

DISSERTATION

EXPLORING THE EQUITY CLIMATE OF CONSTRUCTION EDUCATION IN THE LAND
GRANT SYSTEM: A MIXED METHODS STUDY

Submitted by

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ABSTRACT

EXPLORING THE EQUITY CLIMATE OF CONSTRUCTION EDUCATION IN THE LAND GRANT SYSTEM: A MIXED METHODS STUDY

In the United States, there is a documented demand for educated construction managers, and a bachelor's degree in a construction-related field offers the best prospects for entry into the profession. Furthermore, the construction management profession is projected to grow through 2026, while offering higher than average salaries and an increased prospect for employment when compared to other professions. Despite the demand for educated professionals, the construction management profession is White male-dominated and would benefit from a more gender and ethnically diverse workforce. Given the potential benefits of a more diverse construction workforce and the importance of a bachelor's degree for entering the profession, construction education programs (e.g., construction management, construction engineering, etc.) at colleges and universities are strategically situated to drive a diversity shift within the industry. This is particularly true at land grant universities that are tasked with creating educational opportunities and access for those who have been traditionally underserved in higher education.

This dissertation evaluates the equity climate of undergraduate construction education programs housed in land grant universities. In particular, this dissertation focuses on equity disparities between women and Latinxs, and their respective counterparts, as these two groups have the highest potential to meet the growing demand for construction managers while also increasing the diversity levels of the construction management workforce. Utilizing a convergent mixed methods design, this dissertation is comprised of three semi-autonomous studies, each designed to evaluate a particular aspect of educational equity.

In the first study, enrollment and retention rates, interdepartmental migration patterns, student satisfaction levels, and the graduation success outcomes of undergraduate students enrolled in a large land grant university construction education program were evaluated. Results indicated many noteworthy trends and equity gaps exist, suggesting that the construction education program of interest would be well served to better support female and Latinx students in addition to minority, Pell eligible, and first generation students.

In the second study, a case study is presented which compared current (2010 to 2017) and historic (1990 to 2009) enrollment trends and academic success outcomes (e.g., GPA and graduation rates) for undergraduate Latinx and women student in addition to first generation, Pell eligible, and, minority students at a large CM program (n = 766). Results indicated statistically significant opportunity gaps in enrollment and academic success outcomes exist between underrepresented racial/ethnic minorities and their White peers; and, that the magnitude of some of these opportunity gaps has increased in comparison to historic levels.

In the third study, the physical artifacts of three construction education programs at land grant universities across the United States were evaluated to understand the non-verbal message relating to who belongs and is valued in construction education? Results suggest that construction education programs could implement numerous improvements in creating a more inclusive physical environment as White men are primarily represented as the management workforce while people of color are portrayed as the construction labor workers, and women are underrepresented in the physical artifacts.

At the conclusion of the three studies, significant findings, suggestions for practice, recommendations for future research, and limitations are be discussed as they relate to the equity climate and outcomes of construction education programs in the land grant system. Ultimately,

results indicate that numerous educational disparities exist between women, Latinxs, and their respective counterparts, and that land grant construction education programs would be well served to focus on creating a more equitable educational climate for all.

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DEDICATION

I would like to dedicate this study to my father, John Burgoon (a.k.a, Sloop John B.). You instilled in me a love for God, humanity, construction, and Gordon Lightfoot – in that order.

Thanks, Dad! I love and miss you and cannot wait to see you again.

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CHAPTER 1:
INTRODUCTION AND STUDY DESIGN

This section provides the background for the studies, which focused on the equity climate and outcomes of construction management (CM) education programs in the land grant system. Subsequently, a problem statement is presented, followed by the study purpose. This is followed by an overview of the purpose and methods of the three studies. The chapter terminates with operational definitions, delimitations, limitations, and the researcher's perspective.

Background

The background section will focus on five segments. The first segment addresses the demand for educated construction managers. The second segment concentrates on the need for a more diverse construction workforce. In the third and fourth segments, Latinxs in higher education and women in construction will be discussed. The final segment discusses the land grant system of higher education.

Demand for Educated Construction Managers

According to the U.S. Bureau of Labor Statistics' (BLS) Occupational Outlook Handbook (2019), the U.S. workforce is projected to need 44,800 new construction managers between 2016 and 2026. The entry-level educational requirements for construction managers, particularly at larger construction organizations, calls for a bachelor's degree in a construction, or related, field (Bureau of Labor Statistics, 2019). In addition to architectural and engineering degree programs, undergraduate construction management and construction science programs are among the primary sources for new construction managers (United States Department of Labor & Bureau of Labor Statistics, 2019). Graduates of these programs often experience higher

than average salaries and job placement outcomes (Institutional Planning Research and Effectiveness, 2019; M.E. Rinker Sr. School of Construction Management, 2018). For example, in a survey completed by graduating students at Colorado State University (CSU) for the 2016 to 2017 academic school year, on average, 15.9% of all undergraduate students reported that they were still seeking employment and those who had accepted a position had a starting salary ranging between \$47,000 and \$55,000. For CM students, 3.2% of undergraduate students reported that they were still seeking employment, and those who had accepted a position had a starting salary ranging between \$61,000 and \$62,000 (Institutional Planning, Research, and Effectiveness, 2019).

Diversity in the Construction Workforce

The American Building Association (2010) has stated, “workforce diversity is not just a moral imperative or societal goal; rather, it should be viewed as a competitive advantage and a business opportunity” (pp. 2 - 3). According to McKinsey & Company, organizations in the highest quartile of gender diversity amongst executive management are 15% more likely to have financial returns above the national industry median; and, companies in the highest quartile of racial and ethnic diversity amongst executive management are 35% more likely to have above-average returns (Hunt, Layton, & Prince, 2015).

To date, the U.S. construction industry maintains relatively low levels of gender and racial/ethnic diversity in the management workforce. For example, between 2012 and 2016, Latinx workers accounted for 69% of new construction hires (Wang, Dong, & Vikraman, 2016) and constitute 37% of the US construction and extraction labor force, but only account for 15.3% of construction managers (Bureau of Labor Statistics, 2018). In 2017, women accounted for

approximately 46.9% of the total US workforce, yet only 7.7% of construction managers (Bureau of Labor Statistics, 2018).

Latinxs in Higher Education

Latinxs lag behind other ethnic or racial groups in educational success outcomes in the U.S. (Ogunwole, Drewery, & Rios-Vargas, 2012). As of 2016, 66.7% of Latinxs over the age of 25 had completed high school as compared to 93.3% of non-Latinx Whites and 87.0% of Blacks. A similar trend exists in higher education where 15.5% of Latinxs over the age of 25 held a bachelor's degree as compared to 36.2% of non-Latinx Whites and 22.5% of Blacks (Ryan & Bauman, 2016). When isolating for U.S.-born individuals, Latinxs still have lower college attainment rates than other racial or ethnic groups (Ryan & Bauman, 2016).

The US post-secondary education system has been described as a “pipeline,” which leaks Latinx students at a higher rate than other groups. Universities are underprepared, from a structural and systems standpoint, to support Latinxs and other historically unrepresented or marginalized student groups (Castro, 2014; Yosso & Solórzano, 2006). Latinx students in the higher education system, particularly at predominantly White institutions (PWI), but also at historically Black colleges, can experience elevated levels of hostility and aggression (Archibeque-Engle, 2015; Palmer & Maramba, 2015).

Women in Construction Education

In the U.S. higher education system, women enroll and graduate at a higher rate than men (Lopez & Gonzalez-Barrera, 2014; Ryan & Bauman, 2016). However, within construction education programs, participation rates by women are far lower than men; potentially less than 10% (Del Puerto, Guggemos, & Shane, 2011; Elliott, Burgoon, & Weisshaar, 2019; Oo & Widjaja, 2018). Among the variables that deter women from pursuing an education or career

focused on construction are: 1) poor industry image (Menches & Abraham, 2007); 2) an oppressive male-dominated culture (Amaratunga, Haigh, Shanmugam, Lee, & Elvitigala, 2006; Dainty, Bagilhole, & Neale, 2000); and 3) lack of career understanding (Amaratunga et al., 2006; Moore & Gloeckner, 2007).

Mission of the Land Grant System

In 1862, a bill presented by Vermont Senator Justin Smith Morrill donating public lands to states and territories to provide colleges for agriculture and mechanical arts, also known as the Morrill Act, was signed into law by President Abraham Lincoln. The Morrill Act and subsequent Hatch Act of 1887 allowed the U.S. federal government to donate land and funds to states. As stated by Works and Morgon (1939), the purposes of the Morrill Act were derived from: “1) a protest against the dominance of the classics in higher education; 2) a desire to develop at the college level instruction relating to the practical realities of an agricultural and industrial society; and 3) an attempt to offer to those belonging to the industrial classes preparation for the ‘professions of life’” (p. 11). Today, this tradition is exemplified by numerous construction education departments housed at land-grant institutions.

While the land grant system is funded by all taxpayers of the U.S., it has a history of exclusion towards some U.S. taxpayers. In the post-civil war society, people of color were often excluded from land grant institutions. As such, the Second Morrill Act of 1890 and subsequent bills have allowed for the creation of what are now referred to as “historically Black” and tribal colleges/universities aimed at supporting those that may have been excluded from the land grant system. Currently, the construction management department at Colorado State University (CSU), a public land-grant university, is tasked with demonstrating “inclusiveness and diversity” and providing “opportunity and access” for the citizens of Colorado; including those who have been

historically marginalized and excluded from higher education (“University Mission, Values, and Guiding Principles,” 2018). Even so, construction education departments around the U.S. are still predominately populated by White male students.

Problem Statement

The construction management industry and profession is White male-dominated and would benefit from a more gender and ethnically diverse workforce (Bureau of Labor Statistics, 2018). Given the documented demand for educated construction managers and the strategic position of construction education programs at institutions of higher learning in helping to fill this demand, construction education programs could be a formidable means of providing the industry with a more gender and ethnically diverse workforce. As the second and third largest groups in the U.S., women and Latinxs are among the groups with the highest potential to meet the growing demand for construction managers while also increasing the diversity levels of the construction management workforce (Bureau of Labor Statistics, 2018). However, construction management education programs often mirror industry trends in terms of diversity and higher education, at large, has a poor track record of supporting minority students. Given the history and structures in place in construction management higher education, a student demographic shift to more women, Latinxs, and other traditionally underrepresented groups is unlikely unless construction management programs proactively confront and rectify the systems and culture that create and perpetuate the disparities between differing racial, ethnic, and gender groups. Given the history and mission of the land grant university system, it provides a fertile environment for understanding and potentially addressing equity disparities between women and Latinxs in construction management education and can serve as a flagship for overcoming those disparities in the future.

Study Purpose

The purpose of this study is to evaluate the equity climate and outcomes of undergraduate construction education students in the land grant system; particularly as it relates to women and Latinx. An implicit assumption of this study is that women and Latinxs represent vital and accessible populations in meeting the demand for a more diversified and educated construction management workforce.

Convergent Design Implementation

To achieve the purpose of this study, a convergent mixed methods design was utilized as a means of understanding the equity climate and equity outcomes in construction higher education (Creswell & Clark, 2017). This research design was selected due to its ability to address a problem utilizing a combination of both quantitative and qualitative methods. According to Creswell and Clark (2011), a convergent parallel (now referred to solely as “convergent”) study is a “design in which the researcher uses concurrent timing to implement the quantitative and qualitative strands during the same phase of the research process, prioritizes the methods equally, keeps the strands independent during analysis, and mixes the results during the researcher’s overall interpretation of the data” (p. 410). In implementing a convergent design, this study aggregated the results of three semi-autonomous studies, each designed to better understand the equity climate or equity outcomes of construction education programs in the land-grant system. In the first study, Chapter 2, a non-experimental, comparative, and descriptive research design was utilized to identify trends and equity disparities between female, first-generation, minority, Latinx, and Pell-eligible undergraduate CM students, and their respective counterparts, at a land grant university. In the second study, Chapter 3, a quantitative, non-

experimental, comparative research design was utilized to identify statistically significant disparities between undergraduate student groups enrolled in a land grant CM department between 1990 and 2016. In the third study, Chapter 4, an equity taxonomy was utilized to evaluate the physical artifacts (i.e., pictures, art, signs, etc.) at three construction education programs located at land grant institutions. A visual depiction of the convergent mixed methods study design is illustrated in Figure 1.1.

Philosophical Worldview

The underlying philosophical stance taken in this study is based on a pragmatist's worldview. As noted by Creswell & Clark (2011), a pragmatist's worldview, or stance, focuses "on the consequences of the research, on the primary importance of the questions asked, rather than the method, and on the use of multiple methods of data collection to inform the problems in the study. Thus, it is pluralistic and oriented toward 'what works' in practice" (p. 40). The utilization of a pragmatist stance within this study holds at least two advantages versus other worldviews (e.g., post-positivism, constructivism, etc.). First, a pragmatist worldview is often employed in mixed methods research as it is well situated to accommodate varying research designs and methodologies. Second, and potentially more importantly, a pragmatist stance aligns with the researcher's own professional experience and training within the construction management arena; that is, a focus on "what works in practice" (Creswell & Clark, 2011 p. 40).

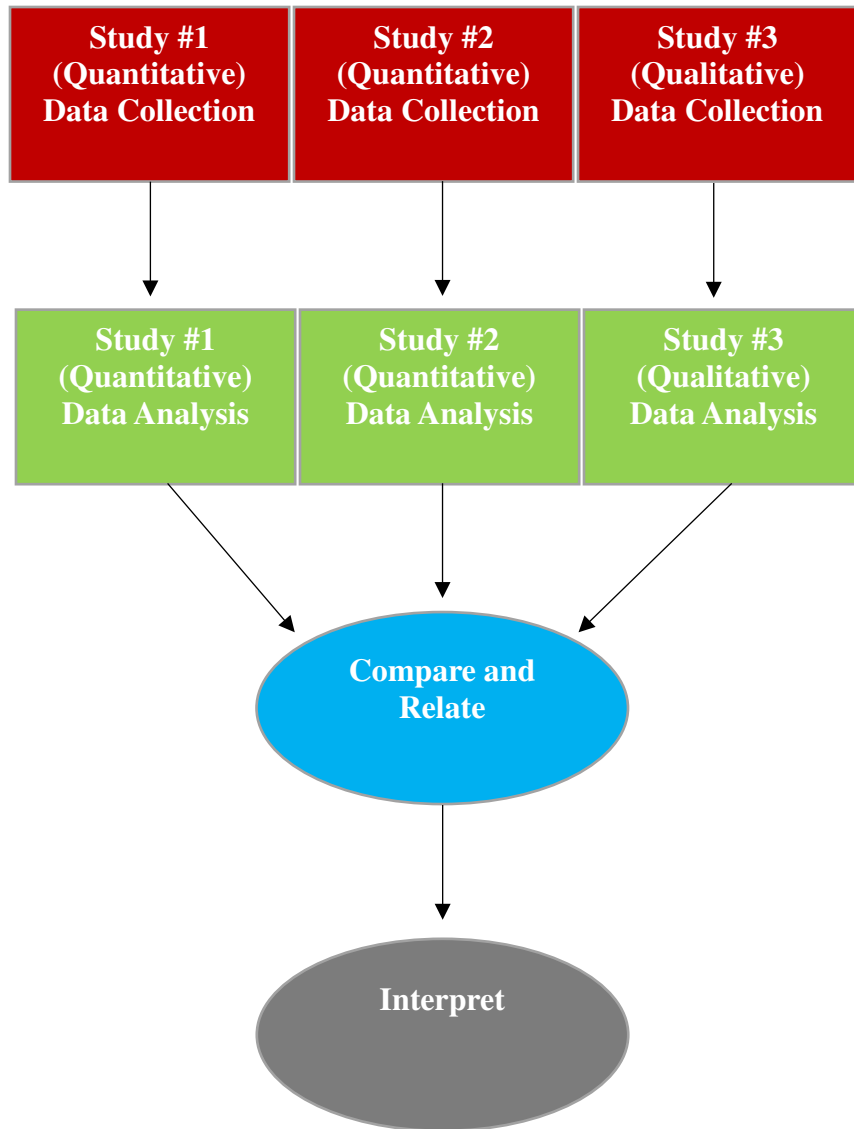


Figure 1.1 Convergent mixed method study design

Three Studies Overview and Methods

This section will focus on the three semi-autonomous studies that were utilized to form the convergent mixed methods dissertation. Each section will provide an overview of an individual study and include an introduction along with the proposed methods, limitations, and delimitations.

Chapter 2: Construction Education at a Land Grant University: Assessing the Equity Gap

The demand for an educated construction management workforce is projected to grow through at least 2026 (United States Department of Labor & Bureau of Labor Statistics, 2019). To help meet this industry demand, construction management education programs at numerous universities have set benchmarks and goals to educate and graduate a sufficient number of students. Many of these programs, particularly those housed at land grant and other public institutions, are directed to support a diverse population of students, including those who have been historically underrepresented or underserved in the U.S. (e.g., Latinxs, women, first-generation students, etc.). To help accomplish this objective, numerous construction management education programs have set goals to support and graduate a more diverse student body (Construction Science Department at Texas A&M University, n.d.; Washington State University Construction Management, 2015).

In spite of these goals, the construction management profession and construction management education programs have low levels of participation among many student groups including women, racial, and ethnic minorities (Del Puerto et al., 2011; Escamilla, Ostadalimakhmalbaf, Pariafsai, Gragera, & Alizadeh, n.d.; Oo & Widjaja, 2018). In conjunction with other factors, it could be conjectured that the disparities between goals and outcomes, in terms of student diversity, could be associated with disparities in the academic equity climate and outcomes (or difference in success outcomes) between groups often observed in higher education (Inman & Mayes, 1999; Ryan & Bauman, 2016). However, research addressing the equity climate and the equity outcomes in construction management education is limited.

Study purpose and research objectives. The purpose of this study was to identify trends and equity gaps between female, first-gen, minority, Latinx, and Pell-eligible undergraduate CM students, and their respective counterparts, at a land grant university located in the mountain

region of the U.S. The results of this study can be utilized as a benchmark for evaluating trends and equity gaps and in the development of strategic initiatives to recruit and retain an increased number of traditionally underrepresented and underserved undergraduate students into CM education. Methods and results could also act as a guide for future research to address the equity gaps in construction education.

A non-experimental, comparative, and descriptive approach was utilized to address the following research objectives:

RO1: To identify trends and equity gaps in department enrollment and retention rates

RO2A: To identify trends and equity gaps in migration patterns into (towards) the CM department

RO2B: To identify trends and equity gaps in migration patterns away from (attrition) the CM department

RO3: To identify trends and equity gaps in job placement, salary, and the perceptions of undergraduate students who had recently graduated from the CM department.

Data retrieval and delimitations. Data for this study were retrieved from reports generated by the institution of interest's Department of Institutional Research, Planning, and Effectiveness (IR) website. The population of interest for this study was undergraduate students majoring in the CM department. Data and reports retrieved from the IR website are publicly accessible and presented in an aggregated format with no unique student identifiers.

IR data and reports are available for differing time frames and student populations. For RO1, the populations of interest were non-minority/minority, con-gen/first-gen, male/female, non-Pell/Pell eligible, and Latinx/non-Latinx undergraduate first semester CM majors. Data were delimited to academic years 2005 to 2016.

For RO2A, the populations of interest were non-minority/minority, con-gen/first-gen, male/female, and non-Pell/Pell eligible undergraduate students who identified as CM majors during their final (or last) semester at the institution of interest but who did not identify as CM majors during their first semester at the institution of interest. Data were delimited to the academic years 2005 to 2016. For RO2B, the populations of interest were the same undergraduate groups listed in R02A, but were delimited to those that identified as CM majors during their first semester but did not identify as CM majors during their final semester at the institution of interest. Data were delimited to academic years 2005 to 2016.

For RO3, the populations of interest were non-minority/minority, con-gen/first-gen, male/female, non-Pell/Pell eligible, and Latinx/non-Latinx undergraduate students who had recently graduated from the CM department. Data were delimited to academic years 2012 to 2016.

Data treatment and evaluation. Data and reports were extracted directly from the IR website. Post extraction, data were aggregated into single reports addressing the research objectives. In calculating department persistence rates, weighted averages were calculated for each group utilizing all delimited years of data. For example, first-year retention rates for new females are the weighted average of all new female students between 2005 and 2016. Weighted averages were utilized to facilitate reporting due to the small and vacillating number of some historically underrepresented populations.

Limitations. Research and data limitations should be considered when interpreting the results of this study. The data utilized in this study are from a single department at a land grant university in the mountain region of the US. Furthermore, while trends and equity gaps are identified, comparative statistical analysis was not utilized. Additional limitations include the

utilization of secondary data and the steep escalation of CM student salaries during the reporting time frame.

Chapter 3: A Longitudinal Comparative Case Study of Enrollment Trends and Academic Success in the Undergraduate Construction Management Education

Construction management education programs at numerous institutions have set goals to attract and retain a more diverse student body (Strategic Plan 2015- 2020, 2015; Strategic Plan, 2016). However, as with many other science, technology, engineering or mathematics (STEM) programs, minority and female students are still proportionally underrepresented despite an increased demand for educated construction professionals (Del Puerto et al., 2011; Escamilla et al., n.d.; Oo & Widjaja, 2018; United States Department of Labor & Bureau of Labor Statistics, 2019). Women and students from minority groups account for approximately 70% of college students, but only 45% of STEM graduates (Olson & Riordan, 2012). Within construction management programs, these numbers are potentially much lower. At one U.S. mountain region construction management program, the aggregated percentage of women (7.1%), Latinx (8.4%), Black (1.3%), and Asian (1.3%) students enrolled from 2007 to 2017 totaled approximately 17.4% (Elliott et al., 2019). Similar trends are witnessed within the construction management profession where between 2012 and 2016, Latinx workers accounted for 69% of new construction hires (Wang, Dong, & Vikraman, 2016) and constituted 37% of the US construction and extraction labor force, but only account for 15.3% of construction managers (Bureau of Labor Statistics, 2018). Furthermore, women account for approximately 46.9% of the total US workforce, yet only 7.7% of construction managers (Bureau of Labor Statistics, 2018).

A trend to a more diverse construction management student body and workforce holds numerous advantages when compared to current trends. As stated by the American Building

Association (2010), workforce diversity can serve as both a moral and competitive advantage within the business world. For example, according to McKinsey & Company, high levels of ethnic and gender diversity among executive management teams increase the probability of above-average financial performance by 35% and 15%, respectively (Hunt et al., 2015).

Given the benefits to the construction industry and goals of construction management education programs to increase diversity, it would benefit construction management education programs to proactively identify and transform the systems and structures that limit the opportunities of historically underrepresented and underserved undergraduate students. An initial step in identifying and modifying the policies and structures that limit the opportunities among students is determining if and where disparities between groups exist in student success outcomes. In identifying differences in outcomes and transforming systems, construction management education programs can provide a value proposition for the major stakeholders in construction management education (students and the construction industry) by supporting students at the individual level and allowing forward-thinking and profit-driven construction organizations access to a more diverse and better-qualified construction management employee pool.

Study purpose and research objectives. The purpose of this study was to systematically explore and compare historic (1990 to 2009) and current (2010 to 2017) equity (or opportunity) gaps, as manifest in enrollment trends and academic success outcomes, at a construction education program. Utilizing an established CM program at a large land grant university as a case study department (CSD), this study compares the enrollment and academic outcomes for women, first gen, and Pell grant eligible, students of color to their respective counterparts, as a

means of evaluating where to allocate financial and personnel resources to address equity gaps and diversity initiatives.

To address the purposes of this study, the following research questions were generated and tested:

RQ1: How does the participation rate among Latinx and minority CM students compare to the population of the State of Colorado?

RQ2: Are there significant differences in students' first year GPA, final GPA, four-year graduation rates, and six-year graduation (or persistence) rates between males and females, Pell and non-Pell recipients, first gen and con gen, minority and non-minority, Latinx and non-Latinx students; and, have these differences changed over time?

RQ3: How well does the combination of first year GPA, birth sex, Pell receipt, first gen, minority, Latinx, and transfer status predict four-year graduation and six-year graduation or persistence rates; and, have these differences changed over time?

Data retrieval and delimitations. Data for this study were requested directly from the institution of interest's IR department. Prior to requesting data, approval was requested by the institution of interest's Institutional Review Board (IRB). The requested data were anonymized with no unique student identifiers. Therefore, it was classified as non-human subject research.

The population for this study were delimited to all students who identified as CM department majors for at least one semester during their tenure at the institution of interest beginning in the fall cohort of 1990 and terminating in the fall cohort of 2017.

Data treatment and evaluation. In addressing RQ1, which compared differences in participation rates among Latinx and minority students at the CSI as compared to the population

of Colorado, Chi-Square Goodness of Fit tests were utilized. To evaluate how well the ratio of Latinx and minority students enrolled in CM matched the ratio Latinxs and minorities in Colorado's population as reported by the U.S. Census Bureau, during the following years: 1990, 2000, 2010, and 2015. Due to the relatively small and vacillating number of Latinx and minority students enrolled in the CSI on any given year, the decision was made to compare U.S. Census data for a specific year (e.g., 1990) to the average ratio in CM for that particular year and the subsequent four years (e.g., 1990 to 1994). In the case of 2015, student data were only available from 2016 through the fall semester 2017.

In addressing RQ2, which identified significant differences in academic success outcomes between groups, Pearson Chi-Square tests were utilized to evaluate four-year graduation rates and six-year graduation/persistence rates. To determine differences in first year cumulative GPA and final cumulative GPA, Independent sample t-tests were utilized to identify gaps in first year cumulative GPA and final cumulative GPA. Effect sizes were utilized to evaluate the magnitude of changes over time. For this study, significance levels were set at the .05 level. First year GPA was included for all students that completed at least one semester of course work. Where data were available for at least six years (i.e., students who enrolled 1990 to 2011), cumulative GPA included only those students who graduated/persistent after their sixth spring semester. Where data was not available for at least six years (i.e., students who enrolled 2012 to 2017), GPA data included only students who had graduated. Four-year graduation rates included only students who graduated by their fourth spring semester of enrollment. Six-year graduation or persistence rates included students who had graduated or persisted during their sixth spring semester.

In addressing RQ3, two stepwise logistic regression models were created to predict four-year graduation and six-year graduation or persistence rates. The first model included minority status, birth sex, Pell recipient, and first gen status. The second model substituted Latinx for minority status.

Limitations. Research and data limitations should be considered when interpreting the results of this study. The data utilized in this study are from a single department at a land grant university in the mountain region of the US. Furthermore, the population of interest included all students who were enrolled in the CM program for at least one semester, which could yield significantly different results than a different population (e.g., CM cohort majors, etc.).

Chapter 4: A Visual Ethnographic Evaluation of Land Grant Programs: Who is Valued in Construction Education?

In an iconic scene from the 1939 film *The Wizard of Oz*, Dorothy Gale steps out of her monochromatic home to a world of Technicolor. After a few brief moments of wonderment, Dorothy states, “Toto, I’ve a feeling we aren’t in Kansas anymore.” Without a word from others, the physical environment of Dorothy’s surroundings let her know that she had just stepped into a new and unknown world – a world that was not “home.” As with Dorothy’s experience entering the world of OZ, the physical environment and artifacts (pictures, art, graffiti, etc.) of a location can relay a powerful unspoken message. Within construction education, the physical artifacts may be relaying an unspoken message about who does (and who does not) belong and is valued in construction education (Archibeque-Engle, 2015). For example, a study by Archibeque-Engle (2015) evaluated the physical artifacts of three animal science departments. Notable findings of exclusionary non-verbal communication identified included a ceiling height cowboy boot with a painting depicting a shootout between “Cowboys and Indians.”

Another example of potentially exclusionary non-verbal communication relating to physical artifacts is depicted in a mural presented in a public university library in the southwestern U.S. Completed in 1939, the first three panels of the mural were intended to represent the contributions of the three major cultures with a fourth mural depicting the union of the three cultures (“Zimmerman Library Artwork,” n.d.). In the first panel of the mural, Native Americans in traditional clothing are depicted weaving blankets and shaping pottery. The second panel depicts Latinxs performing the manual tasks of plowing and building plastering. In the third panel, Anglos are depicted as scientists and doctors. The fourth and final panel, is a look towards the future with Native, Anglo, and Latinx unified through a symbolic handshake (“Zimmerman Library Artwork,” n.d.). While initially well received and intended to be inclusive, more recently, the mural has been utilized as portraying negative stereotypes and non-verbal messages relating to Latinxs as manual laborers and Anglos as scientists (Strange & Banning, 2015).

Independent of individual sentiments surrounding the historic significance or modern relevance of any one particular artifact such as a cowboy boot or mural, within contemporary society, if most university construction educators were asked if they felt that Anglos should be the educated class of society (i.e., construction managers) while Latinxs should be relegated to construction labor positions, they would unflinchingly state their objection to such an assumption. And yet, the physical artifacts presented in a construction education department might convey a different unspoken message.

Study purpose and research objectives. The purpose of this study was to explore the equity climate of the physical artifacts (buildings, relics, etc.) of three construction education programs housed at land grant universities. Utilizing a photographic ethnographical taxonomy

created by Banning, Middleton, and Deniston (2008), this study evaluated the equity climate of the physical environment as a means of exploring who belongs and is valued in construction education. The motivation to explore this research objective is a desire to identify potential patterns as it relates to physical artifacts that focus on “what has been” versus “what could be;” particularly, as it relates to stereotyping of Latinxs as “construction workers” and women being all but absent from the construction industry.

Data retrieval and delimitations. Given the underlying focus on Latinxs and females for this study, all programs selected were located in a state with a relatively high percentage of Latinx residents. The three construction programs evaluated have the following attributes in common:

1. Located in a state where at least 20% of the population identifies as Latinx
2. Formal construction education program has been in existence for at least 50 years
3. At least one building designated exclusively for the construction education department
4. Accreditation by the American Council for Construction Education (ACCE)
5. Land grant university status from the Morrill Act of 1862

After selecting the three sites for evaluation, approval was requested from university officials to photograph the physical artifacts in each department. Digital cameras were utilized to collect still photos of each site.

Data treatment and evaluation. Banning et al.’s (2008) taxonomy of Equity Criteria were utilized for this study. This taxonomy offers a layered approach to address various forms of equity and inclusion. A visual representation is presented in Figure 1.2. In Criteria 1, artifacts are labeled and categorized into four basic categories: Art, Signs, Graffiti (illegitimate signs, etc.),

and Architecture. Criteria 2 evaluates the overarching message of each artifact broken into the following categories: Belongings, Safety, Equality, and Roles. Building on Criteria 2, Criteria 3 evaluates on the bases of traditionally marginalized groups and is referred to as a Multicultural Approach. Within these criteria, Gender, Race, Ethnicity, Religion, Disability, and Sexual Orientation are all addressed. Finally, in Criteria 4, the photographs are evaluated on an Equity Approach as each image is categorized as Negative, Null, Contributions/Additive, or Transformational/ Social Action (Archibeque-Engle, 2015). In order to provide a more robust perspective of the photographic data, four researchers from differing gender and racial/ethnic backgrounds performed evaluations.

To evaluate photographs via the equity criteria, photographs were converted to PDF's and then individually numbered. Then, the four researchers were randomly assigned a starting photograph for each institution and independent evaluation of the photographs, based on the equity criteria, was performed. Post independent evaluation, results were compared and discussed with a consensus being reached on the final categorization of each photograph. These results were then recorded and aggregated.

In the second part of evaluation, recurring themes were identified in the photographs. Particular emphasis was given to women and Latinxs (and other individuals of color) in the thematic portion of the analysis.

Trustworthiness of evaluation. It is important to note that the photographs captured at each site are only at a single point and time and from a perspective of the researchers' choosing. While no intentional details were omitted, it is possible that the researchers' perspective could have caused them to overlook specific information that might also be telling. Additionally, while a strict taxonomy was utilized in the evaluation of each photograph, it should also be pointed out

that the researchers’ assessments of the equity criteria may differ from others due to cultural, social, or other implicit biases.

Level of Analysis	Category/Code	Characteristics of Code
Criteria 1 Type of Artifacts	Art	Paintings, Posters, Sculptures, Trophies
	Signs	Restroom and classroom signs, unofficial signage (e.g., flyers, announcements)
	Graffiti	Illegitimate Signs; drawings on public surfaces (slogan, drawing, scribbles)
	Architecture	Physical Structure
Criteria 2 Message Content	Belonging	Who belongs (or does not belong)
	Safety	Dehumanization of any group; messages that threaten a sense of safety
	Equality	Unequal messages
	Roles	Roles of men and women
Criteria 3 Multicultural Approach	Gender Negative	Specific messages about or for males and females
	Race	Messages specifically about or for African Americans, Latinxs/Hispanics, Native Americans, or other racially defined groups
	Ethnicity	Messages specifically about or for particular groups
	Religion	Messages specifically about religion
	Disability	Messages about physical differences; especially differently-abled with particular attention to the issues of mobility, age, and physical characteristics
	Sexual Orientation	Messages about homosexuality, bisexuality, heterosexuality, etc.
Criteria 4 Equity Approach	Negative	Does not support equity among groups
	Null	Devoid of equity messages; inherently defaults to “White male privilege.”
	Contributions/ Additive	Support equity; but represent what is comfortable for the dominant culture

	Transformational / Social Action	Equity centric perspective rather than the dominant culture perspective
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Figure 1.2. Equity taxonomy

Operational Definitions

Construction Management (CM) Education is an umbrella term utilized to define construction education programs in higher education

Equity Climate is a term that encapsulates concepts that includes “the historical, structural, perceptual, and behavioral dimensions of the college environment (Hurtado, 1994 p. 22)” as it relates to providing all students, but particularly those who have been traditionally marginalized, with equitable social and educational experiences and outcomes.

Equity Outcomes are measurable outcomes typically associated with academic success (grade point average (GPA), graduation and retention rates, job placement, salary, etc.)

First-generation (first gen) students are defined as those attending a college or university who do not have at least one parent that completed a bachelor's degree (Pike & Kuh, 2005).

Latinx or Hispanic is, according to the U.S. Census Bureau, defined as “a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race” (Humes, Jones, & Ramirez, 2011 p. 2).

Land Grant Universities are institutions of higher learning that received the benefits of the Morrill Acts of 1862 and 1890.

Pell-eligible (or Pell) students are low-income undergraduate post-secondary students that qualify for an educational grant provided by the U.S. Department of Education.

Physical Equity Climate is the non-verbal equity messages portrayed by physical artifacts (art, signs, etc.) as they relate to “organizational attitudes and behaviors that foster organizational patterns and atmospheres” (Banning et al., 2008 p. 3).

Terminology for Latin American Heritage

Given the nature of this study, a brief discussion of the terminology utilized to describe individuals of Latin American heritage merits consideration. In 1971, the U.S. government created an ethnic category, Hispanic, as a means of grouping individuals from various racial, ethnic, linguistic, and political origins (Marable, 2000). While the U.S. Census Bureau continues to utilize the term “Hispanic” in conjunction with “Latino” to describe “a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race” (Humes, Jones, & Ramirez, 2011, p. 2), the term is considered “highly unsatisfactory” by some (Archibeque-Engle, 2015, p. 5). Given the contentious nature of the term Hispanic, attempts will be made to minimize its use during this study, although it may be used when describing U.S. Census or other data sources that continue to utilize the term.

When possible, this study will utilize the term Latinx to describe individuals, independent of birth sex, of Latin American origin or heritage.

Delimitations

Delimitations for the three semi-autonomous studies were presented in the three studies overview section. The following delimitations only apply to the convergent mixed methods study.

1. This study is delimited to a focus on Latinxs and women in construction education programs at three land grant universities
2. The evaluation of the equity outcomes and equity climate will be delimited to the three semi-autonomous studies

Limitations

Limitations for the three semi-autonomous studies are presented in the three studies overview section. The following limitations only apply to the convergent mixed methods study.

1. Two of the semi-autonomous studies evaluated utilized secondary data
2. Given the qualitative and idiosyncratic nature of Chapter 4, the overall results of this study are not generalizable. Taken in parts, Chapter 2 and Chapter 3 are from a single university and their generalizability is limited to construction management education programs at land grant institutions.
3. While this study focuses on Latinxs and women, it should be noted these are not the only populations of interest for construction education programs in their pursuits for a more equitable climate and student success outcomes. Other students of color, first generation, Pell eligible, non-traditional students, and other populations could also potentially merit consideration in terms of the equity climate.

Researcher's PerspectiveMy current position as a faculty member in a construction management department at a land grant university and a doctoral student in education with a particular focus on student equity and transformation should be recognized. Furthermore, it should be stated that among my professional goals as an educator and researcher, I aim to help create, improve, and transform the systems and academic environments that have traditionally built barriers to a more diverse student body within construction management education. I am aware that these goals and perceptions have an influence on my biases as a researcher. However, given the potential significance of systematic and grounded academic research in creating a more inclusive environment, my objective is to maintain validity and reliability as a means of upholding the integrity of the investigation and my academic profession.

In addition to the acknowledgment of my current position, I feel that a summary of my background as it relates to construction, construction education, Latinxs, and women in construction is relevant.

Construction has been an integral part of my life for as long as I can remember. My first memory is “helping” my father, a concrete finisher by trade, to bull float a slab. While I was probably less than five years old, I still remember the excitement of knowing that I was building something, and the idea of working professionally in the construction industry was founded at a young age. Throughout my early childhood and formidable years, my father expanded his concrete company and eventually became one of the largest homebuilders in the region – completing approximately 350 homes a year. As such, our family conversations often revolved around the construction industry and home building to the point that family vacations often included a tour of model homes.

After working for a short stint post-high school in the construction trades and recognizing that I was more inclined to the “business” side of construction, I enrolled in a construction management program and subsequently worked for several years in residential construction, including two years as a self-employed contractor, before deciding to pursue a Ph.D. and a career focused on construction education.

While my passion for construction developed at a young age, my desire for a more diverse and open construction management and trade workforce was a more gradual process. My first recollection of Latinxs in construction occurred at about age ten. After eating dinner at a couple’s home, my parents were asked if the younger brother of the wife, a twenty-two-year-old undocumented individual from Honduras, Paul, could live with our family. While it was not uncommon for my parents to open our small home to individuals in need, I recognized this time

it was different and that the person that would be staying with us was “breaking the law” – something I had never known my parents to do. Over the next two years, Paul lived in our home, shared our meals, and even served as my Boy Scout leader. Since he could not legally work, my father loaned him a vehicle and trailer and hired him as a subcontractor doing construction clean-up, which allowed Paul to make a living. While I initially was concerned with “breaking the law,” after two years, I did not see Paul as a lawbreaker but rather another member of our family. Fast-forward six years and I found myself assigned to Salvador, Brazil for a two-year volunteer ecclesiastical mission. As the center of Afro-Brazilian heritage and culture, my time in Salvador helped me to develop a love for the people and culture of Latin America, and great sympathy for the plight of many born into situations less fortunate than myself as they sought for a better life. After returning home and completing my degree in construction management, I continued my professional career in Texas, where I worked with subcontractors, most of whom were originally from Mexico and Central America, on a daily basis. Over time, my Portuguese developed into “Portuñol,” and I learned more and more about the experiences of my subcontractors. Many of them were undocumented and uneducated, but careers in construction allowed them to earn a livable wage and become successful business owners. Still, they would often express their fears of “La Migra” (Immigration and Customs Enforcement (ICE) agents) and eventually being deported. As my friends, colleagues, and the labor force that ultimately put food on my table, I was grateful for my subcontractors, glad that they were able to find employment, and hoped that they could have a better life for themselves and their families.

As a researcher, I recognize the impact of my upbringing and my experiences with my Latinx friends and colleagues that have shaped my desire to focus on Latinxs and their success within construction education. Personally, my experience and training in construction

management began long before I first stepped foot into a college classroom. It started in my home and on the job site as I worked with my father at his craft and trade – something that the children of many Latinxs in the U.S. do daily. Given the practical significance of construction trade experience in being able to manage a construction job effectively, I feel that many first and second generation Latinxs are well suited for positions within the construction management field.

My focus on women in construction is far more practical (and moral). The construction industry has traditionally done a deplorable job of supporting women. As noted by the Occupational Safety and Health Administration (OSHA), the “prevalence of a hostile workplace, restricted access to sanitary toilets, protective clothing and equipment in the wrong sizes, and poor on-the-job training” adversely affect women in construction (Sugerman, Jenkins, & Osorio, 1999 pp. 3). Given that women constitute nearly half the U.S. workforce, it makes both moral and financial sense to increase their participation within the industry. Furthermore, as the father of three pre-teen daughters who have already expressed an interest in the construction industry, I have a moral responsibility to help create a better construction industry and educational environment for them, and all women, in the future.

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CHAPTER 2:
CONSTRUCTION EDUCATION AT A LAND GRANT UNIVERSITY: ASSESSING THE
EQUITY GAP

Summary

The demand for construction managers and construction cost estimators in the United States is projected to increase through 2026, and in order to help meet this demand, numerous construction management (CM) departments at post-secondary universities have set goals to recruit, train, and graduate high caliber students while also providing opportunity and access for students who have been historically underrepresented or underserved in CM education and higher education at large (e.g., female, minority, and first generation students, etc.). This study compared the enrollment and retention rates, interdepartmental migration patterns, and student satisfaction and graduation success outcomes of undergraduate students enrolled in a CM department at a large land grant university. Results indicate many noteworthy trends and equity gaps exist, suggesting that the CM department of interest would be well served to better support female, Latinx, minority, Pell eligible, and first generation students. Opportunities for future research, evaluation, department initiatives, and limitations are also discussed.

Introduction

An aging construction workforce and skills gap has led to a shortage of qualified construction craft workers and professionals (National Center for Construction Education and Research (NCCER), 2013). Furthermore, the demand for construction managers and construction cost estimators in the United States (U.S.) is projected to grow approximately 11 percent from 2016 to 2026; faster than the average profession. (BLS 2016A; BLS 2016B). For individuals

seeking entry into high paying construction management and estimator positions, the best prospects for employment requires construction industry experience and a bachelor's degree in a construction-related field (BLS 2016a; BLS 2016b). As a partial solution to meet the increased industry demand for qualified construction professionals, construction management (CM) departments at numerous post-secondary institutions have established objectives and goals to recruit, train, and graduate high caliber undergraduate students; additionally, many of these institutions, particularly public and land-grant institutions, are tasked with providing educational opportunities to a diverse population of students, particularly those who have been traditionally underrepresented or underserved in higher-education (Strategic Plan 2015- 2020, 2015; Strategic Plan, 2016).

In spite of objectives and goals set by many institutions, low levels of participation among women (typically below 10%) and minorities (potentially below 20%) in CM education, and similar trends occurring in industry, indicate disparities between goals and outcomes (Escamilla, Ostadalimakhmalbaf, Pariafsai, Gragera, & Alizadeh, 2018; US Census, 2016; Raiola & Kovel, 2014; Shane, del Puerto, Strong, Mauro, & Wiley-Jones, 2012; Del Puerto, Guggemos, & Shane, 2011). Potentially, these, and other, disparities between enrollment and retention goals in CM higher education could be associated with the well-documented recruitment and achievement (or equity) gap relating to women, first-gen, minority, lower socioeconomic status (SES), and other traditionally underserved student groups in CM education and higher-education at large (Ryan & Bauman, 2016; Bailey & Dynarski, 2001; Inman & Mayes, 1999). However, except women and, to a lesser extent, minority students, research addressing the equity gaps in CM education is limited. To this end, the following study will identify and evaluate trends and equity gaps in a CM department at a land grant university in the mountain region of the U.S.

Literature Review

Female Students in Construction Education

In the U.S., women of all major demographic groups enroll in post-secondary institutions and graduate with degrees at higher rates than men (Ryan & Bauman, 2016; Lopez & Gonzalez-Barrera, 2014). Nonetheless, women around the world continue to enroll in construction education programs at significantly lower rates than men (Oo & Widjaja, 2018; Shane et al., 2012; Del Puerto, et al., 2011). According to Del Puerto et al. (2011), the percentage of undergraduate female students graduating from the CM program at Colorado State University between 2000 and 2010 ranged from 4.6% to 12.6%, with a 10-year average of 7.9%. At a different U.S. Midwestern university, Shane et al. (2012) reported a steady decline in the percentage of undergraduate female construction engineering students, decreasing from approximately 10% in 2000 to 7% in 2006. Conversely, Oo and Widjaja (2018) reported an increase in the number of females enrolling at three Australian universities between 2006 and 2015. While one university showed only marginal improvements in the number of female enrollees, topping out at just below 5%, the other two universities experienced enrollment trends initiating at close to 10% in 2006 and terminating close to 17% by 2015 (Oo & Widjaja, 2018).

Numerous factors have been posited to deter women from educational and career tracks focused on construction and exacerbate the equity gap; including: 1) a poor image of the construction industry (Meches & Abraham 2007); 2) a male-dominated and oppressive culture (Amaratunga, Haigh, Shanmugam, Lee, & Elvitigala, 2006); Dainty, Bagilhole & Neale, 2000); and 3) a lack of understanding concerning construction careers (Amaratunga et al., 2006; Moore & Gloeckner, 2006). To mitigate these and other deterring factors, researchers have explored the variables relating to the recruitment and retention of females in CM. For example, Bigelow,

Mathew, Ritter, and Elliot (2015) ranked internships, career opportunities, and father working in construction among factors that have the highest correlation with females' decision to pursue a CM degree while identifying mentoring, high school counselors, and work experience ranked among the lowest. These results stand in contrast to the factors posited by Del Puerto et al. (2011) and Moore and Gloeckner (2006), which included mentoring and work experience as critical variables for attracting women into the construction industry.

Minorities and Latinxs in Construction and Higher Education

The achievement gap between Latinxs and non-Latinxs in the construction industry is well documented. For example, from 2012 to 2016, Latinx workers accounted for 69% of new construction hires (Wang, Dong, & Vikraman, 2016) and constituted 36% of the US construction and extraction labor force, but only accounted for 12.4% of construction managers (Census Bureau, 2016). A similar achievement gap also exists for Latinxs in higher-education outcomes. For example, as of 2016, only 15.5% of Latinxs in the U.S. over the age of 25 held a bachelor's degree as compared to 36.2% of non-Latinx Whites (Ryan & Bauman, 2016). On a more promising note for Latinxs in CM education, Escamilla et al. (2018) reported a rise in the enrollment of Latinx students at Texas A&M University for 2008 to 2012.

As with Latinxs, minority students, overall, experience an achievement gap in higher education. For example, as noted by Ryan and Bauman (2016), only 22.5% of Black students over the age of 25 possess a bachelor's degree as compared to 36.2% Whites.

Pell Eligible Students in Higher Education

The purpose of the Federal Pell Grant Program is to provide “need-based grants to low-income undergraduate and certain post baccalaureate students to promote access to postsecondary education” (Federal Pell Grant Program, 2015, p. 1). While Pell eligibility is

based solely on income, Pell eligible students are more likely to come from populations traditionally underrepresented in higher education. For example, during the 2011-2012 academic year at public 4-year institutions, 62.0% of Black students and 51.9% of Latinx students received Pell grants in comparison to 29.9% of White students (Trends in Pell Grant Receipt, 2015). Students from low-income families are less likely to enroll and graduate from post-secondary institutions than their counterparts (Bailey & Dynarski, 2001). However, for minority students, Pell funding increases the likelihood of graduation (Chen & DesJardins, 2010).

First Generation Students in Higher Education

First generation (first-gen) students are defined as those attending a university or college who do not have at least one parent that completed a bachelor's degree (Pike & Kuh, 2005). In the U.S., approximately one in four undergraduate students are first-gen (Redford & Hoyer, 2017). In comparison to continuing generation (con-gen) students - defined as those who have at least one parent who completed a bachelor's degree - first-gen students have a higher probability than con-gen students to identify as a racial and come from a family of SES status (Inman & Mayes, 1999). Furthermore, first-gen students are less likely to complete a bachelor's degree. For example, according to Engle and Tinto (2008), 11% of first-gen students who enrolled in a bachelor's degree program graduated within six years in comparison to 55% of con-gen students.

Study Purpose and Research Objectives

Considering the information and literature presented, the purpose of this study is to identify trends and equity gaps between female, first-gen, minority, Latinx, and Pell-eligible undergraduate CM students, and their respective counterparts, at a land grant university located in the mountain-region of the U.S. It is intended that the results of this study will be utilized as a benchmark for evaluating trends and equity gaps and in the development of strategic initiatives

to recruit and retain an increased number of traditionally underrepresented and underserved undergraduate students into CM education. Methods and results could also act as a guide for future research to address the equity gaps in construction education.

A non-experimental, comparative, and descriptive approach was utilized to address the following research objectives:

RO1: To identify trends and equity gaps in department enrollment and retention rates

RO2A: To identify trends and equity gaps in migration patterns into (towards) the CM department

RO2B: To identify trends and equity gaps in migration patterns away from (attrition) the CM department

RO3: To identify trends and equity gaps in job placement, salary, and the perceptions of undergraduate students who had recently graduated from the CM department.

Data Retrieval and Delimitations

Data for this study were retrieved from reports generated by the institution of interest's Department of Institutional Research, Planning, and Effectiveness (IR) website. The population of interest for this study was undergraduate students majoring in the CM department. Data and reports retrieved from the IR website are publicly accessible and presented in an aggregated format with no unique student identifiers.

IR data and reports were available for differing time frames and populations of students. For RO1, the populations of interest were non-minority/minority, con-gen/first-gen, male/female, non-Pell/Pell eligible, and Latinx/non-Latinx undergraduate first semester CM majors. Data were delimited to academic years 2005 to 2016.

For RO2A, the populations of interest were non-minority/minority, con-gen/first-gen, male/female, and non-Pell/Pell eligible undergraduate students who identified as CM majors during their final (or last) semester at the institution of interest but who did not identify as CM majors during their first semester at the institution of interest. Data were delimited to academic years 2005 to 2016. For RO2B, the populations of interest were the same undergraduate groups listed in R02A, but bound to those that identified as CM majors during their first semester but did not identify as CM majors during their final (or last) semester at the institution of interest. Data were delimited to academic years 2005 to 2016.

For RO3, the populations of interest were non-minority/minority, con-gen/first-gen, male/female, non-Pell/Pell eligible, and Latinx/non-Latinx undergraduate students who had recently graduated from the CM department. Data were delimited to academic years 2012 to 2016.

Data Treatment and Evaluation

Data and reports were extracted directly from the IR website. Post extraction, data were aggregated into single reports addressing the research objectives. In calculating department persistence rates, weighted averages were calculated for each group utilizing all delimited years of data. For example, first-year retention rates for new females are the weighted average of all new female students between 2005 and 2016. Weighted averages were utilized to facilitate reporting due to the small and vacillating number of specific historically underrepresented populations.

Limitations

Research and data limitations should be considered in interpreting the results of this study. The data utilized in this study are from a single department at a land grant university in the

mountain region of the US. Furthermore, while trends and equity gaps are identified, comparative or other statistical analyses were not utilized. Additional limitations include the utilization of secondary data and the steep escalation of CM student salaries during the reporting time frame.

Findings

Retention and Graduation

CM department retention rate percentages are found in Table 2.1.

Table 2.1

CM Department Retention Percentage by Year (Fall Semester); Weighted Average

Student Group	(N)	TS	2nd	3rd	4th	5th	6th	7th	8th
All Students (Average)	(487)	T	83.2	77.0	76.5	74.1	76.2	76.4	77.0
All Students (Average)	(806)	N	75.3	66.2	64.9	61.5	60.6	60.3	60.4
Minority	(50)	T	76.0	68.9	65.0	62.2	63.6	67.9	70.4
Minority	(104)	N	73.1	66.7	64.0	59.4	60.3	61.5	61.7
Non-Minority	(437)	T	84.0	77.9	77.7	75.4	77.5	77.2	77.6
Non-Minority	(702)	N	75.6	66.1	65.0	61.8	60.7	60.1	60.2
Female	(31)	T	87.1	76.0	75.0	60.0	68.4	68.4	68.4
Female	(49)	N	73.5	61.4	66.7	64.9	65.7	67.6	67.7
Male	(456)	T	82.9	77.1	76.6	74.9	76.6	76.9	77.5
Male	(757)	N	75.4	66.5	64.8	61.3	60.3	59.7	59.8
Pell	(110)	T	85.5	75.8	76.9	70.6	76.3	77.5	78.3
Pell	(119)	N	70.6	59.2	53.6	54.8	53.8	55.3	50.0
Non-Pell	(377)	T	82.6	77.3	74.6	72.6	73.0	72.5	72.8

Non-Pell	(687)	N	76.1	67.3	66.5	62.5	61.6	60.9	61.6
First Gen	(162)	T	80.9	74.0	74.1	72.0	72.3	73.6	74.6
First Gen	(181)	N	73.5	67.3	64.4	61.3	60.0	58.8	57.6
Con-Gen	(325)	T	84.3	78.5	77.7	75.3	78.3	78.0	78.3
Con-Gen	(625)	N	75.8	65.9	65.0	61.6	60.8	60.7	61.2
Latinx	(30)	T	83.3	73.1	69.6	70.0	70.6	76.9	83.3
Latinx	(69)	N	71.0	68.5	63.6	56.4	55.6	58.8	56.7

Note: (TS) = Transfer Status; (T) = Transfer; (N) = New

Female student retention. A graphic representing yearly percentage increases (or decreases) from the average student retention rate for female and male students is found in Figure 2.1. Overall, new and transfer male students were retained at a relatively comparable rate to the average of all new and transfer students.

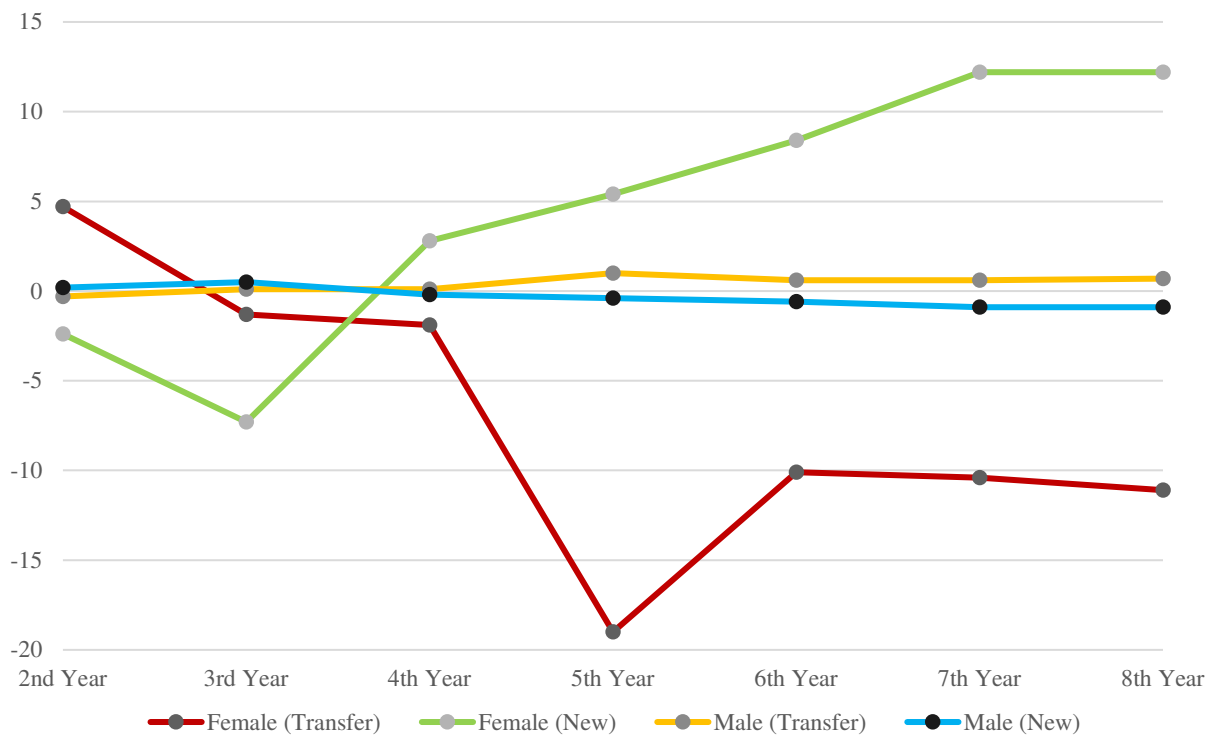


Figure 2.1 Retention Percentage Increase (or Decrease) from All Students (Average)

For new and transfer female students, trends indicated more significant year over year variability than males and an equity gap for female transfer students. For new female students, data suggest that the critical time to address program retention is during the first few years of enrollment when students experience higher than average department attrition rates. After this period, students persisted at a higher than average rate. For female transfer students, retention rates were an area of concern. Beginning in the third year, female students left the CM program at a higher than average rate, and by the eighth year, these students were 11.1% less likely than the average transfer student to have remained enrolled or graduated. In an industry like construction, with low female participation rates, it appears that an equity gap exists for the CM department to better support these students.

Minority and Latinx student retention. A graphic representing yearly percentage increases (or decreases) from the average student retention rate for minority, non-minority, and Latinx students is found in Figure 2.2. Overall, new and transfer non-minority students were retained at a relatively comparable rate to the average of all new and transfer students.

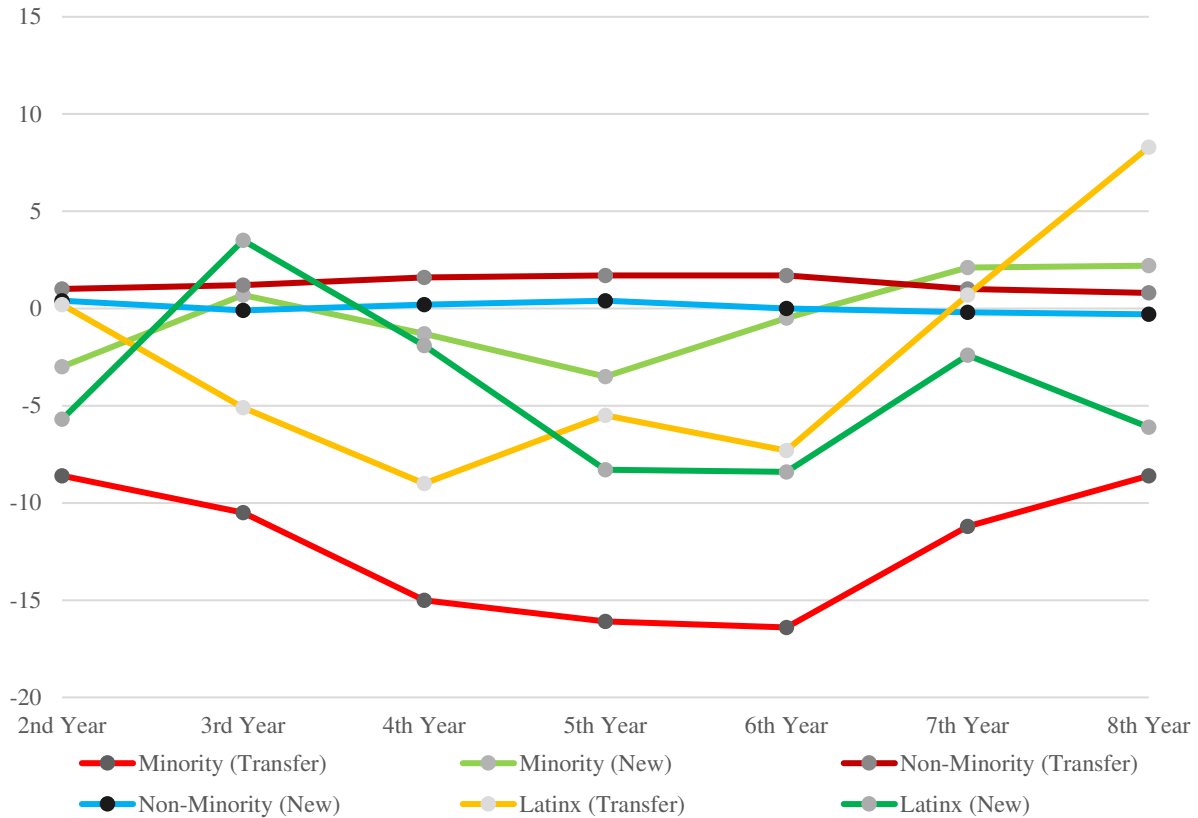


Figure 2.2 Retention Percentage Increase (or Decrease) from All Students (Average)

Similar to the trends observed with females, new and transfer minority and Latinx students experienced more significant year over year variability than non-minorities students. Noteworthy trends or equity gaps were apparent for all populations. By the eighth year, new minority and transfer Latinx and non-minority students graduated or remained enrolled in the CM program at higher than average rates. However, on average, between the second and sixth years of evaluation, new minority and transfer Latinx students remained enrolled at a lower than average rate. After this time, retention or graduation percentages increase for both groups with a stark increase occurring for transfer Latinx students in the seventh and eighth years of evaluation. For new Latinx and transfer minority students, trends indicate an equity gap. Beginning in the second year, except for the third year for new Latinxs, both groups were retained or graduated at a lower than average rate. By the eighth year of evaluation, transfer

minority and new Latinx students were 8.6% and 6.1%, respectively, less likely than the average students to have remained enrolled or graduated.

Pell eligible student retention. A graphic representing yearly percentage increases (or decreases) from the average student retention rate for Pell and non-Pell recipients is found in Figure 2.3. Overall, new non-Pell eligible and transfer Pell eligible students were retained at a marginally higher rate than average. However, transfer Pell eligible students did experience increased variability, particularly during the fifth year observation.

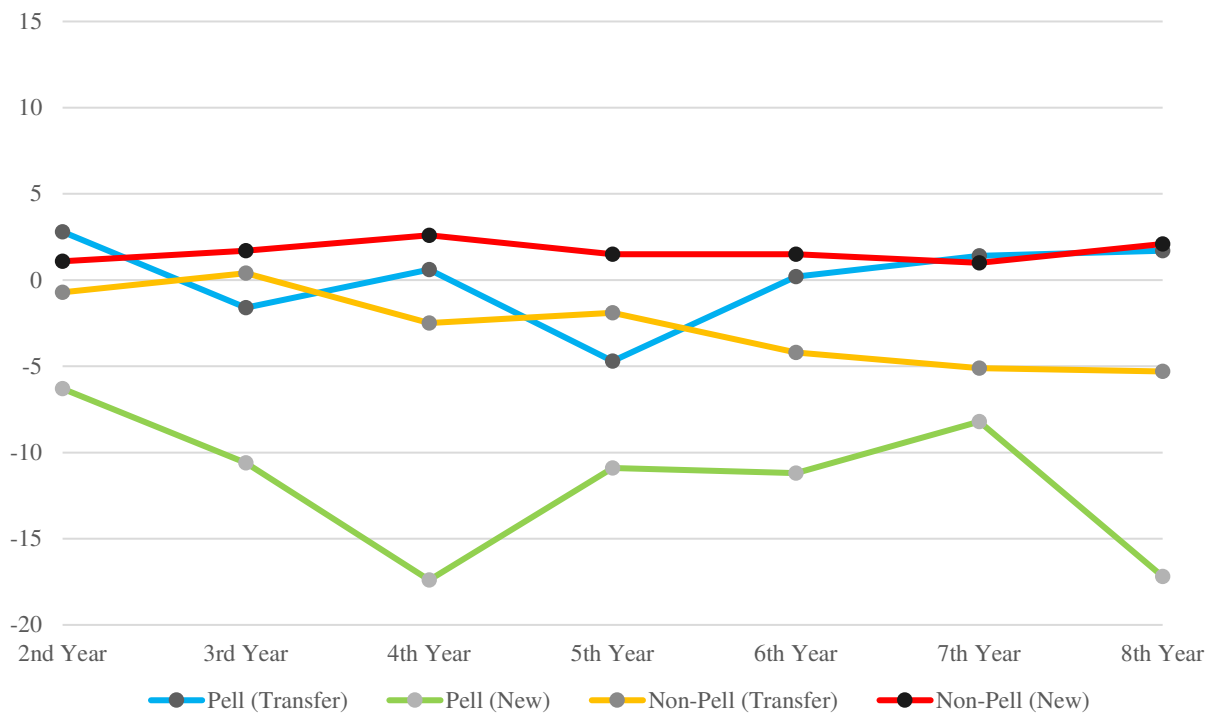


Figure 2.3 Retention Percentage Increase (or Decrease) from All Students (Average)

For transfer non-Pell eligible students, trends indicate an equity gap. Overall, these students experienced a slow and steady decline in retention or graduation and by the final year of observation, were 5.3% less likely to have graduated or been retained than the average transfer student. For new Pell eligible students, the equity gap is more extensive than all other groups. By the second year of enrollment, new Pell eligible students left the program at a concerning rate.

By the eighth year of observation, these students were 17.2% less likely than the average new student to have remained enrolled or graduated. In light of the trend presented, it appears that Pell eligibility is both positively and negatively correlated with student retention depending on the transfer status.

First-Gen student retention. A graphic representing yearly percentage increases (or decreases) from the average student retention rate for first-gen and con-gen students is found in Figure 2.4. Overall, new and transfer con-gen students were retained at a marginally higher than average rate.

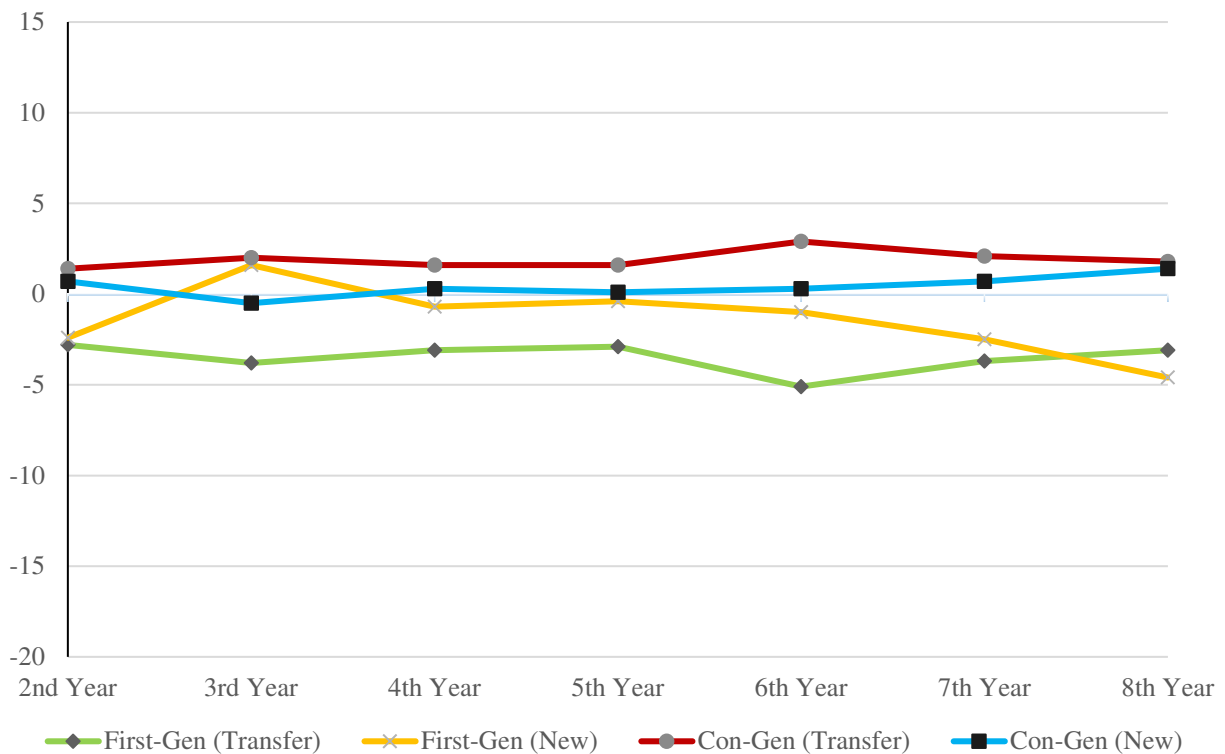


Figure 2.4 Retention Percentage Increase (or Decrease) from All Students (Average)

For new and transfer first-gen students, retention and graduation trends exhibited a relatively steady downward trend. By the eighth year, transfer first-gen students were 3.1% less likely than the average transfer student to have remained enrolled or graduated, and new first-gen

students were 4.6% less likely than the average new student to have stayed enrolled or graduated indicating an equity gap.

Migration Patterns Into (Towards) CM

The breakdown of first semester CM and non-CM majors that identified as CM majors during their last (or final) semester at the institution of interest is found in Table 2.2. For minority, female, and first-gen students that identified as CM majors during their last semester at the institution of interest, the likelihood of identifying as a CM major during their first semester was less than their non-minority, male, and con-gen counterparts indicating an equity gap for the CM program to attract secondary or other university-bound students.

Department level student migration (arrival) patterns are presented in Table 2.3.

Table 2.2

First Semester Major of Students that Identified as CM Majors during their Last Semester

Major Department	T	MI	NMI	F	M	P	NP	FG	CG
CM Majors (%)	52.8	46.9	54.0	46.2	53.3	51.8	53.1	48.7	54.3
Non-CM Majors (%)	47.2	53.1	46.0	53.8	46.7	48.2	46.9	51.3	45.7

Note: (T) = Total; (MI) = Minority; (NMI) = Non-Minority; (M) = Male; (F) = Female; (P) =

Pell Recipient; (NP) = Non-Pell Recipient; (FG) = First-Gen; (CG) = Con-Gen

Table. 2.3

First Semester Major of Students that Migrated into CM (Percentage)

Major Department	T	MI	NMI	F	M	P	NP	FG	CG
Business Intra-College	3.0	0.0	3.7	0.0	3.2	1.6	3.3	1.3	3.6
Civil and Envir. Engineering	8.5	12.5	7.5	11.9	8.2	9.8	8.1	5.1	9.9
Engineering Intra-College	5.0	2.9	5.5	2.4	5.2	5.7	4.8	5.1	4.9

Mechanical Engineering	8.3	6.7	8.7	7.1	8.4	4.1	9.5	8.9	8.1
Design and Merchandising	1.1	0.0	1.4	14.3	0.0	0.0	1.4	0.6	1.3
Health and Exercise Science	4.2	3.8	4.3	9.5	3.8	4.9	4.0	6.4	3.4
Provost / Open Major	56.6	61.5	55.5	35.7	58.4	59.0	56.0	62.4	54.3
Biology	2.2	1.0	2.5	9.5	1.6	1.6	2.4	3.2	1.8
Chemistry	0.9	2.9	0.5	2.4	0.8	1.6	0.7	0.6	1.0
Biomedical Sciences	0.6	0.0	0.7	4.8	0.2	0.0	0.7	0.0	0.8
Other	3.9	1.9	4.3	2.4	4.0	4.1	3.8	1.9	4.7

Note: (T) = Total; (MI) = Minority; (NMI) = Non-Minority; (M) = Male; (F) = Female; (P) =

Pell Recipient; (NP) = Non-Pell Recipient; (FG) = First-Gen; (CG) = Con-Gen

Does not include “first semester” CM majors

Department majors representing less 3% of the population reported under “Other”

Bolded = Top (5) department majors

Overall, first semester provost/open (56.6%) and engineering related (21.8%) majors accounted for the most substantial percentage of migrants entering the CM department. At the group level, provost/open majors accounted for the most substantial proportion of migrants for all groups ranging from 62.4% of first-gen students to 35.7% of female students. Furthermore, civil and environmental, mechanical, and intra-college engineering majors, jointly, accounted for between 19.1% and 22.1% of migrants for all groups.

Among the noteworthy trends within this section is the migration pattern of female students. While provost/open major students accounted for the most significant percentage of female migrants, the average student was 58.5% more likely to migrate from a provost/open major than a female indicating an equity gap. Furthermore, design and merchandising, biology,

and health and exercise sciences, jointly, accounted for 33.3% of females as compared to 5.4% of males.

Migration Patterns Away from (Attrition) CM

The breakdown of first semester CM majors that were retained or migrated away from the CM program during their last (or final) semester at the institution interest is found in Table 2.4. Students from all groups remained enrolled in the DCM at comparable rates ranging from 81.8% of females to 84.2% of first-gen students.

Table. 2.4

Student Migration away from CM

Major Department	T	MI	NMI	F	M	P	NP	FG	CG
CM Majors Retained (%)	83.5	83.6	83.4	81.8	83.6	83.4	83.5	84.2	83.2
CM Majors Migrated (%)	16.5	16.4	16.6	18.2	16.4	16.6	16.5	15.8	16.8

Note: (T) = Total; (MI) = Minority; (NMI) = Non-Minority; (M) = Male; (F) = Female; (P) = Pell Recipient; (NP) = Non-Pell Recipient; (FG) = First-Gen; (CG) = Con-Gen

Department level student migration (departure) patterns are found in Table 2.5, and college-level migration (departure) patterns are found in Table 2.6. Overall, communications, provost/open, real estate finance, human dimensions of natural resources, and horticulture and landscape architecture majors were the landing locations for the largest percentage of departing CM migrants. Numerous notable and contrasting trends emerge between student groups. For example, minority, female, Pell eligible, and first-gen students were substantially more likely to migrate into the colleges of health and human sciences and liberal arts than their respective counterparts. Conversely, non-minority, male, non-Pell, and con-gen students were substantially more likely to migrate into the colleges of agricultural sciences, business, and natural resources

than their respective counterparts. Trends indicate disparate academic interests between student groups.

Table. 2.5

Final Semester Major of Students that Migrated away from CM (Percentages)

Major Department	T	M	NM	F	M	P	NP	FG	CG
Hort & Land Arch	6.7	0.0	7.8	0.0	7.1	3.8	7.4	0.0	8.7
CIS	0.8	5.6	0.0	0.0	0.9	0.0	1.1	0.0	1.1
Finance & Real Estate	8.3	0.0	9.8	0.0	8.9	3.8	9.6	10.7	7.6
Design and Merchandising	2.5	0.0	2.9	0.0	2.7	11.5	0.0	3.6	2.2
Food Science & Nutrition	4.2	0.0	4.9	12.5	3.6	0.0	5.3	0.0	5.4
Exercise Science	4.2	5.6	3.9	12.5	3.6	3.8	4.3	3.6	4.3
Continuing Ed - Admin	1.7	5.6	1.0	12.5	0.9	0.0	2.1	0.0	2.2
Provost / Open Major	10.0	5.6	10.8	0.0	10.7	19.2	7.4	3.6	12.0
Anthropology	0.8	5.6	0.0	0.0	0.9	3.8	0.0	3.6	0.0
Art and Art History	0.8	5.6	0.0	0.0	0.9	3.8	0.0	3.6	0.0
Communication Studies	10.8	16.7	9.8	12.5	10.7	3.8	12.8	7.1	12.0
English	2.5	0.0	2.9	12.5	1.8	7.7	1.1	7.1	1.1
History	3.3	0.0	3.9	0.0	3.6	7.7	2.1	3.6	3.3
Languages and Cultures	0.8	0.0	1.0	12.5	0.0	0.0	1.1	0.0	1.1
Sociology	5.8	16.7	3.9	12.5	5.4	7.7	5.3	14.3	3.3
Biochemistry	0.8	5.6	0.0	0.0	0.9	3.8	0.0	3.6	0.0
Ecosystem Science	3.3	5.6	2.9	12.5	2.7	3.8	3.2	3.6	3.3
Forest Stewardship	5.8	16.7	3.9	0.0	6.3	3.8	6.4	7.1	5.4
Human Dim of Natural Resc.	7.5	5.6	7.8	0.0	8.0	3.8	8.5	7.1	7.6
Other	19.2	0.0	22.5	0.0	20.5	7.7	22.3	17.9	19.6

Note: (T) = Total; (MI) = Minority; (NMI) = Non-Minority; (M) = Male; (F) = Female; (P) =

Pell Recipient; (NP) = Non-Pell Recipient; (FG) = First-Gen; (CG) = Con-Gen

Does not include “final semester” CM majors

Department majors representing less 5% of population reported under “Other”

Bolded = Top (5) department majors

Table 2.6

Final Semester College of Students that Migrated away from CM (Percentage)

College	T	MI	NMI	F	M	P	NP	FG	CG
Agricultural Sciences	9.2	0.0	10.8	0.0	9.8	7.7	9.6	3.6	10.9
Business	15.8	5.6	17.6	0.0	17.0	3.8	19.1	10.7	17.4
Health and Human Sciences	12.5	5.6	13.7	25.0	11.6	15.4	11.7	10.7	13.0
Intra-University	11.7	11.1	11.8	12.5	11.6	19.2	9.6	3.6	14.1
Liberal Arts	27.5	44.4	24.5	50.0	25.9	34.6	25.5	46.4	21.7
Natural Sciences	3.3	5.6	2.9	0.0	3.6	7.7	2.1	7.1	2.2
Natural Resources	20.0	27.8	18.6	12.5	20.5	11.5	22.3	17.9	20.7

Note: (T) = Total; (MI) = Minority; (NMI) = Non-Minority; (M) = Male; (F) = Female; (P) =

Pell Recipient; (NP) = Non-Pell Recipient; (FG) = First-Gen; (CG) = Con-Gen

Does not include “final semester” CM majors

A concerning trend identified in the migration evaluation is the percentage of students that identified as provost/open majors during their last semester. It can be assumed that these students left the university without graduating. Overall, 10.0% of students that migrated away from the CM department identified as provost/open majors during their last semester. This trend was particularly detrimental to Pell eligible students who were 92% more likely than the average student to identify as a provost/open major during their last semester.

CM Graduate Perceptions and Outcomes

Student satisfaction. The results of the student satisfaction question, “How would you evaluate your entire educational experience within your major?” are found in Figure 2.5. Overall, students from all groups reported a “good” or “excellent” experience within the major.

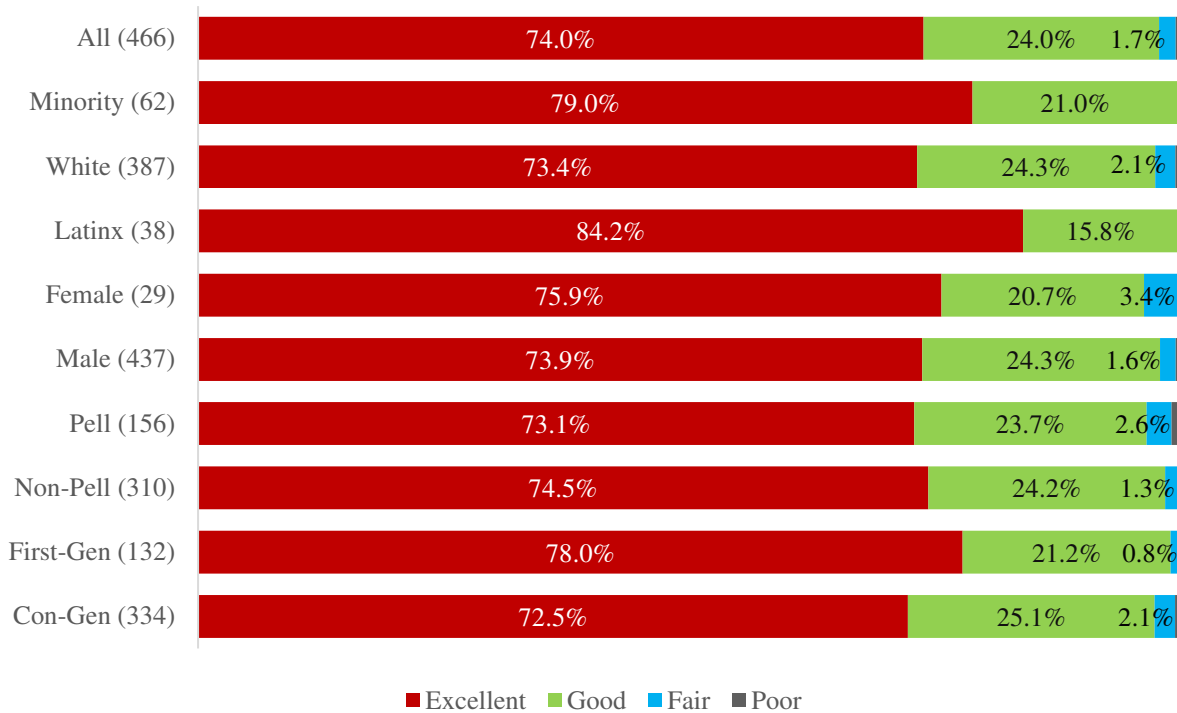


Figure 2.5 How would you evaluate your entire educational experience within your major?

The results of the student satisfaction question, “If you could start over again, would you choose the same major?” are found in Figure 2.6. Overall, students would “probably” or “definitely” select CM as an academic major again. Latinxs reported the highest level of satisfaction with 100% reporting they would “probably” or “definitely” select the same major again. Females reported the highest level of dissatisfaction with their major selection, with 10.3% reporting they would “probably not” or “definitely not” select the same major again.

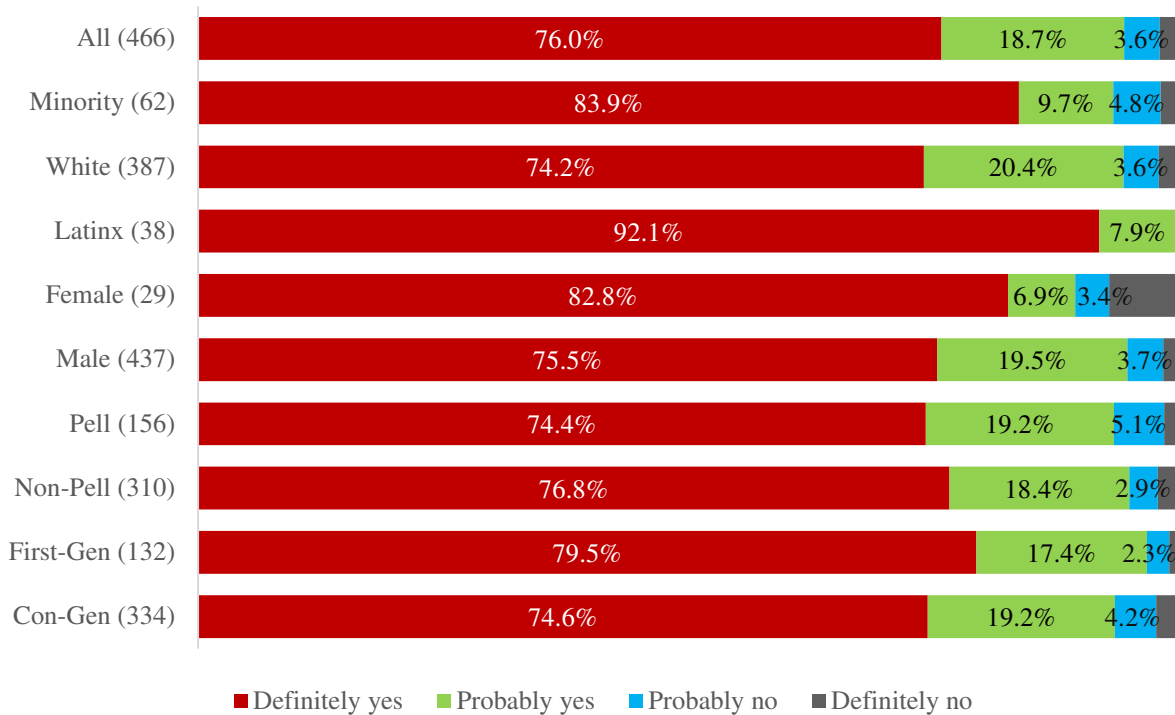


Figure 2.6 If you could state over again, would you choose the same major?

Advising. The results of the advising question, “Did you have a faculty or staff member who was a positive influence on you while you attended [the institution of interest]?” are found in Figure 2.7. Overall, 90.4% of students reported a positive influence by a faculty or staff member. While minority, Pell eligible, and first-gen students reported marginally lower than average levels of positive influence, female students were 89.0% more likely than male students to report no positive faculty or staff influences indicating an equity gap.

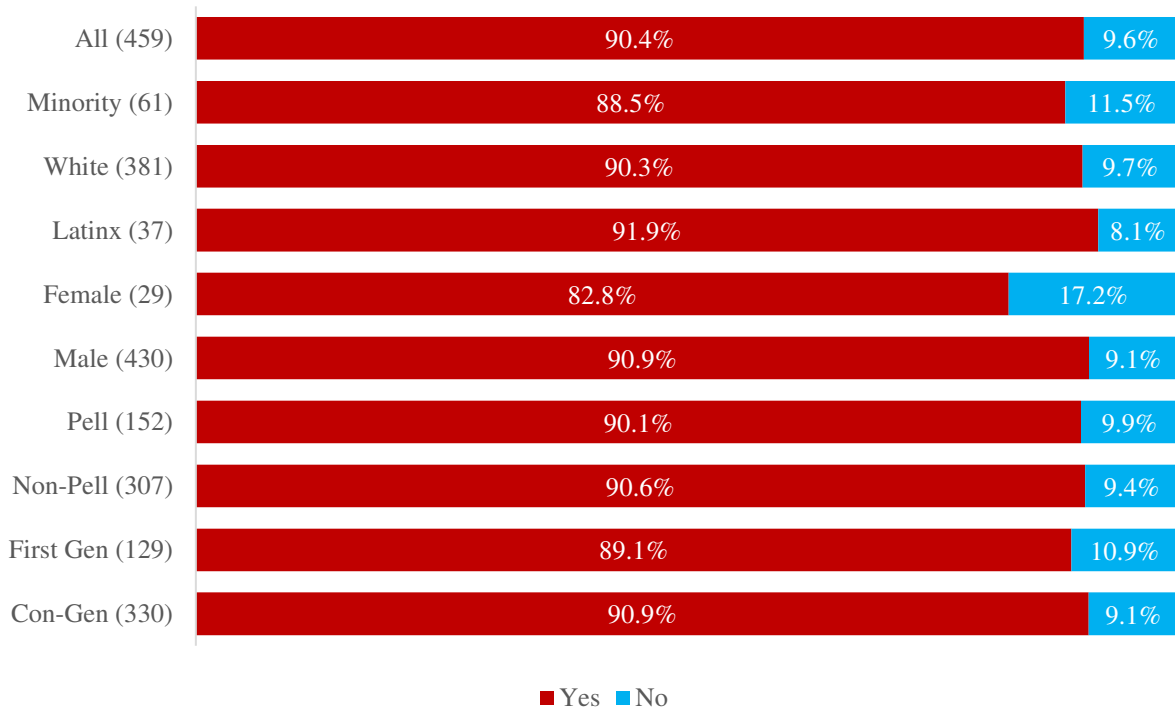


Figure 2.7 Did you have a faculty or staff member who was a positive influence on you while you attended [the institution of interest]?

The results of the advising question, “How would you rate your satisfaction with your advising related to courses, scheduling, and selecting a major?” are found in Figure 2.8. Overall, students reported high levels of satisfaction in relation to course, scheduling, and major advising, with almost 89% reporting “excellent” or “better than average” results. While female students reported the lowest overall levels of satisfaction with academic advising, Latinx students reported the lowest levels of “excellent” satisfaction of any group and the second-highest levels of dissatisfaction.

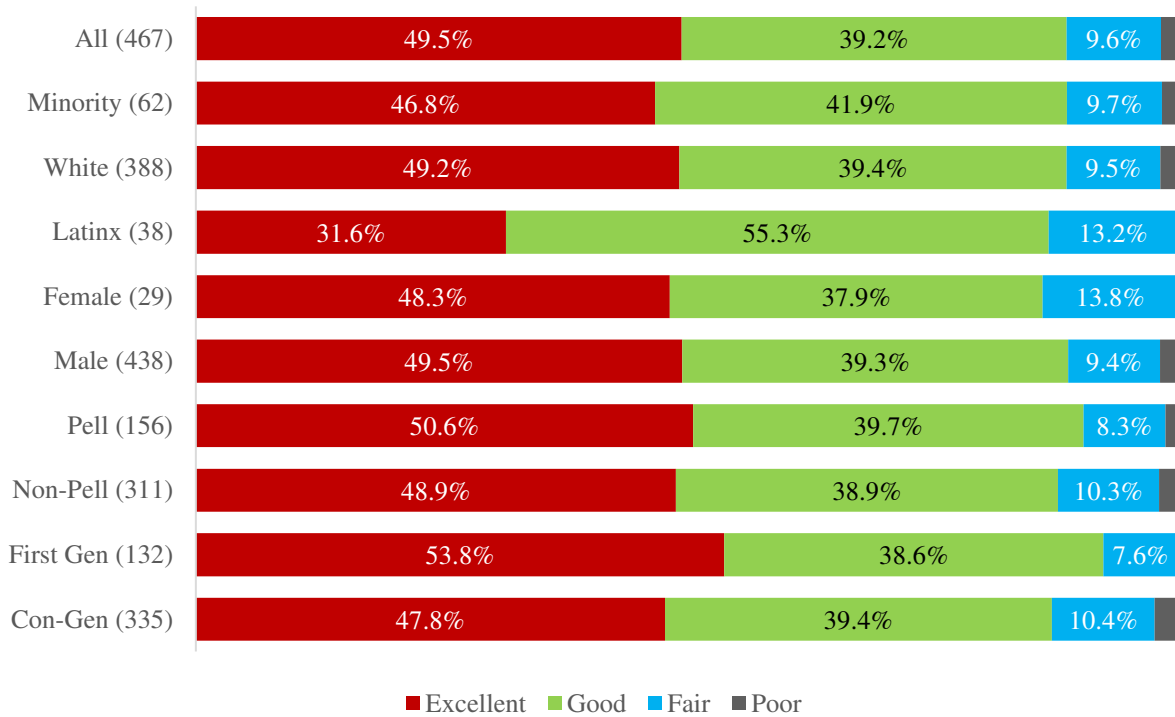


Figure 2.8 How would you rate your satisfaction with your advising related to courses, scheduling, and selecting a major?

The results of the advising question, “To what extent did your department emphasize spending significant amounts of time studying and on academic work?” are found in Figure 2.9. Overall, 74.9% of all students reported that studying was emphasized “very much” or “quite a bit.” For non-White, Latinx, and first-gen students, there appears to be a perceived emphasis on the importance of spending significant amounts of time studying and on academic work. Overall, Latinx students reported the highest levels of academic emphasis, with 89.5% reporting “very much” or “quite a bit.”

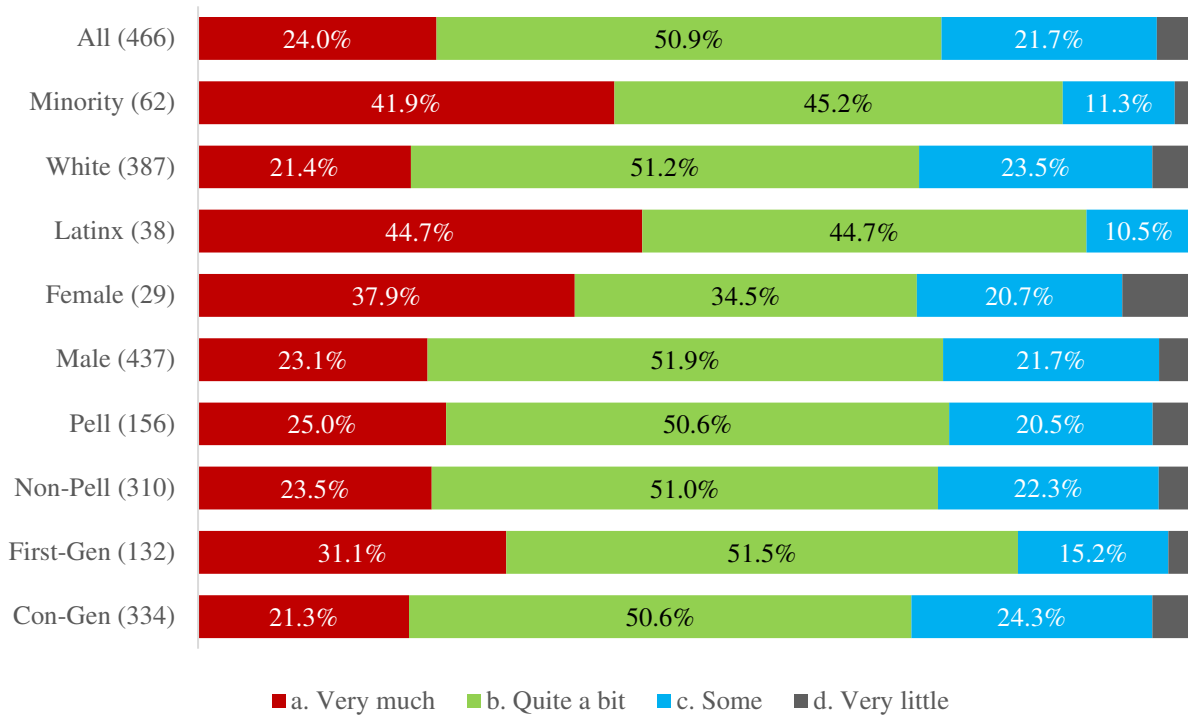


Figure 2.9 To what extent did your department emphasize spending significant amounts of time studying and on academic work?

Internships and employment. The results of the question, “Did you have an internship with your employer prior to graduation?” are found in Figure 2.10. Overall, 56.7% of students accepted an employment position with an organization where they previously had an internship, and more than half of students from all groups did the same. Of particular note, female students were 30.2% more likely than male students to return to an organization where they previously had an internship.

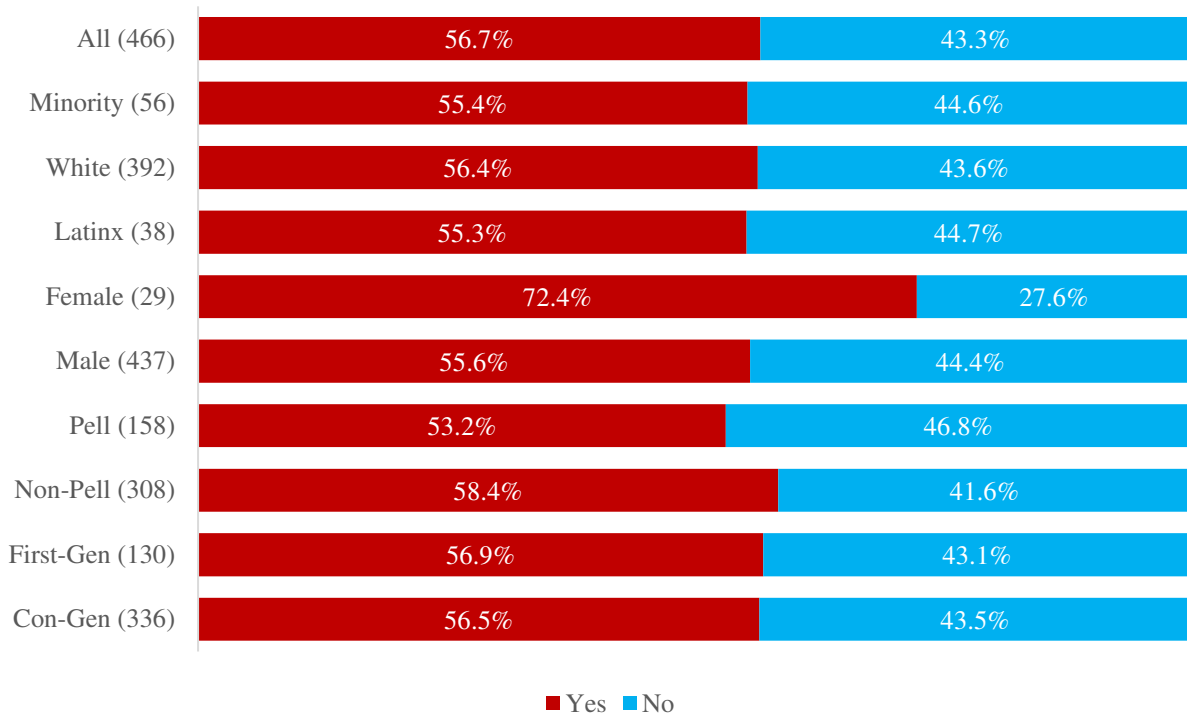


Figure 2.10 Did you intern with your employer prior to graduation?

Salary reports for graduates are found in Figure 2.11. In evaluating compensation data, it is important to note that the average salary for all construction management graduates has increased steadily and steeply over the reporting period. Overall, students returning to an organization where they previously had an internship were more highly compensated than students who did not return to an organization where they previously had an internship. Minority students that returned to an organization where they previously had an internship received the highest levels of compensation, earning approximately \$2000 more than average. Of particular note, female students reported compensation levels well below average. For female students that accepted a position with an organization where they had previously interned, the compensation was approximately \$2000 less than average. For female students that accepted a position with an organization where they did not previously have an internship, reported compensation was \$6000 less than average, amounting to a 10.3% wage gap.

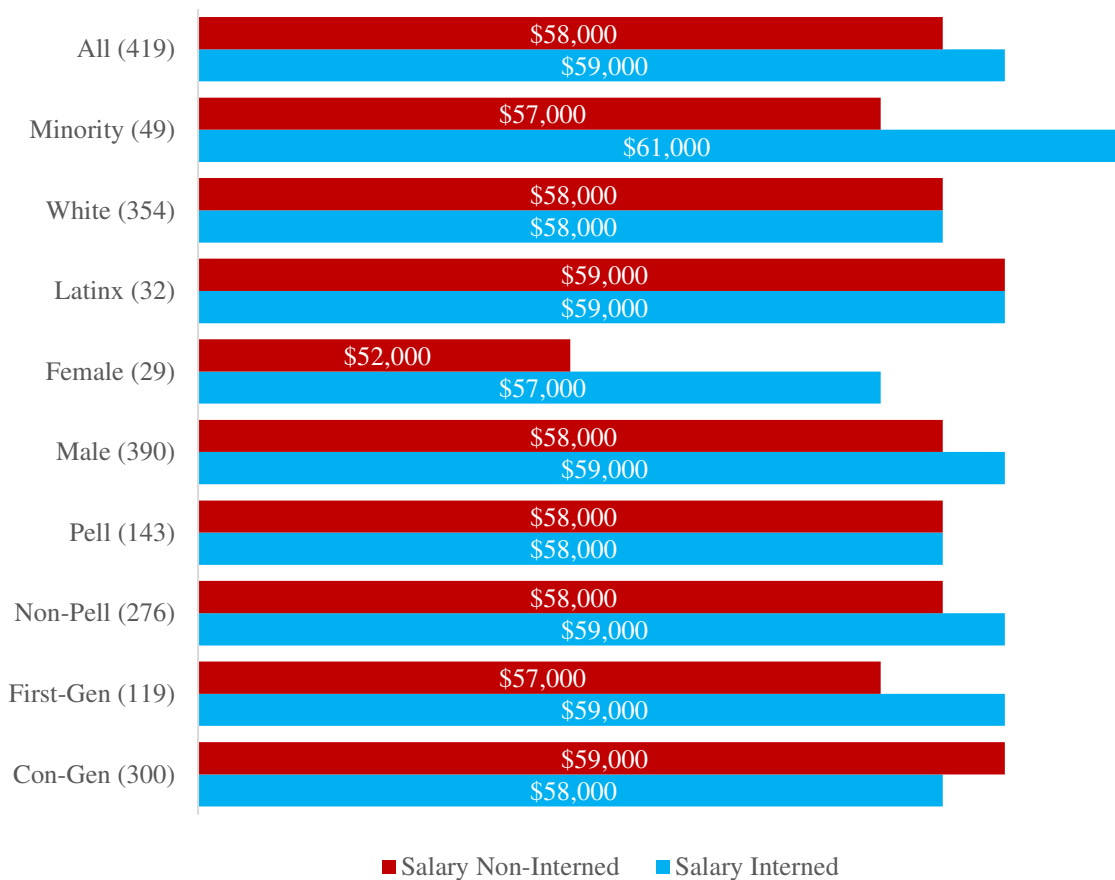


Figure 2.11 Starting Salary

Discussion

Female Students

Noteworthy trends and equity gaps were identified in relation to female CM students that merit further discussion. First, the relative disparity in program retention or graduation between new and transfer female students is a point of unease. While the cause of the disparity could not be identified in this paper, analysis of female transfer students at different post-secondary institutions could identify whether the observed trend is isolated to the institution of interest or a more systemic concern. Furthermore, exit surveys for students who decide to leave CM

programs or first-person interviews with transfer female students could shed increased light on the variables that affect the retention gap.

In terms of student migration into CM, female students were less likely to migrate from a provost/open major than all other student groups and were more likely to migrate into CM from design and merchandising, biology, and health and exercise sciences. As such, it appears that the CM department could potentially benefit from an increased effort to recruit a greater number of female provost/open majors. As a further point of discussion, the interior architecture and design program (which is part of the design and merchandising department) requires all students to complete a construction materials and methods course in the CM department. As the second-largest major of female migrants into the CM department, migration patterns potentially suggest that exposure to CM courses could have a positive relationship with females selecting a CM major.

Migration patterns away from the CM department suggest that academic interests of male and female students who leave the department are disparate. Given the breadth and depth of requisite interests and skills required to succeed in the CM industry, future research could evaluate the differing social drivers for male and female students in pursuing a career in the construction industry and evaluate whether the contexts utilized in meeting CM course learning objectives are in line with the interests of female students.

In terms of CM department perceptions and first destination outcomes, two noteworthy and concerning trends were identified relating to perceived faculty support and starting salaries. In light of the fact that the small number of female CM survey respondents could skew the results, the data suggests that there is an equity gap to better support female students. First, it appears that female CM students feel less supported by faculty and staff than other students.

While the reasons for this were not identified, future research and initiatives, either individual or department-wide, could shed a greater understanding of the variables associated with lower perceived support. Second, an increased understanding of the salary gap would be beneficial. Notably, as it has been noted that construction has a lower gender salary gap than most industries (Bilbo, Bigelow, Rybkowski & Kamranzadeh, 2014), it would be valuable to identify the magnitude of the gap at graduation statistically.

Minority Students

As with females, the retention gap between new and transfer minority students is a point of concern. As observed in second year enrollment rates, transfer minority students leave the CM program early in their academic careers. Again, while the reason for this trend cannot be evaluated in this paper, it appears that increased support for these students during their first (and continuing) years of enrollment and a greater understanding of the variables that adversely affect program persistence is needed.

In terms of department migration patterns, inbound patterns for minority students are similar to the average of all students. However, outbound patterns were less directed towards business or agricultural sciences than the average student and more focused on communications, sociology, and forest stewardship, suggesting a stronger pull towards majors focused on social factors or environmental stewardship.

Latinx Students

In an inverse trend from female and minority students, transfer Latinx students graduated or persisted at higher than average levels while new Latinx students graduated at lower than average levels, indicating an equity gap for new Latinx students. Furthermore, both new and transfer Latinx students experienced relatively high levels of variability in retention. Given this

variability, future statistical analysis focused on temporal aspects relating to student program persistence could be beneficial in understanding the variability in Latinx student persistence. However, at current, it appears that Latinx students, in general, would benefit from increased support, particularly during the first several years of program enrollment.

Pell Eligible Students

Equity gaps to better support Pell eligible students were identified. Among the most pressing gaps is CM department retention rates for new Pell eligible students. As previously noted, these students had the lowest levels of department persistence or graduation rates, resulting in an eight year non-persistence rate 17.2% higher than average. Given that Pell eligible students migrated away from the CM department at a rate comparable to other groups, it can be conjectured that a partial reason for this disparity is due to higher levels of university attrition. Furthermore, Pell eligible students that migrated away from the CM department were almost twice as likely as the average student to identify a provost/open major during their final semester.

Given the time and financial resource commitment by students and the financial resources committed by the U.S. federal government to attend university, advising departments and faculty could make a concentrated effort to direct students who choose to leave the program towards a defined major that better fits the student's academic or personal aptitude. Ideally, maximizing the probability that the resources already expended by the student and government will lead to a university degree.

First-Gen Students

Equity gaps exist in relation to first-gen student persistence as these students are less likely to persist than their con-gen counterparts. However, given the relative flatness of the

persistence trends, it appears that the first year of program enrollment is the most pivotal time to provide increased support.

In terms of department migration into the CM program, first-gen students are slightly more likely than average to migrate from a provost/open major and are slightly less likely to migrate from engineering. In terms of migration away from the CM department, first-gen students were twice as likely to select a liberal arts major as con-gen students but more likely than minorities and women to select business degrees. These results suggest that first-gen students are potentially a less homogenous group, in terms of academic interests, than other groups.

Moving Forward

This study utilized publicly available data to identify and evaluate trends and equity gaps for female, minority, Latinx, Pell eligible, and first-gen undergraduate students enrolled in the CM department at a land grant university in the mountain region of the U.S. The results of this study identified numerous equity gaps and suggest that the CM department of interest would be well served to focus department initiatives and future research on addressing and mitigating the gaps identified.

Specifically, initiatives focused on attracting a higher number of university-bound females, Latinx, Pell-eligible, and minority students could increase the number of first-semester CM majors. Potential recruitment activities could include an increased recruitment focus at high schools or junior colleges that serve more significant percentages of minority, Latinx, or lower SES students, many of whom may hold a negative perception of construction-related careers (Escamilla, Ostadalimakhmalbaf, & Bigelow, 2016). Additionally, open houses, summer camps,

or other outreach programs for female or minority students interested in CM related careers could prove beneficial.

Additional initiatives could focus on mitigating the retention gap for students at the highest risk of attrition (i.e., new Latinx, Pell eligible, and first-gen and transfer female, minority, non-Pell eligible, and first-gen students). For example, summer bridging programs have been shown to positively affect student recruitment and academic outcomes in higher-education (Baker & Slunt, 2017). Further ideas include panel discussion for first-year students where panelists specifically mention their background (e.g., first-gen, minority, etc.) as this has been shown to improve retention and academic performance among first-gen and con-gen students (Stephens, Hamedani, & Destin, 2014). Furthermore, a targeted focus on faculty to female support relationships could be helpful given the disparities previously discussed and opportunities to connect female students to industry professions should be facilitated (Moore & Gloeckner, 2007). Finally, an evaluation of course objectives and the activities and context utilized to meet those objectives could be useful in ensuring that students with potentially different interests (e.g., males and females) are equally served within CM courses as research has shown that this is not always the case (Bachman, Hebl, Martinez, & Rittmayer, 2009). Given the public nature of the data utilized in this study, the author suggests that researchers identify similar data sources for future evaluation and perform similar analyses.

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CHAPTER 3:
A LONGITUDINAL COMPARATIVE CASE STUDY OF ENROLLMENT TRENDS AND
ACADEMIC SUCCESS IN UNDERGRADUATE CONSTRUCTION MANAGEMENT
EDUCATION

Summary

There is a global demand for educated construction managers, and a bachelor's degree in a construction-related field offers some of the best prospects for entry into the profession. Despite demand, undergraduate construction education programs continue to lack gender, racial, and ethnic diversity, potentially due to the opportunity gaps in the U.S. education system that have traditionally underserved low income, minority, and first generation (first gen) students. The following case study compares current (2010 to 2017) and historic (1990 to 2009) enrollment trends and academic success outcomes (e.g., GPA and graduation rates) for undergraduate first generation, Pell eligible, Latinx, minority, and female students within a large CM program (n = 766). Results indicate statistically significant opportunity gaps in enrollment and academic success outcomes exist between underrepresented racial/ethnic minorities (URMs) and their White peers; and, that the magnitude of some of these opportunity gaps has increased in comparison to historic levels. Recommendations, future research, and limitations are discussed.

Introduction

Around the globe, there is a documented demand for educated construction professionals (Australian Government, 2019; Bureau of Labor Statistics, 2019; New Zealand Immigration, 2019). In Australia, employment in construction management positions is projected to “grow strongly” through 2023 with the prospect of “below average” unemployment levels, “much

higher” than average prospects for full-time employment, and “much higher” than average salaries in comparison to other professions (Australian Government, 2019). Similar trends exist in the United States (U.S.) where it is projected that 44,800 new construction management positions will be needed between 2016 to 2026; in addition to the “substantial number” of openings created by current professionals retiring or leaving the occupation (Bureau of Labor Statistics, 2019). The median salary for construction managers (\$93,370) is 233% higher than the median of all professions (Bureau of Labor Statistics, 2019). In both Australia and the U.S., a bachelor’s degree (or equivalent) offers some of the best prospects for entry into the construction management profession (Australian Government, 2019; Bureau of Labor Statistics, 2019).

Despite a robust outlook, the construction management profession is beset by a lack of diversity. For example, female construction managers in Australia (7.3%) and the U.S. (7.7%) are underrepresented in comparison to their participation in the national workforce; 46.7% and 46.9%, respectively (Australian Government, 2019; Bureau of Labor Statistics, 2018). In addition to gender disparities, disparities between Whites and historically underrepresented racial/ethnic minorities (URMs) also exist. In 2018, Blacks constituted 12.3% of the U.S. workforce, yet only 3.1% of construction managers (Bureau of Labor Statistics, 2018). Within the U.S. construction industry, Latinxs are over three times as likely to work as a construction laborer (47.6%) than as a construction manager (15.3%) (Bureau of Labor Statistics, 2018).

The construction industry could benefit significantly from a more diverse construction management workforce. As stated by the American Building Association, “workforce diversity is not just a moral imperative or societal goal; rather, it should be viewed as a competitive advantage and a business opportunity” (Associated Builders and Contractors, 2010, pp. 2-3). An economic case for a more diverse construction management workforce is demonstrated in a 2018

report by McKinsey & Company. According to the report, companies in the highest quartile of gender diversity on their executive teams were 21% more likely to earn above-average financial returns in comparison to companies in the lowest quartile. Furthermore, companies with the highest levels of URM diversity across these teams were 33% more likely to generate above-average financial returns.

Given the potential benefits of a more diverse construction workforce and the importance of a bachelor's degree for entering the profession, construction education programs (e.g., construction management, construction engineering, etc.) at colleges and universities are strategically situated to drive a diversity shift within the industry; thus providing a value-proposition to students and forward-thinking and profit-driven construction organizations. Additionally, for construction education programs at public and land grant universities, which are often tasked with providing an opportunity for all students, including URMs and other historically marginalized groups, diversity efforts can strategically align with the mission and goals of the university and department (*CHHS Strategic Plan 2021; Construction Management Department Strategic Plan 2015- 2020* 2016). Even so, construction education programs around the world lack diversity in relation to the populations they are intended to serve (Elliott, Burgoon, & Weisshaar, 2019; Escamilla, Ostadalimakhmalbaf, Pariafsai, Gragera, & Alizadeh, 2018; Oo, Li, & Zhang, 2018). In part, it can be posited that a deterrent to diversity efforts in CM higher education stems from the well documented "opportunity gap," which underserves numerous non-majority student groups in the U.S. education system.

Prevalent at the earliest stages of formal education, the term "opportunity gap" describes a myriad of historic and modern socio, political, and economic systems that afford particular groups (e.g., Whites, males, etc.) more significant and relevant educational opportunities and

experiences than URMs and other historically marginalized populations which can result in education disparities between groups (Carter & Welner, 2013; Ladson-Billings, 2006). Given the existence of opportunity gaps within higher education, the strategic mission of public and land grant universities, and the benefits of a more diverse CM workforce, a logical first step in better understanding the historic lack of diversity in CM education is to methodically identify historic and current trends, patterns, and opportunity gaps in relation to enrollment and academic success. Thus, providing a benchmark for how well CM departments are supporting traditionally underserved students, and as a means of identifying and dismantling the systems that create and perpetuate opportunity gaps in CM higher education (Archibeque-Engle & Gloeckner, 2016).

Background

The following section focuses on opportunity gaps in the U.S. education system. Beginning with gaps in college preparation and continuing into higher education, this review will focus on URMs, first gen, and low income students.

Teacher Quality Gaps

One of the most significant variables in a student's academic success and preparation for higher education is receiving instruction from a high-quality teacher; yet, low-income, URMs, and English language learners in the U.S. K-12 system are more likely to have novice and underprepared teachers than their high-income, majority peers (Chetty, Friedman, & Rockoff, 2014; Goldhaber, Lavery, & Theobald, 2015; Peske & Haycock, 2006). For example, Peske and Haycock (2006) reported that children in high poverty or high URM schools in Wisconsin, U.S. are almost twice as likely to be assigned a novice teacher and substantially more likely to be taught by out-of-field teachers than students at high income and low URM schools. Furthermore, in Illinois, U.S., there is an inverse correlation between URM and low-income schools and

teacher quality (Peske & Haycock, 2006). Similar results have been found in North Carolina where 7th grade Black students were more likely to be taught math (12.8%) and English (10.6%) by novice teachers than White students (8.3% and 7.7%, respectively) (Clotfelter, Ladd, & Vigdor, 2005).

Academic Achievement Gaps

In conjunction with disparities in teacher quality, URM students are more likely to be placed in remedial courses than White students. Clotfelter et al. (2005) reported that race differences were statistically significant ($p < .05$) for 7th-grade math and English courses and that Black students were almost twice as likely to be placed in remedial courses and less than half as likely to be placed in advanced courses as White students. Similar trends are seen among Latinx students who are more likely to be placed on a vocational (non-college) track in high school and less likely to be enrolled in advanced placement math and science courses (Hill & Torres, 2010; Klopfenstein, 2004); a trend which has been correlated with lower college graduation rates (Dougherty, Mellor, & Jian, 2006).

Social Capital Gaps

As defined by Stanton-Salazar (2004, p. 18), social capital is the “‘connections’ to individuals and networks that can provide access to resources and forms of support to facilitate the accomplishment of goals.” For first gen students, which are also more likely to identify as URM and come from low income families, social capital connections to higher education may be limited (Inman & Mayes, 1999; McCarron & Inkelas, 2006). As reported by Ryan and Ream (2016), first and second generation Latinx immigrants have less robust social capital connections relating to higher education pursuits than their third-generation counterparts. Moreover, as

described by Perez and McDonough (2008), first gen Latinx students rely heavily on extended family for advice and direction in higher education pursuits.

College Participation and Selection Gap

URM and low income students are less likely to attend college or university and, for those students that do attend, they are more likely to attend less selective colleges and universities than more affluent peers (Bailey & Dynarski, 2011; Carnevale & Strohl, 2013; Krogstad & Fry, 2015). Even among high achieving low-income students, the likelihood of enrolling at a selective college or university is substantially lower than for students from high-income families (Wyner, Bridgeland, & DiIulio Jr., 2007). As of 2013, approximately 46% of Latinx students in public colleges and universities attended two-year schools, versus 30% of White students (Krogstad & Fry, 2015). Moreover, while more than 70% of Latinx students in community colleges report wanting to attend a 4-year institution, less than 20% actually attend (Crisp, Nora, & Taggart, 2009).

Gaps within Higher Education

First gen, URM, and low income students can face additional challenges, in comparison to their majority peers, while enrolled in higher education. For example, Strayhorn (2010) identified that students of color in STEM majors, like CM, faced social barriers to success including, negative perceptions of students of color, a lack of racial peers in classes, and negative interactions with same-race students in non-STEM majors. Additionally, URM students may also experience specific forms of racism and nativism in addition to less explicit comments, behaviors, and other forms of microaggressions (Archibeque-Engle, 2015; Perez & McDonough, 2008). For low income, first gen students, financial barriers may hinder their ability to fully engage in activities and programs (i.e., living on campus, extracurricular activities, etc.) that are

associated with academic success (Engle & Tinto, 2008). In conjunction, the opportunity gaps in college preparation and higher education, indicate that first gen, URMs, and low income students are all less likely to remain enrolled in college and receive a bachelor's degree in comparison to their respective counterparts (Bailey & Dynarski, 2011; Bauman & Ryan, 2016; Engle & Tinto, 2008).

Study Purpose

The purpose of this study was to systematically explore and compare historic (1990 to 2009) and current (2010 to 2017) opportunity gaps as manifest in enrollment trends and academic success outcomes in construction education. Utilizing an established CM program at a large land grant university as a case study department (CSD), this study compares the enrollment and academic outcomes of women, first gen, Pell grant eligible, and students of color to their respective counterparts. Ultimately, the goal of this study is to better understand if opportunity gaps exist in CM education and, if they do exist, how opportunity gaps are manifest among different student groups. Interpretations of study findings and areas of critical evaluation are also discussed.

Methodology

Research Questions

To address the purposes of this study, the following research questions were generated and tested:

RQ1: How does the participation rate among Latinx and minority CM students at the CSI compare to the Latinx and minority populations of the State of Colorado, U.S.A.?

RQ2: Are there significant differences in students' first year GPA, final GPA, four-year graduation rates, and six-year graduation or persistence rates between males and females, Pell and non-Pell recipients, first gen and con gen, minority and non-minority, Latinx and non-Latinx students; and, have these differences changed over time?

RQ3: How well does the combination of first year GPA, birth sex, Pell receipt, first gen, minority, Latinx, and transfer status predict four-year graduation and six-year graduation or persistence rates for the years 2010 to 2019?

Case Study Department

The CSD is nested in a college of health and human sciences at a public land grant university in Colorado, U.S.A. As such, the purposes and mission of the CSD align with the overarching purposes and missions of the college and university in which it is situated. As part of a land grant university, the CSD is the recipient of the benefits of the Morrill Act of 1862 and the Hatch Act of 1887, which allowed the U.S. federal government to donate funds and land to states. According to the National Association of State Universities and Land-Grant Colleges (2008), the original “purpose of land grant institutions derived from the desire to offer to individuals from all walks of life, but particularly those who belong to the industrial classes, preparation as it relates to the ‘professions of life’” (p. 4). In keeping with its traditional roots, today the university is committed to: 1) inclusion, opportunity, and success; 2) research that transforms our world; 3) service to society; 4) education to meet the challenges of today and tomorrow; and 5) excellence in all” as a means of fulfilling its land grant mission (“Our Land-Grant Mission,” 2018). Furthermore, the university has also stated a commitment to demonstrating “inclusiveness and diversity” and providing “opportunity and access” for the citizens of Colorado; particularly those who have been historically marginalized and excluded

from higher education ("University Mission, Values, and Guiding Principles," 2018, p. 1). As a department in a college of health and human sciences, the CSD also has a commitment to help fulfill the college's strategic objectives. Among these objectives is the imperative for departments to "use and expand efforts and resources to strategically recruit high-achieving, diverse students, faculty, and staff." (CHHS Strategic Plan, 2021, p. 6)

A formal construction education degree program, formerly known as Light Construction and Marketing, has been in existence at the university since 1946, and since 1987 the program has been referred to as Construction Management (Wagner & Grosse, 2006). Since 1985, the program has been accredited by the American Council of Construction Education (ACCE), the leading accreditation body for U.S. construction education programs (Wagner & Grosse, 2006). As of spring 2019, the CSD had 766 declared bachelor seeking students (Institutional Research Planning & Effectiveness, 2019). Beginning in 2008, the CSD established enrollment caps (n = 800) and academic pre-qualifications (e.g., cumulative GPA of 2.75/4.0) for admission into the undergraduate CM program. As such, students awaiting acceptance into the program are classified as pre-construction management (Pre-CM) (n = 218), until admitted into the program. Starting salaries for undergraduate students in May 2019 were \$65,984, with 97% of students securing plans before graduation (Department of Construction Management, 2019). In addition to an undergraduate CM degree, the CSD offers a Masters of CM degree, which requires a minimal undergraduate GPA of 3.0/4.0 for program admittance.

Data Retrieval and Delimitations

Data for this study were requested and received from the university's Department of Institutional Research, Planning, and Effectiveness (IR) department. Before requesting data, approval was requested from the university's Institutional Review Board (IRB). Given that the

data would be anonymized, with no unique student identifiers, the IRB classified the investigation as non-human subjects research.

The population for this study was delimited to all undergraduate students that self-declared CM or Pre-CM as an academic major for at least one semester while enrolled at the university. The population was delimited to enrollment between fall semester of 1990 and fall semester of 2017 (n = 3373).

Results

Participation Rates

To address RQ1, which compared differences in participation rates among Latinx and minority CM students in the CSD to the population of Colorado, Chi-Square Goodness of Fit tests were utilized. The tests compared how well the ratio of Latinx and minority students enrolled in the CSD matched the ratio Latinxs and minority in Colorado's population, as reported by the U.S. Census Bureau, during the following years: 1990, 2000, 2010, and 2015. Due to the relatively small and vacillating number of Latinx and minority students enrolled in the CSD on any given year, the decision was made to compare U.S. Census data for a specific year (e.g., 1990) to the average ratio in the CSD for that particular year and the subsequent four years (e.g., 1990 to 1994). In the case of 2015, student data were only available from 2016 through the fall semester of 2017. The racial and ethnic breakdown of the CSD enrollment for the years are 1990, 2000, 2010, and 2015 is found in Table 3.1. The results of the Chi-Square Goodness of Fit analysis for minority and Latinx students in the CSD as compared to Colorado for 1990, 2000, 2010, and 2015 are reported in Table 3.2.

Table 3.1

Race and Ethnicity Percentages

Year	White	Black	Asian/Hawaii/ Pac-Island	Latinx	Multiracial	Native American	Other*
1990	88.4	1.0	1.5	6.0	.5	.5	2.1
2000	90.0	.5	.7	4.3	1.2	.6	2.7
2010	80.9	.9	3.5	8.8	2.4	.7	5.1
2015	77.8	.5	.8	13.2	1.6	.8	5.2

*Includes international and no response

Table 3.2

Chi-Square Goodness of Fit analysis comparing observed demographics within the CM undergraduate population with the demographics of State

Group	CM Students 1990 to 1994	CM Students 2000 to 2004	CM Students 2010 to 2014	CM Students 2015 to 2017
Latinx	$\chi^2 = 15.80$	$\chi^2 = 95.31$	$\chi^2 = 40.56$	$\chi^2 = 11.09$
Minority	$\chi^2 = 22.87$	$\chi^2 = 144.85$	$\chi^2 = 56.16$	$\chi^2 = 28.73$

Minority student enrollment. In 1990, Colorado’s minority population was 19.30% as compared to the CSD’s average minority population of 9.74% (n = 38) for the years 1990 to 1994; meaning that minority participation in the CSD was 49.52% less than what would be expected if it matched the minority population of Colorado. In 2000, Colorado’s minority population was 25.50% as compared to the CSD’s average minority population of 7.39% (n = 62) for the years 2000 to 2004; meaning that minority participation in the CSD was 71.02% less than what would be expected if it matched the minority population of Colorado.

In 2010, Colorado’s minority population was 30.00% as compared to the CSD’s average minority population of 14.67% (n = 75) for the years 2010 to 2014; meaning that minority

participation in the CSD was 50.79% less than what would be expected if it matched the minority population of Colorado. In 2015, Colorado's minority population was 30.90% as compared to the CSD's average minority population of 17.83% (n = 64) for the years 2015 to 2017; meaning that minority participation in the CSD was 30.90% less than what would be expected if it matched the minority population of Colorado.

Latinx student enrollment. In 1990, Colorado's Latinx population was 12.90% as compared to the CSD's average Latinx population of 6.15% (n = 24) for the years 1990 to 1994; meaning that Latinx participation in the CSD was 52.30% less than what would be expected if it matched the Latinx population of Colorado. In 2000, Colorado's Latinx population was 17.10% as compared to the CSD's average Latinx population of 4.41% (n = 37) for the years 2000 to 2004; meaning that Latinx participation in the CSD was 74.21% less than what would be expected if it matched the Latinx population of Colorado.

In 2010, Colorado's Latinx population was 20.70% as compared to the CSD's average Latinx population of 9.25% (n = 47) for the years 2010 to 2014; meaning that Latinx participation in the CSD was 55.30% less than what would be expected if it matched the Latinx population of Colorado. In 2015, Colorado's Latinx population was 21.10% as compared to the CSD's average Latinx population of 13.93% (n = 50) for the years 2015 to 2017; meaning that Latinx participation in the CSD was 33.99% less than what would be expected if it matched the Latinx population of Colorado.

Academic Success

To address RQ2, which identified significant differences in academic success outcomes, Pearson Chi-Square tests were utilized to identify disparities in four-year and six-year graduation or persistence rates; and, independent sample t-tests were utilized to identify disparities in first

year cumulative GPA and final cumulative GPA. For both the Pearson Chi-Square and independent sample t-tests, assumptions were checked and met. Significance thresholds for this study were set at the .05 level, and effect sizes were utilized to compare the magnitude of changes over time. First year cumulative GPA results include students that completed at least one semester of course work. Final cumulative GPA results include students who graduated by their sixth spring semester or continued enrollment during their sixth spring semester. Four-year graduation rates include students who graduated by their fourth spring semester. Six-year graduation/persistence rates include students who graduated by their sixth spring semester or continued enrollment during their sixth spring semester.

Male and female students. As presented in Table 3.3 and Table 3.4, chi-square test results indicate no significant differences in four year graduation rates for males and females for the years 1990 to 2009 ($\chi^2 = .433$, $df = 1$, $N = 2859$, $p = .534$) or for the years 2010 to 2017 ($\chi^2 = .408$, $df = 1$, $N = 447$, $p = .532$). That is, male students were no more likely than female students to graduate in four years.

Table 3.3

Chi-Square Analysis of Four-year Graduation Counts for Females and Males (1990 to 2009)

Variable	<i>n</i>	Classification		χ^2	<i>p</i>
		Female	Male		
Graduated				.433	.534
Yes	1011	84	927		
No	1848	167	1681		
Totals	2859	251	2608		

Table 3.4

Chi-Square Analysis of Four-year Graduation Counts for Females and Males (2010 to 2017)

Variable	<i>n</i>	Classification		χ^2	<i>p</i>
		Female	Male		
Graduated				.408	.532
Yes	169	9	160		
No	278	19	259		
Totals	447	28	419		

As presented in Table 3.5 and Table 3.6, chi-square test results indicate no significant differences in six year graduation rates for males and females for the years 1990 to 2009 ($\chi^2 = .098$, $df = 1$, $N = 2859$, $p = .755$) or for the years 2010 to 2017 ($\chi^2 = .056$, $df = 1$, $N = 391$, $p = .813$). That is, for both 1990 to 2009 and 2010 to 2017, male students were no more likely than female students to graduate in six years. Four and six year graduation rates for male and female students are presented in Figure 3.1.

Table 3.5

Chi-Square Analysis of Six-year Graduation Counts for Females and Males (1990 to 2009)

Variable	<i>n</i>	Classification		χ^2	<i>p</i>
		Female	Male		
Graduated				.098	.755
Yes	2337	207	2130		
No	522	44	478		
Totals	2859	251	2608		

Table 3.6

Chi-Square Analysis of Six-year Graduation Counts for Females and Males (2010 to 2017)

Variable	n	Classification		χ^2	p
		Female	Male		
Graduated				.056	.813
Yes	367	22	331		
No	38	2	36		
Totals	391	24	367		

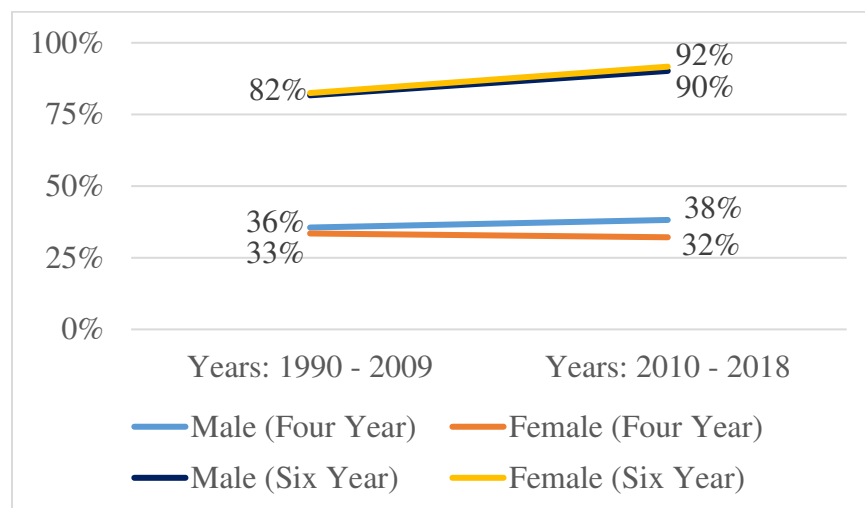


Figure 3.1. Four and six-year graduation rates for males and females.

Table 3.7 presents the results of the t-tests evaluating first year cumulative GPA for the years 1990 to 2009 and the years 2010 to 2017. For 1990 to 2009, results indicate that the mean first year cumulative GPA for male students ($M = 2.68$) was significantly lower ($p < .001$) than for female students ($M = 2.89$). The mean difference of .21 has an effect size d of .33, which is considered small. For 2010 to 2017, results indicate the mean first year cumulative GPA for male

students ($M = 2.86$) was not significantly different ($p = .234$) from female students ($M = 2.98$). The mean difference of .12 has an effect size d of .17.

Table 3.7

Comparison of Female and Male Student's First year GPA for 1990 to 2009 (n = 241 Females and 2499 Males) and 2010 to 2017 (n = 46 Females and 691 Males)

Variable	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
First Year GPA (1990 to 2009)			-4.868	2738	.001	.33
Male	2.68	.631				
Female	2.89	.643				
First Year GPA (2010 to 2017)			-1.191	735	.234	.17
Male	2.86	.660				
Female	2.98	.717				

Table 3.8 presents the results of the t-tests evaluating final cumulative GPA for the years 1990 to 2009 and the years 2010 to 2017. For 1990 to 2009, results indicate the mean final cumulative GPA for male students ($M = 2.95$) was significantly lower ($p < .001$) than for female students ($M = 3.09$). The mean difference of .14 has an effect size d of .31, which is considered small. For 2010 to 2017, results indicate the mean final cumulative GPA for male students ($M = 3.12$) was significantly lower ($p = .049$) than for female students ($M = 3.29$). The mean difference of .17 has an effect size d of .38, which is considered small.

Table 3.8

Comparison of Female and Male Student's Final GPA for 1990 to 2009 (n = 207 Females and 2128 Males) and 2010 to 2017 (n = 22 Females and 331 Males)

<i>Variable</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
Final GPA (1990 to 2009)			-4.315	2333	.000	.31
Male	2.95	.463				
Female	3.09	.446				
Final GPA (2010 to 2017)			-1.978	351	.049	.38
Male	3.12	.386				
Female	3.29	.520				

From a practical standpoint, if current first year cumulative GPA trends hold, 63.0% of female and 62.5% of male students would meet the GPA eligibility requirement for CSD undergraduate program admission by the end of their first year. Furthermore, if current final cumulative GPA trends hold, 68.2% of female and 61.6% of male students would meet the GPA eligibility requirement for graduate school admission at the CSD.

Non-Pell and Pell eligible students. As presented in Table 3.9 and Table 3.10, chi-square test results indicate no significant differences in four year graduation rates for non-Pell and Pell eligible students for the years 1990 to 2009 ($\chi^2 = .084$, $df = 1$, $N = 2859$, $p = .772$) or for the years 2010 to 2017 ($\chi^2 = 1.712$, $df = 1$, $N = 447$, $p = .191$). That is, for both 1990 to 2009 and

2010 to 2017, non-Pell eligible students were no more likely than Pell eligible students to graduate in four years.

Table 3.9

Chi-Square Analysis of Four-year Graduation Counts for Pell and Non-Pell Eligible Students (1990 to 2009)

Variable	<i>n</i>	Classification		χ^2	<i>p</i>
		Non – Pell	Pell		
Graduated				.084	.772
Yes	1011	923	88		
No	1848	1693	155		
Totals	2859	2616	243		

Table 3.10

Chi-Square Analysis of Four-year Graduation Counts for Pell and Non-Pell Eligible Students (2010 to 2017)

Variable	<i>n</i>	Classification		χ^2	<i>p</i>
		Non – Pell	Pell		
Graduated				1.712	.191
Yes	169	126	43		
No	278	222	56		
Totals	447	348	99		

As presented in Table 3.11, chi-square test results indicate a significant difference in six year graduation rates for non-Pell and Pell eligible students for the years 1990 to 2009 ($\chi^2 = 4.078$, $df = 1$, $N = 2859$, $p = .043$). That is, non-Pell eligible students were more likely than Pell eligible students to graduate in six years. Phi for this difference is $-.038$.

Table 3.11

Chi-Square Analysis of Six-year Graduation Counts for Pell and Non-Pell Eligible Students (1990 to 2009)

Variable	<i>n</i>	Classification		χ^2	<i>p</i>
		Non – Pell	Pell		
Graduated				4.078	.043
Yes	2337	2150	187		
No	522	466	56		
Totals	2859	2616	243		

As presented in Table 3.12, chi-square test results indicate no significant difference ($\chi^2 = .583$, $df = 1$, $N = 391$, $p = .445$) in six-year graduation rates for non-Pell and Pell eligible students for the years 2010 to 2017. That is, non-Pell eligible students were no more likely than Pell eligible students to graduate in four years. Four and six-year graduation rates for non-Pell and Pell eligible students are presented in Figure 3.2.

Table 3.12

Chi-Square Analysis of Six-year Graduation Counts for Pell and Non-Pell Eligible Students (2010 to 2017)

Variable	n	Classification		χ^2	p
		Non – Pell	Pell		
Graduated				.583	.445
Yes	353	279	74		
No	38	28	10		
Totals	391	307	84		

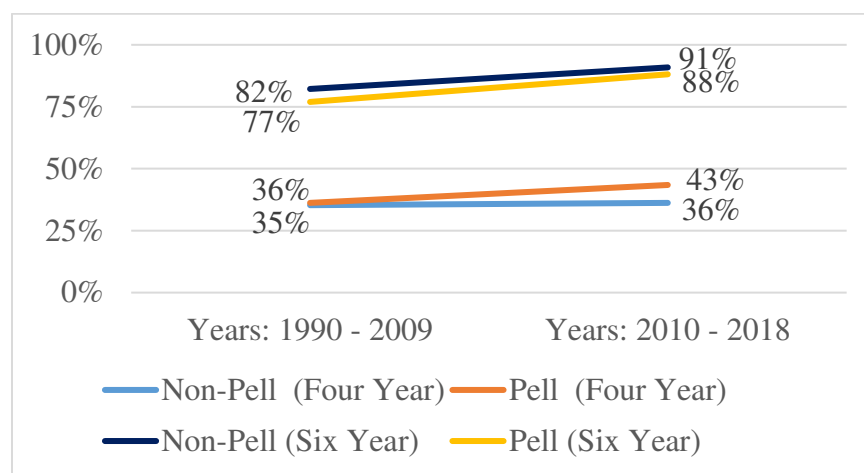


Figure 3.2. Four and six-year graduation rates for Pell and non-Pell.

Table 3.13 presents the results of the t-tests evaluating first year cumulative GPA for the years 1990 to 2009 and the years 2010 to 2017. For 1990 to 2009, results indicate the mean first year cumulative GPA for non-Pell eligible students ($M = 2.70$) was not significantly different ($p = .537$) from Pell eligible students ($M = 2.72$). The mean difference of .02 has an effect size d of .04. For 2010 to 2017, results indicate the mean first year cumulative GPA for non-Pell eligible students ($M = 2.87$) was not significantly different ($p = .650$) from Pell eligible students ($M = 2.84$). The mean difference of .03 has an effect size d of .04.

Table 3.13

Comparison of Pell and Non-Pell Eligible Student's First-year GPA for 1990 to 2009 (n = 2504 Non-Pell and 236 Pell Eligible) and 2010 to 2017 (n = 571 Non-Pell and 166 Pell Eligible)

<i>Variable</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
First Year GPA (1990 to 2009)			-.617	2738	.537	0.04
Non-Pell	2.70	.643				
Pell	2.72	.664				
First Year GPA (2010 to 2017)			.454	735	.650	0.04
Non-Pell	2.87	.650				
Pell	2.84	.709				

Table 3.14 presents the results of the t-tests evaluating final cumulative GPA for the years 1990 to 2009 and the years 2010 to 2017. For 1990 to 2009, results indicate the mean final cumulative GPA for non-Pell eligible students (M = 2.96) was not significantly different (p = .357) than for Pell eligible students (M = 2.99). The mean difference of .03 has an effect size d of .07. For 2010 to 2017, results indicate the mean final cumulative GPA for non-Pell eligible students (M = 3.12) was not significantly different (p = .553) than for Pell eligible students (M = 2.99). The mean difference of .03 has an effect size d of .08.

Table 3.14

Comparison of Pell and Non-Pell Eligible Student's Final GPA for 1990 to 2009 (n = Non-Pell and Pell Eligible) and 2010 to 2017 (n = 279 Non-Pell and 74 Pell Eligible)

<i>Variable</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
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Final GPA (1990 to 2009)						
Non-Pell	2.96	.449				
Pell	2.99	.443				
Final GPA (2010 to 2017)						
Non-Pell	3.12	.396				
Pell	3.15	.399				

From a practical standpoint, if current first year cumulative GPA trends hold, 62.5% of Non-Pell and 62.7% of Pell eligible students would meet the GPA eligibility requirement for CSD undergraduate program admission by the end of their first year. Furthermore, if current final cumulative GPA trends hold, 61.6% of Non-Pell and 63.5% of Pell eligible students would meet the GPA eligibility requirement for graduate school admission at the CSD.

Con gen and first gen students. As presented in table 3.15, chi-square test results indicate a significant difference in four year graduation rates for con gen and first gen students for the years 1990 to 2009 ($\chi^2 = 4.500$, $df = 1$, $N = 2859$, $p = .034$). That is, first gen students were more likely than con gen students to graduate in four years. Phi for this difference is .040.

Table 3.15

Chi-Square Analysis of Four-year Graduation Counts for First Gen and Con Gen (1990 to 2009)

Variable	<i>n</i>	Classification		χ^2	<i>p</i>
		Con Gen	First Gen		
Graduated				4.500	.034
Yes	1011	686	325		

No	1848	1324	524
Totals	2859	2010	849

As presented in Table 3.16, chi-square test results indicate no significant difference in four year graduation rates for con gen and first gen students for the years 2010 to 2017 ($\chi^2 = .293$, $df = 1$, $N = 447$, $p = .588$). That is, con gen students were no more likely than first gen students to graduate in four years.

Table 3.16

Chi-Square Analysis of Four-year Graduation Counts for First Gen and Con Gen (2010 to 2017)

Variable	n	Classification		χ^2	p
		Con Gen	First Gen		
Graduated				.293	.588
Yes	169	122	47		
No	278	194	84		
Totals	447	316	131		

As presented in Table 3.17 and Table 3.18, results indicate no significant differences in six year graduation rates for con gen and first gen students for the years 1990 to 2009 ($\chi^2 = 1.120$, $df = 1$, $N = 2859$, $p = .290$) or for the years 2010 to 2017 ($\chi^2 = 1.831$, $df = 1$, $N = 391$, $p = .176$). That is, for both 1990 to 2009 and 2010 to 2017, con gen students were no more likely than first gen students to graduate in four years. Four and six year graduation rates for con gen and first gen students are presented in Figure 3.3.

Table 3.17

Chi-Square Analysis of Six-year Graduation Counts for First Gen and Con Gen (1990 to 2009)

Variable	<i>n</i>	Classification		χ^2	<i>p</i>
		Con Gen	First Gen		
Graduated				1.120	.290
Yes	2337	1653	684		
No	522	357	165		
Totals	2859	2010	849		

Table 3.18

Chi-Square Analysis of Six-year Graduation Counts for First Gen and Con Gen (2010 to 2017)

Variable	<i>n</i>	Classification		χ^2	<i>p</i>
		Con Gen	First Gen		
Graduated				1.831	.176
Yes	353	251	102		
No	38	23	15		
Totals	391	274	117		

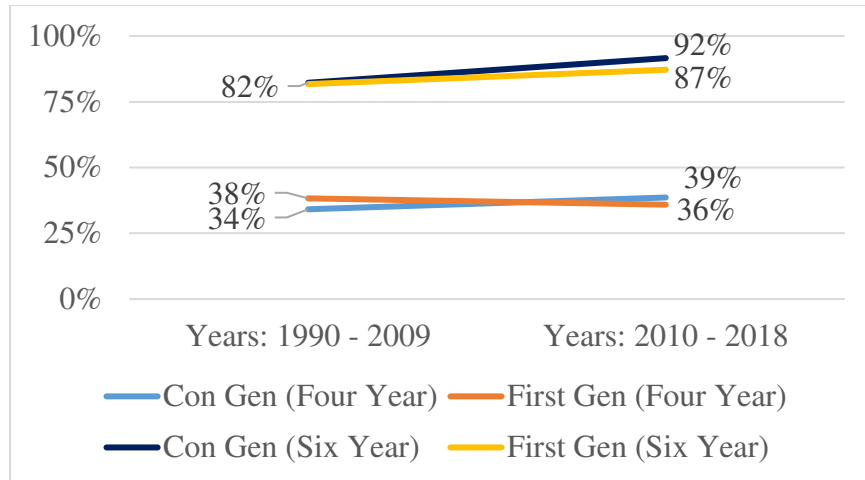


Figure 3.3. Four and six-year graduation rates for first gen and con gen.

Table 3.19 presents the results of the t-tests evaluating first year cumulative GPA for the years 1990 to 2009 and the years 2010 to 2017. For 1990 to 2009, results indicate the mean first year cumulative GPA for con gen students ($M = 2.71$) was not significantly different ($p = .212$) than for first gen students ($M = 2.67$). The mean difference of .04 has an effect size d of .05. For 2010 to 2017, results indicate the mean first year cumulative GPA for con gen students ($M = 2.87$) was not significantly different ($p = .954$) than for first gen students ($M = 2.87$).

Table 3.19

Comparison of Con Gen and First Gen Student's First year GPA for 1990 to 2009 ($n = 1921$ Con Gen and 819 First Gen) and 2010 to 2017 ($n = 543$ Con Gen and 194 First Gen)

Variable	M	SD	t	df	p	d
First Year GPA (1990 to 2009)			1.248	2738	.212	0.05
Non-Pell	2.71	.642				
Pell	2.67	.651				
First Year GPA (2010 to 2017)			-.057	735	.954	0.00

Non-Pell	2.87	.668
Pell	2.87	.652

Table 3.20 presents the results of the t-tests evaluating final cumulative GPA for the years 1990 to 2009 and the years 2010 to 2017. For 1990 to 2009, results indicate the mean final cumulative GPA for con gen students ($M = 2.96$) was significantly higher ($p = .647$) than for first gen students ($M = 2.95$). The mean difference of .01 has an effect size d of .02. For 2010 to 2017, results indicate the mean final cumulative GPA for con gen students ($M = 3.15$) was not significantly different ($p = .105$) than for first gen students ($M = 3.07$). However, the mean difference of .08 has an increased effect size d of .19; just below the threshold of “small” as defined by Cohen.

Table 3.20

Comparison of Con Gen and First Gen Student’s Final GPA for 1990 to 2009 ($n = 1662$ Con Gen and 673 First Gen) and 2010 to 2017 ($n = 251$ Con Gen and 102 First Gen)

<i>Variable</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
Final GPA (1990 to 2009)			.458	2333	.647	.02
Con Gen	2.96	.445				
First Gen	2.95	.458				
Final GPA (2010 to 2017)			1.623	351	.105	.19
Con Gen	3.15	.397				
First Gen	3.07	.934				

From a practical standpoint, if current first year cumulative GPA trends hold, 62.6% of con gen and 62.4% of first gen students would meet the GPA eligibility requirement for CSD

undergraduate program admission by the end of their first year. Furthermore, if current final cumulative GPA trends hold, 63.3% of con gen and 58.8% of first gen students would meet the GPA eligibility requirement for graduate school admission at the CSD.

Non-Latinx and Latinx students. As presented in table 3.21, chi-square test results indicate no significant difference in four year graduation rates for non-Latinx and Latinx students for the years 1990 to 2009 ($\chi^2 = 2.283$, $df = 1$, $N = 2777$, $p = .131$). That is, non-Latinx students were no more likely than Latinx students to graduate in four years.

Table 3.21

Chi-Square Analysis of Four-year Graduation Counts for Non-Latinx and Latinx (1990 to 2009)

Variable	n	Classification		χ^2	p
		Non – Latinx	Latinx		
Graduated				2.283	.131
Yes	973	930	43		
No	1804	1700	104		
Totals	2777	2630	147		

As presented in Table 3.22, chi-square test results indicate a significant difference in four year graduation rates for non-Latinx and Latinx students for the years 2010 to 2017 ($\chi^2 = 5.925$, $df = 1$, $N = 447$, $p = .015$). That is, non-Latinx students were more likely than Latinx students to graduate in four years. Phi for this difference is -.12, which is considered small.

Table 3.22

Chi-Square Analysis of Four-year Graduation Counts for Non-Latinx and Latinx (2010 to 2017)

Variable	<i>n</i>	Classification		χ^2	<i>p</i>
		Non – Latinx	Latinx		
Graduated				5.925	.015
Yes	169	161	8		
No	278	246	32		
Totals	447	407	40		

As presented in Table 3.23, chi-square test results indicate a significant difference in six year graduation rates for non-Latinx and Latinx students for the years 1990 to 2009 ($\chi^2 = 9.480$, $df = 1$, $N = 2777$, $p = .002$). That is, non-Latinx students were more likely than Latinx students to graduate in six years. Phi for this difference is -.06.

Table 3.23

Chi-Square Analysis of Six-year Graduation Counts for Non-Latinx and Latinx (1990 to 2009)

Variable	<i>n</i>	Classification		χ^2	<i>p</i>
		Non – Latinx	Latinx		
Graduated				9.480	.002
Yes	2268	2162	106		
No	509	468	41		
Totals	2777	2630	147		

As presented in Table 3.24 chi-square test results indicate a significant difference in six year graduation rates for non-Latinx and Latinx students for the years 2010 to 2017 ($\chi^2 = .914$, $df = 1$, $N = 391$, $p = .339$), which indicated no significant differences. That is, non-Latinx students were no more likely than Latinx students to graduate in six years. Four and six-year graduation rates for non-Latinx and Latinx students are presented in Figure 3.4.

Table 3.24

Chi-Square Analysis of Six-year Graduation Counts for Non-Latinx and Latinx (2010 to 2017)

Variable	n	Classification		χ^2	p
		Non – Latinx	Latinx		
Graduated				.914	.339
Yes	353	323	30		
No	38	33	5		
Totals	391	356	35		

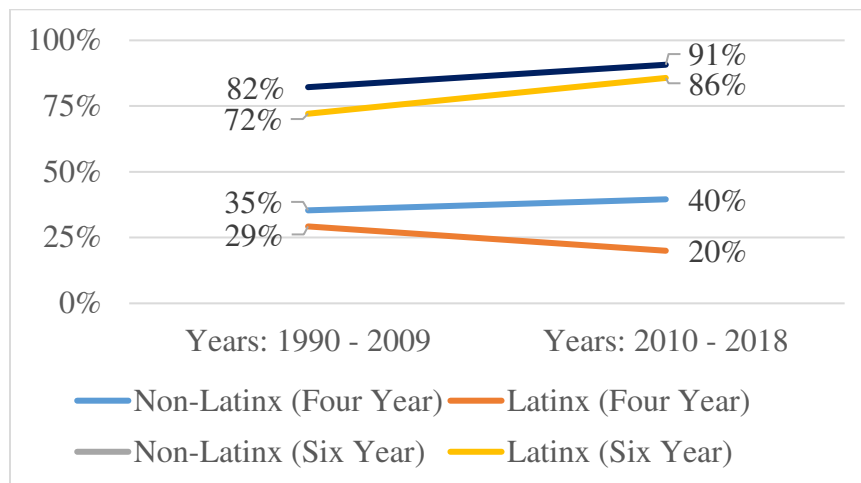


Figure 3.4. Four and six-year graduation rates for Latinx and non-Latinx.

Table 3.25 presents the results of the t-tests evaluating first year cumulative GPA for the years 1990 to 2009 and the years 2010 to 2017. For 1990 to 2009, results indicate the mean first year cumulative GPA for non-Latinx students ($M = 2.70$) was significantly higher ($p = .010$) than for Latinx students ($M = 2.56$). The mean difference of .14 has an effect size d of .23, which is considered small. For 2010 to 2017, results indicate the mean first year cumulative GPA for non-Latinx students ($M = 2.88$) was not significantly different ($p = .218$) than for Latinx students ($M = 2.78$). The mean difference of .14 has an effect size d of .16.

Table 3.25

Comparison of Latinx and Non-Latinx Student's First year GPA for 1990 to 2009 ($n = 2518$ Non-Latinx and 143 Latinx) and 2010 to 2017 ($n = 663$ Non-Latinx and 74 Latinx)

<i>Variable</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>P</i>	<i>d</i>
First Year GPA (1990 to 2009)			2.58	2659	.010	.23
Non-Latinx	2.70	.646				
Latinx	2.56	.620				
First Year GPA (2010 - 2017)			1.23	735	.218	.16
Non-Latinx	2.88	.670				
Latinx	2.78	.601				

Table 3.26 presents the results of the t-tests evaluating final cumulative GPA for the years 1990 to 2009 and the years 2010 to 2017. For 1990 to 2009, results indicate the mean final cumulative GPA for non-Latinx students ($M = 2.96$) was significantly higher ($p = .050$) than for Latinx students ($M = 2.87$). The mean difference of .09 has an effect size d of .20, which is considered small. For 2010 to 2017, results indicate the mean final cumulative GPA for non-

Latinx students ($M = 3.14$) was significantly higher ($p = .007$) than for Latinx students ($M = 2.94$). The mean difference of .20 has an effect size d of .56, which is considered medium.

Table 3.26

Comparison of Latinx and Non-Latinx Student's Final GPA for 1990 to 2009 ($n = 2164$ Non-Latinx and 104 Latinx) and 2010 to 2017 ($n = 323$ Non-Latinx and 74 Latinx)

<i>Variable</i>	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>P</i>	<i>d</i>
Final GPA (1990 to 2009)			1.96	2266	.050	.20
Non-Latinx	2.96	.448				
Latinx	2.87	.425				
Final GPA (2010 to 2017)			2.70	351	.007	.56
Non-Latinx	3.14	.399				
Latinx	2.94	.327				

From a practical standpoint, if current first year GPA trends hold, 63.3% of non-Latinx and 55.4% of Latinx students would be eligible for CM program admission by the end of their first year. Furthermore, if current final GPA trends hold, 63.5% of non-Latinx and 46.7% of Latinx students would be eligible for graduate school admission.

Majority and minority students. As presented in table 3.27, chi-square test results indicate a significant difference in four year graduation rates for majority and minority students for the years 1990 to 2009 ($\chi^2 = 6.44$, $df = 1$, $N = 2859$, $p = .011$). That is, majority students were more likely than minority students to graduate in four years. Phi for this difference is -.047.

Table 3.27

Chi-Square Analysis of Four-year Graduation Counts for Majority and Minority (1990 to 2009)

Variable	<i>n</i>	Classification		χ^2	<i>p</i>
		Majority	Minority		
Graduated				6.44	.011
Yes	1011	939	72		
No	1848	1664	184		
Totals	2859	2603	256		

As presented in table 3.28, chi-square test results indicate a significant difference in four year graduation rates for majority and minority students for the years 2010 to 2017 ($\chi^2 = 6.63$, $df = 1$, $N = 447$, $p = .010$). That is, majority students were more likely than minority students to graduate in four years. Phi for this difference is $-.12$, which is considered small.

Table 3.28

Chi-Square Analysis of Four-year Graduation Counts for Majority and Minority (2010 to 2017)

Variable	<i>n</i>	Classification		χ^2	<i>p</i>
		Majority	Minority		
Graduated				6.63	.010
Yes	169	155	14		
No	278	231	47		
Totals	447	386	61		

As presented in Table 3.29, chi-square test results indicate a significant difference in six year graduation rates for majority and minority students for the years 1990 to 2009 ($\chi^2 = 8.56$, $df = 1$, $N = 2859$, $p = .003$). That is, majority students were more likely than minority students to graduate in six years. Phi for this difference is $-.06$.

Table 3.29

Chi-Square Analysis of Six-year Graduation Counts for Non-Minority and Minority (1990 to 2009)

Variable	<i>n</i>	Classification		χ^2	<i>p</i>
		Majority	Minority		
Graduated				8.56	.003
Yes	2337	2145	192		
No	522	458	64		
Totals	2859	2603	256		

As presented in Table 3.30, chi-square test results indicate no significant difference in six year graduation rates for majority and minority students for the years 2010 to 2017 ($\chi^2 < .000$, $df = 1$, $N = 391$, $p = .982$). Given that the counts were nearly identical, majority students were no more likely than minority students to graduate in six years. Four and six-year graduation rates for majority and minority students are presented in figure 3.5.

Table 3.30

Chi-Square Analysis of Six-year Graduation Counts for Non-Minority and Minority (2010 to 2017)

Variable	<i>n</i>	Classification		χ^2	<i>p</i>
		Majority	Minority		

Graduated			.000	.982
Yes	353	307	46	
No	38	33	5	
Totals	391	340	51	

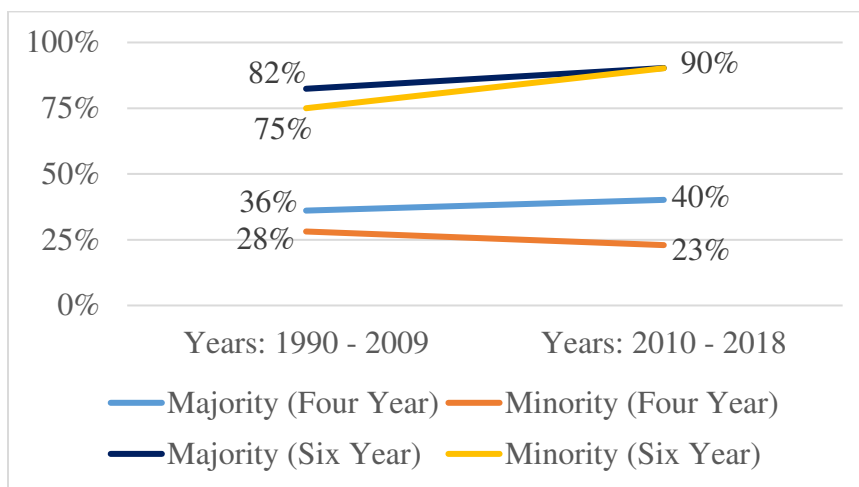


Figure 3.5. Four and six-year graduation rates for minority and non-minority.

Table 3.31 presents the results of the t-tests evaluating first year cumulative GPA for the years 1990 to 2009 and the years 2010 to 2017. For 1990 to 2009, results indicate that first year cumulative GPA for majority students ($M = 2.71$) was significantly higher ($p = .020$) than for minority students ($M = 2.61$). The mean difference of .10 has an effect size d of .16. For 2010 to 2017, results indicate the mean first year cumulative GPA for majority students ($M = 2.88$) was not significantly different ($p = .155$) than for minority students ($M = 2.78$). The mean difference of .10 has an effect size d of .15.

Table 3.31

Comparison of Minority and Majority Student's First year GPA for 1990 to 2009 (n = 2495

Majority and 245 Minority) and 2010 to 2017 (n = 630 Majority and 107 Minority)

Variable	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
First Year GPA (1990 to 2009)			2.33	2738	.020	.16
Majority	2.71	.644				
Minority	2.61	.642				
First Year GPA (2010 to 2017)			1.42	735	.155	.15
Majority	2.88	.668				
Minority	2.78	.631				

Table 3.32 presents the results of the t-tests evaluating final cumulative GPA for the years 1990 to 2009 and the years 2010 to 2017. For 1990 to 2009, results indicate the mean final cumulative GPA for majority students ($M = 2.97$) was significantly higher ($p = .019$) than for minority students ($M = 2.89$). The mean difference of .09 has an effect size d of .18. For 2010 to 2017, results indicate the mean final GPA for majority students ($M = 3.15$) was significantly higher ($p = .002$) than for minority students ($M = 2.96$). The mean difference of .18 has an effect size d of .51, which is considered medium.

Table 3.32

Comparison of Minority and Majority Student's Final GPA for 1990 to 2009 (n = 2145

Majority and 190 Minority) and 2010 to 2017 (n = 307 Majority and 46 Minority)

Variable	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>d</i>
Final GPA (1990 to 2009)			2.35	2333	.019	.18

Majority	2.97	.448			
Minority	2.89	.449			
Final GPA (2010 to 2017)			3.06	351	.002 .51
Majority	3.15	.400			
Minority	2.96	.338			

From a practical standpoint, if current first year cumulative GPA trends hold, 63.5% of majority and 57.0% of minority students would be eligible for CM program admission by the end of their first year. Furthermore, if current final cumulative GPA trends hold, 64.2% of majority and 47.8% of minority students would be eligible for graduate school admission.

Predictive Model

To address RQ3, which utilized demographic variables to predict graduation, four stepwise logistic regression models were created to predict four-year graduation and six-year graduation or persistence rates. The first two models included minority status, birth sex, Pell eligibility, and first gen status as predictor variables for four and six-year graduation rates. The second model substituted Latinx for minority status with all other variables remaining the same. Confidence intervals for all models were set to 95%.

Graduation models. As indicated in Table 3.33, a model including Latinx and Pell status predicted whether or not a student graduated in four-years, $\chi^2 = 11.16$, $df = 2$ $N = 447$, $p = .004$. The Nagelkerke R^2 (.036) indicated the model predicted approximately 3.6% of the variance in whether or not students graduated in four years.

Table 3.33

Regression Model for Four-Year Graduation (Latinxs)

Variables Included	<i>B (SE)</i>	95% CI for Odds Ratio		
		Lower	Odds Ratio	Upper
Constant	-0.525 (.11)			
Pell	0.538* (.25)	1.05	1.71	2.78
Latinx	-1.218* (.43)	0.13	0.30	0.69

Note: $R^2 = .025$ (Cox & Snell), $.034$ (Nagelkerke). Model $\chi^2 (2) = 11.16$, $n = 447$ $p = .004$. * $p < .05$; Excluded Variables: First Gen, Birth Sex

As indicated in Table 3.34, a model including minority and Pell status predicted whether or not a student graduated in four-years, $\chi^2 (2) = 12.29$, $df = 2$, $n = 447$ $p = .002$. The Nagelkerke $R^2 (.037)$ indicated the model predicted approximately 3.7% of the variance in whether or not students graduated in four years. For six-year graduation or persistence rates, the variables of birth sex, Pell status, first gen, and Latinx or minority, were not significant factors in the model.

Table 3.34

Regression Model for Four-Year Graduation (Minority)

Variables Included	<i>B (SE)</i>	95% CI for Odds Ratio		
		Lower	Odds Ratio	Upper
Constant	-0.499 (.11)			
Pell	0.574* (.25)	1.08	1.78	2.91
Minority	-1.054* (.34)	0.18	0.35	0.68

Note: $R^2 = .027$ (Cox & Snell), $.037$ (Nagelkerke). Model $\chi^2 (2) = 12.29$, $n = 447$ $p = .002$. * $p < .05$; Excluded Variables: First Gen, Birth Sex

Discussion

The purpose of this study was to systematically explore and compare historic (1990 to 2009) and current (2010 to 2017) opportunity gaps with the ultimate goal of understanding how these gaps are manifest among different students. The results indicated that despite improvements in six-year graduation rates, opportunity gaps are most prevalent for Latinxs and other URM students in enrollment, cumulative final year GPA's, and four-year graduation rates.

In the first section of analysis, the population of Latinx and minority students enrolled in the CSD was compared to the population of Latinxs and minorities in Colorado. Results indicate that statistically significant (yet shrinking) historic and current opportunity gaps in enrollment exist for Latinx and URM when compared to the population of Colorado. Similar findings of an underrepresented, yet growing population, of Latinx and URM students, have also been observed at a large land grant, construction education program in Texas, U.S.A. suggesting that the observed trends from this study may not be isolated to the CSD (Escamilla et al., 2018).

In the second section of analysis, opportunity gaps in GPA and graduation rates were evaluated and compared. On a positive note, results indicated that six-year graduation rates for all student groups have increased since 1990 to 2009 levels and that the magnitude of graduation disparities for numerous groups have been reduced or remained relatively static over time. In conjunction with near 100% employment rates among CM graduates, six-year graduation results indicate that the proportion of full-time employment in a CM related profession is relatively high for all students who enroll in the CM program.

Despite gains in six-year graduation rates, results suggest numerous statistically significant and practical opportunity gaps exist for traditionally underserved student populations. Of particular note, academic success outcomes suggest that Latinx and other URM students are

significantly underserved in comparison to their peers. These results align with previous research focused on URM students (Archibeque-Engle & Gloeckner, 2016; Bonner & Bailey, 2006).

Additionally, the magnitude of opportunity gaps, as it relates to four-year graduation rates and final cumulative GPA, has increased substantially from 1990 to 2009 levels.

In the final section of analysis, stepwise logistic regression models were created to predict four and six-year graduation rates based on demographic variables. In predicting four-year graduation rates, Latinx and minority status were the only statistically significant variables that were negatively correlated with graduation rates. For six-year graduation rates, demographic variables provided no statistically significant strength to the model. This is likely due to the high levels of graduation (86% to 92%) for all student groups.

In combination, results across the three sections of this study indicate that the CSD is not successfully accomplishing: 1) its historic land grant mission “to offer to individuals from all walks of life, but particularly those who belong to the industrial classes, preparation as it relates to the ‘professions of life’” (National Association of State Universities and Land-Grant Colleges, 2008, p. 4); 2) its university-specific mission to provide opportunity and access for the citizens of Colorado and especially those who have been historically marginalized and excluded from higher education (“University Mission, Values, and Guiding Principles,” 2018); or 3) its college-specific objective to “use and expand efforts and resources to strategically recruit high-achieving, diverse students, faculty, and staff” (CHHS Strategic Plan 2021 p. 6). Based on these results, the following are offered as recommendations to further enhance the CSD’s alignment with strategic diversity efforts.

Articulation Agreements and Targeted Recruitment.

Given the disparities in enrollment and four year graduation rates for Latinx and other URM students and the increased probability of URM students to attend two-year colleges, high levels of collaboration between two and four-year institutions could yield increased educational opportunities for URM students. For example, articulation agreements and recruitment events at community colleges could help ensure that students enrolled at two-year institutions have a clear path for pursuing a bachelor's degree in CM. Furthermore, a concerted effort could be made to ensure that potential and current students have access to CM social capital networks and institutional agents. These institution agents, defined as "a person who has status, authority, and control of resources in a hierarchical system" could include faculty, advisors, and staff that can allow students access to networks and opportunities that might otherwise be unavailable or unknown to URM students (Dowd, Pak, & Bensimon, 2013, p. 6).

One way to potentially facilitate these connections is through brown bag sessions such as research presentations or lectures at two-year colleges where faculty or staff from universities (both URM and non-URM) are available to prospective students (Crisp & Nora, 2012). Targeted high school recruitment at low income, high URM high schools in highly urban areas, could prove useful in recruiting a more diverse CM student body (Escamilla et al., 2018).

Critical Evaluation of Current Systems and Policies

Critically evaluating the current systems and policies that may perpetuate or increase opportunity gaps among traditionally underrepresented students could yield significant results in relation to diversity efforts. For example, the current GPA thresholds for undergraduate acceptance at the CSD is 2.75/4.00 and, as previously mentioned, cumulative first year GPA thresholds for program admission mean that 63.3% of non-Latinx, yet only 55.4% of Latinx students would be eligible for CSD undergraduate admission by the end of their first year;

meaning that non-Latinx students are 14.3% more like to qualify for program acceptance than Latinxs after the first year. However, if the current GPA threshold was decreased by 0.1, the mean difference in cumulative first year GPA scores between Latinx and non-Latinx students from 2009 to 2017, then 68.8% of non-Latinx and 64.9% of Latinx students would be eligible for CSD admission by the end of their first year; meaning that non-Latinx students would only be 6.04% more like to qualify for program acceptance than Latinxs. While this example is specific to the CSD, it illustrates the importance of critically evaluating systems and policies and their impact on different student groups.

Future Research and Limitations

Given that the data utilized in this study is most likely available at numerous institutions, replication of this study at multiple construction education programs could yield more generalizable results. Furthermore, while this study focused on opportunity gaps as manifest in enrollment and academic success outcomes, all opportunity gaps may not have been captured in academic outcomes. Therefore, future research involving in-person interviews with URM's, Pell eligible, and first gen students enrolled in CM could prove valuable. Such research could also shed further insights into the increasing magnitude of disparities in four year graduation rates and cumulative final GPA between URMs and non-URMs.

Limitations should be considered when interpreting the results of this study. The data utilized in this study are from a single CM department at a land grant university in Colorado, US. Furthermore, the population of interest included all students who were enrolled in the CM program for at least one semester. This assumption could yield significantly different results than a different population (e.g., CM cohort majors, etc.).

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CHAPTER 4:
A VISUAL ETHNOGRAPHIC EVALUATION OF LAND GRANT PROGRAMS: WHO IS
VALUED IN CONSTRUCTION EDUCATION?

Summary

A review of employment statistics for the United States (U.S.) Construction Management (CM) profession reveals low participation rates among Latinxs and women. Further, low participation rates of these minority groups are observed in four-year CM education programs at land grant universities. Construction education programs desiring to recruit a more diverse student body may benefit from an increased understanding of the messages portrayed through the physical artifacts (i.e., art, signs, pictures, etc.) on display in their CM facilities. This study evaluated the physical artifacts of three construction education programs at land grant universities to explore non-verbal messages relating to the question of: “Who is valued and belongs in construction education”? Results suggest that construction education programs could implement improvements in creating a more inclusive physical environment. The observed artifacts indicate that White males are regularly named and represented as the management workforce, while people of color are unnamed and overly portrayed as construction laborers. Furthermore, women were unnamed and underrepresented in the physical artifacts across all universities studied. Suggestions for practical implications, interpretations of the findings, and opportunities for future research are discussed.

Introduction

Between January of 2011 and 2019, the United States (U.S.) construction workforce added over two million jobs (Bureau of Labor Statistics, 2011, 2018a). In addition to craft

workers, the construction industry experienced a sharp increase in the demand for construction professionals (e.g., construction managers, estimators, etc.) (Bureau of Labor Statistics, 2018b, 2019). These professions offer better than average salaries, higher than average employment projections, and are anticipated to continue through at least 2026 (Bureau of Labor Statistics, 2019) For individuals seeking entry into construction management (CM) professions, the best prospects for employment require both a bachelor's degree and construction field experience (Bureau of Labor Statistics, 2019).

Despite projected employment demands and better than average compensation levels, the CM profession has yet to attract and retain a gender and ethnically diverse workforce. For example, in 2018 Latinxs accounted for 17.3% of the total U.S. workforce and, within the construction and excavation occupations, Latinxs represented 37.0% of the entire workforce with higher participation rates in numerous labor-intensive occupations such as drywall workers (70.2%), roofers (56.3%), and construction laborers (47.6%) (Bureau of Labor Statistics, 2018c). However, within the construction management profession, only 15.3% of participants identified as Latinx (Bureau of Labor Statistics, 2018c). For women, representation in the profession is even lower as they only account for 7.7% of the construction management workforce, yet almost half of the entire U.S. workforce (Bureau of Labor Statistics, 2018c).

The ability (or inability) to attract and retain a more diverse construction management workforce has financial implications for construction firms. Perryman, Fernando, and Tripathy (2016) reported that an increase in gender diversity in top management teams resulted in decreased organizational risk and better firm performance overall. Similar findings were reported by Hunt, Prince, Dixon-Fyle, and Yee (2018), who demonstrated that gender or ethnic/cultural diversity on executive management teams resulted in increased financial returns in comparison to

less diverse organizations. As stated by Hunt, Layton, and Prince (2015), the numerous competitive advantages for organizations with a diverse management team include: 1) the ability to recruit better talent; 2) stronger customer orientation; 3) increased employee satisfaction; and, 4) improved executive decision making.

Given the strategic station of university and college construction education programs (e.g., construction science, construction management, etc.) in preparing students for management positions within the construction industry, it is essential that these institutions attract and retain a sufficient number of students to meet industry demand. Furthermore, for some public-colleges and universities, there is an impetus to support all students equitably; and, particularly those students that have been traditionally underserved in higher education (Jacobsen & Maeda, 2019). Despite this, enrollment in construction education programs continues to mirror industry trends and is White (non-Latinx) male-dominated (Elliott, Burgoon, & Weisshaar, 2019; Escamilla, Ostadalimakhmalbaf, Pariafsai, Gragera, & Alizadeh, 2018; Oo, Li, & Zhang, 2018). Therefore, it is crucial that construction education programs looking to attract and retain a more diverse group of students, identify systems and cultures that disproportionately serve majority students; particularly, if these systems and cultures do so at the expense of minority students. To this end, for construction education programs seeking to attract and retain a more diverse student body, one area that programs may wish to evaluate is the non-verbal messages that physical artifacts, the created objects of a culture (art, signs, pictures, etc.), convey in terms of who belongs (or does not belong) and is valued in construction education (Archibeque-Engle, 2015).

Background

Within the context of higher education, the interactions and interplay between 1) campus inhabitants (i.e., students, faculty, visitors, etc.), 2) campus activities (i.e., learning, research,

etc.), and 3) both the social (i.e., social functions) and physical environment (i.e., buildings, nature, artifacts, etc.) form the basis of an institutions ecology; or, as described by Strange and Banning (2015), “campus ecology.” At every level, these three components interface to create a campus ecological system that can promote the perception of belonging (or exclusion) for particular individuals and groups; this includes the physical artifacts.

Physical artifacts are a form of symbolic messages and non-verbal statements that can indicate the values and culture of their creators. As described by Berger (2014, p. 17), artifacts embody and concretize various values and achievements...cultural values and beliefs take the form or are manifested in artifacts and objects...what this suggests is that we can use artifacts to help us gain insights into the culture that produced them, if we know how to interpret and ‘read’ them.

As described by Banning (2018), material culture (i.e., physical artifacts) provide non-verbal cues that both describe, prescribe, and predict the order of things. Furthermore, artifacts communicate what (and who) are valued. For current (and potential) students that fit the dominant narrative conveyed by physical artifacts, a campus environment that confirms their sense of place or sense of belonging can feel comforting. Conversely, for those students that do not fit the dominant narrative, the same environment could confer a sense of unwelcome (Banning, Middleton, & Deniston, 2008).

The concept of ambient belonging, a perception of fit within an environment, has also been shown to have a positive (or negative) effect on students’ desire to join a college major (Cheryan, Plaut, Davies, & Steele, 2009). As defined by (Cheryan et al., 2009, p. 1046), “ambient belonging includes fit with the material (e.g., physical objects) and structural (e.g., layout) components of an environment along with a sense of fit with the people who are

imagined to occupy that environment” and “can be ascertained rapidly, even from a cursory glance at a few objects.” As demonstrated by Cheryan et al. (2009), when female students were presented with a masculine or stereotypical physical environment that did not identify with their perception of self, they were less likely to participate than when confronted by a gender or stereotypical neutral environment.

According to Archibeque-Engle (2015), masculine and stereotypical physical environments not only detract from minority students’ sense of belonging, but also serve as a form of microaggressions. As defined by (Perez & McDonough, 2008, p. 2), microaggressions are “forms of systemic, everyday racism used to keep those at the racial margins in their place.” These microaggressions have been described as suffering from a “thousand little cuts,” which can create and compound emotional wounds (Hunn, Harley, Elliott, & Canfield, 2015).

Microaggressions and Inequities Exhibited in Physical Artifacts

Archibeque-Engle (2015), evaluated the physical artifacts of three animal science departments at Predominantly White Institutions. Given the researcher’s unique perspective as a self-described, “Latina, Chicana feminist, former farmworker, land grant educated student (p. 1)”, Archibeque-Engle (2015) posits that her research is situated within a Latina/o Critical Theory (LatCrit) framework; a theoretical framework that “seeks to expose and transform the master narrative in which Latinas/os are confined to stoop labor while White landowners reap the benefit of that labor” (p. 7). Noteworthy themes of exclusion and microaggressions toward minority groups (i.e., women and Latinxs) presented in physical artifacts included, hegemony, patriarchy, and disengaged. Examples of these themes, as displayed in physical artifacts, included a human height cowboy boot painted with a battle scene between “cowboys and Indians,” and a conference room displaying pictures of only European American men.

Ultimately, Archibeque-Engle (2015, p. 13) concluded that animal science departments are “yelling silently that they are not inclusive and welcoming learning environments. In other words, the physical artifacts are telling students as well as faculty and staff that one must fit within a stereotyped image of an American cowboy to be a successful animal scientist.”

Another example of such racial inequities in physical artifacts is presented by Hotchkins and Dancy (2017) in their research on Black students' perceptions of university resident halls. Utilizing a participant-based research methodology that included photographs and group discussions, Hotchkins and Dancy (2017) presented the exclusionary theme of “absent while present,” to describe Black students' perception of a campus' physical artifacts. As reported by Hotchkins and Dancy (2017), the following quotes reflect the sentiments of Black students in the creation of the theme:

‘I feel like I don’t belong in the res[idence] hall because I don’t see myself reflected in the staff, or anywhere else. Not even a picture of a Black athlete! What message does that send?’ (Hotchkins & Dancy, 2017, p. 47)

Similar sentiments were conveyed by another student in the following way:

‘I pay tuition like everyone else, except I don’t see Black names on the buildings, professors in my major or even in the art on the walls. I don’t see an appreciation for difference, only White culture.’ (Hotchkins & Dancy, 2017, p. 47)

Ultimately, the researchers concluded that “absence was perceived as a form of physical, cultural, and intellectual discarding of Blackness and a form of environmental racial microaggression” (Hotchkins & Dancy, 2017, p.45).

A final example of exclusionary non-verbal communication portrayed through physical artifacts is on display in a four mural set exhibited in a university library in the southwestern

U.S. Completed in 1939, the first three murals were intended to represent the individual contributions of Native Americans, Latinxs, and Anglos to the region, with a fourth mural depicting the union of the three cultures in the southwestern region of the U.S. (“Zimmerman Library Artwork,” n.d.). In the first panel of the set, Native Americans in traditional clothing are depicted weaving blankets and shaping pottery. The second panel depicts Latinx workers performing the manual tasks of plowing and building plastering. In the third panel, Anglo men are depicted as scientists and doctors. The fourth and final panel, is a look towards the future with Native, Anglo, and Latinx unified through a symbolic handshake (“Zimmerman Library Artwork,” n.d.). While initially intended to be inclusive, a more recent evaluation of the mural has identified the negative stereotypes and non-verbal messages associated with representing Latinxs as manual laborers and Anglos as scientists (Banning & Luna, 1992; Strange & Banning, 2015).

In each of the three instances, the cultural values of these institutions of higher learning are witnessed in the physical artifacts on display. Given this, it is important for construction education programs to understand the equity (or inequity) message conveyed by the physical artifacts on display in their program. The following section explores photo ethnography and a prescribed taxonomy as a means of understanding the physical equity climate.

Photo Ethnography in Equity Research

The use of photographs and media images has proven to be a useful tool in ethnographic research (Collier & Collier, 1986; Pink, 2007). According to Pink (2007), media images “are becoming increasingly incorporated into the work of ethnographers: as cultural texts; as representations of ethnographic knowledge; and as sites of cultural production, social interaction and individual experiences that themselves form ethnographic fieldwork locales” (p. 1). Images

of places and things are unique in that they can relay a great deal of reviewable information without the use of written words. Furthermore, images can be categorized and evaluated (and reevaluated) utilizing various taxonomies and methods. As described by Banning (1997a), the collection of photographs covers the three most common forms of qualitative data; that is observations, analysis, and interviews. At its heart, ethnography is about storytelling, and, as the adage goes, a picture is worth a thousand words (Banning, 1997a).

As a research tool, photographs have been utilized to address concerns surrounding equity inequalities in higher education. Examples of utilizing photographs to assist in equity research in higher education include the physical and psychological safety climate of university housing (Hotchkins & Dancy, 2017; Banning, 1997b), the adverse effects of negative and stereotypical artifacts on Latinx students (Archibeque-Engle, 2015; Banning & Luna, 1992), and gender inequities in traditionally male-dominated educational fields (Sexton, O'Connell, Banning, & Most, 2014).

Equity Taxonomy

Taxonomies provide an organized framework for evaluating information. According to Milgram and Kishino (1994, p. 1323), “the purpose of a taxonomy is to present an ordered classification, according to which theoretical discussions can be focused, developments evaluated, search conducted, and data meaningfully compared.” One taxonomy that has been utilized to evaluate the equity climate of physical artifacts was generated by Banning, Middleton, and Deniston (2008). Banning, Middleton, and Deniston's (2008) taxonomy classifies artifacts on four criteria that include: 1) type of artifact, 2) message content, 3) multicultural approach, and 4) equity approach. Within each criterion, artifacts are categorized or coded into predetermined categories. For criteria 1 (type of artifact), categories include: 1) art, 2) signs, 3)

graffiti, and 4) architecture. In criteria 2 (message content), categories include: 1) belonging, 2) safety, 3) equality, and 4) roles. In criteria 3 (multicultural approach), categories include: 1) gender negative, 2) race, 3) ethnicity, 4) religion, 5) disability, and 6) sexual orientation. In criteria 4 (equity approach), categories include: 1) contributive, 2) transformational, 3) null, and 4) negative. A visual representation of the taxonomy is displayed in Figure 4.1.

Level of Analysis	Category/Code	Characteristics of Code
Criteria 1 Type of Artifacts	Art	Paintings, Posters, Sculptures, Trophies
	Signs	Restroom and classroom signs, unofficial signage (e.g., flyers, announcements)
	Graffiti	Illegitimate Signs; drawings on public surfaces (slogan, drawing, scribbles)
	Architecture	Physical Structure
Criteria 2 Message Content	Belonging	Who belongs (or does not belong)
	Safety	Dehumanization of any group; messages that threaten a sense of safety
	Equality	Unequal messages
	Roles	Roles of men and women
Criteria 3 Multicultural Approach	Gender Negative	Specific messages about or for males and females
	Race	Messages specifically about or for African Americans, Latinxs/Hispanics, Native Americans, or other racially defined groups
	Ethnicity	Messages specifically about or for particular groups
	Religion	Messages specifically about religion
	Disability	Messages about physical differences; especially differently-abled with particular attention to the issues of mobility, age, and physical characteristics
	Sexual Orientation	Messages about homosexuality, bisexuality, heterosexuality, etc.

Criteria 4 Equity Approach	Negative	Does not support equity among groups
	Null	Devoid of equity messages; inherently defaults to “White male privilege.”
	Contributions/ Additive	Support equity; but represent what is comfortable for the dominant culture
	Transformational / Social Action	Equity centric perspective rather than the dominant culture perspective

Figure 4.1 Equity taxonomy

Land Grant Universities.

Given the history and mission of the land grant university system, it provides a fertile environment for understanding and potentially addressing equity disparities in construction education and can serve as a flagship for overcoming those disparities in the future. The following provides a brief overview of the land grant university system in the U.S.

An 1862 congressional action entitled, *An Act Donating public lands to several States and [Territories] which may provide colleges for the benefit of agriculture and the Mechanic arts*, otherwise known as the Morrill Act, opened federal lands and ushered in the land grant system of education in the U.S. As stated by Works and Morgon (1939, p. 11), the purposes of the Morrill Act were derived from: “1) a protest against the dominance of the classics in higher education; 2) a desire to develop at the college level instruction relating to the practical realities of an agricultural and industrial society; and 3) an attempt to offer to those belonging to the industrial classes preparation for the 'professions of life.'”

While the land grant system was created and funded by U.S. taxpayers, it has a history of exclusion towards certain groups – particularly against individuals of color. In 1890, a second congressional act, commonly known as the Second Morrill Act, was ratified to address racial inequalities and disparities, particularly in the southeastern U.S., by attempting to ensure that federal funds were not dispersed where a distinction of race was made in the admission of

students. Among the outcomes of the second Morrill Act was the creation of what is now known as “historically Black” and subsequent tribal colleges and universities aimed at supporting those that may have been excluded from the land grant system (National Academy Press, 1995).

Study Purpose and Research Objective

The purpose of this study was to evaluate the equity climate of construction education programs as conveyed by physical artifacts. More specifically, this research was intended to identify who belongs (or does not belong) and is valued in construction education.

While numerous groups could be emphasized in a study of physical artifacts, this study focused on women and Latinxs within construction education. These two groups were selected for the following reasons:

1. Women have been identified as an untapped labor source in construction management, but have historically been underrepresented in construction education (Menches & Abraham, 2007).
2. Latinxs are currently the largest racial/ethnic group in the US and will account for approximately one-third of the US population by 2060 (Colby & Ortman, 2015).
3. Latinxs have become an increasingly important group in the construction craft workforce; and, as many large construction companies desire “candidates with both construction experience and a bachelor’s degree in a construction-related field” (Bureau of Labor Statistics, 2019, par. 3), Latinx craft workers could provide a sizable candidate pool.

Ultimately, this study was intended to add to the growing body of ethnographic research and will ideally provide construction educators with a point of reference for evaluating the non-verbal message portrayed by physical artifacts.

Research Methods

This study evaluated photographs of physical artifacts on display at three U.S. land grant universities as a means of understanding the equity message communicated about who belongs (or does not belong) and who is valued in construction education. The following sections provide an overview of the methods utilized in data collection and evaluation.

Site Selection

This study evaluated the physical artifacts of three construction education programs at land grant universities. Each site is located in a different state, and geographical region of the U.S. Site selection was based on researcher accessibility, program size, and university status as a land grant institution. Furthermore, given the underlying focus on Latinxs and females for this study, all programs selected were located in a state with a relatively high percentage of Latinx residents. The three construction programs evaluated have the following attributes in common:

1. Located in a state where at least 20% of the population identifies as Latinx
2. Formal construction education program has been in existence for at least 50 years
3. At least one building designated exclusively for the construction education department
4. Accredited by the American Council for Construction Education (ACCE)
5. Land grant university status from the Morrill Act of 1862

For anonymity purposes, the universities selected are referred to by the following pseudonyms: Agricultural University, Mechanical Arts University, and Old State University.

Research Team

The research team for the study consisted of three full-time construction educators and one undergraduate construction education student. Given the purposes of this study, attempts were made to create a research team that consisted of individuals from various backgrounds in terms of race/ethnicity, country of origin, and gender. The rationale for a diverse research team is

founded in the assumption that the assessment of physical artifacts may vary for individuals due to cultural, social, and gender differences. Given this, the researchers feel that it is important to identify additional attributes that might affect their perspective. The following provides a brief overview of relevant backgrounds and identities for each of the researchers involved in this study:

1. Researcher 1: Jared Burgoon is an Instructor of CM. Mr. Burgoon is a U.S. born, White (non-Latinx) male from a suburban middle/upper-middle-class background.
2. Researcher 2: Erin Arneson is an Assistant Professor of CM. Dr. Arneson is a U.S. born, White (non-Latina) female from a rural middle/upper-middle-class background.
3. Researcher 3: Rodolfo Valdes-Vasquez is an Associate Professor of CM. Dr. Valdes-Valdez is a Panamanian born, mixed-race (Latinx) male from an urban low-income background.
4. Researcher 4: Vanna Hosanny is an undergraduate (second bachelor) CM student and president of the CM department student board of directors. Ms. Hosanny is a Trinidadian and Tobagonian born Afro/Indian (non-Latina) female from a suburban middle/upper-middle-class background. Ms. Hosanny's first bachelor's degree is in Ethnic Studies.

Data Collection

After selecting the three construction education programs for evaluation, permission was requested and granted from program officials to photograph the physical artifacts. Data collection consisted of taking still photographs of physical artifacts utilizing digital cameras. All collected photographs were from public spaces (i.e., classrooms, hallways, etc.) in or of buildings devoted to solely to construction education programs. Photographs were collected by

three of the researchers of this study. Table 4.0 identifies who captured the photographs, and where and when the photographs were collected.

Table 4.0

Photographer, number of photographs, and collection date by university

Message Content	Photographer	Number of Photographs (Post reduction)	Collection Date
Agricultural University	Jared	64	Summer 2016
Mechanical Arts University	Jared	31	Summer 2017
Old State University	Vanna and Erin	45	Fall 2019

Data Treatment

Post collection, all photographs were evaluated and subsequently reduced by two members of the research team, Erin and Jared. Photographs were reduced to both minimize redundancies (e.g., photographs of the same objects from different perspectives) and ensure alignment with the equity taxonomy (e.g., a photograph of artifacts showing buildings under construction that had no unique identifiers regarding gender, race, ethnicity, religion, disability, or sexual orientation was removed from evaluation).

Evaluation Criteria

This study utilized the equity taxonomy offered by Banning, Middleton, and Deniston (2008) to evaluate each photograph. As previously mentioned, the taxonomy evaluates photographs based on the type of artifact, message content, multicultural approach, and equity approach.

Data Evaluation

Data evaluation included both individual and team evaluation of the collected photographs. The following describes each portion of evaluation.

Individual data evaluation. Each researcher was provided with three spreadsheets that contained the criteria and categories contained in Banning, Middleton, and Deniston's (2008) taxonomy along with PDF files of the photographs. Photograph and university evaluation order was randomly assigned for each researcher, and PDF files and spreadsheets were organized accordingly. For evaluation purposes, each photograph was limited to one category per criterion. Each researcher was also instructed to identify themes relating to the equity climate, as described in the taxonomy.

Research team data evaluation. After each member of the research team had evaluated all of the photographs, four separate research meetings were held. In research meeting #1, all four members of the research team were present to discuss the individually identified themes. These themes were subsequently verified, utilizing counts. After research meeting #1, only three members of the research team participated in further evaluation due to previous commitments. In research meeting #2, two members of the research team, Erin and Jared, met to compare and discuss their individual results in regard to the taxonomy classification of the artifacts. As a result of the meeting, complete agreement on the categorization of every photograph was reached. In research meeting #3, one researcher from research meeting #2 and an additional researcher, Jared and Vanna, met to discuss the classification of the artifacts from research meeting #2. Additional insights and reclassifications were added by Vanna. In research meeting #4, Jared and Erin agreed unanimously with the categorization of each photograph from research meeting #3. As a result, a complete agreement was reached by the three researchers, resulting in consensus coding for the criteria and category of each photograph.

Findings

The research team’s consensus coding percentages for criteria and category of analysis are found in Table 4.1 to Table 4.4. As shown in Table 4.1, of the 140 total categorized images, art constituted the largest share of artifact types, ranging from 59.38% to 93.55%, for all three universities, with signs as the next most prevalent.

Table 4.1

Percentage occurrence of “Type of Artifact” at Agricultural University (n = 64), Mechanical Arts University (n = 31), and Old State University (n = 45)

Type of Artifact	Agricultural University	Mechanical Arts University	Old State University
Art	59.38%	93.55%	73.33%
Signs	35.94%	6.45%	24.44%
Graffiti	0.00%	0.00%	0.00%
Architecture	4.69%	0.00%	2.22%

Regarding message content, as shown in Table 4.2, messages relating to belonging were identified as the most prevalent message type at Agricultural University (54.69%) and Old State University (73.33%), with roles as the most prevalent message type at Mechanical Arts University (64.52%).

Table 4.2

Percentage occurrence of “Message Content” at Agricultural University (n = 64), Mechanical Arts University (n = 31), and Old State University (n = 45)

Message Content	Agricultural University	Mechanical Arts University	Old State University

Belonging	54.69%	32.26%	68.89%
Safety	0.00%	0.00%	0.00%
Equality	10.94%	3.23%	8.89%
Roles	34.38%	64.52%	22.22%

Table 4.3 shows the multicultural message. For the universities evaluated, gender is categorized more than 80% of the time with race, ethnicity, and disability also identified as categorized items. Safety was not categorized.

Table 4.3

Percentage occurrence of “Multicultural Approach” at Agricultural University (n = 64),

Mechanical Arts University (n = 31), and Old State University (n = 45)

Multicultural Approach	Agricultural University	Mechanical Arts University	Old State University
Gender	84.38%	87.10%	80.00%
Race	3.13%	9.68%	4.44%
Ethnicity	6.25%	0.00%	2.22%
Religion	0.00%	0.00%	0.00%
Disability	6.25%	3.23%	13.33%
Sexual Orientation	0.00%	0.00%	0.00%

Table 4.4 shows the categorized equity percentages for all artifacts. While Mechanical Arts University was categorized as having the highest percentage (19.35%) of contributions/additive artifacts, the number of artifacts categorized as negative was identical (19.35%). For both

Agricultural and Old State University, null and negative categorized percentages exceeded 95%. A complete evaluation of each university can be found in Tables A1 to Table A3 in Appendix A.

Table 4.4

Percentage occurrence of “Equity Approach” at Agricultural University (n = 64),

Mechanical Arts University (n = 31), and Old State University (n = 45)

Equity Approach	Agricultural University	Mechanical Arts University	Old State University
Negative	25.00%	19.35%	13.33%
Null	73.44%	61.29%	82.22%
Contributions/Additive	1.56%	19.35%	4.44%
Transformational/ Social Action	0.00%	0.00%	0.00%

In addition to the use of the taxonomy created by Banning, Middleton, and Deniston (2008), individual analysis and group discussion concerning the equity climate of construction education programs as conveyed by physical artifacts identified themes surrounding who is valued in construction education. Of particular note, evaluation found the following themes: the “named majority,” the “working minority,” and tokenism. The identified theme of the “named majority” is based on the recurring theme of acknowledging and naming White men (particularly, donors, alumni, and faculty) in positions of management, authority, and power. This contrasted with a theme of the “working minority,” which is based on the recurring theme of portraying unnamed people of color as construction laborers and craftworkers and the underrepresentation of women and people of color in physical artifacts overall. Where women and people of color were represented in artifacts, the concept of tokenism (i.e., the appearance of diversity without inclusion) was identified as a descriptor. Tokenism was derived from a

combination of the “named majority” and “working minority,” which in itself is a form of tokenism, in addition to photographs that could be explicitly viewed as a portrayal of tokenism. A representation of the three themes are found in Figures 4.2 to 4.6.

Examples of the “named majority” were identified in evaluation. Figure 4.2 is a digital display located in a main passage of the construction building at Agricultural University. The title "Past Presidents" (names and companies redacted) implies that these individuals held a position of leadership and power. While the individual contributions of these men are theoretically significant, the ubiquity of White men depicted in leadership roles, particularly within the broader context of the physical environment, could be perceived as exclusionary to women, people of color, and others (Archibeque-Engle, 2015). Figure 4.3 is plaques mounted to an exterior wall labeled "Construction Hall of Fame" at Old State University. In so far as can be distinguished, all of the names listed are men. Similar to the "Past Presidents" display at Agricultural University, the recurring theme of highlighting the accomplishments of men, while excluding women, could convey a non-verbal message that conflict with department diversity goals and initiatives.



Figure 4.2 Electronic display showing "Past Presidents" (names and companies redacted) displayed at Agricultural University.



Figure 4.3 "Construction Hall of Fame" wall at Old State University.

The “working minority” theme was identified as a descriptor for unnamed people of color depicted in construction labor roles. Figure 4.4 and Figure 4.5 are photographs displayed at Mechanical Arts University and Old State University, respectively. In both instances, people of color are represented as construction laborers. While acknowledging the importance of craftworkers within the construction industry is arguably significant, the overrepresentation of people of color in labor positions, particularly when contrasted with “named majority,” could continue to perpetuate stereotypes and inequitable social norms; ultimately resulting in an environment that feels exclusionary for marginalized groups (Archibeque-Engle, 2015; Strange & Banning, 2015).



Figure 4.4 Image of people of color working in craft positions displayed at Mechanical Arts University.



Figure 4.5 Image of people of color working in craft positions displayed at Old State University.

The final recurring theme was tokenism (i.e., the appearance of diversity, but without inclusion), which works in conjunction with the “named majority” and “working minority.”

Given the recurring pattern of naming White men, while leaving artifacts of women and people of color as unnamed, it can be perceived as a form of tokenism. Furthermore, some staged photographs further exacerbated the perception of tokenism toward non-majority individuals.

For example, Figure 4.6 is a photograph displayed at Agricultural University. While both women and men are represented in the image, the staged photograph was perceived as tokenism by members of the research team.

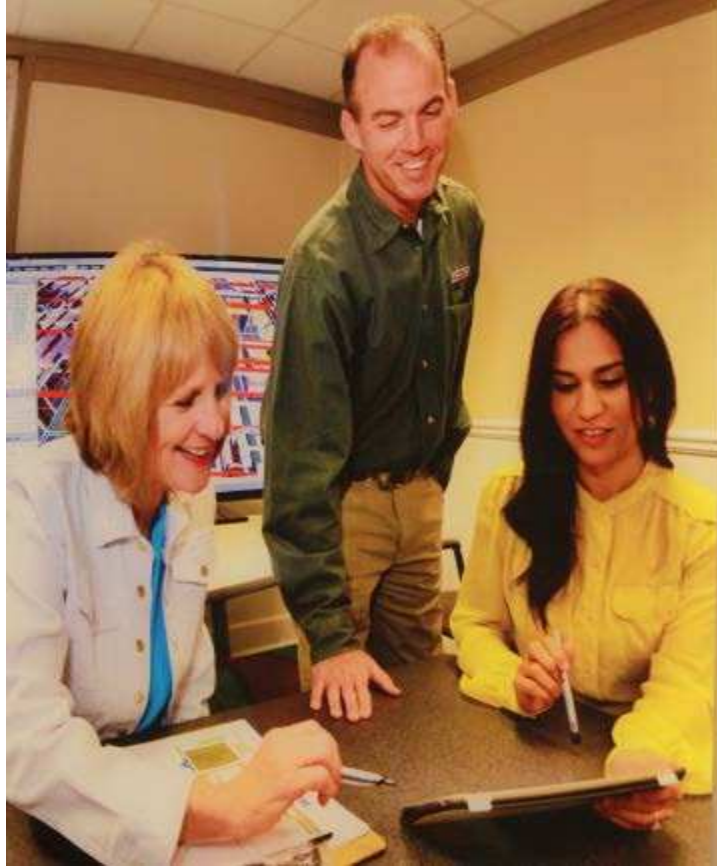


Figure 4.6 Image of diverse gender group (staged) displayed at Agricultural University.

Discussions

The purpose of this study was to evaluate the equity climate of construction education programs as conveyed by physical artifacts. More specifically, this research was intended to identify who is valued and who belongs (or does not belong) in construction education. In addressing the purpose of this study, results suggest that the non-verbal message relayed by physical artifacts is that White men are valued and belong in roles of recognition and power in construction education. Conversely, the non-verbal message portrayed to people of color and women is that they do not belong. Furthermore, results suggest that a potentially more damaging microaggression conveyed to people of color is that their value is in construction labor (not management) positions.

The results of this study align with previous studies addressing equity disparities and belonging in traditionally White male-dominated fields and institutions (Archibeque-Engle, 2015; Banning & Luna, 1992). For example, Archibeque-Engle (2015) identified hegemony, patriarchy, and disengaged as themes communicated by the physical artifacts of three university animal science departments. While this study did not name them as such, the represented role and power disparities between racial/ethnic groups (i.e., Whites and people of color) and the underrepresentation of women overall align well with themes of racial/ethnic hegemony and patriarchy (Gold, 2004).

Similar findings were also reported by Hotchkins and Dancy (2017) in their work on the racial climate of resident halls as perceived by Black students. Among the themes identified by the researchers through group discussions and photographic analysis was the concept of “absent while present” as a form of microaggression toward Black students (Hotchkins & Dancy, 2017).

Whether intended or not, the non-verbal messages communicated by physical artifacts in the evaluated construction education programs echo the sentiment of the 1939 Three Peoples Murals; that is, that White men are the educated, management class and Latinxs and other people of color the working class. Arguably, if most construction educators and administrators were asked if they agreed with this assertion, they would unflinchingly state their objection. And yet, the physical artifacts presented convey this message.

Given these results, it would be appropriate for construction education programs to evaluate the physical artifacts in their programs. While one means of evaluation has been demonstrated in this study, the following section offers additional suggestions for creating a more inclusive physical environment.

Suggestions for Practice

A recurring theme identified during analysis was the trend of construction education departments highlighting and naming donors, alumni, and faculty in the physical environment. While the value of a robust donor and alumni network are perhaps numerous, the results of this study suggest that this practice can generate non-verbal messages of exclusion towards women, Latinxs, and other minority groups. As a result, the researchers suggest that construction education departments systematically evaluate the current physical artifacts and proactively take steps to create a physical environment that communicates a greater sense of belonging, particularly for those who have been historically marginalized.

While the proposition of creating an environment that communicates a greater sense of belonging is straightforward, implementation could be far more complex, particularly if implemented in a way that is perceived to slight the past service of faculty, alumni, and donors or as an act of tokenism towards marginalized groups. For example, while increasing the number of photographs of women and people of color in management roles could be useful and necessary in numerous instances, a blanket replacement of existing photographs with more “diverse groups” could ultimately result in an environment perceived as cliché and forced. Furthermore, such an environment could be perceived as disingenuous to both majority and minority individuals as it neither recognizes the past and current systems that created and perpetuate equity disparities in construction education or acknowledge the hard work of donors, alumni, and faculty that have contributed to a department's current successes. Given these complexities, the researchers offer the following two ideas as primers for identifying and addressing current inequities in the physical environment.

Physical artifacts as counter-stories to dominant narratives. According to Solorzano and Yosso (2001), counter-stories challenge dominant narratives and provide counter perspectives that can help dismantle inequitable systems such as the historic White male dominance in construction education. In particular, counter-stories are powerful tools that have the capacity to: 1) create community among those on the fringes of society; 2) challenge long-held beliefs and narratives; 3) help marginalized individuals realize they are not alone in what they experience; and, 4) provide a framework for a more meaningful existence (Solorzano & Yosso, 2001). While the presentation of counter-stories could be implemented in numerous ways, the following is an example that could be implemented in relation to women in construction.

A prominent conference room or hallway could highlight the accomplishments of high-achieving women in construction (construction faculty, practitioners, etc.). In particular, “named” photographs accompanied by quotes and personal biographies highlighting the challenges and successes that these women have experienced during their careers could prove transformative as the display overtly contradicts the existing non-verbal narrative offered in the physical environment, which almost exclusively recognizes the accomplishments of men. Additionally, the display could be accompanied by statements emphasizing a department’s unique commitment to supporting women in the construction field. Arguably, such a display could elicit opportunities for formal and informal learning and dialogue surrounding gender disparities in the construction industry. Furthermore, given the growing importance of gender diversity in relation to corporate social responsibility (CSR), corporate and individual donors may be keenly interested in financially backing such equity endeavors (Loosemore & Lim, 2017).

Photovoice evaluation. A second idea for addressing equity concerns in the physical environment is through photovoice. As with this study, photovoice utilizes photographs as a means of engagement and empowerment. However, photovoice differs from this study in that it is participatory in nature and recognizes that participants (often those with the least power) are the most knowledgeable individuals about their present conditions (Hallowell & Yugar-Arias, 2016; Castleden & Gavin, 2008). As described by Wang (2006 p. 148), “photovoice has three main goals: to enable people to 1) record and represent their everyday realities; 2) promote critical dialogue and knowledge about personal and community strengths and concerns; and, 3) reach policymakers.” Given the participatory nature of photovoice research, it could potentially offer construction department administrators and other stakeholders with a greater understanding of the inequities and perceptions of the physical environment as perceived by those most affected. That is, inequalities in the physical environment, as perceived traditionally marginalized individuals, would be shared by those in a position to make changes. While this study does not allow for an in-depth discussion of photovoice methodologies, given the disparities identified in this study, the researchers suggest that women and Latinx students and faculty, in addition to members of other traditionally marginalized groups, be invited to participate in department photovoice research.

Limitations and Future Research

Data collection and evaluation for this study was limited to three construction education programs, and evaluations were limited to four individuals with a predetermined taxonomy. It is important to note that the photographs captured at each site are only at a single point in time and from a perspective of the researchers’ choosing. While no intentional details were omitted, it is

possible that the researchers' perspectives could have caused them to overlook particular artifacts or features that may be relevant to the current study.

Given the variability of physical artifacts that could exist in construction education departments, replication of this study at different construction education programs is suggested. Future research that includes a critical evaluation of digital photographs and artifacts on construction department webpages, marketing material, etc., could prove beneficial. In addition to photographic techniques presented in this study, other qualitative research techniques, such as interviews with underrepresented students, could share additional insights into the effects of physical artifacts on students' sense of belonging (Hotchkins & Dancy, 2017).

Conclusion

The financial benefits of a more diverse construction management workforce are copious, and construction education programs are pivotal in driving a diversity shift within the industry. Given the capacity of physical artifacts to prescribe and predict the order of things, the researchers hope that this study will elicit critical evaluation and conversations between construction, faculty, administrators, students, and other stakeholders about the inclusive nature (or the lack thereof) of the physical artifacts portrayed in construction education departments.

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APPENDIX A

Table A1

Equity Taxonomy Results for Agricultural University (n = 64)

Type of Artifacts	Message Content	Multicultural Approach	Equity Approach
Signs	Equity	Gender	Null
Architecture	Equity	Disability	Negative
Signs	Belonging	Gender	Null
Architecture	Equity	Disability	Null
Art	Belonging	Gender	Negative
Art	Belonging	Gender	Negative
Signs	Belonging	Gender	Null
Art	Belonging	Gender	Negative
Art	Belonging	Gender	Null
Art	Belonging	Gender	Null
Art	Belonging	Gender	Null
Art	Belonging	Gender	Negative
Signs	Equity	Gender	Null
Art	Belonging	Gender	Null
Signs	Equity	Disability	Null
Art	Roles	Gender	Null
Art	Roles	Gender	Null
Art	Roles	Gender	Negative
Art	Belonging	Race	Null
Signs	Roles	Gender	Null
Art	Belonging	Gender	Null
Art	Belonging	Ethnicity	Null
Art	Equity	Gender	Negative
Art	Belonging	Gender	Null
Signs	Belonging	Gender	Null

Type of Artifacts	Message Content	Multicultural Approach	Equity Approach
Art	Belonging	Gender	Null
Art	Belonging	Race	Null
Art	Roles	Gender	Null
Art	Roles	Gender	Null
Art	Roles	Ethnicity	Negative
Art	Roles	Ethnicity	Null
Art	Roles	Gender	Null
Art	Belonging	Gender	Null
Signs	Belonging	Gender	Null
Art	Roles	Ethnicity	Negative
Art	Roles	Gender	Null
Signs	Roles	Gender	Null
Signs	Belonging	Gender	Null
Signs	Belonging	Gender	Null
Signs	Belonging	Gender	Null
Signs	Belonging	Gender	Null
Signs	Belonging	Gender	Null
Signs	Belonging	Gender	Null
Signs	Belonging	Gender	Null
Signs	Belonging	Gender	Null
Art	Roles	Gender	Negative
Art	Belonging	Gender	Contributive/Additive
Signs	Belonging	Gender	Null
Art	Roles	Gender	Null
Art	Belonging	Gender	Negative
Art	Belonging	Gender	Negative
Signs	Belonging	Gender	Null
Signs	Belonging	Gender	Null
Architecture	Equity	Disability	Negative
Art	Roles	Gender	Null

Type of Artifacts	Message Content	Multicultural Approach	Equity Approach
Signs	Roles	Gender	Null
Signs	Roles	Gender	Null
Signs	Roles	Gender	Null
Art	Belonging	Gender	Null
Art	Belonging	Gender	Null
Art	Roles	Gender	Null
Art	Roles	Gender	Negative
Art	Roles	Gender	Negative
Art	Roles	Gender	Negative

Table A2

Equity Taxonomy Results for Mechanical Arts University (n = 31)

Type of Artifacts	Message Content	Multicultural Approach	Equity Approach
Art	Belonging	Gender	Contributive/Additive
Art	Belonging	Gender	Contributive/Additive
Art	Belonging	Gender	Contributive/Additive
Art	Belonging	Gender	Contributive/Additive
Art	Role	Gender	Contributive/Additive
Art	Role	Gender	Contributive/Additive
Signs	Equity	Disability	Negative
Art	Belonging	Gender	Negative
Art	Role	Gender	Negative
Art	Role	Gender	Negative
Art	Role	Gender	Negative
Art	Role	Race	Negative
Art	Belonging	Gender	Null
Art	Belonging	Gender	Null
Art	Belonging	Gender	Null
Art	Belonging	Gender	Null

Art	Belonging	Gender	Null
Art	Role	Gender	Null
Art	Role	Gender	Null
Art	Role	Gender	Null
Art	Role	Gender	Null
Art	Role	Gender	Null
Art	Role	Gender	Null
Art	Role	Gender	Null
Art	Role	Gender	Null
Art	Role	Gender	Null
Art	Role	Gender	Null
Art	Role	Gender	Null
Art	Role	Gender	Null
Art	Role	Gender	Null
Sign	Role	Gender	Null
Art	Role	Race	Null
Art	Role	Race	Null

Table A3

Equity Taxonomy Results for Old State University (n = 45)

Type of Artifacts	Message Content	Multicultural Approach	Equity Approach
Art	Belonging	Ethnicity	Contributive/Additive
Art	Belonging	Gender	Contributive/Additive
Signs	Belonging	Disability	Negative
Signs	Belonging	Disability	Negative
Signs	Equity	Disability	Negative
Signs	Equity	Disability	Negative
Art	Belonging	Gender	Negative
Art	Roles	Race	Negative
Signs	Equity	Disability	Null
Signs	Equity	Disability	Null
Architecture	Belonging	Gender	Null

Art	Roles	Gender	Null
Signs	Roles	Gender	Null
Art	Roles	Race	Null

CHAPTER 5: SUMMARY AND CONCLUSIONS

This chapter provides a summary of the three studies, the significant findings, and conclusions in relation to the overarching convergent mixed methods design. Additionally, recommendations for future research and limitations will be discussed as they relate to the equity climate and outcomes of construction management (CM) education programs in the land grant system.

Study Summary

There is a documented demand for college-educated construction professionals, and the construction management profession offers higher than average salaries and career security prospects (Bureau of Labor Statistics, 2019). Despite employer demands for educated construction professionals, the profession is White male-dominated and would benefit from a more gender, racially, and ethnically diverse workforce (Bureau of Labor Statistics, 2018). As the second and third largest groups in the U.S. workforce, women and Latinxs rank among the groups with the highest potential to meet the growing demand for construction managers while also increasing the diversity levels of the construction management workforce. As a strategic partner with the construction industry in educating the future construction workforce, construction education departments at colleges and universities play a vital role in shaping the future demographic makeup of the construction management workforce.

Unfortunately, construction education programs often mirror industry trends in terms of population diversity and higher education has a poor record of supporting minority students (Elliott, Burgoon, & Weisshaar, 2019). The failure of construction education programs to attract,

support, and graduate a diverse population of students is particularly troubling for U.S. land grant institutions which were created with the express mission of offering an applied education “to those belonging to the industrial classes” (National Association of Public and Land-grant Universities, 2008, p.4). Consequently, the purpose of this study was to evaluate the equity climate and equity outcomes of undergraduate construction education students in the land grant system with an emphasis on women and Latinx students.

To accomplish the study purpose, a convergent mixed methods design was put forward as a means of better understanding the equity climate and equity outcomes of construction education. According to Creswell and Clark (2011), a convergent study is a

design in which the researcher uses concurrent timing to implement the quantitative and qualitative strands during the same phase of the research process, prioritizes the methods equally, keeps the strands independent during analysis, and mixes the results during the researcher’s overall interpretation of the data (p. 410).

To accomplish a convergent design, the following sections will briefly discuss the objectives and aggregate the disparities and other noteworthy findings from the three semi-autonomous studies presented in Chapter 2, Chapter 3, and Chapter 4 of this dissertation.

Disparities and Noteworthy Findings from Chapter 2

The purpose of this study was to identify trends and equity gaps between female, first-gen, minority, Latinx, and Pell-eligible undergraduate CM students, and their respective counterparts, at a land grant university. It was intended that the results of this study would be utilized as a benchmark for evaluating trends and equity gaps, and in the development of strategic initiatives to recruit and retain an increased number of traditionally underrepresented and underserved undergraduate students into CM education. As it relates to women and Latinxs,

several noteworthy disparities were identified. Table 5.1 summarizes disparities (italicized) and other noteworthy findings from Chapter 2.

Table 5.1

Key Findings Addressing Equity Climate (EC) and Equity Outcome (EO) From Chapter 2

Women	Latinxs
RO1: To identify trends and equity gaps in department enrollment and retention rates	
- <i>EO: Transfer females retained at a lower rate than males</i>	- <i>EO: New Latinxs retained at a lower rate than non-Latinxs</i>
- <i>EO: New females retained at a higher rate than males (after 3rd year)</i>	- <i>EO: Transfer Latinxs retained at a higher rate than non-Latinxs (after 7th year)</i>
RO2A: To identify trends and equity gaps in migration patterns into (towards) the CM department	
- <i>EC: Females (35.7%) are less likely to migrate from Open Majors to CM major than males (58.4%)</i>	N/A
RO2B: To identify trends and equity gaps in migration patterns away from (attrition) the CM department	
- <i>EC: Female are more likely to migrate to liberal arts (50%) and health and human sciences (25%) than males</i>	N/A
RO3: To identify trends and equity gaps in job placement, salary, and the perceptions of undergraduate students who had recently graduated from the CM department	
- <i>EC: Females (17.2%) are almost twice as likely to report no positive faculty or staff interactions as males (9.1%)</i>	- <i>EC: Latinxs reported lower than average satisfaction with advising</i>
- <i>EO: Females (\$57,000) that interned for a company reported lower starting salaries than males (\$59,000)</i>	- <i>EC: Latinxs perceive the most considerable emphasis on spending significant amounts of time studying and on academic work of any group</i>
- <i>EO: Females (\$52,000) that did not intern for a company reported lower starting salaries than males (\$59,000)</i>	- <i>EC: Overall, Latinx students reported the highest satisfaction within the CM major</i>

-
- EO: Females (72.4%) are more likely to accept a position with a company they interned with than males (55.6%)
-

Disparities and Noteworthy Findings from Chapter 3

The purpose of this study was to systematically explore and compare historic (1990 to 2009) and current (2010 to 2017) opportunity gaps (or equity disparities), as manifest in enrollment trends and academic success outcomes in construction education. Utilizing an established CM program at a large land grant university as a case study department (CSD), this study compares the enrollment and academic outcomes of women, first gen, Pell grant eligible, and students of color to their respective counterparts. Ultimately, the goal of this study is to better understand if opportunity gaps exist in CM education and, if they do exist, how opportunity gaps are manifest among different student groups. As it relates to women and Latinxs, several noteworthy disparities were identified. Table 5.2 summarizes disparities (italicized) and other noteworthy findings from Chapter 3.

Table 5.2

Key Findings Addressing Equity Climate (EC) and Equity Outcome (EO) From Chapter 3

Women	Latinxs
RQ1: How does the participation rate among Latinx and minority CM students at the CSD compare to the Latinx and minority populations of the State of Colorado?	
N/A	- <i>EO: Latinxs are significantly underrepresented in CM in comparison to Colorado's population</i>
RQ2: Are there significant differences in students' first year GPA, final GPA, four-year graduation rates, and six-year graduation or persistence rates between males and females, Pell and non-Pell recipients, first gen and con gen, minority and non-minority, Latinx and non-Latinx students; and, have these differences changed over time?	

Women	Latinxs
<ul style="list-style-type: none"> - EO: Females perform as well (or better) than males in all academic success outcomes 	<ul style="list-style-type: none"> - <i>EO: Latinxs (20%) are half as likely to graduate in 4 years as non-Latinxs (40%)</i> - <i>EO: Latinxs (M = 2.94) have significantly lower cumulative final year GPA's than non-Latinxs (M = 3.14); and, the disparity has grown over time</i>
<p>RQ3: How well does the combination of first year GPA, birth sex, Pell receipt, first gen, minority, Latinx, and transfer status predict four-year graduation and six-year graduation or persistence rates?</p>	
<ul style="list-style-type: none"> - EO: Female status is not a significant predictor of four or six year graduation rates 	<ul style="list-style-type: none"> - <i>EO: Latinx status is a significant negative predictor of four year graduation rates</i>

Disparities and Noteworthy Findings from Chapter 4

The purpose of this study was to evaluate the equity climate of construction education programs as conveyed by physical artifacts. More specifically, this research is intended to identify patterns as it relates to the non-verbal message physical artifacts communicate in relation to "who belongs" and is valued in construction education. Ultimately, this study is intended to add to the growing body of ethnographic research and will ideally provide construction educators with a point of reference for evaluating the non-verbal message portrayed by physical artifacts. Table 5.3 summarizes disparities (italicized) and other noteworthy findings from Chapter 4.

Table 5.3

Key Findings Addressing Equity Climate (EC) and Equity Outcome (EO) From Chapter 4

Women	Latinxs
<p>RO: To evaluate the equity climate of construction education programs as conveyed by physical artifacts. More specifically, this research is intended to identify who belongs (or does not belong) and is valued in construction education.</p>	
<p>- <i>EC: Women are unnamed and underrepresented in the physical environment of construction education programs</i></p>	<p>- <i>EC: Latinxs are unnamed and overrepresented in the construction labor force and underrepresented in the construction management roles</i></p>

Convergent Design Results and Discussion

While the central findings of each individual study presented in this dissertation are valuable to the body of knowledge surrounding the equity climate of construction education in the land grant system, an integration of the three studies provides a more robust picture. In accomplishing this objective, it is important to return to the fundamental purpose of this dissertation which is, to evaluate the equity climate and outcomes of undergraduate construction education students in the land grant system; particularly as it relates to women and Latinxs.

For the purposes of this study, the concept of equity climate was operationally defined as a term that captures concepts that include “the historical, structural, perceptual, and behavioral dimensions of the college environment” (Hurtado, 1994, p. 22), as they relate to providing all students, but particularly those who have been traditionally marginalized, with equitable social and educational experiences and outcomes. Arguably, in a gender and racially/ethnically equitable educational climate, one could posit that a level of convergent positive (or negative) outcomes would be observed across differing student groups. Conversely, one could posit that in

an inequitable educational environment, a level of divergent outcomes would be observed across different gender and racial/ethnic groups. As suggested by the results of all three studies presented in this dissertation, it appears that the latter is the case for construction higher education in the land grant system.

Across all three studies, higher levels of divergence in success outcomes were reported for Latinx and women students in comparison to non-Latinxs and men. For example, while women performed better academically than men, they were almost twice as likely to report no positive interactions with faculty or staff and were habitually underrepresented in the physical artifacts. Furthermore, while women were over 30% more likely to return to work for an employer with whom they interned, they reported lower starting salaries; and, if women did not return to work for a previous employer, the financial penalty was even more severe. Similarly, Latinx students perceived the most considerable emphasis on spending significant amounts of time studying and on academic work, yet they had significantly lower GPAs, reported lower than average satisfaction with advising, were less likely to be retained, and were more commonly portrayed as construction laborers in the physical environment than their non-Latinx peers.

Ultimately, the disparate success outcomes observed between student groups in and across the three studies presented in this dissertation suggest that construction education in the land grant system does not support women and Latinx students in the same way as men and non-Latinx students. Furthermore, given the breadth of the disparities observed, it appears that equity problems facing construction education are systemic in nature. Therefore, the tools required to deconstruct the inequitable system need to be as diverse as the problems they are facing. While the educational inequities identified in this study are multifaceted, the land grant system and construction education have a history of finding novel solutions to practical problems. To this

end, the following two sections will explore recommendations for practice and future research founded in understanding and overcoming disparities in construction education.

Recommendations for Practice

Throughout the course of this dissertation, numerous recommendations and suggestions for practice were presented as a means of addressing the equity disparities present in land grant construction education programs. While previously discussed in each respective chapter, the following is a synopsis of the recommendations for future practice.

In Chapter 2, recommendations for recruiting and retaining an increased number of women and Latinx students were presented. Among the principal recommendations was an increased recruitment effort at high schools and two-year colleges – particularly those that serve a large percentage of Latinx and other traditionally underserved students – in conjunction with open houses, summer camps, or other outreach programs which specifically target female or Latinx students interested in construction education. Additional initiatives included, summer bridging programs, panel discussion for first-year students where panelist specifically mention their backgrounds, and a targeted focus on connecting female students with industry professionals as each of these has been shown or posited to have a positive effect on student success (Baker & Slunt, 2017; Stephens, Hamedani, & Destin, 2014; Moore & Gloeckner, 2007). A final recommendation focused on ensuring construction course objectives, content, activities, and context aligned with the interest of both male and female students; particularly, as research has shown that this might not always be the case for females in STEM courses (Bachman, Hebl, Martinez, & Rittmayer, 2009).

In Chapter 3, recommendations focused on addressing disparities in academic success outcomes (e.g., graduation, final GPA, etc.). Among the principal recommendations was a focus

on targeted recruitment, initiatives to increase social capital, articulation agreements, and the critical evaluation of systems and policies. In conjunction with the recommendation from Chapter 2 to recruit at two-year colleges with more significant percentages of Latinx students, research presentations at two-year colleges with faculty and staff from university construction education programs could ultimately allow students greater access to social capital networks and opportunities that might otherwise be unavailable or unknown (Dowd, Pak, & Bensimon, 2013; Crisp & Nora, 2012). Furthermore, articulation agreements could provide a clear path for pursuing a bachelor's degree in construction education in addition to providing opportunities for students to graduate more quickly. An additional recommendation highlighted the importance of critically evaluating current systems and policies that might systematically exclude Latinxs or other groups. The example of decreasing the minimum GPA threshold for undergraduate construction program admittance by 0.1, the mean difference in cumulative first year GPA scores between Latinx and non-Latinx students from 2009 to 2017, resulted in a substantial decrease in the program acceptance disparities between Latinx and non-Latinx students.

In Chapter 4, recommendations focused on addressing disparities in non-verbal messages surrounding who belongs and is valued in construction education as conveyed by physical artifacts. Among the principal recommendations was utilizing physical artifacts as counter-stories and the utilization of photovoice as a means of addressing equity concerns in the physical environment. The concept of presenting counter-stories was presented due to their ability to dismantle inequitable systems – such as the male dominance in construction education artifacts – and their potential ability to elicit opportunities for learning and dialogue surrounding gender disparities in the construction education (Solorzano & Yosso, 2001). In the same vein, photovoice was presented as a means of connecting those who historically hold the least power,

but who are most knowledgeable about disparities, (i.e., historically marginalized individuals) with decision-makers (Hallowell & Yugar-Arias, 2016; Castleden & Gavin, 2008)

Future Research

This dissertation augments the limited literature surrounding the equity climate of construction education programs. Given the results and observations presented in this study, it could serve as a guide in directing future research.

In Chapter 2, disconcerting trends and disparities were identified. Given that this study was delimited to a single construction department at a mountain-region land grant university, this study, at least in part, could be replicated at other institutions to understand if the results are limited to one institution or more generalizable. For example, the questions from the exit survey from the institution of interest could be utilized to gain information about multiple institutions. Future research could also explore disparities in the academic interests of male and female students given the choice of academic major after migrating out of construction management. Additionally, research to expand the nominal body of knowledge surrounding first-gen, Pell eligible, and minority students in construction education appears justified. For example, the results indicating low program completion rate by new Pell eligible students indicate that an equity disparity exists and merits future evaluation.

In Chapter 3, statistically significant disparities in four-year graduation rates and first-year and final GPA were identified in relation to Latinx and non-Latinx students. Again, given that evaluations were only completed in a single department, future studies incorporating additional construction programs could explore if the identified trends are isolated or more widespread. Such studies would be particularly necessary at construction programs with

established enrollment caps and academic pre-qualifications (GPA., etc.) as these criteria might systematically discriminate against Latinx and other underserved student groups.

In Chapter 4, the question of “who belongs” and is valued in construction education was explored. Results presented the tendency of construction programs to portray Latinxs and people of color as unnamed members of the labor force and underrepresent women in physical artifacts. Future research exploring the physical equity climate of construction education programs deserves consideration. Giving the relative simplicity in data collection and evaluation, at a minimum, construction departments could formally (or informally) evaluate the physical equity climate and make improvements. Insights from minority students and faculty could prove beneficial. Other areas of evaluation where visual ethnographic techniques could be utilized include the evaluation of marketing material, websites, and department social media accounts.

Critical Theories as a Means of Understanding

While building upon the research topics and disparities addressed in this dissertation is important, it is essential to note that this dissertation did not explore the potential causes of these disparities. In light of this, the following section proposes future theoretical perspectives and research ideas to further explore the equity climate for Latinxs, women, and other marginalized groups in construction education.

Given the cultural dominance of White men within construction higher education and the educational equity disparities identified in this study, the utilization of critical theoretical perspectives (e.g., Critical Race Theory (CRT), Latinx Critical Theory (LatCrit), Intersectionality Theory) and correlating research designs could provide increased insights into the underlying causes of equity disparities identified (and not identified) in this study (Arch-Engle, 2015; Perez, 2010; Viruell-Fuentes, 2012). For example, Latinx Critical Theory (LatCrit)

could provide a basis for future studies regarding Latinx students. Implicit in the name, LatCrit is a theory that situates Latinxs at the epicenter of critical analysis within the broader context of oppressive societal systems. Stated differently, “LatCrit is a theory that elucidates Latinas/Latinos’ multidimensional identities and can address the intersectionality of racism, sexism, classism, and other forms of oppression” (Bernal, 2002 p. 108). Furthermore, LatCrit not only identifies the intersectionality of oppressive systems and situations affecting Latinxs, but it also elicits participants and practitioners to stimulate social and political action as a means of interrupting these systems (Delgado & Stefancic, 2001).

Central to the utilization of LatCrit Theory is the recognition that marginalized individuals are the owners of legitimate knowledge and that the voices and stories of these individuals, although traditionally discounted, are pivotal in understanding and dismantling inequitable and oppressive systems. Furthermore, it is vital to recognize the importance that storytelling (and counter-story telling) has in understanding and dismantling inequitable and oppressive systems (Delgado and Stefancic, 2001). As described by Solorzano and Yosso (2001), counter-storytelling challenges the dominant narrative of those in power and provides counter perspectives that further unsettle the dominant narrative. Among the chief utility functions of utilizing counter-stories in research and pedagogy is a story’s capacity to: 1) create community among those on the fringes of society by bringing a sense of humanity to educational theory and practice; 2) challenge the long-held beliefs of the majority and provide a framework to understand how to transform those beliefs; 3) help marginalized individuals realize they are not alone and that there are possibilities beyond what they currently experience; and, 4) provide the framework for visualizing a more meaningful existence than can be derived from the current reality or a story alone (Solorzano & Yosso, 2001).

Given the tenets of LatCrit, particularly the importance of counter-storytelling, research employing LatCrit as a means of understanding disparities with construction education must acknowledge and confront not only the individual and societal implications of oppressive systems but also that the individuals who experience the macro and microaggressions of these systems are the holders and creators of knowledge (Bernal, 2002). From an epistemological standpoint, this requires researchers to embrace a subjectivist approach aimed at racial emancipation and set aside objectivist traditions of distance or impartiality often found in construction education research (Lincoln & Lynham, 2011).

Applied Critical Research

The three studies completed in this dissertation were exploratory and did not incorporate critical underpinnings. In doing so, the researcher attempted to maintain, to the extent possible, a quasi-post positivist paradigm. However, in the visual ethnographic study presented in Chapter 4, the study could be repeated from a critical paradigm. For example, a LatCrit perspective could be utilized; particularly, if the analysis was completed by Latina students or faculty members. In utilizing this approach, the analysis could also serve as the story (or counter-story) of the researchers themselves (Archibeque-Engle, 2015b).

Additional critical research could also explore the underlying causes of academic disparities by exploring the lived experiences of students who have been the victims of the inequitable systems observed in construction education. Again, returning to a critical theoretical base, first-person interviews with minority students could prove invaluable in understanding how formal (and informal) systems and cultures inequality serve students. In doing so, the creating of stories and counter-stories can support other minority students and elucidate areas of improvement that would likely be overlooked by majority individuals.

Concluding Thoughts

The Morrill Act of 1862 was derived to address a specific educational need of the mid-nineteenth century. As stated by the Association of Public and Land-Grant Universities:

The First Morrill Act (1862) reflected a growing demand for agricultural and technical education in the United States. While a number of institutions had begun to expand upon the traditional classical curriculum, higher education was still widely unavailable to many agricultural and industrial workers. The Morrill Act was intended to provide a broad segment of the population with a practical education that had direct relevance to their daily lives. (Miller, 2016 par. 6)

By creating a unique solution to the educational needs of the nineteenth century, the land grant system opened the door for individuals from all walks of life to obtain both a liberal and practical education. However, the positive effects of the Morrill Act did not terminate in the nineteenth century. Instead, these effects endure to this day as land grant universities continue to support individuals and states through research, extensions, and teaching (National Research Council, 1996).

Similarly, construction education was created to address a specific educational need in the mid-twentieth century. Recognizing the need for a new class of construction professionals, at least 20 colleges implemented some form of construction education program in the post-World War II era (Kniewel, 1965). The learning requirements for these construction professionals were diverse; no longer would the exclusive understanding of architecture or engineering suffice. These industry professionals needed to gain a breadth of knowledge that ranged from supervision to philosophy, home economics to blueprint reading (Kniewel, 1965). With such an extensive range of knowledge required, institutions of higher learning looked beyond individual schools and departments for solutions to the problem. For example, at Colorado State University, the Light Construction and Marketing program established in 1946 pushed educational boundaries

and was the “first interdepartmental curriculum-crossing ever allowed at the college” (Knievel, 1965, p. 16). As with the advent of the land grant system, solutions to address the educational problems of the mid-twentieth century have ultimately resulted in the creation of construction education programs that continue to offer high wages and prospects for employment to college graduates (Bureau of Labor Statistics, 2019).

As in times past, there are current educational needs in the twentieth century, and, as supported by the findings of this dissertation, one of those needs is to create a more equitable construction education climate at land grant institutions. Invariably, the process of creating a more equitable educational climate will be complicated. However, given the history of the land grant system and construction education programs in addressing complex problems, a solution can be found that will reap benefits for generations to come.

Role of the Researcher

As previously stated, one of my professional goals as an academic is to help create, improve, and transform the systems and academic environments that have traditionally built barriers to a more diverse student body within construction management education. With the completion of this dissertation, I hope I have, at least in a small part, put forth something that may help improve the lives of my current and future students from non-majority backgrounds. Even so, I also acknowledge that I, and construction education at large, have a remarkably long way to go. In the pursuit of a more equitable academic environment, I understand that I am uniquely situated – for both good and bad. I have a professional background that spans from industry to academia and academic training that spans from construction to critical education. Furthermore, I am from a privileged background in terms of race, culture, immigration status, and socioeconomic status. Given my unique position of privilege and power, I recognize that I

will never understand what it is like to be an undocumented Latinx student or the only woman in a construction classroom full of men. However, I can use my position and privilege to continue to bring to light the experiences of these individuals and serve as an ally for students individually and as part of the larger collective.

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