Technological Infrastructure Equity for Minority Serving Institutions in Construction Education

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Abstract: In the U.S. and its territories, over 800 identified Minority Serving Institutions (MSI) exist. Despite the number of MSI and the diverse population that they targeted, there is a gap in the number of higher education degrees obtained by minority students in relation to non-minority students. The root cause(s) of the gap must be determined to take tangible actions to reduce and, ideally, eliminate this obtainment gap. When considering this gap, there is a question of whether the learning technology infrastructure is equivalent between MSI and non-MSI. Depending on the institutions, some institutions provide only 2-year degrees and act as feeder institutions for other institutions. With a smaller student body and no graduate college, do these MSI institutions offer the same level of learning technology infrastructure support? What is infrastructure support? Learning technology infrastructure consists of the underlying technology systems provided by federal, state, university, or departments to support digital learning and teaching. Learning technology infrastructure resources can include buildings, the electrical grid, broadband internet, computer labs, and others. During the COVID-19 pandemic, as many communities relied on the learning technology infrastructure for delivering coursework, it became evident that not all communities had the same level, specifically rural, economically disadvantaged, and/or minority communities. The concern for rural communities is not unique to the U.S., with many other countries reporting a similar phenomenon. The research objective of this paper is to determine if any structural issues limit students graduating from MSI, more specifically from construction programs. The methodology used in this paper includes a robust literature review to assess the state of the learning technology infrastructure at MSI and non-MSI, particularly the construction programs. The literature review indicates very little research on MSI as a whole. Based on the literature review, “Minorities in Construction Management” had no search results, leaving much room for improvement.

Keywords: Construction Management Degrees, Minorities in Construction, Minority Serving Institutions, Minority Student Outcomes.

Introduction

During the COVID-19 pandemic, as many communities relied on the learning technology infrastructure for delivering coursework, it became evident that not all communities had the same infrastructure level, specifically rural communities [1]. This concern in rural communities is not unique and extends to economically disadvantaged, and/or minority communities, as many countries worldwide report a similar phenomenon [2]. Evidence exists that more rural areas of the U.S. also have smaller budgets for public education, specifically K12 [3] (Figure 1).

There are approximately 800 separate institutions on the NASA Minority Serving Institution (MSI) list [4], which make up about 10% of post-secondary institutions and 26% of students [5]. MSIs have been identified through a series of Executive Actions by which the U.S. Department of Commerce, the U.S. Department of Education, and the U.S. Department of the Interior allocate specific funding to MSI institutions. However, while federal funding is available, about

59.3% of MSIs are funded [6]. It is critical to determine if students graduating from these MSIs are employed in Science, Technology, Engineering, and Math (STEM) fields, especially as workforce shortages continue [7]. Further, students graduating from MSIs may receive lower than average salaries, except for Asian Americans and Pacific Islanders (AANAPISI) and Alaskan Native or Native Hawaiians (AANH) [8].

Therefore, given the need for graduates in fields supporting STEM fields [7], it is imperative for STEM and the construction industry to determine which demographics are missing and why they are not seeking employment in these fields. Women only comprise around 35% of the STEM workforce, which drops to 7.6% in construction project managers [9].

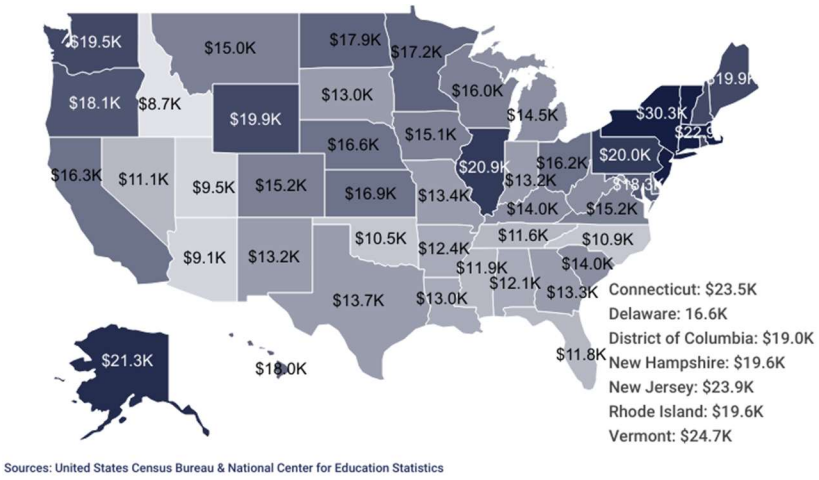

Figure 1. Public K-12 Spending Per Student [3]

Ecton and Dougherty [10] illustrate how these differences are apparent when students self-select for Career and Technical Education (CTE) paths. Students receiving free/reduced lunches are likelier to choose a CTE construction concentration [10]. Once students have self-selected for construction careers, additional impediments can be identified. These include the lack of diversity in the workforce, which can be evident in a lack of seeing persons who are similar to self [11].

As construction managers can vary in education level from high school degree CTE, to university and post-graduate degree [12], it is worthwhile to investigate the construction workforce from their entry point. A relationship with construction through family, friends, or work experience can be a predictor for the decision to enter the construction careers [11, 12, 13]. Additionally, construction managers come from various degrees, including Architecture, Civil Engineering, Interior Design, and others (Figure 2) [15]. Within construction degree programs, there are accredited ACCE Construction Management degrees, ABET ETAC Construction Engineering Technology and Construction Management Engineering Technology degrees, ABET ANSAC Construction Management Technology degrees, ABET Construction Engineering degrees, and a variety of other named degrees, either accredited or not, which represent the

construction management degreed workforce. While this paper focuses on the college degreed construction management workforce, a broad look at the workforce in general is provided for context.

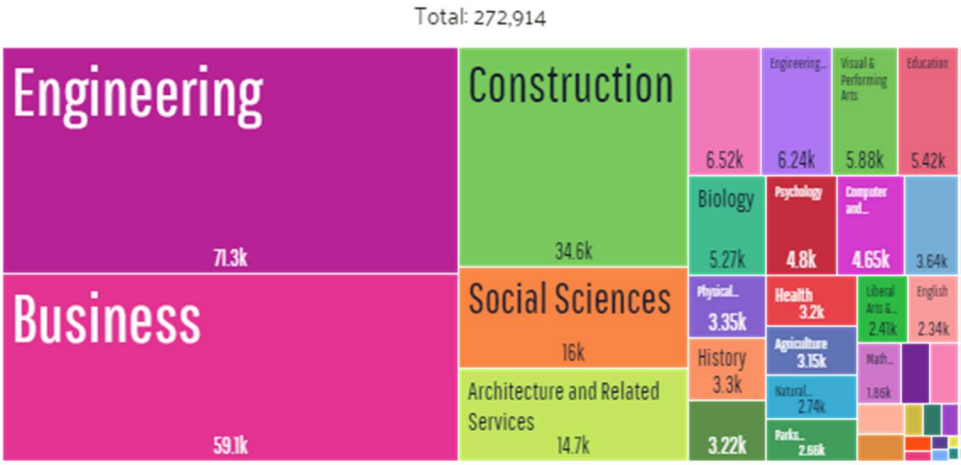

Figure 2. Construction Manager Workforce Degrees [15]

Professional Minorities in Architecture, Construction, and Engineering

As of 2018, men comprised approximately 72% of the American Institute of Architects (AIA) membership [16]. In contrast, women of all races comprise approximately 21.1% of AIA membership [17]. Similarly, the U.S. Dept. of Labor indicates 27.4% of the architecture workforce are women [18]. Women can expect lower wages than men in most fields within the U.S. For example, in architecture, women architects can expect approximately 83% of their male counterparts [18]. In civil engineering, about 16.6% of the workforce are women, and they can expect approximately 86% of their male counterparts' wages [18]. Women account for about 7.6% of construction project managers and can expect approximately 91% of their male counterparts' wages [18]. While this paper is focused on minorities in construction, the existing literature provides insight into what is currently collected and reported. As of 2010, there were approximately 1.5 million persons in U.S. engineering roles, and they identified as 72% White, 1% two or more races, 4% Black, 17% Asian, and 5% Hispanic [19], as depicted in Figure 3. Hispanic persons were not identified separately in Figure 3 but are 13.5% Hispanic and 86.5% non-Hispanic [15].

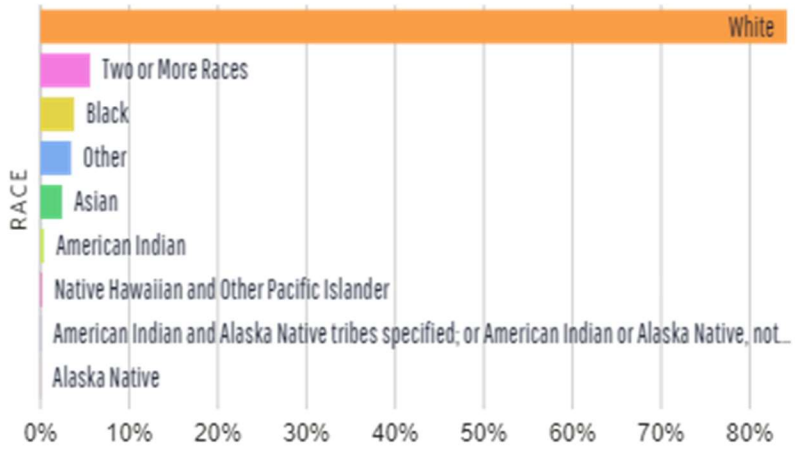

Figure 3. Construction Manager Workforce by Race [15]

United States Minority College Demographic

Minorities represent a significant portion of the U.S. demographics. According to the U.S. Census Bureau [20], minorities (non-white alone) represent 41.1% of the population in the U.S. [20]. This includes people identifying as Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian, and Other Pacific Islander, or two or more races. The U.S. Census reports the overall population includes American Indian and Alaska Native (1.3%), Asian (5.7%), Black or African American (13.6%), Hispanic or Latino (19.1%), Native Hawaiian and Pacifica Islander (0.3%), white (not Hispanic or Latino) (57.9%), and more than one race (1.8%) [20].

This can be compared to ages associated with completing college degrees (20-34), American Indian and Alaska Native (0.8%), Asian (11.0%), Black or African American (13.2%), Hispanic or Latino (20.4%), Native Hawaiian and Pacifica Islander (0.2%), white (62.4%), and more than one race (3.3%) [21]. A comparison to the future academe of 1) master's degrees; American Indian and Alaska Native (0.5%), Asian (11.0%), Black or African American (11.3%), Hispanic or Latino (11.2%), Native Hawaiian and Pacifica Islander (0.3%), white (62.4%), and more than one race (3.3%) (NSF 2019); and 2) doctoral degrees; American Indian and Alaska Native (0.4%), Asian (10.1%), Black or African American (7.7%), Native Hawaiian and Pacifica Islander (0.1%), Hispanic or Latino (7.8%), white (71.1%), and more than one race (2.8%) [21]. What is evident is the divergence between the minority population and the number of minorities seeking advanced degrees. If fewer minorities seek advanced degrees, then there are fewer minorities available for faculty positions.

Thus, given the background, the research objective of this paper is to determine if any structural issues limit students graduating from MSI, more specifically from construction programs.

Methodology

The data for this research was collected through a literature review using the PRISMA systematic review [22] (Figure 4). The PRISMA systematic review does not require the use of the "gray" boxes or columns, what remains is the center two blue columns [22].

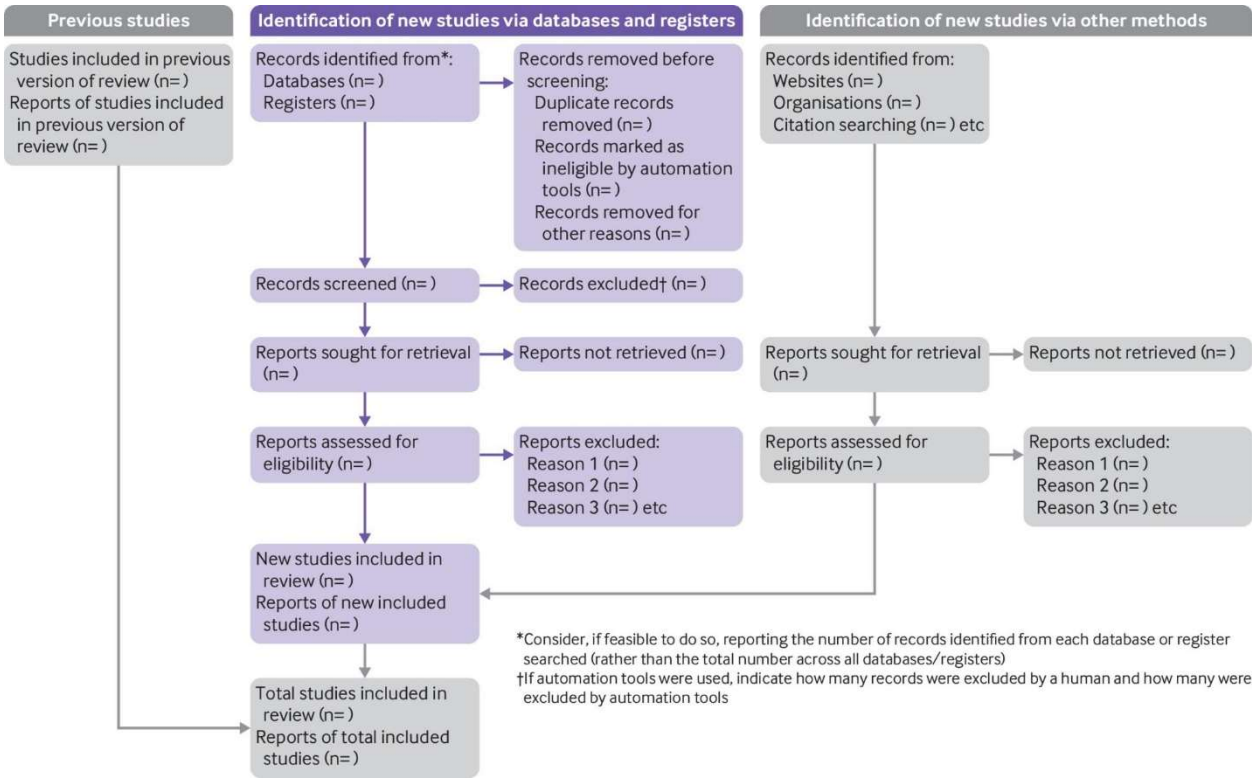

Figure 4. PRISMA Systematic Review [22]

The university library search engine was used as the database for the search, with the total number of records screened shown in Table 1. The search terms were limited to 1- The resource title, 2- Publication date between 2013 and 2023, and 3- Available online (Table 1). The search terms were searched again, and 4- Scholarly and Peer-reviewed were added as a search limitation. The results of the search were then screened by the research team to extract the relevant information for this research project. Since most of the pertinent information found was narrative, the information was analyzed using a qualitative research methodology. This data collection process and analysis were used because they are considered critical to synthesizing the existing research on a particular topic.

Table 1. Search Engine Results

Title Search Term	**Not Peer Reviewed**	**Peer Reviewed**
Learning Technology Infrastructure	259	48

Higher Education Attainment Gap	40	4
Minorities in Construction Management	96	8
Minority Serving Institutions	813	99
Sub Totals	**1,208**	**159**

Based on the PRISMA systematic review, records were removed if they were duplicates, were not focused in the U.S., and were excluded if they did not include the concept of education. One item that must be noted, is the terms “architecture” and “construction” are used for computing and medical fields. This is also true for “learning” which is also a computing term, and frequently used outside of education. Published abstracts and supplements, commentaries, letters to the editor or other opinion-based articles were excluded from the analysis. Another constraint used to filter the compiled articles was not to include articles about MSI involvement in research and collaborations. While a constraint was imposed for publication years 2013-2023, some of the datasets referenced in prior studies included prior years. While the older data is interesting, it may not be representative of the current state of MSIs.

Based on the database search for “Learning Technology Infrastructure,” there were only two applicable articles after review. There were zero applicable articles for “Higher Education Attainment Gap,” and no articles were found for “Minorities in Construction Management,” which met the secondary review factors. For “Minority Serving Institutions,” 27 articles met the limiting factors/constraints set for review. It is interesting to note that many of the publications from the “Minority Serving Institutions” search phrase are from the same group of authors. While they are experts in the field, many additional publications were reviews of their work. It points towards a limited voice in this area.

Results/Discussion

The research determines structural issues that limit students graduating from MSI, specifically entering the construction industry. The research starting from K-12 found that K-12 instructors may lack the requisite knowledge of STEM specialties, which can create a deficit for students [23]. MSI college entrance SAT scores are lower than non-MSI at about 89.3%, except AANAPISI and AANH, which tend to be much closer to average [5]. When considering how instructors respond to students who may have additional needs due to their K-12 education, they may be unable to overcome “deficit ideology” [24, 25]. MSI are more likely to have minority students who did not take Advanced Placement courses than non-MSIs [26]. It may take students at MSIs longer to graduate [27], which makes the degree more costly.

Active learning pedagogies are typically presented as part of a construction curriculum. This type of pedagogy may well fit with a “1st-Person Education,” which allows students to create their

own content rather than relying on an instructor [28]. MSIs include 2-year and 4-year programs, tend to be more teaching-oriented, and may have different faculty degree requirements [29].

The MSI tuition per full-time equivalent student is about 39.7% of non-MSI, a significant cost-savings to students [8]. MSIs provide services to students from low-income communities [30] who may struggle to access technology [31, 32]. Technology access limitations can be overcome with "computer loaner programs" and delivering content via non-traditional methods like social media or blogs [31]. While laptop purchase programs can put additional costs on students, universities provide computer support services and wireless networks, which help students who do not otherwise have access [32, 33].

MSI instructional expenses are about 42.8% of non-MSI, indicating that less money is being spent per student [8], which could indicate a structural problem. As per Vargas [34], no studies are focused on federal resource allocation at MSIs. The number of HSIs has increased while the funding has decreased, which also points to a structural issue [34]. However, the likelihood of being funded increases with additional minorities. A similar statement can be made about the longevity of the institutional classification status with the ability to gain funding [34]. However, there are still deficits which could be offset by additional federal funding [35].

There is an opportunity to evaluate whether instructors assume students lack the necessary skills to be successful at the university or do not value education [25]. Further, Warren et al. [25] postulate this is an "instructional barrier." which could also be considered a structural deficiency. While not a deficiency but a proposed solution, one school uses cohorts of students to support identity and likeness within a classroom setting [36], faculty-student rapport is recognized by students as meaningful [37]. MSIs provide a stronger focus on academic advising and support services [5]. It is more likely for Black engineering and doctoral students to graduate from HBCUs, Hispanic doctoral students from HSIs, and white students from predominantly white institutions [38, 39]. It is also true that HSIs employ a higher percentage of minority faculty [40]. Aquino and Scott [31] propose administrative support for faculty inclusion training. Further, MSI administrations can hire minority faculty and provide mentorship for minority faculty to move into administrative positions [41]. There is evidence students who graduate from MSIs will do better financially than those who do not [35]; however, that may be limited to AANAPISI and AANH [8].

Conclusions

While significant literature describes what an MSI is, little research exists about the current state and outcomes. Executive orders, grants, and other documents are focused on establishing and funding MSI. However, there is little peer-reviewed research in these areas. Using a PRISMA literature review, this paper sought to determine any structural issues that limit students graduating from MSI, specifically entering the construction industry. Proposed solutions include cohorts of students support identity and likeness [36] and meaningful faculty-student rapport

[37]. MSIs focus more on academic advising and support services [5, 23]. It is more likely for Black engineering and doctoral students to graduate from HBCUs, and Hispanic doctoral students from HSIs [38, 39]. HSIs employ a higher percentage of minority faculty [40]. Aquino and Scott [31] propose administrative support for faculty inclusion training. MSI administrations can hire minority faculty and provide mentorship for minority faculty to move into administrative positions [41]. Mentoring is an important support tool for both students and faculty [23]. The research objective was to determine if any structural issues limit MSI students from entering the construction industry. There is very little research on MSI as a whole. The search term "Minorities in Construction Management" provided no results indicating a need for research in this area.

Research Limitations and Future Research

The research used the university library database, and it can be a limitation as databases possessed by institutions are not comprehensive. In addition, search terms were also a limiting factor. While "construction management" is not the only descriptor for college degrees in construction, papers will define most construction degree programs under an umbrella term like "construction" or "construction management" [42]. While "building science" does describe degree programs, it does not describe a career path.

Given the existence of various areas that could be explored, one of the areas could investigate how faculty-student rapport and mentoring translate into career success for the students during their lifetimes using a longitudinal research method. Also, studies can be conducted to determine the best practices from successful MSI across the nation. Future research can also investigate the impact of alumni success and student mentoring on student career success.

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