Predicting Student Achievement in the Construction Domain: Correlation of Contributing Factors Given Construction Education Self-Efficacy, Motivation, and Planned Behavior

by

Rogers Hunt III

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Approved by

Reginald A. Blockett, Chair, Assistant Professor, Educational Foundations, Leadership & Technology Chih-hsuan Wang, Professor, Educational Foundations, Leadership & Technology Jane B. Teel, Clinical Professor, Educational Foundations, Leadership & Technology Kenneth Sands, Assistant Professor, McWhorter School of Building Science

Abstract

The construction industry continues to experience increased demand for a skilled and diverse workforce, underscoring the importance of identifying factors associated with student achievement in construction education programs. The purpose of this study was to examine whether academic performance and construction education self-efficacy predict student success on a nationally recognized professional credential examination. Specifically, this research investigated whether a two-predictor model using grade point average (GPA) midpoint and construction education self-efficacy (CESE) predicted pass/fail outcomes on the American Institute of Constructors (AIC) Level I examination. Differences in construction education self-efficacy, direct assessment of student learning outcomes (SLOs), and applied experience were also examined across GPA categories.

This study employed a quantitative, predictive research design. Data were collected from 55 construction education students and recent graduates from American Council for Construction Education (ACCE) accredited baccalaureate programs who had completed the AIC Level I examination. Binary logistic regression was used to analyze the predictive model, while independent-samples t tests and Welch's analysis of variance were used for group comparisons.

Results indicated that the two-predictor model did not significantly predict pass/fail outcomes on the AIC Level I examination. Grade point average midpoint showed a positive but not statistically significant relationship with exam outcomes, and no significant differences in construction education self-efficacy were observed between students who passed and those who did not. However, statistically significant differences in direct assessment learning outcomes were found across GPA categories. Findings suggest that academic performance is associated with demonstrated competency achievement, while GPA and self-efficacy alone are insufficient predictors of professional certification exam outcomes. Implications for construction education assessment and student preparation are discussed.

Artificial Intelligence (AI) Use Disclosure Statement

In the preparation of this dissertation, the following Artificial Intelligence (AI) tools were used: Microsoft Copilot and Grammarly. These tools were used primarily for formatting, reference checking, grammar, and spelling. The author acknowledges full responsibility for the intellectual content of this work and has ensured that all AI-assisted sections have been reviewed and revised for accuracy and appropriate academic style. All AI-generated content was reviewed and validated for relevance, appropriateness, and accuracy before incorporation into the final document to maintain the scholarly integrity of this research

Digital Accessibility Use Disclosure Statement

In the preparation of this dissertation, the following digital accessibility tools were used to ensure this document complies with federal requirements: Word for Microsoft 365 MSO (Version 2603 Build 16.0.19822.20086) 64-bit. The author acknowledges full responsibility for the intellectual content of this work and has made a good faith effort to comply with digital accessibility requirements in publishing, wherein the nature of the content does not significantly change in order to do so. Furthermore, all content has been reviewed and revised to meet these requirements prior to final publication

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Chapter 1

Introduction

The U.S. construction industry is one of the largest markets in the world. Construction represents 4.1% of the U.S. Gross Domestic Product (GDP), with expenditures estimated at 1,449 billion dollars by 2023 (Wang, 2020) The future of the U.S. construction industry is promising, with professional demand projected to outpace average growth across all occupations from 2018 to 2028 at 10%. This robust growth is a testament to the industry's resilience and potential. The U.S. construction industry currently employs over 11.3 million people, with a diverse workforce that includes 10.3% Women, 88.1% White, 6.4% African American, 1.9% Asian, and 30.4% of Hispanic or Latino descent, with a median age of 42.6 (Bureau of Labor Statistics, U.S. Department of Labor, 2020). Higher Education plays a crucial role in shaping the future of the U.S. construction industry, particularly in construction management. Through professional development, academic preparation, and assessment, it significantly impacts the competencies of construction professionals and construction project outcomes (Almashhadani & Almashhadani, 2023). This underscores the value of academic preparation in the industry.

The Construction Workforce

Construction is a highly competitive and risky industry that relies heavily on the skill set and body of knowledge contributed by its workforce. Fundamentally, the construction workforce comprises three groups: key personnel referred to as “key people,” construction management personnel, and skilled craft personnel. Key people are the owners and closely associated top managers who may be minority stockholders. There may be as few as three key people for many construction companies and one or two for smaller companies (Schleifer, Sullivan, and Murdough, 2014).

Construction management personnel are responsible for project planning, coordination, budgeting, supervision, and productivity. These responsibilities require management skills and knowledge, including leadership, communication (oral/written), others' motivation, health and safety, decision-making, and forecasting and planning (Egbu, 1999). Construction management personnel are qualified construction professionals who have gained industry knowledge through postsecondary coursework and on-the-job training.

Skilled craft personnel specialize in one or more of the 50 Construction Specifications Institute (CSI) Master Format specification divisions (i.e., division 3 concrete, division 26 electrical). Requirements include work experience, on-the-job training, and often formal vocational education, but not a bachelor's degree. Journeyman-level skilled craft personnel are considered experts and have a minimum of three years of working experience or have completed an apprenticeship program.

Construction is a fast-moving and ever-evolving industry. The construction professional's role now includes many front-end services, which increases the required skill set of new college graduates due to the influence of globalization on business and the construction industry (Choudhury, 2001). Additionally, an expanded skill set is necessary as alternative contractual delivery systems, collaborative partnerships, new management initiatives, and global markets require professionals and students to have a broader awareness of construction methods and project management issues (Ahmed et al., 2014). Relying solely on educational institutions to develop the body of knowledge for construction professionals is impractical. Back, Macdonald, and Grau (2012) suggested that a university education is no longer adequate for preparing project professionals for their future roles.

Construction Industry Educational Partners

In order to assist construction management programs with curriculum development, program standards assessment, professional development, and employment opportunities, universities have established partnerships with construction industry accreditation bodies and industry advocacy organizations such as the National Center for Construction Education & Research (NCCER), the Associated Builders and Contractors (ABC), the American Council for Construction Education (ACCE), and the American Institute of Constructors (AIC).

NCCER develops standardized construction and maintenance curriculum and assessments with portable credentials in more than 70 construction skills areas, also known as crafts, and a complete series of assessments that require students to apply newly learned classroom skills on a construction job site or at one of the over 6,000 NCCER-accredited training and testing centers located across the United States. NCCER's workforce development process of accreditation, instructor certification, standardized curriculum, registry, assessment, and certification is crucial in the industry's workforce development efforts (National Center for Construction Education & Research, 2020).

ABC is a construction industry lobbying association whose core purpose is to advance and defend the merit shop's non-union principles in the construction industry and provide members and their employees with an opportunity to succeed (Associated Builders and Contractors, 2020). ABC sponsors student chapters that operate at many universities. Members can attend conferences, compete in competitions, and apply for scholarships offered by ABC. The exposure generated by these opportunities helps students enhance their employability with companies seeking new graduates and interns.

The construction accreditation process fosters high standards for professional learning in construction and is a means of strengthening construction education (American

Council for Construction Education, 2020). It does so by requiring programs to achieve and maintain a level of quality that merits accreditation. Accreditation is a means of providing formal recognition that a program meets the industry's high educational standards and is therefore qualified to educate its future practitioners. Established in 1974, ACCE's mission is to be the leading global advocate of quality construction education and promote, support, and accredit quality construction education programs. ACCE serves over 90 construction education programs and boosts formal relationships with over 13 industry associations and corporate partners. In collaboration with its member institutions and industry partners, ACCE developed a set of guidelines that included 20 student learning outcomes (SLOs) that construction education students should achieve before graduating. The ACCE SLOs reflect Bloom's Taxonomy identification of four of the six intellectual skills and abilities as being remembering, understanding, applying, analyzing, evaluating, and creating, including the following ("Document 103B: Standards and criteria for the accreditation of postsecondary construction education degree programs," 2019):

1. Create written communications appropriate to the construction discipline.
2. Create oral presentations appropriate to the construction discipline.
3. Create a construction project safety plan.
4. Create construction project cost estimates.
5. Create construction project schedules.
6. Analyze professional decisions based on ethical principles.
7. Analyze construction documents for planning and management of construction processes.
8. Analyze methods, materials, and equipment used to construct projects.

9. Understand the role of the construction manager as a member of different multi-disciplinary project teams.
10. Apply electronic-based technology to manage the construction process.
11. Apply basic surveying techniques for construction layout and control.
12. Understand different methods of project delivery and the roles and responsibilities of all constituencies involved in the design and construction process.
13. Understand construction risk management.
14. Understand construction accounting and cost control.
15. Understand construction quality assurance and control.
16. Understand construction project control processes.
17. Understand the legal implications of contract, common, and regulatory law to manage a construction project.
18. Understand the basic principles of sustainable construction.
19. Understand the basic principles of structural behavior.
20. Understand the basic principles of mechanical, electrical and piping systems.

The American Institute of Constructors Constructor Certification Commission (2018) suggested that a practical yet efficient, comprehensive assessment process following nationally acceptable psychometric guidelines is required to ensure students receive a high-quality education. Therefore, it presented the American Institute of Constructors (AIC) Associate Constructor (AC) Level 1 certification examination as a generic assessment tool that all ACCE accredited four-year construction management programs could use to develop, implement, analyze, and improve their program's ability to evaluate the mastery of student learning outcomes. The AIC AC Level 1 Exam evaluates ACCE SLOs 6, 7, 8, and 12 – 20 while adhering to the assessment guidelines or requirements of ACCE, their institution, and their regional accreditation agency. According to (Flumo, 2020) AIC administers the AIC AC Level 1 Exam twice yearly (Spring & Fall) at over 60 university-based exam sites. About 50 construction education programs mandate the exam's use, with some schools requiring students to pass or meet another performance metric. The exam pass rate ranges from 65% to 70%. Gender and ethnicity data are optional and not required during registration. N. Flumo (2020) estimated that of the exam students, 70-75% are male, 25-30% are female, 75% are white, and 25% are minority.

Furthermore, Elliott, Thevenin, and Bigelow (2017) suggests that students enrolled in construction education programs should be empirically investigated to elucidate their role in educational pursuits and program performance and completion. Therefore, the *Construction Training Attitudes and Intentions Scale (CTAIS)* construction education domain-specific survey instrument was used to assess psychological constructs useful in understanding and predicting human behavior that influences completion and success among construction education training participants. Research indicates that domain-specific measures have greater predictive power than general measures for construction education self-efficacy (CESE), construction education motivation (CEM), and construction education planned behavior (CEPB), thereby increasing the utility of the findings for construction management faculty.

Statement of the Problem

The construction industry is ever changing, and a recognized need is for younger, diverse, and knowledgeable construction professionals. Increased spending, an aging workforce, and a surge in public, private, two year, and for profit institutions offering construction education should serve as conduits to a construction workforce revitalization. However, low participation percentages among women and minorities in construction education indicate disparities in the objectives and goals established by institutions (Escamilla et al., 2018). Moreover, the employment gap between craft personnel and construction management personnel has created a negative cultural perception among women and ethnic minorities in construction that must be addressed (Escamilla, Ostadalimakhmalbaf, and Bigelow, 2016). Furthermore, differences between enrollment and retention goals in construction education may be associated with recruitment and achievement gaps affecting women, first-generation students, minority students, students from lower socioeconomic backgrounds, and other traditionally underserved student groups in higher education as a whole (Ryan and Bauman, 2016). Notwithstanding, there is no apparent link between student performance, program curriculum, internship and co-op opportunities, and faculty with construction industry experience on achievement for construction education students.

Purpose of the Study

The purpose of this study is to examine whether a two-predictor model using grade point average (GPA) midpoint and construction education self-efficacy (CESE) can predict pass/fail outcomes on the American Institute of Constructors Level I examination. The study also examines differences in construction education self-efficacy between students who pass and those who do not pass, as well as differences in student learning outcomes and applied experience across GPA bands.

Research Questions

The following research questions guided this study:

1. Do grade point average (GPA) and construction education self-efficacy (CESE) significantly predict pass/fail outcomes on the American Institute of Constructors Level I examination?

2. Do students who pass the American Institute of Constructors Level I examination differ in construction education self-efficacy (CESE) from those who do not pass?

3. Do direct assessment outcomes (SLO_mean) and applied experience totals (exp_total) differ significantly across GPA categories?

Significance of Study

Given the construction industry's impact on the national economy, both the public and private sectors can benefit from an improved understanding of how to better recruit, retain, train, and graduate future construction management professionals. With increasing construction spending projections over the next 20 years, an aging workforce, and a deteriorating infrastructure, this research could usefully inform construction education programs, construction firms, and other partners in the built environment. A vibrant construction industry should also reflect the nation's demographics and its customers, including women and minorities. This research could provide data to aid institutions and employers in developing organizational strategic planning. Findings are based on 55 complete student records (45 pass, 10 fail). The relatively small number of failure cases limits the events-per-predictor ratio for the logistic regression model, and results should therefore be interpreted with caution due to reduced statistical power.

Assumptions of the Study

Several assumptions were applied before the study. First, the AIC AC Level 1 Exam was assumed to be a valid, domain specific indicator of student achievement in construction education programs. Second, construction education programs utilized the AIC AC Level 1 Exam as a program assessment tool. It is also feasible that students enrolled in programs that do not require passing the AIC AC Level 1 Exam as a graduation criterion may not take the exam seriously. Finally, the study assumed that employers valued credentialed construction education graduates.

Limitations of the Study

Several limitations should be considered when interpreting the findings of this study.

First, the sample size was relatively small, with 55 complete responses included in the final analysis. Although sufficient for exploratory analysis, this sample size limits statistical power and reduces the generalizability of the findings. In particular, the number of students who failed the AIC Level I Exam was low (n = 10), which constrains the ability to detect statistically significant relationships between predictors and exam outcomes.

Second, the outcome variable was imbalanced, with a substantially larger proportion of students classified as passing the exam (approximately 82%) compared to those who failed (18%). This class imbalance influenced model performance, resulting in high overall classification accuracy but poor identification of failing students. As such, the model demonstrates limited utility for identifying at-risk students.

Third, the predictive performance of the model was limited. The independent variables included in the model grade point average (GPA) midpoint and construction education self-efficacy (CESE) did not demonstrate statistically significant relationships with exam outcomes. Additionally, the model explained only a small proportion of the variance in student performance and exhibited weak discrimination ability. Therefore, the model should be interpreted as exploratory rather than predictive.

Fourth, GPA was collected as categorical ranges and converted into midpoint values for analysis. While this approach enabled the use of GPA as a continuous variable, it introduces approximation and may reduce measurement precision.

Fifth, exam performance was based on self-reported score ranges rather than official AIC Level 1 exam records. This introduces the potential for reporting bias and may affect the accuracy of the outcome variable.

Finally, the scope of predictors included in this study was limited. Although additional constructs such as construction education motivation (CEM) and construction education planned behavior (CEPB) were collected, they were not included in the final model due to data limitations. Other potentially relevant factors, such as test preparation, prior work experience, institutional differences, and nonacademic influences, were not examined and may help explain variability in exam outcomes.

Definition of Terms

The following definitions of terms are furnished to provide, as nearly as possible, clear and concise meanings of terms as used in this study.

1. Contractual Delivery System - Method for organizing and financing design, construction, operations, and maintenance services for a structure or facility by entering into legal agreements with one or more entities or parties.
2. Direct Assessment - Quantified observations and ratings of student performance
3. Front End Services - The process of developing sufficient strategic information to address risk and make decisions to commit resources to maximize the potential for a successful project.
4. Graduation - Outcome of students completing a program within a cohort, measured in six years (bachelor's) or three years (associate's)
5. Graduation Efficacy - Ability to produce a desired or intended result before graduating.

6. Gross Domestic Product (GDP) - Total value of goods produced and services provided in a country for one year
7. Indirect Assessment - Qualitative evaluations of student achievement
8. Master Format - Coding system for organizing construction documents, contracts, design specifications, and operational manuals. It uses specific numbers and associated titles that make up a universal indexing system.
9. Merit Shop - Non-union contractor
10. Persistence - Continued enrollment at any institution
11. Retention- Continued enrollment within the same institution for the fall semesters of a student's first and second year
12. Student Learning Outcome (SLO) - Specify what students will know, be able to do, or be able to demonstrate when they have completed or participated in a Course or Program

Organization of the Study

Chapter 1 introduces the study, the problem, its purpose, research questions, significance, assumptions, limitations and delimitations, and definitions of terms. Chapter 2 consists of a literature review of college choice, the field of study, retention, academic performance, and career preparation. It discusses the differences between disadvantaged and underrepresented students and their historical representation within the construction industry. Chapter 3 addresses the procedures, data collection, and data analysis of the research. It describes the methods, including sample screening that yielded 55 usable cases, instruments, and the analytic sequence (binary logistic regression (GPA + CESE), ROC curve analysis, and Welch ANOVA for GPA band comparisons). Reliability and validity evidence for the CESE scale are summarized. Chapter 4 presents the research results, including the logistic model coefficients, ROC curve, confusion matrix, and GPA band analyses for SLO and applied experience, followed by the sample's demographic characteristics. Chapter 5 concludes the dissertation with a summary, conclusions, and recommendations for further research.

Chapter 2

Review of Literature

Chapter 1 introduced the study and its purpose, articulated the research questions, and defined the problem statement, definitions, significance, organization, and limitations. Chapter 2 presents the literature review, including various relevant perspectives to provide context on the history of the construction industry, its projected future, and the nature of its personnel. This chapter also presents findings from the literature relevant to generational characteristics and tendencies, as well as to higher education, student learning, and assessment, to provide context for the research methods employed. The review includes studies from various disciplines, including education, construction, engineering, architecture, and others. Peer reviewed journal articles and proceedings publications, other dissertations, books, periodicals, and other outlets were accessed through multiple databases, and by investigating references cited in relevant articles, a thorough review was compiled to inform the study.

Purpose of the Study

This study empirically investigated whether a parsimonious two-predictor model, grade point average (GPA) midpoint and construction education self-efficacy (CESE), could predict pass/fail status on the AIC Level I Exam. In addition, the research explored how direct assessment of student learning outcomes (SLO) and applied experience totals varied across GPA bands.

Research Questions

The following research questions guided this study:

1. Do grade point average (GPA) and construction education self-efficacy (CESE) significantly predict pass/fail outcomes on the American Institute of Constructors Level I examination?
2. Do students who pass the American Institute of Constructors Level I examination differ in construction education self-efficacy (CESE) from those who do not pass?
3. Do direct assessment outcomes (SLO_mean) and applied experience totals (exp_total) differ significantly across GPA categories?

Student Success and Self-Efficacy in Higher Education

Student success in higher education has evolved beyond narrow measures such as grades or completion rates and is now understood as a multidimensional construct shaped by academic, psychological, and contextual factors. Contemporary scholarship emphasizes that student success is influenced not only by individual academic ability but also by institutional structures, access to resources, and students' sense of belonging within their educational environment (Blockett et al., 2022; Taylor, 2022). Blockett et al. (2022) draw particular attention to how these dynamics operate for historically marginalized student populations, demonstrating that success is not uniformly experienced and must be examined within broader social and institutional contexts. These perspectives collectively affirm that higher education institutions bear significant responsibility for creating conditions under which all students can thrive.

Recent work further argues that student success initiatives must account for the conditions under which students learn, including support systems, instructional practices, and opportunities for engagement (Taylor, 2022). Within this framework, psychological constructs such as motivation and self-perception play a central role in shaping how students approach learning tasks and persist through academic challenges. As a result, understanding the internal drivers of student performance has become an important component of higher education research.

One of the most widely recognized frameworks for understanding these internal drivers is self-efficacy theory, introduced by Albert Bandura. Originating in his 1977 work on behavioral change, self-efficacy refers to an individual's belief in their capacity to successfully perform tasks required in specific situations (Bandura, 1977). The concept was subsequently formalized in Bandura's social cognitive theory as an individual's judgment of their capability to organize and execute courses of action required to attain designated levels of performance (Bandura, 1986). In educational settings, students with higher self-efficacy are more likely to engage with challenging material, persist in the face of difficulty, and demonstrate higher levels of academic performance. These characteristics make self-efficacy a critical variable when examining student success across disciplines.

In addition to psychological frameworks, educational models such as Bloom's Taxonomy provide a structured way to understand how students progress from foundational knowledge to higher-order cognitive skills (Bloom et al., 1956; Anderson & Krathwohl, 2001). This progression is particularly relevant in applied fields, where students must not only acquire knowledge but also demonstrate the ability to apply, analyze, and evaluate concepts in real-world contexts. The integration of cognitive development frameworks with self-efficacy theory provides a more comprehensive understanding of how students learn and perform in academic environments.

Taken together, these perspectives suggest that student success is best understood through a combination of external conditions and internal beliefs. Within this study, Construction Education Self-Efficacy (CESE) is examined as a domain-specific application of self-efficacy theory, reflecting students' confidence in their ability to perform tasks related to construction education. Drawing on Bandura's (1986) foundational framework, CESE operationalizes self-efficacy within the applied context of construction education, where technical competence and procedural knowledge are central to academic and professional performance. Positioning CESE within the broader higher education literature provides a theoretical foundation for examining how psychological factors interact with academic performance in applied disciplines. This framework also supports the interpretation of findings and informs the recommendations presented in Chapter 5. The CESE construct is grounded in Bandura's (1977) self-efficacy theory and reflects students' perceived capability to perform tasks within the construction education context.

The History of Construction

It is essential to understand the evolution of the related industries of the built environment and how the design and construction professional disciplines have behaved and changed over time. As this research focused on student achievement in the construction education domain, it is also necessary to better understand the target population and the role higher education plays in developing future construction industry professionals.

Construction in Ancient Civilizations to the Nineteenth Century

The practice of construction, encompassing agriculture, shelter, and transportation, has evolved over nearly four thousand years, influenced by early civilizations like the Mesopotamians and Egyptians. These societies established sophisticated techniques and legal codes, such as King Hammurabi's code, which mandated professional accountability in construction.(Beard, J.L., Loulakis, M.C., & Wundram, E.C., 2001).

During the Roman Empire, architect Marcus Vitruvius documented design processes, emphasizing the importance of a comprehensive knowledge base for builders. Following the fall of Rome, the Renaissance revived architectural significance, as seen in the work of figures like Filippo Brunelleschi and Leon Battista Alberti (Beard et al., 2001). The latter distinguished art from craft and emphasized design through drawings, leading to a division of architectural responsibilities that solidified in the mid-18th century with the rise of formal architectural education at the École des Beaux-Arts in Paris (Thomsen & Sanders, 2011).

The United States's Role in Advancing the Construction Industry

During the mid-1800s, the United States emerged as a prominent leader in progress and creativity. Despite being partially disrupted to some extent by the Civil War, the mid to late 19th century Industrial Revolution significantly influenced the design and construction industry. Entrepreneurship facilitated the development of task, labor, and skill specialization, leading to significantly more elaborate structures and other human-made advancements in the built environment (Beard et al., 2001). The advent of electricity quickly led to the development of new motors, pumps, elevators, and other technological advancements and mechanisms by which buildings and civil projects were enhanced (Hughes, 1984). Another significant technological breakthrough during that period was the transition from structural iron to carbon steel, allowing designers and engineers to increase the span and height, overcoming historical limitations. Mechanical engineers began to specialize in air conditioning by the 1950s. Thomsen and Sanders observed, "The past 150 years have seen breathtaking technological change and economic vitality driving ever-increasing specialization and fragmentation" (Thomsen & Sanders, 2011, p. 11).

Amidst the Industrial Revolution in the 19th century, another significant development entailed the establishment of professional groups and organizations associated with design and building. The American Society of Civil Engineers was established in 1852 and is the oldest engineering society in the nation (American Society of Civil Engineers, 2016). The

American Institute of Architects was also established in the United States in 1857 to advance its members' scientific and practical perfection and elevate the profession's standing (American Institute of Architects, 2016). These newly established groups offered their members specialized expertise, industry best practices, support for markets, and the earliest stages of accepted contract language (Thomsen & Sanders, 2011), which maintained and further promoted the division between the design and construction disciplines. Disciplinary segregation coincided with the emergence of formal licensure. The Miller Act of 1935 was a significant legislative achievement that greatly influenced the establishment of a clear distinction between design and construction. Among other things, the main objective of the measure was to mandate separate bonds for both payment and enhancing the efficiency of federal construction projects to safeguard the interests of the government and stakeholders (Wallick & Stafford, 1964). The legislation intensified the differentiation between the fields, as companies focusing on the design phase did not include or could not undertake the project's building aspect.

While construction practices in ancient civilizations were largely based on craft knowledge and manual techniques, the field has undergone significant transformation with the advancement of engineering principles, materials science, and project management methodologies. Over time, construction evolved from a trade based practice into a complex and interdisciplinary field requiring formal education and specialized training.

The emergence of construction as an academic discipline was driven by the increasing complexity of the built environment and the need for a skilled workforce capable of managing modern construction processes. This shift led to the development of construction management and construction science programs within higher education institutions, where students are trained to integrate technical knowledge with practical application. As a result, construction education now plays a critical role in preparing students for professional practice and industry demands.

Developing Construction Professionals

Science scholars suggest that the national economy depends on science, technology, and mathematics (STEM) graduates with 21st-century skills, including critical thinking, communication, and collaboration. Construction engineers, construction managers, and skilled workers typically have these competencies. A study on secondary students' (n=9,880) attitudes towards STEM showed that students generally had a moderate interest in STEM careers, including those in the construction industry. Most students (51.4%) showed interest in veterinary work, while the smallest group (29.8%) was interested in physics careers. The study also indicated differences per gender and racial demographics, with females (30%) less interested in engineering careers and Asian students (47%) showing the most interest in STEM careers. Nevertheless, university and industry programs aim to address the need for workers with STEM competencies and 21st-century skills and close the STEM competencies. The 21st-century skills achievement gap between United States and global students continues to rise (Faber et al., 2013).

Likewise, college STEM students have shown a reluctance to pursue STEM-based construction industry careers despite the high demand, high placement rates, and high salary opportunities, albeit for an entirely different reason other than the lack of STEM competencies, 21st-century skills, or the challenges of design and construction curricula. For example, in a university survey of 30 senior-level engineering students, 81% of whom have construction industry experience, half stated that they would not pursue a construction career after graduation. The common theme among those with limited experience in or no knowledge of the construction industry is hot, dangerous, tedious, and inconsistent work with extended hours. However, worker quality of life issues did not hinder those entering the construction industry. Instead, they viewed opportunities such as problem-solving, hands-on work, travel, and the ability to see the project process from initiation to close-out as an incentive to pursue a career in the construction industry (Engineering News-Record, 2014). In addition, employers in various sectors value a building and construction industry graduate due to technical skills, business knowledge, and communication skills. First, it is essential to understand how construction engineering, construction management, and skilled trades differ and the practitioners' development requirements in these personnel sectors.

Construction Engineering

Regarding construction engineering, the Alabama Building Code describes the practice of engineering as any professional service that requires engineering education, training, and experience in the application and exceptional knowledge of mathematics, physical and engineering sciences. The services may include utilities, structures, buildings, mechanical and electrical processes, projects, and other activities. The engineering practice does not include architecture, machinery, or machinery and equipment operators. A professional engineer has obtained a license from the State Board of Licensure for Professional Engineers and Land Surveyors and is qualified to practice engineering (Alabama Building Code Title 34. Professions and Businesses, 1975). However, construction engineering may be an overlooked discipline by most seeking an engineering degree. Engineering generally consists of four major primary branches: chemical engineering, civil engineering, electrical engineering, and mechanical engineering, with construction engineering being one of the numerous subdisciplines and interdisciplinary subjects (Frodeman, Klein, and Pacheco, 2017).

Moreover, of the 765 U.S. institutions with ABET-accredited engineering programs, only 55 offer a degree in construction engineering or construction engineering technology (Accreditation Board for Engineering and Technology, 2020). Nevertheless, the need for construction engineering programs remains as great as it did over two decades ago when Tener (1996) stated, "The practice of construction engineering and management in the United States increasingly demands professional engineers who are capable of solving technical, management, social, political, and leadership problems as tough as those faced in any other engineering discipline." Consequently, individuals seeking professional engineering careers in the construction industry typically pursue an undergraduate degree in civil engineering or construction engineering.

The origins of construction education can be traced as early as the first part of the twentieth century as a part of the practical aspects of many early civil engineering degree programs (Abudayyeh et al,. 2000). Increased specializations in construction engineering after World War II forced civil engineering programs to develop construction specialty degree undergraduate programs (Oglesby, 1990) such as structural engineering, environmental engineering, mechanical, electrical, and plumbing (MEP), and heating, ventilation, and air conditioning (HVAC). Evolving from the roots of civil engineering, Oglesby (1990) suggested that construction engineering education focuses on the building life cycle from conception, design, and procurement through construction, operation, and maintenance. Furthermore, Abudayyeh et al. (2000) indicated that construction engineering undergraduate education would lead to a B.S. degree, with most graduates entering construction industry careers related to the design of facilities as environmental, geotechnical, structural, transportation, or water resources engineers. At its 2011 conference, the American Society of Civil Engineers defined construction engineering as "the series of technical activities throughout the project delivery process that supports construction and constructability decisions and plans along with field operations; create a safe and productive construction environment; and seek to avoid and solve the engineering issues associated with delivering a project" (McTavish & Stallard, 2011, p. 729). The definition aligns with Johnston and Marceau's (1995) assertion that construction is a process that must be designed (engineered) and managed; however, due to the technical nature of construction engineering and the program curriculum's breadth, the management aspects of construction engineering are often overlooked. Industry experts suggested:

> No matter how elegant an engineering solution can be, it can only be effective if it is communicated. Therefore, the construction engineer must be taught how to solve a problem and communicate the solution across educational, cultural, and language barriers (McTavish and Stallard, 2011).

Construction Management

The construction industry is continuously changing. To keep up, construction companies must adapt to new construction building technology and management systems changes that tend to occur every 10-15 years. Therefore, an emphasis on understanding and responding to change weighs squarely on the personnel managing construction projects. However, the most detrimental risk to construction companies is the need for more available personnel in leadership roles due to the construction industry's response to change. (Scott, 2020) cites the rapid retirement rate of baby boomers and the 2001-2009 recession as significant contributors to the current shortage of construction managers. She also suggests that persistent COVID-19 economic downturns may further exacerbate the available construction personnel leadership gap. As an essential core competency of construction managers, leadership skills are an increasingly important objective for globally competitive construction companies (Back et al,. 2012). Therefore, in addition to applying technical competencies, construction managers must draw upon their understanding of operations management, organizational behavior, and communication knowledge and techniques developed through industry and academic experience (McCarthy, 2010). In addition, research has concluded that industry-university partnerships are beneficial to effective joint strategic planning, curriculum development, industry advisory committee involvement, student and faculty internships, and outcome-based success measures (Tener, 1996).

The American Council for Construction Education (ACCE) fosters high standards for professional learning in construction through accreditation and the promotion of industry-university partnerships. ACCE serves over 90 construction education programs and boosts formal relationships with over 13 industry associations and corporate partners. In collaboration with its member institutions and industry partners, ACCE developed guidelines that included 20 student learning outcomes (SLOs) that construction education students should accomplish before graduating (American Council for Construction Education, 2020). A student's ability to create project schedules and cost estimates, analyze documents, materials, and equipment, and apply technology to manage the construction process correlates to a construction manager's essential attribute to plan, schedule, and control construction operations.

Practical experience gained by full-time employment after graduation and co-op or internship opportunities as an undergraduate, helps establish a basic grounding in construction fundamentals and the development of the construction manager's time horizon. Ideally, 1-3 years of project field management experience is necessary for time horizon development. Entry-level construction managers must know how projects work and have a time horizon that expands the project's entirety. However, more experienced construction managers responsible for corporate strategy and business development and undertaking tasks and project types outside their area of expertise, may have time horizons that span a career or longer (McCarthy, 2010). Nevertheless, the essential attributes of experience, project control management, and forecasting will have limited effectiveness without the ability to work harmoniously with other people. The construction manager must have the personality and insight that will enable them to delegate tasks, administer conflict resolution, and provide direction to project personnel, often under tense and difficult circumstances. Doing so requires an appreciation and understanding of the human factor (Sears, Clough, and Sears, 2008).

Skilled Trades

The skilled craft workforce is the heart of the construction industry through its competitiveness and availability to implement construction expertise (Rowings, Federle, and Birkland, 1996). Whereas engineers and construction managers are responsible for designing and managing construction projects, skilled craft personnel are relied upon to carry out construction methods learned through years of practical application in the construction trades. Mechanical skills, emphasis on production, use of hand tools, and pride in work quality broadly identify this group of construction industry workers, as skilled craft personnel typically find gratification in transforming raw materials into a finished product (Tidewater Technology Associates, 1985). The availability of this personnel group critically impacts construction project cost performance. Skilled craft personnel specialize in one or more of the 50 Construction Specifications Institute (CSI) Master Format specification divisions (i.e., division 3 concrete, division 26 electrical).

In 1997, the National Center for Construction Education and Research (NCCER) found that most U.S. construction firms (92%) reported shortages in skilled labor. Relative to later state statistics, research indicates that 62% of Alabama's general contractors need more qualified, skilled craft personnel (Olsen et al., 2012). Demographic changes contributed to the current labor shortage in the U.S. workforce, particularly in the construction industry, which was predicted as early as the 1980s (Fullerton, 1998). Moreover, emerging technology, skill development changes, and the negative image of construction also impacted the skilled construction workforce (Chini, Brown, and Drummond, 1999).

Estimates indicated that through the year 2000, the American white male (41%) would be the largest single demographic in the 140 million U.S. workforce. However, an increase in women, minorities, and immigrants in the workforce required the U.S. construction industry to modify its recruiting and training efforts for this diverse demographic to respond to the pending deficit attributed to the aging white male construction worker (Packer and Johnston, 1987). Currently, the U.S. construction industry employs over 11.3 million people, consisting of 10.3% Women, 88.1% White, 6.4% African American, 1.9% Asian, and 30.4% of Hispanic or Latino descent, with a median age of 42.6 (Bureau of Labor Statistics, U.S. Department of Labor, 2020). Nevertheless, despite available job opportunities, the construction industry winning the battle for a younger, diverse workforce was not inevitable due to more lucrative benefit packages, hourly wages, and stability found with manufacturing companies (Roths, 1998).

Customarily, the construction skilled craft worker relied on trade unions for placement opportunities and education via apprenticeship programs and on-the-job training. However, in the early 1980s, open-shop (non-union) companies' evolving business practices loosened trade unions' influence in the construction industry. However, Kadlub (1998) suggested that non-union companies should have done better and improved the skilled labor pool by providing training methods that were shorter and less effective than traditional union instruction. Of further consequence was the rising dilemma relative to the apparent stigma cast upon the construction worker, as cited by one researcher:

The term "construction worker," embodied as the unskilled manual laborer, has negative connotations for young people. To youngsters, "construction workers" are ditch diggers they see calling obscenities to passersby, loafing on the job. Most associated with dirt, sweat, and a gruff demeanor, the construction worker lacks prestige, class, and respectability (Rosenthal, 1990).

As the U.S. construction industry searches for long-term solutions to the skilled craft worker shortage, it may find solace in the efforts made at the regional level by independent agencies such as the Alabama Industrial Development Training (AIDT), which encourages economic development through job-specific training. Established in the fiscal year 1970-71 as a contract program reporting to the State Board of Education through the Department of Education Division of Vocational-Technical Education, AIDT is the primary sponsor of the Construction Trades Training (CTT) program. CTT aims to provide career pathway opportunities to high school graduates and second chance options for "Ready to Work" program graduates via developing skillsets that lead to well paid and in-demand jobs (Telfair, 2018). The result of similar recruitment and vocational education programs may stem the adverse effects of an aging workforce, the elimination of vocational training in high schools, and the emphasis on college for high school graduates on the skilled craft workforce.

Theoretical Contributions of Higher Education as Practice

Viewing higher education as practice involves seeing teaching, learning, and assessment as socially situated, historically informed, and purpose-driven activities, not just technical functions. This perspective, derived from practice theory (Bourdieu, 1977; Kemmis et al., 2014), emphasizes the co-constructive nature of meaning-making by educators, students, and institutions within patterned actions, shared norms, and power-laden contexts. Within this framework, learning outcomes, assessment, and student success are not neutral mechanisms, but intentional practices grounded in equity commitments and disciplinary epistemologies.

Practice Theory and Higher Education Teaching

In practice, higher education draws on theories of habitus, praxis, and professional judgment. Bourdieu (1977) proposed that practices are rooted in embodied dispositions of social structures, and Kemmis et al. (2014) referred to “practice architectures” as the cultural, material, and social conditions that make possible or limit educational work. In higher education, this framing reveals the interactions between curricula, pedagogy, and policy and how these shape student experiences, especially for historically marginalized learners.

Drawing on practice-based approaches, scholars such as Blockett (2022) and Taylor Jr. (2022a, 2022b) focused on racialized and minoritized identities. Blockett’s work on Black queer men in education shows how classroom practices can affirm or marginalize students through everyday pedagogical decisions. Taylor Jr.’s scholarship highlights the role of institutional practices on Black male identity development and persistence and reminds us that teaching is inherently relational and political.

Student Learning Outcomes and Bloom’s Taxonomy

Bloom’s Taxonomy (revised by Anderson and Krathwohl, 2001) is a practice-based taxonomy. It is not just a cognitive hierarchy, but a design practice that purposefully guides the alignment of learning goals, instruction, and assessment. Clear Student Learning Outcomes (SLOs) are the way in which institutional values and disciplinary standards are made measurable and the way in which subjective educational goals are translated into observable actions.

Applying Bloom's taxonomy logically, educators transition from surface-level cognitive skills to higher-order practices such as critical analysis, knowledge creation, and ethical reasoning. This supports Shulman's (2005) concept of signature pedagogies, which emphasize how professional ways of thinking are developed through authentic practice that is repeated.

Assessment as a Mode of Reflective Practice

Assessment as a practice activity in higher education is fundamentally a learning-centered and equity-informed activity. Wiggins and McTighe (2005) suggest that assessment should be backward designed to support meaningful learning and transfer. Assessments are not just accountability measures, but also reflective practices that inform teaching, support student growth, and reveal structural inequities.

Practice-oriented assessment is about students showing what they have learned and whose knowledge counts. Blockett et al. stress the significance of culturally responsive assessment practices that validate diverse modes of expression and meaning making, thereby fostering more inclusive conceptions of academic excellence.

Learning Styles, Agency and Student Engagement

Although the notion of fixed learning styles has been empirically challenged (Pashler et al., 2008), a practice-based perspective shifts the focus to learning preferences, strategies and agency. Effective teaching practices recognize that students vary in their engagement with content and create flexible learning environments that offer multiple pathways to mastery.

Taylor Jr. emphasizes the importance of pedagogical practices that acknowledge students' lived experiences and cultural knowledge and connect pedagogy to identity and belonging. Such practices enhance engagement and persistence, especially for students navigating historically exclusionary educational spaces.

Student Success as an Emergent Practice

Finally, student success is not an individual trait but an emergent outcome of institutional practices. Tinto (2012) underscores that persistence is influenced by classroom experiences, academic support, and meaningful interactions between faculty and students. From a practice perspective, transforming the everyday practices of teaching, advising, and assessment is necessary to foster belonging, competence, and purpose to improve student success.

Blockett and Taylor Jr. collectively demonstrate that equitable student success requires an understanding of the ways power, identity, and practice intersect in higher education. The contributions offered a vision of higher education as a moral and social practice aimed at justice, inclusion, and transformative learning.

Recognition of Construction as a Discipline in Higher Education

American colleges and universities continue to make substantial changes to their construction curricula in response to the shifting demands of the construction industry. Colleges and universities started acknowledging construction as a separate discipline in the early 1970s, apart from architecture or civil engineering. As a result of this acknowledgment, specialized programs in construction management and construction engineering were established, offering students specialized instruction and training in project management, construction practices, and construction law. The development of stand-alone construction programs cleared the path for an all-encompassing and targeted approach to construction education. In response to the need for program assessment or certification, accreditation bodies such as the American Council for Construction Education (ACCE) were established (American Council for Construction Education, 2020).

Integration of Industry Partnerships and Professional Development

Establishing robust partnerships with construction companies, industry associations, and professional organizations has enabled universities to effectively bridge the gap between academia and industry. Industry professionals visit the classroom through these partnerships, exposing students to contemporary business practices and offering networking opportunities. Most construction management programs encourage students to pursue professional certifications, such as the Certified Construction Manager (CCM), Certified Professional Constructor (CPC), or LEED accreditation, enhancing their marketability and demonstrating their commitment to ongoing professional development. Often, professional certifications require a prerequisite certification or pre-exams that higher education programs use as student learning assessments. The Fundamentals of Engineering (F.E.) exam, part one of the two-part exam for licensure as a Professional Engineer (PE), can be an assessment tool for university engineering schools and their engineering libraries. University engineering libraries can evaluate their collections and determine whether they meet the needs of their engineering students by examining the F.E. exam results provided by the National Council of Examiners for Engineering and Surveying (NCEES) (Bossart 2021).

Construction management programs at universities accredited by the American Council for Construction Education (ACCE) must assess programmatic student learning outcomes (ACCE, 2020). Every program must submit a quality improvement plan to ACCE based on the assessment findings (ACCE, 2020). This assessment aims to ensure that the program is continuously improved. The Associate Constructor (AC) exam was developed by the American Institute of Constructors (AIC) Constructor Certification Commission (CCC). To become a Certified Professional Constructor (CPC), candidates must pass the A.C. exam, the first of two certification levels offered by AIC. It consists of 300 multiple-choice questions administered over one day in two four-hour blocks. Skills and knowledge are measured and reported within the subject areas: 1. Communication Skills; 2. Engineering Concepts; 3. Management Concepts; 4. Materials Methods Project Modeling and Visualization; 5. Bidding and Estimating; 6. Budgeting and Cost Control; 7. Planning and Scheduling; 8. Construction Safety; 9. Construction Geomatics; and 10. Project Administration (Leathem et al., 2018). These exams focus on performance in specific subjects rather than overall passing rates for assessment purposes. Programs that require all their students to take the exam, regardless of whether they require students to pass the exam to graduate, can use the exam results as a curriculum evaluation tool.

Integration of Practical Industry Experience

Over the past fifty years, colleges have emphasized the value of real-world experience in construction education. Cooperative education programs, internships, and industry partnerships were developed to provide students and faculty with real-world exposure and hands-on learning opportunities. Students and faculty are better equipped to handle the demands of the construction field and gain valuable insights into the industry's complexities by working on projects with professionals. Construction professionals who have spent time in private and public companies are finding professional opportunities open to them in academia. Many schools are hiring professors of practice who focus on preparing students for the "real world" of the built environment. These faculty were typically off the tenure track and focused on teaching rather than research. Significant industry experience allows these faculty to fill a niche in their college that might have been ignored due to the lack of faculty with such experience. Their value in higher education is varied and appreciated, as they can provide unique perspectives and skills, access to new networks, and knowledge concerning how to craft win-win partnerships between universities and companies. Before entering academia, these practitioners may have been responsible for or participated in industry-university relations, for which they liaised with academia for student recruitment, continuing education for employees, and research partnerships (Levine, 2015).

There are also opportunities to join a university later in life as an adjunct professor. Often, these positions were created to leverage knowledge and aid the expansion of undergraduate research programs or degree tracks. To promote residential construction education, ACCE awards a Dupree Construction Education Fund up to $5,000 in conjunction with the National Housing Endowment to a candidate pursuing an advanced degree in construction management with a desire to teach residential construction in an ACCE accredited construction management program.

However, according to (Mccuen, 2007), the significance of industry experience as a prerequisite for new faculty members has been undermined by favoring a doctoral degree in construction education programs' hiring procedures at universities in the United States. Examining the job postings from 1992 through 1994 determined that 71% of the selected sample necessitated prior expertise in the field. However, they must still specify a Ph.D. or doctorate as a mandatory qualification. An examination of the job postings made in the autumn of 2006 indicated a decrease in the necessity for prior experience since only 60% of the newly available academic posts demanded industrial expertise. In addition, out of the 37 job announcements made in the fall of 2006, 14 or 38% specified that a Ph.D. or doctorate was necessary. Furthermore, it is noteworthy that out of the 14 programs that necessitated a doctoral degree, only 3, or 21%, demanded any industrial experience in conjunction with the Ph.D. or doctorate. These findings corroborate the observed pattern that industry expertise is becoming less necessary for construction faculty while a doctoral degree is increasingly preferred. The average tenure necessary for individuals applying for the academic vacancies advertised was 3.8 years. This average is calculated solely from the announcements that explicitly state the minimum number of years of industry experience needed for the post. The average duration of 3.8 years differs from scientific studies on the time needed for knowledge accumulation and the development of expertise in a particular subject area (Mccuen, 2007).

Nevertheless, the departure of experience as a required credential for new construction faculty is counterintuitive because it removes expert industry knowledge from the classroom in an applied science discipline. Results from Leinhardt and Greeno's (1986) examination of expert-novice differences in teaching concluded that teaching is a complex cognitive skill that "requires the construction of plans and the making of rapid inline decisions" in a "relatively ill-structured dynamic environment" (Leinhardt & Greeno, 1986, p. 75). Experience is how cognitive skills evolve from novice to expert-level status. This link of experience to expert teaching is essential in educating construction students.

Since the establishment of the American Council for Construction Education (ACCE) in 1974, the construction education sector at universities and colleges in the United States has undergone significant transformations to accommodate the industry's ever-evolving requirements. Educators have been able to better prepare students for successful careers in the construction industry by acknowledging construction as a distinct discipline, incorporating practical experience, and cultivating partnerships with industry organizations. As the industry continues to evolve, construction education programs must remain dynamic, continuously adapting to emerging trends and technologies, ensuring that graduates are equipped with the skills and knowledge needed for the future of construction (Liska, 2002).

History of the Oldest US Construction Education Baccalaureate

Booker T. Washington, a Hampton Institute alumnus and former enslaved individual, was assigned the ab initio role of establishing a school without land, faculty, or students.

Tuskegee University originated in a modest room adjacent to Butler Chapel AME Zion Church in Tuskegee, Alabama, and then expanded to 100 acres with a brick kiln; it now spans 5,000 contiguous acres featuring over 100 structures. Several original structures were designed by Robert R. Taylor, the first African American Massachusetts Institute of Technology graduate and an architect engaged by Booker T. Washington, in whose honor Tuskegee University's School of Architecture and Construction Science is named.

In 1883, Tuskegee University provided vocational training for African Americans in tin smithing, brick making, painting, and plastering. It was among the inaugural programs at a Historically Black College and University (HBCU) nationwide. The Tuskegee program equipped African Americans to become master builders, responsible for America's largest concentrated physical enterprise, constructed entirely by African Americans for its designated purpose and occupancy.

The Construction Science and Management (CSM) Program, formerly known as Building Contracting, was established in 1933 as a four-year degree program within the Department of Mechanical Industries and continues to uphold the University's founding principle of "Learning to do by doing." The updated CSM curriculum offered professional training in construction project management. The program can be completed in four years and provides diverse courses, including construction methods, sustainability principles, surveying, project controls management, building information modeling, business, humanities, physical sciences, and general studies. The four-year construction science curriculum cultivates "Project Ready" construction professionals adept in managing personnel, finances, time, and physical resources while comprehensively understanding the quality and safety standards mandated for all construction professionals.

In 2010, the Board of Trustees elevated the architecture and construction science departments from the College of Engineering, Architecture and Physical Sciences (CEAPS) to the Robert R. Taylor School of Architecture and Construction Science (TSACS). The Taylor School, situated in the Willcox A, C, and E buildings, is founded on a belief in the power of architecture and construction science to uplift the human condition and give form to society's highest aspirations. Students are equipped to become civic architects and community leaders who articulate a vision for improved communities.

Students gain advantages from the CSM Co-op/Internship Program by obtaining college credit for employment in their major discipline, generating income for tuition and expenses, translating academic knowledge into practical experiences, cultivating a professional network, and enhancing professionalism and self-assurance. The current curriculum offers additional training and certifications, including OSHA 10 & 30 Hour, Erosion Control Management (QCI), and Landscape Management (Hunt, 2018).

Underrepresented Construction Education Students

According to the Bureau of Labor Statistics (BLS), in 2018, the United States (U.S.) is expected to grow around 10 percent in the demand for construction managers from 2018 to 2028. This growth rate is higher than the average for other professions. Individuals immediately seeking high-paying construction management careers must possess construction industry expertise and hold a bachelor's degree in a construction-related subject (BLS, 2018). In response to the growing demand for skilled construction workers, many postsecondary institutions have implemented construction management (CM) programs to attract, educate, and graduate exceptional undergraduate students. Moreover, many universities, especially public ones, are responsible for offering educational opportunities to a wide range of students, specifically those who have historically been underrepresented or underserved in higher education (WSU CM Strategic Plan 2015-2020, 2015; Texas A&M Strategic Plan 2016-2021, 2016). Despite the objectives and goals established by various institutions, the participation rates of women (usually less than 10%) and minorities (possibly less than 20%) in CM education reveal discrepancies between the intended outcomes and the actual results (Escamilla et al., 2018; Shane et al., 2012; Del Puerto et al., 2011). Possibly, the differences in enrollment and retention goals in CM higher education may be linked to the widely acknowledged recruitment and achievement gap concerning women, first-generation students, minority groups, individuals from lower socioeconomic backgrounds, and other historically underserved student populations in CM education and higher education in general (Ryan & Bauman, 2016; Bailey et al., 2011; Inman & Mayes, 1999).

Female Students in Construction Education

Women in the United States have a greater enrollment and graduation rate from postsecondary institutions than men (Ryan & Bauman, 2016; Lopez & Gonzalez-Barrera, 2014). However, women globally still have much lower enrollment rates in construction education programs than men (Oo & Widjaja, 2018; Shane et al., 2012; Del Puerto et al., 2011). Del Puerto et al. (2011) found that the proportion of female undergraduate students completing a CM program at a Western institution in the United States varied from 4.6% to 12.6% between 2000 and 2010. The average percentage throughout the ten years was 7.9%. Shane et al. (2012) observed a consistent decrease in the proportion of female undergraduate students studying construction engineering at another university in the U.S. Midwest. The ratio dropped from around 10% in 2000 to 7% in 2006. In contrast, Oo and Widjaja (2018) documented a rise in the enrollment of female students at three Australian universities from 2006 to 2015. One institution slightly increased the number of female students by just under 5%. However, the other two universities had enrollment rates that started at around 10% in 2006 and ended at over 17% in 2015 (Oo & Widjaja, 2018).

Several reasons have been suggested to discourage women from pursuing educational and career paths in construction, worsening the gender disparity in the field. The factors contributing to the negative perception of the construction industry are 1. a negative image of the industry (Menches & Abraham, 2007); 2. a culture dominated by men and characterized by oppression (Amaratunga et al., 2006; Dainty et al., 2000); and 3. a lack of awareness and knowledge about career opportunities in construction (Amaratunga et al., 2006; Moore & Gloeckner, 2007). In order to address these and other issues that discourage participation, researchers have investigated the characteristics associated with the recruitment and retention of females in the field of CM. Bigelow et al. (2015) conducted a study to determine the factors most strongly correlated with females' decision to pursue a CM degree. They found that internships, career opportunities, and having a father working in construction were the factors with the highest correlation. On the other hand, mentoring, high school counselors, and work experience were found to have the lowest correlation. These findings contradict the criteria proposed by Del Puerto et al. (2011) and Moore and Gloeckner (2007), which suggested that mentoring and work experience are essential variables for luring women into the construction business.

Minorities and Latinos in Construction and Higher Education

Extensive documentation exists on the disparities in occupation between individuals of Latino and non-Latino backgrounds within the construction sector. Between 2012 and 2016, Latino workers comprised 69% of new construction hires and represented 36% of the overall construction and extraction labor force in the United States. However, they only comprised 12.4% of construction managers during the same period. There is also a comparable disparity in higher-education achievements for Latinos. As of 2016, the percentage of Latinos in the United States who were above 25 and had a bachelor's degree was only 15.5%, whereas the percentage of non-Latino Whites with a bachelor's degree was 36.2% (Ryan & Bauman, 2016). Escamilla et al. (2018) observed an increase in Latino students enrolling at Texas A&M University from 2008 to 2012, a positive development for Latinos pursuing higher education in construction. Similar to Latinos, minority students, as a whole, encounter an educational disparity in higher education. According to Ryan and Bauman (2016), the percentage of black students over 25 with a bachelor's degree is only 22.5%, whereas the percentage of whites is 36.2%.

Students eligible for Pell Grants in higher education

The Federal Pell Grant Program offers financial assistance through need-based grants to economically disadvantaged undergraduate and post-baccalaureate students to increase access to higher education. Although only income determines Pell eligibility, students who qualify for Pell Grants are more likely to be members of historically underrepresented groups in higher education. During the 2011-2012 academic year at public 4-year schools, a higher percentage of black students (62.0%) and Latino students (51.9%) received Pell grants compared to white students (29.9%) (Trends in Pell Grant Receipt 2015). Individuals from economically disadvantaged backgrounds have lower enrollment and completion rates in higher education than their peers (Bailey & Dynarski, 2001). Nevertheless, Pell's assistance enhances the probability of minority students' graduation (Chen & DesJardins, 2010).

First Generation Students in Higher Education

First-generation (first-gen) students are individuals enrolled in a university or college whose parents have yet to obtain a bachelor's degree (Pike & Kuh, 2005). Approximately

25% of undergraduate students in the United States are first-generation, according to Redford & Hoyer, (2017). First-generation students, individuals whose parents did not obtain a bachelor's degree, are more likely than continuing-generation (con-gen) students to identify as a racial minority and originate from a family with a lower socioeconomic position (Inman & Mayes, 1999). In addition, first-generation students have a lower likelihood of attaining a bachelor's degree. Engle and Tinto (2008) found that only 11% of first-generation students who entered a bachelor's degree program completed their degree within six years, while 55% of their counterparts from continuing-generation backgrounds did so.

Assessing the Equity Gap in Construction Education

Research on correcting the disparities in CM education is lacking, particularly when it comes to women and, to a lesser degree, minority students. However, a study by (Burgoon et al., 2020) found that while male students were retained at a similar rate as female students, there was an equity gap for female transfer students. The study suggests that the critical time to address retention is during the first few years of enrollment when students experience higher-than-average department attrition rates. Female transfer students left the CM program at a higher-than-average rate, and by the eighth year, they were 11.1% less likely to remain enrolled or graduate than the average transfer student.

Middle-class, non-minority, and Latino students retain at a similar rate to the average, but minority and Latino students experience more variability than non-minority students. Equity gaps are evident for all populations. New minority and transfer Latino students graduated or remained enrolled in the CM program at higher than average rates by the eighth year. However, between the second and sixth years of evaluation, new minority and transfer Latino students remained enrolled at a lower-than-average rate.

New non-Pell-eligible and transfer Pell-eligible students were retained at a slightly higher rate than the average but experienced increased variability, especially during the fifth-year observation. There is an equity gap for transfer non-Pell eligible students, with them experiencing a slow decline in retention or graduation. The equity gap for new Pell-eligible students is more extensive, with students leaving the program at a concerning rate by the second year and less likely to remain enrolled or graduate by the eighth year.

A targeted focus by faculty on 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). Construction science, construction technology, and construction management are all derivatives of civil engineering, and engineering and construction share the concept of masculinity. Engineering tends to attract more middle-class or upper-middle-class males, while construction tends to attract more working-class males. Moreover, most higher education instructors specialize in their degree field and have not been exposed to education foundations courses, let alone diversity, equity, and inclusion courses. Suppose they have not simply progressed straight through their education from undergraduate to doctorate. In that case, they bring with them into their classrooms not only the methods of teaching they learned from their previous professors (white males) but also attitudes and experiences from the work environment that are often biased and abusive towards females. Eisenberg (1998) supported this claim and referred to the ongoing psychological, physical, and sexual abuse that women who work in the construction industry experience, particularly on construction job sites. Foley (2007) questioned how faculty experiences impacted pedagogy on their interactions with female students and the lack of preparation most professors have before entering the classroom. Foley's research deconstructs masculine technocratic pedagogy in engineering and construction science education, suggesting the incorporation of liberative pedagogies. Liberating the construction classroom from improper masculinity requires teachers, instructors, and professors to have cultural awareness in various areas, including gender, class, race, and sexuality. Professors should show compassion in their attempts to educate individuals and incorporate students' life experiences into the classroom. Critical educators need to understand, affirm, and analyze these experiences, using them in ways that neither unqualifiedly endorse nor delegitimate them (Foley, 2007).

Graduating Disadvantaged College Students

In 2019, the RAND Corporation defined disadvantaged students as students whose family, social, or economic circumstances hinder their learning at school. Consequently, these circumstances may still exist when a disadvantaged student decides to attend college. Once a disadvantaged student enrolls in college, the emphasis shifts to the importance of retention and graduation. One of the most challenging goals for any college is to increase retention, but it is one of the most important goals due to its direct effect on graduation rates. "Student success is predicted by continuity and intensity of the enrollment, along with the content of the curriculum" (Handel, 2009, p.52). Students cite numerous reasons for withdrawal from college, including family reasons, lack of time, academics being more complicated than thought, financial aid, and wrong fit with the school, among other issues. In addition, some students are not prepared for college and suffer grade inflation in high schools (Moen & Martin, 2010). Demographic, academic, and financial factors influence disadvantaged college students (Braunstein, Lesser, and Pescatrice, 2008). Therefore, college choice, the field of study, academic performance, and career preparation are critical factors to the graduation efficacy of disadvantaged college students.

College Preparation

The Pell Institute (2022) highlights several programs that seek to level the playing field for disadvantaged students who desire to attend college, including Upward Bound, Talent Search, and Student Support Services (SSS), collectively known as TRIO. TRIO programs provide academic tutoring, personal counseling, mentoring, financial guidance, and other support necessary for educational access and retention. They have served over 800,000 low-income, first-generation students and students with disabilities. Findings from a 1998 quasi-experimental design study suggest that SSS has a statistically significant positive effect on student success, persistence, and retention (Chaney et al., 1997). Over three years, the study tracked (n=5,800) students at 47 postsecondary institutions. A comparison group of (n=2,900) students was constructed to match the demographic and educational profiles of (n=2,900) first-year SSS participants enrolled during the 1991-92 academic year. The study concluded that SSS participants were likelier to remain enrolled in higher education, accrue more college credits, and earn higher grade point averages (GPAs). Braunstein et al. (2008) also spoke highly of programs to aid disadvantaged college student retention. The researchers investigated whether programs that provide services to achieve equal education opportunities help low-income, first-generation college students and individuals with disabilities graduate from college. The three-year comparison of logistic regression models study examined the retention rates of freshman-level disadvantaged student program participants (n=130) to that of all first-year students (n=2,368) enrolled at a midsized Predominately White Institution (PWI). The study also indicated that race was a significant factor in the retention of all first-year students at the institution, suggesting that white students, regardless of disadvantaged student program participation, are more likely to return in the second year (Braunstein et al., 2008).

College Selection

Historically, Black Colleges and Universities (HBCUs) in the U.S. have battled several challenges, including declining enrollment numbers and lower-than-average graduation and retention rates. Despite these challenges, a two-year Gallup-Purdue Index study reveals that black graduates of HBCUs are more likely than black graduates of other institutions to be thriving, robust, consistent, and progressing in several areas of their lives, particularly in their financial and purpose well being (Seymour & Ray, 2015). The study included (n=55,812) college graduates, 520 black graduates of HBCUs, and 1,758 black graduates of other colleges to compare financial well-being and purpose well-being. Financial well-being gauges how effectively people manage their economic lives to reduce stress and increase security. Conversely, purpose well-being gauges social relationships and meditation to achieve goals. Braunstein et al. (2008) findings lead one to question whether there could be a performance gap between HBCUs and non-HBCUs. In 2012, the Frederick D. Patterson Research Institute published a straightforward comparison of descriptive statistics with a controlled analytical approach to examine the retention rates of students enrolled in HBCUs (n=85) and non HBCUs (n=1,875) that serve similar populations. The study concluded that HBCUs do have a lower retention rate than non-HBCUs. However, when including the regression equation, the number of Pell Grant dollars per enrolled undergraduate, SAT critical reading scores, and SAT math scores, HBCUs statistically retain more students than non-HBCUs (Richards et al., 2012). These findings are consistent with similar research chronicling college achievement that concluded HBCUs graduate black students at higher rates (38 % versus 32% for comparable non-HBCUs) despite their students' having lower standardized test scores and greater financial need (Wyllie 2018). Richards and Awokoya (2012) added that the study factored in age, gender, average income, location, high school success, and other factors that could paint a more accurate picture of what individual students face and how HBCUs perform.

Financial aid can be a significant factor for many students since meeting financial obligations is troublesome for students from disadvantaged areas and backgrounds (Gordon and Copes, 2010). The Pell Grant program, established in 1972, allocates nearly $30 billion annually to help students from low-income families attend college. Over 60% of all African American college students receive a Pell Grant (U.S. Department of Education, 2017). Also, according to the U.S. Department of Education, National Center for Education Statistics, Integrated Postsecondary Education Data System (IPEDS), the share of undergraduate students receiving Pell Grants rose from 25% (21.9 million) in 2007-08 to a peak of 40% (24.7 million) in 2011-12. It declined steadily to 32% (22.2. million) in 2017-18. These grants were typically reserved for students whose families earn less than $40,000 annually. The percentage of low-income students at all the nation's HBCUs is greater than that of students who qualify for Pell Grants nationwide (The Journal of Blacks in Higher Education, 2006).

Program Selection and Retention

Suppose family, social, or economic circumstances are critical to defining a disadvantaged student. In that case, disadvantaged college students must seek degree programs with the best return on investment that ensures expedient yet complete college matriculation. Using an empirical and quantitative methodology, Belser et al. (2017) questioned to what extent undergraduate Science, Technology, Engineering, and Math (STEM) retention (from the first year to the second year) can be predicted by participation in STEM majors that emphasize career preparation. The authors examined three variables as potential predictors of retention in STEM-related majors: (a) a STEM-focused career planning intervention, (b) students' initial major declarations, and (c) changes in scores on a measure of career readiness. The study participants (n=315) included undeclared (n=54), STEM (n=212), or non-STEM (n =49) and compared students (n=181) who took a STEM-focused career planning course to students (n=134) who took a STEM seminar course without a career planning focus. Institutional data and participant 4-point Likert-type scale results indicated that undergraduate students who initially declared a STEM major and participated in career planning had higher retention rates.

Corresponding literature about the retention and graduation of disadvantaged college students suggests that a high population of disadvantaged college students attending HBCUs, a sense of involvement and belonging, impacted student success and retention (Credle and Dean, 1991). Credle & Dean's (1991) findings align with Seymour & Ray's (2015) reasoning as to why students select to attend an HBCU. HBCUs with academic programs that provide pathways to STEM-based careers successfully address student retention issues. Programs implemented at non-HBCUs to increase the retention and graduation of disadvantaged students have also yielded success. However, the concentrated population of shared commonalities such as financial aid needs and lower average college entrance exam scores enables the HBCU to retain disadvantaged college students more effectively.

Equity in Construction Education

A comparative review of the literature addressing equity gaps in construction education indicated that the success variables for underrepresented students are similar to those for disadvantaged students. Although there is a difference between underrepresented and disadvantaged students, factors such as Pell Grant eligibility and first-generation college enrollment are primary commonalities. In contrast, race, ethnicity, and gender are secondary. In other words, an African American female student from a single-parent household may only sometimes meet the requirements of a disadvantaged student. However, if enrolled in a construction science and management program, she is an underrepresented student. Burgoon et al. (2020) compared the enrollment and retention rates, interdepartmental migration patterns, and student satisfaction and graduation success outcomes of undergraduate students enrolled in a Construction Management (CM) program. They aimed to identify trends and equity gaps between female, first-gen, minority, Latino, and Pell-eligible undergraduate CM students and their counterparts. The research results benchmarked strategic initiatives to recruit and retain traditionally underrepresented undergraduate students into CM education (Burgoon et al., 2020, p. 21). The study findings indicated correlated and frequent equity gaps for each underrepresented group compared to the majority student population. Initiatives focused on recruiting more college-bound females, Latino, Pell-eligible, and minority students could increase the number of first-semester CM students. Additionally, efforts focused on mitigating the retention gap for students at the highest risk of attrition were specific suggestions in the research study (Burgoon et al., 2020, p. 31).

In further examining the differences between underrepresented and disadvantaged students, it is vital to understand retention and graduation at HBCUs. One hypothesis would suggest that a higher percentage of disadvantaged students attend HBCUs. However, Richards and Awokoya (2012) questioned whether there is a performance gap between HBCUs and non-HBCUs and how the gap changes when serving similar populations (Richards & Awokoya, 2012, p. 12). A straightforward comparison of descriptive data suggests that HBCUs have lower retention rates than non-HBCUs. However, when accounting for low-income, minority, and students with lower SAT scores, HBCUs statistically retain more students than non-HBCUs (Richards & Awokoya, 2012, p. 13). "When we focus on the graduation of blacks specifically, HBCUs would outperform non-HBCUs by 13 percentage points" (Richards & Awokoya, 2012, p.15). Similar to (Burgoon et al., 2020), Richards and Awokoya

(2012) point to first-gen, low-income, and underrepresented populations' lack of college readiness, suggesting a needed alignment of the K-12 and higher education pipeline (Richards & Awokoya, 2012, p. 15).

Ultimately, student demographics, discipline, or college selection are not solely indicators of student success. Weigensberg et al. (2012) concluded that motivation, attitude, commitment, and confidence are critical to student success. A successful student will likely be motivated to learn, make a concerted effort to attend class and meetings, and feel that academic achievement is within their scope of abilities. Ajzen's (1991) theory of planned behavior is used to build the concepts that Fox and Spector (2010) say can be used to predict how well students will perform in construction education. These concepts include intention, norm, attitude, and planned behavior control. Ultimately, Elliott et al. (2018) refinement of the Construction Training Attitudes and Intention Scale (CTAIS), comprising Construction Education Self-efficacy (CESE), Construction Education Motivation (CEM), and Construction Education Planned Behavior (CEPB), provided construction educators with a concise construction-domain-specific instrument with demonstrated reliability and validity for predicting education performance and attrition (Elliott et al., 2018).

Chapter 3

Methods

Chapter 1 introduced the study and its purpose, articulated the research questions, and defined the problem statement, definitions, significance, organization, and limitations. Chapter 2 presented a literature review, including various relevant perspectives to provide context on the history of the construction industry, its projected future, and the nature of its personnel. The review included findings relevant to generational characteristics and tendencies, as well as findings related to higher education, student learning, and assessment, providing context for the research methods. The review, which included studies from various disciplines, was based on peer-reviewed journal articles and conference proceedings, dissertations, books, periodicals, and other outlets accessed through multiple databases. Investigating references cited among relevant articles further enriched the review. Chapter 3 presents the research methods, specifically including the study design, variables used for comparison, the mechanics of the instrumentation, information on the population, the pilot study and its findings, and data collection strategies.

Overall Design of the Study

This investigation employed a predictive research design, binary logistic regression for the predictive model, and ANOVA/Welch ANOVA for the GPA-band comparisons. The predictive phase used 55 complete student records (45 pass, 10 fail), yielding an events-per-predictor ratio of 22.5, which is above the 10-EPV rule. The study used an existing instrument, the adapted Construction Training Attitudes and Intentions Scale (CTAIS), to assess construction education self-efficacy (CESE). Construction education motivation (CEM) and construction education planned behavior (CEPB) items were collected but not analyzed in the predictive model because their zero-order correlations with exam outcome were trivial ($|r| \leq .14$).

Prior to the complete study, a quantitative pilot effort was used to inform the overall investigation regarding which independent variables would be practical and useful for comparison. Simple linear regression was used to model the relationship between a scalar response (dependent variable) and one or more explanatory variables (independent variables). Additionally, a quantitative pilot survey was administered to identify potential issues with the electronic data collection strategy. Participants in the pilot were graduate-level education research students at a large southeastern university, but not from the target population of construction education participants. No pilot data were carried into the primary analysis.

Following refinement of the survey based on the pilot study and approval by the university's Institutional Review Board (IRB), the full survey, including CTAIS questions, was delivered electronically to the target population. The survey included demographic questions to support predictive analysis using binary logistic regression and comparative analysis using Welch ANOVA.

This study investigated whether grade point average (GPA) midpoint and construction education self-efficacy (CESE) predict AIC Level I Exam performance, and whether direct assessment student learning outcomes (SLO) and applied experience totals differ across GPA bands.

The strength of this study is its ability to observe and measure statistical relationships between variables without manipulating the independent variables, without random assignment, control groups, or pretesting. However, selection may affect internal validity. According to McMillan (2012), "selection" refers to differences in characteristics among subjects across groups. This study focused specifically on construction education students, and results may differ for other STEM populations.

Participants

Quantitative research commonly uses probability sampling methods like simple random sampling, stratified sampling, or cluster sampling to achieve representativeness and enable statistical generalization to a broader population. In contrast, qualitative research often uses nonprobability sampling methods such as purposeful, criterion, or maximum variation sampling to intentionally select participants who can provide rich, detailed, and pertinent information about the phenomenon being studied. Nevertheless, according to Creswell (2014), the choice of sampling method should align with the research approach, purpose of the study, and research questions. Therefore, purposeful sampling was used in this study to select a minimum of 100 participants, 19 years of age and older, including construction management students and recent graduates from ACCE accredited baccalaureate programs who had taken the AIC Associate Constructor (AC) Level I Exam. This aligns with Saunders et al. (2012) definition of homogeneous sampling, where participants share key characteristics (e.g., major and academic background).

The sampling approach used in this study aligns with established practices in educational research, where non-probability sampling methods are commonly employed in applied settings (Creswell, 2014). Given the specific population of interest and the context in which the data were collected, this approach was appropriate for addressing the research questions. Additionally, the sample size is consistent with recommendations for statistical analyses such as logistic regression, where sufficient cases per predictor are required to ensure stable estimates (Sanders et al., 2012). Together, these considerations support the adequacy of the sample for the purposes of this study.

After removing incomplete submissions, duplicate IDs, and cases with missing GPA, 55 complete records (45 pass, 10 fail) remained for analysis. This yielded an events-per-predictor ratio of 22.5, which satisfies the 10-EPV guideline.

Purposive sampling may introduce researcher bias. Because the sample consisted only of students from ACCE accredited programs who participated in the AIC Level I Exam, sampling bias may be present. Random sampling or inclusion of broader construction-related populations could reduce this bias. However, the study required a focused population to address the research questions.

Instrumentation

Following the pilot study, revisions were made to improve clarity and reduce redundancy, including reducing the number of items and simplifying response formats.

This study utilized the adapted CTAIS (Elliott et al., 2017) to assess construction education self-efficacy (CESE). The instrument included 37 items across three subscales: construction education motivation (CEM; 9 items), construction education planned behavior (CEPB; 14 items), and construction education self-efficacy (CESE; 14 items).

The survey instrument consisted of multiple sections designed to capture demographic information, academic performance, self-efficacy, applied experience, and student learning outcomes. Demographic items included categorical questions related to age range, gender, race/ethnicity, academic classification, and prior construction-related experience to provide a descriptive profile of the sample.

Academic performance was measured using self-reported GPA ranges. These rang-es were converted into midpoint values to create a continuous variable (gpa_num) for use in statistical analyses.

The dependent variable, exam outcome (pass_exam), was derived from partici-pants' self-reported AIC Level I Exam score ranges and dichotomized into pass (1) and fail (0) based on the AIC passing threshold of 70%.

Construction education self-efficacy (CESE) was measured using the relevant sub-scale of the Construction Training and Assessment Instrument Survey (CTAIS). The CESE construct consisted of 14 items measured on a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5), with composite scores calculated as the mean of all items.

Applied experience (exp_total) was calculated as a composite score reflecting par-tici-pants' reported involvement in construction-related activities, including internships, field-work, and hands-on experience.

Student learning outcomes (SLO_mean) were measured using direct assessment items aligned with program-level learning objectives. Composite scores were computed as the mean of the included items, with lower values indicating stronger agreement and higher perceived performance.

Student learning outcomes (SLO_mean) were measured using direct assessment items aligned with program-level learning objectives. These items were designed to capture students' perceived attainment of key competencies within the Construction Science and Management program.

Items were measured using a 5-point Likert-type scale, and subscale scores were computed by averaging item responses. Higher scores indicate higher levels of each con-struct.

CEM and CEPB were collected for future research but were excluded from the predic-tive model due to trivial zero-order correlations with exam outcomes.

Cronbach's alpha was computed to assess internal consistency. The CESE scale demonstrated strong reliability ($\alpha = .93$), exceeding the .70 threshold (Morgan et al., 2007).

The final instrument included the adapted CTAIS along with demographic and categorical questions.

Pilot Study

The pilot study utilized Qualtrics to host the web based survey. The pilot instrument included seven demographic questions, five nominal-type questions, five 'yes' or 'no' type questions, and 30 5-point Likert-style scale questions. Based on the pilot results, the survey instrument was refined prior to implementation in the main study. The pilot study was used to assess the clarity and internal consistency of the survey instrument. Reliability analysis yielded a Cronbach's alpha of .60 ($n = 30$), which was considered acceptable for an exploratory study. Graduation Efficacy and Internship/co-op experience were measured using multiple survey questions combined into a single score, with higher scores reflecting greater internship or co-op experience.

The pilot study Mean measurements scales reported the following reliability statistics of the 30 5-point Likert-style scale questions: graduation efficacy ($M=0.490$, $\alpha=.951$, $k=20$), field of study ($M=0.385$, $\alpha=.652$, $k=3$), internship/co-op experience ($M=0.386$, $\alpha=.654$, $k=3$), and college choice ($M=0.332$, $\alpha=.713$, $k=5$). The descriptive statistics were summarized for all variables in Table 1, where Graduation Efficacy and Internship/co-op experience were measured using multiple survey questions combined into a single score, with higher scores reflecting greater internship or co-op experience. Stepwise multiple regression analysis determined which independent variables (cumulative grade point average, field of study, internship/co-op experience, and college choice) were statistically significant predictors of graduation efficacy. Overall, Table 2 shows the predictor variable (cumulative grade point average) correlates strongly with the DV of graduation efficacy and that the correlation is unlikely to occur by chance (R = .39, R^2 = .15, F(1, 28) = 4.97, p = .034. Independent variables (field of study, internship/co-op experience, college choice) were not statistically significant predictors of graduation efficacy and were excluded from the model. However, correlations existed between IV's cumulative grade point average and field of study (p = .03), cumulative grade point average and internship/co-op experience p = .02), field of study and internship/co-op experience (p < .001), field of study and college choice (p = .01), and internship/co-op experience and college choice (p = .02) as shown in Table 3.

Table 1 Descriptive Statistics of Continuous Variables (pilot study)

Variable	*n*	*Mean*	*SD*
Graduation Efficacy	30	2.55	0.841
Cumulative Grade Point Average	30	1.67	0.711
Internship/Co-op Experience	30	4.07	1.57

Table 2 Frequencies for Categorical Variable (pilot study)

*A-Frequencies for Categorical Variable-*College Choice		
Category	*n*	%
HBCU	18	60%
CGPA	12	40%
*B-Frequencies for Categorical Variable-*Field of Study		
Category	*n*	%
Engineering	8	26.7%
Architecture	7	23.3%
Business	5	16.7%
Undecided	10	33.3%

Table 3 Means, Standard Deviations, and Correlations of Study Variables (pilot study)

Variable	*M*	*SD*	1.	2.	3.	4.	5.
Graduation Efficacy	2.55	0.84	-				
Cumulative Grade Point	1.67	0.77	.02*	-			
Internship/Co-op Experience	4.07	1.57	.40	.02*	.001***	-	

Note. $^*p < .05$, $^{**}p < .01$, $^{***}p < .001$

Implementation of the Full Study Survey

The instrument was submitted to the university's Institutional Review Board (IRB) for expedited approval, given that the potential risk for participants was minimal. Appendices to the proposal included copies of the investigator's and advisor's Collaborative Institutional Training Initiative (CITI) certificates; a copy of the survey as would be seen by participants on a computer screen, phone, or other mobile device; a copy of sample language soliciting participation; and representative permission and confirmation of interest from construction firms whose employees were potential participants. The IRB approved the proposal in November 2021 (see Appendix B for the approved IRB Protocol 21-553).

The 71-question survey was administered from December 2021 until May 2024 through the Qualtrics platform (see Appendix C for the survey instrument). Long data collection periods tend to increase potential internal validity threats, including historical effects, maturation, instrument decay, testing effects, attrition, selection bias, and regression to the mean; however, the subject matter, population, and the use of an existing standardized exam as a dependent variable minimized potential internal validity threats by ensuring uniform administration and scoring, thereby reducing instrumentation and testing threats. The study population consisted of students who shared the same academic discipline and similar academic progression, which reduced variation associated with maturation effects. The exam maintained its assessment of the same subject matter throughout the research duration, which decreased the likelihood that historical events would impact how participants performed.

The adapted Construction Training Attitudes and Intentions Scale (CTAIS), a construction education domain-specific survey instrument with established reliability and validity, was used to assess psychological constructs useful in understanding and predicting human behavior that influences completion and success among construction education participants. Additional questions were included to establish study variables. Research planning meetings with the American Council for Construction Education (ACCE) suggested that solicitation would be better received through the American Institute of Constructors (AIC) rather than directly from the investigator. The AIC was provided with prescriptive language to use in email correspondence with the target pool of construction management students or recent graduates (within five years) who have completed the AIC AC Level I Exam. The correspondence clearly articulated the study's purpose, that participation was voluntary, that responses would be anonymous, and that there was no compensation for participation. In addition to the Qualtrics survey link, a copy of the approved IRB protocol and the assigned study number were included. Reminder correspondence was also sent within two to three months of the original solicitation.

Participants could access the survey using any device with an internet connection, whether fixed or portable. The survey format required participants to answer each question before progressing to the next, minimizing the number of incomplete responses. On average, each participant spent approximately 10 to 15 minutes completing the survey. The instrument was approved to secure and use data for research purposes by the university’s Office of Research Compliance and adhered to the Family Educational Rights and Privacy Act (FERPA) (20 U.S.C. § 1232g; 34 CFR Part 99) to protect the privacy of student education records. The survey access was closed in May 2024, allowing data analysis to commence.

Data Analysis

After the survey access window was closed, data were exported from Qualtrics into Excel, and IP addresses and location data were deleted. The statistical software package used to analyze the data was the Statistical Package for the Social Sciences (SPSS)

Statistics 29. A research question matrix (see Appendix D) was created to systematically organize and visually illustrate the interconnections among the research questions and to identify potential research design risks. The dataset was initially screened for missing data and multivariate outliers. Cronbach's alpha coefficient was used to report reliability statistics. Cronbach's alpha for the CESE scale was .93, exceeding the .70 criterion. The descriptive statistics for all variables were summarized and presented in Table 4.

Research Question 1: "Can a two-predictor model combining grade point average (GPA) midpoint and construction education self-efficacy (CESE) predict pass/fail status on the AIC Level I Exam?"

Binary logistic regression (forced entry) was used to examine whether academic performance and self-efficacy predict success on the Level I Exam. Model fit was evaluated using ROC analysis. A probability cut-off was established to evaluate classification performance, including failure rate and precision rate (Table 7). Additional variables derived from the survey instrument were considered for inclusion in the analysis. Student Learning Outcomes (SLO_mean) was computed as a composite mean score of Likert-type items assessing perceived learning and skill development. Experience (exp_total) was calculated as an aggregate measure of students' internship and co-op exposure, with higher values indicating greater applied experience. Candidate variables such as SLO_mean, exp_total, and demographic factors were screened but excluded to satisfy the 10-EPV rule and because their zero-order correlations with pass/fail were trivial. Reference category coding ("dummy coding") was used to represent categorical variables derived from the instrument responses. A model summary (Table 6) was presented to report relationships between independent variables and the dependent variable and whether those relationships were likely to occur by chance. (Table 5) presents correlations among measured scales.

Research Question 2: “Are construction education self-efficacy (CESE) scores different for students who pass the Level I Exam compared with those who do not pass?”

An independent-samples t-test with a 1,000-sample bootstrap was utilized to compare CESE means for students who pass and those who do not pass.

Research Question 3: “Do direct assessment outcomes (SLO_mean) and applied experience totals (exp_total) differ across GPA categories?”

A Welch one-way ANOVA was used to examine differences in SLO_mean and exp_total across five GPA bands (Table 7). This approach was selected due to unequal group sizes and the potential violation of the homogeneity of variance assumption, making it more robust than the traditional one-way ANOVA.

Summary

Chapter 3 detailed the research methods used in a study on construction education among undergraduate students. The study used a predictive design centered on binary logistic regression (GPA + CESE) and complementary Welch ANOVAs for GPA-band comparisons. The adapted Construction Training Attitudes and Intentions Scale (CTAIS) was used to measure self-efficacy, motivation, and planned behavior. A pilot study was conducted to refine the instrument. The complete survey was administered electronically to a targeted population of construction education students. The instrument demonstrated strong internal consistency (α_CESE = .93). The study aimed to identify Level I Exam achievement predictors, including academic performance, direct-assessment student learning outcomes, and applied experience totals, and to determine differences in psychometric measures across student performance levels.

Chapter 4

Findings

The study's findings and the associated data for each research question are presented in Chapter 4. Descriptive statistics based on the responses to the Qualtrics web based survey, demographic data, and analyses of binary logistic regression for the predictive model and ANOVA/Welch-ANOVA for the GPA-band comparisons were developed using the Statistical Package for the Social Sciences (SPSS©).

Purpose of the Study

This study empirically investigated whether a parsimonious two-predictor model, grade point average (GPA) midpoint, and construction education self-efficacy (CESE) could predict pass/fail status on the AIC Level I Exam. In addition, the research examined how direct-assessment learning outcomes (SLOs) and total applied experience varied across GPA bands.

Research Questions

The following research questions guided this study:

1. Do grade point average (GPA) and construction education self-efficacy (CESE) significantly predict pass/fail outcomes on the American Institute of Constructors Level I examination?

2. Do students who pass the American Institute of Constructors Level I examination differ in construction education self-efficacy (CESE) from those who do not pass?

3. Do direct assessment outcomes (SLO_mean) and applied experience totals (exp_total) differ significantly across GPA categories?

Data Collection and Overall Information

Potential participants were contacted via email through the American Institute of Constructors (AIC) and invited to participate. The solicitation emphasized that participation was voluntary and included a copy of the university's Institutional Review Board (IRB) approval. The survey was administered via Qualtrics, and data was analyzed using SPSS. Once in SPSS, IP addresses and location data were deleted in accordance with the IRB-approved protocol. Any incomplete or otherwise non-responsive survey results were removed. Data was then collated and prepared for analysis.

Descriptive Statistics

Descriptive statistics were computed for the primary study variables (Table 4). The exam pass rate was relatively high, with 45 students (81.8%) classified as passing and 10 students (18.2%) classified as failing ($N = 55$). The mean GPA midpoint was 3.31 ($SD = 0.47$). Student learning outcomes (SLO_mean) were measured using composite scores derived from direct-assessment items. Students' average SLO score was 1.82 ($SD = 0.77$), with lower values indicating stronger agreement and higher perceived performance. The average applied experience score (exp_total) was 12.91 ($SD = 3.75$). Construction education self-efficacy (cese_mean) had a mean of 1.35 ($SD = 0.56$), indicating high levels of perceived self-efficacy. The dependent variable, pass_exam, was derived from students' self-reported AIC Level I Exam score ranges and dichotomized into pass (1) and fail (0).

Table 4 Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
cese_mean	55	1.00	4.86	1.3506	.55911
SLO_mean	55	1.00	4.83	1.8212	.77121
exp_total	55	9.00	27.00	12.9091	3.75289
gpa_num	55	1.75	3.85	3.3064	.46895
Valid N (listwise)	55				

Correlation Analysis

Zero-order correlations among study variables are presented in Table 5. Exam pass/fail status was not significantly correlated with GPA midpoint (r = .230, p = .092), construction education self-efficacy (CESE; r = .007, p = .962), student learning outcomes (SLO_mean; r = −.049, p = .725), or applied experience totals (exp_total; r = −.176, p = .198). Although GPA midpoint demonstrated a positive association with pass/fail status, the relationship was not statistically significant. GPA midpoint and CESE were retained in the logistic regression model based on theoretical relevance and prior research.

Table 5 Correlations

		pass_exam	cese_mean	SLO_mean	exp_total	gpa_num
pass_exam	Pearson Correlation	1	.007	-.049	-.176	.230
	Sig. (2-tailed)		.962	.725	.198	.092
	N	55	55	55	55	55
cese_mean	Pearson Correlation	.007	1	.570**	.457**	.178
	Sig. (2-tailed)	.962		.000	.000	.194
	N	55	55	55	55	55
SLO_mean	Pearson Correlation	-.049	.570**	1	.454**	.306*
	Sig. (2-tailed)	.725	.000		.001	.023
	N	55	55	55	55	55
exp_total	Pearson Correlation	-.176	.457**	.454**	1	.009
	Sig. (2-tailed)	.198	.000	.001		.946
	N	55	55	55	55	55
gpa_num	Pearson Correlation	.230	.178	.306*	.009	1
	Sig. (2-tailed)	.092	.194	.023	.946	

N	55	55	55	55	55

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Binary Logistic Regression

A binary logistic regression was performed with GPA midpoint and construction education self-efficacy (CESE) as predictors of exam success (Table 6). The model demonstrated weak explanatory power, with Cox & Snell $R^2 = .047$ and Nagelkerke $R^2 = .076$. The Hosmer–Lemeshow test was not statistically significant, $\chi^2(7) = 11.243$, $p = .128$, indicating acceptable model fit.

Neither predictor was statistically significant. GPA midpoint approached significance ($B = 1.124$, $SE = 0.684$, Wald = 2.698, $p = .100$, OR = 3.076), suggesting a positive but non-significant association with passing the exam. Construction education self-efficacy was not a significant predictor ($B = -0.172$, $SE = 0.664$, Wald = 0.067, $p = .795$, OR = 0.842). These findings indicate that the model does not significantly predict pass/fail outcomes.

Table 6 Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	gpa_num	1.124	.684	2.698	1	.100	3.076
	cese_mean	-.172	.664	.067	1	.795	.842
	Constant	-1.897	2.188	.751	1	.386	.150

a. Variable(s) entered on step 1: gpa_num, cese_mean.

Classification Accuracy

A classification analysis was conducted using a probability cutoff of 0.50 (Table 7). The model correctly classified 83.6% of cases overall. However, classification performance differed substantially across outcome groups. Among students who failed the exam, only

10% were correctly identified, while 90% were misclassified as passing. In contrast, 100% of students who passed were correctly classified.

These results indicate that the model was highly accurate in identifying passing students but performed poorly in identifying failing students. Given that the majority of students in the sample passed the exam, the model demonstrates a bias toward the majority class.

Table 7 Classification Table[a]

Observed			Predicted		
			pass_exam		Percentage Correct
			.00	1.00	
Step 1	pass_exam	.00	1	9	10.0
		1.00	0	45	100.0
	Overall Percentage				83.6

a. The cut value is .500

ROC Curve Analysis

A receiver operating characteristic (ROC) curve analysis was conducted to evaluate the model's discrimination ability. The area under the curve (AUC) was 0.643, indicating weak predictive accuracy as shown in Figure 1. Although the model performs better than chance, its ability to distinguish between students who pass and those who fail is limited.

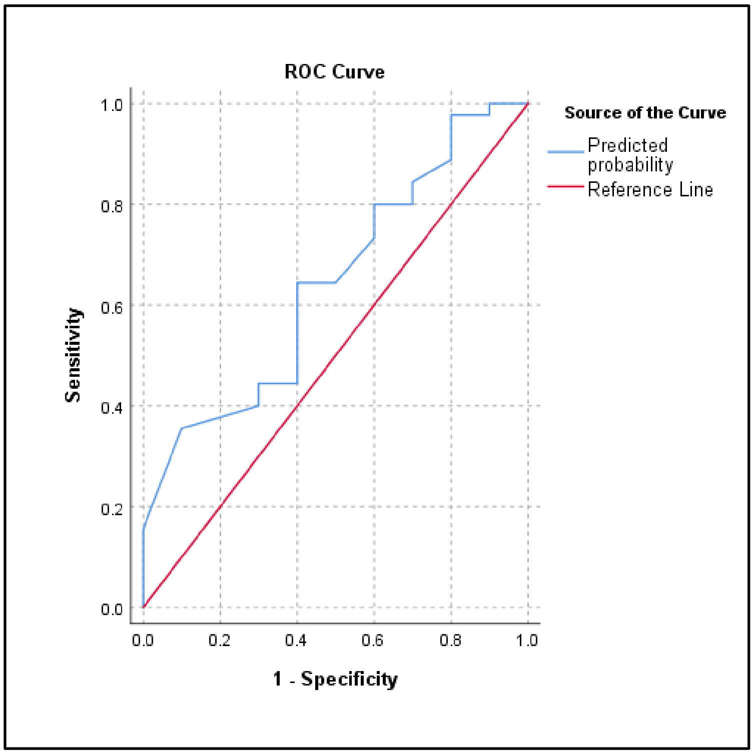

Figure 1 Receiver Operating Characteristic (ROC) Curve

Independent Samples T-Test

An independent-samples t-test was conducted to compare CESE scores between students who passed and those who failed. Results indicated no statistically significant difference, $t(53) = 0.41$, $p = .684$. The mean difference was 0.082, with a small and non-significant effect size (Hedges' $g = 0.14$). These findings indicate that CESE does not differ between students who pass and those who fail.

ANOVA Results

A Welch's ANOVA was conducted to examine differences in student learning outcomes and applied experience across GPA bands. Welch's ANOVA was used due to its robustness to violations of homogeneity of variance.

Results indicated that direct-assessment learning outcomes differed significantly across GPA bands, $F(4, 50) = 4.90$, $p = .002$, partial $\eta^2 = .28$. In contrast, applied experience totals did not differ significantly across GPA bands, $F(4, 50) = 0.75$, $p = .562$, partial $\eta^2 = .06$.

Chapter 5

Summary

A total of 100 surveys were distributed to eligible Construction Management majors. After excluding students with incomplete or unusable records due to missing values during data cleaning, 55 complete student records remained for analysis. A binary logistic regression was used to model the relationship between the independent variables and the dependent variable (Exam Status) to predict the success of students taking the AIC Level I Exam. Using a binary logistic regression and Welch's ANOVA analysis, results indicated that Midpoint GPA was positively associated with successful completion of the AIC Level I Exam; however, this relationship was not statistically significant. Additionally, CESE had no statistically significant contribution to the model for predicting successful completion of the AIC Level I Exam.

Approximately 82% of the sample passed the exam, while 18% failed. Student learning outcomes based on direct assessment were significantly different across GPA bands, whereas the total hours of applied experience were not. In terms of using this model as a screening tool to identify students who may need additional preparation prior to sitting for the exam, the model demonstrated strong performance in identifying passing outcomes but limited ability to correctly identify failing outcomes. Ultimately, the findings indicate that academic performance may serve as an indicator of one's ability to achieve certification; however, within this sample, it was not a statistically significant predictor. Additionally, confidence in a person's ability to perform construction-related tasks, independent of their academic performance, was not a reliable predictor of one's ability to successfully complete the AIC Level I Exam.

Research Question 1

The two-predictor model's ability to classify students was influenced by the distribution of outcomes within the sample. The model correctly classified a high percentage of passing students; however, it demonstrated limited ability to correctly identify failing students. Therefore, when the model predicts that students will pass the exam, this prediction is generally accurate; however, the model is less effective in identifying those who may fail.

Furthermore, the model's overall accuracy was high; however, this accuracy was largely influenced by the majority of students passing the exam. As such, the model's practical utility for identifying students at risk of failing the exam is limited. The data suggest that while a two-predictor model may provide some general insight into exam outcomes, it is not sufficiently robust to serve as a reliable early-alert tool for identifying at-risk students. The model is better suited for exploratory or program-level analysis rather than for making individual-level decisions regarding exam readiness.

As such, due to the sample size ($n = 55$) and the uneven number of students passing versus failing the exam (approximately 82 percent of students passed), the results of the model should be interpreted as a program-level exploratory method rather than a predictive screening tool.

Research Question 2

The data show that there were no differences between students who passed the AIC Level I Exam and those who did not on their construction education self-efficacy (CESE). The independent samples t-test resulted in a small, non-significant difference, and the relationship between the pass/fail outcome and CESE was nearly nonexistent. Therefore, in a practical sense, CESE did not independently help to predict whether or not an individual would pass/fail within this sample set.

That being said, one should not interpret the lack of statistical significance for CESE as indicative that self-efficacy is not important for construction education. “CESE demonstrated no meaningful relationship with exam outcomes. These findings suggest that neither academic performance nor self-efficacy significantly predicted exam outcomes within this sample. These findings are consistent with Bandura’s (1977) assertion that individuals with higher self-efficacy are more likely to engage in challenging tasks and persist despite difficulty.

Research Question 3

Welch's ANOVA test results indicated a statistically significant difference in SLO average scores among GPA groups (bands), along with a relatively large effect size for this difference. Therefore, Welch's ANOVA results support the idea that GPA categories represent meaningful differences in direct assessment of learning outcomes. The results also confirm that students who have been assigned to higher GPA bands have demonstrated stronger performance on SLO assessments than their lower GPA counterparts and thus further reinforce the position that academic readiness is an important indicator of competency achievement.

In contrast, the total number of hours of applied experience were not significantly different among GPA bands. As such, these findings suggest that the total hours of applied experience collected by this study are not highly related to GPA classification. Additionally, there was no significant relationship found between GPA (as a continuous measure) and either SLO averages or total hours of applied experience. These findings indicate that while GPA banding and correlations between GPA and student performance provide two potentially different ways of viewing student performance patterns.

Conclusions

This study examined whether grade point average (GPA) and construction education self-efficacy (CESE) significantly predict pass/fail outcomes on the American Institute of Constructors (AIC) Level I examination. Using binary logistic regression, the results indicated that the model including GPA and CESE was not statistically significant, indicating that these variables did not meaningfully contribute to predicting student success on the AIC Level I Exam within this sample. These findings suggest that both academic performance and self-efficacy are relevant components in understanding student success in the construction domain. The results align with existing literature indicating that prior academic achievement is a consistent predictor of performance, while also reinforcing the importance of psychological constructs such as self-efficacy in influencing student outcomes. Although the model explains a modest proportion of the variance, it provides a practical and interpretable framework for identifying students who may be at risk of not passing the AIC Level I Exam.

In my role as Associate Professor and Department Head of the Construction Science and Management Program at Tuskegee University, the AIC CAC Exam is being used to assess the eligible Student Learning Outcomes (SLOs) and to equip graduating seniors with a professional certification that may enhance their career opportunities. In previous years, pass rates for the Level I Exam have been low, highlighting the need for improved preparation strategies and stronger alignment between curriculum delivery and exam expectations. While individual student outcomes may vary based on prior experience and external responsibilities, this study provides insight into factors that may contribute to student success.

Beginning in Spring 2026, students enrolled in CSMT 0432 are required to take the AIC CAC exam. Per the CSMT 0432 syllabus, passing the AIC Level I Exam (with a minimum passing score of 70% or higher per AIC) will result in full credit of 20% of the overall grade;

any grade below a passing score will be used as received (in percentage grade) for the AIC 20% of the overall course grade. In addition, the exam fees will be refunded to students who pass the AIC CAC Exam. These actions are intended to provide students with a sense of "skin in the game" and to promote engagement consistent with construction education motivation (CEM) and construction education planned behavior (CEPB) constructs.

To prepare for the exam, students selected one of ten AIC CAC Exam study guide topics to review and discuss in class. Each student also introduced a Kahoot game as an interactive quiz for their chapter review, thereby supporting active learning and potentially strengthening construction education self-efficacy (CESE). These instructional strategies are aligned with the study findings, which highlight the importance of both academic preparedness and self-efficacy in predicting exam success.

Overall, this study provides insight that can inform instructional strategies aimed at improving student performance on the AIC CAC Exam. By integrating structured academic preparation with strategies that support student confidence and engagement, construction programs may better position students for success on professional certification exams. AIC CAC Exam data from the Spring 2026 class and subsequent Tuskegee University Construction Science and Management Program graduates may contribute to future research on predicting student achievement in the construction domain.

Limitations

Several limitations should be considered when interpreting the findings of this study. First, the outcome variable was imbalanced, with a substantially larger proportion of students classified as passing the AIC Level I Exam. This imbalance influenced the classification performance of the model, as it was more accurate in identifying passing students than failing students, thereby limiting its usefulness for identifying at-risk students.

Second, the predictive performance of the model was limited. Neither GPA midpoint nor construction education self-efficacy (CESE) was statistically significant in predicting pass/fail outcomes. In addition, the model demonstrated low explanatory power and weak discrimination ability, indicating that it captures only a small portion of the variability in exam outcomes.

Third, the relatively small number of failure cases in the sample limited the statistical power of the logistic regression model and reduced the ability to detect significant relationships between predictors and exam outcomes.

Fourth, GPA was collected as categorical bands and converted into midpoint values for analysis. While this approach allowed for continuous modeling, it introduces approximation and may reduce the precision of the GPA variable.

Finally, exam performance was based on self-reported score ranges rather than official exam records, which may introduce reporting bias.

Implications and Recommendations

The findings of this study have substantial implications for institutions committed to educational equity and the success of first generation and underrepresented students in construction related fields. HBCUs may particularly benefit from expanding the types of variables collected in future studies, as such institutions tend to foster close knit academic environments and faculty student relationships that may not be fully captured by conventional academic metrics alone. Including indicators such as mentorship engagement, perceptions of campus climate, or involvement in culturally relevant learning communities could enhance the model's predictive power in this context. Because many HBCUs have limited enrollment in specialized majors such as Construction Management, interdisciplinary collaborations could be beneficial. Pooling data across several HBCUs (ideally with ACCE accredited programs) would help meet sample size thresholds needed for valid regression or SEM analysis. This collaborative approach could also support benchmarking efforts across similar institutions. Another vital focus for HBCUs is identifying predictors of persistence. Since HBCU students are statistically more likely to be Pell eligible, first generation, or managing off campus employment (Njoku et al., 2024; Council of Economic Advisers, 2024), capturing different nuances is key for designing tailored support services. Tracking GPA recovery following academic probation, retention rates after internship involvement, or the long-term effects of financial aid interruptions can yield a deeper understanding of enduring student achievement. Furthermore, other pertinent variables should include experiential learning and community engagement; for instance, student participation in community-based initiatives, alumni mentorship programs, or involvement in minority contractor associations could serve as potential indicators of post-graduation success.

Recommendations

Based on the results of the current study, construction education programs may wish to use the GPA midpoint as a gauge of when students will be prepared to take their exams and as an early screen for academic success within the first semester of their program. Programs that do this will be able to allocate targeted support to students who appear to be struggling (e.g., tutoring, study plans, prep workshops) and assess how well these support systems align with the program's SLOs. The significant differences in SLO performance across GPA bands suggest that it is valuable to examine assessment data collected based on program outcomes and identify which subject matter areas need additional support to prepare students to perform adequately on the exam.

While many construction management (CM) programs use the AIC Level I Exam as a direct assessment tool, several factors, primarily related to validity and cognitive alignment, may prompt other programs to seek alternative methods to measure Student Learning Outcomes (SLOs). Some programs elect to use their own assessment exam, whereas others may use an in-house comprehensive exam in combination with the AIC Level I Exam. It is worth noting that ACCE accredited CM programs have diverse missions; therefore, a program focused on developing students' confidence and self perception alongside technical knowledge may regard the AIC Level I Exam as an inadequate measure of that holistic development. Nevertheless, the correlation between the construction education domain specific psychological constructs identified in the CTAIS and student achievement, whether measured by grade point average, the AIC Level I Exam, or a program-specific comprehensive exam, can help construction education programs better plan and develop effective curricula for future construction industry professionals.

Since initiating this study, changes have been made to the ACCE student learning outcomes and the AIC Level I Exam. The ACCE Board of Trustees approved revisions to Section 9 (Academic Quality Planning and Process and Outcome Assessment), including the number of Student Learning Outcomes (SLOs), at its 2022 Annual Meeting on July 14, 2022. The purpose of reducing the 20 Student Learning Outcomes (SLOs) to 17 was to streamline the accreditation process by eliminating redundancies, removing obsolete requirements, and clarifying the intent of the outcomes (see Appendix E). Several SLOs were found to overlap with others. For example, the committee proposed eliminating SLO 7 ("Analyze construction documents") because it was already integrated into SLOs 3, 4, and 5. Similarly, SLO 13 ("Understand construction risk management") was recommended for deletion because the topic was already addressed via other SLOs, and the current wording was considered too broad to be meaningful.

SLO 10 ("Apply electronic based technology") was marked for deletion because electronic technology is now routinely incorporated into nearly all construction projects in the developed world, making a standalone outcome redundant.

Some SLOs were revised rather than deleted to ensure their purpose was unmistakable. For instance, SLO 20 was updated to specifically include HVAC, plumbing, fire suppression, and low voltage systems to clarify the intent of construction principles. Feedback from program leaders and Visiting Team (VT) chairs indicated that the existing process involved excessive documentation and repetitive reporting. By combining and reducing the number of SLOs, the ACCE aimed to streamline the assessment cycle, making it more manageable for programs with limited "people power". Reducing the total number of outcomes helped address concerns about interpretation differences among visiting teams and provided a more consistent framework for programs to demonstrate compliance.

Analogous to the ACCE SLO revisions, in 2022, the American Institute of Constructors (AIC) moved from Associate Constructor to Certified Associate Constructor to better recognize it as a national certification. AIC maintains a rigorous certification process designed to validate the technical proficiency and ethical standards of construction management professionals. While these credentials, such as the Certified Associate Constructor, confirm an individual's mastery of industry benchmarks, the organization clarifies that personal traits like leadership and passion are measured through workplace performance rather than testing.

To ensure the examinations remain psychometrically valid and relevant, the AIC conducts a comprehensive job task analysis every five years to align exam content with current field expectations. Recent initiatives, such as an item writing workshop held in October 2025, focused on enhancing item quality and on using educational frameworks, such as Bloom’s Taxonomy, to better define cognitive requirements for candidates. This structured approach ensures that the certification serves as a credible national benchmark for technical excellence while distinguishing formal knowledge from interpersonal soft skills. By improving item bank health and transparency in reporting, the AIC continues to strengthen the professional standing of its certificate holders in a competitive market.

As one of the largest, most economically impactful industries in our society, there is a great opportunity to continue meaningful research in the construction discipline and related to the built environment in general. Research exploring how academic performance, industry experience, and psychological factors influence student success in construction management programs is important. However, while higher education institutions and industry certifications effectively assess technical proficiency, further research is needed on the development of interpersonal skills and holistic professional growth.

For future research, several directions are recommended. Researchers could collect the continuous exam scores (i.e., raw scores and sub-section scores) of each student's exam(s), so they would have enough data to develop multiple regression models that provide a more detailed picture of the relationship between the predictor variable (GPA at midterm) and the outcome variable (exam score). Also, researchers should strive to collect larger samples of data from students across more than one semester and from more than one institution, especially from HBCUs and ACCE accredited programs. Additionally, researchers could include other potential predictors in the model (e.g., GPA trend during the semester, GPA trend in foundational courses, attendance/learning management system metrics, variables related to internships, etc.) and utilize methods of validation (e.g., cross-validation, utilizing a different group of students to test the model) to increase the reliability and generalizability of the findings.

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Appendix A

Adapted Construction Training Attitudes and Intentions Scale

CTAIS - Operationalized Constructs and Survey Items.

Construction Education Self-Efficacy (CESE) Items

Construct	Adapted Item
CESE 1	My past experiences and accomplishments increase my confidence that I will be able to perform well in construction education.
CESE 2	My past experiences and accomplishments increase my confidence that I will be able to successfully complete a construction education program.
CESE 3	Construction education is within the scope of my abilities.
CESE 4	Successfully completing a construction education program is within the scope of my abilities.
CESE 5	I am usually a good judge of my own capabilities.
CESE 6	Other people that know me well perceive me as being a capable person.
CESE 7	My estimates of how well I can deal with a new situation are usually very accurate.
CESE 8	I expect to be able to do things that need to be done to successfully complete a construction education program.
CESE 9	If I take construction courses which involved many different tasks, some easy and some difficult, I would probably do very well at almost all of them.
CESE 10	If I take a construction course in an unfamiliar area, I expect to be able to successfully complete the course.
CESE 11	If I were asked to take a course in an area of construction which I didn't know much about, I could do well.
CESE 12	If I were asked to take a course in an area of construction which I didn't know much about, I could successfully complete the training/courses.
CESE 13	I can generally do the work necessary to accomplish my goals in education courses.
CESE 14	I am confident that I can do well in construction education that deal with tool operation, using tools or body to move objects.

Construction Education Motivation (CEM) Items.

Construct	Adapted Item
CEM 1	I value construction-related education.
CEM 2	Construction education is useful for my development.
CEM 3	I will be able to apply what I have learned in construction education to a job.
CEM 4	I am motivated to learn the skills taught in construction education programs.
CEM 5	I would like to improve my construction-related skills
CEM 6	I am willing to invest effort to improve construction-related skills and competencies just for the sake of learning.
CEM 7	I am willing to invest effort to improve my skills and competencies in order to prepare myself for a construction-related job.
CEM 8	Taking construction education courses is a high priority for me.
CEM 9	I am willing to invest effort on my personal time to develop construction-related skills.

Construction Education Planned Behavior (CEPB) Items and Response Format.

Construct	Adapted Item	Response Options
CEPB 1	I will attend the meetings of this construction education program on a regular basis:	1 = "Extremely Unlikely" to 5 = "Extremely Likely"
CEPB 2	I will successfully complete this construction education course:	1 = "Extremely Unlikely" to 5 = "Extremely Likely"
CEPB 3	I would make an effort to attend the meetings of construction education courses on a regular basis:	1 = "I Definitely Would Not" to 5 = "I Definitely Would"
CEPB 4	I would make an effort to successfully complete a construction education program:	1 = "I Definitely Would Not" to 5 = "I Definitely Would"
CEPB 5	I intend to attend the meetings of a construction education program on a regular basis:	1 = "Strongly Disagree" to 5 = "Strongly Agree"
CEPB 6	I intend to successfully complete construction education:	1 = "Strongly Disagree" to 5 = "Strongly Agree"
CEPB 7	Most people who are important to me think that [I should - I should not] participate in construction education:	1 = "I should" to 5 = "I should not"
CEPB 8	It is expected of me that I attend the meetings of a construction education program on a regular basis:	1 = "Definitely False" to 5 = "Definitely True"
CEPB 9	It is expected of me that I would successfully complete a construction education program:	1 = "Definitely False" to 5 = "Definitely True"
CEPB 10	Most people whose opinions I value would approve of my participating in a construction education program:	1 = "Strongly Disagree" to 5 = "Strongly Agree"
CEPB 11	For me to successfully complete construction education is:	1 = "Extremely Bad" to 5 = "Extremely Good"
CEPB 12	For me to attend the meetings of a construction education program is:	1 = "Extremely Worthless" to 5 = "Extremely Valuable"
CEPB 13	For me to complete a construction education program is:	1 = "Extremely Worthless" to 5 = "Extremely Valuable"
CEPB 14	For me to attend the meeting of a construction education program is:	1 = "Extremely Unpleasant" to 5 "Extremely Pleasant"

Appendix B

Approved IRB Protocol - 21-553

Revised 09/14/2022

AUBURN UNIVERSITY HUMAN RESEARCH PROTECTION PROGRAM (HRPP)

PERSONNEL MODIFICATION APPLICATION

For assistance, contact: **The Office of Research Compliance (ORC)**

Phone: **334-844-5966** E-Mail: IRBAdmin@auburn.edu Web Address: http://www.auburn.edu/research/vpr/ohs

Submit completed form and supporting materials as one PDF through the IRB Submission Page

Handwritten forms are not accepted. Where links are found hold down the control button (Ctrl) then click the link.

(USE THIS FORM ONLY TO REQUEST A MODIFICATION TO KEY PERSONNEL)

Today's Date: 9/22/2023

Principal Investigator (PI): Rogers Hunt III

AU IRB Protocol Number: 21-553 EX2111

Study Title: Predicting Student Achievement in the Construction Domain: Correlation of Contributing Factors Given Construction-Education Self-Efficacy, Motivation, and Planned Behavior

Add the following personnel

ONLY for expedited and full board studies is a copy of CITI documentation required when adding new personnel.

Name: Reginald A. Blockett	**Degree(s):** Ph.D.
Rank/Title: Assistant ProfessorClick Rank/Title	**Department/School:** Educational Foundations, Leadership, and Technology
Role/responsibilities in this project: Committee Chair and Advisor, Faculty Advisor, Principal Investigator, and answering questions from potential participants and participants.	
AU affiliated? ☒ Yes ☐ No If no, name of home institution: Click or tap here to enter text.	
Plan for IRB approval for non-AU affiliated personnel? Click or tap here to enter text.	
Do you have any known competing financial interests, personal relationships, or other interests that could have influence or appear to have influence on the work conducted in this project? ☐ Yes ☒ No	
If yes, briefly describe the potential or real conflict of interest: Click or tap here to enter text.	
Completed required CITI training? ☒ Yes ☐ No If NO, complete the appropriate CITI basic course and update the revised Exempt Application form.	
If YES, choose course(s) the researcher has completed: Refresher Course 9/16/2026 Human Sciences Basic Course 9/20/2026	
Name: Click or tap here to enter text.	**Degree(s):** Click or tap here to enter text.
Rank/Title: Choose Rank/TitleClick Rank/Title	**Department/School:** Choose Department/School
Role/responsibilities in this project: Click or tap here to enter text.	
AU affiliated? ☐ Yes ☐ No If no, name of home institution: Click or tap here to enter text.	
Plan for IRB approval for non-AU affiliated personnel? Click or tap here to enter text.	
Do you have any known competing financial interests, personal relationships, or other interests that could have influence or appear to have influence on the work conducted in this project? ☐ Yes ☐ No	
If yes, briefly describe the potential or real conflict of interest: Click or tap here to enter text.	
Completed required CITI training? ☐ Yes ☐ No If NO, complete the appropriate CITI basic course and update the revised Exempt Application form.	
If YES, choose course(s) the researcher has completed: Choose a course Expiration Date Choose a course Expiration Date	

Remove the following personnel

Name	Role in Protocol
Jonathan E. Taylor	Committee Chair and Advisor, Faculty Advisor
Click or tap here to enter text.	Click or tap here to enter text.

The Auburn University Institutional Review Board has approved this Document for use from 09/26/2023 to -------------
Protocol # 21-553 EX 2111

Signatures

Signature of Principal Investigator:__________ **Date: 9/22/2023**

Signature of Faculty Advisor (If applicable):__________ **Date: 9/22/2023**

****Note IRB approval is required before requested revisions may be implemented**

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)
COMPLETION REPORT - PART 1 OF 2
COURSEWORK REQUIREMENTS*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Reginald Blockett (ID: 11710108)
- **Institution Affiliation:** Auburn University (ID: 964)
- **Institution Email:** rzb0118@auburn.edu
- **Institution Unit:** Educational FLT
- **Phone:** 3135155465

- **Curriculum Group:** IRB # 2 Social and Behavioral Emphasis - AU Personnel - Basic/Refresher
- **Course Learner Group:** IRB # 2 Social and Behavioral Emphasis - AU Personnel
- **Stage:** Stage 1 - Basic Course
- **Description:** Choose this group to satisfy CITI training requirements for Key Personnel (including AU Faculty, Staff and Students) and Faculty Advisors involved primarily in Social/Behavioral Research with human subjects.

- **Record ID:** 52406579
- **Completion Date:** 19-Sep-2023
- **Expiration Date:** 19-Sep-2026
- **Minimum Passing:** 80
- **Reported Score*:** 82

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Belmont Report and Its Principles (ID: 1127)	19-Sep-2023	3/3 (100%)
The Federal Regulations - SBE (ID: 502)	26-Feb-2021	5/5 (100%)
Assessing Risk - SBE (ID: 503)	26-Feb-2021	4/5 (80%)
Informed Consent - SBE (ID: 504)	26-Feb-2021	4/5 (80%)
Privacy and Confidentiality - SBE (ID: 505)	01-Mar-2021	4/5 (80%)
Students in Research (ID: 1321)	19-Sep-2023	3/5 (60%)
Unanticipated Problems and Reporting Requirements in Social and Behavioral Research (ID: 14928)	01-Mar-2021	4/5 (80%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: www.citiprogram.org/verify/?k0c868659-ea4a-4426-b4cb-6399c9056161-52406579

Collaborative Institutional Training Initiative (CITI Program)
101 NE 3rd Avenue
Suite 320
Fort Lauderdale, FL 33301 US

Email: support@citiprogram.org
Phone: 888-529-5929
Web: https://www.citiprogram.org

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)
COMPLETION REPORT - PART 2 OF 2
COURSEWORK TRANSCRIPT**

** NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- **Name:** Reginald Blockett (ID: 11710108)
- **Institution Affiliation:** Auburn University (ID: 964)
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- **Curriculum Group:** IRB # 2 Social and Behavioral Emphasis - AU Personnel - Basic/Refresher
- **Course Learner Group:** IRB # 2 Social and Behavioral Emphasis - AU Personnel
- **Stage:** Stage 1 - Basic Course
- **Description:** Choose this group to satisfy CITI training requirements for Key Personnel (including AU Faculty, Staff and Students) and Faculty Advisors involved primarily in Social/Behavioral Research with human subjects.

- **Record ID:** 52406579
- **Report Date:** 19-Sep-2023
- **Current Score**:** 82

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT	SCORE
The Federal Regulations - SBE (ID: 502)	26-Feb-2021	5/5 (100%)
Belmont Report and Its Principles (ID: 1127)	19-Sep-2023	3/3 (100%)
Assessing Risk - SBE (ID: 503)	26-Feb-2021	4/5 (80%)
Informed Consent - SBE (ID: 504)	26-Feb-2021	4/5 (80%)
Privacy and Confidentiality - SBE (ID: 505)	01-Mar-2021	4/5 (80%)
Unanticipated Problems and Reporting Requirements in Social and Behavioral Research (ID: 14928)	01-Mar-2021	4/5 (80%)
Students in Research (ID: 1321)	19-Sep-2023	3/5 (60%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)
COMPLETION REPORT - PART 1 OF 2
COURSEWORK REQUIREMENTS*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Reginald Blockett (ID: 11710108)
- **Institution Affiliation:** Auburn University (ID: 964)
- **Institution Email:** rzb0118@auburn.edu
- **Institution Unit:** Educational FLT
- **Phone:** 3135155465

- **Curriculum Group:** Responsible Conduct of Research
- **Course Learner Group:** AU Basic RCR Training for ALL Faculty, Staff, Postdocs, and Students
- **Stage:** Stage 1 - RCR
- **Description:** This course is for investigators, staff and students with an interest or focus in **Biomedical Research**. This course contains text, embedded case studies AND quizzes.

- **Record ID:** 52406588
- **Completion Date:** 20-Sep-2023
- **Expiration Date:** 20-Sep-2026
- **Minimum Passing:** 90
- **Reported Score*:** 92

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Authorship (RCR-Basic) (ID: 16597)	20-Sep-2023	5/5 (100%)
Collaborative Research (RCR-Basic) (ID: 16598)	20-Sep-2023	4/5 (80%)
Conflicts of Interest and Commitment (RCR-Basic) (ID: 16599)	20-Sep-2023	4/5 (80%)
Data Management (RCR-Basic) (ID: 20896)	20-Sep-2023	3/5 (60%)
Mentoring and Healthy Research Environments (RCR-Basic) (ID: 20983)	20-Sep-2023	5/5 (100%)
Peer Review (RCR-Basic) (ID: 16603)	20-Sep-2023	5/5 (100%)
Research Misconduct (RCR-Basic) (ID: 16604)	20-Sep-2023	5/5 (100%)
Plagiarism (RCR-Basic) (ID: 15156)	20-Sep-2023	5/5 (100%)
Using Animal Subjects in Research (RCR-Basic) (ID: 13301)	20-Sep-2023	5/5 (100%)
Research Involving Human Subjects (RCR-Basic) (ID: 13566)	20-Sep-2023	5/5 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: www.citiprogram.org/verify/?k38e55622-93c9-4e00-a002-9fd29207ecd1-52406588

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COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COMPLETION REPORT - PART 2 OF 2

COURSEWORK TRANSCRIPT**

** NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- **Name:** Reginald Blockett (ID: 11710108)
- **Institution Affiliation:** Auburn University (ID: 964)
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- **Record ID:** 52406588
- **Report Date:** 20-Sep-2023
- **Current Score**:** 92

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT	SCORE
Using Animal Subjects in Research (RCR-Basic) (ID: 13301)	20-Sep-2023	5/5 (100%)
Research Involving Human Subjects (RCR-Basic) (ID: 13566)	20-Sep-2023	5/5 (100%)
Plagiarism (RCR-Basic) (ID: 15156)	20-Sep-2023	5/5 (100%)
Authorship (RCR-Basic) (ID: 16597)	20-Sep-2023	5/5 (100%)
Collaborative Research (RCR-Basic) (ID: 16598)	20-Sep-2023	4/5 (80%)
Conflicts of Interest and Commitment (RCR-Basic) (ID: 16599)	20-Sep-2023	4/5 (80%)
Data Management (RCR-Basic) (ID: 20896)	20-Sep-2023	3/5 (60%)
Mentoring and Healthy Research Environments (RCR-Basic) (ID: 20983)	20-Sep-2023	5/5 (100%)
Peer Review (RCR-Basic) (ID: 16603)	20-Sep-2023	5/5 (100%)
Research Misconduct (RCR-Basic) (ID: 16604)	20-Sep-2023	5/5 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: www.citiprogram.org/verify/?k38e55622-93c9-4e00-a002-9fd29207ecd1-52406588

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Revised 10/06/2021

AUBURN UNIVERSITY HUMAN RESEARCH PROTECTION PROGRAM (HRPP)

EXEMPT REVIEW APPLICATION

For assistance, contact: **The Office of Research Compliance (ORC)**
Phone: **334-844-5966** E-Mail: **IRBAdmin@auburn.edu** Web Address: **http://www.auburn.edu/research/vpr/ohs**
Submit completed form and supporting materials as one PDF through the IRB Submission Page
Hand written forms are not accepted. Where links are found hold down the control button (Ctrl) then click the link.

1. Project Identification **Today's Date: November 11, 2021**

Anticipated start date of the project: December 1, 2021 Anticipated duration of project: 1 Year

a. Project Title: Predicting Student Achievement in the Construction Domain: Correlation of Contributing Factors Given Construction-Education Self-Efficacy, Motivation, and Planned Behavior

b. Principal Investigator (PI): Rogers Hunt III Degree(s): B.S., MEng. Rank/Title: Graduate Student
Department/School: Educational Foundations, Leadership, and Technology
Role/responsibilities in this project: PI / Data collection, reporting, and answering questions from potential participants and participants
Preferred Phone Number: (205) 821-5912 AU Email: rzh0054@auburn.edu

Faculty Advisor Principal Investigator (if applicable): Jonathan E. Taylor, Ph.D.
Rank/Title: Associate Professor, Program Coordinator Department/School: Educational Foundations, Leadership, and Technology
Role/responsibilities in this project: Committee Chair and Advisor, Faculty Advisor Principal Investigator, and answering questions from potential participants and participants
Preferred Phone Number: (334)844-3078 AU Email: jonathan.taylor@auburn.edu

Department Head: James W. Satterfield Department/School: Educational Foundations, Leadership, and Technology
Preferred Phone Number: (334) 844-4460 AU Email: jws0089@auburn.edu
Role/responsibilities in this project: Department Head

c. Project Key Personnel – Identify all key personnel who will be involved with the conduct of the research and describe their role in the project. Role may include design, recruitment, consent process, data collection, data analysis, and reporting. (To determine key personnel, see decision tree). *Exempt determinations are made by individual institutions; reliance on other institutions for exempt determination is not feasible. Non-AU personnel conducting exempt research activities must obtain approval from the IRB at their home institution.*

Key personnel are required to maintain human subjects training through CITI. Only for EXEMPT level research is documentation of completed CITI training NO LONGER REQUIRED to be included in the submission packet. NOTE however, **the IRB will perform random audits of CITI training records to confirm** reported training courses and expiration dates. Course title and expiration dates are shown on training certificates.

Name: Rogers Hunt III Degree(s): B.S., MEng.
Rank/Title: Graduate Student Department/School: Educational Foundations, Leadership, and Technology
Role/responsibilities in this project: Principal Investigator, Data collection, reporting, and answering questions from potential participants and participants
- AU affiliated? ☒ Yes ☐ No If no, name of home institution: Click or tap here to enter text.
- Do you have any known competing financial interests, personal relationships, or other interests that could have influence or appear to have influence on the work conducted in this project? ☐ Yes ☒ No
- If yes, briefly describe the potential or real conflict of interest: Click or tap here to enter text.
- Plan for IRB approval for non-AU affiliated personnel? Click or tap here to enter text.
- Completed required CITI training? ☒ Yes ☐ No If NO, complete the appropriate CITI basic course and update the revised Exempt Application form.

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- If YES, choose course(s) the researcher has completed: Human Sciences Basic Course 1/28/2022
Refresher Course 1/28/2022

Name: Jonathan E. Taylor Degree(s): Ph.D
Rank/Title: Associate Professor, Program Coordinator Department/School: Educational Foundations, Leadership, and Technology
Role/responsibilities in this project: Faculty Advisor Principal Investigator, and answering questions from potential participants and participants
- AU affiliated? ☒ Yes ☐ No If no, name of home institution: Click or tap here to enter text.
- Do you have any known competing financial interests, personal relationships, or other interests that could have influence or appear to have influence on the work conducted in this project? ☐ Yes ☒ No
- If yes, briefly describe the potential or real conflict of interest: Click or tap here to enter text.
- Plan for IRB approval for non-AU affiliated personnel? Click or tap here to enter text.
- Completed required CITI training? ☒ Yes ☐ No If NO, complete the appropriate CITI basic course and update the revised EXEMPT application form.
- If YES, choose course(s) the researcher has completed: Human Sciences Basic Course 7/29/2023
Internet Research 7/29/2023

Name: Click or tap here to enter text. Degree(s): Click or tap here to enter text.
Rank/Title: Choose Rank/Title Department/School: Choose Department/School
Role/responsibilities in this project: Click or tap here to enter text.
- AU affiliated? ☐ Yes ☐ No If no, name of home institution: Click or tap here to enter text.
- Do you have any known competing financial interests, personal relationships, or other interests that could have influence or appear to have influence on the work conducted in this project? ☐ Yes ☐ No
- If yes, briefly describe the potential or real conflict of interest: Click or tap here to enter text.
- Plan for IRB approval for non-AU affiliated personnel? Click or tap here to enter text.
- Completed required CITI training? ☐ Yes ☐ No If NO, complete the appropriate CITI basic course and update the revised EXEMPT application form.
- If YES, choose course(s) the researcher has completed: Choose a course Expiration Date
Choose a course Expiration Date

d. **Funding Source –** Is this project funded by the investigator(s)? Yes ☐ No ☒
Is this project funded by AU? Yes ☐ No ☐ If YES, identify source Click or tap here to enter text.
Is this project funded by an external sponsor? Yes ☐ No ☐ If YES, provide name of sponsor, type of sponsor (governmental, non-profit, corporate, other), and an identification number for the award.
Name: Click or tap here to enter text. Type: Click or tap here to enter text. Grant #: Click or tap here to enter text.

e. List other AU IRB-approved research projects and/or IRB approvals from other institutions that are associated with this project. Describe the association between this project and the listed project(s):
Click or tap here to enter text.

2. Project Summary

a. Does the study *TARGET* any special populations? Answer YES or NO to all.

Minors (under 18 years of age)	Yes ☐ No ☒
Auburn University Students	Yes ☐ No ☒
Pregnant women, fetuses, or any products of conception	Yes ☐ No ☒
Prisoners or wards (unless incidental, not allowed for Exempt research)	Yes ☐ No ☒

Temporarily or permanently impaired Yes ☐ No ☒

b. Does the research pose more than minimal risk to participants? Yes ☐ No ☒

If YES, to question 2.b, then the research activity is NOT eligible for EXEMPT review. Minimal risk means that the probability and magnitude of harm or discomfort anticipated in the research is not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or test. 42 CFR 46.102(i)

c. Does the study involve any of the following? *If YES to any of the questions in item 2.c, then the research activity is NOT eligible for EXEMPT review.*

Procedures subject to FDA regulations (drugs, devices, etc.) Yes ☐ No ☒

Use of school records of identifiable students or information from instructors about specific students. Yes ☐ No ☒

Protected health or medical information when there is a direct or indirect link which could identify the participant. Yes ☐ No ☒

Collection of sensitive aspects of the participant's own behavior, such as illegal conduct, drug use, sexual behavior or alcohol use. Yes ☐ No ☒

d. Does the study include deception? Requires limited review by the IRB* Yes ☐ No ☒

3. MARK the category or categories below that describe the proposed research. Note the IRB Reviewer will make the final determination of the eligible category or categories.

☒ **1.** Research conducted in established or commonly accepted educational settings, involving normal educational practices. The research is not likely to adversely impact students' opportunity to learn or assessment of educators providing instruction. 104(d)(1)

☒ **2.** Research only includes interactions involving educational tests, surveys, interviews, public observation if at least ONE of the following criteria. (The research includes data collection only; may include visual or auditory recording; may NOT include intervention and only includes interactions). **Mark the applicable sub-category below (I, ii, or iii). 104(d)(2)**

☒ **(i)** Recorded information cannot readily identify the participant (directly or indirectly/ linked);
OR
- surveys and interviews: no children;
- educational tests or observation of public behavior: can only include children when investigators do not participate in activities being observed.

☐ **(ii)** Any disclosures of responses outside would not reasonably place participant at risk; **OR**

☐ **(iii)** Information is recorded with identifiers or code linked to identifiers and IRB conducts limited review; no children. **Requires limited review by the IRB.***

☐ **3.** Research involving Benign Behavioral Interventions (BBI)** through verbal, written responses including data entry or audiovisual recording from adult subjects who prospectively agree and ONE of the following criteria is met. (This research does not include children and does not include medical interventions. Research cannot have deception unless the participant prospectively agrees that they will be unaware of or misled regarding the nature and purpose of the research) **Mark the applicable sub-category below (A, B, or C).** 104(d)(3)(i)

☐ **(A)** Recorded information cannot readily identify the subject (directly or indirectly/ linked); **OR**

☐ **(B)** Any disclosure of responses outside of the research would not reasonably place subject at risk; **OR**

☐ **(C)** Information is recorded with identifies and cannot have deception unless participants prospectively agree. **Requires limited review by the IRB.***

☐ **4.** Secondary research for which consent is not required: use of identifiable information or identifiable bio-specimen that have been or will be collected for some other 'primary' or 'initial' activity, if one of the following criteria is met. Allows retrospective and prospective secondary use. **Mark the applicable sub-category below (i, ii, iii, or iv).** 104 (d)(4)

☐ **(i)** Bio-specimens or information are publicly available;

☐ **(ii)** Information recorded so subject cannot readily be identified, directly or indirectly/linked investigator does not contact subjects and will not re-identify the subjects; **OR**

☐ **(iii)** Collection and analysis involving investigators use of identifiable health information when us is regulated by HIPAA "health care operations" or "research" or "public health activities and purposes" (does not include bio-specimens (only PHI and requires federal guidance on how to apply); **OR**

☐ **(iv)** Research information collected by or on behalf of federal government using government generated or collected information obtained for non-research activities.

☐ **5.** Research and demonstration projects which are supported by a federal agency/department AND designed to study and which are designed to study, evaluate, or otherwise examine: (i)public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or service under those programs. (must be posted on a federal web site). 104.5(d)(5) (must be posted on a federal web site)

☐ **6.** Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives and consumed or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture. The research does not involve prisoners as participants. 104(d)(6)

**Limited IRB review – the IRB Chair or designated IRB reviewer reviews the protocol to ensure adequate provisions are in place to protect privacy and confidentiality.*

***Category 3 – Benign Behavioral Interventions (BBI) must be brief in duration, painless/harmless, not physically invasive, not likely to have a significant adverse lasting impact on participants, and it is unlikely participants will find the interventions offensive or embarrassing.*

*** *Exemption categories 7 and 8 require broad consent. The AU IRB has determined the regulatory requirements for legally effective broad consent are not feasible within the current institutional infrastructure. EXEMPT categories 7 and 8 will not be implemented at this time.*

4. Describe the proposed research including who does what, when, where, how, and for how long, etc.

a. Purpose

Purpose: In students majoring in Construction Management (n>150), comparing the contributing factors of those scoring at least 70% on the American Institute of Constructors (AIC) Associate Constructor (AC) Level 1 certification examination (AIC AC Level 1 Exam) versus those who scored below 70%.

b. Participant population, including the number of participants and the rationale for determining number of participants to recruit and enroll.

Purposeful sampling will be used to select 150 minimum study participants 19 years of age and older, including construction management students and recent construction management graduates from ACCE accredited baccalaureate programs who have taken the American Institute of Constructors (AIC) Associate Constructor (AC) Level 1 Exam. Interest/permission has been established with the American Council of Construction Education, the American Institute of Constructors, and institutions that administer the AIC AC Level 1 Exam as an assessment tool for student achievement. All of which are interested in this study's findings and will assist with recruitment and in the distribution of the survey instrument. The nationwide focus of this research will provide proper coverage for the desired population sample.

c. Recruitment process. Address whether recruitment includes communications/interactions between study staff and potential participants either in person or online. *Submit a copy of all recruitment materials.*

The student PI will not be meeting the participants. Instead, the student PI will be emailing a digital Qualtrics survey link to the AIC testing coordinator, who will email the link to the participants directly, using their national database. The student PI has already obtained permission from James Hogan, AIC President, to conduct the study and to administer and collect the survey data via Qualtrics. Upon completing the survey, participants will view a message thanking them for the time spent taking the survey and inform them that their responses have been recorded. There will be no further contact with the participants before or after the distribution of the survey. A follow up email reminder may be sent dependent upon the initial survey response.

d. Consent process including how information is presented to participants, etc.

A consent to participate in the research option will be provided at the initiation of the survey. I will briefly explain the research and informed consent information in the survey introduction. In the introduction section, participants will be instructed that if they do not want to participate, they may simply click, "No, I do not consent – exit/end survey" to withdraw from the study. Participants who agree to be involved will be asked to click "Yes, I consent - continue to survey" and then complete the survey. Participants who proceed with the survey are consenting that they are 19 years of age or older. Any information collected through their participation will be used to fulfill the education requirements for a Ph.D. degree at Auburn University. Any information obtained in connection with this study will remain anonymous. The results of this research may be used in future presentations and or publications. If so, no personally identifying information will be presented. Participation is entirely voluntary, and participants may withdraw at any time during the study.

e. Research procedures and methodology

This study will implement correlational quantitative research methods. This study's primary purpose is to empirically investigate the effects academic performance, applied experience, and other demographic factors have on student achievement when considering construction education domain-specific psychological constructs. By analyzing the direct assessment scores of student learning outcomes (SLOs) across these independent variables, this research can inform construction education programs, construction firms, and other partners in the built environment such that they are able to better provide organizational strategic planning for recruiting and educating a diverse construction management student population and develop effective curriculum for future construction industry professionals. For this study, I will be administering a 22-question survey to a minimum of 150 college students or recent graduates (> 5 years) who completed the AIC AC Level 1 Exam. The participants may also have been enrolled in an American Council of Construction Education (ACCE) accredited construction program. The Construction Training Attitudes and Intentions Scale (CTAIS), a construction education domain-specific survey instrument with established reliability and validity, will be used to assess psychological constructs useful in understanding and predicting human behavior that influences completion and success among construction education and training participants. Additional demographic questions will be included to establish study variables. A factorial analysis of covariance will be used to determine the influence of variables, and an ANOVA will be used to assess the significance of any variable differences.

f. Anticipated time per study exercise/activity and total time if participants complete all study activities.
The study survey will take approximately 10 to 15 minutes to complete.

g. Location of the research activities.
On-line. Nationwide distribution of survey instrument.

h. Costs to and compensation for participants? If participants will be compensated describe the amount, type, and process to distribute.
There is no cost to nor compensation for participants.

i. Non-AU locations, site, institutions. *Submit a copy of agreements/IRB approvals.*
Click or tap here to enter text.

j. Additional relevant information.
Click or tap here to enter text.

5. Waivers
Check applicable waivers and describe how the project meets the criteria for the waiver.

☐ Waiver of Consent (Including existing de-identified data)

☒ Waiver of Documentation of Consent (Use of Information Letter, rather than consent form requiring signatures)

☐ Waiver of Parental Permission (in Alabama, 18 years-olds may be considered adults for research purposes)

a. Provide the rationale for the waiver request.
No "wet" signatures will be obtained from participants; rather, consent is indicated when the survey is begun.

6. Describe the process to select participants/data/specimens. If applicable, include gender, race, and ethnicity of the participant population.

Participates/data will be selected based on major/field. Participants will be in at least the senior year of a construction education program and at least 19 years of age. Demography may be noted but does not eliminate the ability to participate.

7. Describe why none of the research procedures would cause a participant either physical or psychological discomfort or be perceived as discomfort above and beyond what the person would experience in daily life (minimal risk).

This research in this study involves no more than minimal risk to the subjects. The probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in the daily life or during the performance of routine physical or psychological examinations or tests" (Protection of Human Subjects 2018). Participants' involvement in this research is voluntary. Participants may select to withdraw from the study at any time without consequence. Time spent in the study is not meant to take away from academic and/or daily life experience.

8. Describe the provisions to maintain confidentiality of data, including collection, transmission, and storage. Identify platforms used to collect and store study data. *For EXEMPT research, the AU IRB recommends AU BOX or using an AU issued and encrypted device. If a data collection form will be used, submit a copy.*

Participants will not be required to write their names or sign the survey. Surveys will be distributed, and data collected and stored via the Auburn University Quartics survey platform and destroyed upon completing the study.

a. If applicable, submit a copy of the data management plan or data use agreement.

9. Describe the provisions included in the research to protect the privacy interests of participants (e.g., others will not overhear conversations with potential participants, individuals will not be publicly identified or embarrassed).

Meetings between project personnel and project participants is not required. The survey instrument introduction will outline research activities; that participation is voluntary; and describe the procedures to be performed.

10. Additional Information and/or attachments.

In the space below, provide any additional information you believe may help the IRB review of the proposed research. If attachments are included, list the attachments below. Attachments may include recruitment materials, consent documents, site permissions, IRB approvals from other institutions, data use agreements, data collection form, CITI training documentation, etc.

Attachments Included: 1. Informed Consent, 2. Information Letter, 3. Sample Survey Invitation, 4. Sample Follow up Email, 5. Pdf Copy of Survey Instrument, 6. AIC Consent, CITI Certifications (PI & Faculty Advisor PI)

Required Signatures *(If a student PI is identified in item 1.a, the EXEMPT application must be re-signed and updated at every revision by the student PI and faculty advisor. The signature of the department head is required only on the initial submission of the EXEMPT application, regardless of PI. Staff and faculty PI submissions require the PI signature on all version, the department head signature on the original submission)*

Signature of Principal Investigator: [signature] **Date:** 11/29/2021

Signature of Faculty Advisor (If applicable): Jonathan Taylor **Date:** 12/06/2021

Signature of Dept. Head: James Satterfield Digitally signed by James Satterfield Date: 2021.12.13 07:13:29 -06'00' **Date:**

Version Date: 11/29/2021

AUBURN UNIVERSITY

GRADUATE SCHOOL

(NOTE: DO NOT SIGN THIS DOCUMENT UNLESS AN IRB APPROVAL STAMP WITH CURRENT DATES HAS BEEN APPLIED TO THIS DOCUMENT.)

INFORMATION LETTER

for a Research Study entitled

Predicting Student Achievement in the Construction Domain: Correlation of Contributing Factors Given Construction-Education Self-Efficacy, Motivation, and Planned Behavior"

Purpose: In students majoring in Construction Management (n>150), comparing the contributing factors of those scoring at least 70% on the American Institute of Constructors (AIC) Associate Constructor (AC) Level 1 certification examination (AIC AC Level 1 Exam) versus those who scored below 70%.

You are invited to participate in a research study to determine if undergraduate students' GPA, internship opportunities, gender, social-economic status, and self-motivation effects AIC AC Level 1 Exam performance. The study is being conducted by Rogers Hunt III, Ph.D. / Candidate, under the direction of Jonathan E. Taylor, Ph.D., Associate Professor, Program Coordinator in the Auburn University Department of Educational Foundations, Leadership and Technology. You are invited to participate because you are a construction management student or recent graduate who has taken the AIC Level 1 AC Exam and is age (19) or older.

Your participation is completely voluntary. If you decide to participate in this research study, you will be asked to complete a 22-question Qualtrics (electronic-based) survey. Your total time commitment will be approximately 10-15 minutes.

There is no foreseen risk with this study. The risks associated with participating in this study are not more significant in and of themselves than those ordinarily encountered in the daily life or during the performance of routine physical or psychological examinations or tests. To minimize these risks, we will not meet with participants. Instead, the research and informed consent information will be briefly explained in the survey introduction. Participants may choose to withdraw from the study at any time without affecting their relationship with the researcher, Auburn University, the American Council for Constriction Education (ACCE), or the American Institute of Constructors (AIC). Any information obtained in connection with this study will remain anonymous.

There is no direct benefit or compensation associated with participating in this study. Therefore, if you decide to participate, you will not be compensated.

If you change your mind about participating, you can withdraw at any time by closing your browser window. If you choose to withdraw, your data can be withdrawn as long as it is identifiable. Once you've submitted anonymous data, it cannot be withdrawn since it will be unidentifiable. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University, the Department of Educational Foundations, Leadership and Technology, the American

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AUBURN UNIVERSITY
GRADUATE SCHOOL

Council for Constriction Education (ACCE), or the American Institute of Constructors (AIC).

Any information collected through your participation will be used to fulfill the education requirements of Rogers Hunt III for a Ph.D. degree at Auburn University. Any information obtained in connection with this study will remain anonymous. Information obtained through your participation may be used in future presentations and or publications. If so, no personally identifying information will be presented.

If you have questions about this study, please contact Rogers Hunt III at rzh0054@auburn.edu 205-821-5912 or Jonathan E. Taylor, Ph.D. at jonathan.taylor@auburn.edu 334-844-3078

If you have questions about your rights as a research participant, you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334)-844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION ABOVE, YOU MUST DECIDE IF YOU WANT TO PARTICIPATE IN THIS RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, PLEASE CLICK ON THE LINK BELOW. YOU MAY PRINT A COPY OF THIS LETTER TO KEEP.

The Auburn University Institutional Review Board has approved this document for use from _________ to ________. Protocol #_______

LINK TO SURVEY

https://auburn.qualtrics.com/jfe/form/SV_dhslFPTLeWxPjiC

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Sample Email – Survey Invitation

Dear AIC Members and Certification Examinee,

Research Study entitled

Predicting Student Achievement in the Construction Domain: Correlation of Contributing Factors Given Construction-Education Self-Efficacy, Motivation, and Planned Behavior "

You are invited to participate in a research study to determine if undergraduate students' GPA, internship opportunities, gender, social-economic status, and self-motivation effects AIC AC Level 1 Exam performance. You have been identified as an ideal participant due to your subject matter experience.

Purpose: In students majoring in Construction Management (n>150), comparing the contributing factors of those scoring at least 70% on the American Institute of Constructors (AIC) Associate Constructor (AC) Level 1 certification examination (AIC AC Level 1 Exam) versus those who scored below 70%.

The study is being conducted by Rogers Hunt, III ADED Ph.D. candidate, under the direction of Dr. Jonathan E. Taylor, Dissertation Committee Chair, in the Auburn University Department of Educational Foundations, Leadership, and Technology. Any information obtained in connection with this study will remain anonymous.

This survey will only take 10-15 minutes to complete and your viewpoints will be greatly appreciated.

Information obtained through your participation may be used in future presentations and or publications. No personally identifying information will be presented. Your participation is completely voluntary, and you can withdraw at any time during the study. Participants who proceed with the survey are consenting that they are 19 years of age or older.

There in no compensation, costs, no foreseen risks and no direct benefits for participating in this study.

To start the qualtrics.XM survey link below:

https://auburn.qualtrics.com/jfe/form/SV_dhslFPTLeWxPjiC

This invitation is only intended for the email recipient. Please do not forward this email nor survey link to any other parties.

Thank you for your time.

This survey is powered by qualtrics.XM is the world's first **experience** management platform, designed to gather, analyze and act on core business data. Qualtrics uses Transport Layer Security (TLS) encryption (also known as HTTPS) for all transmitted data. Services are hosted by trusted data centers that are independently audited using the industry standard SSAE-18 method.

Sample Follow up via email- 1 month after the initial invitation. Repeated in the 3rd and 5th months.

Dear AIC Members and Certification Examinee,

Research Study entitled

Predicting Student Achievement in the Construction Domain: Correlation of Contributing Factors Given Construction-Education Self-Efficacy, Motivation, and Planned Behavior "

This is a reminder that you are invited to participate in a research study to determine if undergraduate students' GPA, internship opportunities, gender, social-economic status, and self-motivation effects AIC AC Level 1 Exam performance. You have been identified as an ideal participant due to your subject matter experience.

Purpose: In students majoring in Construction Management (n>150), comparing the contributing factors of those scoring at least 70% on the American Institute of Constructors (AIC) Associate Constructor (AC) Level 1 certification examination (AIC AC Level 1 Exam) versus those who scored below 70%.

The study is being conducted by Rogers Hunt, III ADED Ph.D. candidate, under the direction of Dr. Jonathan E. Taylor, Dissertation Committee Chair, in the Auburn University Department of Educational Foundations, Leadership, and Technology. Any information obtained in connection with this study will remain anonymous.

This survey will only take 10-15 minutes to complete and your viewpoints will be greatly appreciated.

Information obtained through your participation may be used in future presentations and or publications. No personally identifying information will be presented. Your participation is completely voluntary, and you can withdraw at any time during the study. Participants who proceed with the survey are consenting that they are 19 years of age or older.

There in no compensation, costs, no foreseen risks and no direct benefits for participating in this study.

To start the qualtrics.XM survey link below:

https://auburn.qualtrics.com/jfe/form/SV_dhslFPTLeWxPjiC

This invitation is only intended for the email recipient. Please do not forward this email nor survey link to any other parties.

Thank you for your time.

This survey is powered by qualtrics.XM is the world's first **experience** management platform, designed to gather, analyze and act on core business data. Qualtrics uses Transport Layer Security (TLS) encryption (also known as HTTPS) for all transmitted data. Services are hosted by trusted data centers that are independently audited using the industry standard SSAE-18 method.

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Tools ∨ Saved at 4:44 PM Draft

Preview Publish

Search...

Predicting n Domain

IQ Score: Fair

ERMA 8206 SP 2020

Predicting Student Achievement in the Construction Domain

Introduction

...

Thank you for agreeing to participate in this research study. Rogers Hunt, III ADED Ph.D. candidate, is conducting the study under Dr. Jonathan E. Taylor, Dissertation Committee Chair, in the Auburn University Department of Educational Foundations, Leadership, and Technology. This survey will take approximately 10 to 15 minutes to complete.

Purpose: In students majoring in Construction Management (n>150), comparing the contributing factors of those scoring at least 70% on the American Institute of Constructors (AIC) Associate Constructor (AC) Level 1 certification examination (AIC AC Level 1 Exam) versus those who scored below 70%.

This research's will empirically investigate the effects academic performance, applied experience, and other demographic factors have on student achievement when considering construction education domain-specific psychological constructs.

By participating, you are consenting that you are 19 years of age or older. Any information collected through your participation will be used to fulfill the education requirements for a Ph.D. degree at Auburn University. Any information obtained in connection with this study will remain anonymous. The results of this research may be used in future presentations and or publications. If so, no personally identifying information will be presented. Your participation is entirely voluntary, and you can withdraw at any time during the study.

Directions: Please click the appropriate response to each question. Additional instructions may be provided as needed throughout the survey.

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Q0 Informed Consent

The research in this study involves no more than minimal risk to the subjects. The probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in the daily life or during the performance of routine physical or psychological examinations or tests" (Protection of Human Subjects 2018). Participants' involvement in this research is voluntary. Participants may choose to withdraw from the study at any time without affecting their relationship with the researcher, Auburn University, the American Council for Constriction Education (ACCE), or the American Institute of Constructors (AIC).

I consent to participating in this research study:

- ○ Yes, I consent - continue to survey
- ○ No, I do not consent - exit / end survey

Import from library | Add new question

Add Block

Demographics

Demographics

The following questions will help to structure the participant population for this research study. Please answer the questions as they relate to you.

Q1

Which gender do you most identify with?

- ○ Male
- ○ Female
- ○ Prefer not to say
- ○ Other: please specify __________

Q2 *

Which racial group do you best identify with?

- ○ White
- ○ Black or African American
- ○ American Indian or Alaska Native
- ○ Asian
- ○ Native Hawaiian or Pacific Islander
- ○ Other: please specify ______________

Q3 *

What is your academic classification?

- ○ Freshman
- ○ Sophomore
- ○ Junior
- ○ Senior
- ○ Recent Graduate 1-5 years
- ○ Graduate over 5 years

Q4 *

Do / Did you receive Federal Financial Aid? (i.e. scholarships, grants, loans, work-study)

- ○ Yes
- ○ No
- ○ I Don't Know

Q5 Have you completed a FASFA Application? *

Have you completed a FASFA Application?

- ○ Yes
- ○ No
- ○ I Don't Know

Q6

Do / Did you qualify for the Pell Grant?

- Yes
- No
- I Don't Know

Q7

Are / Were you the first in your immediate family (i.e. grandmother/mother, grandfather/father, siblings) to attend college?

- Yes
- No
- I Don't Know

Import from library | Add new question

Add Block

Academic Performance - College

Academic Performance - College

We would like to know more about your college experiences and academic performance. Please answer the questions as they relate to you.

Q8

What did you score on the American Institute of Constructors (AIC) Associate Constructor (AC) Level 1 Exam?

- 90-100 Percent
- 80-89 Percent
- 70-79 Percent
- 60-69 Percent
- 50-59 Percent
- Below 50 Percent

Q9

What is / was your Cumulative Grade Point Average (CGPA) based on a 4.0 Scale at the time you took the AIC AC Level 1 Exam? Please round up to the nearest score.

- 4.0 or Higher (90-100 Percent)
- 3.0 - 3.9 or (80-89 Percent)
- 2.0 – 2.9 or (70-79 Percent)
- 1.9 or Below (65-69 Percent)
- N/A - Select if your college dose not use the 4.0 scale

Q10

Is / Was Construction Science and Management (or construction/building related) your initial enrolled major?

- Yes
- No

Q11

If Construction Science and Management (or construction/building related) was not your initial enrolled major, what major did you transfer from?

- Engineering
- Architecture
- Business
- Undecided
- Other: please specify ______________

Import from library | Add new question

Add Block

Applied Industry Experience - Student

Applied Industry Experience - Student

We would like to know more about your opportunities to gain industry experience while in college. Please answer the questions as they relate to you.

Q12

Did your program prepare you for an Internship or Co-op (i.e. host career fairs, mock interviews, resume writing seminars)?

- Yes
- No
- I Don't Know

Q13

Did you participate in an construction industry related internship and/or co-op opportunity while in college?

- Yes
- No

Q14

Indicate to the degree in which you Agree or Disagree with the following statements

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
An internship/co-op will help me better understand the course lecture content.	O	O	O	O	O
An internship/co-op will help me better prepare for the AIC AC Level 1 Exam	O	O	O	O	O
An internship/co-op will lead to a job offer after graduation.	O	O	O	O	O

Import from library Add new question

Add Block

Applied Industry Experience - Faculty

Applied Industry Experience - Faculty

We would like to know more about the construction industry experience of your program faculty. Please answer the questions as they relate to you.

Q15

Did the majority of your construction faculty members indicate that they had construction industry work experience?

- Yes
- No
- I Don't Know

Q16

iQ ☆

Indicate to the degree in which you Agree or Disagree with the following statements

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Faculty members with construction industry work experience will help me better understand the course lecture content.	O	O	O	O	O
Faculty members with construction industry work experience will help me better prepare for the AIC AC Level 1 Exam	O	O	O	O	O
Faculty members with construction industry work experience will better prepare me for construction related employment after graduation.	O	O	O	O	O

Import from library | Add new question

Add Block

Construction Training Attitudes and Intentions Scale (CTAIS)

Construction Training Attitudes and Intentions Scale (CTAIS)

The following questions will be used to assess psychological constructs useful in understanding and predicting human behavior that influences completion and success in construction related programs.

Q17

iQ

Indicate to the degree in which you Agree or Disagree with the following statements

Construction Education Self-Efficacy (CESE)

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
My past experiences and accomplishments increase my confidence that I will be able to perform well in construction education.	O	O	O	O	O
My past experiences and accomplishments increase my confidence that I will be able to successfully complete a construction education program.	O	O	O	O	O
Construction education is within the scope of my abilities.	O	O	O	O	O
Successfully completing a construction education program is within the scope of my abilities.	O	O	O	O	O
I am usually a good judge of my own capabilities.	O	O	O	O	O
Other people that know me well perceive me as being a capable person.	O	O	O	O	O
My estimates of how well I can deal with a new situation are usually very accurate.	O	O	O	O	O
I expect to be able to do things that need to be done to successfully complete a construction education program.	O	O	O	O	O
If I take construction courses which involved many different tasks, some easy and some difficult, I would probably do very well at almost all of them.	O	O	O	O	O
If I take a construction course in an unfamiliar area, I expect to be able to successfully complete the course.	O	O	O	O	O
If I were asked to take a course in an area of construction which I didn't know much about, I could do well.	O	O	O	O	O
If I were asked to take a course in an area of construction which I didn't know much about, I could successfully complete the training/courses.	O	O	O	O	O
I can generally do the work necessary to accomplish my goals in education courses.	O	O	O	O	O
I am confident that I can do well in construction education that deal with tool operation, using tools or body to move objects.	O	O	O	O	O

Q18

iQ

Indicate to the degree in which you Agree or Disagree with the following statements

	Construction Education Motivation (CEM)				
	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I value construction-related education.	O	O	O	O	O
Construction education is useful for my development.	O	O	O	O	O
I will be able to apply what I have learned in construction education to a job.	O	O	O	O	O
I am motivated to learn the skills taught in construction education programs.	O	O	O	O	O
I would like to improve my construction-related skills	O	O	O	O	O
I am willing to invest effort to improve construction-related skills and competencies just for the sake of learning.	O	O	O	O	O
I am willing to invest effort to improve my skills and competencies in order to prepare myself for a construction-related job.	O	O	O	O	O
Taking construction education courses is a high priority for me.	O	O	O	O	O
I am willing to invest effort on my personal time to develop construction-related skills.	O	O	O	O	O

Q19

Indicate to the degree in which you Agree or Disagree with the following statements

Construction Education Planned Behavior (CEPB)

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I will "Likely" attend the meetings of this construction education program on a regular basis:	O	O	O	O	O
I will "Likely" successfully complete this construction education course:	O	O	O	O	O
I would "Definitely" make an effort to attend the meetings of construction education courses on a regular basis:	O	O	O	O	O
I would "Definitely" make an effort to successfully complete a construction education program:	O	O	O	O	O
I intend to attend the meetings of a construction education program on a regular basis:	O	O	O	O	O
I intend to successfully complete construction education:	O	O	O	O	O
Most people who are important to me think that I should participate in construction education:	O	O	O	O	O
It is expected of me that I attend the meetings of a construction education program on a regular basis:	O	O	O	O	O
It is expected of me that I would successfully complete a construction education program:	O	O	O	O	O
Most people whose opinions I value would approve of my participating in a construction education program:	O	O	O	O	O
For me to successfully complete construction education is good:	O	O	O	O	O
For me to attend the meetings of a construction education program is valuable:	O	O	O	O	O
For me to complete a construction education program is valuable:	O	O	O	O	O
For me to attend the meeting of a construction education program is pleasant:	O	O	O	O	O

Import from library

Add new question

Add Block

American Council for Construction Education (ACCE)

American Council for Construction Education (ACCE)

The following questions pertain to student learning outcomes (SLO) identified by the ACCE as minimum requirements for students graduating with a Construction Management related degree. Indicate to the degree in which you Agree or Disagree with the following

Q20

iQ *

The program curriculum and internship/co-op experience (if applicable) prepared me to meet the following student learning objectives:

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Analyze decisions based on ethics	O	O	O	O	O
Analyze construction methods, materials & equipment.	O	O	O	O	O
Analyze construction documents	O	O	O	O	O
Understand the different roles and responsibilities of all constituencies involved in the design and construction process	O	O	O	O	O
Understand construction risk management	O	O	O	O	O
Understand construction accounting	O	O	O	O	O
Understand quality assurance and control	O	O	O	O	O
Understand project control processes	O	O	O	O	O
Understand the legal implications of contract law.	O	O	O	O	O
Understand the basic principles of sustainable construction.	O	O	O	O	O
Understand basic structural behavior	O	O	O	O	O
Understand the basic principles of MEP systems	O	O	O	O	O

Import from library

Add new question

Add Block

American Institute of Constructors Certifications

American Institute of Constructors Certifications

AIC would like to know about your plans for future professional credentialing in the construction industry.

Q21

Students who score at least a 70 Percent on the AIC Level 1 Exam qualify for the Associate Constructor Certification. Do you plan to apply to take the Associate Constructor Certification Exam?

- ○ Yes
- ○ No
- ○ Undecided

Q22

If you intend to earn and maintain the Associate Constructor Certification, will you pursue the Certified Professional Constructor (CPC) Level 2 Certification when qualified to do so?

- ○ Yes
- ○ No
- ○ Undecided

Import from library | Add new question

Add Block

End of Survey

We thank you for your time spent taking this survey.

Your response has been recorded.

CITI PROGRAM

Completion Date 29-Jan-2019
Expiration Date 28-Jan-2022
Record ID 30076901

This is to certify that:

Rogers Hunt

Has completed the following CITI Program course:

IRB # 2 Social and Behavioral Emphasis - AU Personnel - Basic/Refresher (Curriculum Group)
IRB # 2 Social and Behavioral Emphasis - AU Personnel (Course Learner Group)
1 - Basic Course (Stage)

Under requirements set by:

Auburn University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w28fd42f5-6e7e-45e1-b99e-b33c739d7731-30076901

CITI PROGRAM

Completion Date 29-Jul-2020
Expiration Date 29-Jul-2023
Record ID 37155627

This is to certify that:

Jonathan Taylor

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

IRB Additional Modules
(Curriculum Group)
Defining Research with Human Subjects - SBE
(Course Learner Group)
1 - Basic Course
(Stage)

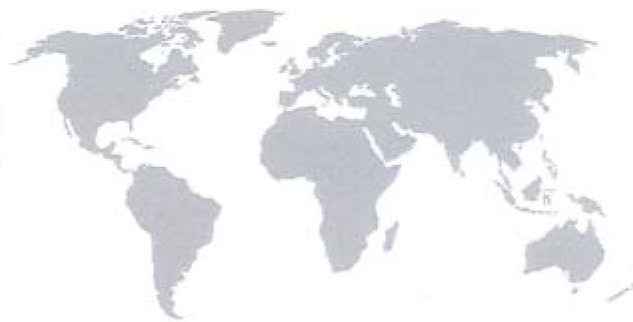
Under requirements set by:

Auburn University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wdf12d150-db29-48f2-809b-b34a4493529f-37155627

CITI PROGRAM



Completion Date 29-Jul-2020
Expiration Date 29-Jul-2023
Record ID 37155645

This is to certify that:

Jonathan Taylor

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

IRB Additional Modules
(Curriculum Group)
Internet Research - SBE
(Course Learner Group)
1 - Basic Course
(Stage)

Under requirements set by:

Auburn University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?w9204e0f1-f31f-43f1-9230-9eff21e0e370-37155645

Appendix C

Survey Instrument

Predicting Student Achievement in the Construction Domain

Introduction

Thank you for agreeing to participate in this research study. Rogers Hunt, III HIED Ph.D. candidate, is conducting the study under Dr. Reginald Blockett, Dissertation Committee Chair, in the Auburn University Department of Educational Foundations, Leadership, and Technology. This survey will take approximately 10 to 15 minutes to complete.

Purpose: In students majoring in Construction Management (n>150), comparing the contributing factors of those scoring at least 70% on the American Institute of Constructors (AIC) Associate Constructor (AC) Level 1 certification examination (AIC AC Level 1 Exam) versus those who scored below 70%.

This research will empirically investigate the effects academic performance, applied experience, and other demographic factors have on student achievement when considering construction education domain-specific psychological constructs.

By participating, you are consenting that you are 19 years of age or older. Any information collected through your participation will be used to fulfill the education requirements for a Ph.D. degree at Auburn University. Any information obtained in connection with this study will remain anonymous. The results of this research may be used in future presentations or publications. If so, no personally identifying information will be presented. Your participation is entirely voluntary, and you can withdraw at any time during the study.

Directions: Please click the appropriate response to each question. Additional instructions may be provided as needed throughout the survey.

The research in this study involves no more than minimal risk to the subjects. The probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in the daily life or during the performance of routine physical or psychological examinations or tests" (Protection of Human Subjects 2018). Participants' involvement in this research is voluntary. Participants may choose to withdraw from the study at any time without affecting their relationship with the researcher, Auburn University, the American Council for Constriction Education (ACCE), or the American Institute of Constructors (AIC).

I consent to participating in this research study:

- ○ Yes, I consent - continue to survey
- ○ No, I do not consent - exit / end survey

Demographics

Demographics

The following questions will help to structure the participant population for this research study. Please answer the questions as they relate to you.

Which gender do you most identify with?

- ○ Male
- ○ Female
- ○ Prefer not to say
- ○ Other: please specify _______________

Which racial group do you best identify with?

- ○ White
- ○ Black or African American
- ○ American Indian or Alaska Native
- ○ Asian
- ○ Native Hawaiian or Pacific Islander
- ○ Other: please specify _______________

What is your academic classification?

- Freshman
- Sophomore
- Junior
- Senior
- Recent Graduate 1-5 years
- Graduate over 5 years

Do / Did you receive Federal Financial Aid? (i.e. scholarships, grants, loans, work-study)

- Yes
- No
- I Don't Know

Have you completed a FASFA Application?

- Yes
- No
- I Don't Know

Do / Did you qualify for the Pell Grant?

- Yes
- No
- I Don't Know

Are / Were you the first in your immediate family (i.e. grandmother/mother, grandfather/father, siblings) to attend college?

- Yes
- No
- I Don't Know

Academic Performance - College

Academic Performance - College

We would like to know more about your college experiences and academic performance. Please answer the questions as they relate to you.

What did you score on the American Institute of Constructors (AIC) Associate Constructor (AC) Level 1 Exam?

- ○ 90-100 Percent
- ○ 80-89 Percent
- ○ 70-79 Percent
- ○ 60-69 Percent
- ○ 50-59 Percent
- ○ Below 50 Percent

What is / was your Cumulative Grade Point Average (CGPA) based on a 4.0 Scale at the time you took the AIC AC Level 1 Exam? Please round up to the nearest score.

- ○ 4.0 or Higher (90-100 Percent)
- ○ 3.0 - 3.9 or (80-89 Percent)
- ○ 2.0 – 2.9 or (70-79 Percent)
- ○ 1.9 or Below (65-69 Percent)
- ○ N/A - Select if your college dose not use the 4.0 scale

Is / Was Construction Science and Management (or construction/building related) your initial enrolled major?

- ○ Yes
- ○ No

If Construction Science and Management (or construction/building related) was not your initial enrolled major, what major did you transfer from?

- Engineering
- Architecture
- Business
- Undecided
- Other: please specify ______________

Applied Industry Experience - Student

Applied Industry Experience - Student

We would like to know more about your opportunities to gain industry experience while in college. Please answer the questions as they relate to you.

Did your program prepare you for an Internship or Co-op (i.e. host career fairs, mock interviews, resume writing seminars)?

- Yes
- No
- I Don't Know

Did you participate in an construction industry related internship and/or co-op opportunity while in college?

- Yes
- No

Indicate to the degree in which you Agree or Disagree with the following statements

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
An internship/co-op will help me better understand the course lecture content.	O	O	O	O	O
An internship/co-op will help me better prepare for the AIC AC Level 1 Exam	O	O	O	O	O
An internship/co-op will lead to a job offer after graduation.	O	O	O	O	O

Applied Industry Experience - Faculty

Applied Industry Experience - Faculty

We would like to know more about the construction industry experience of your program faculty. Please answer the questions as they relate to you.

Did the majority of your construction faculty members indicate that they had construction industry work experience?

- O Yes
- O No
- O I Don't Know

Indicate to the degree in which you Agree or Disagree with the following statements

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Faculty members with construction industry work experience will help me better understand the course lecture content.	O	O	O	O	O
Faculty members with construction industry work experience will help me better prepare for the AIC AC Level 1 Exam	O	O	O	O	O
Faculty members with construction industry work experience will better prepare me for construction related employment after graduation.	O	O	O	O	O

Construction Training Attitudes and Intentions Scale (CTAIS)

Construction Training Attitudes and Intentions Scale (CTAIS)

The following questions will be used to assess psychological constructs useful in understanding and predicting human behavior that influences completion and success in construction related programs.

Indicate to the degree in which you Agree or Disagree with the following statements

	Construction Education Self-Efficacy (CESE)				
	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
My past experiences and accomplishments increase my confidence that I will be able to perform well in construction education.	O	O	O	O	O
My past experiences and accomplishments increase my confidence that I will be able to successfully complete a construction education program.	O	O	O	O	O

Construction education is within the scope of my abilities.	○	○	○	○	○
Successfully completing a construction education program is within the scope of my abilities.	○	○	○	○	○
I am usually a good judge of my own capabilities.	○	○	○	○	○
Other people that know me well perceive me as being a capable person.	○	○	○	○	○
My estimates of how well I can deal with a new situation are usually very	○	○	○	○	○

Construction Education Self-Efficacy (CESE)

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
accurate.					
I expect to be able to do things that need to be done to successfully complete a construction education program.	○	○	○	○	○
If I take construction courses which involved many different tasks, some easy and some difficult, I would probably do very well at almost all of them.	○	○	○	○	○
If I take a construction course in an unfamiliar area, I expect to be able to successfully complete the course.	○	○	○	○	○
If I were asked to take a course in an area of construction which I didn't know much about, I could do well.	○	○	○	○	○
If I were asked to take a course in an area of construction which I didn't know much about, I could successfully complete the training/courses.	○	○	○	○	○
I can generally do the work necessary to accomplish my goals in education courses.	○	○	○	○	○
I am confident that I can do well in construction education that deal with tool operation, using tools or body to move objects.	○	○	○	○	○

Indicate to the degree in which you Agree or Disagree with the following statements

Construction Education Motivation (CEM)

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I value construction-related education.	O	O	O	O	O
Construction education is useful for my development.	O	O	O	O	O
I will be able to apply what I have learned in construction education to a job.	O	O	O	O	O
I am motivated to learn the skills taught in construction education programs.	O	O	O	O	O
I would like to improve my construction-related skills	O	O	O	O	O
I am willing to invest effort to improve construction-related skills and competencies just for the sake of learning.	O	O	O	O	O
I am willing to invest effort to improve my skills and competencies in order to prepare myself for a construction-related job.	O	O	O	O	O
Taking construction education courses is a high priority for me.	O	O	O	O	O
I am willing to invest effort on my personal time to develop construction-related skills.	O	O	O	O	O

Indicate to the degree in which you Agree or Disagree with the following statements

	Construction Education Planned Behavior (CEPB)				
	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I will "Likely" attend the meetings of this construction education program on a regular basis:	O	O	O	O	O
I will "Likely" successfully complete this construction education course:	O	O	O	O	O
I would "Definitely" make an effort to attend the meetings of construction education courses on a regular basis:	O	O	O	O	O
I would "Definitely" make an effort to successfully complete a construction education program:	O	O	O	O	O
I intend to attend the meetings of a construction education program on a regular basis:	O	O	O	O	O
I intend to successfully complete construction education:	O	O	O	O	O
Most people who are important to me think that I should participate in construction education:	O	O	O	O	O
It is expected of me that I attend the meetings of a construction education program on a regular basis:	O	O	O	O	O
It is expected of me that I would successfully complete a construction education program:	O	O	O	O	O
Most people whose opinions I value would approve of my participating in a construction education program:	O	O	O	O	O
For me to successfully complete construction education is good:	O	O	O	O	O
For me to attend the meetings of a construction education program is valuable:	O	O	O	O	O
For me to complete a construction education program is valuable:	O	O	O	O	O
For me to attend the meeting of a construction education program is pleasant:	O	O	O	O	O

American Council for Construction Education (ACCE)

American Council for Construction Education (ACCE)

The following questions pertain to student learning outcomes (SLO) identified by the ACCE as minimum requirements for students graduating with a Construction Management related degree. Indicate to the degree in which you Agree or Disagree with the following

The program curriculum and internship/co-op experience (if applicable) prepared me to meet the following student learning objectives:

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Analyze decisions based on ethics	O	O	O	O	O
Analyze construction methods, materials & equipment.	O	O	O	O	O
Analyze construction documents	O	O	O	O	O
Understand the different roles and responsibilities of all constituencies involved in the design and construction process	O	O	O	O	O
Understand construction risk management	O	O	O	O	O
Understand construction accounting	O	O	O	O	O
Understand quality assurance and control	O	O	O	O	O
Understand project control processes	O	O	O	O	O
Understand the legal implications of contract law.	O	O	O	O	O
Understand the basic principles of sustainable construction.	O	O	O	O	O
Understand basic structural behavior	O	O	O	O	O
Understand the basic principles of MEP systems	O	O	O	O	O

American Institute of Constructors Certifications

American Institute of Constructors Certifications

AIC would like to know about your plans for future professional credentialing in the construction industry.

Students who score at least a 70 Percent on the AIC Level 1 Exam qualify for the Associate Constructor Certification. Do you plan to apply to take the Associate Constructor Certification Exam?

- Yes
- No
- Undecided

If you intend to earn and maintain the Associate Constructor Certification, will you pursue the Certified Professional Constructor (CPC) Level 2 Certification when qualified to do so?

- Yes
- No
- Undecided