12-2023

Factors That Influenced Current Gen Z Undergraduate Students Enrolled in Construction-Related Programs to Pursue a Career in Construction

Bishesh Bharadwaj
bbharad@clemson.edu

FACTORS THAT INFLUENCED CURRENT GEN Z UNDERGRADUATE STUDENTS ENROLLED IN CONSTRUCTION-RELATED PROGRAMS TO PURSUE A CAREER IN CONSTRUCTION

A Thesis
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
Construction Science and Management

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by
Bishesh Bharadwaj
December 2023

Accepted by:
Dr. Jason D. Lucas, Committee Chair
Dr. Dhaval Gajjar
Dr. Vivek Sharma

ABSTRACT

This retrospective survey-based study explores the various factors that influenced Gen Z undergraduate students currently enrolled in construction-related programs to pursue a career in construction, combining the insights from overarching studies divided into two segments. The first part of the study focuses on understanding the exposure and participation of Gen Z students in STEM and construction programs during their middle and high school years to better understand the influence of such programs at the school level for a career decision in construction. Structured academic frameworks like semester curricula and offered electives emerged as a significant channel of STEM exposure, with the highest participation rate in Mathematics and Statistics in both middle and high school. There was a notable increase in student participation in construction programs as they transitioned from middle to high school, demonstrating a growing interest nurtured through schools in shaping the career trajectory toward construction.

The second segment of the study broadens the scope, delving into two realms: first, understanding the perception of students on how influential the middle and high school curriculum were in their decision to pursue a career in construction, and second, exploring the influence of multifaceted factors in their decision. It was revealed that students who participated in STEM and construction programs during their formative schooling years modestly perceived such experience as an influential factor as opposed to those who did not participate. However, exploration of various factors rendered such experience, while valuable, less impactful compared to personal background, such as

family influence and practical considerations such as attractive career prospects in influencing students to pursue a career in construction.

Together, these studies underscore the necessity of a holistic approach in attracting and preparing the next generation for a career in construction. They suggest that educational initiatives should be complemented by efforts that address social influence and align with students' aspirations and the practical realities of the construction industry. This dual focus is essential for an effective workforce pipeline to address the current workforce shortage the construction industry faces.

DEDICATION

I would like to dedicate this to my grandma, **Ambika Koirala**, and my parents, **Umanath Niraula** and **Narbada Koirala**.

ACKNOWLEDGMENTS

I would like to extend my sincere thanks to Dr. Jason D. Lucas for providing me with this opportunity. His unwavering support and guidance throughout this journey have been a source of immense joy and learning. This accomplishment is testament to his steadfast mentorship. I owe him an immeasurable debt of gratitude.

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CHAPTER ONE

INTRODUCTION

The United States construction industry is one of the major sectors of the nation's economy demonstrating substantial growth. By October 2023, the total spending in the U.S construction industry for the year reached 2,027.1 billion, with notable increase of 10.7% from October 2022 (U.S. Census Bureau, 2023). This massive financial footprint of the industry is highlighted by its contribution of 4.2% to the nation's GDP in 2019 (Bureau of Economic Analysis, 2021). Such prominence has naturally created a plethora of opportunities across the industry, resulting in a rise in demand for construction workers across the nation. However, the industry continues to face severe problems with the availability and sufficiency the workforce (Alsharef et. al, 2021; MSCM, 2016).

Delving deeper into the roots to understand the cause for this shortage unravels a concerning trend. There is a lack of students interested in pursuing their career in the construction industry. This repulsion is not without a reason. Many students in schools have a negative perception about pursuing a career in construction, often viewing it as a less desirable career path (Escamilla et al., 2016; Hugo et.al., 2018; Bilbo et.al., 2009a). Such perception of the students can create a formidable challenge to the construction industry.

In order to effectively address and potentially overturn these perceptions, it is necessary to understand how students in their middle and high school years are exposed to the construction related curriculum or activities. It is also important to identify other external factors outside of educational influence for students that influence them to pursue a career in construction. This research aims to identify the factors driving students' inclination towards a career in construction.

Research Problem

Despite construction industry being one of the pivotal sectors in the U.S. economy, the trend of declining interest among students to pursue a career in construction is a concern for the industry. While a negative perception about the industry is omnipresent, the factors encouraging students during middle and high school to pursue a career in construction remain unexplored. This study endeavors in determining and evaluating the factors that influenced middle and high school students to pursue a career in construction. From a broader perspective, this study aims to understand one of the major components of the workforce supply pipeline of the construction industry—the middle and high school years for the students, and what factors during this timeframe plays a role in encouraging students to pursue a career in construction. This will fill the literature gap for further studies and help develop intervention programs aiming to address the workforce shortage the construction industry is facing.

The study aims to answer the following research questions:

Q1. What STEM opportunities were the currently enrolled Gen Z undergraduate students in construction related programs exposed to during their middle and high school years?

Q1.1 What STEM curriculum/programs, and how often were they offered to middle and high school students?

Q1.2. Did schools offer any construction-related curriculum to introduce students to the construction industry?

Q2. How often did the currently enrolled Gen Z undergraduate students in construction related programs take advantage of such opportunities during their middle and high school years?

Q2.1. What STEM curriculum/programs have the students participated in?

Q3. What factors influenced Gen Z undergraduate students currently enrolled in construction related programs to pursue a career in construction?

Q3.1. Did participation in STEM/construction related programs during middle and high school influence their decision to pursue a career in construction?

Q3.2. What were other influencing factors for students to pursue a career in construction?

Q3.3. What factors were most influential in driving students to pursue a career in construction?

Research Objectives

The following research objectives will be undertaken in this study:

Objective 1:

Identify STEM opportunities that the Gen Z undergraduate students currently enrolled in construction related programs were exposed to during their middle and high school years.

Gen Z is a demographic cohort that has grown up in a world dominated by digital technology and is often referred to as technology savvy (Gaidhani et al., 2019; Schwieger & Ladwig, 2018). This has shaped their characteristics, behaviors, and perception in a different way than prior generations (Twenge, 2017). As this generation is ready to enter the workforce, understanding their prior exposure to STEM becomes imperative. By understanding the STEM opportunities that the Gen Z undergraduate students currently enrolled in various construction related programs were exposed to during their middle and high school years, we can gain insight into the role of education institutions to help students find an interest in a particular career.

Objective 2:

Evaluate how often the currently enrolled Gen Z students in construction related programs took advantage of such opportunities during their middle and high school years.

From traditional classrooms setting to online platforms, from hands-on workshops to virtual simulations, STEM opportunities have been more accessible to students than ever before (Bossi, 2018). However, accessibility doesn't necessarily mean that students will participate or engage with the resources. It is important to understand how often these students took advantage of the available resources to translate it into possible career interest.

Objective 3:

Identify the factors that influenced Gen Z students currently enrolled in construction related programs to pursue a career in construction.

The middle and high school levels are mostly characterized as years when the students are constantly exploring their interest and recognizing their academic potential. This objective identifies the factors that influenced the Gen Z students currently enrolled in construction related programs to pursue a career in construction.

Although school environment with its curriculum and extracurricular activities has a huge impact in influencing students to pursue a particular career path, which may apply the same to a construction career, other external factors should not be overlooked. For instance, a child born in a family with a construction background or a construction business can have an early exposure to the industry, which can instill a sense of familiarity and interest toward the industry. Understanding all the influences from school environments to external factors can be valuable considering the current challenges faced by the construction industry to attract newer generations. By identifying and evaluating the factors, insights are offered that can be useful for the educational and industry stakeholders in designing a strategy to attract Gen Z to the construction industry.

Research Methods

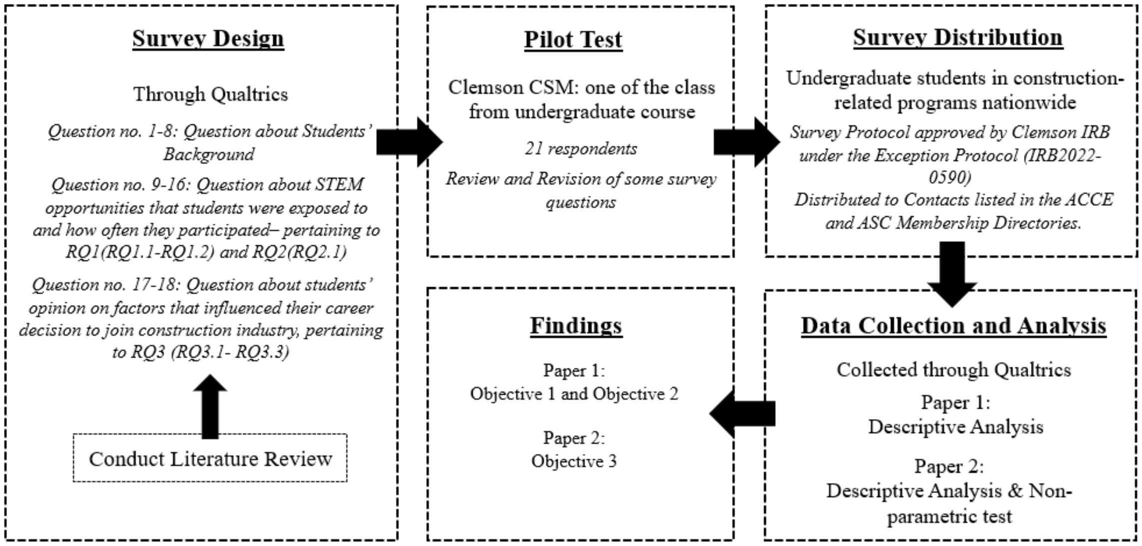

Figure 1: Research Methodology

This study's research methodology utilized a two-step-five-phased approach as shown in Figure 1. The study is a quantitative study that used a survey questionnaire to collect data.

Step 1: Data Collection

Phase 1: Survey Design

A survey research design was employed after conducting a thorough literature review of the subject. A questionnaire was utilized as a primary research tool. The survey was administered using Qualtrics and targeted undergraduate students enrolled in construction-related programs throughout the United States. The questionnaire was structured into three main sections:

Section 1: Starting from questions no.1 through 8, this section gathered demographic and background information about the respondents. It was comprised of

Multiple-Choices Questions (MCQs) that allowed for standardized responses and open-ended questions that allowed for personalized responses.

Section 2: Questions no. 9 through 16 included questions that aimed to understand STEM opportunities the students were exposed to during their middle and high school years and how often they participated in them. It was comprised of 'Yes or No' and MCQ's with the option to choose multiple choices. This section pertains to RQ1 (RQ1.1-RQ1.2) and RQ2 (RQ2.1).

Section 3: Questions no. 17 through 18 aimed to capture students' opinions on the factors that influenced their career decision to join the construction industry. It was comprised of a 5-point Likert-scale and an MCQ question. This section pertains to RQ3 (RQ3.1-RQ3.3).

The complete survey questionnaire is provided in Appendix 1 for reference.

Phase 2: Pilot Test

A pilot test was conducted before the main distribution of the survey. The pilot test involved a total of 21 respondents from one of the Clemson Construction Science and Management (CSM) undergraduate classes. Based on the feedback from this test, some of the survey questions were reviewed and revised to make them easier to understand, but coherent at the same time.

Phase 3: Survey Distribution

Firstly, the survey protocol was approved by Clemson IRB under the Exception Protocol, making sure the study adhered to ethical standards even before the pilot test was conducted. Next, the survey was distributed to the construction programs nationwide through contacts listed in the ACCE and ASC membership directories. The survey was voluntary, and the respondents' anonymity was preserved. The data collected followed protocol to ensure respondent confidentiality.

Step 2: Method of Analysis and Findings

Phase 4: Data Collection and Analysis

A quantitative approach including descriptive analysis and statistical test were utilized to analyze the data.

Phase 5: Findings

The findings from phase 4 was documented in two separate research papers:

Paper 1: This paper discusses the STEM opportunities that currently enrolled Gen Z students in AEC- accredited programs were exposed to and how often they took advantage of such opportunities during their middle and high school years. This content addresses Objective 1 and 2. This is presented in Chapter 3 of this thesis.

Paper 2: This paper discusses the factors that influenced Gen Z students currently enrolled in AEC-accredited programs to pursue a career in construction during their middle and high school years. This content addresses Objective 3. This is presented in Chapter 4 of this thesis.

Chapter 5 includes a summarization of all findings, limitations of research, discussion, conclusions, and future research.

CHAPTER TWO

LITERATURE REVIEW

1. Introduction to STEM Education

1.1 Definition and Importance of STEM

STEM (Science, Technology, Engineering, and Mathematics) addresses society's need for advancements in technology and scientific exploration, drives economic growth, ensures national security, and fosters personal development, producing knowledgeable and productive individuals (Zollman, 2012). The importance of STEM education in boosting creativity, efficiency, and economic growth, which are foundational for addressing contemporary societal needs, is recognized in many nations (Caprile et al., 2015). As the labor market for the STEM opportunities has seen a growth in recent decades, the relevance of STEM skills in the future is becoming increasingly perceivable (Black et al. 2021), the engagement of the newer generation of students is pivotal.

1.2 Global Demand for STEM Skills

STEM skills are highly demanded in every economic sector (Marginson & Australian Council of Learned Academies, 2013). The fast-paced digitalization, technology, and automation worldwide are leading to the need for new skills that are mostly related to STEM disciplines. The future is near when an employer will be looking for a person possessing 21st-century STEM skills, which include adaptive thinking and complex problem-solving abilities. For instance, STEM skills will become more in demand with the Automation and Robotics sectors growing exponentially and integrating with various industries. Furthermore, STEM abilities are gaining global recognition and are speaking as a core of development for developed and developing countries. Countries like Nigeria, considered developing nations, are experiencing a surge in demand for STEM skills (Dele-Ajayi et al., 2021), further highlighting the global trend and the ubiquitous importance of STEM education. These skills are in demand beyond STEM sectors, making them a critical interdisciplinary skill (Marginson & Australian Council of Learned Academies, 2013). To meet the increasingly high demand for STEM skills, there is a growing emphasis on introducing STEM education early at the school level to prepare the next generation for future global challenges.

2. Declining Interest in STEM Education

The rapid advancement of STEM has been crucial in addressing societal needs and driving economic growth. However, despite the increasing demand for STEM skills throughout the economic sectors, STEM education is observing a severe decline in students' interest towards it.

2.1 The Impending STEM Workforce Crisis

Members of the baby boomer generations, born between 1946 to 1964, are moving towards retirement, leaving a void in the STEM workforce. In addition, new generation students are becoming less interested in pursuing STEM career (Engberg & Wolniak, 2013). This poses a significant challenge to the STEM sector. The decline of interest in STEM is not just a matter of numbers. Instead, this decline indicates a more significant trend or shift in perception. There are deeper underlying issues beyond declining numbers, possibly related to cultural, societal, and educational factors that influence the newer generation's perception and interest in STEM careers (Grossman & Porche, 2014)

2.2 Decline in STEM-Interested Students

A concerning on-going trend-- the number of students showing interest in STEM has declined year after year. It is a global phenomenon and a big issue as students worldwide tend to divert away from STEM education (Venville et al., 2013). There are lots of factors contributing to this decline. For instance, A study by Kenneth, A. (2022) observed a gender gap in STEM enrollment in higher education and universities.. Lack of adequate exposure to STEM opportunities during the formative years has caused lower student participation in STEM education during college education. A very low percentage of students pursue a career in STEM programs in the United States compared to other programs, and the difference is even more significant in the minority and low-income groups (Villiers et al., 2015).

3. The Gen Z Cohort: A New Challenge

Gen Z refers to individuals born after 1995 and before 2010 (Seemiller & Grace, 2015). This generation's unique psycho-social traits influence their behavior, setting them apart from previous generations. This is the generation native to the technology era where everything is globalized. Their values, beliefs, attitudes, and ambitions are influenced by the globalized context, which makes them the first truly 'global' generation (Maioli, 2017), thus rendering this cohort a new challenge. They are expected to make up thirty percentage of the workforce by 2025 (Urgal, 2023). This underscores the significance of policymakers and educators engaging with this cohort to formulate a solid plan and create an environment where this generation can function effectively.

3.1 Gen Z's lack of interest in STEM field

The Gen Z cohort is known for its short attention span (Rothman, 2016). They find the STEM courses offered by the school to be boring and unpleasant. This perception of the Gen Z cohort is one of the leading causes for many students to drop out of the STEM curriculum (Persano Adorno et al., 2021). Increasing STEM involvement to build the next generation of qualified STEM workers is crucial. K-12 and postsecondary students lack STEM interest amidst society's and the job market's expectations. The National Research Council (2011), advised educators in 2011 to raise the percentage of students choosing STEM careers after high school, especially students of color, women, and low-income students. In another study by Roganova & Lanovenko (2020), it is stated that the motivation of Gen Z students to learn about the STEM sector has remained the same; however, the approach to learning has changed. This indicates that the educational system will switch towards a digital adaptive environment to attract the newer generation towards STEM education and ensure a robust workforce for the future.

4. Diversity and Inclusion in STEM

4.1 Current State of Diversity in STEM

STEM workforce is well known for its disparities in gender, ethnicity, and socioeconomic representation (Codiroli Mcmaster, 2017). For instance, according to the National Science Board (NSB) (2015), only 28% of the Science and Engineering workforce in the United States is female, despite them constituting half of the college-educated workforce. A complete understanding of this underlying gender gap could be hard to unfold; however, the major factors causing this problem are mostly related to societal and cultural perceptions (Master, 2021). Gender stereotypes still persist in our society. According to Berg et al. (2018), the STEM sectors, such as computer science, are often considered a man's job. Due to this prevailing gender stereotype, even the most enthusiastic females are discouraged from pursuing such careers.

The inability of the United States to meet its STEM workforce diversity goals has long been attributed to the failure of the academic pipeline to maintain a steady supply of underrepresented minority students (Beasley & Fischer, 2012). One of the main reasons behind this is the lack of access and equity to STEM programs for students from underprivileged communities in school (Byars-Winston, 2014). As a result, only a few students from these communities choose to pursue STEM subjects in high school and beyond (Atkinson et al. 2007). The lack of student access and diversity in STEM education ultimately limits workforce diversity in STEM careers (Avendano et al., 2019).

According to Stahl et al. (2010), diversifying the STEM workforce based on culture and gender can positively impact the organization. It can boost creativity, satisfaction, productivity, synergy, and a state of well-being in the team. Typically, diversity in the organization can lead to innovation when people from different cultures and genders, with different experiences, backgrounds, and skill sets come together to solve a problem (Daily & Eugene, 2013).

4.2 Initiatives and Programs Promoting Diversity in STEM Education

STEM education has a pivotal role in addressing contemporary societal demands. There have been several efforts from organizations, institutions, and the government to promote STEM education for diverse backgrounds, including different cultures, ethnicities, gender, or sexual identities, as an effort to address inequality (García-Holgado et al., 2021). For instance, there have been some efforts to improve access and equity for underrepresented communities to STEM education through Title 1 schools and other initiatives. In 1965, Congress approved Title 1 school legislation signed into law by President Lyndon B. Johnson to ensure America's underprivileged kids meet academic standards to narrow the gap with the privileged ones (Hooker, 2013**.** While there have been some notable successes in promoting diverse participation in STEM education, the gap continues to widen despite all the efforts. A persistent effort from all sectors is crucial in ensuring diversity in STEM.

5. Construction Education: A Closer Look

5.1 Construction's Place in STEM

Construction education is a subset of STEM that lays the groundwork for students interested in the construction and engineering industries. The importance of the construction sector in STEM is highlighted by the fact that it addresses societal needs for infrastructure, housing, and other built environments, moving towards economic growth and long-term national development (Ofori, 2015). Within STEM, construction is among the industries that are heavily impacted by the workforce shortage (GIATEC, 2019; Hugo et.al., 2018). The primary reason for this is an alarmingly low number of students interested in pursuing careers in the building and construction sector. Students in schools have a negative perception of the construction business, believing that working in the field is "dirty" and "boring," (Escamilla et al., 2016; Hugo et.al., 2018; Bilbo et.al., 2009).

5.2 Gen Z's Perception of the Construction Industry

The building and construction sector is regularly criticized for taking too long to adopt new methods and innovative ideas. The construction industry gets perennially dinged for needing to be faster to innovate and adapt to new technology (Amusan et.al., 2018). According to Seetha (2014), among a proportionately low number of those students who decide to join the construction industry, a significant number of them are not very enthusiastic about the field. For tech-savvy Gen Z's, the industry does offer much excitement. This leads to a deficit in students' abilities, mainly in their soft skills.

Soft skills in the construction industry are a broad skill set, competencies, behaviors, mindsets, and personal qualities that workers can effectively navigate their environment, work well with others, achieve their goals, and perform well (Usman, 2020). Students often lack technical skills and develop a negative perception of the industry, like in the case of construction. By offering hands-on experience, proper education, and training, the students' perception of the industry can be altered, and the industry can eventually retain talent.

6. Factors Influencing STEM Career Choices

6.1 Theoretical Framework

Understanding and identifying the factors that impact students' career choices are critical because shortages of STEM-skilled labor will affect future economic growth (Lopez & Marco, 2023). Furthermore, identifying the factors that contribute to an interest in STEM careers may contribute to understanding how students learn STEM content and provide guidance for designing intervention strategies (Hall et al., 2011). Educators, peers, and familial influence motivates students' STEM career choices (Nugent et al., 2015). Middle and High school students are at the age when they explore different things and develop interests. They also recognize their strengths and weaknesses in different subject matters. Thus, an appropriate intervention at this stage could be helpful and timely for them to determine the subject choices following their interests (Maltese & Tai, 2011).

Several studies have been conducted to understand the factors influencing interest in STEM careers. For instance, Bahar & Adiguzel (2016) studied the factors affecting students' interest in STEM-related careers. In Bahar & Adiguzel's (2016) study, the selected factors were based on the hypothesis that students' interests in STEM careers are shaped by SCCT-suggested constructs such as outcome expectations, goal orientation, and self-efficacy. Similarly, sub-constructs include people (teachers, family, relatives, friends, etc.), school-related factors (curriculum, classroom activities, extracurricular activities, competitions/fairs, etc.), self-motivation, and job expectations (Bahar & Adiguzel, 2016). Additionally, the factors that influence the STEM Career Choices is mapped out in Table 1.

6.2 Influential Factors Identified in Previous Studies

Factors Influencing STEM Career Choices	**Relevant Studies**
Middle and High School General Curriculum	*Sahin & Waxman (2021); Sadler et al. (2013)*
Summer Camp	*Drey (2016); Kager (2015)*
After School Program	*Sahin et al. (2016); Krishnamurthi et al. (2014)*
Family Influence	*Kocak et al. (2021);Halim et al. (2018); Sheehan et al. (2018)*
Teacher Impression	*Bahar & Adiguzel (2016); Lichtenstein et al. (2014)*
Toy/Video Games	*Hughes (2017); Griffith (2018)*
High Starting Salary	*Duku et al. (2021);Bain & Lefebvre (2022))*
Technical Skills Required	*Blotnicky et al. (2014)*
Possibility to be promoted quickly	*Theodora et al. (2019)*
Job variety/diversity	*Duku et al. (2021; Uyar et al. (2011)*

Table 1: Mapping out of the Factors Influencing STEM Career Choices

7. The Gap in Current Literature

7.1 The Missing Link: Understanding Construction Career Choices

From the literature review, it can be concluded that the newer generations, significantly Gen Z's, have a declining interest in STEM education, and it gets even more pronounced in the construction sector. Most of Gen Z, they perceive that the construction industry does not offer excitement or a fascinating career. While several studies are delving into why the construction industry is failing to attract the younger generation, more research should be needed on what factors might attract them to the construction career.

7.2 Objective of the Study

In order to fill the important gap in literature, the main objective of this study is to explore and understand the factors influencing Gen Zs in middle and high school years to pursue a career in the construction industry. Understanding what factors influence this cohort of generations becomes crucial to the construction industry's future. Below are some of the significances of this research discussed:

Industry Relevance: By identifying the factors influencing Gen Z's career choices, industry stakeholders can use the insight from this study to tailor their recruitment and retention strategies. This can ensure a steady influx of fresh talent.

Educational Implications: The findings of this study can provide insight into the education institutions when it comes to creating curricula and extracurricular activities that match the interests and ambitions of Gen Z. This can help make construction education more attractive to the Gen Z generation.

CHAPTER THREE

STEM EXPOSURE AND PARTICIPATION DURING MIDDLE AND HIGH SCHOOL OF GEN Z STUDENTS ENROLLED IN CONSTRUCTION RELATED PROGRAMS

Abstract

This study investigates the early exposure and participation of students in STEM and construction-related curricula during their middle and high school years. A survey was conducted among Gen Zs currently enrolled in undergraduate construction-related programs throughout the United States. Key findings reveal significant exposure to STEM disciplines, predominantly through structured academic frameworks like semester curricula and offered electives. Mathematics and statistics programs were observed to be the central pillar in STEM participation. A noteworthy progression in engagement with construction-related programs from middle to high school was observed. This progression signifies the growing interest nurtured through schools to trace the potential career trajectory toward the construction field. These insights highlight the important role of early educational exposure in shaping career aspirations, emphasizing the need for eclectic and consistent STEM opportunities.

Keywords: STEM, Exposure, Construction, Middle and High School

Introduction

The significance of Science, Technology, Engineering, and Mathematics (STEM) in today’s modern era is globally admitted. According to Zollman (2012), STEM education fosters personal development, produces knowledgeable and productive individuals who have a capacity to address modern societal needs. Moreover, STEM disciplines are the major contributor to the technological advancement witnessed by the modern world. Early exposure of students to STEM education during their middle and high school years is significant to drive students into STEM career (DeJarnette, 2012).

The construction industry, which is one of the vital segments of STEM, is facing workforce shortages. One major cause of the shortage is students having a negative perception of the industry (Escamilla et al., 2016; Hugo et al., 2018). The Gen Z cohort, born between 1995 and 2010, is the next-generation workforce. This cohort is currently at the front of the academic pipeline, making career decisions that will determine the future workforce of various industries, including construction. Gen Z is native to the digital world and possesses unique characteristics and learning preferences (Szymkowiak et al. 2021). In this regard, understanding their exposure and attitude toward STEM education during their schooling years is crucial. Gen Z demands a hands-on, tech-heavy, immersive learning experience, which is very different from what the traditional pedagogical styles offer (Monzoni et al., 2021; Chicioreanu & Amza, 2018). This shift in the learning style, combined with the construction sector's societal and economic importance, necessitates understanding the early educational exposure of Gen Z students in relation to STEM and construction education. This study seeks to understand what STEM and constructed-related opportunities the Gen Z cohort were exposed to and have participated in during middle and high school, which could play a role in influencing them to pursue a career in construction.

Literature Review

1. Definition of STEM and its Importance in Middle and High School

STEM (Science, Technology, Engineering, and Mathematics) addresses society's need for advancements in technology and scientific exploration, drives economic growth, ensures national security, and fosters personal development, producing knowledgeable and productive individuals (Zollman, 2012). The importance of STEM education in boosting creativity, efficiency, and economic growth, which are foundational for addressing contemporary societal needs, is recognized in many nations (Caprile et al., 2015). A study by Bagiati et al. (2010) indicated that introducing STEM programs and activities to young students at an early age positively influences their perceptions and attitude towards the subject, which highlights the importance of its early exposure. This exposure to integrated STEM education in k-12 is crucial not only for equipping students with the necessary skills required in the modern world, but also to foster a problem-solving attitude. This prepares them for future educational pursuits and enables them to effectively address the global challenges they will inevitable face (McCurdy et al., 2020).

2. Diversity and Inclusion in STEM

2.1 The Current State of Diversity in STEM

STEM workforce is well known for its disparities in gender, ethnicity, and socioeconomic representation (Codiroli Mcmaster, 2017). For instance, according to the National Science Board (NSB) (2015), only 28% of the Science and Engineering workforce in the United States is female, despite them constituting half of the college-educated workforce. A complete understanding of this underlying gender gap could be hard to unfold; however, the major factors causing this problem are mostly related to societal and cultural perceptions (Master, 2021). Gender stereotypes still persist in our society. According to Berg et al. (2018), the STEM sectors, such as computer science, are often considered a man's job. Due to this prevailing gender stereotype, even the most enthusiastic females are discouraged from pursuing such careers.

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3. The Gen Z Cohort: A New Challenge

Gen Z refers to individuals born after 1995 and before 2010 (Seemiller & Grace, 2015). This generation's unique psycho-social traits influence their behavior, setting them apart from previous generations. This is the generation native to the technology era where everything is globalized. Their values, beliefs, attitudes, and ambitions are influenced by the globalized context, which makes them the first truly 'global' generation (Maioli, 2017), thus rendering this cohort a new challenge. They are expected to make up thirty percentage of the workforce by 2025 (Urgal, 2023). This underscores the significance of policymakers and educators engaging with this cohort to formulate a solid plan and create an environment where this generation can function effectively.

3.1 Attitude of Gen Z towards STEM

The Gen Z cohort is known for its short attention span (Rothman, 2016). They find the STEM courses offered by the school to be boring and unpleasant. This perception of the Gen Z cohort is one of the leading causes for many students to drop out of the STEM curriculum (Persano Adorno et al., 2021). Increasing STEM involvement to build the next generation of qualified STEM workers is crucial. K-12 and postsecondary students lack STEM interest amidst society's and the job market's expectations. The National Research Council (2011) advised educators in 2011 to raise the percentage of students choosing STEM careers after high school, especially students of color, women, and low-income students. In another study by Roganova & Lanovenko (2020), it is stated that the motivation of Gen Z students to learn about the STEM sector has remained the same; however, the approach to learning has changed. This indicates that the educational system will switch towards a digital adaptive environment to attract the newer generation towards STEM education and ensure a robust workforce for the future.

4. Overview of STEM Opportunities Offered in Middle and High School and Student Participation

4.1 Types of STEM programs available during middle and high school

The educational landscape has seen a surge in STEM programs available for middle and high school students with diverse interests and aptitudes. Table 2 provides a various, but not exhaustive, list of STEM programs/initiatives offered through Middle and High School, sourced from various pieces of literature.

STEM Programs/ Initiatives Offered in Middle / High School	Relevant Studies
Mathematics And Statistics Related	Yu et al. (2021); Harrell-Williams et al. (2019); Selling, (2016); Slavin et al. (2009)
Physical Science Related	Sadler et al. (2013); Hazari et al. (2013)
Biology and Biomedical Science Related	Herrmann-Abell et al. (2016); Markowitz, (2004)
Computer Science and Engineering Related	Marcu et al. (2010); Martin et al. (2011); Cohoon et al. (2011)
Information Technology Related	Ismaili, (2020); Hollman et al. (2019)
Engineering Design Related	Hughes & Denson, (2021); Anderson & Gajjar, (2021) ; Becker & Mentzer, (2015); Apedoe et al., (2008)
Construction and Engineering Related	Wao et al. (2022); Safapour & Kermanshachi, (2020)
Construction Skills Trade Related	Anderson & Gajjar, (2021)
Design and Creativity	Anderson & Gajjar, (2021); Wao et al., (2022)
Design and Modeling Related	Anderson & Gajjar, (2021); Gharib et al. (2018)

Table 2: Mapping out of the STEM Curriculum/Initiatives offered in Middle and High School

4.2 Innovative STEM Initiatives

In a one-week summer camp, Noak et al. (2022) introduced an innovative approach for middle and high school students to learn the concept of engineering and programming. 35 students participated in the first camp and 30 students participated in the second camp. In both the camps, there were students representing different ethnicity and 50% of them were female. The study utilized tools such as SparkDun Inventor's Kit, Scratch, and Java to teach students about the basics of engineering and programming. The camp targeted to improve critical thinking, problem solving for which students were offered a hands-on projects related to engineering and computing.

Similarly, Yu et al. (2021) conducted a study targeting the underrepresented Latinx middle school students from southern California. In the study, the students were exposed to high-quality afterschool math programs aiming to encourage these students' participation in math. The study identified four culturally responsive practices that helped the students to feel more engaged with the program. The practices included the promotion of an inclusive, safe, and respectful program climate, engaging in personal conversation, facilitation opportunities for mutual and math learning across diverse cultures and perspectives, and promoting math and a range of social-emotional skills across several contexts. The role of culturally responsive practices was recognized to be crucial in achieving high-quality after-school programs. This suggests that such practices can be a significant factor in influencing students towards STEM.

While the comprehensive statistics of GEN Z's participation in STEM during middle and high school are not explicitly provided in the referenced study, innovative approaches to the programs hold the possibility to improve students' engagement in STEM programs. As discussed by Roganova & Lanovenko (2020), the motivation of Gen Z students to learn about the STEM sector has remained the same; however, the approach to learning has changed.

4.3 Link Between STEM Education in School and Choosing STEM in College

STEM education during middle and high school years lays the foundation for future academic and career pursuit. Maltese & Tai (2011) conducted a study to determine what school-based factor influences students to pursue a STEM in college. The finding shows that higher enrollment in STEM programs in high school was positively associated with students' future academic pursuit in STEM degree. Similarly, Franz-Odendaal et al., (2020) hosted a science camp for Nova Scotian public school 7th graders to examine their attitude towards Math. The finding suggested that girls who attended the Science camp were more likely to pursue a career in STEM in the future compared to the girls with the same Math grades who did not participate in the camp. It is emphasized that allowing girls to attend all-girls science camp and interact with female STEM professionals can influence their interest in STEM.

5. Construction Education: A Closer Look

5.1 Construction's Place in STEM

Construction education is a subset of STEM that lays the groundwork for students interested in the construction and engineering industries. The importance of the construction sector in STEM is highlighted by the fact that it addresses societal needs for infrastructure, housing, and other built environments, moving towards economic growth and long-term national development (Ofori, 2015). Within STEM, construction is among the industries that are heavily impacted by the workforce shortage (GIATEC, 2019; Hugo et.al., 2018). The primary reason for this is an alarmingly low number of students interested in pursuing careers in the building and construction sector. Students in schools have a negative perception of the construction business, believing that working in the field is "dirty" and "boring," (Escamilla et al., 2016; Hugo et.al., 2018; Bilbo et.al., 2009).

5.2 Types of Construction Programs/Curriculum available during middle and high school

Table 2A pulled from Table 2 provides a various, but not exhaustive, list of construction related programs/initiatives offered through Middle and High School, sourced from various pieces of literature.

STEM Programs Offered in Middle / High School	Papers
Engineering Design Related	Hughes & Denson, (2021); Anderson & Gajjar, (2021); Becker & Mentzer, (2015); Apedoe et al., (2008)
Construction and Engineering Related	Wao et al. (2022); Safapour & Kermanshachi, (2020)
Construction Skills Trade Related	Anderson & Gajjar, (2021)
Design and Creativity	Anderson & Gajjar, (2021); Wao et al., (2022)
Design and Modeling Related	Anderson & Gajjar, (2021); Gharib et al., (2018)

Table 2A: Mapping out of Construction Programs/Initiatives offered in Middle/High School

5.3 Gen Z's Perception of the Construction Industry

The building and construction sector is regularly criticized for taking too long to adopt new methods and innovative ideas. The construction industry gets perennially dinged for needing to be faster to innovate and adapt to new technology (Amusan et.al., 2018). According to Seetha (2014), among a proportionately low number of those students who decide to join the construction industry, a significant number of them are not very enthusiastic about the field. For tech-savvy Gen Z's, the industry does offer much excitement. This leads to a deficit in students' abilities, mainly in their soft skills. Soft skills in the construction industry are a broad skill set, competencies, behaviors, mindsets, and personal qualities that workers can effectively navigate their environment, work well with others, achieve their goals, and perform well (Usman, 2020). Students often lack technical skills and develop a negative perception of the industry, like in the case of construction. By offering hands-on experience, proper education, and training, the students' perception of the industry can be altered, and the industry can eventually retain talent.

Methodology

Figure 2 below shows the three steps utilized for the methodology opted in this study.

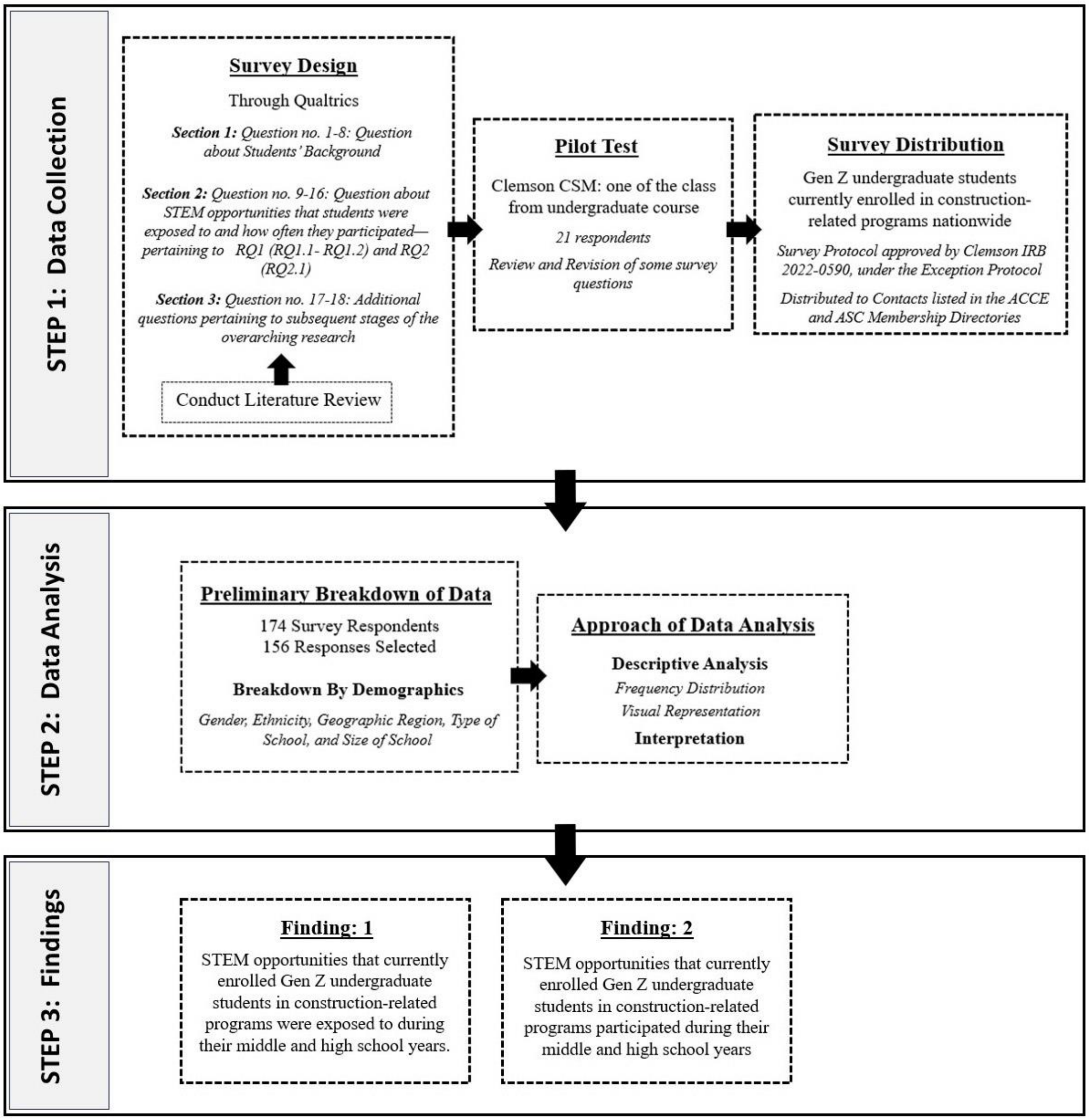

Figure 2: Methodology Flowchart for Chapter 3

Step 1: Data Collection

Phase 1: Survey Design

A survey research design was employed after conducting a thorough literature review of the subject. A questionnaire was utilized as a primary research tool. The survey was administered using Qualtrics and targeted undergraduate Gen Z students enrolled in construction related programs throughout the United States. The questionnaire was structured into three main sections:

Section 1: Questions no.1 through 8, this section collected demographic and background information about the respondents. It was comprised of Multiple-Choices Questions (MCQs) that allowed for standardized responses and open-ended questions that allowed for personalized responses.

Section 2: Questions no. 9 through 16 included questions that aimed to understand STEM opportunities the students were exposed to during their middle and high school years and how often they participated in them. It was comprised of 'Yes or No' and MCQ's with the option to choose multiple choices. This section pertains to RQ1 (RQ1.1-RQ1.2) and RQ2 (RQ2.1).

Section 3: This section incorporated additional questions pertaining to subsequent stages of the overarching research.

Phase 2: Pilot Test

A pilot test was conducted before the main distribution of the survey. The pilot test involved a total of 21 respondents from one of the Clemson Construction Science and Management (CSM) undergraduate classes. Based on the feedback from this test, some of the survey questions were refined for clarity and to ensure that appropriate data analysis could take place.

Phase 3: Survey Distribution

The survey protocol was approved by Clemson IRB under the Exception Protocol prior to pilot test to make sure the study adhered to ethical standards (IRB2022-0590). The survey was then distributed to undergraduate construction programs. Potential participating programs were identified through the membership directories of the Associate Schools of Construction (ASC) and American Council for Construction Education (ACCE). The contacts for these programs as identified by the membership director were emailed an invitation letter to distribute to their undergraduate students. Participation was voluntary, and the survey was anonymous keeping the identity of the respondents unrevealed.

Step 2: Data Analysis

Phase 1: Preliminary Breakdown of Data

Of the 174 survey participants, 156 provided complete responses. In the gender distribution, males comprised a significant portion at 78.2% (122 respondents), while females accounted for 21.8% (34 respondents). The geographic distribution of respondents is shown in figure 3.

Regarding ethnicity, the predominant group was White, non-Hispanic, with 134 respondents (85.9%). The initial ethnic categories provided to the respondents in the survey and their respective counts were: Hispanic (9 respondents), American Indian or

Alaska Native (4 respondents), Asian (1 respondent), Native Hawaiian and other Pacific Islander (1 respondent), Some other race, non-Hispanic (1 respondent), and Multiracial (3 respondents). Due to the small number of respondents in these categories, they are grouped as 'Others' in Table 3, accounting for 12.2% (19 respondents) of the sample. Additionally, 1.9% (3 respondents) chose not to specify their ethnicity.

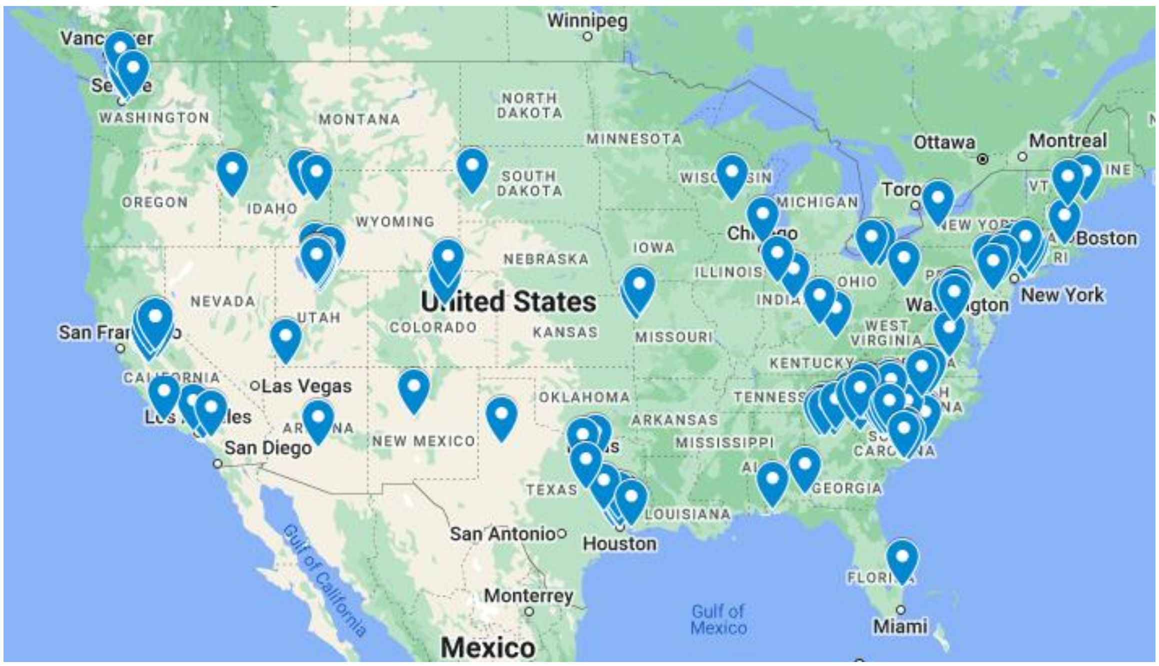

Figure 3: Geographic Distribution of the Survey Respondents

For high school types, the majority, 73 respondents (46.8%), had attended a Public School Title 1 (General curriculum only). Public School Non-Title 1 (General Curriculum only) was chosen by 23 respondents (14.8%). Public schools with a Specialty/Technical Curriculum or Career Technology Center and Private schools (General curriculum only) both got equal number of respondents, each with 27 respondents (17.3%). Categories with minimal representation, namely ‘Charter School

(General Curriculum only)’ with 2 respondents and ‘Other’ category with 1 respondent, are combined into the 'Other' category in Table 3, representing 1.9% (3 respondents).

Furthermore, the respondents were asked to provide the approximate number of students in their graduating class to gain insights about the size of school. The school size has been categorized into three categories as below:

Small Size School = Up to 200 students per graduating class

Medium Size School = More than 200 and up to 400 students per graduating class

Large Size School = More than 400 students in a graduating class

148 respondents out of 156 total respondents of the survey were selected in this division. 7 respondents did not answer the question that asked for the approximate number of students in their graduating class, and one respondent answered 4000, which was considered as an outlier and removed.

Variables	# of Respondents	% of Respondents
Gender		
Male	122	78.2%
Female	34	21.8%
Ethnicity		
White, non-Hispanic	134	85.9%
Others	19	12.2%
Prefer not to Answer	3	1.9%
Geographic Region		
South	95	60.9%
West	37	23.7%
Northeast	15	9.6%
Midwest	9	5.8%
High School Type		
Public School Title 1 (General Curriculum only)	73	46.8%
Public School Non-Title 1 (General Curriculum only)	23	14.8%
Public School with Specialty/Technical Curriculum or Career Technology Center	27	17.3%
Private School (General Curriculum only)	27	17.3%
Private School with Specialty/Technical Curriculum or Career Technology Center	3	1.9%
Other	3	1.9%
Size of School		
Small Sized School (≤ 200 Students)	42	28.4%
Medium Sized (200 < Students ≤ 400)	52	35.1%
Large Sized (Students > 400)	54	36.5%

Table 3: Demographic Distribution of the Respondents

Phase 2: Approach for Data Analysis

Descriptive Analysis: Descriptive Statistics were used to summarize and interpret the data. The software utilized for this was Excel.

A. Frequency Distribution: The first step involved calculating the frequency and percentages of responses for each survey question. This provided an overview of the number of respondents who were exposed to STEM opportunities, the channels through which they were exposed and their participation rates in STEM opportunities during their formative Middle and High school years.

B. Visual Representation: Data was visually represented using visuals aids wherever required. This helped in understanding patterns, comparisons, and trends in data.

The results from the descriptive analysis were interpreted in the context of research objectives.

Step 3: Findings

Finding 1: This paper discusses the STEM opportunities that Gen Z undergraduate students currently enrolled in construction-related programs were exposed to during their middle and high school years.

Finding 2: This paper discusses how often the Gen Z undergraduate students currently enrolled in construction-related programs took advantage of STEM opportunities during their middle and high school years.

Findings

Exposure to STEM Opportunities

Data was collected in order to assess the STEM opportunities the students were exposed to in middle and high school. Out of 155 respondents (1 did not respond to these specific questions), a significant majority of 106 students (68.38%) reported that STEM opportunities were offered to them in their middle school which grew to 125 students (80.64%) having STEM offerings in high school.

Table 4 provides an overview of the exposure to STEM opportunities for students during their middle and high school.

Stem Exposure	Middle School # of Respondents (n= 155)	% of Respondents	High School # of Respondents (n= 155)	% of Respondents
Offered	106	68.38%	125	80.64%
Not Offered	49	31.62%	30	19.36%

Table 4: STEM Program Availability in Middle and High School

Channels of STEM Exposure

In middle school, 55.7% of those exposed to STEM identified the channel as semester curriculum. This percentage is notably increased in high school, where 68.0% of those whose high schools had STEM programs identified opportunities through semester curriculum. Elective courses also served as a significant source of STEM exposure

(51.9% for middle school students; 51.2% for high school students). Other channels of opportunities are shown in Table 5.

Channels	**Middle School**		**High School**	
	# of Respondents (n= 106)	**% of Respondents**	**# of Respondents (n= 125)**	**% of Respondents**
Through Semester Curriculum	59	55.7%	85	68.0%
Through Offered Electives	55	51.9%	64	51.2%
With After School	18	17%	25	20.0%
Summer Camps	8	7.5%	11	8.8%

Table 5: Channels of STEM Program Offering in Middle and High School

Participation In STEM Opportunities

An examination of student participation in STEM opportunities during middle and high school reveals distinct patterns. In middle school, out of 107 respondents, 62 (57.9%) reported participating in STEM opportunities, leaving 45 (42.1%) who did not. Transitioning to high school, the participation rate increased, with 84 out of 126 respondents (66.7%) engaging in STEM opportunities, while 42 (33.3%) refrained shown in Table 6.

Stem Participation	Middle School # of Respondents (n = 107)	Middle School % of Respondents	High School # of Respondents (n = 126)	High School % of Respondents
Participated	62	57.9%	84	66.7%
Not Participated	45	42.1%	42	33.3%

Table 6: STEM participation in Middle and High School

An exploration of the programs offered to students in middle and high school highlighted diverse STEM areas of focus. From a sample of 57 middle school respondents (5 students did not respond to this question), the top three programs were Mathematics and Statistics Related with 22 students (38.6%), Construction Science and Engineering Related with 13 students (22.8%), and Physical Science Related with 12 students (21.1%). The least represented was Electrical/Electronics Engineering Related with just 1 student (1.8%).

In high school, from a sample of 83 respondents (1 student did not respond), Mathematics and Statistics Related remained the most popular with 33 students (39.8%). This was closely followed by Construction Science and Engineering Related with 27 students (32.5%) and Physical Science Related with 23 students (27.7%). Aerospace Engineering was the least common, offered to only 2 students (2.4%). Table 7 shows the Participation of students in various STEM programs in Middle and High School.

The data signifies varied interests and opportunities in STEM fields, with a consistent preference for mathematics and construction science across both educational levels for those students who are currently enrolled in a construction-related undergraduate program.

Programs Offered	Middle School # of Respondents (n = 57)	Middle School % of Respondents	High School # of Respondents (n = 83)	High School % of Respondents
Mathematics and Statistics Related	22	38.6%	33	39.8%
Construction Science and Engineering Related	13	22.8%	27	32.5%
Physical Science Related	12	21.1%	23	27.7%
Engineering and Design	7	12.3%	21	25.3%
Computer Science and Engineering Related	14	24.6%	20	24.1%
Construction Trade Related	7	12.3%	19	22.9%
Design and Creativity (ex: architecture)	15	26.3%	19	22.9%
Information Technology Related	12	21.1%	11	13.3%
Biological and Biomedical Science Related	2	3.5%	11	13.3%
Electrical / Electronics Engineering Related	1	1.8%	8	9.6%
Mechanical Engineering Related	4	7.0%	8	9.6%
Aerospace Engineering	-	-	2	2.4%

Table 7:Participation of students in various STEM programs in Middle and High School

Exposure Vs. Participants

Developing Combined Frequency Matrix

In the survey, the students were asked about their exposure to STEM through different channels and what programs they participated in during middle and high school. Both of the questions were ‘select all that apply’ where students can choose multiple options, leading to combinations of responses. This results in a many-to-many relationship, where multiple courses can be related to multiple channels for a single student. That makes it impossible to pair a specific course with a specific channel for each student. The combined frequency matrix Figure 4 and Figure 5 displays how many respondents selected both a specific channel and a specific course. The matrix can provide insights into potential overlap between the channel and a course offering.

During Middle School

Upon developing a combined frequency matrix for middle school STEM exposure and participation, several patterns emerge that provide insights into what programs are offered through which channels. A total of 17 counts of students selected both STEM offerings through semester curriculum and participated in Mathematics and Statistics programs, which is the highest observed count in the frequency table. Mathematics and Statistics programs frequency plummets in the other three channels as compared to through Semester Curriculum. While courses such as ‘Mathematics and Statistics Related’, ‘Design and Creativity’ etc. exhibit higher frequency in the matrix table, courses such as ‘Electrical/Electronics Engineering Related’, ‘Biological and Biomedical

Science Related exhibit lower counts in the matrix table. It is noteworthy that the heatmap shows a higher count in the first column that is through semester curriculum than the column representing other channels.

Figure 4 is the combined frequency matrix heatmap that shows how many students selected both a specific channel and a specific course in Middle School.

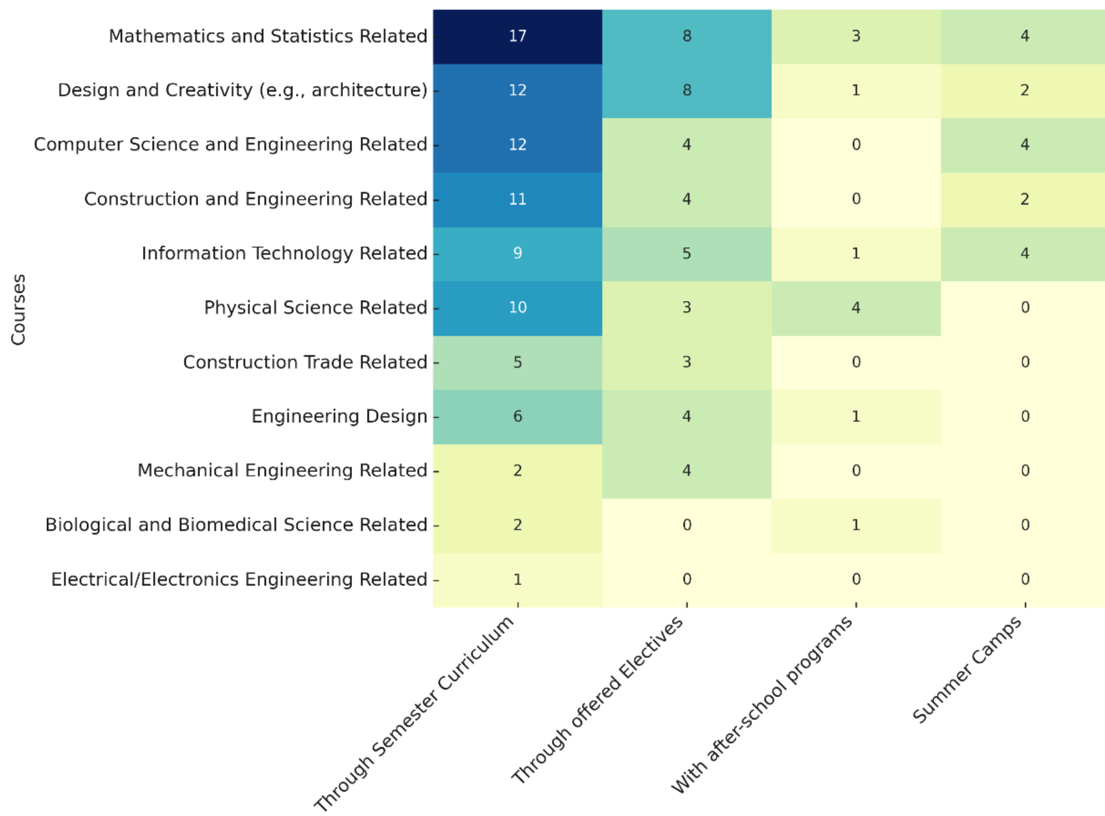

Figure 4: Combined Frequency Matrix Heatmap for Middle School

For Construction Related Programs

In context of construction-related courses exposed and participation in middle school, several notable patterns were observed to get insights into different construction-related programs offered in middle schools through different channels. Design and Creativity is the most prominent construction-related program observed in the matrix heatmap with 12 counts through semester programs and 8 through offered electives. It is followed by Construction and Engineering related with 11 counts through semester curriculum, while low counts through other channels similar as Design and Creativity. Similar to the overall STEM in middle school, the construction-related courses higher concentration of counts in the first column of the matrix heatmap that is 'Through Semester Program' and relatively lower counts moving right of the table through other channels.

During High School

Upon developing a combined frequency matrix for high school STEM exposure and participation, several patterns emerge that provide insights into what programs are offered through which channels. A total of 28 students selected both STEM offerings through electives and participated in Mathematics and Statistics Related programs, which is the highest count observed in the frequency table. Similarly, it is noteworthy that Mathematics and Statistics Related also have a higher frequency through offered electives, while it has a relatively low frequency through after-school programs and summer camps programs with 4 counts on each. While courses like 'Mathematics and

Statistics Related' and 'Construction Science and Engineering Related' exhibit high frequency in the matrix, courses such as 'Aerospace Engineering' have limited representation, with only 2 counts through offered electives. It is noteworthy that after-school programs and summer camps exhibit relatively low counts in all the programs offered as compared to the other two channels.

Figure 5 is the combined frequency matrix heatmap that shows how many students selected both a specific channel and a specific course in High School.

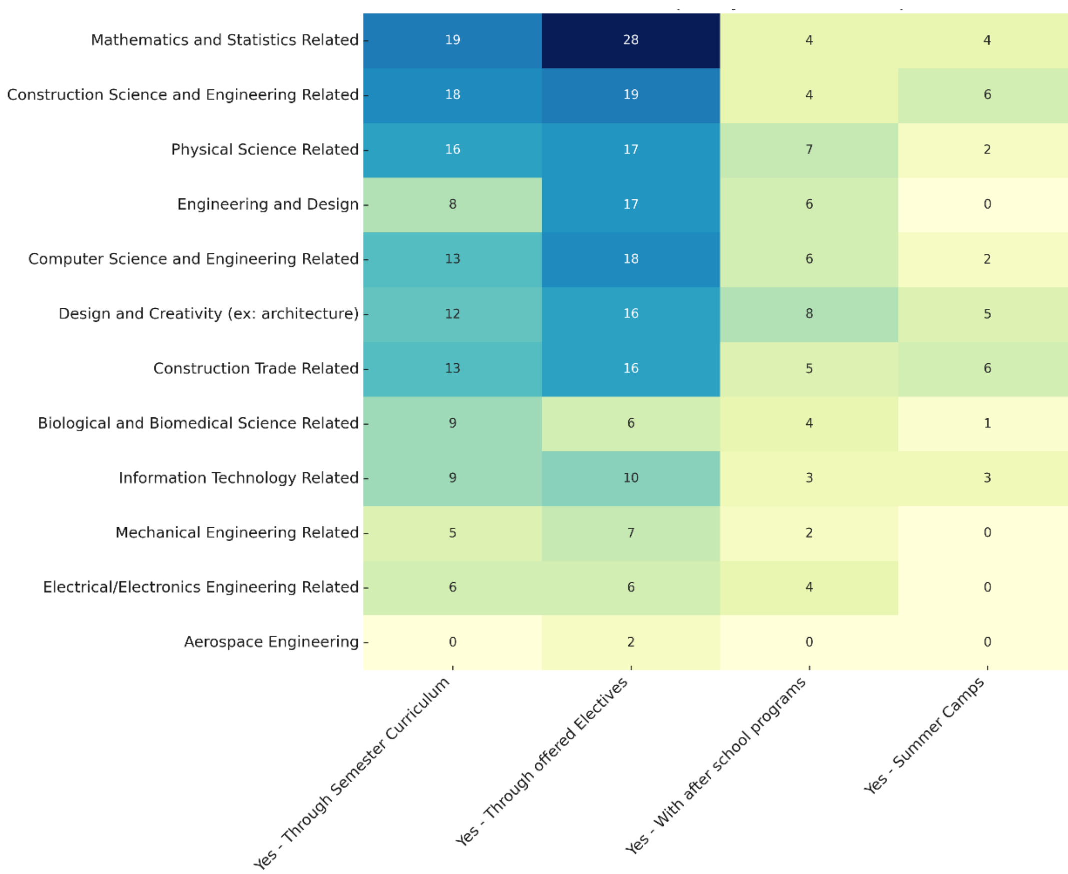

Figure 5: Combined Frequency Matrix Heatmap for High School

For Construction Related Programs

In the context of construction-related course exposure and participation in high school, several patterns emerge that provide insights into what construction-related programs were offered through which channels. The 'Construction Science and Engineering Related' course is particularly prominent, with a notable count across both electives (19 counts) and semester curriculum (18 counts). Similarly, the 'Engineering and Design' course has 17 counts through electives; however, this drops to 8 participants in the semester curriculums. Other programs related to construction, such as 'Construction Trade Related' and 'Design and Creativity', also exhibit a fair count in the through semester curriculum and offered electives channels. Similarly, construction-related programs, with after-school programs and summer camps, exhibit relatively lower counts than the other two channels.

Demographics Breakdown

Gender Participation in STEM Programs During Middle School

It observed that approximately one-half of the male students participated in STEM programs, while about three-fourth of the female students participated during their middle school. However, the small number of female responses limits the inferences from the data. Table 8 shows the summary of gender participation in STEM programs during Middle School.

Gender	Participated	Not Participated	Sample Size
Male	43 (53.1%)	38 (46.9%)	81
Female	19 (73.1%)	7 (26.9%)	26

Table 8: Gender Participation in STEM during Middle School

Upon reviewing gender participation in middle school STEM programs, noticeable patterns of interest and involvement emerged. From the male sample of 40 students, Mathematics and Statistics Related was the most popular, with 14 participants (35.0%). This was followed by Construction Science and Engineering Related, with 10 students (25.0%). Notably, there was no reported participation in Design and Creativity or Electrical/Electronics Engineering Related among male students.

From the female sample of 17 students, Mathematics and Statistics Related again led the way, with 8 participants (47.1%). Computer Science and Engineering Related also stood out, drawing the interest of 5 female students (29.4%). The least pursued by females was Construction Trade Related, with only 1 participant (5.9%).

The data underscores a shared enthusiasm for mathematics across both genders during middle school. However, certain program areas, such as computer science, showed a heightened interest among females, whereas areas like construction science were more favored by males. Table 9 shows the gender participation in various STEM programs during middle school.

STEM Programs Offered	Male		Female	
	# of Respondents (n = 40)	% of Respondents	# of Respondents (n = 17)	% of Respondents
Mathematics and Statistics Related	14	35.0%	8	47.1%
Construction Science and Engineering Related	10	25.0%	3	17.6%
Physical Science Related	8	20.0%	4	23.5%
Engineering and Design	4	10%	3	17.6%
Computer Science and Engineering Related	9	22.5%	5	29.4%
Construction Trade Related	6	15.0%	1	5.9%
Design and Creativity (ex: architecture)	9	22.5%	6	35.3%
Information Technology Related	8	20.0%	4	23.5%
Biological and Biomedical Science Related	1	2.5%	1	5.9%
Electrical / Electronics Engineering Related	0	0.00%	1	5.9%
Mechanical Engineering Related	2	5.0%	2	11.8%

Table 9: Gender participation in various STEM programs during middle school

Gender Participation in High School

It observed that in both gender, about two-third of the students participated in the STEM while the others did not participated even if they had STEM programs offered during their high school. Table 10 shows the summary of gender participation in STEM programs during high school.

Gender	Participated	Not Participated	Sample Size
Male	64 (67.4%)	31 (32.6%)	95
Female	20 (64.5%)	11 (35.5%)	31

Table 10: Gender participation in STEM during high school

An examination of gender participation in STEM programs during high school revealed distinct preferences and opportunities among male and female students. From a sample of 63 male students, the most prevalent programs were Mathematics and Statistics Related with 24 participants (38.1%), closely followed by Construction Science and Engineering Related and Physical Science Related, both with 18 students (28.6%). The least pursued by males was Mechanical Engineering Related with 5 participants (7.9%).

On the other hand, from the sample of 20 female students, Mathematics and Statistics Related emerged as the top choice with 9 participants (45.0%). Design and Creativity, as well as Construction Science and Engineering Related, both attracted 8 female participants (40.0%). The least represented among females was Engineering and Design, with 3 participants (15.0%). Table 11 shows the gender participation in various STEM programs during high school.

STEM Programs Offered	Male		Female	
	# of Respondents (n = 63)	% of Respondents	# of Respondents (n = 20)	% of Respondents
Mathematics and Statistics Related	24	38.1%	9	45.0%
Construction Science and Engineering Related	19	30.2%	8	40.0%
Physical Science Related	18	28.6%	5	25.0%
Engineering and Design	18	28.6%	3	15.0%
Computer Science and Engineering Related	15	23.8%	5	25.0%
Construction Trade Related	13	20.6%	6	30.0%
Design and Creativity (ex: architecture)	11	17.5%	8	40.0%
Information Technology Related	6	9.5%	5	25.0%
Biological and Biomedical Science Related	7	11.1%	4	20.0%
Electrical / Electronics Engineering Related	6	9.5%	2	10%
Mechanical Engineering Related	5	7.9%	3	15.0%

Table 11: Gender participation in various STEM programs during high school

Demographic Breakdown Through Type of School

Middle School

In evaluating the STEM offerings in middle school across school types, distinct patterns were observed. A total of 106 students who reported that STEM opportunities were offered to them during their middle school were selected under this category. They are further sub-categorized into students who went to different types of school during their middle school.

Public School Title 1 (General Curriculum only) = 48 students

Public School Non-Title 1 (General Curriculum only) = 20 students

Public School with Specialty/Technical Curriculum or Career Technology Center = 19 students

Private School (General Curriculum only) = 16 students

Only the respondents who reported that the STEM opportunities were offered to them during their middle school that is 106 students is included in this division. In middle schools, 28 (58.3%) students from Public Title 1 schools reported STEM being offered through the semester curriculum, and 27 (56.3%) through electives. From Public Non-Title 1 schools, 8 (40.0%) and 11 (55.0%) students reported offerings via the semester curriculum and electives, respectively. In Public Schools with a Specialty Curriculum, 10 (52.6%) students reported offerings in both channels. Conversely, Private schools indicated a stronger curriculum offering, with 11 (68.8%) students reporting so.

Type of School	Through Semester Curriculum	Through Offered Electives	Through After School Program	Through Summer Camps	Sample Size
Public School Title 1 (General Curriculum only)	28 (58.3%)	27 (56.3%)	9 (18.8%)	3 (6.3%)	48
Public School Non-Title 1 (General Curriculum only)	8 (40.0%)	11 (55.0%)	3 (15.0%)	2 (10.0%)	20
Public School with Specialty/Technical Curriculum or Career Technology Center	10 (52.6%)	10 (52.6%)	2 (10.5%)	1 (5.3%)	19
Private School (General Curriculum only)	11 (68.8%)	6 (37.5%)	4 (25.0%)	1 (6.3%)	16

Table 12: Type of school Vs. Different channels of STEM offerings in middle school

Participation in STEM opportunities during Middle School years

Table 13 shows the summary of the STEM participation of students in different types of schools during their middle school years.

Type of School	Participated	Not Participated	Sample Size
Public School Title 1 (General Curriculum only)	24 (50.0%)	24 (50.0%)	48
Public School Non-Title 1 (General Curriculum only)	14 (70.0%)	6 (30.0%)	20
Public School with Specialty/Technical Curriculum or Career Technology Center	11 (57.9%)	8 (42.1%)	19
Private School (General Curriculum only)	10 (58.8%)	7 (41.2%)	17

Table 13: Participation in STEM in middle school according to different types of school

Evaluating the participation of students during their middle school year in various STEM curriculums across different types of schools provides a few insights. ‘Mathematics and Statistics Related’ demonstrated the most participated curriculum throughout all four types of schools. In Public School Title 1 (General Curriculum only) with a sample size of 22 students, STEM programs such as ‘Mathematics and Statistics Related’, ‘Construction Science and Engineering Related’, ‘Design and Creativity’ had a participation of around one-third of the total students who participated in the STEM programs. Other school types with a very limited sample size, however, provide insights at the surface level of the students’ participation in STEM field during their middle school years. Table 14 shows the participation of students in their middle school years in different STEM programs attending different types of school.

Type of School	Public School Title 1 (General Curriculum only) (n = 22)	Public School Non-Title 1 (General Curriculum only) (n = 13)	Public School with Specialty/Technical Curriculum or Career Technology Center (n= 11)	Private School (General Curriculum only) (n = 9)
Mathematics and Statistics Related	8 (36.4%)	5 (38.4%)	4 (36.4%)	5 (55.6%)
Construction Science and Engineering Related	7 (31.8%)	4 (30.8%)	1 (9.1%)	0 (0.0%)
Physical Science Related	4 (18.2%)	4 (30.8%)	1 (9.1%)	3 (33.3%)
Engineering and Design	3 (13.6%)	2 (15.4%)	1 (9.1%)	0 (0.0%)
Computer Science and Engineering Related	4 (18.2%)	5 (38.5%)	2 (18.2%)	3 (33.3%)
Construction Trade Related	2 (9.1%)	2 (15.4%)	3 (27.3%)	0 (0.0%)
Design and Creativity (ex: architecture)	7 (31.8%)	2 (15.4%)	3 (27.3%)	2 (22.2%)
Information Technology Related	5 (22.7%)	2 (15.4%)	2 (18.2%)	2 (22.2%)
Biological and Biomedical Science Related	1 (4.5%)	1 (7.7%)	0 (0.0%)	0 (0.0%)
Electrical / Electronics Engineering Related	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Mechanical Engineering Related	2 (9.1%)	1 (7.7%)	1 (9.1%)	0 (0.0%)

Table 14: Various STEM programs participation in middle school according to type of school

High School

In the high school sample, 32 (54.2%) students from Public Title 1 schools reported curriculum-based STEM offerings, with a notable 40 (67.8%) reporting elective-based offerings. Public Non-Title 1 schools had 7 (36.8%) students reporting curriculum offerings, but a significant 16 (84.2%) for electives. Public Schools with a Specialty Curriculum reported balanced offerings with 15 (62.5%) students for the curriculum and 12 (50.0%) for electives. Private schools had 8 (42.1%) students reporting curriculum-based offerings, but a higher 15 (78.9%) for electives. This data showcases the diverse STEM offering patterns tailored to each school type.

Type of School	**Through Semester Curriculum**	**Through Offered Electives**	**Through After School Program**	**Through Summer Camps**	**Sample Size**
Public School Title 1 (General Curriculum only)	32 (54.2%)	40 (67.8%)	11 (18.6%)	3 (5.1%)	59
Public School Non-Title 1 (General Curriculum only)	7 (36.8%)	16 (84.2%)	5 (26.3%)	3 (15.8%)	19
Public School with Specialty/Technical Curriculum or Career Technology Center	15 (62.5%)	12 (50.0%)	6 (25.0%)	2 (8.3%)	24
Private School (General Curriculum only)	8 (42.1%)	15 (78.9%)	3 (15.8%)	2 (10.5%)	19

Table 15: Type of school Vs. Different channels of STEM offerings in high school

Participation In STEM opportunities during High School years

Table 16 shows the summary of the STEM participation of students in different types of schools during their high school years.

Gender	Participated	Not Participated	Sample Size
Public School Title 1 (General Curriculum only)	37 (62.7%)	22 (37.3%)	59
Public School Non-Title 1 (General Curriculum only)	14 (73.7%)	5 (26.3%)	19
Public School with Specialty/Technical Curriculum or Career Technology Center	14 (58.3%)	10 (41.7%)	24
Private School (General Curriculum only)	16 (80.0%)	4 (20.0%)	20

Table 16: Participation in STEM in high school according to different types of school

Evaluating the participation of students during their high school years in various STEM curriculums across different types of schools provides an insight into the tendency of the students' participation. 'Mathematics and Statistics Related' demonstrated the higher proportion of participants as compared to other STEM programs throughout all four types of schools. Table 17 shows various STEM programs participation in high school according to type of schools.

Type of School	**Public School Title 1 (General Curriculum only) (n = 36)**	**Public School Non-Title 1 (General Curriculum only) (n = 14)**	**Public School with Specialty/Technical Curriculum or Career Technology Center (n = 14)**	**Private School (General Curriculum only) (n = 16)**
Mathematics and Statistics Related	16 (44.4%)	7 (50.0%)	4 (28.6%)	5 (31.3%)
Construction Science and Engineering Related	12 (33.3%)	6 (42.9%)	3 (21.4%)	4 (25.0%)
Physical Science Related	9 (25.0%)	7 (50.0%)	0 (0.0%)	6 (37.5%)
Engineering and Design	10 (27.8%)	4 (28.6%)	4 (28.6%)	2 (12.5%)
Computer Science and Engineering Related	10 (27.8%)	3 (21.4%)	2 (14.3%)	4 (25.0%)
Construction Trade Related	9 (25.0%)	3 (21.4%)	4 (28.6%)	3 (18.8%)
Design and Creativity (ex: architecture)	6 (16.7%)	7 (50.0%)	3 (21.4%)	2 (12.5%)
Information Technology Related	5 (13.9%)	3 (21.4%)	1 (7.1%)	1 (6.3%)
Biological and Biomedical Science Related	3 (8.3%)	3 (21.4%)	1 (7.1%)	4 (25.0%)
Electrical / Electronics Engineering Related	2 (5.6%)	1 (7.1%)	4 (28.6%)	1 (6.3%)
Mechanical Engineering Related	3 (8.3%)	1 (7.1%)	4 (28.6%)	0 (0.00%)
Aerospace Engineering	1 (2.8%)	1 (7.1%)	0 (0.0%)	0 (0.0%)

Table 17: Various STEM programs participation in high school according to type of school

Breakdown According to Size of School

Middle School

The study evaluated the offering of middle schools based on their size. The results are summarized in Table 18 below. It can be observed that as the school size increased, the percentage of respondents reporting that they were offered STEM opportunities during their middle school gradually increased. Large sized school with over 400 students in a graduating class showed the highest rate of STEM offering with 74.1% of the students who attended large sized school reporting it. It is followed by medium sized schools at 69.2% and then small sized schools at 59.6%.

Size Of Schol	**Offered**	**Not Offered**	**Sample Size**
Small Sized (≤ 200 Students)	25 (59.6%)	17 (40.4%)	42
Medium Sized (200 < Students ≤ 400)	36 (69.2%)	16 (30.8%)	52
Large Sized (Students > 400)	40 (74.1%)	14 (25.9%)	54

Table 18: STEM offering in middle school vs. size of school

Channels of Exposure

The study evaluated the different sizes middle of schools offering STEM programs through various channels in the middle school. The result is summarized in Table 18. While the majority of students who attended a small or medium sized school during their middle school reported that the STEM programs were offered as the part of the semester curriculum, 65% of the students who attended large sized school during their middle school reported that they were offered STEM programs through offered elective. It is also observed that STEM offering through after school programs and through summer camps, remain less significant with only small percentage of students reporting it that they were offered through these channels in all three sized school.

Type of School	Through Semester Curriculum	Through Offered Electives	Through After School Program	Through Summer Camps	Sample Size
Small Sized (≤ 200 Students)	17 (68.0%)	11 (44.0%)	3 (12.0%)	2 (8.0%)	25
Medium Sized (200 < Students ≤ 400)	25 (69.4%)	17 (47.2%)	6 (16.7%)	5 (13.9%)	36
Large Sized (Students > 400)	14 (35.0%)	26 (65.0%)	7 (17.5%)	0 (0.0%)	40

Table 19: Size of school Vs. Different channels of STEM offerings in middle school

Participation in STEM opportunities during Middle School years

The study assessed the participation rates of students in STEM programs in middle schools of varying sizes. Table 20 summarizes the result below. The participation rates in small and medium sized schools are relatively similar and higher; however, it was observed that only 47.5% of the students who attended large sized school for their middle school reported that they participated in the STEM programs that were offered.

Size Of School	Participated	Not Participated	Sample Size
Small Sized (≤ 200 Students)	17 (68.0%)	10 (32.0%)	25
Medium Sized (200 < Students ≤ 400)	25 (69.4%)	11 (30.6%)	36
Large Sized (Students > 400)	19 (47.5%)	21 (52.5%)	40

Table 20: Participation in STEM in middle school according to size of school

Participation in different types of STEM programs during Middle School years

Table 21 shows the summary of students' participation in STEM programs enrolled in different sizes of school during their middle school.

Type of School	**Small Sized (n = 15)**	**Medium Sized (n = 23)**	**Large Sized (n = 18)**
Mathematics and Statistics Related	9 (60.0%)	4 (17.4%)	8 (44.4%)
Construction Science and Engineering Related	5 (33.3%)	6 (26.1%)	2 (11.1%)
Physical Science Related	5 (33.3%)	5 (21.7%)	2 (11.1%)
Engineering and Design	1 (6.7%)	2 (8.7%)	4 (22.2%)
Computer Science and Engineering Related	6 (40.0%)	3 (13.0%)	4 (22.2%)
Construction Trade Related	1 (6.7%)	3 (13.0%)	3 (16.7%)
Design and Creativity (ex: architecture)	4 (26.7%)	9 (39.1%)	2 (11.1%)
Information Technology Related	4 (26.7%)	5 (21.7%)	2 (11.1%)
Biological and Biomedical Science Related	0 (0.0%)	1 (4.3%)	1 (5.6%)
Electrical / Electronics Engineering Related	0 (0.0%)	1 (4.3%)	0 (0.0%)
Mechanical Engineering Related	0 (0.0%)	2 (8.7%)	2 (11.1%)

Table 21: Various STEM programs participation in middle school according to size of school

High School

The study evaluated the offering STEM opportunities of high schools based on their size. The results are summarized in Table 22 below. It can be observed that the percentage of students reporting that they were offered STEM opportunities during high school of all sized school was observed to be higher, with over three-quarters of the students in all size that they were offered STEM opportunities during their high school. It was also observed that the percentage of students reporting that they were exposed to STEM opportunities during their high school also increased from middle school.

Size Of Schol	**Offered**	**Not Offered**	**Sample Size**
Small Sized ($\leq$ 200 Students)	32 (76.2%)	10 (23.8%)	42
Medium Sized (200 < Students $\leq$ 400)	43 (82.7%)	9 (17.3%)	52
Large Sized (Students > 400)	45 (83.3%)	9 (16.7%)	54

Table 22: STEM offering in high school vs. size of school

Channels of Exposure

The study evaluated the different size of school offering STEM programs through various channels in the middle school. The result is summarized in Table 23. Unlike middle school where the students who attended a small and medium sized school reported the majority of the STEM programs were offered through semester curriculum, in high school it was observed that over two-third of the students in all sized school reported that they were offered STEM programs through offered electives. This fact remained the same in the case of large sized school, however. In the case of small and medium sized school, the percentage of students reporting STEM offerings through semester curriculum dropped as compared to during middle school with the rise in percentage for offered through electives. It is also observed that STEM offering through after school programs and through summer camps, remained less significant with only small percentage of students reporting it that they were offered through these channels in all three sized school in high schools as well just like middle school.

Type of School	**Through Semester Curriculum**	**Through Offered Electives**	**Through After School Program**	**Through Summer Camps**	**Sample Size**
Small Sized (≤ 200 Students)	16 (50.0%)	22 (68.8%)	5 (15.6%)	3 (9.4%)	32
Medium Sized (200 < Students ≤ 400)	27 (62.8%)	30 (69.8%)	8 (18.6%)	5 (11.6%)	43
Large Sized (Students > 400)	17 (37.8%)	31 (68.9%)	10 (22.2%)	2 (4.4%)	45

Table 23: Size of school Vs. Different channels of STEM offerings in high school

Participation in STEM opportunities during High School years

The study assessed the participation rates of students in STEM programs in high schools of varying sizes. Table 24 summarizes the result below. The participation rates for all three sized schools are relatively similar and higher with over 60% of students from all school sized reporting they participated in STEM programs during their high school years. It is noteworthy that the participation rate in Large sized school transitioning from middle to high school improved.

Size Of Schol	**Participated**	**Not Participated**	**Sample Size**
Small Sized (≤ 200 Students)	25 (65.4%)	7 (34.6%)	32
Medium Sized (200 < Students ≤ 400)	28 (65.1%)	15 (34.9%)	43
Large Sized (Students > 400)	27 (60.0%)	18 (40.0%)	45

Table 24: Participation in STEM in middle school according to size of school

Participation in different STEM programs during High School years

Table 25 shows the summary of students' participation in STEM programs enrolled in different sizes of school during their middle school.

Type of School	Small Sized (n = 15)	Medium Sized (n = 23)	Large Sized (n = 18)
Mathematics and Statistics Related	10 (40.0%)	11 (39.3%)	10 (37.0%)
Construction Science and Engineering Related	10 (40.0%)	9 (32.1%)	7 (25.9%)
Physical Science Related	8 (32.0%)	9 (32.1%)	4 (14.8%)
Engineering and Design	4 (16.0%)	7 (25.0%)	10 (37.0%)
Computer Science and Engineering Related	8 (32.0%)	5 (17.9%)	6 (22.2%)
Construction Trade Related	4 (16.0%)	6 (21.4%)	7 (25.9%)
Design and Creativity (ex: architecture)	3 (12.0%)	9 (32.1%)	7 (25.9%)
Information Technology Related	5 (20.0%)	4 (14.3%)	2 (7.4%)
Biological and Biomedical Science Related	2 (8.0%)	5 (17.9%)	3 (11.1%)
Electrical / Electronics Engineering Related	1 (4.0%)	3 (10.7%)	4 (14.8%)
Mechanical Engineering Related	0 (0.0%)	2 (7.1%)	6 (22.2%)
Aerospace Engineering Related	0 (0.0%)	1 (3.6%)	1 (3.7%)

Table 25: Various STEM programs participation in high school according to size of school

Discussion

The main goal of the research was to understand the exposure and participation of currently construction program enrolled Gen Z undergraduate students in STEM opportunities during their middle and high school years, to understand their trajectory towards construction industry. After analyzing the data collected through a survey of 156 respondents, the following insights have emerged.

Overall STEM Exposure and Participation

Middle School Vs. High School

With 80.64% of the students responded that they were exposed to STEM opportunities during their high school years compared to 68.38% during their middle school years, suggesting an increased emphasis on STEM education in high school or demonstrating the growing interest of students as they advance academically. Supporting this, a study by McLure et.al (2022) found a shift towards more advanced STEM application in high school, particularly in Engineering and Science. This shift not only reflects the advance high school STEM education, but also correlates with increased students' interest and engagement. Such trend is imperative as it exposes students to a broader array of STEM disciplines to explore and develop interest before making higher education decisions.

Channels of STEM Exposure

Both middle and high school data emphasized that the semester curriculum is the primary channel for students. 68% of the students who had STEM opportunities in their high school responded that they were offered those programs through semester curriculum and 55.7% of respondents in middle school. This underscores the role of schools to expose students to STEM programs as preparation for higher education. Many universities and colleges operate on a semester system. Therefore, offering STEM opportunities to students through a semester curriculum better prepares students for their higher education. The semester curriculum is followed by offered electives in both middle and high school. Emphasis on allowing students to choose their program of interest, can allow students to focus in the area of interest and specialization. Despite their potential, STEM opportunities through summer camps and after-school had a low proportion of students responding that they were offered STEM programs through these channels. As these channels can be highly engaging and productive in encouraging students towards learning (Binns et al., 2016; Krishnamurthi et al., 2014; Yilmaz et al., 2010), there is a gap for potential growth and emphasis in the future.

Participation

In terms of participation, the growth of STEM exposure moving upward from middle school to high school demonstrated an increased participation rate, with 66.7% of students participating in STEM programs who had a STEM opportunity as compared to 57.9% in middle school. This increased participation rate can indicate a growing interest of students in STEM programs as they progress in their academic journey. One possible reason for this increase could be associated with career aspirations. As the students approach college, they might be more inclined to consider their future careers. With STEM disciplines offering abundant opportunities and lucrative career prospects (Peterson et al., 2015), more students might be motivated to participate in the STEM curriculum in high school.

Regarding the participation of the students across different programs in middle and high school, there is a clear pattern of preference observed. ‘Mathematics and Statistics Related’ was consistently on top of the list in both middle and high school, with 38.6% of the respondents who had exposure to STEM opportunities participating in middle school and 39.8% in high school. The other notable programs excluding construction-related programs were ‘Physical Science Related’, and ‘Computer Science Related’, with approximately one-fourth of students who had STEM opportunities participating in these programs, both during middle and high school. Such a trend can emphasize the importance of these disciplines in STEM education.

Construction Related Programs

Focusing on construction-related programs, a noteworthy progression was observed. For example, ‘Construction Science and Engineering Related’ programs saw a nearly 10% increase in participation from middle to high school. Similarly, participation in ‘Engineering and Design’ and ‘Construction Trade Related’ programs increased significantly, moving from middle to high school. This probably could be attributed to the budding interest of students in the construction career as they grow up. Early and sustained exposure to such disciplines can indeed channel students' interest toward a career in construction. Similarly, 'Design and Creativity' which could be considered a subsidiary of construction aligned with such as architectural endeavors, also had a consistent participation of students, with almost one-fourth of students who had STEM opportunities engaged in these programs in both middle and high school.

Demographic Considerations

Gender Participation

The survey response collected from Gen Z undergraduate students enrolled in construction programs nationwide had a predominantly male response, with 78.2% of the respondents identifying as male and 21.8% female out of 156 respondents. The construction industry is a male-dominated industry, which can be attributed to societal norms, the perception of gender roles entrenched in our culture, and the physical demands of certain construction jobs (Akinlolu & Haupt, 2020; Galea et al., 2015). This trend is reflected in survey responses as well. Therefore, a female sample size was relatively smaller than the male during the analysis. Therefore, the analysis should be taken only as an insight.

The analysis points to a strong participation rate in mathematics and statistics in both genders in both middle and high school. However, specific programs like 'Design and Creativity' in both middle and high school had more female participation rates than males. This emphasizes the importance of understanding gender preferences to ensure eclectic STEM programs catering to varied interests.

Size of School

The shift in offering STEM programs from a semester curriculum in middle school to electives in high school indicates a trend in the educational system. As students progress in their academic journey toward making their career choices, there is an emphasis on allowing students to choose their program of interest, reflecting a shift towards specialization.

Usually, the larger the school, the more resources it is equipped with to offer an eclectic range of programs. However, the participation rate discrepancy in STEM programs in large-sized schools as compared to the medium and small-sized schools, with large schools showing a lower rate of participation, especially in middle school, could be tied, making a speculation that the wide range of options could have impacted this, as opposed to the smaller schools where the options could be limited. Alternatively, another explanation could be that with the larger setting, a student can be easily overwhelmed or less engaged due to the larger class sizes or less personalized attention affecting their decision to participate.

Hypothesis Development for Subsequent Research

The findings of this study lay the groundwork for overarching research, which further explores the factors influencing students to pursue a career in construction. The pattern emerging from the data indicates the possibility that various STEM exposures and participation during students' middle and high school years can be a precursor to their career choice. For example, high participation in construction-related programs may forecast a growing interest in construction fields.

Conclusion

The exploration of STEM exposure and participation of students during their middle and high school years resulted in several insights. First, a considerable portion of students who participated in the survey reported having the privilege of STEM exposure during their middle and high school years. It was observed that this exposure often came through structured academic frameworks like semester curricula and offered electives. This emphasizes the foundational role schools play with their education structure in indulging students towards STEM disciplines. Furthermore, the observation also revealed the significance of STEM disciplines such as ‘Mathematics and Statistics’ in the STEM landscape, which consistently attracts high student participation, which calls for the schools to integrate such programs into their curricula actively.

Regarding construction, a notable progression was observed in the participation in construction-related programs moving from middle to high school. The rising participation of students as observed transitioning from middle to high schools in programs like ‘Construction Science and Engineering Related’, ‘Engineering Design’ and ‘Construction Trades’ provides a roadmap for the construction industry and academia to early exposure in these programs can catalyze attracting more students into the domain in future. The journey from initial exposure and participation in construction-related programs during their middle and high school years, as charted by this study, to making a career decision to join the construction industry is a testament to the profound impact of early educational experiences on career trajectories. This accentuates the role of educational institutions in shaping future professional and industry leaders.

CHAPTER FOUR

FACTORS THAT INFLUENCED CURRENT GEN Z UNDERGRADUATE STUDENTS ENROLLED IN CONSTRUCTION RELATED PROGRAMS TO PURSUE A CAREER IN CONSTRUCTION

Abstract

This retrospective study explores the factors that influenced the Gen Z undergraduate students currently enrolled in construction programs nationwide to pursue a career in construction. Participants were surveyed with a designed set of questionnaires that targeted to assess factors that they perceive to be significant in influencing them to pursue a career in construction. Survey analysis revealed that students who participated in STEM and construction related programs during their formative middle and high school years modestly perceive these experience higher as a factor to pursue a career in construction than the students who did not participated in such programs. However, in the broader spectrum of factors, it was observed that the overarching influences were familial, and career prospects the construction industry offers such as eclectic opportunities that demands technical skillsets and financial security all of which outweighed the formative educational factors.

Keywords: Gen Z, STEM/Construction Education, Career prospects, Family impact

Introduction

The United States construction industry is one of the major sectors of the nation's economy demonstrating substantial growth. By October 2023, the total spending in the U.S construction industry for the year reached 2,027.1 billion, with notable increase of 10.7% from October 2022 (U.S. Census Bureau, 2023). This massive financial footprint of the industry is highlighted by its contribution of 4.2% to the nation's GDP in 2019 (Bureau of Economic Analysis, 2021). Such prominence has naturally created a plethora of opportunities across the industry, resulting in a rise in demand for construction workers across the nation. However, the industry continues to face severe problems with the availability and sufficiency the workforce (Alsharef et. al, 2021; MSCM, 2016).

Delving deeper into the roots to understand the cause for this shortage unravels a concerning trend. There is a lack of students interested in pursuing their career in the construction industry. This repulsion is not without a reason. Many students in schools have a negative perception about pursuing a career in construction, often viewing it as a less desirable career path (Escamilla et al., 2016; Hugo et.al., 2018; Bilbo et.al., 2009a). Such perception of the students can create a formidable challenge to the construction industry.

Addressing the labor shortage, the construction industry is facing necessitates a comprehensive understanding of factors that influences students to pursue a career in construction, especially during their formative middle and high school years. While the role of the school curricula in impacting career decision is well recognized, the study takes this as a hypothesis to test if the early exposure to STEM and construction related programs during middle and high school years has higher influence on students who participated in these programs than who did not participate to pursue a career in construction. Additionally, the study stretches to understand the broader array of influences ranging from educational exposure to social influences and career prospects that motivated the Gen Z students currently enrolled in Construction programs to join the construction industry. The study aims to provide insights that could help tailor educational programs and industry recruitment strategies nuanced influencing factor of the emerging workforce.

Literature Review

1. Construction Education: A Closer Look

1.1 Construction's Place in STEM

Construction education is a subset of STEM that lays the groundwork for students interested in the construction and engineering industries. The importance of the construction sector in STEM is highlighted by the fact that it addresses societal needs for infrastructure, housing, and other built environments, moving towards economic growth and long-term national development (Ofori, 2015). Within STEM, construction is among the industries that are heavily impacted by the workforce shortage (GIATEC, 2019; Hugo et.al., 2018). The primary reason for this is an alarmingly low number of students interested in pursuing careers in the building and construction sector. Students in schools have a negative perception of the construction business, believing that working in the field is "dirty" and "boring," (Escamilla et al., 2016; Hugo et.al., 2018; Bilbo et.al., 2009).

1.2 Gen Z's Perceptions of the Construction Industry

The building and construction sector is regularly criticized for taking too long to adopt new methods and innovative ideas. The construction industry gets perennially dinged for needing to be faster to innovate and adapt to new technology (Amusan et.al., 2018). According to Seetha (2014), among a proportionately low number of those students who decide to join the construction industry, a significant number of them are not very enthusiastic about the field. For tech-savvy Gen Z's, the industry does offer much excitement. This leads to a deficit in students' abilities, mainly in their soft skills. Soft skills in the construction industry are a broad skill set, competencies, behaviors, mindsets, and personal qualities that workers can effectively navigate their environment, work well with others, achieve their goals, and perform well (Usman, 2020). Students often lack technical skills and develop a negative perception of the industry, like in the case of construction. By offering hands-on experience, proper education, and training, the students' perception of the industry can be altered, and the industry can eventually retain talent.

2. Factors Influencing STEM Career Choices

2.1 Theoretical Framework

Understanding and identifying the factors that impact students' career choices are critical because shortages of STEM-skilled labor will affect future economic growth (Lopez & Marco, 2023). Furthermore, identifying the factors that contribute to an interest in STEM careers may contribute to understanding how students learn STEM content and provide guidance for designing intervention strategies (Hall et al., 2011). Educators, peers, and familial influence motivates students' STEM career choices (Nugent et al., 2015). Middle and High school students are at the age when they explore different things and develop interests. They also recognize their strengths and weaknesses in different subject matters. Thus, an appropriate intervention at this stage could be helpful and timely for them to determine the subject choices following their interests (Maltese & Tai, 2011).

Several studies have been conducted to understand the factors influencing interest in STEM careers. For instance, Bahar & Adiguzel (2016) studied the factors affecting students' interest in STEM-related careers. In Bahar & Adiguzel's (2016) study, the selected factors were based on the hypothesis that students' interests in STEM careers are shaped by SCCT-suggested constructs such as outcome expectations, goal orientation, and self-efficacy. Similarly, sub-constructs include people (teachers, family, relatives, friends, etc.), school-related factors (curriculum, classroom activities, extracurricular activities, competitions/fairs, etc.), self-motivation, and job expectations (Bahar &

Adiguzel, 2016). Additionally, the factors that influence the STEM Career Choices is mapped out in Table 1.

2.2 Influential Factors Identified in Previous Studies

Factors Influencing STEM Career Choices	**Relevant Studies**
Middle and High School General Curriculum	*Sahin & Waxman (2021); Sadler et al. (2013)*
Summer Camp	*Drey (2016); Kager (2015)*
After School Program	*Sahin et al. (2016); Krishnamurthi et al. (2014)*
Family Influence	*Kocak et al. (2021);Halim et al. (2018); Sheehan et al. (2018)*
Teacher Impression	*Bahar & Adiguzel (2016); Lichtenstein et al. (2014)*
Toy/Video Games	*Hughes (2017); Griffith (2018)*
High Starting Salary	*Duku et al. (2021);Bain & Lefebvre (2022))*
Technical Skills Required	*Blotnicky et al. (2014)*
Possibility to be promoted quickly	*Theodora et al. (2019)*
Job variety/diversity	*Duku et al. (2021; Uyar et al. (2011)*

Table 1 (copy): Mapping out of the Factors Influencing STEM Career Choices

3. The Gap in Current Literature

3.1 The Missing Link: Understanding Construction Career Choices

From the literature review, it can be concluded that the newer generations, significantly Gen Z's, have a declining interest in STEM education, and it gets even more pronounced in the construction sector. Most of Gen Z, they perceive that the construction industry does not offer excitement or a fascinating career. While several studies are delving into why the construction industry is failing to attract the younger generation, more research should be needed on what factors might attract them to the construction career.

3.2 Objective of the Study

In order to fill the important gap in literature, the main objective of this study is to explore and understand the factors influencing Gen Zs in middle and high school years to pursue a career in the construction industry. Understanding what factors influence this cohort of generations becomes crucial to the construction industry's future. Below are some of the significances of this research discussed:

Industry Relevance: By identifying the factors influencing Gen Z's career choices, industry stakeholders can use the insight from this study to tailor their recruitment and retention strategies. This can ensure a steady influx of fresh talent.

Educational Implications: The findings of this study can provide insight into the education institutions when it comes to creating curricula and extracurricular activities that match the interests and ambitions of Gen Z. This can help make construction education more attractive to the Gen Z generation.

Methodology

Figure 6 below shows the three steps utilized for the methodology opted in this study.

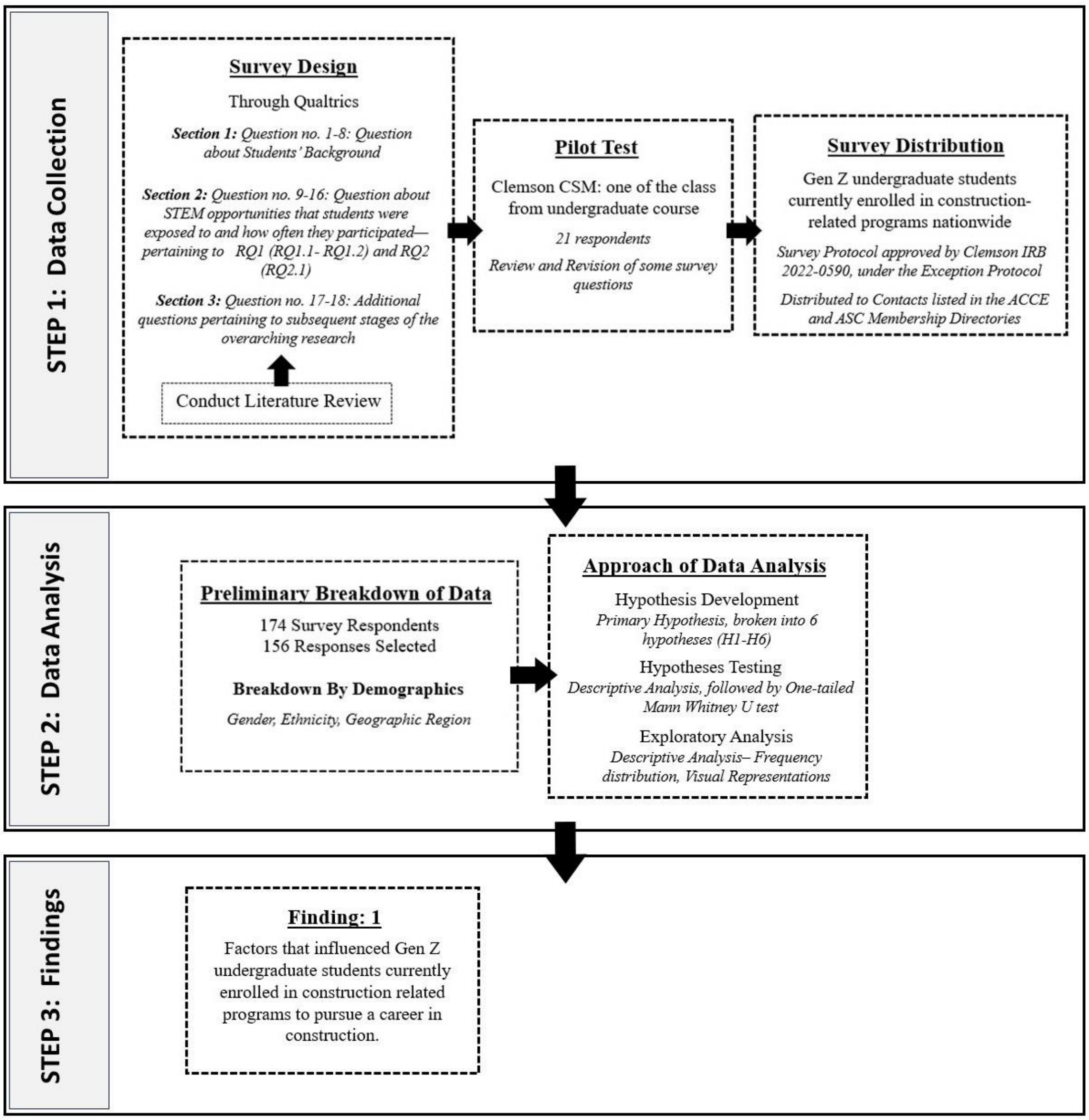

Figure 6: Methodology Flowchart for Chapter 4

Step 1: Data Collection

Phase 1: Survey Design

A survey research design was employed after conducting a thorough literature review of the subject. A questionnaire was utilized as a primary research tool. The survey was administered using Qualtrics and targeted undergraduate Gen Z students enrolled in construction related programs throughout the United States. The questionnaire was structured into three main sections.

Section 1: Questions no.1 through 8, this section collected demographic and background information about the respondents. It was comprised of Multiple-Choices Questions (MCQs) that allowed for standardized responses and open-ended questions that allowed for personalized responses.

Section 2: Questions no. 9 through 16 included questions that aimed to understand STEM opportunities the students were exposed to during their middle and high school years and how often they participated in them. It was comprised of 'Yes or No' and MCQ's with the option to choose multiple choices. This section was mainly focused to collect insights for the prior study to this in the overarch.

Section 3: Question no. 17-18 included questions that aimed to gather respondents' view on factors that influenced their career decision to pursue a career in construction, pertaining to RQ3 (RQ3.1-RQ3.3)

Phase 2: Pilot Test

A pilot test was conducted before the main distribution of the survey. The pilot test involved a total of 21 respondents from one of the Clemson Construction Science and Management (CSM) undergraduate classes. Based on the feedback from this test, some of the survey questions were refined for clarity.

Phase 3: Survey Distribution

The survey protocol was approved by Clemson IRB under the Exception Protocol prior to pilot test to make sure the study adhered to ethical standards. The survey was then distributed to the construction programs nationwide through the contacts listed in the ACCE and ASC membership directories, to which few schools responded. Participation was voluntary, and the survey was anonymous keeping the identity of the respondents unrevealed.

STEP 2: Data Analysis

Phase 1: Preliminary Breakdown of Data

Of the 174 survey participants, 156 provided complete responses. In the gender distribution, males comprised a significant portion at 78.2% (122 respondents), while females accounted for 21.8% (34 respondents). The geographic distribution of the respondent is shown in figure 3.

Regarding ethnicity, the predominant group was White, non-Hispanic, with 134 respondents (85.9%). The initial ethnic categories provided to the respondents in the survey and their respective counts were: Hispanic (9 respondents), American Indian or

Alaska Native (4 respondents), Asian (1 respondent), Native Hawaiian and other Pacific Islander (1 respondent), Some other race, non-Hispanic (1 respondent), and Multiracial (3 respondents). Due to the small number of respondents in these categories, they are grouped as 'Others' in Table 26, accounting for 12.2% (19 respondents) of the sample. Additionally, 1.9% (3 respondents) chose not to specify their ethnicity.

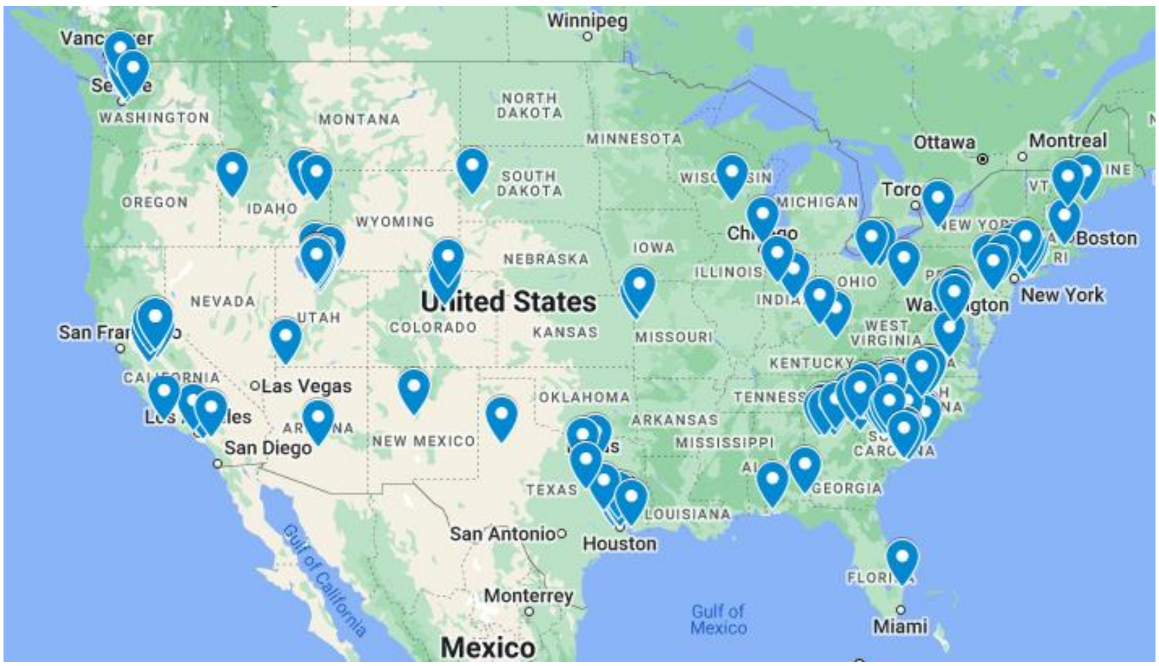

Figure 3 (copy): Geographic Distribution of the Survey Respondents

Variables	# of Respondents	% of Respondents
Gender		
Male	122	78.2%
Female	34	21.8%
Ethnicity		
White, non-Hispanic	134	85.9%
Others	19	12.2%
Prefer not to Answer	3	1.9%
Geographic Region		
South	95	60.9%
West	37	23.7%
Northeast	15	9.6%
Midwest	9	5.8%

Table 26: Demographic distribution of respondents for chapter 4

Phase 2: Approach for Data Analysis

Section 1: Hypothesis Development

With the findings of the previous study, a hypothesis was developed to be tested in this study. Below is the primary hypothesis and its subdivisions.

Primary Hypothesis:

Current Gen Z undergraduate students enrolled in construction-related programs who participated in STEM/construction programs during middle and/or high school perceive such experience as an influential factor to pursue a career in construction.

Six specific hypotheses were developed in align to the survey questions as a sub-hypotheses that explore different facets of this broader assertion and to make the hypotheses testable.

Hypothesis 1 (H1):

Students who participated in STEM program(s) during their middle school years consider “Middle School General Curriculum” higher as an influence than those who didn’t not participate.

Hypothesis 2 (H2):

Students who participated in STEM program(s) during their high school years consider “High School General Curriculum” higher as an influence than those who didn’t not participate.

Hypothesis 3 (H3):

Students who participated in STEM program(s) during their middle school years consider “STEM/Construction electives” higher as an influence than those who didn’t not participate.

Hypothesis 4 (H4):

Students who participated in STEM program(s) during their high school years rated “STEM/Construction electives” higher as an influence than those who didn’t not participate.

Hypothesis 5 (H5):

Students who participated in construction program(s) during their high school years consider “High School General Curriculum” higher as an influence than those who didn’t not participate.

Hypothesis 6 (H6):

Students who participated in at least one or more construction programs during their high school years consider “STEM/Construction Electives” higher as an influence than those who did not participate.

Section 2: Hypothesis Testing

For each sub-hypotheses, firstly, two groups were formed—students who participate and who did not participate in the particular program the hypothesis is being tested along with their corresponding ratings of the particular channel as an influential factor offered in the Likert-scale. The properties table was created showing the number of respondents on each group and respective median and mode rating of each group. A one-tailed Mann-Whitney U test was performed to check if there is a statistics difference between rating of two groups.

Section 3: Exploratory Analysis

To gain a broader understanding of the various factors that influenced Gen Z undergraduate students to pursue a career in construction, an exploratory analysis of several factors extracted from Table 1 of literature review was conducted. This section contained two parts namely part 1 and part 2.

Part 1 consisted of the analysis of the data obtained from Likert-scale which asked the respondents to rate each factor on the scale of 1 to 5, 1 being not influential to 5 being most influential in their decision to pursue a career in construction. A descriptive analysis was conducted to get an understanding of influential factors based on the rating from the respondents for each factor. This was followed by a demographic breakdown of the responses into gender and income group. For the gender, with two independent variables, a Mann-Whitney U test was conducted to test the statistical difference between groups across each factor. A Bonferroni correction was applied to the alpha level to avoid the risk of type I error as the test conducted multiple comparisons.

Part 2 consisted of the analysis of the data obtained from the survey question which asked the respondents to select one factor that in their opinion was the most influential factor to pursue a career in construction. A descriptive analysis was conducted to get an understanding of the factors. Similarly, the descriptive analysis of the demographic breakdown was also conducted to understand if there were any differences between the demographic groups.

Step 3: Findings

Findings 1: Factors that influenced Gen Z undergraduate students currently enrolled in construction related programs to pursue a career in construction.

Findings

This section presents the results from the quantitative analysis that was conducted for the study. Beginning with the test of the primary hypotheses, this section stretches to the exploratory analysis of the external factors that influenced students to pursue a career in construction.

Testing Hypothesis:

Hypothesis 1 (H1):

Students who participated in STEM program(s) during their middle school years consider "Middle School General Curriculum" higher as an influence than those who didn't not participate.

Data was extracted from the survey and was categorized on the basis of those who participated in the STEM program(s) during their middle school years and those who did not participate, along with their corresponding rating for the "Middle School General Curriculum" as an influence to pursue a career in construction. Those who reported they were not offered STEM programs in their middle school were included in the group of who did not participate. Outliers were removed using the 1.5 IQR method. (Note: The same approach was utilized for testing other hypothesis as well, that is for H2 - H6)

The null hypothesis and alternative hypotheses were formulated, which are as follows:

Null Hypothesis (H_o) = The distribution of influence scores on "Middle School General Curriculum" between individuals who did and who did not participate in STEM program(s) during their middle school are identical.

Alternative Hypothesis (H_1) = The distribution of influence scores on "Middle School General Curriculum" between individuals who did and who did not participate in STEM program(s) during their middle school are not identical.

Properties Table:

Stats	**Participated**	**Not Participated**
Count	62	76
Mean	1.94	1.0
Median	1.5	1
Mode	1	1

Table 27: Descriptive table of distribution for hypothesis 1 grouping

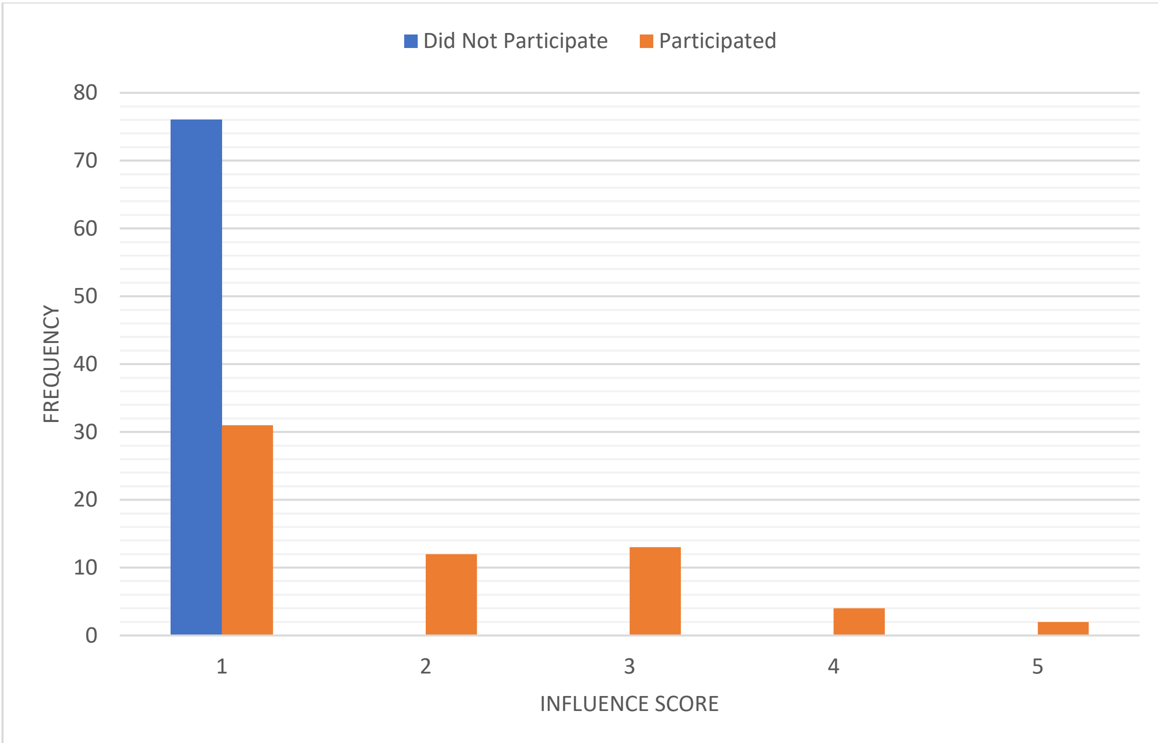

Figure 7: Cluster Bar Chart showing the Frequency Distribution across ratings for Hypothesis 1 grouping

One-tailed Mann-Whitney U test, a non-parametric test, was selected to compare the statistical difference between two groups. (Note: The same approach of normality testing was used for other hypotheses as well, that is for H2 – H6)

The result of Mann-Whitney U generated the following results. This test was followed by computing the rank-biserial correlation to compute the effect size represented by ‘r’.

Mann-Whitney U = 1178.0

One-tailed p-value = <0.001

r = 0.5

Given the small p-value, the null hypothesis is rejected, and the alternative hypothesis is accepted. This indicates that there is a statistically significant difference in the influence scores on “Middle School General Curriculum” between individuals who did and who did not participate in STEM program(s). From the properties Table 27, it indicates that participation in STEM program offered through semester programs during middle school might have a role in influencing students toward a career in construction.

The effect size (r) was found to be 0.5, which indicates a moderate difference between the participants’ and non-participants' rating. While the effect is not large, it is not trivial either. This suggests that the programs have a tangible influence on those who participated, as a factor influencing their decision to pursue a career in construction.

Hypothesis 2 (H2):

Students who participated in STEM program(s) during their high school years consider “High School General Curriculum” higher as an influence than those who didn’t not participate.

Data was extracted from the survey and was categorized on the basis of those who participated in the STEM program(s) during their high school years and those who did not participate, along with their corresponding rating for the “High School General Curriculum” as an influence to pursue a career in construction. Those who reported they were not offered STEM programs in their high school were included in the group of who did not participate. The null hypothesis and alternative hypothesis were formulated, which are as follows:

Null Hypothesis (H_o) = The distribution of influence scores on "High School General Curriculum" between individuals who did and who did not participate in STEM program(s) during their high school are identical.

Alternative Hypothesis (H_1) = The distribution of influence scores on "High School General Curriculum" between individuals who did and who did not participate in STEM program(s) during their high school are not identical.

Properties Table

Stats	Participated	Not Participated
Count	84	68
Mean	2.51	1.43
Median	2.5	1
Mode	1	1

Table 28: Descriptive table of distribution for hypothesis 2 grouping

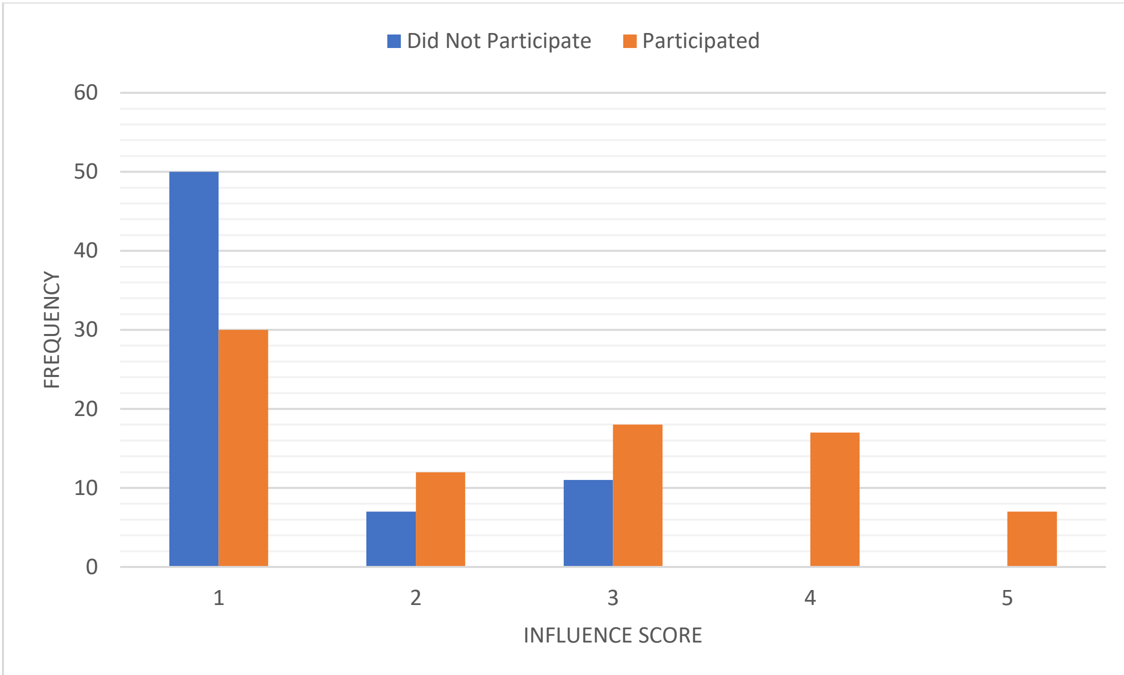

Figure 8: Cluster Bar Chart showing the Frequency Distribution across ratings for Hypothesis 2 grouping

The result of one-tailed Mann-Whitney U generated the following results. This test was followed by computing the rank-biserial correlation to compute the effect size represented by ‘r’

Mann-Whitney U = 1862.5

One-tailed p-value = <0.001

r = 0.328

Given the small p-value, we reject the null hypothesis and accept the alternative hypothesis. This indicates that there is a statistically significant difference in the influence scores on “High School General Curriculum” between individuals who did and who did not participate in STEM program(s) during their High School. From the properties Table 28, it indicates that participation in STEM program offered through semester programs during high school might have a role in influencing students toward a career in construction.

Hypothesis 3 (H3):

Students who participated in STEM program(s) during their middle school years consider "STEM/Construction electives" higher as an influence than those who didn't not participate.

Data was extracted from the survey and was categorized on the basis of those who participated in the STEM program(s) during their middle school years and those who did not participate, along with their corresponding rating for the "STEM/Construction Electives" as an influence to pursue a career in construction. Those who reported they were not offered STEM programs in their middle school were included in the group of who did not participate. The null hypothesis and alternative hypothesis were formulated, which are as follows:

Null Hypothesis (H_o) = The distribution of influence scores on "STEM/Construction Electives" between individuals who did and who did not participate in STEM program(s) during their middle school are identical.

Alternative Hypothesis (H_1) = The distribution of influence scores on "STEM/Construction Electives" between individuals who did and who did not participate in STEM program(s) during their middle school are not identical.

Properties Table:

Stats	Participated	Not Participated
Count	62	73
Mean	2.39	1.04
Median	2.0	1
Mode	1	1

Table 29: Descriptive table of distribution for hypothesis 3 grouping

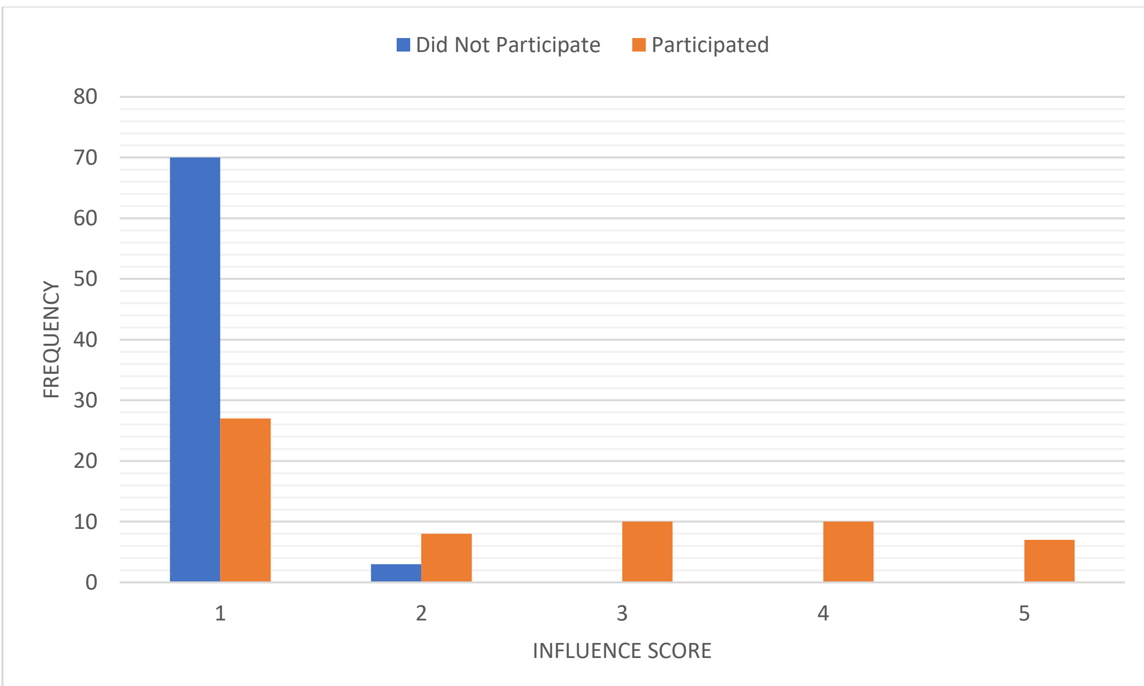

Figure 9: Cluster Bar Chart showing the Frequency Distribution across ratings for Hypothesis 3 grouping

The result of one-tailed Mann-Whitney U generated the following results. This test was followed by computing the rank-biserial correlation to compute the effect size represented by ‘r’

Mann-Whiteny U = 2068.0

p-value = 0.008

r = 0.20

Given the small p-value, we reject the null hypothesis and accept the alternative hypothesis. This indicates that there is a statistically significant difference in the influence scores on “STEM/Construction Electives” between individuals who did and who did not participate in STEM program(s) during their Middle School. From the properties Table 29, it indicates that participation in STEM or construction related program through electives programs during middle school might have a role in influencing students toward a career in construction.

Hypothesis 4 (H4):

Students who participated in STEM program(s) during their high school years rated “STEM/Construction electives” higher as an influence than those who didn’t not participate.

Data was extracted from the survey and was categorized on the basis of those who participated in the STEM program(s) during their high school years and those who did not participate, along with their corresponding rating for the “STEM/Construction Electives” as an influence to pursue a career in construction. Those who reported they were not offered STEM programs in their high school were included in the group of who did not participate. The null hypothesis and alternative hypothesis were formulated, which are as follows:

Null Hypothesis (H_o) = The distribution of influence scores on “STEM/Construction Electives” between individuals who did and who did not participate in STEM program(s) during their high school are identical.

Alternative Hypothesis (H_1) = The distribution of influence scores on “STEM/Construction Electives” between individuals who did and who did not participate in STEM program(s) during their high school are not identical.

Properties Table

Stats	**Participated**	**Not Participated**
Count	84	54
Mean	2.33	1.0
Median	1.0	1
Mode	1	1

Table 30: Descriptive table of distribution for hypothesis 4 grouping

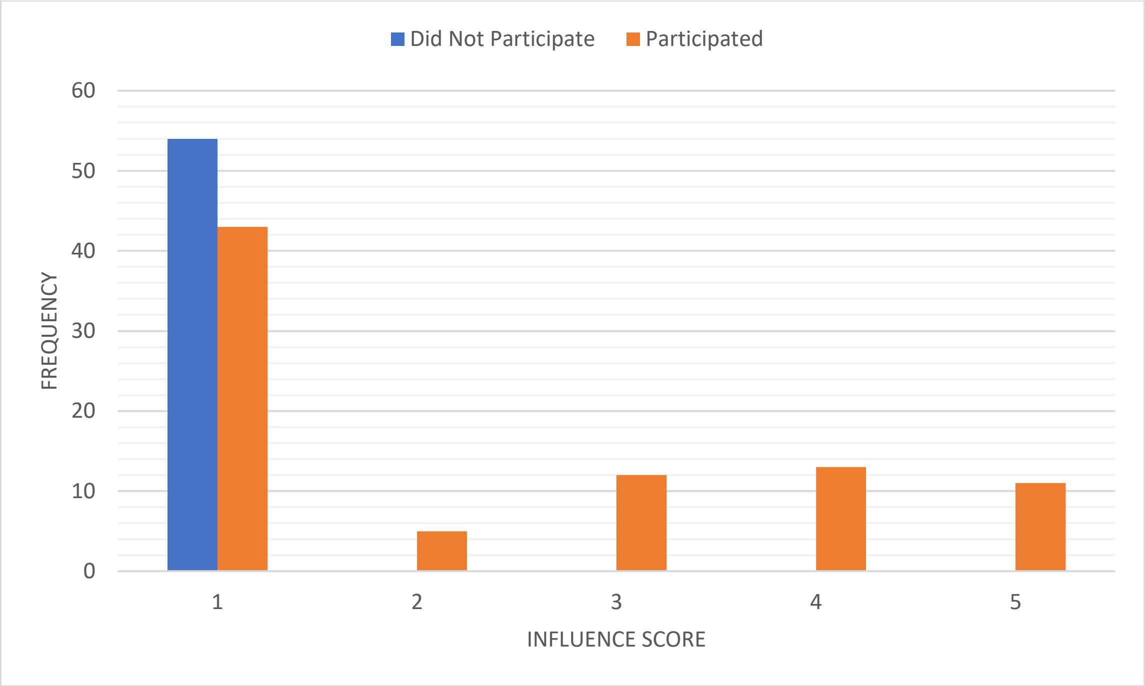

Figure 10: Cluster Bar Chart showing the Frequency Distribution across ratings for Hypothesis 4 grouping

The result of one-tailed Mann-Whitney U generated the following results. This test was followed by computing the rank-biserial correlation to compute the effect size represented by ‘r’

Mann-Whitney U = 1161.0

p-value = <0.001

r = 0.48

Given the small p-value, we reject the null hypothesis and accept the alternative hypothesis. This indicates that there is a statistically significant difference in the influence scores on “STEM/Construction Electives” between individuals who did and who did not participate in STEM program(s) during their High School. From the properties Table 30, it indicates that participation in STEM or construction related programs through electives programs during high school might have a role in influencing students toward a career in construction.

Hypothesis 5 (H5):

Students who participated in construction program(s) during their high school years consider "High School General Curriculum" higher as an influence than those who didn't not participate.

Data was extracted from the survey and was categorized on the basis of those who participated in at least one or more construction related programs during their middle school years and those who did not participate, along with their corresponding rating for the "High School General Curriculum" as an influence to pursue a career in construction. Those who reported they were not offered STEM programs in their middle school were included in the group of who did not participate. The null hypothesis and alternative hypothesis were formulated, which are as follows:

Null Hypothesis (H_o) = The distribution of influence scores on "High School General Curriculum" between individuals who participated in at least one or more construction related programs during their high school and did not participate in any are identical.

Alternative Hypothesis (H_1) = The distribution of influence scores on "High School General Curriculum" between individuals who participated in at least one or more construction related programs during their high school and did not participate in any are not identical.

Properties Table:

Stats	Participated	Not Participated
Count	56	96
Mean	2.70	1.63
Median	3.0	1
Mode	1	1

Table 31: Descriptive table of distribution for hypothesis 5 grouping

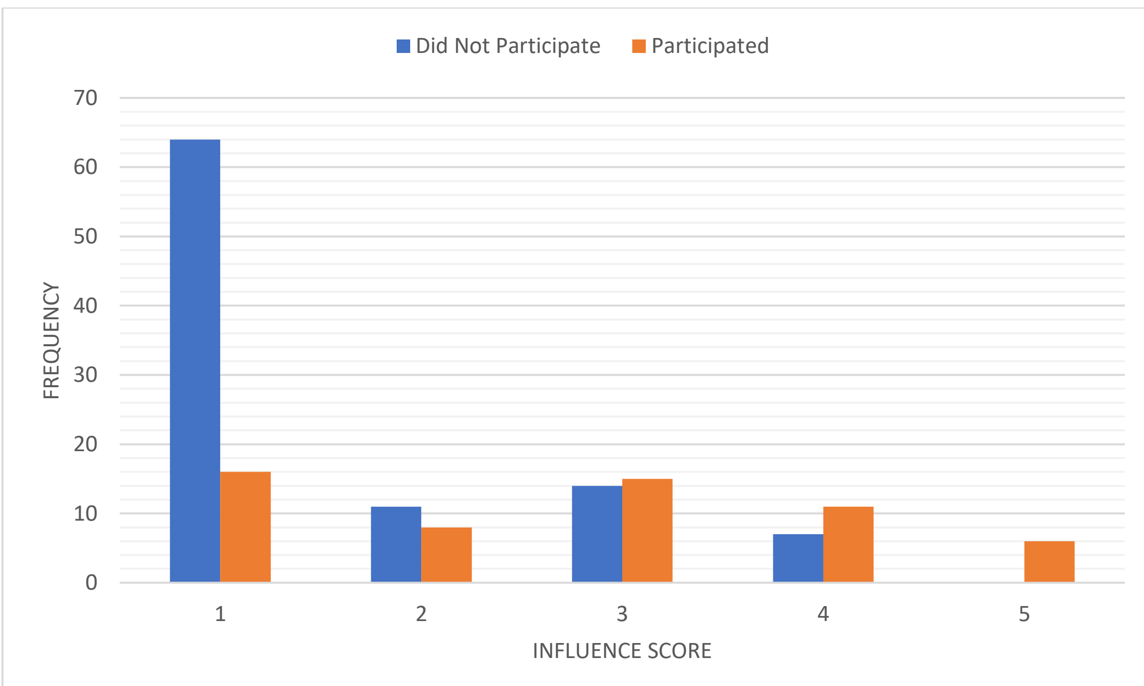

Figure 11: Cluster Bar Chart showing the Frequency Distribution across ratings for Hypothesis 1 grouping

The result of one-tailed Mann-Whitney U generated the following results. This test was followed by computing the rank-biserial correlation to compute the effect size represented by ‘r’.

Mann-Whitney U = 1484.5

One-tailed p-value = <0.001

r = 0.448

Given the small p-value, we reject the null hypothesis and accept the alternative hypothesis. This indicates that there is a statistically significant difference in the influence scores on "High School General Curriculum" between individuals who participated in at least one or more construction related programs during their high school and did not participate in any. From the properties Table 31, it indicates that participation in construction related program(s) through high school semester program during high school might have a role in influencing students toward a career in construction.

Hypothesis 6 (H6):

Students who participated in at least one or more construction programs during their high school years consider "STEM/Construction Electives" higher as an influence than those who did not participate.

Data was extracted from the survey and was categorized on the basis of those who participated in at least one or more construction related programs during their middle school years and those who did not participate, along with their corresponding rating for the "STEM/Construction" as an influence to pursue a career in construction. Those who reported they were not offered STEM programs in their middle school were included in the group of who did not participate. The null hypothesis and alternative hypotheses were formulated, which are as follows:

Null Hypothesis (H_o) = The distribution of influence scores on "STEM/Construction Electives" between individuals who participated in at least one or more construction related programs during their high school and did not participate in any are identical.

Alternative Hypothesis (H_1) = The distribution of influence scores on "STEM/Construction Electives" between individuals who participated in at least one or more construction related programs during their high school and did not participate in any are not identical.

Properties Table:

Stats	**Participated**	**Not Participated**
Count	56	77
Mean	2.75	1.0
Median	3.0	1
Mode	1	1

Table 32: Descriptive table of distribution for hypothesis 6 grouping

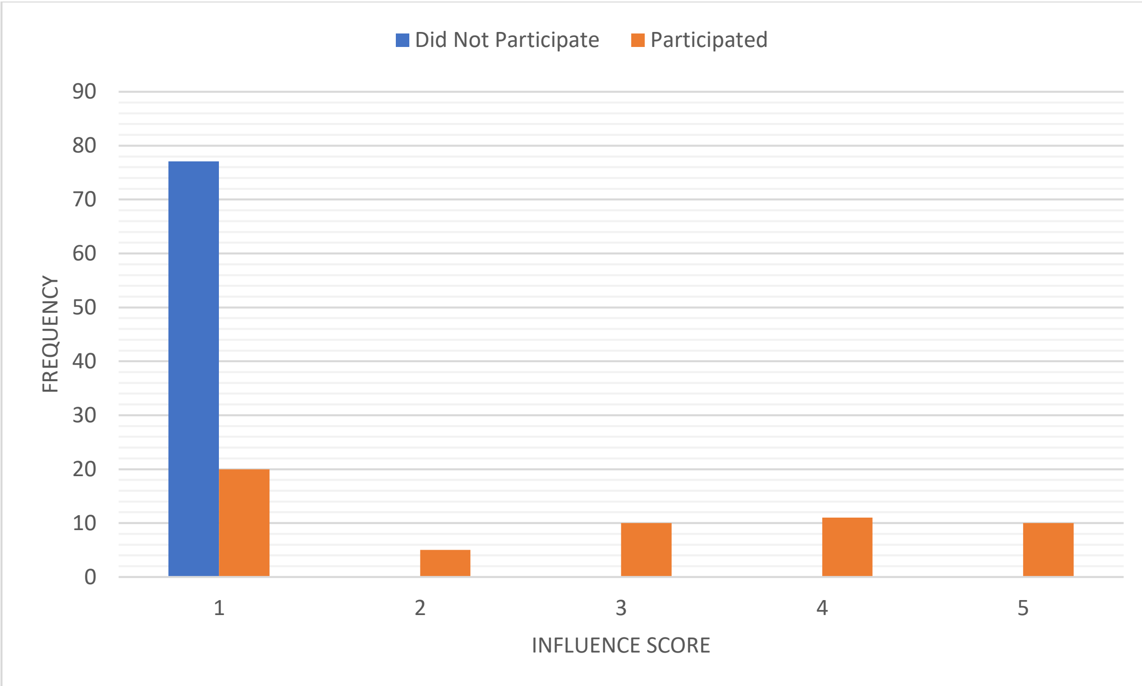

Figure 12: Cluster Bar Chart showing the Frequency Distribution across ratings for Hypothesis 6 grouping

The result of one-tailed Mann-Whitney U generated the following results. This test was followed by computing the rank-biserial correlation to compute the effect size represented by ‘r’.

Mann-Whitney U = 770.0

One-tailed p-value = <0.001

r = 0.643

Given the small p-value, we reject the null hypothesis and accept the alternative hypothesis. This indicates that there is a statistically significant difference in the influence scores on “STEM/Construction Electives” between individuals who participated in at least one or more construction related programs during their high school and did not participate in any. From the properties Table 32, it indicates that participation in construction related program(s) through offered electives during high school might have a role in influencing students toward a career in construction.

Exploratory Analysis of Influencing Factors

To gain a broader understanding of the various factors that influenced Gen Z undergraduate students to pursue a career in construction, the study conducted an exploratory analysis of other factors that come into play.

Part 1:

There were 16 factors pulled from the literature review (Table 1), which were presented to the respondents of the survey to rate each factor through a Likert-scale from 1-5, where 1 being not influential and 5 being the most influential factor to drive them to pursue a career in construction. The following subsections present the results from the analysis of the data from the Likert-scale. The analysis provides insights into the perceived influence of various factors on individuals' decision to pursue a career in construction.

Descriptive Analysis

In examining the factors that influenced the Gen Z students currently enrolled in construction related programs, the central tendencies like mean, median and mode were utilized to gather the insights. A 1.5 IQR method was employed to remove the outliers if any. Table 33 provides the Mean, Median and Mode ratings across each factor. Career related factors such as “Job variety/diversity”, “Opportunities to work outside the office”, “Technical Skills required in the Industry”, “Possibility to be promoted quickly”, and “High Starting Salary” were observed to have a higher median and mode ratings. It is followed by Family and Background related factors were rated moderately. Formative education and schooling related factors observed the least of the ratings.

Factors	Sample Size	Mean	Median	Mode
Job Variety/Diversity	156	3.95	4	5
Opportunities to Work Outside an Office	156	3.87	4	5
High Starting Salary	156	3.67	4	5
Possibility to be Promoted Quickly	156	3.52	4	4
Technical Skills Required in the Industry	156	3.39	4	5
Advise from Family Member	156	3.26	3	5
Toys (e.g., Legos, Kinex, etc.)	156	2.92	3	1
Family Business/ Grew up in Construction	156	2.56	4	1
Video Games (e.g., Minecraft)	156	2.15	1	1
Teacher Impression	156	2.14	1	1
High School General Curriculum	156	2.10	1	1
STEM/Construction Elective	156	2.00	1	1
Middle School General Curriculum	147	1.39	1	1
Guidance Counselor	145	1.39	1	1
STEM/Construction After School Program	138	1.22	1	1
STEM/Construction Summer Camp	130	1.00	1	1

Table 33: Descriptive table for factors rated through Likert-scale

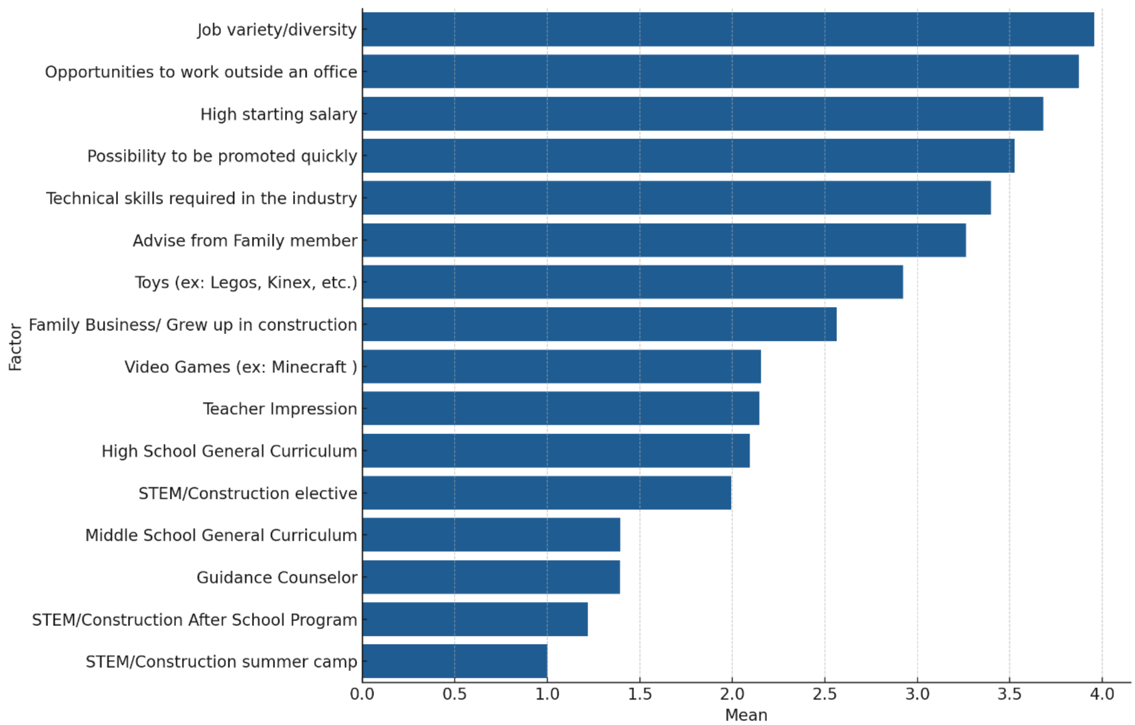

Figure 13: Bar chart showing the mean distribution across different factors

Breakdown By Demographics

Gender

The Mann-Whitney U test was utilized to assess the gender-based perception differences in factors that influenced them to pursue a career in construction. A total response of 156, with 122 male responses and 34 female responses were extracted along with their corresponding rating of each factor. 1.5 IQR method was used to remove the outlier if any. The data was loaded into the SPSS software to perform the test. Table 34 shows the results obtained from the test. To account for the risk of Type 1 errors associated with multiple factors comparisons, a Bonferroni correction was applied to set a more stricter significance level. Bonferroni Corrected Alpha calculated as $\alpha =$ 0.05/(Number of comparisons), with gives the adjusted $\alpha = 0.0031$.

Post correction, three factors were observed to show statistically significant differences between genders:

Technical Skills required in the industry ($U=1101.50$, $p = <0.001$); Toys (eg., Legos, Kinex) ($U= 1379.00$, $p = 0.002$), and Opportunity to work outside an office ($U= 995.50$, $p<0.01$).

Factors	# of Male	# of Female	U-statistics	p-value
Middle School General Curriculum	116	31	1774.00	0.884
High School General Curriculum	122	34	2045.00	0.893
STEM/Construction After School Program	106	28	1232.00	0.02
STEM/Construction Summer Camp	103	27	1390.5	1.00
STEM/Construction Elective	122	34	1896.00	0.380
Family Business/ Grew up in Construction	122	34	2067.50	0.976
Advise from Family Member	122	34	1986.50	0.700
Guidance Counselor	112	28	1320.00	0.075
Teacher Impression	122	34	2033.00	0.848
Toys (e.g., Legos, Kinex, etc.)	122	34	1379.00	0.002
Video Games (e.g., Minecraft)	122	31	1338.50	0.006
Opportunities to Work Outside an Office	106	34	995.50	<0.001
High Starting Salary	122	34	1839.00	0.295
Possibility to be Promoted Quickly	122	34	1940.00	0.553
Technical Skills Required in the Industry	122	34	1101.50	<0.001
Job Variety/Diversity	122	34	1922.00	0.491

Table 34: One-tailed Mann Whitney U test result for group by gender

Part 2

There was a separate question included in the survey to select one factor in their opinion, which was the most influential for them to choose construction industry.

Descriptive Analysis

In examining the response for the most significant factor that influenced the respondents to pursue a career in construction, 156 samples were analyzed through descriptive analysis. The results reveal that ‘Family’ was the most frequently chosen factor, with 41% of respondents choosing it as their primary influence in their decision to pursue a career in construction. It was followed by the ‘Number of Opportunities the Field Offers’, which was selected by 22.4% of the respondents. Similarly, ‘Aptitude in the Industry’ was also a noteworthy factor with 14.1% of respondents recognizing it as the primary factor. In contrast, similar to the results obtained through Likert-scale in part 1, Formative education and schooling factors displayed a low frequency of respondent recognizing them as a key motivator. Table 35 shows the frequency and percentage distribution of responses across all factors.

Factors	# of Respondents (n= 156)	% of Respondents
Family	64	41%
Number of Opportunities the field offer	35	22.4%
Aptitude in the Industry	22	14.1%
Friends	16	10.3%
Toys, video games, etc. growing up	9	5.8%
Teachers	6	3.8%
Related Subject in Middle/High School	3	1.9%
After School or Summer Camp Programs	1	0.6%

Table 35: Distribution of selection for most influential factor to pursue a career in construction

Breakdown by Program Participation in High School

The respondents were divided into three categories: those who participated in Constructions program(s); who participated in other STEM programs but no construction program(s); and who did not participate in STEM/Construction programs in high school at all. For all three categories, it was observed that Family was the predominant pick. It was followed by the career prospect factor ‘Number of Opportunities the field offers’ with approximately one-fifth of respondents in each group selecting it. It is noteworthy that formative education related factors were the lease selected factors in all three groups, with very small percentage of participants who participated in Construction programs in high school selecting it. Table 36 shows the distribution of the respondents into three categories, and the factors they selected as the most influential for their career decision in construction.

Factors	Construction Program Participants (n = 56)	STEM programs participants but no Construction Related (n= 27)	No Participation in STEM/Construction Programs (n = 73)
Family	19 (33.92%)	15 (55.56%)	30 (41.09%)
Number of Opportunities the field offer	13 (23.21%)	5 (18.52%)	17 (23.29%)
Aptitude in the Industry	9 (16.07%)	1 (3.70%)	12 (16.44%)
Friends	5 (8.92%)	2 (7.41%)	9 (12.32%)
Toys, video games, etc. growing up	5 (8.92%)	1 (3.70%)	3 (4.11%)
Teachers	1 (1.79%)	3 (11.11%)	2 (2.74%)
Related Subject in Middle/High School	3 (5.35%)	0 (0.00%)	0 (0.00%)
After School or Summer Camp Programs	1 (1.78%)	0 (0.00%)	0 (0.00%)

Table 36: Comparison of factors selected grouped by program participation in high school

Demographic Breakdown

Gender

The study further examined the distinctions between male and female respondents in terms of the factors that influenced them to pursue a career in construction. A total sample of 156 respondents, with 122 male responses and 34 female response was considered for the analysis. The analysis indicated that for both male and female respondents, ‘Family’ was the most selected factor influencing their career choice to join construction industry, with 39.3% male and 47.1% female respondents. The result from the general analysis, Table 35, almost echoed in the gender breakdown, with career related choices having a moderate response and formative education and schooling at the bottom for both genders. Table 37 shows the frequency and percentage distribution across all factors according to gender.

STEM Programs Offered	Male		Female	
	# of Respondents (n = 122)	% of Respondents	# of Respondents (n = 34)	% of Respondents
Family	48	39.3%	16	47.1%
Number of Opportunities the field offer	30	24.6%	5	14.7%
Aptitude in the Industry	15	12.3%	7	20.6%
Friends	14	11.5%	2	5.9%
Toys, video games, etc. growing up	8	6.6%	1	2.9%
Teachers	5	4.1%	1	2.9%
Related Subject in Middle/High School	1	0.8%	2	5.9%
After School or Summer Camp Programs	1	0.8%	0	0.0%

Table 37: Comparison of most influential factor selected according to gender

Discussion

This study aimed to evaluate the factors that influenced Gen Z undergraduate students currently enrolled in construction-related programs nationwide to pursue a career in construction. This was a retrospective study targeting the experiential insights from the participants. The study used the survey-based methodologies to collect insights from students who had already made the decision to join the construction industry, focusing to yield insights that are based on actual experience.

Influence of Formative Education

One of the main focus areas of this study was to examine whether students who had previously participated in STEM and construction related programs during their middle and high school years consider these experiences as higher on influential scale, compared to the students who did not participate in such programs, as a factor to pursue a career in construction. It was found that students who engaged in such programs, typically available as a part of semester curriculum or elective course, as observed from previous study, were indeed more likely to consider these experience higher as an influence than those who did not participate. This indicates that engagement to STEM and construction related opportunities during formative education can play its part in influencing students to pursue a career in construction. It also emphasizes the relevance of such educational frameworks in students' career development. Furthermore, this suggests that early targeted education interventions can contribute tracing career trajectories of students.

However, when the analysis was expanded to include a broader spectrum of potential influences that included career prospect, social background factors alongside educational experiences, formative education and schooling did not emerge as the significant factor. While it was observed that educational experiences might have a role in fostering specific interest in career decision making, their relative weight was observed to be low when viewed in a boarder spectrum of factors.

Family Influence and Career Prospect

The findings from part 2 analysis underscored the preeminence of family influence with the factor identified by 41% of the respondents as the most influential factor to pursue a career in construction. This was echoed in all two of the demographics breakdown as well-- gender and income level. According to the Social Cognitive career theory (SCCT), learning experiences and self-efficacy from familial interactions play a critical role in career development (Bandura, 1997). The role of family in career-related choices behavior has been studied by Ferry et al. (2000) and found out that family plays a significant influence. This was reflected in the findings of the study, underscoring the importance of socialization process in career choices.

Similarly, from the findings of part 1 through Likert-scale, factors pertaining to career prospect such as “Job variety/diversity”, “Opportunities to work outside the office”, “Technical Skills required in the Industry”, “Possibility to be promoted quickly”, and “High Starting Salary” resonated strongly with respondents. This is indicative of a pragmatic approach by Gen Z, valuing immediate and clear career benefits (Barhate &

Dirani, 2022). Furthermore, the significance of ‘Number of Opportunities the Field Offers’ as recognized by 22.4% of the respondents indicates the students’ notion of the construction industry as having an eclectic career opportunity and offers an attractive paycheck to lure them to the career in construction.

It is noteworthy to discuss that the result part 1 Likert-scale highlighted factors related to career prospect as the most significant factors to influence students to pursue a career in construction; however, the result from part 2 analysis where respondents were asked to select one factor which they recognize as the most influential factor, family emerged out to the most significant factor. This apparent contradiction may not necessarily be a reflection of the conflicting data, but rather indication of the layered dimensions of the influence. The Likert-scale responses captured a broad assessment of the various factors that influenced them to pursue a career in construction. In doing so, this format encourages a more analytical and detached mode of thinking where respondents are more likely to consider their overall perception of the industry. However, direct questions like selecting one option are more likely to elicit a more reflexive and personal insights, which might have driven majority of the respondents to choose social influences like such as Family.

Conclusion

This retrospective study evaluates the various factors that influenced Gen Z undergraduate students currently enrolled in construction related programs to pursue a career in construction. Through survey, it was found that students who participated in STEM and construction related programs during their formative middle and high school years rated these experiences higher as the factors that influenced them to pursue a career in construction than the students who did not participate in such programs. However, the exploratory analysis of the factors in a broader scale inclusive of career prospect, social influence, and educational exposure outweighed the educational exposures to the overarching family and career prospect influences. The study further revealed nuanced differences in the factors influencing male and female students, where it was found that factors such as 'Technical Skill required in the industry', 'Opportunities to work outside of and office', and childhood influences such as playing with Toys like Legos and Kinex were significantly stronger to male than female. Similarly, in the income division, it was found that there was a difference in perspective to the factor 'Technical skills needed for the industry' between low income and high-income group.

The insights obtained from the study indicate the pathway for the industry representatives to attract more new generations of students towards the construction industry. Key among the priorities is the major role of family influence, which possibly emanates from the deeply rooted in familial ties and the legacy of construction within the family. Similarly, the result showing career prospects as another key priority indicates that Gen Zs are more future oriented. Therefore, the construction industry must clearly convey the economic trajectory and long-term benefits associated with the career in construction. The construction sector is called upon to innovate its recruitment and educational approach in such a way that it boasts comprehensive strategies that put emphasis on family and career prospective at the forefront.

CHAPTER FIVE

CONCLUSION

Limitation of the Study

This study had several limitations. First, the study relies on the self-reported data from Gen Z undergraduate students enrolled in construction related programs nationwide. This may cause the response to be biased or ignorant which might affect the preciseness of the findings. Additionally, the survey was based on the college students who already joined the construction career, this could cause a bias in the response as these students might have exposure to the industry through internships and have learned about the career prospect of the construction industry, which could influence their response to the survey. This biased could have been neutralized if the survey was only conducted with freshmen students as opposed to the survey approach including students from all years.

The cross-sectional nature of the survey focusing on the Gen Z students that captures a snapshot of time may not be reflective to the evolution of students' perceptions over a longer period. The limited number of responses may impact the generalization of the findings including in the demographic breakdown, as it may not represent the broader population, therefore, increasing the risk of swayed accuracy. Continuing to the limitation of the responses, the study's demographic composition, with a majority of male responses, which reflects the existing gender disparity in the construction industry, also impacts the study by limiting the generalization of findings across genders.

Future Research

The findings from this study lay a foundation for several future studies. This study observed that certain STEM and construction curriculum in school were impactful to an extent to influence students to pursue a career in construction. However, the formative education was not found to be as impactful as other factors such as familial background and career prospect the industry offers. This opens the avenue to study how the school curriculum can be made more impactful. Along the lines of this, a future study could assess the role of technology and digital media considering the influence of modern tools to ignite interest in the construction field. This could provide a critical insight on making intervention programs effective to pull students' interest towards construction.

Similarly, this study was deprived of diverse participant pool as the study relied on the response of college students pursuing construction programs. Including those from different educational backgrounds and those who chose alternate career path could provide a more holistic view of the factors influencing career decision to pursue construction. Furthermore, more granular analysis diving into the depth of how factors such as gender, ethnicity, socio-economic status influence students' career trajectories in construction could provide a clear understanding of these crucial influencing elements.

Conclusion

The first study revealed that middle and high school provides an eclectic exposure to STEM disciplines. These STEM programs are mostly offered through semester curricula and through offered electives. Mathematics and Statistics was found out to be the central pillars of STEM participation, emphasizing their foundational interdisciplinary importance in these STEM disciplines. The progression of students from middle school to high school showed the increased participation of students in construction related programs. Similarly, the second study expanded the investigation to include a broader spectrum of influence beyond formal education. It was observed that while formative middle and high school education plays a role in tracing trajectories towards construction career, it is the factor like family influence and perceived career benefits outweigh the educational exposures to motivate students to join a career in construction. The intervention aiming to attract more students to the construction industry must address the personal and practical considerations alongside the academic offerings.

Two studies altogether call out for a holistic approach to attracting and preparing the next generation for the construction industry. It is undeniable that educational exposure plays a significant role driving students toward a career in construction. However, there is an indication that these exposures should be complimented by efforts to embrace social influence and provide mentorship and guidance that align with students' personal career aspiration and realities of the industry. By addressing the multifaceted layer of influence that impacts students career choices in construction, academia and industry stakeholders can more efficiently construct the pipeline for the emerging workforce towards the construction industry—potentially filling the workforce shortage the construction industry in facing at this time.

APPENDICES

Appendix A

Survey Questionnaires

Consent Form

Factors Impacting Career Choice to Join the Construction Industry

Jason Lucas, PhD is inviting you to volunteer for a research study. Dr. Lucas is an Associate Professor at Clemson University conducting the study with Dr. Dhaval Gajjar and Bishesh Bharadwaj, Masters Student.

Study Purpose: The purpose of this research is to understand the secondary education background of undergraduate students and what influenced their decision to enter the construction industry. Voluntary Consent: Participation is voluntary, and you have the option to not participate.

Activities and Procedures: Your part in the study will be to answer a brief questionnaire administered through Qualtrics. Participation Time: It will take you about five (5) minutes to complete the survey. Risks and Discomforts: We do not know of any risks or discomforts to you in this research study. Possible Benefits: You may not benefit directly from taking part in this study, however, it provides a better understanding of what influences students in taking construction which in turn will help to target specific educational and recruitment activities for the industry to help grow interest in getting more people into the construction fields.

PROTECTION OF PRIVACY AND CONFIDENTIALITY: The results of this study may be published in scientific journals, professional publications, or educational presentations. The information collected during the study could be used for future research studies or distributed to another investigator for future research studies without additional informed consent from the participants or legally authorized representatives. No identifiable information will be collected during the study or on the research study instruments.

CONTACT INFORMATION: If you have any questions or concerns about your rights in this research study, please contact the Clemson University Office of Research Compliance (ORC) at 864-656-0636 or irb@clemson.edu. The Clemson IRB will not be able to answer some study-specific questions. However, you may contact the Clemson IRB if the research staff cannot be reached or if you wish to speak with someone other than the research staff. If you have any study-related questions or if any problems arise, please contact Bishesh Bharadwaj at bbharad@g.clemson.edu.

CONSENT: By participating in the study, you indicate that you have read the information written above, have been allowed to ask any questions, and you are voluntarily choosing to take part in this research. You do not give up any legal rights by participating in this research study. By continuing in this survey, you consent to participate in this study.

Do you consent to take participate in this study by completing this survey?

- ○ Yes
- ○ No

Education Background

What is your current program level?

- ○ Freshman
- ○ Sophomore
- ○ Junior
- ○ Senior
- ○ Post-Bachelor

What is your date of birth (MM/DD/YYYY)

[ ]

Please specify your gender.

- ○ Male
- ○ Female
- ○ Prefer not to answer

What ethnicity do you best identify as?

- ○ Hispanic
- ○ White, non-Hispanic
- ○ Black or African American
- ○ American Indian or Alaska Native
- ○ Asian
- ○ Native Hawaiian and Other Pacific Islander
- ○ Some Other Race, non-Hispanic
- ○ Multiracial
- ○ choose not to answer

What is the name of the city and state of your high-school that you attended "majority" of the time?

[ ]

What was the ZIP Code of your high-school that you attended "majority" of the time?

[ ]

Approximately how many students were in your graduating class?

[ ]

What was the type of high-school that you primarily attended?

- ○ Public School Title 1 (General Curriculum only)
- ○ Public School Non- Title 1 (General Curriculum only)
- ○ Public School with Specialty/Technical Curriculum or Career Technology Center
- ○ Private School (General Curriculum only)
- ○ Private School with Specialty/Technical Curriculum or Career Technology Center
- ○ Charter School (General Curriculum only)
- ○ Charter School with Specialty/Technical Curriculum
- ○ [ ] Other

Please specify any type of specialty/technical curriculum that was offered in your high-school. (select all that apply)

- ☐ Construction and Engineering Related
- ☐ Construction Trade Related
- ☐ Information Technology Related
- ☐ Computer Science and Engineering Related
- ☐ Electrical/Electronics Engineering Related
- ☐ Mechanical Engineering Related
- ☐ Mathematics and Statistics Related
- ☐ Physical Science Related
- ☐ Biological and Biomedical Science Related
- ☐ Engineering Design

☐ Design and Creativity (ex: architecture)
☐ Design and Modeling (ex: BIM, 3D Printing, etc.)
☐ ____ Others (please specify)

Please specify any type of specialty/technical curriculum that you participated in your high-school. (select all that apply)

☐ Construction and Engineering Related
☐ Construction Trade Related
☐ Information Technology Related
☐ Computer Science and Engineering Related
☐ Electrical/Electronics Engineering Related
☐ Mechanical Engineering Related
☐ Mathematics and Statistics Related
☐ Physical Science Related
☐ Biological and Biomedical Science Related
☐ Engineering Design
☐ Design and Creativity (ex: architecture)
☐ Design and Modeling (ex: BIM, 3D Printing, etc.)
☐ ____ Others (please specify)
☐ None

Did the Middle School you attended have STEM-specific programs? (select all that apply)

☐ Yes - Through Semester Curriculum
☐ Yes - Through offered Electives
☐ Yes - With after school programs
☐ Yes - Summer Camps
☐ ____ Yes, Others (please specify)
☐ No

Did you participate in any of these programs during middle school?

○ Yes
○ No

Which program(s) did you participate in during middle school? (select all that apply)

☐ Construction and Engineering Related
☐ Construction Trade Related
☐ Information Technology Related
☐ Computer Science and Engineering Related
☐ Electrical/Electronics Engineering Related
☐ Mechanical Engineering Related
☐ Mathematics and Statistics Related
☐ Physical Science Related
☐ Biological and Biomedical Science Related
☐ Engineering Design
☐ Design and Creativity (ex: architecture)
☐ Design and Modeling (ex: BIM, 3D Printing)
☐ ____ Others (please specify)

Did the High School you attended have STEM-specific programs? (select all that apply)

☐ Yes - Through Semester Curriculum
☐ Yes - Through offered Electives
☐ Yes - With after school programs
☐ Yes - Summer Camps
☐ ____ Yes, Others (please specify)
☐ No

Did you participate in any of these programs in high school?

○ Yes
○ No

Which program(s) did you participate in during high school? (select all that apply)

☐ Construction Science and Engineering Related
☐ Construction Trade Related
☐ Information Technology Related
☐ Computer Science and Engineering Related
☐ Electrical/Electronics Engineering Related
☐ Mechanical Engineering Related
☐ Mathematics and Statistics Related
☐ Physical Science Related
☐ Biological and Biomedical Science Related
☐ Engineering and Design
☐ Design and Creativity (ex: architecture)
☐ Design and Modeling (ex: BIM, 3D Printing)
☐ ____ Others (please specify)

On a scale of 1 to 5, 5 being the most significant influence, to what extent did the following factors influence your decision to enter a career in construction?

	1	2	3	4	5
Middle School General Curriculum	○	○	○	○	○
High School General Curriculum	○	○	○	○	○
STEM/Construction After School Program	○	○	○	○	○
STEM/Construction summer camp	○	○	○	○	○
STEM/Construction elective	○	○	○	○	○
Family Business/ Grew up in construction	○	○	○	○	○
Advise from Family member	○	○	○	○	○
Guidance Counselor	○	○	○	○	○
Teacher Impression	○	○	○	○	○
Toys (ex: Legos, Kinex, etc.)	○	○	○	○	○
Video Games (ex: Minecraft)	○	○	○	○	○
Opportunities to work outside an office	○	○	○	○	○
High starting salary	○	○	○	○	○
Possibility to be promoted quickly	○	○	○	○	○
Technical skills required in the industry	○	○	○	○	○
Job variety/diversity	○	○	○	○	○

In your opinion, who/what prompted you the most to pursue a career in construction?

- ○ Family
- ○ Friends
- ○ Teacher
- ○ Guidance Counselor
- ○ Related Subject in Middle School / High School
- ○ After school or summer camp program
- ○ Toys, video games, etc. growing up
- ○ Aptitude in the industry
- ○ The number of opportunities the field offer
- ○ [ ] Other (please specify)

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