UTAH DATA RESEARCH CENTER

Postsecondary Outcomes for Low-Income Students in Utah

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Abstract

Education is an important component of human capital, and college education is crucial for upward mobility for low-income students. This research uses data from the Utah State Board of Education (USBE) and the Utah System of Higher Education (USHE) to investigate postsecondary outcomes for low-income students from Utah high school cohorts 2012 to 2014. Low-income status is determined by students' eligibility to receive free or reduced lunch as of their last high school enrollment. Postsecondary outcomes examined include enrollment, cumulative GPA, award achievement, drop-out pattern, time to enrollment, time to award, and time to drop out. Levene's tests and t-tests were applied to identify any statistically significant differences in these outcomes between low-income students and the control group. The results suggest that while low-income status is associated with lower postsecondary enrollment and award rates as well as higher drop-out rates, the differences in length of time to enrollment, awards, and drop-out were not significant among low-income students and the control group. Furthermore, percentages of students enrolling, dropping out, and receiving various levels of awards are illustrated to provide an overview of the loss of low-income students in postsecondary education.

Keywords

low-income, postsecondary outcomes, Utah System of Higher Education, State of Utah, Utah State Board of Education

1 | Introduction

1.1 | Background

While the Utah Data Research Center (UDRC) has conducted studies on Utah students' characteristics such as intergenerational poverty (Martinez, 2021; Martinez, 2020; Martinez, 2019), gender (Tao & Scott, 2021), and area deprivation in Utah (Fenn, 2021), effects of being low-income in high school is a topic to be explored. This study focuses on the education outcomes such as enrollment and awards for low-income students in Utah.

Understanding low-income students' postsecondary outcomes may be valuable as 30% of the students in this study met the criteria for being considered "low-income" (See Table 2). Education is an important component of human capital, and education attainment could potentially increase productivity as well as long-term wages (Heckman, Humphries, & Gregory, 2018; Becker, 1964). Career and Technical Education (CTE) program graduates in Utah experienced 35% to 59% higher wages (Scott, 2019). In addition, the completion of any postsecondary program is associated with higher wages and increased general consumption. This increase in consumption benefits the state from both increased economic activity and potential sales tax collected (Scott, 2020). The current study aims to focus on low-income students in Utah and their education outcomes to develop a deeper understanding of the challenges they face as they pursue postsecondary education.

In addition to common indicators of student success such as enrollment in postsecondary education, award attainment, and length of time to award (Venezia, 2005), this study also investigates students' performance such as grade point average (GPA) and drop-out patterns. GPA could be an estimate of students' academic performance, while drop-out patterns could highlight the demographic who discontinue postsecondary education after the initial enrollment. Financial burden is a possible factor for low-income students to consider when deciding whether to pursue postsecondary enrollment and if so, whether to continue their postsecondary education after the initial postsecondary enrollment.

For the purpose of this study, "low-income" is defined by the eligibility to receive free or reduced lunch benefits. For each student, the low-income status is collected from the last enrollment record in USBE data. Those who were eligible to receive free or reduced lunch benefits in high school according to their last high school enrollment were the "low-income" students in this study. In contrast, high school students who were not eligible for free or reduced lunch benefits as of the last high school enrollment were considered the control group for this research, even if they had been eligible in enrollment records prior to their last enrollment at USBE. This study examines students in the high school cohort from 2012 to 2014. Table 1 includes the Annual Household Income Limits before taxes in this timeframe to be eligible for The School Breakfast Program (USDA, 2022). Household income limits for the school year 2021-2022 are included for reference purposes.

This study aims to investigate postsecondary outcomes such as students' enrollment at a degree-granting institution or technical college, students' last cumulative GPA at degree-granting institutions, time frame to students' first enrollment, students' attainment level such as associate degree and bachelor's degree, time frame to students' first awards by attainment level, and students' drop-out pattern in postsecondary institutions. For each outcome, low-income students and the control group are compared to identify any statistical

Table 1: Annual Household Income Limits before taxes to be eligible for The School Breakfast Program (USDA, 2022)

Household Size	SY 21-22	SY 14-15	SY 13-14	SY 12-13
1	$23,828	$21,590	$21,257	$20,665
2	$32,227	$29,101	$28,694	$27,991
3	$40,626	$36,612	$36,131	$35,317
4	$49,025	$44,123	$43,568	$42,643
5	$57,424	$51,634	$51,005	$49,969
6	$65,823	$59,145	$58,442	$57,295
7	$74,222	$66,656	$65,879	$64,621
8	$82,621	$74,167	$73,316	$71,947

significance using Levene's test and t-tests. Levene's tests are applied to examine whether the variances in the different education outcomes are equal for low-income students and the control group. With results from Levene's tests, student's t-tests or Welch's t-tests are subsequently applied to identify statistically significant differences between these two groups of students.

With student demographic data from USBE and enrollment and awards data from USHE, the objectives of this study include the following: 1) To analyze the difference between the control group and low-income students in postsecondary enrollment and award, level of achievement, time to award, and GPA in Utah postsecondary education. 2) To identify patterns in various postsecondary measures, such as postsecondary enrollment, postsecondary awards, time to postsecondary enrollment and award, and GPA, and determine if statistical significance exists between students who were eligible for free or reduced lunch and those who were not.

1.2 | Literature Review

The relationship between socioeconomic status (SES) and educational attainment has been well documented (White, 1982; McLoyd, 1989; McLoyd, 1998; Sirin, 2005; Bailey & Dynarski, 2011). The aim of this literature review is to highlight a few prominent studies on the topic and provide historical background to contrast with the current study which focuses on recent high school cohorts. Overall, previous works of literature suggest a positive relationship between household income and children's academic achievement.

In social science, McLoyd (1989; 1998) documented the relation of poverty and low SES to a range of negative child outcomes, such as low IQ, educational attainment and achievement, and social-emotional problems. McLoyd's (1989) review provided strong evidence that children whose parents experience economic difficulties are more pessimistic about their educational and vocational futures. Parents with financial strain and unstable employment may display signs of depressed mood and lower levels of warmth, nurturance, and monitoring of children. McLoyd noted that family income, in contrast with differences in children's socio-emotional function or neighborhood income, accounted for more differences in children's cognitive development and academic achievement.

With a sample of over 100,000 students at 6,871 schools and 128 school districts, Sirin (2005) performed a meta-analysis similar to White's (1982) review. Sirin reported a weaker correlation between SES and academic performance than the correlation White found using the 1970s data. Sirin attributed the weaker correlation to changes in policies such as the availability of funding. Sirin found the size of the relationship between SES and educational attainment increased by each school level, suggesting that the gap between low- and high-SES students in academic achievement expanded throughout students' lives. In addition, Sirin found that students from lower SES backgrounds achieved lower GPAs and had a higher drop-out rate when compared with their peers.

Another research noted that college choice was determined not only by the students and their academic preparation, but also by financial constraints, lack of information about the value of different college options, and other factors that are driven by family, peers, school, and community (Bailey & Dynarski, 2011). Authors further found one-third of low-income students received bachelor's degrees by age 25, compared to two-thirds of their peers. Students from high-income families were six times more likely than those from low-income families to receive a bachelor's degree by age 25. The authors highlighted the complex interaction of financial, academic, and social factors in students' college completion even after enrollment at college.

In contrast, another study (Hamilton, 2013) reported a negative relationship between family financial support and grades and a positive relationship with degree completion in a nationally representative sample. The author suggested that students with parental funding may perform well enough to remain in school without striving for a high GPA. At the same time, parents who faced SES disadvantage were less engaged in their children's academic choices and experiences than more affluent parents. As a result, parents' financial investment was positively correlated to college completion, while negatively correlated to GPA.

2 | Methods

2.1 | Data

To study the effects of being eligible for low or free lunch on postsecondary educational outcomes, data from the public high school cohorts from 2012 to 2014 are joined with enrollment and graduation data from USHE. For each student, the binary low-income indicator from the last enrollment record at USBE was used to identify those who were low-income. For this study, students who had "1" in this binary low-income indicator variable from their last USBE enrollment records were identified as "low-income" students. In contrast, students who had "0" from their last USBE enrollment records were considered the control group. The number of

students from these cohorts was 118,524. Among all students, 82,115 were in the control group, while 35,648 were identified as low-income students.

In addition, demographic data at USBE enrollment for each student were collected. Demographic variables examined in this study include gender, race, immigration status, refugee status, English language learning (ELL) status, and special education status. As the focus of this study is primarily on the effects of experiencing low-income, demographic data are only examined to illuminate the students' background instead of acting as inputs to statistical tests performed.

In the race category, the main subgroups are Asian, Black, White, Hispanic, Native American, Multiracial, Pacific Islander, and Unknown. Immigration status, refugee status, and special education status are binary variables indicating whether a student was identified in these groups. Students' most recent ELL status in USBE data is transformed to a binary variable, with "1" representing those who were English learners (Y) or eligible but opted out (O), and "0" representing those who reclassified as fluent (F), were monitored (M), or not needed (N).

Next, enrollment and graduation data from USHE are joined with USBE data. For data quality, students whose first awards at a postsecondary institution in Utah were graduate degrees without obtaining a prior bachelor's, associate, or lower level of attainment were excluded from this study. This process removed 761 students from this study. As a result, the final sample size for this study consists of 117,763 students.

For each student, binary variables are created to denote whether the individual enrolled at a degree-granting institution or technical college, whether the individual obtained at least one postsecondary award, whether the individual had concurrent enrollment or enrolled at a technical college while in high school, and whether the individual dropped out of postsecondary education. Finally, numeric, continuous variables are obtained to represent the individual's GPA from degree-granting institutions for those who enrolled, the time between high school completion and the first academic year of postsecondary enrollment, the time between the first postsecondary enrollment and award, and the length of time the individual remained enrolled in postsecondary education prior to dropping out.

For the binary indicators of postsecondary enrollment and award status, data from degree-granting institutions and technical colleges were combined to indicate whether the student continued their education beyond high school and subsequently received an award. Award levels are obtained from degree-granting institutions for comparison of those obtaining the same type of degree. The main award levels from degree-granting institutions are certificate--less than one year, certificate--one to two years, associate, bachelor's, and graduate degrees. Students' first enrollment date at a degree-granting institution after high school completion is considered their first enrollment, to exclude concurrent enrollment students. For technical colleges, students must be certificate seekers to be considered enrolled. Completion of technical colleges must have an exit code of "graduate" to be considered as receiving an award. Award levels at technical colleges are coded according to the lengths of the awards obtained by students. Certificates requiring less than 300 hours were coded as level 1A, certificates requiring 300 to 900 hours were coded as level 1B, and certificates requiring more than 900 hours were coded as level two.

Concurrent enrollment is defined as students appearing in degree-granting institution enrollment data prior to high school completion. Enrollment at a technical college while in high school is defined by having an enrollment objective of "secondary" in enrollment data from technical colleges.

GPA for those enrolled at a degree-granting institution is defined as the last cumulative GPA for the individual, excluding nulls. For data quality, GPA values between 0.001 and 0.100 on a 4.0 scale were excluded from this study analysis. GPAs of zero were included, in addition to GPA values from 0.101 to 4.000.

"Dropping out" in this study is defined as students who enrolled at a postsecondary institution but have not yet received an award, and were not enrolled for the academic year 2020, the latest data the UDRC had access to as of the time of this report. The limitation of using this definition is that the students may be absent this school year but plan on returning; however, this approximation represents the length of time the students remained in postsecondary education prior to stopping. As the lengths of various programs could be drastically different for degree-granting institutions and technical colleges, separate statistical tests were performed.

Time to awards at a degree-granting institution is defined as the time between students' first enrollment at a degree-granting institution and their first award. This definition eliminates any potential delays between high school completion and students' first postsecondary enrollment. Time to enrollment, time to awards, and time to drop out are measured in years for degree-granting institutions. In contrast, time to awards and time to drop out are measured in days for technical colleges as programs at technical colleges tend to require fewer hours to complete. Time to awards

in technical colleges is the difference between students' first start date and their first exit date with an exit code of "graduation". The number of days in technical colleges prior to dropping out is the difference between students' first start date and their last exit date.

2.2 | Statistical Testing

To study the statistical significance in education outcomes, Levene's test and t-tests are performed to evaluate the outcomes of low-income students and the control group. Levene's test is applied to evaluate if the variances in education outcomes are different for these two groups of students. For this study, Levene's test is used to check the assumption of equal variances or homoscedasticity before proceeding with the appropriate t-test. A p-value greater than 0.05 of Levene's test shows that the variances are equal and there is no difference in variances of both groups.

When variances in education outcomes are the same for low-income students and the control group, a student's t-test is then applied to examine any statistically significant difference in the education outcome; otherwise, a Welch's t-test is performed. A t-test is generally used to test the hypothesis that the averages in two different groups are the same. A student's t-test assumes equal variances in the outcomes of the two groups, while a Welch's t-test does not.

In addition, chi-square tests are performed to examine whether low-income status and education outcomes are independent. While t-tests are typically performed on numeric data, such as length of time to enrollment, chi-square tests are performed on categorical data, such as whether students enroll or receive an award. The null hypothesis of the chi-square test of independence for this study is that the education outcomes are independent of students' low-income status.

The statistical tests in this study are performed in python version 3.9.7 with SciPy library version 1.7.1.

2.3 | Limitations

The current study is limited in a few ways. First, USHE data only include public technical colleges and degree-granting institutions in Utah. Data from private postsecondary institutions such as Brigham Young University and Westminster College were not available for this study. In addition, enrollment and awards data were not available for students who continued their academic careers outside of Utah.

Second, low-income students are identified by using the last high school enrollment record. This method does not distinguish between long-term and short-term poverty. Children who experienced long-term low household income may suffer more developmental concerns. Low-income status at the last high school enrollment does not capture the full history of students' experiences.

Third, the tests do not establish causal relations between being low-income and postsecondary outcomes. Levene's test and t-test establish whether the differences between the variances and the averages between low-income students and the control group are statistically significant. However, many other factors contribute to students' postsecondary success. For example, parental involvement in children's education decisions, influence from peer groups, and advice from school counselors. A sense of belonging was found to be critical to students' success at college (Strayhorn, 2018). How students connect with their environment and others could have an impact on their postsecondary outcomes. These factors were not measured or studied in the current research but could be crucial in students' academic success.

Finally, the definition of dropping out serves as an approximation as it may be limited to students who were not enrolled for the academic year 2020. Students may have opted out this year and returned at a later date.

3 | Results

3.1 | Descriptive Statistics

Sample for this study consists of USBE graduating cohorts 2012 – 2014, or 117,763 students who completed high school between 2012 and 2014 in Utah. Table 2 is the make-up of each demographic subgroup. Please see Appendix Table A for the demographic information for the low-income students in this study.

3.2 | Concurrent or technical college enrollment while in high school

The effects of concurrent enrollment (CE) and technical school enrollment while in high school are first studied. Overall, 43.80% of the students enrolled at a postsecondary institution while in high school. For low-income high school students, 32.87% had CE or technical college enrollment while in high school. Students in the control group had a 48.55% postsecondary enrollment rate while in high school. Of those who continued onto postsecondary enrollment after high school completion, 59.92% had CE or technical college enrollment while in high school.

High school students who plan to attend degree-granting institutions after high school completion may pursue concurrent enrollment, while high school students who plan to attend a technical

Table 2: Demographic summaries for USBE cohorts studied in this research. N=117,763

Demographic group	Number of students	Percentage
Low Income	35,648	30.27%
Non-Low Income (control)	82,115	69.73%
Male	60,867	51.69%
Female	56,896	48.31%
Refugee	239	0.20%
Special Education	12,075	10.25%
Immigrant	1,059	0.90%
English Learner	4,687	3.98%
Asian	2,753	2.34%
Black	2,032	1.73%
White	91,379	77.60%
Hispanic	17,253	14.65%
Native American	1,975	1.68%
Multiracial	193	0.16%
Pacific Islander	1,926	1.64%
Unknown	252	0.21%

college may enroll at a technical college while in high school.

Separate two-way ANOVA analyses were performed to examine the interaction term between low-income status and enrollment at a postsecondary institution while in high school. The p-values obtained from ANOVA analysis on enrollment at a degree-granting institution for low-income status, concurrent enrollment, and the interaction term are statistically significant ($p<0.05$). This result indicates that low-income status is significantly associated with enrollment at degree-granting institutions, concurrent enrollment is significantly associated with enrollment at degree-granting institutions, and interaction of both low-income status and concurrent enrollment is significantly associated with enrollment at a degree-granting institution. Students who had concurrent enrollment while in high school are associated with a higher enrollment rate at degree-granting institutions, while low-income students are associated with a lower enrollment rate at degree-granting institutions.

The p-values obtained from ANOVA analysis on enrollment at a technical college for low-income status, technical college enrollment while in high school, and the interaction term are statistically significant ($p<0.05$). The result signals that low-income status significantly affects enrollment at technical colleges, technical college enrollment while in high school significantly affects enrollment at technical colleges after high school completion, and interaction of both low-income status and technical college enrollment while in high school significantly affects enrollment in technical colleges. Students who enrolled at a technical college while in high school are associated with a higher enrollment rate at technical colleges, while low-income students are associated with a lower enrollment rate at technical colleges.

3.3 | Postsecondary enrollment

Among all students in the sample, 30.27% were low-income students. Overall, 50.26% of the students enrolled in at least one postsecondary institution. Of all low-income students, 37.73% enrolled in postsecondary education. In contrast, 55.70% of the control group enrolled in a postsecondary institution. Among all enrolled students, 22.72% were low-income students. Table 3 is the make-up of each demographic subgroup for those who enrolled at a postsecondary institution.

Table 3: Demographic summaries for high school students who enrolled in postsecondary education. N=59,190

Demographic group	Number of students	Percentage
Low Income	13,449	22.72%
Non-Low Income (control)	45,741	77.28%
Male	29,487	49.82%
Female	29,703	50.18%
Refugee	109	0.18%
Special Education	3,285	5.55%
Immigrant	344	0.58%
English Learner	888	1.50%
Asian	1,391	2.35%
Black	829	1.40%
White	49,553	83.72%
Hispanic	5,863	9.91%
Native American	602	1.02%
Multiracial	75	0.13%
Pacific Islander	751	1.27%
Unknown	126	0.21%

Chi-square test was performed to examine the relationship between low-income status and postsecondary enrollment. The null hypothesis for this chi-square test is that no significant association exists between low-income status and postsecondary enrollment. With the resulting p-value from this Chi-square test less than 0.001, the null hypothesis is rejected. Students' low-income status and their postsecondary enrollment are related.

To study whether statistical significance exists in postsecondary enrollment for the control group and the low-income students, Levene's test was first applied to examine the equality of variance in enrollment rates between these two groups. Equal variance in different groups is sometimes called homogeneity of variance. The null hypothesis for this Levene's test is that the variances are equal, or that the variances in postsecondary enrollment rates for low-income students and the control group are equal. With the resulting p-value from this Levene's test less than 0.001, the null hypothesis is rejected. The variances in postsecondary enrollment rates for the control group and the low-income students are significantly different.

With the result of Levene's test, a Welch's t-test is performed to study if postsecondary enrollment is significantly different for the control group and low-income students. Welch's t-test is chosen instead of the standard student's t-test as the variances between these two groups are not equal. The null hypothesis for this Welch's t-test is that no difference in postsecondary enrollment exists between the control group and the low-income students. With the resulting p-value from this Welch's t-test less than 0.001, the null hypothesis is rejected. The postsecondary enrollment rate is statistically significantly lower for low-income students compared to the control group.

Further statistical testing was performed to examine the interaction between low-income status and gender (Appendix Supplementary Information A) as well as low-income status and concurrent enrollment and technical college enrollment while in high school (Appendix Supplementary Information B). Please see Appendix for details of these tests.

3.4 | Postsecondary awards

Among those who enrolled in a postsecondary institution, 44.21% received at least one USHE postsecondary award prior to 2022. Of all low-income students, 34.35% received at least one postsecondary award. In contrast, 47.10% of the control group received at least one award. For all students who received at least one award, 17.66% were low-income students. Table 4 breaks down the demographic make-up of those who received an award.

Table 4: Demographic summaries for high school students who received at least one USHE postsecondary award. N=26,166

Demographic group	Number of students	Percentage
Low Income	4,620	17.66%
Non-Low Income (control)	21,546	82.34%
Male	11,233	42.93%
Female	14,933	57.07%
Refugee	21	0.08%
Special Education	933	3.57%
Immigrant	128	0.49%
English Learner	190	0.73%
Asian	684	2.61%
Black	208	0.79%
White	23,088	88.24%
Hispanic	1,804	6.89%
Native American	159	0.61%
Multiracial	15	0.06%
Pacific Islander	160	0.61%
Unknown	48	0.18%

A chi-square test was performed to examine the relationship between low-income status and postsecondary awards. The null hypothesis for this chi-square test is that no significant association exists between low-income status and postsecondary awards. With the resulting p-value from this chi-square test less than 0.001, the null hypothesis is rejected. Students' low-income status is related to whether they received at least one postsecondary award. Please see table 15 for a summary of all statistics tests and results for the various postsecondary outcomes studied in this research.

To study whether statistical significance exists in receiving at least one postsecondary award between the control group and the low-income students, Levene's test was first applied to examine the equality of variance in award rates between these two groups. The null hypothesis for this Levene's test is that the variances are equal, or that the variances in postsecondary award rates for low-income students and the control group are equal. With the resulting p-value from this Levene's test less than 0.001, the null hypothesis is rejected. The variances in postsecondary award rates for the control group and the low-income students are

significantly different.

With the result of Levene's test verifying that the variances are not equal, a Welch's t-test is performed to study if the postsecondary award rate is significantly different for the control group and low-income students. The null hypothesis for this Welch's t-test is that no difference in postsecondary awards exists between the control group and low-income students. With the resulting p-value from this Welch's t-test less than 0.001, the null hypothesis is rejected. The postsecondary award rate is significantly lower for low-income students compared to the control group.

Further statistical testing was performed to examine the interaction between low-income status and gender on postsecondary awards. Please see Appendix Supplementary Information C for the results of the ANOVA test.

3.5 | Students at degree-granting institutions

For students who enrolled at degree-granting institutions after completing high school, a few education outcomes were studied. These outcomes include the length of time between high school completion and enrollment at a degree-granting institution, cumulative GPA while enrolled in a degree-granting institution, level of attainment, length of time between postsecondary enrollment and award, whether the student dropped out, and length of time before dropping out for those who did.

3.5.1 | Time to enrollment at degree-granting institutions

Overall, it took 1.9 years on average for students to enroll in a degree-granting institution after high school completion. Among those who enrolled at a degree-granting institution, 77.92% were students from the control group, while 22.08% were low-income students. For the control group, the average time to enroll was 1.90 years. For low-income students, the average was 1.94 years. Table 5 breaks down the demographic make-up of those who enrolled at a degree-granting institution and the average length of time to enrollment. One possible explanation for the difference in length of time to enrollment for male and female students could be for those who serve an ecclesiastical mission after high school completion, men serve two years for LDS missions, while women serve one and a half years.

To study whether statistical significance exists in the length of time to enrollment at a degree-granting

Table 5: Demographic summaries for high school students who enrolled at a degree-granting institution and the average length of time to enrollment. N=55,801

Demographic group	Number of students	Percentage	Time in years to Enrollment
Low Income	12,323	22.08%	1.94
Non-Low Income (control)	43,478	77.92%	1.90
Male	27,702	49.64%	2.26
Female	28,099	50.36%	1.56
Refugee	109	0.20%	1.48
Special Education	2,732	4.90%	2.16
Immigrant	314	0.56%	1.65
English Learner	815	1.46%	1.79
Asian	1,372	2.46%	1.48
Black	787	1.41%	1.87
White	46,804	83.88%	1.93
Hispanic	5,362	9.61%	1.81
Native American	560	1.00%	1.81
Multiracial	75	0.13%	2.07
Pacific Islander	728	1.30%	2.29
Unknown	113	0.20%	1.79

institution between the control group and the low-income students, Levene's test was applied to examine the equality of variance in the length of time to enrollment a degree-granting institution between these two groups before a t-test was performed. The null hypothesis for this Levene's test is that the variances are equal, or that the variances in time to enrollment at a degree-granting institution for low-income students and the control group are equal. With the resulting p-value from this Levene's test less than 0.001, the null hypothesis is rejected. The variances in time to enrollment at a degree-granting institution for the control group and the low-income students are significantly different.

With the result of Levene's test verifying that the variances are not equal, a Welch's t-test is performed to study if the length of time to enrollment at a degree-granting institution is significantly different for the control group and low-income students. The null hypothesis for this Welch's t-test is that no difference in the length of time to enrollment at a degree-granting institution exists between the control group and low-income students. With the resulting p-value from this Welch's t-test less than 0.05, the null hypothesis is rejected. The length of time to enroll in a degree-granting institution is statistically significantly longer for low-income students compared to the control group.

3.5.2 | Cumulative GPA at degree-granting institutions

Cumulative GPA can be an estimate of academic performance. The average GPA for all students who enrolled at a degree-granting institution was 2.655. The average GPA for students in the control group was 2.741, while the average GPA for low-income students was 2.350. Table 6 contains the average GPA for students in various demographic groups.

To study whether statistical significance exists in cumulative GPA between the control group and the low-income students, Levene's test was applied to examine the equality of variance in cumulative GPA between these two groups before a t-test was performed. The null hypothesis for this Levene's test is that the variances are equal, or that the variances of cumulative GPA for low-income students and the control group are equal. With the resulting p-value from this Levene's test less than 0.001, the null hypothesis is rejected. The variances in cumulative GPA for the control group and the low-income students are significantly different.

With the result of Levene's test verifying that the variances are not equal, Welch's t-test is performed to study if cumulative GPA is significantly different for the control group and low-income students. The null hypothesis for this Welch's t-test is that no difference in cumulative GPA exists between the control group and low-income students. With the resulting p-value from this Welch's t-test less than 0.001, the null hypothesis is rejected. The cumulative GPA is statistically significantly lower for low-income students compared to the control group.

Table 6: Average GPA for students in various demographic groups. N=55,801

Demographic group	Average GPA
Low Income	2.350
Non-Low Income (control)	2.741
Male	2.537
Female	2.770
Refugee	2.262
Non-Refugee	2.656
Special Education	2.125
Non-Special Education	2.682
Immigrant	2.423
Non-Immigrant	2.656
English Learner	2.018
Non-English Learner	2.664
Asian	2.696
Black	2.094
White	2.734
Hispanic	2.203
Native American	1.995
Multiracial	2.232
Pacific Islander	2.022
Unknown	2.425

3.5.3 | Levels of attainment at degree-granting institutions

Among all students who enrolled at a degree-granting institution, 40.82% obtained an award prior to 2022. Of those who received an award, 15.97% were low-income students. For all students from the control group who enrolled at a degree-granting institution, 44.02% obtained an award. Of all low-income students who enrolled at a degree-granting institution, 29.52% obtained an award.

Students may obtain various levels of academic degrees from degree-granting institutions. The main categories are certificates requiring less than one year, certificates requiring one to two years, associate degrees, bachelor's degrees, and graduate

degrees. Figure 1 demonstrates the proportions of students obtaining different types of degrees. The amount of time required to obtain these degrees increases from left to right. Due to the insufficient sample size of low-income students obtaining a graduate degree, students obtaining graduate degrees are not shown in Figure 1.

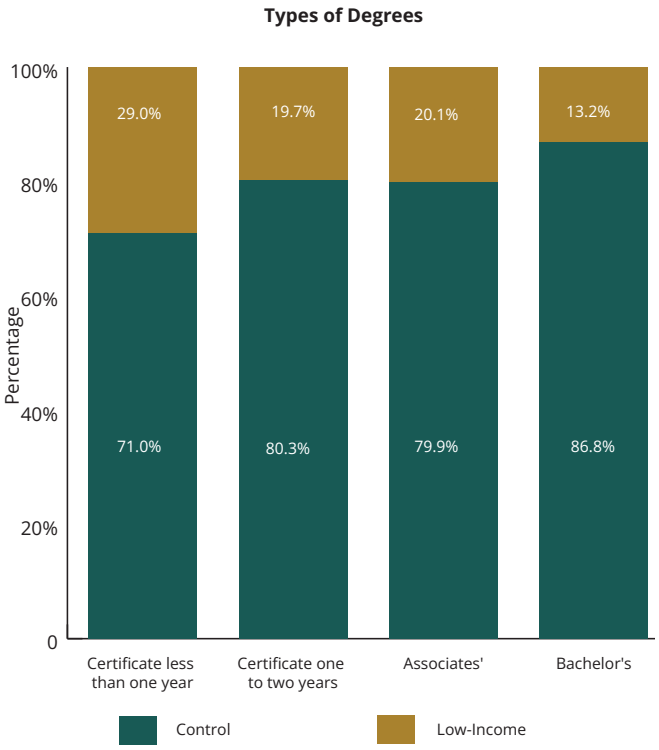

Figure 1: Proportion of students obtaining different levels of degree attainment

The amount of time required to obtain these degrees could vary drastically. Students are further separated by their highest attainments to further examine any statistically significant differences in the length of the time to receive an award between the control group and low-income students for each level of degree attainment. Table 7 shows the average length of time to receive a certificate requiring less than one year.

For students who received a certificate requiring less than one year, Levene's test was first applied to examine the equality of variance in the length of time to award between low-income students and the control group. The null hypothesis for this Levene's test is that the variances are equal, or that the variances of the length of time to receive a certificate requiring less than one year for low-income students and the control group are equal. With the resulting p-value from this Levene's test greater than 0.05, the null hypothesis is not rejected. The variances in the length of time to receive a certificate requiring less than one year for the control group and the low-income students are not significantly different.

Table 7: Average length of time to receive a certificate requiring less than one year from a degree-granting institution for students in various demographic groups. N=334

Demographic group	Number of students	Percentage	Time in years to award
Low Income	97	29.04%	1.61
Non-Low Income (control)	237	70.96%	1.97
Male	221	66.17%	2.00
Female	113	33.83%	1.58
Refugee	--	--	--
Special Education	33	9.88%	1.79
Non-Special Education	301	90.12%	1.87
Immigrant	--	--	--
English Learner	--	--	--
Asian	--	--	--
Black	--	--	--
White	268	80.24%	1.90
Hispanic	57	17.07%	1.68
Native American	--	--	--
Multiracial	--	--	--
Pacific Islander	--	--	--
Unknown	--	--	--

Note: -- denotes insufficient sample size

With the result of Levene's test, a student's t-test is performed to study if the length of time to receive a certificate requiring less than one year is significantly different for the control group and low-income students. The null hypothesis for this student's t-test is that no difference in the length of time to receive a certificate requiring less than one year exists between the control group and low-income students. With the resulting p-value from this student's t-test greater than 0.05, the null hypothesis is not rejected. The length of time to receive a certificate requiring less than one year is not significantly different for low-income students compared to the control group.

The next type of degree studied is certificates

requiring one to two years at a degree-granting institution. Table 8 shows the average length of time to receive a certificate requiring less than one year.

Table 8: Average length of time to receive a certificate requiring one to two years from a degree-granting institution for students in various demographic groups. N=1,008

Demographic group	Number of students	Percentage	Time in years to award
Low Income	199	19.74%	3.77
Non-Low Income (control)	809	80.26%	3.72
Male	684	67.86%	3.66
Female	324	32.14%	3.89
Refugee	--	--	--
Special Education	48	4.76%	3.38
Non-Special Education	960	95.24%	3.75
Immigrant	--	--	--
English Learner	12	1.19%	3.25
Non-English Learner	996	98.81%	3.74
Asian	26	2.58%	4.04
Black	--	--	--
White	882	87.50%	3.71
Hispanic	76	7.54%	3.78
Native American	--	--	--
Multiracial	--	--	--
Pacific Islander	12	1.19%	3.42
Unknown	--	--	--

Note: -- denotes insufficient sample size

For students who received a certificate requiring one to two years, Levene's test was first applied to examine the equality of variance in the length of time to award between low-income students and the control group. The null hypothesis for this Levene's test is that the variances are equal, or that the variances of the length of time to receive a certificate requiring one to two years for low-income students and the control group are equal. With the resulting p-value from this Levene's test greater than 0.05, the null hypothesis is not rejected. The variances in the length of time to receive a certificate requiring one to two years for the control group and the low-income students are not significantly different.

With the result of Levene's test, a student's t-test is performed to study if the length of time to receive a certificate requiring one to two years is significantly different for the control group and low-income students. The null hypothesis for this student's t-test is that no difference in the length of time to receive a certificate requiring one to two years exists between the control group and low-income students. With the resulting p-value from this student's t-test greater than 0.05, the null hypothesis is not rejected. The length of time to receive a certificate requiring one to two years is not significantly different for low-income students and the control group.

Next, students who received an associate degree are studied. Table 9 shows the average length of time to receive an associate degree.

For students who received an associate degree, Levene's test was first applied to examine the equality of variance in the length of time to award between low-income students and the control group. The null hypothesis for this Levene's test is that the variances are equal, or that the variances of the length of time to receive an associate degree for low-income students and the control group are equal. With the resulting p-value from this Levene's test greater than 0.05, the null hypothesis is not rejected. The variances in the length of time to receive an associate degree for the control group and the low-income students are not significantly different.

With the result of Levene's test, a student's t-test is performed to study if the length of time to receive an associate degree is significantly different for the control group and low-income students. The null hypothesis for this student's t-test is that no difference in the length of time to receive an associate degree exists between the control group and low-income students. With the resulting p-value from this student's t-test less than 0.001, the null hypothesis is rejected. The length of time to receive an associate degree is statistically significantly different for low-income students compared to the control group.

Finally, students who received a bachelor's degree are studied. Table 10 shows the average length of time to receive an associate degree.

For students who received a bachelor's degree, Levene's test was first applied to examine the equality of variance in the length of time to award between low-income students and the control group. The null hypothesis for this Levene's test is that the variances are equal, or that the variances

Table 9: Average length of time to receive an associate degree from a degree-granting institution for students in various demographic groups. N=7,471

Demographic group	Number of students	Percentage	Time in years to award
Low Income	1,502	20.10%	2.90
Non-Low Income (control)	5,969	79.90%	2.74
Male	3,073	41.13%	2.82
Female	4,398	58.87%	2.74
Refugee	--	--	--
Special Education	275	3.68%	3.08
Non-Special Education	7,196	96.32%	2.76
Immigrant	33	0.44%	3.12
Non-Immigrant	7,438	99.56%	2.77
English Learner	66	0.88%	3.82
Non-English Learner	7,405	99.12%	2.76
Asian	155	2.07%	3.24
Black	46	0.62%	3.02
White	6,591	88.22%	2.73
Hispanic	542	7.25%	3.14
Native American	69	0.92%	2.55
Multiracial	--	--	--
Pacific Islander	56	0.75%	2.43
Unknown	--	--	--

Note: -- denotes insufficient sample size

of the length of time to receive a bachelor's degree for low-income students and the control group are equal. With the resulting p-value from this Levene's test less than 0.01, the null hypothesis is rejected. The variances in the length of time to receive a bachelor's degree for the control group and the low-income students are significantly different.

With the result of Levene's test, a Welch's t-test is performed to study if the length of time to receive a bachelor's degree is significantly different for the control group and low-income students.

Table 10: Average length of time to receive a bachelor's degree from a degree-granting institution for students in various demographic groups. N=13,891

Demographic group	Number of students	Percentage	Time in years to award
Low Income	1,832	13.19%	3.32
Non-Low Income (control)	12,059	86.81%	3.34
Male	5,771	41.54%	3.61
Female	8,120	58.46%	3.15
Refugee	13	0.09%	3.69
Non-Refugee	13,878	99.91%	3.33
Special Education	196	1.41%	3.56
Non-Special Education	13,695	98.59%	3.34
Immigrant	59	0.42%	3.54
Non-Immigrant	13,832	99.58%	3.34
English Learner	57	0.41%	3.65
Non-English Learner	13,834	99.59%	3.34
Asian	468	3.37%	3.52
Black	109	0.78%	3.55
White	12,461	89.71%	3.33
Hispanic	689	4.96%	3.41
Native American	52	0.37%	3.27
Multiracial	10	0.07%	3.00
Pacific Islander	73	0.53%	3.44
Unknown	29	0.21%	3.62

The null hypothesis for this Welch's t-test is that no difference in the length of time to receive a bachelor's degree exists between the control group and low-income students. With the resulting p-value from this Welch's t-test greater than 0.05, the null hypothesis is not rejected. The length of time to receive a bachelor's degree is not significantly different for low-income students compared to the control group.

Due to the insufficient sample size of low-income students receiving a graduate degree prior to

academic year 2020, statistical tests were not performed for students who received a graduate degree.

3.5.4 | Drop outs at degree-granting institutions

For this study, dropping out of a degree-granting institution is defined as students who enrolled but have not yet received an award, and were not enrolled as of 2020, the most recent year of enrollment records available at the time of this research. Out of all students who enrolled in a degree-granting institution, 43.79% have dropped out. For the control group, 40.23% of students dropped out, while 56.35% of the low-income students dropped out. Among those who dropped out, 28.42% were low-income students. Table 11 shows the average length of time in a degree-granting institution before students dropped out.

Chi-square test was first performed to examine the relationship between low-income status and whether students dropped out of degree-granting institutions. The null hypothesis for this chi-square test is that no significant association exists between low-income status and dropped out. With the resulting p-value from this Chi-square test less than 0.001, the null hypothesis is rejected. Students' low-income status is related to whether they dropped out from degree-granting institutions.

When studying whether students drop out after enrolling at a degree-granting institution, Levene's test was applied to examine the equality of variance in the drop-out rate between low-income students and the control group. The null hypothesis for this Levene's test is that the variances are equal, or that the variances of the drop-out rates for low-income students and the control group are equal. With the resulting p-value from this Levene's test less than 0.001, the null hypothesis is rejected. The variances in drop-out rates for the control group and the low-income students are significantly different.

With the result of Levene's test, a Welch's t-test is performed to study if the drop-out rate is significantly different for the control group and low-income students. The null hypothesis for this Welch's t-test is that no difference in the drop-out rate exists between the control group and low-income students. With the resulting p-value from this Welch's t-test less than 0.001, the null hypothesis is rejected. The drop-out rate is significantly different for low-income students compared to the control group.

Finally, the length of time for students who remained in a degree-granting institution is compared between the control group and low-income students. Levene's test was first applied to examine the equality of variance in the length of time prior to dropping out between low-income students and the control group. The null hypothesis for this Levene's test is that the variances are equal, or that the variances of the length of time prior to dropping out for low-income students and the control group are equal. With the resulting p-value from this Levene's test less than 0.001, the null hypothesis is rejected. The variances in the length of time prior to dropping out for the control group and

Table 11: Average length of time in a degree-granting institution before dropping out for students in various demographic groups. N=24,435

Demographic group	Number of students	Percentage	Time in years before dropping out
Low Income	6,944	28.42%	1.92
Non-Low Income (control)	17,491	71.58%	2.07
Male	12,422	50.84%	2.02
Female	12,013	49.16%	2.04
Refugee	70	0.29%	2.64
Non-Refugee	24,365	99.71%	2.03
Special Education	1,731	7.08%	1.83
Non-Special Education	22,704	92.92%	2.04
Immigrant	173	0.71%	2.29
Non-Immigrant	24,262	99.29%	2.03
English Learner	567	2.32%	2.10
Non-English Learner	23,868	97.68%	2.03
Asian	515	2.11%	2.39
Black	512	2.10%	2.13
White	19,308	79.02%	2.02
Hispanic	3170	12.97%	2.04
Native American	363	1.49%	1.89
Multiracial	43	0.18%	2.02
Pacific Islander	475	1.94%	1.77
Unknown	49	0.20%	2.20

the low-income students are significantly different.

With the result of Levene's test, a Welch's t-test is performed to study if the length of time prior to dropping out is significantly different for the control group and low-income students. The null hypothesis for this Welch's t-test is that no difference in the length of time prior to dropping out exists between the control group and low-income students. With the resulting p-value from this Welch's t-test less than 0.001, the null hypothesis is rejected. The length of time prior to dropping out is statistically significantly different for low-income students compared to the control group.

Figure 2 illustrates the number of students enrolled at degree-granting institutions from each USBE cohort year. In each of the three years studied, enrollment was the highest immediately after high school completion, and the decrease in enrollment is followed by a spike back up two years after high school. This observation is consistent with the religious practice of serving an LDS mission after high school and a change in missionary age (Walker, 2012). It was announced during the October 2012 General Conference of the Church of Jesus Christ of Latter-Day Saints that the minimum age for missionary service for young men had been lowered from 19 to 18 and that the minimum age for young women had been lowered from 21 to 19 (The Church of Jesus Christ of Latter-Day Saints News Release, 2012). As seen in the graph, the enrollments for cohort year 2012 at two years after high school completion does not bounce back with a slope similar to that of cohort 2013 or 2014. Please see appendix supplementary information D for a graph of enrollment by cohort year for low-income students.

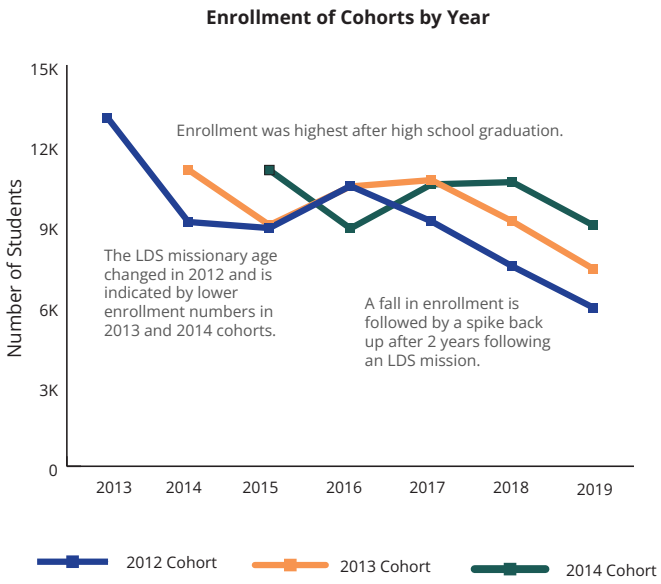

Figure 2: Number of students enrolled at degree-granting institutions by cohort year for all students

3.6 | Students at Technical Colleges

For students who enrolled at technical colleges after completing high school, similar education outcomes are studied. These outcomes include the length of time between high school completion and enrollment at a technical college, length of time between technical college enrollment and award, whether the student dropped out, and length of time before dropping out for those who did. To study the length of time between technical college enrollment and award, awards levels are controlled for using the number of hours required. Certificates requiring less than 300 hours were coded as level 1A, certificates requiring 300 to 900 hours were coded as level 1B, and certificates requiring more than 900 hours were coded as level Two. Unlike degree-granting institutions, cumulative GPA data are not available for technical college students.

3.6.1 | Time to Enrollment at Technical Colleges

For all students who enrolled at a technical college, it took 2.70 years on average for students to enroll in a technical college after high school completion. Among those who enrolled, 71.68% were students from the control group, while 28.32% were low-income students. For the control group, the average was 2.72 years. For low-income students, the average was 2.64 years. Table 12 breaks down the demographic make-up of those who enrolled at a technical college and the average lengths of time before they enrolled.

Similar to previous methods, Levene's test was first applied to examine the equality of variance in the length of time to enrollment at a technical college between these two groups. The null hypothesis for this Levene's test is that the variances are equal, or that the variances in time to enrollment at a technical college for low-income students and the control group are equal. With the resulting p-value from this Levene's test greater than 0.05, the null hypothesis is not rejected. The variances in time to enrollment at a technical college for the control group and the low-income students are not significantly different.

With the result of Levene's test verifying that the variances are not equal, a student's t-test is performed to examine if the length of time to enrollment at a technical college is significantly different for the control group and low-income students. The null hypothesis for this student's t-test is that no difference in the length of time to enrollment at a technical college exists between the control group and low-income students. With the resulting p-value from this student's t-test greater than 0.05, the null hypothesis is not rejected. No significant difference in time to enrollment at a technical college exists between low-income

students and the control group.

Table 12: Demographic summaries for high school students who enrolled at a technical college and the average lengths of time before they enrolled. N=7,077

Demographic group	Number of students	Percentage	Time in years to Enroll
Low Income	2,004	28.32%	2.64
Non-Low Income (control)	5,073	71.68%	2.72
Male	3,414	48.24%	3.13
Female	3,663	51.76%	2.29
Refugee	--	--	--
Special Education	772	10.91%	2.57
Non-Special Education	6,305	89.09%	2.71
Immigrant	49	0.69%	2.43
Non-Immigrant	7,028	99.31%	2.70
English Learner	102	1.44%	3.09
Non-English Learner	6,975	98.56%	2.70
Asian	54	0.75%	2.56
Black	88	1.24%	2.57
White	5,920	83.65%	2.72
Hispanic	877	12.39%	2.48
Native American	70	0.99%	2.93
Multiracial	--	--	--
Pacific Islander	44	0.62%	3.59
Unknown	20	0.28%	2.65

Note: -- denotes insufficient sample size

3.6.2 | Levels of attainment at technical colleges

Among all students who enrolled at a technical college, 59.62% obtained an award prior to 2022. Of those who received an award, 26.55% were low-income students. For all students from the control group who enrolled at a technical college, 61.09% obtained an award. Of all low-income students who enrolled at a degree-granting institution, 55.89% obtained an award.

Programs at technical colleges may require significantly different number of hours to complete. Using the number of required hours to complete the programs, students' certificates were coded to three main levels of awards. Certificates requiring less than 300 hours were coded as level 1A, certificates requiring 300 to 900 hours were coded as level 1B, and certificates requiring more than 900 hours were coded as level two. Out of 4,219 students who obtained at least one technical college certificate, required hours data were missing for 916 students, or 21.71%. Of the students whose required hours data were available for their completed programs, 56.80% completed a program at level 1A, 30.88% completed a program at level 1B, and 12.32% completed a program at level two. Figure 3 below illustrates the proportion of students obtaining the various levels of awards at technical colleges.

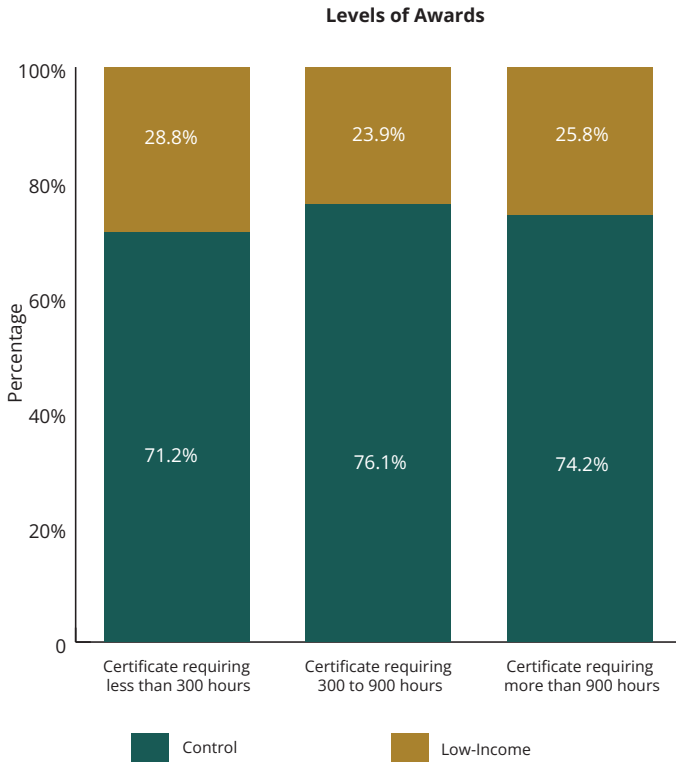

Figure 3: Proportion of students obtaining different levels of awards at technical colleges

As the number of required hours to obtain these certificates could vary significantly, students are further separated by their levels of awards at technical colleges to further examine any statistically significant differences in the length of the time to receive a certificate between the control group and low-income students for each level of attainment. Table 13 shows the average length of time to receive a certificate requiring less than 300 hours.

For students who received a certificate requiring less than 300 hours, Levene's test was first applied to examine the equality of variance in the length of time to award between low-income students and the control group. The null hypothesis for this

Table 13: Average length of time to receive a certificate requiring less than 300 hours from a technical college for students in various demographic groups. N=1,876

Demographic group	Number of students	Percentage	Time in days to award
Low Income	541	28.84%	94
Non-Low Income (control)	1,335	71.16%	92
Male	852	45.42%	94
Female	1,024	54.58%	91
Refugee	--	--	--
Special Education	202	10.77%	107
Non-Special Education	1,674	89.23%	91
Immigrant	16	0.85%	94
Non-Immigrant	1,860	99.15%	92
English Learner	24	1.28%	120
Non-English Learner	1,852	98.72%	92
Asian	--	--	--
Black	23	1.23%	86
White	1,553	82.78%	94
Hispanic	257	13.70%	87
Native American	19	1.01%	63
Multiracial	--	--	--
Pacific Islander	--	--	--
Unknown	--	--	--

Note: -- denotes insufficient sample size

Levene's test is that the variances are equal, or that the variances of the length of time to receive a certificate requiring less than 300 hours for low-income students and the control group are equal. With the resulting p-value from this Levene's test greater than 0.05, the null hypothesis is not rejected. The variances in the length of time to receive a certificate requiring less than 300 hours for the control group and the low-income students are not significantly different.

With the result of Levene's test, a student's t-test is performed to study if the length of time to receive a certificate requiring less than 300 hours is significantly different for the control group and low-income students. The null hypothesis for this student's t-test is that no difference in the length of time to receive a certificate requiring less than 300 hours exists between the control group and low-income students. With the resulting p-value from this student's t-test greater than 0.05, the null hypothesis is not rejected. The length of time to receive a certificate requiring less than 300 hours is not significantly different for low-income students and the control group.

The next type of degree studied is certificates requiring 300 to 900 hours at a technical college. Table 14 shows the average length of time to receive a certificate requiring 300 to 900 hours.

For students who received a certificate requiring 300 to 900 hours, Levene's test was first applied to examine the equality of variance in the length of time to award between low-income students and the control group. The null hypothesis for this Levene's test is that the variances are equal, or that the variances of the length of time to receive a certificate requiring 300 to 900 hours for low-income students and the control group are equal. With the resulting p-value from this Levene's test greater than 0.05, the null hypothesis is not rejected. The variances in the length of time to receive a certificate requiring 300 to 900 hours for the control group and the low-income students are not significantly different.

With the result of Levene's test, a student's t-test is performed to study if the length of time to receive a certificate requiring 300 to 900 hours is significantly different for the control group and low-income students. The null hypothesis for this student's t-test is that no difference in the length of time to receive a certificate requiring 300 to 900 hours exists between the control group and low-income students. With the resulting p-value from this student's t-test greater than 0.05, the null hypothesis is not rejected. The length of time to receive a certificate requiring 300 to 900 hours is not significantly different for low-income students and the control group.

Finally, students who received a certificate requiring more than 900 hours are studied. Table 15 shows the average length of time to receive a certificate requiring more than 900 hours.

For students who received a certificate requiring more than 900 hours, Levene's test was first applied to examine the equality of variance in the length of time to award between low-income students and the control group. The null hypothesis for this Levene's test is that the variances are equal, or that the variances of the length of time to receive a certificate requiring more than 900 hours for low-income students and the control group are equal. With the

Table 14: Average length of time to receive a certificate requiring 300 to 900 hours from a technical college for students in various demographic groups. N=1,020

Demographic group	Number of students	Percentage	Time in days to award
Low Income	244	23.92%	205
Non-Low Income (control)	776	76.08%	194
Male	386	37.84%	209
Female	634	62.16%	189
Refugee	--	--	--
Special Education	78	7.65%	238
Non-Special Education	942	92.35%	193
Immigrant	--	--	--
English Learner	12	1.18%	293
Non-English Learner	1008	98.82%	195
Asian	16	1.57%	238
Black	11	1.08%	201
White	875	85.78%	195
Hispanic	102	10.00%	205
Native American	--	--	--
Multiracial	--	--	--
Pacific Islander	--	--	--
Unknown	--	--	--

Note: -- denotes insufficient sample size

resulting p-value from this Levene's test greater than 0.05, the null hypothesis is not rejected. The variances in the length of time to receive a certificate requiring more than 900 hours for the control group and the low-income students are not significantly different.

With the result of Levene's test, a student's t-test is performed to study if the length of time to receive a certificate requiring more than 900 hours is significantly different for the control group and low-income students. The null hypothesis for this student's t-test is that no difference in the length of time to receive a certificate requiring more than 900 hours exists between the control group and

Table 15: Average length of time to receive a certificate requiring more than 900 hours from a technical college for students in various demographic groups. N=407

Demographic group	Number of students	Percentage	Time in days to award
Low Income	105	25.80%	290
Non-Low Income (control)	302	74.20%	285
Male	122	29.98%	278
Female	285	70.02%	290
Refugee	--	--	--
Special Education	42	10.32%	261
Non-Special Education	365	89.68%	289
Immigrant	--	--	--
English Learner	--	--	--
Asian	--	--	--
Black	--	--	--
White	343	84.28%	287
Hispanic	49	12.04%	296
Native American	--	--	--
Multiracial	--	--	--
Pacific Islander	--	--	--
Unknown	--	--	--

Note: -- denotes insufficient sample size

low-income students. With the resulting p-value from this student's t-test greater than 0.05, the null hypothesis is not rejected. The length of time to receive a certificate requiring more than 900 hours is not significantly different for low-income students and the control group.

3.6.3 | Drop-outs at technical colleges

Similar to the measurement for the length of time to award at technical colleges, the length of time before a student dropped out of a technical college was measured in days for this study. Dropping out of a technical college is defined as students who enrolled but have not yet received an award, and are not enrolled as of June 30, 2020. Out of all students who enrolled in a technical college, 31.36% have dropped out. For the control group,

29.94% of students dropped out, while 34.93% of the low-income students dropped out. Among those who dropped out, the average number of days prior to dropping out was 326 days, and 31.55% were low-income students. Table 16 shows the average length of time in a technical college before students dropped out.

Table 16: Average length of time in a technical college before dropping out for students in various demographic groups and the average length of time before students dropped out. N=2,219

Demographic group	Number of students	Percentage	Time in days before dropping out
Low Income	700	31.55%	326
Non-Low Income (control)	1,519	68.45%	329
Male	1,268	57.14%	377
Female	951	42.86%	247
Refugee	--	--	--
Special Education	299	13.47%	383
Non-Special Education	1,920	86.53%	319
Immigrant	16	0.72%	470
Non-Immigrant	2,203	99.28%	327
English Learner	38	1.71%	464
Non-English Learner	2,181	98.29%	325
Asian	11	0.50%	281
Black	35	1.58%	380
White	1,822	82.11%	327
Hispanic	298	13.43%	321
Native American	28	1.26%	451
Multiracial	--	--	--
Pacific Islander	15	0.68%	2.68
Unknown	--	--	--

Note: -- denotes insufficient sample size

To study students' drop-out rates after enrolling at a technical college, chi-square test was first performed to examine the relationship between low-income status and whether students dropped out of technical colleges. The null hypothesis for this chi-square test is that no significant association exists between low-income status and dropped out at technical colleges. With the resulting p-value from this Chi-square test less than 0.001, the null hypothesis is rejected. Students' low-income status is related to whether they dropped out from technical colleges.

Next, Levene's test was applied to examine the equality of variance in the drop-out rates between low-income students and the control group. The null hypothesis for this Levene's test is that the variances are equal, or that the variances of the drop-out rates for low-income students and the control group are equal at technical colleges. With the resulting p-value from this Levene's test less than 0.001, the null hypothesis is rejected. The variances in drop-out rates for the control group and the low-income students are significantly different.

With the result of Levene's test, a Welch's t-test is performed to study if the drop-out rates are significantly different for the control group and low-income students. The null hypothesis for this Welch's t-test is that no difference in the drop-out rates exists between the control group and low-income students. With the resulting p-value from this Welch's t-test less than 0.001, the null hypothesis is rejected. The drop-out rate is significantly different for low-income students compared to the control group.

Finally, the length of time students remained in a technical college is compared between the control group and low-income students. Levene's test was first applied to examine the equality of variance in the length of time prior to dropping out between low-income students and the control group. The null hypothesis for this Levene's test is that the variances are equal, or that the variances of the length of time prior to dropping out for low-income students and the control group are equal at technical colleges. With the resulting p-value from this Levene's test greater than 0.05, the null hypothesis is not rejected. The variances in the length of time prior to dropping out for the control group and the low-income students are not significantly different.

With the result of the Levene's test, a student's t-test is performed to study if the length of time prior to dropping out is significantly different for the control group and low-income students at technical colleges. The null hypothesis for this student's t-test is that no difference in the length of time prior to dropping out exists between the control group and low-income students. With the resulting p-value from this student's t-test greater than 0.05, the null hypothesis is not rejected. The length of time prior to dropping out is not significantly different for low-income students and the control group.

A summary of all statistics tests and results for the various postsecondary outcomes studied in this research is shown in table 17 below.

Table 17: Summary of statistics tests applied to examine the various postsecondary outcomes and the test statistics. Asterisks indicate significant p-values levels. (* p<0.05, ** p<0.01, *** p<0.001).

Postsecondary outcome	Test applied	Test statistics
Postsecondary enrollment	Chi-square	3212.38***
Postsecondary enrollment	Levene's test	2125.41***
Postsecondary enrollment	Welch's t-test	-58.03***
Postsecondary awards	Chi-square	684.75***
Postsecondary awards	Levene's test	4103.95***
Postsecondary awards	Welch's t-test	-27.06***
Time to enroll at degree-granting institutions	Levene's test	25.62***
Time to enroll at degree-granting institutions	Welch's t-test	2.51*
Cumulative GPA at degree-granting institutions	Levene's test	332.03***
Cumulative GPA at degree-granting institutions	Welch's t-test	-31.65***
Time to a certificate requiring less than one year from degree-granting institutions	Levene's test	0.02
Time to a certificate requiring less than one year from degree-granting institutions	student's t-test	-1.52
Time to a certificate requiring one to two years from degree-granting institutions	Levene's test	2.53
Time to a certificate requiring one to two years from degree-granting institutions	student's t-test	0.41
Time to an associate degree from degree-granting institutions	Levene's test	0.95
Time to an associate degree from degree-granting institutions	student's t-test	3.37***
Time to a bachelor's degree from degree-granting institutions	Levene's test	7.46**
Time to a bachelor's degree from degree-granting institutions	Welch's t-test	-0.61
Drop out status at degree-granting institutions	Chi-square test	684.75***
Drop out status at degree-granting institutions	Levene's test	145.41***
Drop out status at degree-granting institutions	Welch's t-test	31.93***
Time to drop out at degree-granting institutions	Levene's test	30.96***
Time to drop out at degree-granting institutions	Welch's t-test	-8.98***
Time to enroll at technical colleges	Levene's test	0.74
Time to enroll at technical colleges	student's t-test	-1.30
Time to level 1A certificate at technical colleges	Levene's test	0.83
Time to level 1A certificate at technical colleges	student's t-test	0.56
Time to level 1B certificate at technical colleges	Levene's test	1.17
Time to level 1B certificate at technical colleges	student's t-test	1.20
Time to level two certificate at technical colleges	Levene's test	0.40
Time to level two certificate at technical colleges	student's t-test	0.21

Table 17 (continued): Summary of statistics tests applied to examine the various postsecondary outcomes and the test statistics. Asterisks indicate significant p-values levels. (* p<0.05, ** p<0.01, *** p<0.001).

Postsecondary outcome	Test applied	Test statistics
Drop out status at technical colleges	Chi-square test	16.37***
Drop out status at technical colleges	Levene's test	58.68***
Drop out status at technical colleges	Welch's t-test	4.01***
Time to drop out at technical colleges	Levene's test	0.82
Time to drop out at technical colleges	student's t-test	-0.14

4 | Discussion

When studying students' postsecondary enrollment and award rates at either a degree-granting institution or technical college, Levene's test and Welch's t-test returned p-values indicating statistically significant differences between the control group and low-income students. Consistent with previous research (White, 1982; Sirin, 2005), findings from the current research indicate that low-income students had lower enrollment and awards rates at postsecondary institutions. While 30% of all students in the data were low-income students, only 23% of the students who enrolled in a postsecondary institution were low-income. Out of all students who obtained at least one award, only 18% were low-income students. The proportions of low-income students were reduced at both enrollment and completion (see Tables 3 and 4).

Focusing on students who enroll at a degree-granting institution, Levene's test and the subsequent Welch's t-test found p-values indicated statistically significant differences in the time to enrollment and cumulative GPA. It took low-income students longer to enroll at degree-granting institutions, and once enrolled, they achieved lower GPAs. It is important to highlight that statistical significance must be interpreted with context. For example, the average length of time to enrollment for the control group was 1.94 years, compared to an average of 1.90 years for low-income students (see Table 5). The magnitude of the difference, though statistically significant, may be pragmatically minuscule. A similar pattern in magnitude of the difference is observed in students' cumulative GPA. Though statistically significant, the average GPA for low-income students is 2.350, a C+ average, compared to the control group's average GPA of 2.471, a B- average (Table 6).

The proportion of low-income students decreases as the amount of time required to obtain an award increases (Fig. 1). Low-income students made up 29% of the students who received certificates requiring less than one year, comparable to the general make-up of all students from Table 1. For certificates requiring one to two years or an associate degree, the proportion of low-income students decreased to 20%. When examining those who received a bachelor's degree, only 13% were low-income students. Finally, the sample size became insufficient when studying low-income students who received a graduate degree. One possible explanation may be low-income students were more likely to enroll in programs that they could complete in a shorter amount of time, requiring less financial commitment in school expenses. In a social context, they may have received encouragement or advice from their families, peers, or counselors that the lower attainment levels are more achievable or appropriate given the financial burden that comes with higher levels of attainments.

Though more low-income students selected to obtain a certificate requiring less than one year of coursework, no statistically significant difference was found in the amount of time it took for the control group and low-income students using Levene's test and student's t-test. The results of Levene's test and the subsequent student's t-test for those who received a certificate requiring one to two years also found no significant difference in the variance in the timeframe to completion between the control group and low-income students, and no statistically significant difference in the time to award between the two groups. For students who received an associate degree, while no statistically significant difference was found between the variances in the time to complete an associate degree, low-income students took significantly longer to obtain associate degrees. This t-test result should be interpreted with the analysis from Table 9, which shows the actual difference in this timeframe between the control group and low-income students was 0.16 years, or approximately 2 months. The practical difference between the two groups may not be substantive. Finally, for students who

received a bachelor's degree, Levene's test found a statistically significant difference in the variances in time to award for the control group and low-income students; however, the subsequent student's t-test found no statistically significant difference in the time to award. The statistical results from the timeframe to the various levels of degrees suggests that low-income students with sufficient knowledge about their educational options and resources to pursue a postsecondary award could achieve the award in a similar timeframe as their peers.

Drop-out rates at degree-granting institutions were examined next. The results of Levene's test and the subsequent Welch's test indicate that the variances in drop-out rates and the actual drop-out rates were significantly different for low-income students and the control group. Low-income students were dropping out at a statistically significantly higher rate than their peers at degree-granting institutions. When studying the length of time students remained in degree-granting institutions prior to dropping out, p-values from Levene's test and the subsequent Welch's test suggest that the variances in the time prior to dropping out and the actual amount of time prior to dropping out were statistically significantly different for the control group and low-income students. Table 10 provides the actual difference between these two groups, and the average time prior to dropping out was 0.15 years, or under two months. This difference, though found to be statistically different, may not be practically different in students' experiences.

Findings from this research further support previous literature which found that CTE could improve economic mobility and students' outcomes (Rosen, Visher, & Beal, 2008). For students who enrolled at technical colleges, no significant variances were found in time to enrollment between the control group and low-income students. The subsequent student's t-test also found no statistical significance in the length of time between high school completion and technical college enrollment. When studying the amount of time to a technical college certificate controlling for the instruction hour requirements, similar results were obtained showing no significant variances and no significant difference in the amount of time to obtain certificates between the control group and low-income students for each of the three main levels of awards offered at technical colleges.

The drop-out rates at technical colleges showed a similar pattern as degree-granting institutions. Levene's test and the subsequent Welch's test suggest that the variances in drop-out rates and the actual drop-out rates were significantly different for low-income students and the control group. Low-income students were dropping out at a statistically significantly higher rate than the control group.

When Levene's test was applied to the length of time students remained in technical colleges before dropping out, no significant difference was found in the variances in time prior to dropping out between low-income students and the control group. The subsequent student's t-test also found no significant difference in the length of time prior to dropping out between low-income students and the control group. Contrasting Table 5 and Table 12, a higher percentage of students enrolled at technical colleges were low-income students when compared to students who enrolled at degree-granting institutions. Students also appear to take longer to enroll at technical colleges when compared to degree-granting institutions, suggesting the age of the students at technical colleges may be older than students in degree-granting institutions.

In sum, results from Levene's tests and t-tests performed on various education outcomes suggest significant differences in enrollment and obtaining an award, but the differences were not significant when examining the amount of time to those milestones. In addition, among students who received an award from degree-granting institutions, low-income students were more likely to receive awards that required shorter timeframes to completion. Figure 3 further demonstrates the outcomes for all students who enrolled in a postsecondary institution.

Consistent with findings from the t-tests, Figure 4 demonstrates a smaller proportion of low-income students who complete a postsecondary award, a smaller proportion of low-income students who are currently pursuing an award, and a larger proportion of the students who dropped out. Low-income students completed postsecondary awards at a significantly lower rate and dropped out at a significantly higher rate when compared to the control group.

To further highlight the leaky pipeline from high school to postsecondary education, all students in this study are included in Figure 4 to include high school students who did not pursue postsecondary education.

Figure 5 illustrates the proportion of low-income students who did not enroll in postsecondary education, which is strikingly larger than the proportion from the control group. Furthermore, the proportion of those who completed postsecondary education for the low-income students was less than half of that of the control group.

The relationship between family income and educational achievement is complex. Students' educational achievement may be affected

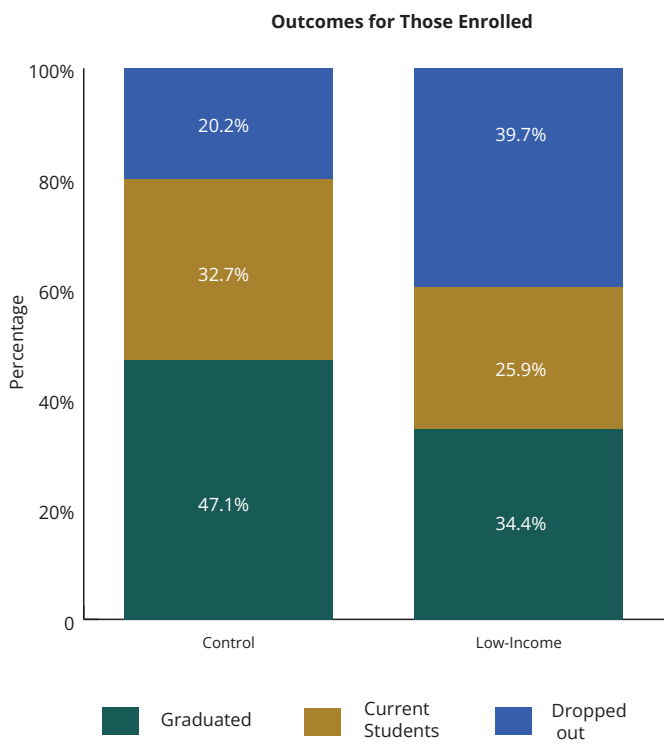

Figure 4: education outcomes for students who enrolled at postsecondary institutions

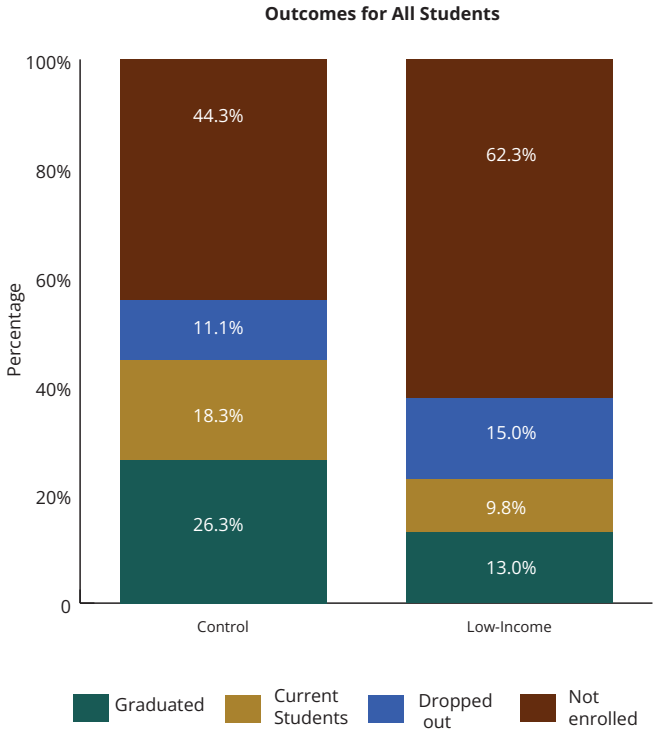

Figure 5: education outcomes for all students in this study

by several factors. Students' experiences related to being low-income but not examined in this study may include health issues stemming from a nutritional deficit, stress from the insecurity of shelter or food, or the inability to receive medical treatment for illness. These factors often place more stress on a student, which can negatively impact the students' academic performance. Low-income students may also face challenges such as lack of electronic equipment or study material at home, and lack of internet access.

Furthermore, parents' beliefs and behaviors were indirectly linked to children's academic achievement. Parents' years of education and level of involvement have been found to be important factors (Ardila, Rosselli, Matute, & Guajardo, 2005; Perna & Titus, 2005). Parents in low-income families may work multiple jobs or have long work hours, resulting in less availability to assist children with schoolwork. Parents may set lower educational expectations, and their children may be less motivated towards obtaining a postsecondary award (Davis-Kean, 2005). Family emotional support has also been found to be an important predictor of student success (Roksa & Kinsley, 2019). Household income is not the only dimension of family support when considering low-income students' postsecondary outcomes. First-generation college students may face challenges such as a lack of positive role models (Perna & Titus, 2005). Students' families serve as their fundamental social capital and provide emotional support.

Finally, students function in their environment, which includes their families, schools, and communities. Low-income students may encounter lower academic expectations from their teachers, while the power of self-fulfilling prophecy is stronger on low-income students (Jussim, Eccles, & Madon, 1996). In addition, teachers in schools with primarily low-income student enrollments reported high levels of job stress (Herman, Hickmon-Rosa, & Reinke, 2018). The school environment may be considered when examining the academic achievements of low-income students. Furthermore, Utah's Governor Cox recently issued an executive order permitting state employees to fill staffing gaps at Utah schools, further highlighting the effects of the omicron variant of COVID-19 and labor shortages in Utah schools (Utah Gov. Spencer J. Cox, 2022). Teachers play an important role in students' academic development, and access to high-quality instructions could contribute to students' postsecondary success.

4.1 | Future Research

Recently, the College Board announced that the SAT will be transitioning to a digital format (College Board, 2022) after some prestigious schools announced that test scores would not be required (Lu, 2021; UC Office of the President, 2021). In the past, standardized testing has been linked to the marginalization of low-income students during the admissions process, as some students lack the resources for test prep courses. Future research should be conducted on the effects of this decision on postsecondary outcomes such as postsecondary enrollment.

The intersection of race and low-income status has been studied in the past (McLoyd, 1998). Future research could examine the effects of being low-income on racial minorities in Utah in addition to other demographic minority groups such as special education students, refugees, immigrants, and English learners. Understanding the interaction between low-income status and being a member of these groups could assist in further comprehension of the experiences of students who belong to multiple minority groups.

Finally, the long-term earnings of low-income students are not within the scope of the current study; however, it could deepen understanding of the role of postsecondary education and quantify the financial gains for individuals as well as tax revenues for the state. Higher earnings for low-income students could signal upward mobility and financial independence. Future research on the financial outcomes for low-income students with various education attainments could be useful in developing a broader view of the role of postsecondary education.

5 | Conclusion

Following USBE cohorts from 2012 to 2014, this study investigated statistically significant differences in postsecondary outcomes between low-income students and their peers. Being low-income in high school was associated with a lower postsecondary enrollment rate, lower postsecondary award rate, lower cumulative GPA, and higher drop-out rates. Though the difference in postsecondary award rates was statistically significant, the differences in timeframes to awards were not as significant. This result suggested that low-income students with sufficient knowledge about their educational options and resources to pursue a postsecondary award could achieve the award in a similar timeframe as their peers.

This study further highlighted the loss of low-income students beginning at high school completion. Fewer low-income students enrolled at postsecondary institutions, and even fewer obtained a postsecondary award. Drop-out rates among low-income students were significantly higher than their peers. Lack of postsecondary education may impact long-term earning potentials for these low-income students and subsequently their upward mobility.

The findings from this study provide important insight for Utah policymakers. Understanding the challenges faced by low-income students and the resources they require to pursue postsecondary education could serve a practical use for education researchers and policymakers in their efforts to better evaluate the implications of low-income status on educational outcomes and to provide equal educational opportunities for all.

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Data Partners

Utah State Board of Education

UTAH SYSTEM OF HIGHER EDUCATION

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Appendix Table A

Appendix Table A: Demographic summaries for low-income USBE cohorts studied in this research. N=35,648

Demographic group	Number of students	Percentage
Male	18,502	51.90%
Female	17,146	48.10%
Refugee	138	0.39%
Special Education	5,413	15.18%
Immigrant	719	2.02%
English Learner	3,150	8.84%
Asian	780	2.19%
Black	999	2.80%
White	20,913	58.67%
Hispanic	10,587	29.70%
Native American	1,252	3.51%
Multiracial	59	0.17%
Pacific Islander	979	2.75%
Unknown	79	0.22%

Appendix Supplementary Information A

A two-way ANOVA test is performed to study postsecondary enrollments and the interaction of low-income status and gender. Low-income status and gender are the independent variables, and postsecondary enrollment is the dependent variable. The p-values obtained from ANOVA analysis for low-income status, gender, and the interaction term are statistically significant ($p<0.001$). This result suggests that low-income status is associated significantly with postsecondary enrollment, gender is associated significantly with postsecondary enrollment, and interaction of both low-income status and gender is associated significantly with postsecondary enrollment. Male students are associated with a lower enrollment rate at postsecondary institutions, and low-income students are associated with a lower enrollment rate at postsecondary institutions.

Appendix Supplementary Information B

To study the effects of concurrent enrollment (CE) and technical school enrollment while in high school are studied, separate two-way ANOVA analyses were performed to examine the interaction term between low-income status and enrollment at a postsecondary institution while in high school. The p-values obtained from ANOVA analysis on enrollment at a degree-granting institution for low-income status, concurrent enrollment, and the interaction term are statistically significant ($p<0.05$). This result indicates that low-income status is significantly associated with enrollment at degree-granting institutions, concurrent enrollment is significantly associated with enrollment at degree-granting institutions, and interaction of both low-income status and concurrent enrollment is significantly associated with enrollment at a degree-granting institution. Students who had concurrent enrollment while in high school are associated with a higher enrollment rate at degree-granting institutions, while low-income students are associated with a lower enrollment rate at degree-granting institutions.

The p-values obtained from ANOVA analysis on enrollment at a technical college for low-income status, technical college enrollment while in high school, and the interaction term are statistically significant ($p<0.05$).

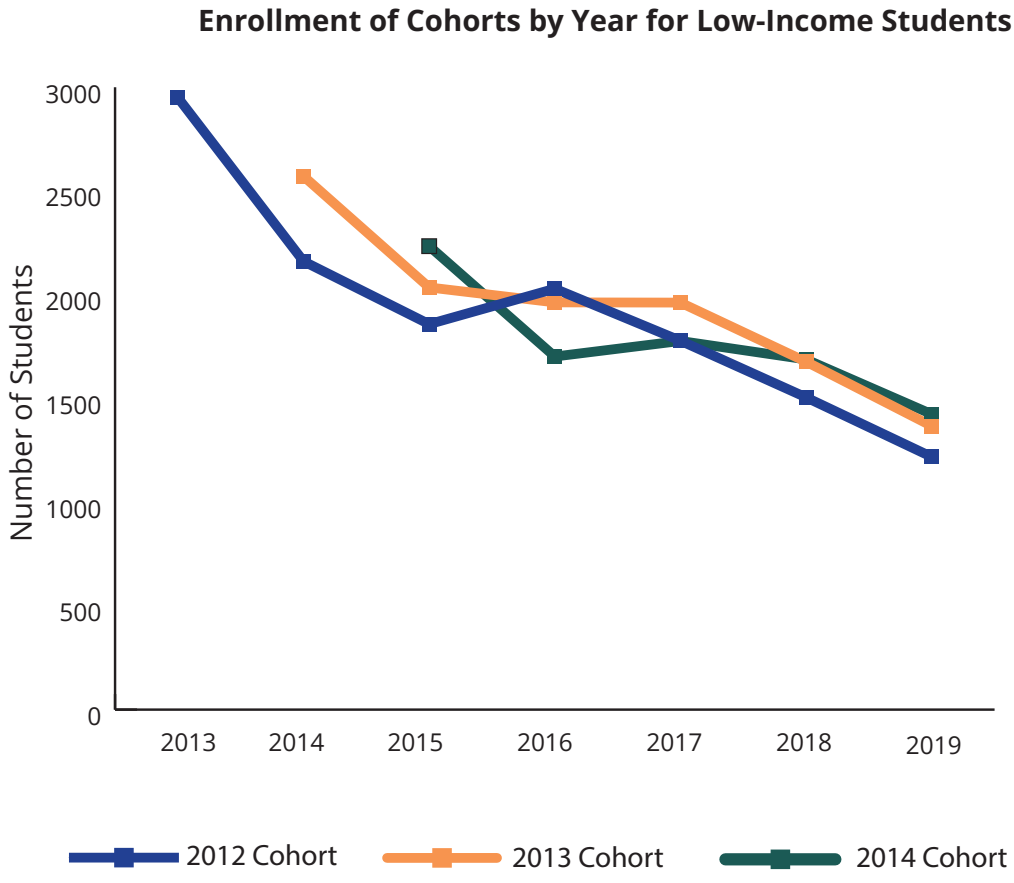
The result signals that low-income status significantly affects enrollment at technical colleges, technical college enrollment while in high school significantly affects enrollment at technical colleges after high school completion, and interaction of both low-income status and technical college enrollment while in high school significantly affects enrollment in technical colleges. Students who enrolled at a technical college while in high school are associated with a higher enrollment rate at technical colleges, while low-income students are associated with a lower enrollment rate at technical colleges.

Appendix Supplementary Information C

A two-way ANOVA test was performed to examine the interaction term between low-income status and gender on postsecondary awards. The p-values obtained from ANOVA analysis on receiving at least one postsecondary award for low-income status, gender, and the interaction term are statistically significant ($p<0.001$). This result suggests that low-income status significantly affects receiving a postsecondary award, gender significantly affects receiving a postsecondary award, and interaction of both low-income status and gender significantly affects receiving a postsecondary award. Female students are associated with a higher postsecondary awards rate, while low-income students are associated with a lower postsecondary awards rate.

Appendix Supplementary Information D

Appendix Figure 1 demonstrates the number of low-income students enrolled at degree-granting institutions from each USBE cohort year. In contrast with the enrollment figure for all students (figure 2), the spike in enrollment at two years after high school completion is less pronounced.



Appendix Figure A: Number of low-income students enrolled at degree-granting institutions by cohort year