290.1	1	.0001	0.568			
Keystone Algebra Achievement Level	0.879	.035	628.4	1	.0001	2.407			

TABLE 6. Logistic Regression Analysis of Postsecondary Enrollment for 9th Grade Cohorts

Statistically Significant Individual Independent Variables	β	Se β	Wald's X^2	*df*	*p*	Exp(β) Odds Ratio	Model X^2 (*p*)	Pseudo R^2	*n*
Total # Rigorous Courses	.528	.004	20387.8	1	.0001	1.700	37443.9 (.0001)	.16	315143
Total # Advanced Courses	.213	.001	27510.9	1	.0001	1.238	48377.8 (.0001)	.21	315143
AP Courses Dummy (None=0; 1 or more=1)	1.844	.010	31028.3	1	.0001	6.323	39817.2 (.0001)	.17	315143
Historically Underperforming Status	-1.23	.008	22173.9	1	.0001	.292	22912.9 (.0001)	.10	315143
Keystone Literature Achievement Level	1.729	.016	11276.2	1	.0001	5.634	11635.2 (.0001)	.16	101632
Advanced Algebra	1.160	.011	10574.3	1	.0001	3.189	10323.1 (.0001)	.05	315143
Gender	-.501	.008	3862.8	1	.0001	.606	3910.3 (.0001)	.02	315143
Economically Disadvantaged	-1.032	.008	15567.2	1	.0001	.356	15597.9 (.0001)	.07	315143
Suburban	.577	.008	4796.5	1	.0001	1.781	4870.8 (.0001)	.02	289394
Final Models*									
Model 1***							**57699.7 (.0001)**	**.27**	**283864**
Constant	.043	.016	7.5	1	.006	1.043			
Total # Advanced Courses**	.174	.001	16921.7	1	.0001	1.190			
Advanced Algebra	.812	.013	3714.3	1	.0001	2.253			
Historically Underperforming Status	-.726	.009	5842.1	1	.0001	.484			
Gender	-.420	.009	2019.2	1	.0001	.657			
Suburban	.336	.009	1284.3	1	.0001	1.400			
Model 2							**21281.3 (.0001)**	**.30**	**91875**
Constant	-.539	.030	314.8	1	.0001	.583			
Total # Advanced Courses**	.153	.002	4486.4	1	.0001	1.165			
Historically Underperforming Status	-.498	.017	824.1	1	.0001	.608			
Advanced Algebra (Dummy)	.651	.024	711.8	1	.0001	1.917			
Gender	-.374	.017	506.8	1	.0001	.688			
Suburban	.318	.017	363.4	1	.0001	1.374			
Keystone Literature Achievement Level	.806	.019	1721.1	1	.0001	2.240			

TABLE 7. Logistic Regression Analysis of Postsecondary Persistence to Year 2

Individual Independent Variables	β	Se β	Wald's X^2	*df*	*p*	Exp(β) Odds Ratio	Model X^2 (*p*)	Pseudo R^2	*n*
Total # Rigorous Courses	.377	.004	7272.1	1	.0001	1.457	11414.1 (.0001)	.10	203098
Total # Advanced Courses	.145	.002	9245.4	1	.0001	1.156	13166.5 (.0001)	.11	203098
Enrollment Status at Entry (Part/Full-time)	1.948	.018	11975.6	1	.0001	7.017	10712.2 (.0001)	.10	191306
Advanced Algebra (Dummy)	.447	.021	444.9	1	.0001	1.564	413.0 (.0001)	.004	203098
Years (2-year/4-year)	1.674	.013	15594.0	1	.0001	5.334	15097.23 (.0001)	.13	202791
City	-.691	.017	1752.7	1	.0001	.501	1617.10 (.0001)	.02	182712
Historically Underperforming Status	-1.165	.013	8132.8	1	.0001	.312	7983.93 (.0001)	.07	203098
Economically Disadvantaged	-1.091	.013	6910.5	1	.0001	.336	6610.8 (.0001)	.06	203098
Keystone Algebra Achievement Level	1.234	.024	2626.8	1	.0001	3.435	2437.6 (.0001)	.06	66352
Final Models*									
Model 1***							**20741.2(.0001)**	**.211**	**171858**
Constant	.069	.032	4.7	1	.031	1.071			
Total # Advanced Courses**	.084	.002	2298.5	1	.0001	1.087			
Advanced Algebra (Dummy)	.193	.027	50.6	1	.0001	1.213			
Enrollment Status at Entry (Part/Full-time)	1.010	.022	2127.5	1	.0001	2.746			
Years (2-year/4-year)	.928	.018	2643.0	1	.0001	2.530			
City	-.304	.020	224.1	1	.0001	.738			
Historically Underperforming Status	-.566	.017	1145.2	1	.0001	.568			
Model 2							**6687.1 (.0001)**	**.207**	**56183**
Constant	-.070	.059	1.422	1	.233	.933			
Total # Advanced Courses**	.083	.003	745.4	1	.0001	1.087			
Years (2-year/4-year)	.868	.031	760.1	1	.0001	2.381			
Enrollment Status at Entry (Part/Full-time)	1.032	.039	712.8	1	.0001	2.805			
Advanced Algebra (Dummy)	.119	.048	6.1	1	.014	1.126			
City	-.218	.036	37.3	1	.0001	.805			
Historically Underperforming Status	-.491	.029	281.5	1	.0001	.612			
Keystone Algebra Achievement Level	.181	.033	31.0	1	.0001	1.199			
Model 3							**6727.6 (.0001)**	**.208**	**56183**
Constant	-.165	.057	8.5	1	.004	.848			
Total # Advanced Courses**	.084	.003	770.4	1	.0001	1.088			
Years (2-year/4-year)	.874	.031	772.1	1	.0001	2.396			
Enrollment Status at Entry (Part/Full-time)	1.046	.039	731.5	1	.0001	2.845			
Advanced Algebra (Dummy)	.145	.048	9.1	1	.003	1.156			
Keystone Algebra Achievement Level	.220	.032	46.5	1	.0001	1.246			
City	-.172	.036	22.5	1	.0001	.842			
Economically Disadvantaged	-.533	.030	325.2	1	.0001	.587			
Model 4***							**20887.5 (.0001)**	**.213**	**171858**
Constant	-.029	.031	.873	1	.350	.971			
Total # Advanced Courses**	.086	.002	2447.6	1	.0001	1.090			
Years (2-year/4-year)	.942	.018	2731.1	1	.0001	2.564			
Enrollment Status at Entry (Part/Full-time)	1.031	.022	2215.9	1	.0001	2.804			
Advanced Algebra (Dummy)	.235	.027	75.2	1	.0001	1.265			
City	-.255	.021	152.0	1	.0001	.775			
Economically Disadvantaged	-.618	.017	1306.0	1	.0001	.539			

TABLE 8. Logistic Regression Analysis of Postsecondary Retention to Year 2

Individual Independent Variables	β	Se β	Wald's X^2	*df*	*p*	Exp(β) Odds Ratio	Model X^2 (*p*)	Pseudo R^2	*n*
Total # Rigorous Courses	.258	.003	7901.9	1	.0001	1.295	10609.7 (.0001)	.08	203098
Total # Advanced Courses	.101	.001	9527.5	1	.0001	1.106	11712.8 (.0001)	.08	203098
Advanced Algebra (Dummy)	.220	.019	133.6	1	.0001	1.246	129.8 (.0001)	.001	203098
Enrollment Status at Entry (Part/Full-time)	1.538	.017	8172.9	1	.0001	4.656	7839.3 (.0001)	.06	191306
Years (2-year/4-year)	1.209	.012	10614.4	1	.0001	3.350	10285.8 (.0001)	.08	202791
Suburban	.291	.011	688.7	1	.0001	1.337	688.2 (.0001)	.006	182712
Historically Underperforming Status	-.843	.011	5873.27	1	.0001	.430	5747.4 (.0001)	.04	203098
Economically Disadvantaged	-.801	.011	4959.4	1	.0001	.449	4803.23 (.0001)	.04	203098
Keystone Algebra Achievement Level	1.000	.022	2156.23	1	.0001	2.718	2061.9 (.0001)	.05	66352
Final Models*									
Model 1***							**17906.2 (.0001)**	**.138**	**191088**
Constant	-.131	.018	55.4	1	.0001	.877			
Total # Rigorous Courses	.173	.003	3143.4	1	.0001	1.189			
Enrollment Status at Entry (Part/Full-time)	.890	.019	2129.2	1	.0001	2.436			
Years (2-year/4-year)	.624	.014	1884.7	1	.0001	1.866			
Economically Disadvantaged	-.485	.013	1435.1	1	.0001	.616			
Model 2							**5873.7 (.0001)**	**.139**	**62345**
Constant	-.307	.034	79.1	1	.0001	.736			
Total # Rigorous Courses	.159	.005	919.2	1	.0001	1.172			
Enrollment Status at Entry (Part/Full-time)	.876	.035	644.5	1	.0001	2.402			
Years (2-year/4-year)	.551	.026	461.7	1	.0001	1.735			
Economically Disadvantaged	-.431	.023	364.9	1	.0001	.650			
Keystone Algebra Achievement Level	.295	.026	130.8	1	.0001	1.343			

TABLE 9. Logistic Regression Analysis of Postsecondary Persistence to Year 3

Individual Independent Variables	β	Se β	Wald's X^2	*df*	*p*	Exp(β) Odds Ratio	Model X^2 (*p*)	Pseudo R^2	*n*
# Rigorous Courses	.385	.005	7054.0	1	.0001	1.47	10909.4 (.0001)	.12	135954
# Advanced Courses	.149	.002	9103.3	1	.0001	1.161	12828.6 (.0001)	.14	135954
Enrollment Status at Entry (Part/Full-time)	1.889	.021	8154.9	1	.0001	6.613	7986.8 (.0001)	.10	128149
Years (2-year/4-year Institution)	1.828	.015	15310.2	1	.0001	6.219	15339.18 (.0001)	.17	135763
Economically Disadvantaged	-1.126	.014	6288.6	1	.0001	.324	6094.6 (.0001)	.068	135954
City	-.674	.018	1398.2	1	.0001	.510	1319.8 (.0001)	.017	122158
Institution Sector	.584	.016	1353.3	1	.0001	1.792	1450.3 (.0001)	.016	135954
Advanced Algebra	.418	.023	327.5	1	.0001	1.519	310.6 (.0001)	.004	135954
Historically Underperforming Status	-1.201	.014	7526.5	1	.0001	.301	7430.8 (.0001)	.08	135954
Final Model*									
Model 1							**22560.1 (.0001)**	**.26**	**128023**
Constant	-.363	.023	247.99	2	.0001	.695			
Total # Advanced Courses**	.091	.002	2897.1	1	.0001	1.095			
Enrollment Status at Entry (Part/Full-time)	.832	.024	1170.48	1	.0001	2.299			
Years (2-year/4-year)	1.139	.018	3990.03	1	.0001	3.123			
Historically Underperforming Status	-.704	.016	1895.8	1	.0001	.695			
Model 2							**22750.4 (.0001)**	**.257**	**128023**
Constant	-.430	.022	370.3	1	.0001	.650			
Total # Advanced Courses**	.094	.002	3104.9	1	.0001	1.099			
Years (2-year/4-year)	1.161	.018	4150.7	1	.0001	3.192			
Enrollment Status at Entry (Part/Full-time)	.852	.024	1228.5	1	.0001	2.344			
Economically Disadvantaged	-.758	.017	2101.3	1	.0001	.469			

TABLE 10. Logistic Regression Analysis of Postsecondary Retention to Year 3

Individual Independent Variables	β	Se β	Wald's X^2	*df*	*p*	Exp(β) Odds Ratio	Model X^2 (*p*)	Pseudo R^2	*n*
Total # Rigorous Courses	.282	.003	8362.8	1	.0001	1.326	11118.4 (.0001)	.11	135954
Total # Advanced Courses	.113	.001	10479.4	1	.0001	1.120	12840.7 (.0001)	.12	135954
Enrollment Status at Entry (Part/Full-time)	1.578	.022	5297.02	1	.0001	4.845	5824.20 (.0001)	.06	128149
Years (2-year/4-year)	1.781	.014	15196.8	1	.0001	5.993	16617.7 (.0001)	.16	135763
Economically Disadvantaged	-.866	.013	4469.3	1	.0001	.421	4467.9 (.0001)	.044	135954
Historically Underperforming Status	-.916	.012	5456.6	1	.0001	.400	5477.5 (.0001)	.05	135954
Institution Sector	.584	.016	1353.3	1	.0001	1.792	1450.3 (.0001)	.016	135954
Advanced Algebra	.418	.023	327.5	1	.0001	1.519	310.6 (.0001)	.004	135954
Historically Underperforming Status	-1.201	.014	7526.5	1	.0001	.301	7430.8 (.0001)	.08	135954
Final Models*									
Model 1							**22252.3 (.0001)**	**.22**	**128023**
Constant	-1.053	.024	1946.7	1	.0001	.349			
Total # Advanced Courses**	.071	.001	3510.3	1	.0001	1.074			
Enrollment Status at Entry (Part vs. Full-time)	.482	.025	369.7	1	.0001	1.620			
Years (2-year/4-year)	1.269	.017	5682.118	1	.0001	3.557			
Historically Underperforming Status	-.452	.014	999.311	1	.0001	.636			
Model 2							**22421.3 (.0001)**	**.222**	**128023**
Constant	-1.085	.023	2151.2	1	.0001	.338			
Total # Advanced Courses**	.073	.001	3668.0	1	.0001	1.075			
Years (2-year/4-year)	1.282	.017	5806.0	1	.0001	3.603			
Enrollment Status at Entry (Part/Full-time)	.492	.025	386.1	1	.0001	1.636			
Economically Disadvantaged	-.506	.015	1169.5	1	.0001	.603			

TABLE 11. Logistic Regression Analysis of Postsecondary Graduation within 4 Years

Statistically Significant Individual Independent Variables	β	Se β	Wald's X^2	*df*	*p*	Exp(β) Odds Ratio	Model X^2 (*p*)	Pseudo R^2	*n*
Total # Rigorous Courses	.216	.004	3766.0	1	.0001	1.241	4431.7 (.0001)	.08	68497
Total # Advanced Courses	.088	.001	4480.8	1	.0001	1.092	4975.6 (.0001)	.10	68497
Enrollment Status at Entry (Part/Full-time)	1.749	.038	2131.6	1	.0001	5.74	2887.2 (.0001)	.06	64664
Years (2-year/4-year)	1.055	.020	2701.2	1	.0001	2.872	2930.6 (.0001)	.06	68497
Historically Underperforming Status	-1.022	.018	3127.6	1	.0001	.360	3328.8 (.0001)	.06	68497
Institution Sector (Public/Private)	.724	.017	1793.8	1	.0001	2.062	1829.3 (.0001)	.04	68497
City	-.799	.025	1062.6	1	.450	.450	1128.8 (.0001)	.02	61961
Economically Disadvantaged	-.972	.019	2531.5	1	.0001	.378	2701.7 (.0001)	.052	68497
Final Model*									
Model 1							**8837.5 (.0001)**	**.17**	**64605**
Total # Advanced Courses**	.062	.001	1850.7	1	.0001	1.064			
Enrollment Status at Entry (Part/Full-time)	1.152	.041	784.92	1	.0001	3.163			
Years (2- year/4-year)	.200	.024	67.834	1	.0001	1.221			
Institution Sector (Public/Private)	.540	.019	773.8	1	.0001	1.715			
Historically Underperforming Status	-.731	.020	1326.3	1	.0001	.482			

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