

# Underrepresented Minorities' and Women's Engineering Degree Attainment and Academic Makerspaces by the Numbers

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### Introduction

In a recent study on academic makerspaces, Andrews et al. (2021) wrote "...more attention needs to be paid to helping marginalized groups feel like they belong and reap the full benefits of makerspace participation." This prompted the researchers to question whether a relationship exists between engineering degree program ranking, the prevalence of makerspaces on university campuses, and underrepresented minorities' and women's engineering degree attainment. Comparing information about engineering programs against the list of best maker schools in higher education may shed some light on which schools are more likely to have makerspaces or makerspace programs. This investigation goes a step further by comparing maker schools with race/ethnicity and gender demographic data from those institutions' engineering programs.

### Best Maker Schools in Higher Education

The last decade has seen a rise in the number of makerspaces located on college and university campuses [2], [3]. An exact inventory of academic makerspaces does not exist, but in 2021, the Make Community LLC teamed up with Newsweek to create the Best Maker Schools in Higher Education. This list contained 200 international schools that had a maker focus program or on campus makerspace(s). A variety of institutions made the list including community colleges, design schools, vocational and trade schools, technical institutes along with other colleges and universities. The institutions were only listed and not ranked.

#### A. Carnegie Classification of the Best Maker Schools in Higher Education

Of the 200 schools listed, 125 are in the United States. Out of the 125 schools, two could not be located within the Carnegie Classification system. The majority of the remaining 123 US schools offered 4-year or more degrees, except for the eight community colleges that offered 2-year associate degrees. The ratio of private to public institutions was 56 to 69. Of the public institutions, 42 have a Carnegie Classification of R1 and 11 are classified as R2. The numbers are lower for private institutions, with 27 having a Carnegie Classification of R1 and four are classified as R2. Abilene Christian University is the only Doctoral/Professional University that made the list. Thirteen Master's and 12 Baccalaureate's Colleges and Universities were listed for their makerspace and maker programs. Olin College was one of three Special Focus 4-year

institutions on the list. A total of 13 public Hispanic-Serving Institutions (HSI) made the list: five have a Carnegie Classification of R1, one is classified as R2, and one is classified as M2. The remaining six HSIs are Associate's Colleges. Moorhouse and Spellman Colleges were the only representation of Historically Black Colleges and Universities (HBCU) and are included with the Baccalaureate Colleges. Navajo Technical University was the only Tribal College or University (TCU) listed. For a breakdown of universities by Carnegie Classification see Table 1.

### Engineering Program Relationship to Make Minded Campuses

The Engineering and Engineering Technology by the Numbers 2019 report [4] written by the American Society of Engineering Education was used for the most current data on engineering degree programs. The report is organized by categories such as degree level, number of degrees awarded, discipline, institutional expenditures, faculty, student race/ethnicity and gender. Not all engineering programs or schools are included, and most categories listed the top 10, 20, or 50 programs by category. Only institutions that granted 4-year Baccalaureates or higher degrees were used from the Best Maker Schools in Higher Education list; therefore, Associate's Colleges were not included in the analysis.

Table 1. Carnegie Classification of the Best Maker Schools in Higher Education 2021

Carnegie Classification	Private	Public	Total
R1	27	42	69
R2	4	11	15
D/PU	1	0	1
M1	4	4	8
M2	4	2	6
M3	1	0	1
Baccalaureate Colleges*	11	1	12
Associate's Colleges	0	8	8
Special Focus Institutions	3	0	3
Tribal Colleges and Universities	0	1	1
<b>Total</b>	<b>55</b>	<b>69</b>	<b>124</b>

\* Moorhouse and Spellman Colleges are included in the Baccalaureate Colleges.

A. *Best Makerspace Institutions and the Top 50 Institutions by Total Bachelor's Degrees Awarded to Underrepresented Minorities and Women*

It would be misleading to look at the list of institutions awarding the highest number of engineering bachelor's degrees since this list is dominated by larger and/or engineering focused institutions. This was an institutional macro-level analysis and does not look at the exact number of degrees conferred by each discipline or college. Instead, the first comparison was between the best makerspace institutions and the top 50 institutions by total bachelor's degrees awarded to underrepresented minorities. A total of 17 institutions appeared on both lists. Arizona State University, University of Texas at Austin, and the University of New Mexico are the HSI on both lists. Only three HBCUs were in the top 50 institutions by total bachelor's degrees awarded to underrepresented minorities: Florida A&M University, North Carolina Agricultural & Technical State University, and Prairie View A&M University, and these institutions did not appear on the makerspace list. When comparing between the best makerspace institutions and the top 50 Institutions by total bachelor's degrees awarded to women, over half (26) of the institutions appear on both list. Arizona State University, University of Texas at Austin, and Texas A&M are HSI that appear on both lists, but there was an absence of HBCUs or TCUs.

B. *Best Makerspace Institutions and the Top 50 Institutions by Percentage Bachelor's Degrees Awarded to Underrepresented Minorities*

Top 50 institutions by percentage of bachelor's degrees awarded to underrepresented minorities gives a very different view of the landscape. Only one non-minority serving institutions, Pennsylvania State University, appeared on both lists. Two Hispanic-Serving Institutions, the University of New Mexico and Texas A&M are represented on both the best makerspace institutions and the top 50 institutions by percentage. Navajo Technical University also appears on both lists. 12 historically black colleges appear on the top 50 institutions by percentage of bachelor's degrees awarded to underrepresented minorities, but do not appear on the best makerspace institutions list.

C. *Best Makerspace Institutions and the Top 20 Institutions by Percentage Bachelor's Degrees Awarded to Women*

The next comparison was made of the top 20 institutions by percentage of bachelor's degrees awarded to women verses those that made the Newsweek's best maker schools list. While the other three categories contain 50 institutions, this category presents 20 entries. Once again, Navajo Technical University appears on both list. There is no representation of HBCUs or HSIs in this category. Almost half (9) of the universities in this category appear on both list.

D. *Summary of the Best Makerspace Institutions and the Top Engineering Bachelor's Degrees Awarded to Underrepresented Minorities and Women*

Over half of the top 50 Institutions that grant bachelor's degrees that are awarded to women have a makerspace or a

maker program. This number drops to 17 institutions when dealing with bachelor's degrees awarded to underrepresented minorities. No Institution had a strong representation across the board. Navajo Technical University, the sole Tribal college on either list appeared in the institutions by percentage of bachelor's degrees awarded to both underrepresented minorities and women. HBCUs, by percentage, represent a significant amount of the bachelor's degrees awarded to underrepresented minorities, but their participation in makerspaces and maker activities was not as well known or represented compared to other types of institutions.

**US News & World Report Best Colleges Engineering Program Ranking and Make Minded Campuses**

Finally, this study looked at these data through the lens of a college ranking system. The US News & World Report Best Colleges Ranking systems is one of the most accessible university rankings available. The 2021 rankings of college engineering programs at doctoral granting institutions was published and accessed on their website [5]. The most important fact to point out was that of the top 25 ranking undergraduate engineering programs, all appeared on the Best Maker Schools in Higher Education list except Cornell University, the University of Southern California, and North Carolina State University. While these schools did not appear on the list, they all have some form of maker activities or makerspaces on their campus as per their university websites.

**Plans For Future Work**

After initial exploration, there is opportunity for future work looking deeper into the relationship between engineering degree program ranking, underrepresented minorities' and women's engineering degree attainment, and the prevalence of maker culture on university campuses. The Carnegie Classifications of Institutions of Higher Education may not be the best way to organize this work, although others have suggested something similar [6]. There is enough evidence to support further investigations of makerspaces and maker culture at Tribal Colleges and Universities, Hispanic-Serving Institutions, and Historically Black Colleges and Universities.

**References**

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