



GENERAL REPORT

June 2023

Brett Campbell

Utah Graduate Student Characteristics and Workforce Outcomes

Key Findings

This report aimed to identify the critical characteristics of Utah postsecondary graduates pursuing a graduate degree. Besides demographic data, the percentage of students who earned a graduate degree outside of Utah and those who attended private institutions are included. Additionally, this report explored how many students can fill Utah's high-demand and high-wage jobs at the post-baccalaureate level. Finally, the following question is answered: what is the picture of underrepresented populations seeking graduate degrees from the Utah System of Higher Education institutions?

Key Takeaways

- Almost one in four students who earned a bachelor's degree from a USHE institution pursued a graduate degree. More than three-fourths of those students stayed in Utah.
- More than half of graduate degrees earned in Utah are master's degrees.
- Utah awarded more master's degrees in business and health professions than other states in the Intermountain West.
- Currently, an equal proportion of men and women sought graduate degrees, but longitudinally, men are experiencing a downward trend while women exhibit an upward trend.
- Fewer than 10% of students seeking graduate degrees came from underrepresented populations. Most underrepresented students earned master's degrees.
- Underrepresented students were likelier to leave Utah to pursue their graduate degrees.
- Popular master's degrees among underrepresented populations were in public administration, social work, and multi-/interdisciplinary studies.
- While the number of undergraduate students enrolled in STEM graduate programs trended upward, the number of graduates changed little.

Purpose

Increasingly, graduate degrees are considered necessary in the job market (Chamorro-Premuzic, 2020; Torpey, 2018; Wendler, Cline, Rock, Bell, & McAllister, 2010). In other circumstances, a graduate degree is a pathway to promotion. A graduate degree is one in four (25.1%) degrees conferred in the United States (NCES 2021). Similarly, 25.6% of all degrees conferred in Utah are from graduate-level programs.

Nationally, education beyond a bachelor's degree encompassed specific trends. For example, men were more likely to enroll in professional degrees, while women tended to pursue master's degrees. Sax (2001) found that while the number of women's graduate degrees has increased dramatically, only one in four graduate degrees are earned by women. Perna (2004) found that many women sought a second bachelor's degree instead of seeking a graduate degree.

Increasingly underrepresented populations are pursuing master's degrees. Underrepresented populations average 27.5% of all master's degrees earned in the U.S. between 2015 and 2020. However, they comprise fewer than twenty percent (19.5%) of all doctorate degrees. These proportions have changed little. As a comparison, underrepresented populations include 37.0% of the U.S. population. One unexpected finding was that a more significant proportion of Black women enrolled in graduate programs than Black men and white women (Perna, 2004).

Box 1. Brief key terms

- **CIP Family:** The first two digits of the Classification of Instructional Program taxonomy developed by NCES.
- **Completion:** Identification of students who completed the graduate program.
- **In-state institution:** Any institution providing graduate-level awards within Utah.
- **Ownership:** NCS designation as to the ownership of the institution. The local government oversees public institutions, while private institutions include non-profit and for-profit entities.
- **Status:** Two options were available: those who enrolled in a graduate degree program at a USHE institution and earned that degree (coded as 1) and those who enrolled and had not earned a graduate degree by the time this data was collected (0). These latter students may still have been enrolled.
- **Underrepresented Students:** Students who identify as Black or African American, Native American or Alaskan Native, Native Hawaiian or other Pacific Islander, Latinx or Hispanic, or two or more racial identities. Asian Americans and white students are omitted.

Millet (2003; English & Umbach, 2016) found that undergraduates who majored in arts or sciences (humanities, social sciences, mathematics, sciences, interdisciplinary studies) were more likely to enroll in

graduate school than those who majored in professional/applied majors (health, education, business). The exception appeared to be educators who are more likely to enroll in a master's program soon after earning their bachelor's degrees (Zhang, 2005).

While such information is being tracked at the national level, more examination is needed at the state level. The purpose of this study was to report on graduate degrees earned in Utah.

Prior Research

Research examining graduate studies is restricted to understanding those who apply to graduate schools. These studies can be divided into three groups. The first set of studies looks at underrepresented students, while the second group inspects undergraduate debt's role in applying to graduate school. Finally, the last thread explores the role of parental support in applying to graduate school.

Several factors were identified. Some elements support underrepresented students from applying to graduate students, while other factors hinder them. From interviewing underrepresented first-year students in graduate programs, Morelon-Quainoo and colleagues (Morelon-Quainoo et al., 2009) documented that limited and poor interactions among faculty and other students contribute to fewer underrepresented students persisting through graduate school. In seeking a supportive graduate school experience, underrepresented students looked at institutional reputation, financial aid, faculty reputations related to supporting students, and the campus climate related to diversity.

Latinx students had the smallest share of graduate students at 5.7% of all doctorates. Ramirez (2011; see also English & Umbach, 2016) found that Latinx students struggle to obtain positive faculty mentoring, undergraduate research experience, and positive letters of recommendation from faculty.

Concern regarding debt affects whether students decide to apply to graduate school. Consistently, economists found a non-linear relationship where a moderate level of debt decreases the number of students applying, but past that band, the number of students applying increases again. This relationship indicates that a certain amount of debt is tolerable for many, but debt is not an issue for a second segment of potential graduate students. Related, Chen and Bahr (2021) found that 36.0% of graduate applicants lack undergraduate debt compared to 59.0% in 1996 (Millet, 2003). They suggested that the cost of education may dictate how far students pursue educational goals.

Millet (2003) reported that by their fourth year, more than 50.0% of graduate students borrowed funds for their education, with at least \$10,000 borrowed. For first-year graduate students in public institutions, the percentage of students who borrowed more than doubled between 1990 and 1996.

The last set of studies examined parental involvement's role in graduate school enrollment. The earliest research showed no effect of parental involvement on graduate school aspiration or enrollment (Stolzenberg, 1994). By breaking it down by the type of degree sought, Mullen, Goyette, and Soares (2003) found no parental effect for MBA programs but a small effect for other master's programs. Strong parental support was found for students pursuing doctoral and professional degree programs. For example, Buttaro, Battle, and Pastrana (2010) found parental emotional support for Black students seeking graduate degrees, but few could provide financial support.

While it may appear that prior studies do not inform this research, the context for this study can be garnered. Systemic barriers in graduate school programs inform who participates in graduate programs and at what level. As a debt-averse culture, enrollment in a graduate program may be avoided in specific segments of Utah. Finally, the professional pathway may influence if and when graduate degrees are sought.

Objective

This project aimed to track Utah bachelor's degree earners into and through graduate school.

The specific research questions were:

- What are the characteristics of those who enroll in graduate-level programs?
- What are the most popular graduate-level programs within USHE institutions?
- How well are USHE institutions providing graduates of science, technology, engineering, and math (STEM)?
- How are underrepresented populations faring in graduate programs?

Box 2. Brief data and methods

The data in this project came from the National Student Clearinghouse (NSC) and the USHE databases. Students were identified within the USHE graduates database and matched with NSC.

Graduates included in this study received their bachelor's degrees between 2014 and 2019. These students were matched to enrollment in a graduate program between 2015 and 2022. Data was aggregated into descriptive statistics, and inferential analyses were conducted on graduation and some trends.

See Appendix A for a more detailed description of the research methods.

Results

Based on NSC data, all students who earned a bachelor's degree at any USHE institution between 2014 and 2019 were matched with the National Students Clearinghouse (NSC). These students were followed to the institutions that housed their graduate program. The original number of students with a bachelor's degree was 103,824. Of these, 45.1% identified as women and 54.9% as men. White students comprised 86.8% of this sample, Latinx/Hispanic 6.4%, Asian Americans 3.0%, Black/African American 1.2%, Native American 0.5%, Pacific Islander 0.4%, and multi-racial identities 1.7%.

From this cohort, 23.0% of USHE students who graduated with a bachelor's degree went to graduate school. Of these, 54.0% earned a master's degree; 1.3% earned a doctoral research degree (Ph.D.); and 8.6% earned professional degrees (M.D., J.D., etc.). The remaining 36.1% had not earned a graduate degree by the spring semester of 2022. Many graduate students (78.6%) attended school in Utah, and

most (84.0%) attended public institutions. Table 1 compares in-state vs. out-of-state attendees with public and private institutions.

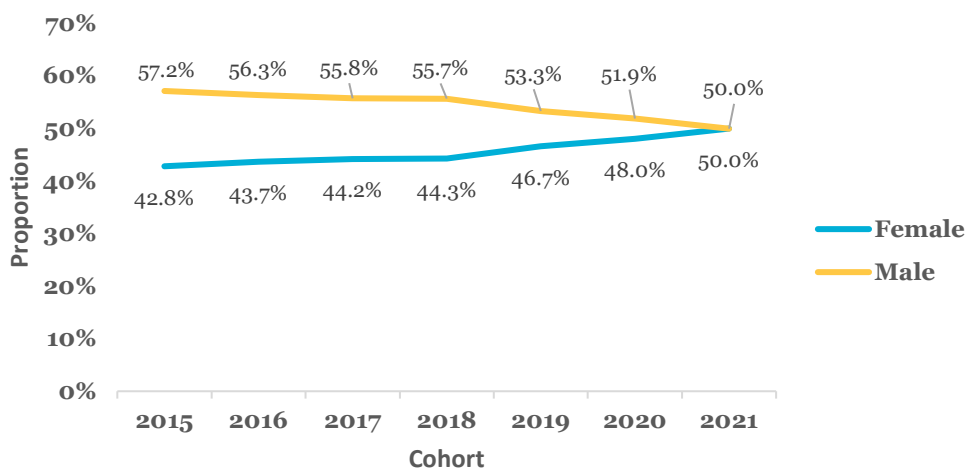
Table 1. Institutional Ownership and Location of Utah Graduate Students (percentages in parentheses)

	In-State		Out-of-State		Total	
Public	30,675	(72.3%)	4,995	(11.7%)	35,630	(84.0%)
Private	2,677	(6.3%)	4,120	(9.7%)	6,797	(16.0%)
Total	33,352	(78.6%)	9,075	(21.4%)	42,427	

Enrollment

Most graduate students were men (53.5%). This is the reverse of undergraduate students, where 52.4% are women. However, the percentage of men seeking graduate degrees relative to women is trending downward.

Figure 1. Graduate Students' Percentages Over Time by Gender



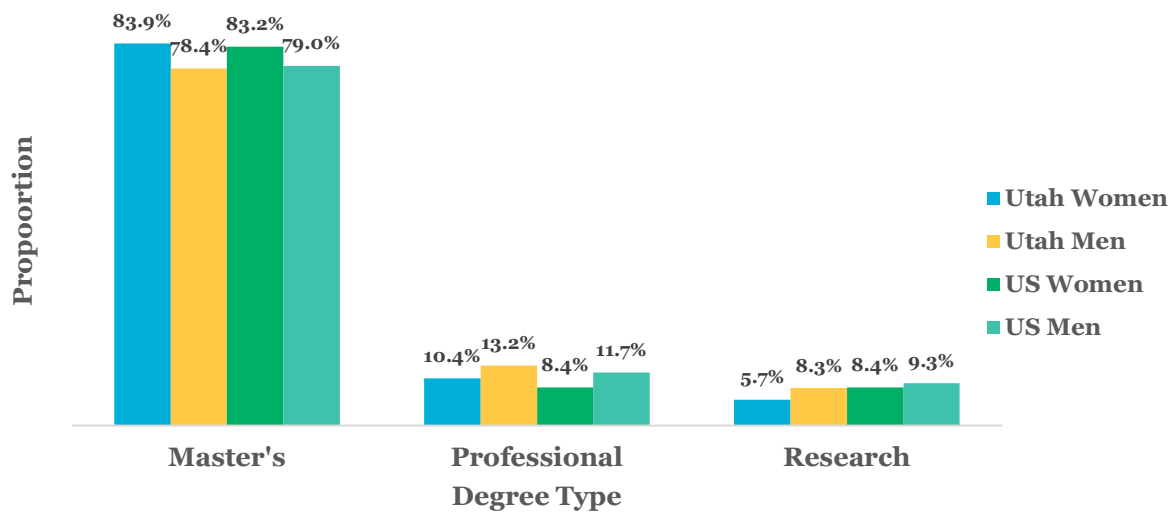
As seen in Figure 2, women are more likely to earn master’s degrees and have far less representation in doctoral programs.¹ The proportion of women earning master’s degrees is comparable to the national level, but women from Utah are far less represented in doctoral research degrees compared to the national level. Fewer men from Utah are seeking doctoral research degrees. However, more Utah men seek professional doctoral programs.

Men were equally likely to attend in-state or out-of-state for professional doctorate degrees, whereas women were more likely to stay in-state. Men are slightly more likely to attend out-of-state schools than

¹ Those who did not identify as male or female were less than 0.0002%.

women in research doctorate programs. More women earn a master’s degree outside of Utah than men. Similar findings are reported in the *Women in the Economy Commission* report (Jeppsen, 2018).

Figure 2. Graduate Degrees Earned by Gender, Utah and United States



Utah’s graduate students are predominantly white (87.3%). The rest are Latinx/Hispanic (6.1%) or Asian American (3.0%). All other racial categories comprised the remaining 3.6%. In other words, 7.9% of graduate students are from underrepresented populations. Overall, underrepresented graduate students are likelier to earn a Master’s degree and least likely to earn a research doctorate. Professional doctorate degrees are nearly equal between the two groups. A higher proportion of Utah’s underrepresented students (15.1%) seek doctorates compared to the national percentage of underrepresented students (12.1%).

Table 2. Percentage Breakdown of Degree Type Earned by Gender and Location of the Graduate Program

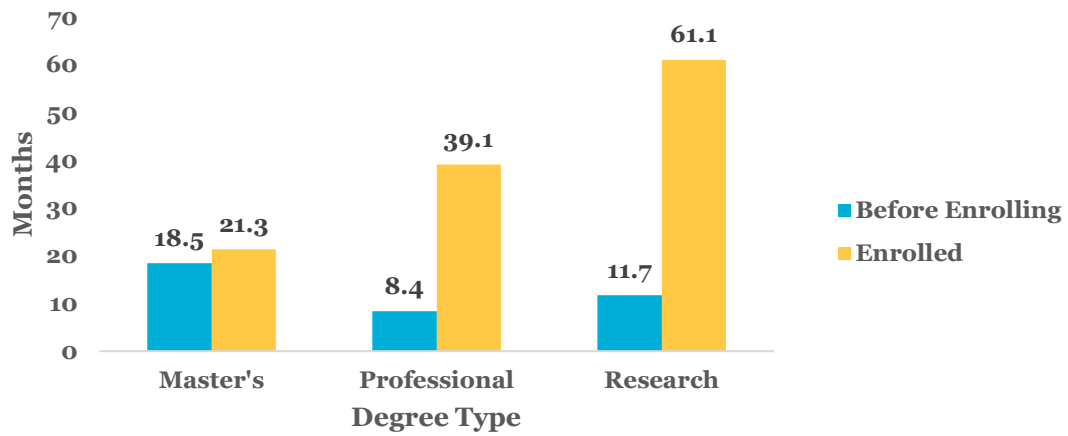
	In-state		Out-of-State	
	Female	Male	Female	Male
Master’s	77.6	82.5	22.4	17.5
Professional Doctorate	76.4	52.1	23.6	47.9
Research Doctorate	90.9	87.0	9.1	13.0

Time to Enroll

While slightly fewer students had all the data for this analysis, the demographic breakdown paralleled those presented previously. Students who sought doctorate degrees enroll at younger ages than those who sought master’s degrees. Those who enrolled in professional doctorate programs waited only 8.4 months before beginning their program. The mean age of the professional doctoral student was 26.5 months.

Research doctoral students started at a mean age of 25.4 years, having waited almost one year (M = 11.7 months).

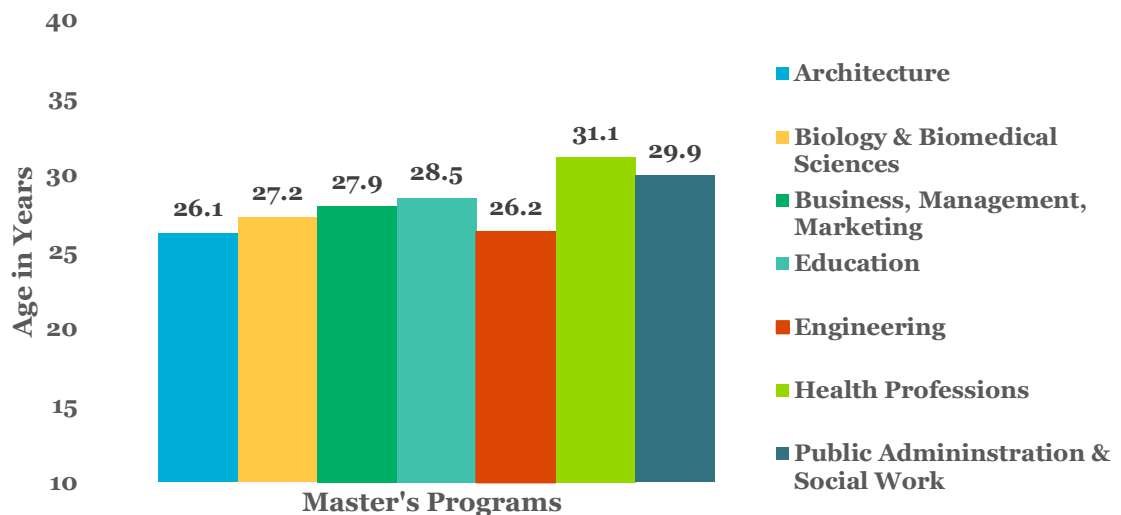
Figure 3. Time (months) Between Earning a Bachelor’s Degree and Enrolling in Graduate School, and Length of Enrollment in Graduate School



Masters students started at an average of 18 months after earning their bachelor’s degrees (M = 18.5, SD = 18.1). The average age of a master’s student at enrollment was 28.4 years (SD = 6.2). The age at which a student enrolls could be field-of-study-dependent. For example, engineering and architecture master’s students enrolled much younger than those in public administration and social work or health professional programs. This might indicate that work experience contributes to graduate school enrollment timing.

How long a student waited to enroll depended on the type of degree sought and the institution's characteristics; however, individual factors, such as gender or race, did not impact how long a student waited to enroll. Those who attended private in-state institutions waited the longest time before they enrolled.

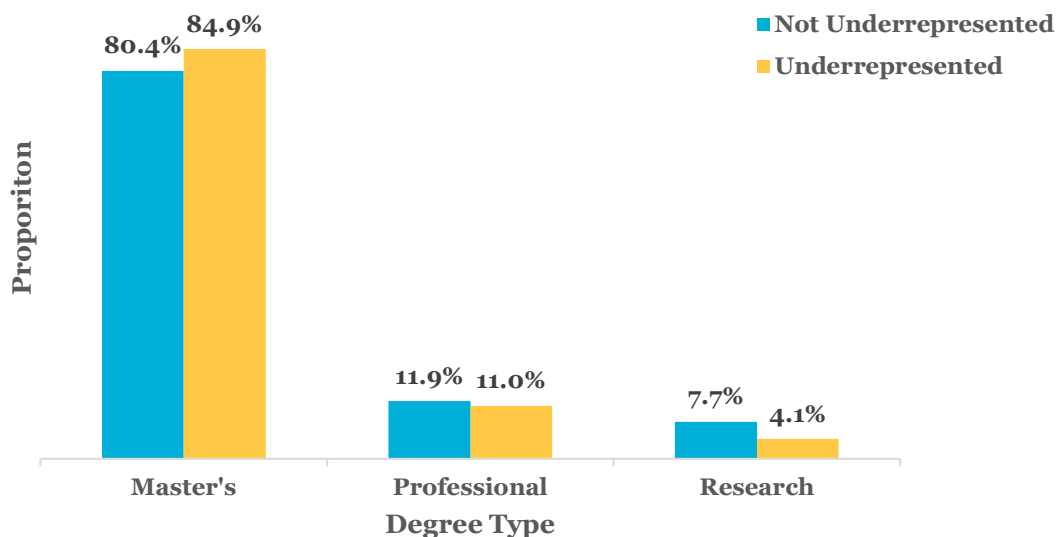
Figure 4. Mean Age at Enrollment for Most Popular Master’s Programs



Degrees Earned

The difference in the number of students earning a graduate degree between underrepresented students and those who were not was significant.² For master's degrees and doctoral research degrees, fewer underrepresented students earned a graduate degree. The exception was among professional doctorate earners in which the two groups were comparable.

Figure 5. Breakdown of Graduate Degrees Earned by Underrepresented Students



A higher proportion of underrepresented students earned a graduate degree outside of Utah than those students who were not underrepresented. The discrepancy was the greatest with master's programs and the smallest with professional doctoral programs. Larger segments of Black (35.7%) and Native American students (32.0%) left Utah for graduate programs. Only 18.6% attended a Historically Black College or University (HBCU) or a Hispanic-serving institution (HSI).³

Not all students earning a graduate degree may have left Utah. Approximately 10.5% of master's students may have earned their degree through an online program. The proportion of Utah students enrolled in online courses was lower than reported nationally. The Department of Education (NCES, 2021) reported that 20.1% of all graduate students are enrolled in exclusively online programs.

Underrepresented students enrolled in online programs at rates similar to the state level. For example, 33.0% of Black students enrolled in graduate programs online, while Latinx students' enrollment rate is 19.6%. Additional research is needed to explore online education in Utah and the participation rates of underrepresented students.

² $\chi^2 = 62.81, p < 0.001$

³ HIS's were identified through the Hispanic Association of Colleges and Universities.

Table 3. Percentage of degree type earned by representation and location of the graduate program.

	In-state		Out-of-State	
	Under-represented	Not Under-represented	Under-represented	Not Under-represented
Master's	70.8	80.9	29.2	19.1
Professional Doctorate	60.0	62.4	40.0	37.6
Research Doctorate	85.6	88.9	14.4	11.1

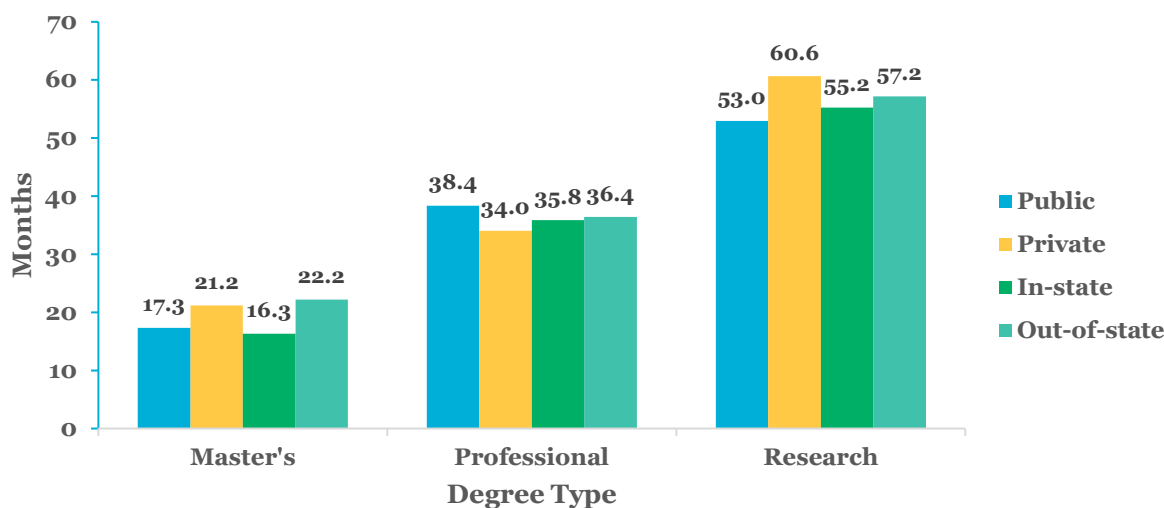
Over 25% of underrepresented students who left Utah for a graduate degree went to Arizona (13.5%) or California (14.6%). Other popular states included Texas (6.0%), Washington (4.3%), and Illinois (4.2%). These students attended public (53.6%) or private institutions (46.4%) almost equally. Those students who sought research doctorates attended public institutions at a much greater rate (84.6%).

Underrepresented students who earned graduate degrees outside of Utah attended mostly large- (69.7%) or medium-sized institutions (22.0%).⁴

Time to Graduate

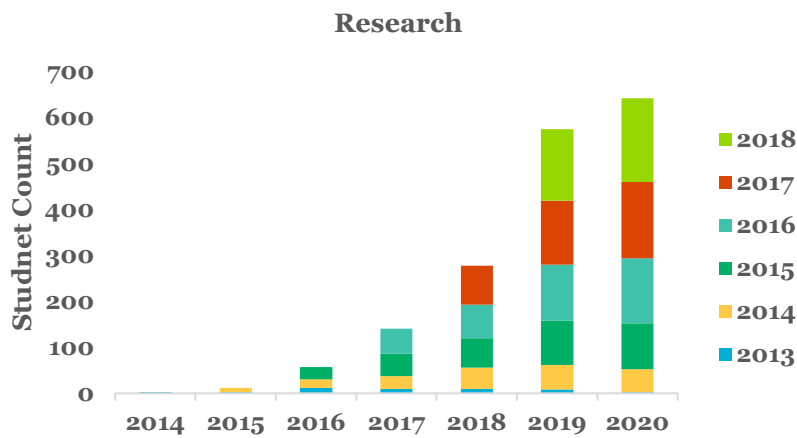
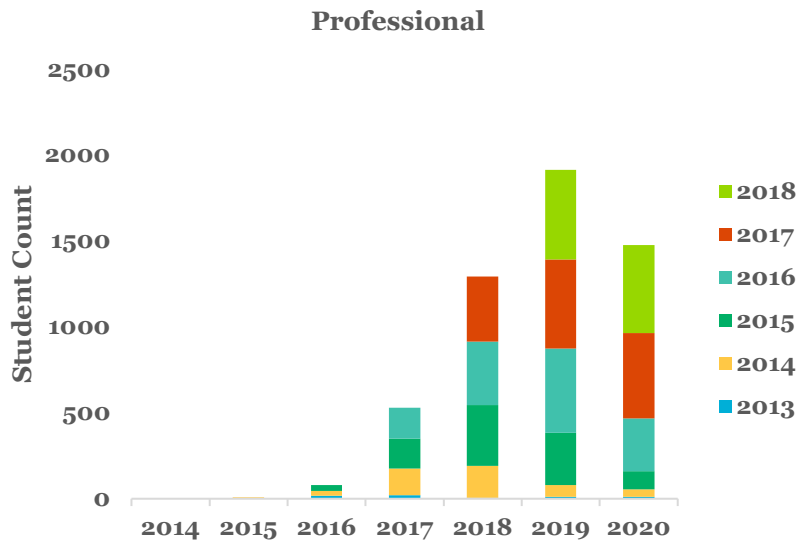
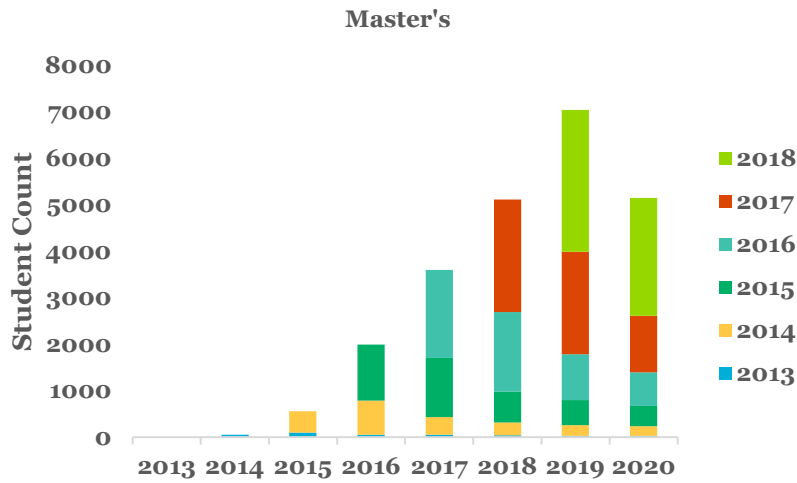
The mean time to earn a master's degree was 19.7 months, 57.6 months for research doctorates, and 37.6 months for professional doctorates. With the increasing number of students enrolled in master's programs, the time has decreased.

Figure 6. Mean Number of Months to a Degree Earned by Degree Type and Institutional Characteristics



⁴ Institutional size was identified through the Carnegie Classification of Institutions of Higher Education.

Figure 7. Number of Graduate Degrees Earned by Cohort Year and Degree.⁵ Y-axes are specific to each degree type.



⁵ Numbers in graph are suppressed since some cell sizes are less than 10.
UTAH SYSTEM OF HIGHER EDUCATION

Other demographic characteristics were associated with a graduate student's time to graduate. Women took longer than men in research doctorate programs, while men took longer in professional doctorate programs. Racial or ethnic identity did not correlate with the time needed to graduate.

Students attending an in-state institution graduated more quickly, except among professional doctorate programs in which in-state students took longer than out-of-state students. Out-of-state public institutions graduated students in both types of doctoral degrees more quickly than out-of-state private institutions.

Eleven percent of enrolled students had yet to earn a graduate award in this sample, which was fairly consistent across cohorts. Most unfinished degrees were those seeking master's, with 12.8% of all master's students left unfinished. More than one in four (27.9%) master's students at private institutions had not finished. For research doctorate degrees, the incompleteness rate is 3.9% and 1.9% for professional degrees.

Cohort Differences

The number of degrees earned increased across the degree types each year until the COVID-19 pandemic interrupted student progress (see Figure 7). Master's degrees peaked in the second year and then dropped. While the total number of master's degrees increased year over year, a drop occurred in 2020, and the same was seen in research doctorates.

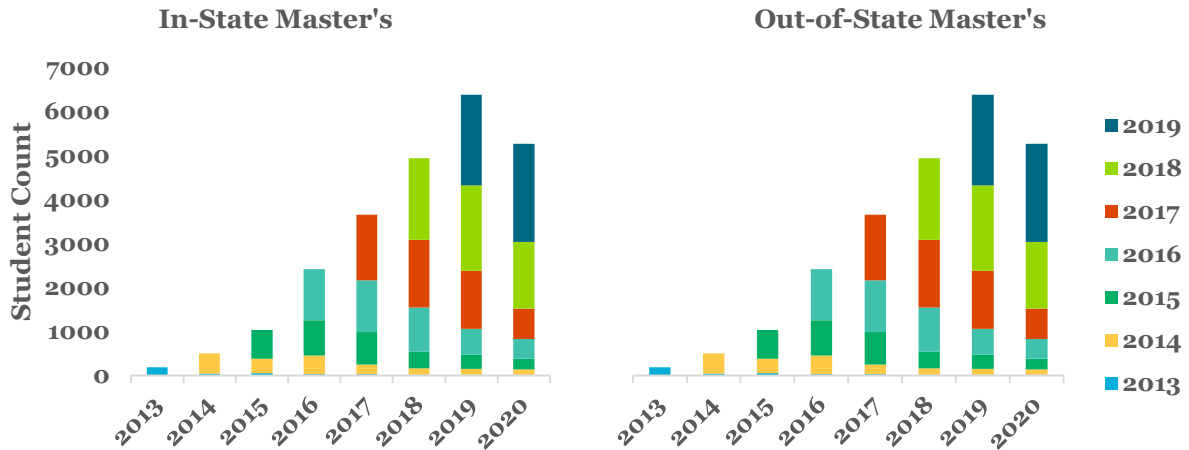
Professional doctorates are peaking at just above 500 graduates per cohort. The pandemic drop occurs in the older cohorts. Those who were struggling with completion hit a new barrier in COVID-19. An alternative explanation may be that the pandemic provided a new perspective that discouraged medical professionals from continuing in this industry.

Research doctorates also increased year after year. The number of degrees earned drops after the sixth year. Any pandemic effect is among the older cohorts, but it is small. Ph.D. programs could adapt more quickly to pandemic measures as the expectation of students is a focus on self-study and away from lectures.

Most postsecondary graduates earned a master's degree in Utah; the next largest group included those who earned master's degrees outside of Utah. This can be seen by comparing the y-axes of Figures 8, 9, and 10. The annual number of doctorate degrees, both professional and research, earned within Utah remained consistent by cohort, but the number of professional doctoral degrees earned outside of Utah rose steadily. A recent uptick in the number of out-of-state research doctorates can be seen in Figure 10.

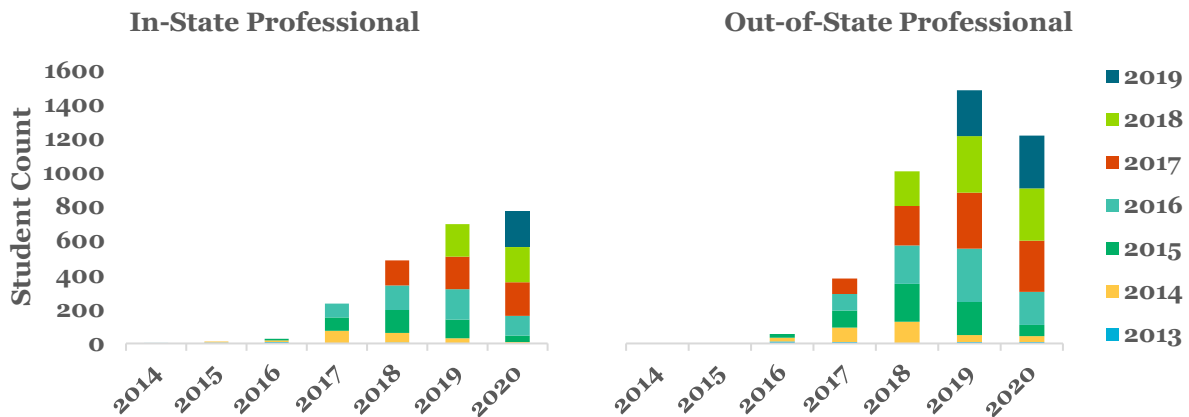
Almost nine out of ten graduate students are white. More than three-fourths attend graduate school in Utah, and more than one-half earn a master's degree. Underrepresented students tend to pursue master's degrees and are more willing to leave Utah for graduate studies than historically represented students. A significant proportion of underrepresented students earned graduate degrees outside of Utah.

Figure 8. Number of Master Degrees Earned by Cohort Year.⁶



The number of master’s degrees earned within and outside of Utah continued to increase. In exploring the time, it takes to earn a master’s degree, in-state master’s students more quickly, while most out-of-state students take at least two years, with many taking longer. It may be that these out-of-state students are part-time students or could be enrolled in an online program. Current data reporting methods do not include if a student is enrolled in an online program.

Figure 9. Number of Professional Degrees Earned by Cohort Year.⁷



Two findings emerge from the professional degree numbers (see Figure 9). The total annual numbers of in-state professional degrees increase year after year, but the variation between cohort numbers is slight. For any year, the three youngest cohorts are within 15 degrees earned. This means that only a small number of students are attaining professional degrees. The second finding is that increasingly, more students are earning professional degrees outside of Utah. Only a handful of Utahns earned a professional degree outside of Utah before 2016. Since then, a surge occurred that was recently impacted by pandemic

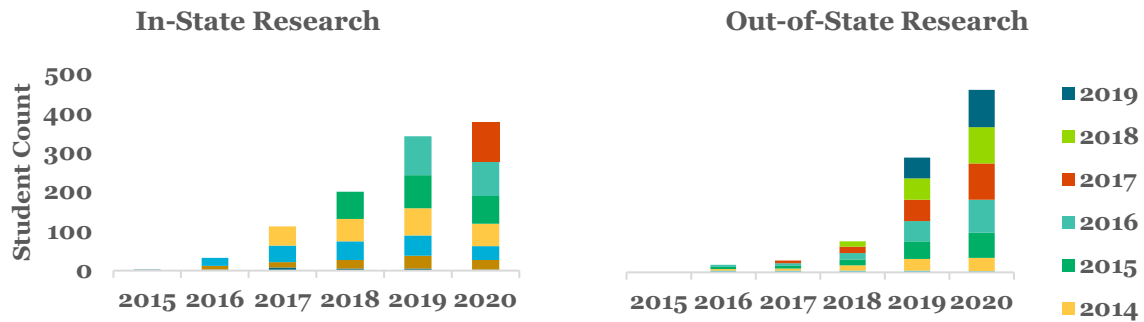
⁶ Counts are not provided for out-of-state research doctorates because the number of awards earned in cells is fewer than 10.

⁷ Counts are not provided for out-of-state research doctorates because the number of awards earned in cells is fewer than 10.

safety measures. The number of individuals earning professional degrees outside of Utah has exceeded those earning in-state degrees starting in 2016.

Overall, the number of students earning research doctorates is more than one-half of those earning professional doctorates. The number of research graduates within Utah varies only slightly by cohort and year. On the other hand, research doctorates are increasingly attained outside of Utah. Those students leaving Utah to pursue a research doctorate take longer to earn that degree.

Figure 10. Number of Research Doctorates Earned by Cohort Year.⁸



To summarize, almost one in four bachelor’s degree earners pursue a graduate degree. Slightly more men pursue graduate degrees than women, and men are more likely to seek doctoral degrees. These percentages reflect what is reported at the national level. One difference observed in Utah is the high proportion of students enrolled in the business, education, and health professions programs.

⁸ Counts are not provided for out-of-state research doctorates because the number of awards earned in cells is fewer than 10.

Most Popular Graduate Programs

The most popular graduate programs for Utah students differ from the United States as well as Utah’s neighboring states. According to national data, Utah students are far more concentrated in specific fields of study. More Utah students seek master’s degrees in business and health professions, but few pursue degrees in the humanities and engineering.

Utah’s Department of Workforce Services identifies eight high-demand engineering segments (mechanical, civil, industrial, electrical, computer hardware, aerospace, health and safety, and environmental). The mean annual growth rate for these segments is reported as 2.8%. However, these jobs are available with a bachelor’s degree. It may be that few of these jobs require the specialized skills that are acquired in a graduate degree. Another explanation may be that promotions within these fields may not be very competitive as graduate degrees are used to signal advancement potential. On the other hand, the high proportion of business master’s degrees could suggest the value of having an MBA in the Utah corporate environment. This may be in seeking specific employment positions or promotions.

Table 4. NCES Percentage Breakdown of Utah’s Top Master’s Degrees Conferred in 2019-20 by Percent in the Intermountain West. Fields are ordered as most popular in the United States.

State	Business	Education	Health Professions	Humanities	Engineering	All Others
Arizona	21.8	30.2	18.4	2.7	4.1	22.9
Colorado	28.1	12.5	14.6	5.7	7.1	31.9
Idaho	16.9	23.1	15.0	4.5	6.0	34.5
Nevada	15.6	32.5	16.3	4.8	3.9	26.8
New Mexico	15.8	24.9	16.0	8.7	8.9	25.7
Utah	33.8	28.1	21.0	1.6	1.7	13.8
Wyoming	17.6	18.1	11.2	14.0	7.3	31.8
USA	23.4	17.4	16.0	6.8	6.3	30.0

More students from Utah enroll in business and health profession programs than in neighboring states and nationally. Far fewer Utahns enroll in computer sciences, social sciences, psychology, and the natural sciences. NCES includes the CIP families, biology and biomedical sciences, mathematics, physics, and chemistry in the natural sciences category.

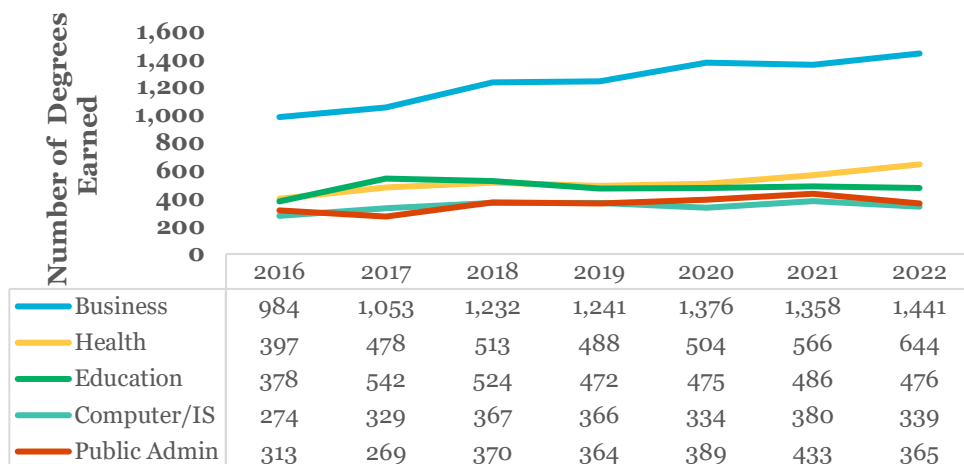
When looking at the top interests in master’s programs, the percentage differs somewhat from the national data between 2015 and 2022 (see Table 5). The top ten CIP families comprise 88% of all master’s degrees within USHE institutions.

Table 5. Top Ten CIP Family Master’s Degrees at USHE Institutions

Rank	CIP Family	Percent of all Master’s Degrees	Percent Underrepresented
1	Business, Management, Marketing (52)	29.4	7.3
2	Health Professions (51)	12.6	9.6
3	Education (13)	12.2	7.2
4	Public Administration, Social Service (44)	9.0	15.3
5	Computer/Information Systems (11)	8.0	6.8
6	Engineering (14)	7.7	4.8
7	Psychology (42)	3.5	9.5
8	Visual and Performing Arts (50)	2.2	8.7
9	Multi-/Interdisciplinary Studies (30)	1.8	14.3
10	Physical Sciences (40)	1.8	7.3

The public administration and social service family is popular among Utah’s underrepresented populations. Multi- and interdisciplinary studies are also popular among underrepresented students. These programs include international studies, nutrition, and gerontology. Psychology and fine arts are more popular among underrepresented students. Few underrepresented students are seeking master’s degrees in business and health professions. On average, underrepresented graduate students comprise 16.0% of USHE graduate students.

Figure 11. Top Five CIP Family Master’s Degrees over time



Business programs have seen steady increases in degrees earned, while the health professions’ growth has not been as steep. The number of master’s degrees in education is declining, which may reflect a drop in

the number of undergraduate students seeking employment in education. This is despite teacher shortages occurring in western states (e.g., California, Nevada, and Utah) and certain economic regions (urban and rural). Nationally, prospective teachers have dropped since 2019 (Barnes, April 2022). Utah’s State Board of Education has reported struggles filling mathematics, science, and special education vacancies for several years.

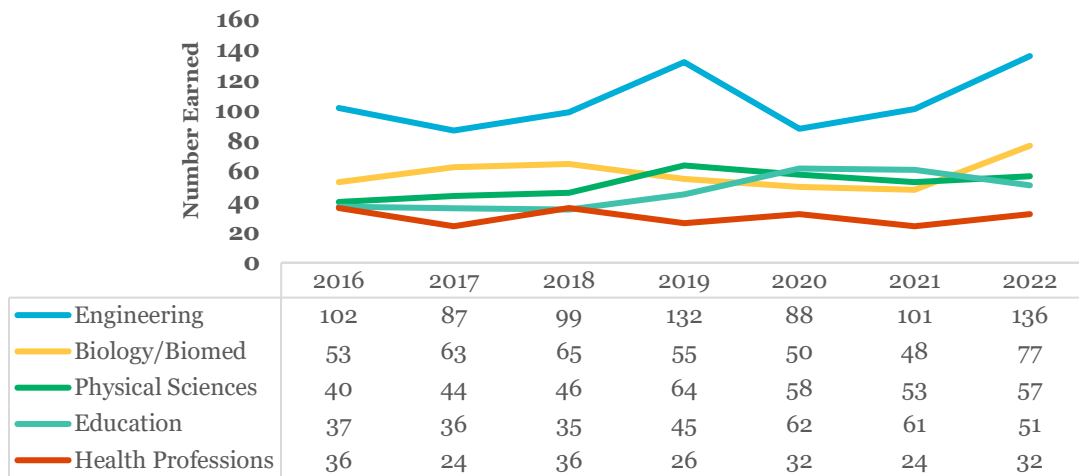
Like master’s degrees, research doctorates in engineering and the health professions remain popular. However, the natural sciences are much more dominant at this degree level. Biological and physical sciences make up one-quarter of doctoral research degrees. The top ten doctoral research degrees in Table 6 make up 86.3% of all doctoral research degrees. Underrepresented graduates tend to earn research doctorates in psychology and other social sciences.

Table 6. Top Ten Doctoral Research Degrees at USHE Institutions

Rank	CIP Family	Percent of All Doctoral Research Degrees	Percent Underrepresented Student Doctoral Research Degrees
1	Engineering (14)	22.2	3.3
2	Biological/Biomedical Sciences (26)	12.7	8.8
3	Physical Sciences (40)	10.8	3.1
4	Education (13)	9.3	8.0
5	Health Professions (51)	7.0	8.7
6	Psychology (42)	6.3	12.3
7	Social Sciences (45)	6.2	9.7
8	Computer/Information Systems (11)	4.9	2.7
9	Mathematics and Statistics (27)	4.2	1.4
10	Visual and Performing Arts (50)	2.7	0.0

Looking at the trends for the top five research doctorate CIP families, engineering was consistently at the top despite wide swings in enrollment. Education and physical sciences plateaued a few years ago, but the number of degrees earned has dropped recently.

Figure 12. Top Five CIP Family Doctoral Research Degrees at USHE Institutions Over Time



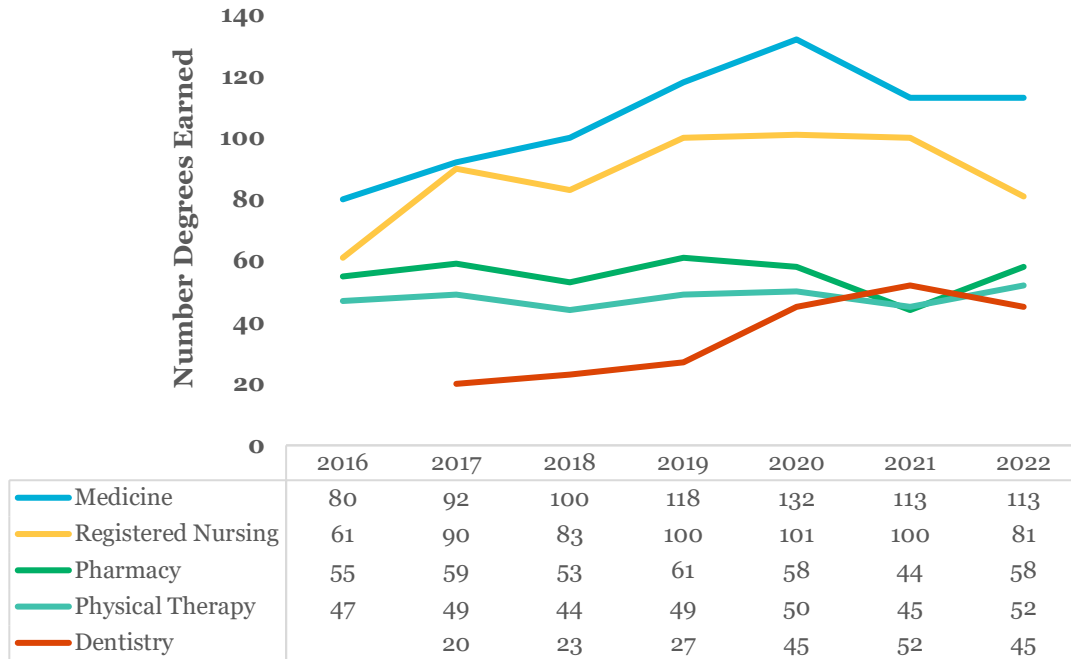
Of the professional doctoral degrees, 76.1% were from the health professions, and the remaining 23.9% were law degrees. The top five medical degrees are shown in Table 7. Physicians and doctoral nursing are the most popular health professions at this level. Pharmacy and physical therapy programs are producing significant numbers of graduates as well. Other medical occupations not shown include occupational therapy and audiology.

Table 7. Top Five Health Professional Doctoral Programs

Rank	CIP Family	Percent of All Professional Degrees	Percent Underrepresented Student Professional Degrees
1	Medicine (MD)	22.7	10.9
2	Registered Nursing	18.8	6.9
3	Pharmacy	12.6	10.9
4	Physical Therapy	10.7	8.0
5	Dentistry	5.3	10.9

Underrepresented students average 9.6% of all professional doctorate degrees in health. Interestingly, they are distributed equally across the medical fields. Occupational therapy has the highest proportion of underrepresented students at 14.1%, and Audiology has the lowest proportion at 6.0%. Across the five years studied, 12.2% of law students were underrepresented.

Figure 13. Top Five Medical Doctoral Programs Over Time



Most students who left Utah sought the same professional doctoral degrees offered in Utah. Only a small percentage sought programs unavailable in Utah institutions, such as a Doctor of Theology. The professional doctorate architecture degree was a one-of-a-kind program at the University of Hawaii.

Table 8. Percent of Degrees Sought Outside of Utah With Within Degrees

Rank	Master's		Doctoral Research		Professional Doctorate	
1	Health Professions	27.8%	Engineering	19.9%	Health Professions	69.5%
2	Business, Management & Marketing	13.0%	Physical Sciences	15.9%	Legal Professions	27.2%
3	Education	12.5%	Biology & Biomedical Sciences	11.2%	Agriculture	1.2%
4	Public Administration & Social Services	9.6%	Health Professions	7.2%	Education	0.7%
5	Psychology	4.9%	Psychology	6.1%	Visual & Performing Arts	0.4%
6	Engineering	3.5%	Social Sciences	5.8%	Psychology	0.3%

7	Visual & Performing Arts	3.0%	Mathematics & Statistics	5.8%	Social Sciences	0.2%
8	Biology & Biomedical Sciences	2.5%	Business, Management & Marketing	5.1%	Business	0.1%
9	Computer & Information Systems	2.5%	English Language & Literature	4.0%	Architecture	0.1%
10	Social Sciences	2.3%	Education	3.6%	Engineering	0.1%

Overall, Utahns are far more interested in business and health professions than the national average and among neighboring states. A smaller proportion of Utahns is interested in degrees aligned with the helping industries, such as psychology or social services, than at the national level. The data collected in this report identifies underrepresented students pursuing graduate degrees in these fields of study, specifically public administration, social services, and multi- or interdisciplinary studies, which are less popular programs among non-underrepresented graduate students.

Science, Technology, Engineering, and Mathematics

For several decades, policymakers have emphasized the need for additional science, technology, engineering, and mathematics (STEM) graduates. National leaders set a goal for an additional one million graduates in STEM fields between 2013 and 2023 (Reddick, Struve, Mayo, Miller, & Wang, 2018).

Interest in STEM graduate programs differs from the national average when looking at enrollment data. Nationally, higher enrollment averages exist in engineering, biology and biomedical sciences, social sciences, and agricultural sciences. On the other hand, Utah shows higher enrollment levels in computer and information sciences, the health professions, natural resources, and multi- and interdisciplinary studies.

Table 13. Breakdown of STEM Graduate School Enrollees at USHE Institutions

CIP Family	Percent of Utah STEM	Percent of U.S. STEM
Agricultural Sciences	0.9	2.3
Biology & Biomedical Sciences	9.3	12.7
Computer & Information Sciences	18.3	11.4
Engineering	20.9	24.1
Health Professions	15.7	11.1
Mathematics	3.1	4.3
Multi-/Interdisciplinary studies	6.5	1.2
Natural Resources	1.7	0.5
Physical Sciences	7.1	6.3
Psychology	8.3	8.4
Social Sciences	8.0	15.4

STEM degrees include both those who earn master’s degrees as well as research doctorates. However, STEM graduate degrees exclude professional doctorates. Health professions exclude graduates who are medical doctors, physical therapists, and pharmacists but include those who conduct research in these fields. Psychology and other social sciences also are popular among Utah’s students.

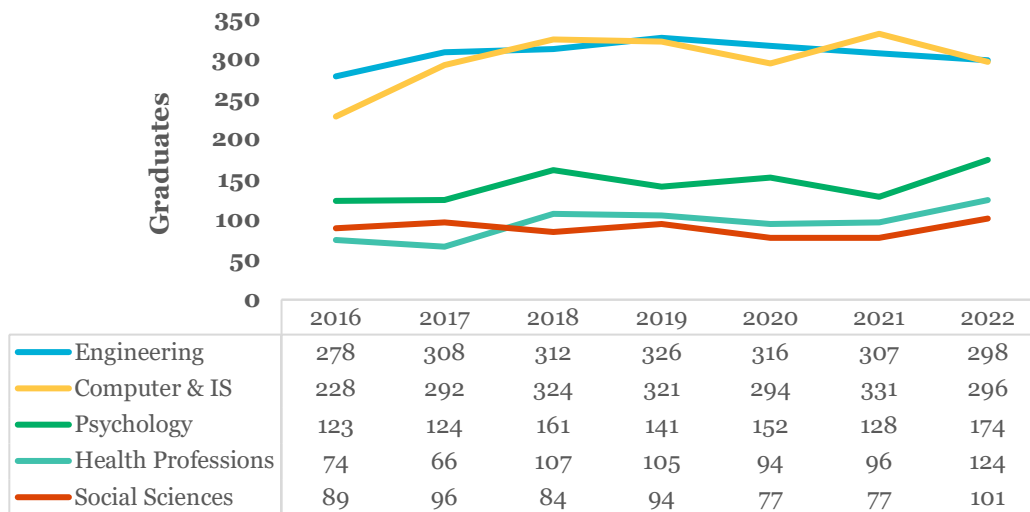
Master’s Degrees

Among those who earned master’s degrees in STEM, engineering, computer, and information sciences are the most popular. Computer and information science jobs that require a master’s degree are listed as one

of Utah’s four-star jobs. However, these fields have leveled out in recent years after growing the number of graduates up to 2019. Utah’s Department of Workforce Services reports an average annual growth rate of 2.8% among computer and information research scientists with master’s degrees (DWS 2022).

Further, the number of psychologists and health researchers may be growing. The three main concentrations of health professions are biomedical informatics, clinical investigation, and the most popular, public health.

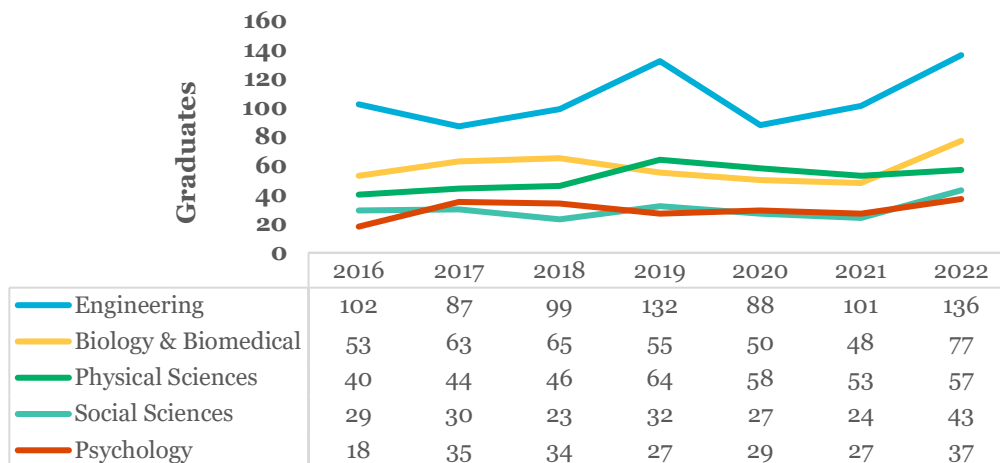
Figure 14. Top Five STEM Master’s Degree CIP Families Over Time



Doctoral Degrees

Similar to master’s degrees, engineering is the most popular STEM doctorate. Far more doctorates are earned in engineering than other STEM doctorates. The number of degrees awarded peaked in 2019, dropped during the COVID pandemic, and has since returned to its former trend.

Figure 15. Top Five STEM Ph.D. Degree CIP Families Over Time



Instead of computer and information sciences and health profession fields, more master’s degrees are earned in biology and biomedical sciences, in addition to the physical sciences. Nationally, the biomedical science industry is experiencing high growth (Bureau of Labor Statistics, January 9, 2023). Salt Lake City does have a biomedical industry presence, but the Utah Department of Workforce Services predicts a growth rate of 7.2% compared to the national rate of 17.0%.

Students have shown an increased interest in physical sciences, on par with biology and biomedical science. Similarly, doctorates in the social sciences and psychology are seeing increases in the number of recent graduates. While the pandemic may have repressed the number of graduates in recent years, a rebound is occurring.

Underrepresented Graduates

Among those who earn master’s degrees in STEM fields, women were overrepresented in psychology, the health professions, and multi- and interdisciplinary studies. In contrast, men were overrepresented in engineering and computer and information systems. As for the small proportion of women in engineering and computer and information sciences, researchers documented that most women leave engineering and computer science undergraduate programs (Johnson & Sheppard, 2004; Severiens & ten Dam, 2012; Varma, 2007). Reasons for not earning a degree in these fields included poor advising, unsupportive classroom culture, and resistant faculty. These circumstances have led to fewer women entering undergraduate programs, limiting the number of female engineers and computer scientists at the graduate school level.

Table 14. Percent of Graduate Degrees Earned by Gender and Degree Type

CIP Title	Master’s		Ph.D.	
	Female	Male	Female	Male
Agricultural Sciences	45.6	54.4	30.8	69.2
Biology & Biomedical Sciences	49.0	51.0	37.3	62.7
Computer & Information Sciences	24.0	76.0	26.1	73.9
Engineering	16.7	83.3	19.0	81.0
Health Professions	63.3	36.7	43.9	56.1
Mathematics	42.5	57.5	31.8	68.2
Multi-/Interdisciplinary studies	69.2	30.8	100.0	0.0
Natural Resources	42.4	57.6	63.6	36.4
Physical Sciences	37.2	62.8	36.7	63.3
Psychology	74.1	25.9	71.0	29.0

Social Sciences	45.8	54.2	43.8	56.3
------------------------	------	------	------	------

Eighty percent of full-time U.S. scientists and engineers identify as white or Asian American. Graduate-level enrollees nationwide are predominantly white (38.3%) or international students (37.2%, NCSES, 2021). The remaining underrepresented students earn 22.0% of all undergraduate STEM degrees, 13.0% of all STEM master’s degrees, and only 10% of STEM doctoral degrees (NCSES, 2021; Salama, Toven-Lindsey, Levis-Fitzgerald, Barber & Hasson, 2021). As a comparison, underrepresented populations comprise 29.0% of the U.S. population. This lack of representation in STEM fields has been characterized as pervasive and long-standing (Russell, Escobar, Russell, Roberson & Thomas, 2018; Wilson et al., 2014).

Part of this narrowing pipeline stems from fewer graduates with bachelor’s degrees enrolling in graduate school compared to white students. Fewer potential students can be recruited and enrolled in STEM graduate programs. Other barriers for underrepresented graduate students interfere with earning a post-baccalaureate degree (Graham, 2013; Starks & Matthaeus, 2018; Wilson, DePass & Bean, 2018). Such barriers include social climate, lack of or poor mentors, the student’s sense of belonging (Fisher et al., 2019; Hurtado, Cabrera, Lin, Arellano, & Espinosa, 2009; Moreira et al., 2019), the lack of support networks (McMurtry, 2019; Roksa, Wang, Feldon & Ericson, 2022), and cost (Roberts et al., 2021). Sowell and colleagues (Sowell, Allum & Okahana, 2015) identified that 36.0% of underrepresented students withdrew from doctoral programs at the institutions they studied.

Table 15. Percent of graduate degrees Earned by Utah’s Underrepresented Students by Degree Type

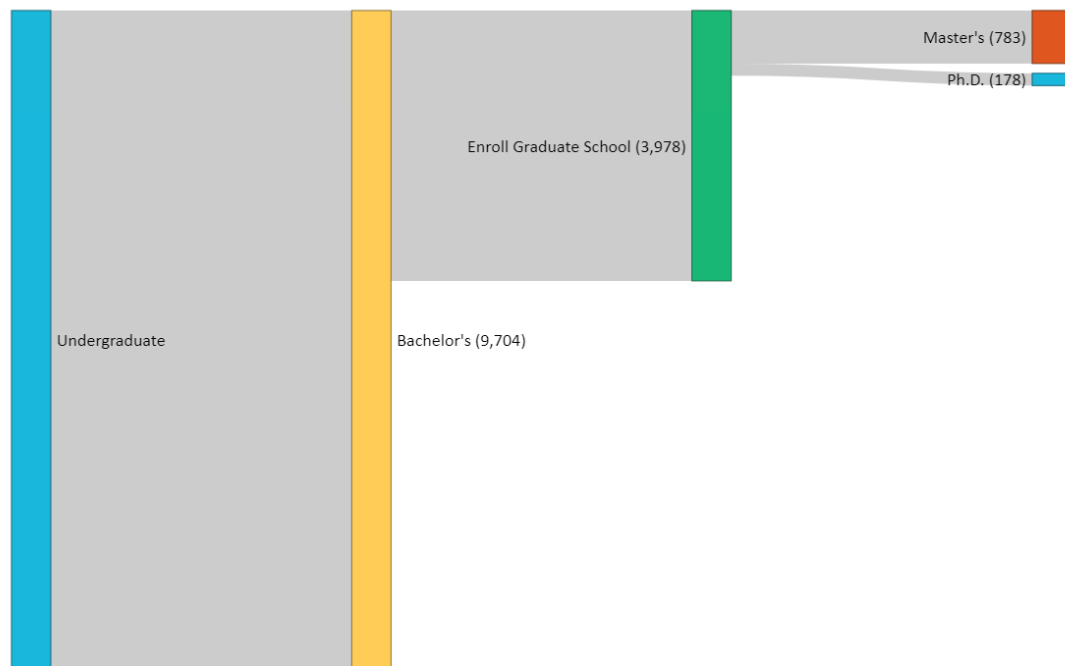
CIP Title	Master’s	Ph.D.
Agriculture	4.9	10.7
Biology & Biomedical Sciences	6.8	8.8
Computer & Information Sciences	7.1	2.0
Engineering	4.8	3.3
Health Professions	14.4	7.9
Mathematics	5.7	1.4
Multi-/Interdisciplinary	14.0	0.0
Natural Resources	4.0	0.0
Physical Sciences	7.3	3.1
Psychology	9.7	12.3
Social Sciences	10.0	9.7

As Table 15 shows, high STEM participation by underrepresented students does not occur in typical STEM fields. Further, no underrepresented graduate students have graduated with a Ph.D. in natural resources or multi-interdisciplinary studies in over eight years. In most cases, fewer undergraduate students earn doctorate degrees proportional to master's degrees.

Interest in STEM among underrepresented students is growing, but only some earn graduate degrees. Growth in the number of STEM bachelor's degrees among underrepresented students averaged 4.7% across this sample, and enrollment in graduate school matches what is occurring across the United States.

The number of underrepresented students enrolling in STEM graduate programs increased by approximately 11.0% per year, and the percentage of graduate degrees also increased sharply. From these cohorts, 54.3% of these students earned a master's degree within three years, and 12.6% earned a research doctorate within five years. This equates to 63.3% of the students earning a timely degree.

Figure 16. Differences Between Undergraduate STEM Students from Earning Bachelor's to Graduate Degrees



To summarize, most Utahns who seek STEM graduate-level degrees are in engineering, computer sciences, and the health professions. Interest in STEM health masters' degrees is trending slowly upward, as are doctorates in engineering. Few women are earning degrees in computer sciences and engineering. While interest among underrepresented students is high, only a small percentage earn a master's degree, with fewer earning doctorates.

Implications

This report aimed to identify the critical characteristics of Utah's postsecondary graduates who pursue a graduate degree. Included was the identification of the most popular graduate degree programs. Additionally, this report shows how many students are prepared for careers in STEM sectors. Finally, the report explored how underrepresented populations fared in seeking graduate degrees.

Almost one in four students who earn a bachelor's degree from USHE institutions pursue a graduate degree, and more than three-fourths of those students stay in Utah to pursue their graduate degree. More than half of those who earn a graduate degree earn master's degrees, and those who seek master's degrees tend to be older than those who seek doctorate degrees. Additionally, a greater proportion of students who seek master's degrees will earn those degrees compared to those who seek doctorate degrees.

Utah institutions award more master's degrees in business and health professions than other states in the Intermountain West. The number of business and health master's degrees continues to trend upward. Engineering, biology/biomedical sciences, and physical sciences are the most popular for research doctorates, with growth in engineering and biology and biomedical sciences.

Currently, the proportion of men and women seeking graduate degrees is almost equal, but fewer men are pursuing graduate degrees than before. On the other hand, women are taking longer than men to earn their degrees. Additionally, only some women are graduating from engineering and computer information science programs. In response to these low graduation rates, institutions in other states are establishing programs to increase and retain women in engineering and computer science programs (Estrada et al., 2016; Xu, 2016). While it is beyond this project's scope to investigate what USHE institutions are doing to recruit and retain women in these programs, such an assessment would be warranted.

Less than ten percent of students seeking graduate degrees come from underrepresented populations. Most underrepresented graduate students earn master's degrees, and these students are more likely to leave Utah to pursue a graduate degree. The most popular master's degrees are in public administration, social work, and multi- and interdisciplinary studies. Psychology research doctorates are also popular. Utah's underrepresented students tend to seek non-traditional STEM programs such as multi- or interdisciplinary studies or the social sciences.

Barriers identified in prior research may contribute to low graduation among underrepresented populations. These include positive faculty mentoring, supportive departmental culture (Morelon-Quainoo et al., 2009; Ramirez, 2011), financial (Millet, 2003), and familial support (Buttaro, Battle, and

Pastrana, 2010). To what extent these issues exist among USHE institutions requires deliberative self-study within these colleges and departments.

While the number of undergraduate students enrolling in STEM graduate programs is trending upward, the number of graduates has changed little. Slightly more than half are earning a graduate degree on time. Research suggests that undergraduate STEM programs must prepare all students for graduate work, and institutions must address barriers that allow students to persist toward their goals (Toven-Lindsey, Levis-Fitzgerald, Barber, & Hasson, 2015). Estrada and colleagues (2016) suggest that preparation programs are needed to identify successful interventions and review data within an iterative feedback process.

Limitations

One limitation of this research was that most contextual data came from secondary sources. The data reported by the National Center for Educational Statistics (NCES) is collected and coded differently than other sources. For example, NCES STEM data relied on the National Center for Science and Engineering Statistics Taxonomy of Disciplines. Other organizations used the Department of Homeland Security STEM Designated Degree Program List. For purposes of direct comparison to reported national numbers in this report, the NCES taxonomy was used. Differences in proportions and counts were based on the source of data and the differences in category definitions.

Mostly, these analyses were descriptive and did not identify causal relationships. Trends shown may lead the reader to believe a causal relationship is established. However, statistical protocols commonly accepted as demonstrating causality were not conducted. Inferential analyses related to the time to enroll and the time to graduate were conducted. These results were in the text, but the analysis details can be found in the Appendix. Additional research is necessary to establish causal relationships among other topics presented in this report.

Appendix A. Methodology

Methodology & Results

All students must have earned at least a bachelor's degree at a USHE institution between 2014 and 2019 and were matched with the National Student Clearinghouse (NSC). These students were tracked to their graduate institution regardless of location as long as it was within the United States. The NSC file was matched to the USHE student database to add demographic data. Information such as required hours, credit hours earned, and credit hours transferred were added from the USHE graduation database.

In specific analyses, specifically top programs and STEM programs, the counts between the NSC data and USHE data were significantly different. In these situations, the study relied solely on USHE data.

Student Data

The original number of students earning a bachelor's degree was 103,824. Students who earned a bachelor's degree outside of Utah but a graduate degree at a USHE institution were excluded from the analysis. Of these students, 45.1% identified as women. White students comprised 86.8% of this sample, Latinx/Hispanic 6.4%, Asian Americans 3.0%, Black/African American 1.2%, Native American 0.5%, Pacific Islander 0.4%, and multi-racial identities 1.7%.

Variables

- **CIP family:** The first two digits of the six-digit Classification of Instructional Program (CIP) taxonomy developed by NCES.
- **Completion:** Identification of students who completed the graduate program.
- **Degree type:** The three graduate-level degree codes [7 (Master's), 17 (academic doctoral), 18 (professional)] as recognized by IPEDS.
- **Enrollment age:** Age at enrollment; calculated from birthdate and the NSC enrollment begin date for the graduate program.
- **Enrolled length:** Time between the enrollment begin data and the enrolled end data as identified by NSC.
- **Ethnicity:** Race or ethnicity as defined by NCES categories: Asian American, Black/African American, Latinx/Hispanic, Native American/Alaskan Native, Pacific Islander, White, Two or more races, non-resident.
- **Enrollment year:** The first year enrolled in a graduate program, or Enrollment Begin year as identified by NCS.
- **Gender:** Three self-identified classifications: female, male, and unspecified.
- **Graduation date:** The date the graduate degree was awarded.
- **Graduate GPA:** Cumulative GPA from the graduate program.

- **Graduate student:** Enrolled in a graduate program in a USHE degree-granting institution where the student earned their first bachelor's degree.
- **In-state institution:** Any institution providing graduate-level awards within Utah.
- **Out-of-state institution:** Any institution providing degrees outside of Utah but within the U.S.
- **Previous degree type:** The minimum award code (bachelor's or 5) as determined by IPEDS.
- **Ownership:** NCS designation as to the ownership of the institution. The local government oversees public institutions, while private institutions include both non-profit and for-profit entities.
- **Status:** Two options were available: those who enrolled in a graduate degree program at a USHE institution and earned that degree (coded as 1) and those who enrolled and had not earned a graduate degree by the time this data was collected (0).
- **STEM:** Science, Technology, Engineering, and Mathematics fields were identified using the National Center for Science and Engineering Statistics Taxonomy of Disciplines in alignment with NCES surveys.
- **Underrepresented students:** Students who identified as Black, Latinx/Hispanic, Pacific Islander, Native American/Alaskan Native, or having two or more racial or ethnic identities were classified as underrepresented.
- **University type:** The institutional mission as a research institution (UU & USU) or regional service provider (WSU, UVU, SUU, UT).

Results

Factorial Analysis of Variance

Three-way ANOVA was employed for each of the two dependent variables. The first dependent variable was *months before enrolling* (MBE), and the second was *months before graduation* (MBG). Independent analyses included individual and institutional characteristics. Individual characteristics were gender and underrepresentation. Too few students of color prevented examination by race or ethnicity. Instead, one dichotomous variable was used: underrepresented and not underrepresented. The two institutional characteristics were ownership (public or private) and state (in-state vs. out-of-state). One last variable was also used in the analysis of degree type, which consisted of the three graduate degrees: master's, research doctorate, and professional doctorate. A total of four 2 x 2 x 3 ANOVAs were conducted.

Months before Enrolling

The first analysis examined MBE by the two individual characteristics, gender and underrepresentation. No three-way interaction was statistically significant when considering MBE in a graduate program ($F_{(2, 14678)} = 0.12$, n.s.). No two-way interactions were significant (gender by underrepresentation, $F_{(2, 14678)} = 0.03$, n.s.; gender by degree type, $F_{(2, 14678)} = 0.28$, n.s.; underrepresentation by degree type, $F_{(2, 14678)} = 0.47$, n.s.). The only significant main effect that was degree type ($F_{(2, 14678)} = 43.29$, $p < 0.001$, partial $\eta^2 =$

0.006; gender, $F_{(1, 14678)} = 2.37$, n.s.; underrepresentation, $F_{(2, 14678)} = 0.77$, n.s.). Means are reported in Table A1.

Table A1. Means and standard deviations of student characteristics for months enrolled until graduation.

Gender	Master's	Research	Professional
Female	19.46 (18.60)	9.61 (11.43)	13.81 (12.62)
Male	17.53 (17.60)	7.96 (8.66)	10.58 (10.67)

The second MBE analysis included state by ownership by type. The three-way interaction was significant, ($F_{(2, 14681)} = 12.97$, $p < 0.001$, partial $\eta^2 = 0.002$). Master's students waited longer than students in the doctorate programs, both research and professional. Private in-state master's students waited significantly longer than students in the other master's programs.

Two of the subsequent analyses were statistically significant, including degree type by state ($F_{(2, 14681)} = 5.35$, $p = 0.003$, partial $\eta^2 = 0.005$) and degree type by ownership ($F_{(2, 14681)} = 9.68$, $p < 0.001$, partial $\eta^2 = 0.001$). However, state by ownership was not significant, $F_{(1, 14681)} = 0.11$, n.s. Two of the three main effects were significant (degree type, $F_{(2, 14681)} = 120.29$, $p < 0.001$, partial $\eta^2 = 0.02$; ownership, $F_{(1, 14681)} = 8.76$, $p < 0.003$, partial $\eta^2 = 0.001$). No difference existed between in-state and out-of-state schools regarding MBE, state, $F_{(1, 14681)} = 3.58$, n.s.

Table A2. Means and standard deviations of institutional characteristics regarding months before enrolling in a graduate program.

State	Ownership	Master's	Research	Professional
In-State	Public	16.60 (17.25)	9.51 (10.57)	12.14 (11.71)
	Private	26.14 (21.36)	10.00 (13.33)	11.58 (9.74)
Out-of-State	Public	16.57 (16.10)	6.88 (7.49)	10.30 (10.40)
	Private	18.32 (17.32)	10.39 (10.68)	12.63 (12.44)

Months to Graduation

Exploring individual characteristics, Months before Graduation (MBE) included degree type (master's vs. research doctorate vs. professional doctorate), gender, and representation (underrepresented vs. not underrepresented). This three-way ANOVA was not significant, $F_{(2, 14693)} = 0.30$, n.s. One two-way ANOVA was significant between degree type and gender, $F_{(4, 14577)} = 4.94$, $p = 0.001$, partial $\eta^2 = 0.001$. Female research doctorates took significantly longer to graduate than men. Male professional doctorate students took longer than women. The interactions between degree type and underrepresentation ($F_{(2, 14577)} = 1.13$, n.s.) and between gender and underrepresentation ($F_{(1, 14577)} = 2.26$, n.s.) were not significant. The only

main effect that was significant was degree type ($F_{(2, 14596)} = 183.68, p < 0.001, \text{partial } \eta^2 = 0.03$; gender, $F_{(1, 14596)} = 4.57, \text{n.s.}$; underrepresentation, $F_{(1, 14596)} = 4.57, \text{n.s.}$).

Table A3. Means and standard deviations of student characteristics for months enrolled until graduation.

Gender	Master's	Research	Professional
Female	19.43 (11.62)	60.50 (12.54)	36.07 (7.58)
Male	19.35 (12.03)	54.24 (13.07)	37.43 (9.45)

Institutional characteristics on time to graduation were also explored. The independent variables included state (in-state vs. out-of-state) and ownership (public vs. private). The three-way ANOVA was significant, $F_{(2, 14693)} = 8.30, p = 0.0002, \text{partial } \eta^2 = 0.001$. Across all three degree types, in-state public institutions took less time to graduate, except students in professional doctorate programs, who took significantly longer to graduate than those in private programs. In-state Professional doctorate programs may be related to the predominant programs specific to that institution. Out-of-state public research graduates also took less time than graduates at out-of-state private research institutions. Finally, in-state public institution graduates took less time than out-of-state public and in-state and out-of-state private institutions.

Table A4. Means and standard deviations

State	Ownership	Master's	Research	Professional
In-State	Public	12.46 (11.74)	52.77 (13.29)	39.06 (8.68)
	Private	20.13 (10.87)	59.17 (15.28)	32.62 (3.65)
Out-of-State	Public	22.24 (11.07)	53.23 (12.88)	37.77 (10.02)
	Private	22.24 (11.83)	61.85 (14.30)	35.14 (9.81)

Two of the two-way ANOVAs, degree type by state ($F_{(2, 14596)} = 4.57, p = 0.02, \text{partial } \eta^2 = 0.001$) and degree type by ownership ($F_{(2, 14596)} = 3.88, p = 0.01, \text{partial } \eta^2 = 0.001$), were also significant. However, state by ownership was not significant, $F_{(1, 14596)} = 2.19, \text{n.s.}$ All three main effects were significant (degree type, $F_{(2, 14596)} = 186.25, p < 0.001, \text{partial } \eta^2 = 0.03$; state, $F_{(1, 14596)} = 10.03, p = 0.002, \text{partial } \eta^2 = 0.001$; ownership, $F_{(1, 14596)} = 4.13, p = 0.04, \text{partial } \eta^2 = 0.0001$).

Survival Analysis

Survival analysis explored factors influencing graduate students not earning their intended award. This analysis is ideal for measuring attrition and graduation patterns (Miller & Leski, 2014). Factors include degree type (master's, research doctorate, or professional doctorate), gender, underrepresented

population status, and ownership (public vs. private). Too few non-white students were enrolled in graduate programs to explore by specific racial or ethnic identity.

The time variable used was the time enrolled in the graduate program. Time was measured as a monthly continuous variable, and the event of interest was graduation. Several student and institutional variables were examined as separate analyses, including gender (female vs. male), representation (underrepresented vs. not underrepresented), state (in-state vs. out-of-state), and institutional ownership (public vs. private).

The base model only included degree types; the other models had one predictor stratified by degree type. Means and Kaplan-Meier statistics are shown in Table A5.

Table A5. Mean enrollment time in months with standard error in parentheses.

	Master's	Research	Professional	Mantel-Cox Log Rank
Base Model	24.28 (0.17)	58.56 (0.92)	37.80 (0.25)	1677.70*
Female	23.99 (0.22)	61.50 (1.63)	37.18 (0.33)	4.57
Male	24.43 (0.25)	57.22 (1.14)	37.92 (.033)	
Underrepresented	23.86 (0.34)	58.30 (2.14)	38.76 (0.60)	1.46
Not Underrepresented	24.42 (0.20)	58.60 (1.02)	37.56 (0.27)	
In-state	22.99 (0.22)	56.09 (1.44)	38.37 (0.28)	161.55*
Out-of-State	26.29 (0.26)	60.36 (1.19)	37.32 (0.39)	
Public	23.33 (0.19)	58.19 (0.99)	34.91 (0.50)	83.33*
Private	26.75 (0.36)	60.57 (2.53)	39.04 (0.27)	

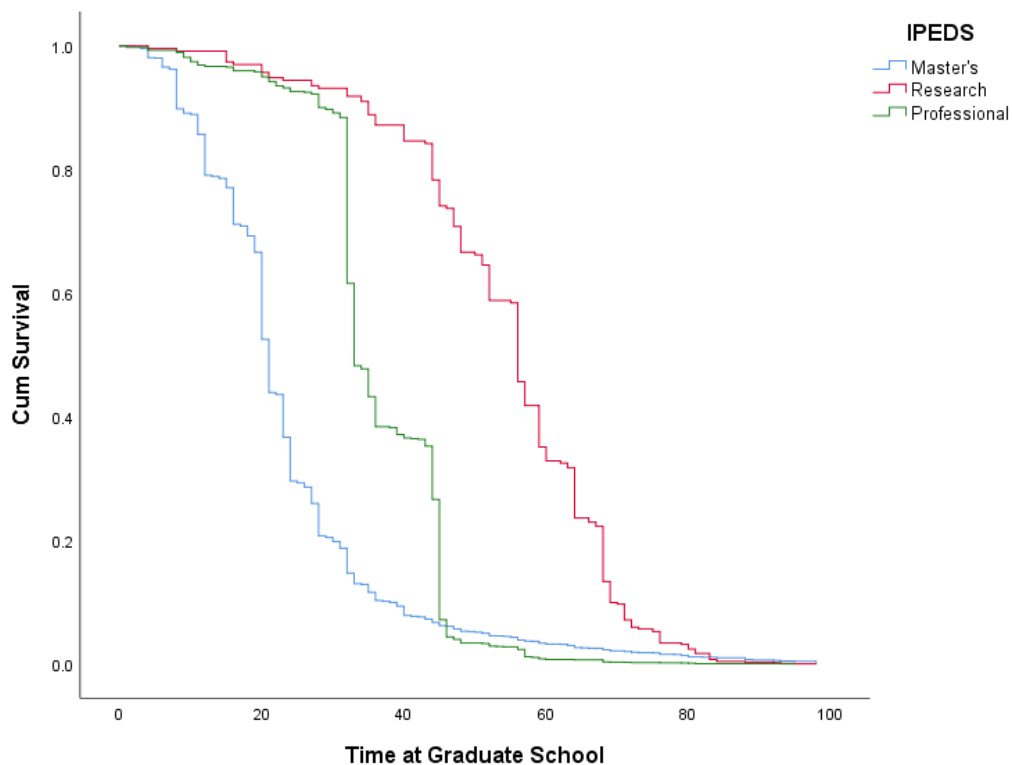
A Cox Proportional Hazards regression was utilized to explore the multi-variate effects of individual and institutional characteristics on completing a graduate program. Predictors include degree type (master's, research doctorate, professional doctorate), gender, underrepresentation, institutional ownership (public vs. private), and in-state (in-state vs. out-of-state). The model was statistically significant $\chi^2 = 858.07$, $p <$

0.001. Gender did not contribute to the model, while the other three variables did. The two institutional characteristics had a suppressor effect on the model.

Table A6. Beta weights of the Cox regression survival analysis.

	β	SE	Wald	p-value
Gender	.003	0.02	0.03	0.13
Underrepresentation	0.03	0.02	1.39	0.24
Age at Enroll	-0.01	0.002	19.10	>0.001
Cohort Year	0.15	0.01	652.35	>0.001
In-state	-0.15	0.02	70.14	>0.001
Ownership	-0.15	0.02	54.58	>0.001

Figure A1. Survival function by degree type. Time is measured in months.



References

- Barnes, Adam. 2022. "Here's what's driving the nationwide teacher shortage." *The Hill*.
<https://thehill.com/changing-america/enrichment/education/3276034-heres-whats-driving-the-nationwide-teacher-shortage>; April 21, 2022.
- Jr., Buttaro, Juan Battle Anthony, and Jr. Antonio Pastrana. 2010. "The aspiration–attainment gap: Black students and education." *Journal of Negro Education* 79, no. 4: 488-502.
- Chen, Rong, and Peter Riley Bahr. 2021. "How Does Undergraduate Debt Affect Graduate School Application and Enrollment?" *Research in Higher Education* 62, no. 4: 528-555.
- Chamorro-Premuzic, Tomas. 2020. "Should you go to graduate school?" *Harvard Business Review*.
<https://hbr.org/2020/01/should-you-go-to-graduate-school>.
- Department of Workforce Services. 2022. "Occupational Projections 2020-2030." Utah Job Outlook. Last modified September 2022.
<https://jobs.utah.gov/wi/data/library/employment/occprojections.html>.
- English, David Judson, and Paul D. Umbach. 2016. "Graduate school choice: An examination of individual and institutional effects." *The Review of Higher Education* 39, no. 2: 173-211.
- Estrada, M., Burnett, M., Campbell, A.G., Campbell, P.B., Denetclaw, W.F., Gutiérrez, C.G., Hurtado, S., John, G.H., Matsui, J., McGee, R. and Okpodu, C.M., 2016. Improving underrepresented minority student persistence in STEM. *CBE—Life Sciences Education*, 15(3), p.es5.
- Fisher, Aaron J., Rodolfo Mendoza-Denton, Colette Patt, Ira Young, Andrew Eppig, Robin L. Garrell, Douglas C. Rees, Tenea W. Nelson, and Mark A. Richards. 2019. "Structure and belonging: Pathways to success for underrepresented minority and women Ph.D. students in STEM fields." *PloS one* 14, no. 1: e0209279.
- Graham, Eva. 2013. "The Experiences of Minority Doctoral Students at Elite Research Institutions." *New Directions for Higher Education* 163.
- Hamrick, Karen. 2021. "Women, minorities, and persons with disabilities in science and engineering." *National Science Foundation*.
- Hurtado, Sylvia, Nolan L. Cabrera, Monica H. Lin, Lucy Arellano, and Lorelle L. Espinosa. 2009. "Diversifying science: Underrepresented student experiences in structured research programs." *Research in Higher Education* 50: 189-214.
- Johnson, Michelle J., and Sheri D. Sheppard. 2004. "Relationships between engineering student and faculty demographics and stakeholders working to affect change." *Journal of Engineering Education* 93, no. 2: 139-151.
- McMurtry, Jerry R. 2019. "Development of an alliance supporting Native American and Alaska Native graduate students in science, technology, engineering, and mathematics." *New Directions for Higher Education* 2019, no. 187: 19-28.

- Millett, Catherine M. 2003. "How undergraduate loan debt affects application and enrollment in graduate or first professional school." *The Journal of Higher Education* 74, no. 4: 386-427.
- Moreira, Rosana G., Karen Butler-Purry, Adrienne Carter-Sowell, Shannon Walton, Isah V. Juranek, Linda Chaloo, Gloria Regisford, Richard Coffin, and Angela Spaulding. 2019. "Innovative professional development and community building activity program improves STEM URM graduate student experiences." *International Journal of STEM Education* 6, no. 1: 1-16.
- Morelon-Quainoo, Carla, Susan D. Johnson, Rachelle Winkle-Wagner, John A. Kuykendall, Ted N. Ingram, and Lilia Santiago. 2009. "The advanced-degree pipeline for graduate and professional students of color: Issues of access and choice." *Standing on the outside looking in: Underrepresented students' experiences in advanced degree programs*: 5-24.
- Mullen, Ann L., Kimberly A. Goyette, and Joseph A. Soares. 2003. "Who goes to graduate school? Social and academic correlates of educational continuation after college." *Sociology of Education*: 143-169.
- National Center for Education Statistics. Digest of Education Statistics: 2020. 2021. <https://nces.ed.gov/programs/digest/d20>.
- Perna, Laura W. 2004. "Understanding the decision to enroll in graduate school: Sex and racial/ethnic group differences." *The Journal of Higher Education* 75, no. 5: 487-527.
- Ramirez, Elvia. 2011. "No One Taught Me the Steps": Latinos' experiences applying to graduate school." *Journal of Latinos and Education* 10, no. 3: 204-222.
- Reddick, Richard J., Laura E. Struve, Jeffrey R. Mayo, Ryan A. Miller, and Jennifer L. Wang. 2018. "e Don't Leave Engineering on the Page": Civic Engagement Experiences of Engineering Graduate Students." *Journal of Higher Education Outreach and Engagement* 22, no. 2: 127-155.
- Roberts, Sonia F., Elana Pyfrom, Jacob A. Hoffman, Christopher Pai, Erin K. Reagan, and Alysson E. Light. 2021. "Review of Racially Equitable Admissions Practices in STEM Doctoral Programs." *Education Sciences* 11, no. 6: 270-281.
- Roksa, Josipa, Yapeng Wang, David Feldon, and Matthew Ericson. 2022. "Who is publishing journal articles during graduate school? Racial and gender inequalities in biological sciences over time." *Journal of Diversity in Higher Education* 15, no. 1: 47-57.
- Russell, Melody L., Martha Escobar, Jared A. Russell, Boakai K. Robertson, and Misty Thomas. 2018. "Promoting pathways to STEM careers for traditionally underrepresented graduate students." *Negro Educational Review* 69, no. 1-4: 5-143.
- Sax, Linda J. 2001. "Undergraduate science majors: Gender differences in who goes to graduate school." *The Review of Higher Education* 24, no. 2: 153-172.
- Seibert, Scott E., Maria L. Kraimer, Brooks C. Holtom, and Abigail J. Pierotti. 2013. "Even the best-laid plans sometimes go askew: career self-management processes, career shocks, and the decision to pursue graduate education." *Journal of Applied Psychology* 98, no. 1: 169-10

- Sellami, Nadia, Brit Toven-Lindsey, Marc Levis-Fitzgerald, Paul H. Barber, and Tama Hasson. 2021. "A unique and scalable model for increasing research engagement, STEM persistence, and entry into doctoral programs." *CBE—Life Sciences Education* 20, no. 1: ar11.
- Severiens, Sabine, and Geert Ten Dam. "Leaving college: A gender comparison in male and female-dominated programs." *Research in Higher Education* 53, no. 4 (2012): 453-470.
- Sowell, Robert, Jeff Allum, and Hironao Okahana. 2015. "Doctoral initiative on minority attrition and completion." *Washington, DC: Council of Graduate Schools* 1.
- Starks, Brian Chad, and William H. Matthaeus. 2018. "STEM recruitment and beyond: The messenger is the medium." *Journal of STEM Education: Innovations and Research* 19, no. 4.
- Stolzenberg, Ross M. 1994. "Educational continuation by college graduates." *American Journal of Sociology* 99, no. 4: 1042-1077.
- Torpey, Elka. 2018. "Employment outlook for graduate-level occupations: Career Outlook: U.S. Bureau of Labor Statistics." <https://www.bls.gov/careeroutlook/2018/article/graduate-degree-outlook.htm>.
- Toven-Lindsey, Brit, Marc Levis-Fitzgerald, Paul H. Barber, and Tama Hasson. 2015. "Increasing persistence in undergraduate science majors: A model for institutional support of underrepresented students." *CBE—Life Sciences Education* 14, no. 2: ar12.
- Wendler, Cathy, Brent Bridgeman, Fred Cline, Catherine Millett, JoAnn Rock, Nathan Bell, and Patricia McAllister. 2010. "The path forward: The future of graduate education in the United States." *Educational Testing Service*.
- Wilson, Marendra A., Anthony L. DePass, and Andrew J. Bean. 2018. "Institutional interventions that remove barriers to recruit and retain diverse biomedical Ph.D. students." *CBE—Life Sciences Education* 17, no. 2: ar27.
- Wilson, Zakiya S., Saundra Y. McGuire, Patrick A. Limbach, Michael P. Doyle, Luigi G. Marzilli, and Isiah M. Warner. 2014. "Diversifying science, technology, engineering, and mathematics (STEM): an inquiry into successful approaches in chemistry." *Journal of Chemical Education* 91, no. 11: 1860-1866.
- Zhang, Liang. 2005. "Advance to graduate education: The effect of college quality and undergraduate majors." *The Review of Higher Education* 28, no. 3: