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# Immediate Impacts of Informal Learning Intervention on High School Students' Career Attitude toward Construction by Gender

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## Abstract

The construction industry is facing a growing workforce shortage, further exacerbated by the underrepresentation of women. This shortage highlights the urgent need to recruit younger generations into construction careers while also promoting gender diversity. To address this issue, informal learning interventions, such as summer programs, offer unique opportunities to shape the career interests and aspirations of high school students. However, limited research has explored how such informal learning experiences can influence career development in the construction field, particularly in relation to gender differences. This study aims to examine the immediate effects of a two-week construction-focused summer program, which significantly integrates counter-stereotypical components, on high school students' career attitudes toward construction, employing a modified Social Cognitive Career Theory (SCCT) framework. The SCCT model in this research incorporates four key constructs, namely self-efficacy, outcome expectations, vocational interests, and career choice goals. It also accounts for the influence of personal demographics (e.g., age, gender, background) and contextual factors (e.g., family support, school influence). With a particular emphasis on gender differences, this study investigates how participation in such a program affects students' self-efficacy, outcome expectations, career interests and choice goals in construction fields. It also analyzes how students reacted to the integration of counter-stereotypical components in the program. Quantitative data was collected through pre- and post-program surveys assessing the four main variables from the SCCT model, as well as demographic information and contextual factors, such as parental support and school influence. Comparisons of pre- and post-program data indicated minimal overall changes in self-efficacy, outcome expectations, vocational interests, and career choice goals, with no statistically significant differences observed. Correlation analysis revealed vocational interests emerged as a significant predictor of career choice goals. Gender-specific analyses highlighted notable differences, where males exhibiting strong alignment between self-efficacy, outcome expectations, and career choice goals, while females showed strong relationships between self-efficacy and vocational interests but weaker or negative associations between other variables. These results suggest that the program may require further tailoring to address the unique needs and challenges faced by female students. Limitations of the study include a small sample size and an unbalanced gender distribution, which potentially influence the results and reduce statistical power. Future research should aim to recruit larger and more balanced samples to provide a more robust understanding of the impacts of informal learning interventions. The significance of this study for the construction education community is notable. By examining the impact of informal educational interventions on students' career attitudes, especially in underrepresented groups, this research offers critical knowledge for educators

aiming to tackle labor shortages and enhance gender inclusivity in construction fields. The findings will be instrumental in designing gender-responsive programs that motivate students of all genders to explore professions in construction, ultimately fostering diversity and sustainability in the construction workforce.
Keywords: Construction Education, Gender Diversity, Informal Learning, Summer program, Social Cognitive Career Theory (SCCT), K12 Education, Career Development

## 1. Introduction

The construction industry remains a critical driver of economic development worldwide, particularly in the United States, where there is a robust demand for construction workers [1]. However, it is currently faces a severe workforce shortage - particularly in construction management (CM) - as seasoned professionals retire and fewer young generations enter the field [2]. Compounding these challenges is the persistent underrepresentation of women in construction, further limiting the talent pool [3]. To address both the labor shortage and gender imbalance and ensure the industry's sustainability and growth, it is imperative to attract the younger generation at an early stage and provide them with an enriched learning experience that can spark their interest in CM careers [4].

One promising strategy for recruiting new generations of workers and promoting gender diversity involves the use of informal learning interventions, such as summer programs and workshops, to spark high school students' interests in construction careers [5]. In contrast to traditional learning methods, informal learning offers a flexible, interactive environment where learners can freely explore and absorb information at their own pace [6], [7], [8]. Through informal learning, individuals acquire knowledge organically, often in real-world contexts that enhance retention and applicability [9]. However, the existing literature specifically examining their impact on high school students' construction-related career development remains limited. Furthermore, there is a need for deeper insights into how gender influences the ways in which these construction-focused programs can cultivate positive attitudes toward construction fields and mitigate stereotypes and attract more diverse students [10].

To address these gaps, this study applies a modified Social Cognitive Career Theory (SCCT) framework [11], [12], emphasizing on four primary constructs: self-efficacy (i.e., beliefs in one's ability to successfully complete specific tasks), outcome expectations (i.e., beliefs about the consequences of performing tasks required for success), vocational interests, and career choice goals. Self-efficacy plays a crucial role in motivating individuals to engage with and persist in pursuits related to their careers [13]. Vocational interests reflect the patterns of likes, dislikes, and preferences toward specific career domains, while career choice goals pertain to individuals' aspirations and intentions to pursue specific career paths [13]. SCCT provides a comprehensive framework for understanding how personal and environmental factors jointly

influence career development. The theory emphasizes that personal factors (e.g., demographics, gender) and contextual elements (e.g., parental support, school influence) collectively shape career paths [11], [12], [13], [14]. This integrative approach allows for a nuanced exploration of how various influences intersect to guide career decision-making processes, particularly in fields where certain groups, such as women in construction, remain underrepresented.

Understanding the impact of counter-stereotypical activities on students, particularly female students, is of great theoretical and practical importance due to the potential influence of gender bias and stereotypical views on construction work on self-efficacy and vocational interests [15]. For instance, stereotypes that depict construction industry as physically strenuous and predominantly male can dissuade female students from viewing it as a feasible career path [16]. These stereotypes not only diminish confidence in one's ability to succeed in construction-related tasks but also weaken interest in exploring such careers altogether. Counter-stereotypical activities - such as highlighting successful female professionals in construction, promoting collaborative and creative problem-solving tasks, and emphasizing the diverse skill sets required for modern construction careers - have the potential to challenge these biases [17].

Accordingly, this study examines how a two-week construction-focused summer program structured with counter-stereotypical elements impacts high school students' self-efficacy, outcome expectations, vocational interests, and career choice goals in construction fields. It also investigates whether and how gender moderates these relationships. In line with SCCT, there are two research questions and five hypotheses in this study:

- How does a two-week construction-focused summer program affect high school students' self-efficacy, outcome expectations, vocational interests, and career choice goals in the construction field?
- Whether and to what extent does gender moderate the relationships among self-efficacy, outcome expectations, vocational interests, and career choice goals after participating in the construction-focused summer program?
- H1: Participation in the construction-focused summer program will increase students' self-efficacy related to the construction field.
- H2: Participation in the construction-focused summer program will increase students' outcome expectations related to the construction field.
- H3: Participation in the construction-focused summer program will increase students' vocational interests related to the construction field.
- H4: Participation in the construction-focused summer program will increase students' career choice goals related to the construction field.
- H5: The relationships among self-efficacy, outcome expectations, vocational interests, and career choice goals after participating in the construction-focused summer program will vary by gender.

Given the scarcity of empirical work targeting these specific constructs within a construction context, these hypotheses contribute to a deeper understanding of how informal learning intervention can address the pressing labor shortage while promoting gender diversity.

## 2. Methods

To test the hypotheses, this study employed a pre-post design to assess high school students' self-efficacy, outcome expectations, vocational interests, and career choice goals in construction fields before and after the summer program. A total of 24 high school students participated in the program, 18 of whom were males. All participants completed the pre-program surveys, and 19 students completed the post-program surveys. The study encompassed the assessment of four SCCT constructs through both pre and post surveys utilizing a 5 Likert-scale. Self-efficacy was evaluated comprising 14 items gauging the level of agreement with statements like "Construction education is within the scope of my abilities." Outcome expectations were assessed through 10 items, including statements like "Graduating with a BS degree in a construction educational program will likely allow me to receive a good job offer." Vocational interests and career choice goals were evaluated through 3 and 4 items respectively. Furthermore, the pre-survey also included the collection of data pertaining to personal demographics, parental influences, and school influences.

Paired analysis was used to test the first four hypotheses as it detects pre-post changes while controlling for individual variability [18]. Correlation analysis was utilized to identify whether there were associations among these four constructs in both pre-and post-program. A gender-specific analysis was also conducted to investigate whether there were moderation effects of gender on four SCCT constructs. The data analysis process included the following steps: checking participant matching, handling missing data, calculating internal consistency (e.g., Cronbach's alpha), computing composite scores, checking assumptions, assessing the summer program's effects, exploring correlational analysis, testing the role of gender, and interpretation. The data analysis was conducted by using R. The results are presented in the following section.

## 3. Results and discussion

Since 19 of the 24 students completed pre- and post-surveys, the analysis was restricted to the sample size 19 to ensure valid pre-post comparisons. The responses from pre- and post-program surveys were validated by calculating Cronbach's alpha for four SCCT constructs. Cronbach's alpha is a measure of internal consistency that indicates how well the items within each construct are correlated and whether they collectively measure the intended construct effectively [19]. Table 1 presents the results of internal consistency across four constructs. The internal consistency values suggest that the items relating to the constructs either met or surpassed the widely acknowledged threshold of $\alpha$=0.70, indicating a high level of reliability for the survey tools used.

**Table 1 Cronbach's alpha**

| | Alpha for pre-program | Alpha for post-program |
|---|---|---|
| **Self-efficacy** | 0.82 | 0.89 |
| **Outcome expectations** | 0.87 | 0.91 |
| **Vocational interest** | 0.77 | 0.71 |
| **Carrer choice goals** | 0.86 | 0.86 |

*3.1 Pre-and post-program comparisons*

A combination of statistical tests was employed to evaluate the effects of the construction-focused summer program on students' SCCT constructs. Paired t-tests were used to assess changes in constructs that met normality assumptions, while the Wilcoxon signed-rank test, a non-parametric method, was applied for constructs where normality was violated [20]. The paired t-test increases the test's sensitivity, particularly useful when dealing with limited sample sizes. In cases where normality assumptions are violated, the Wilcoxon signed-rank test presents a reliable alternative method by assessing the ranked differences between paired observations instead of the raw data distributions [18], [21]. Paired t-tests were conducted to assess changes in self-efficacy, outcome expectations, and vocational interests, as they pass the normality tests. For career choice goals, where normality was violated, the Wilcoxon signed-rank test was used alongside the rank-biserial correlation to evaluate pre- and post-program differences [18], [22]. The descriptive and inferential statistics for all constructs are summarized in Table 2.

**Table 2 Results for comparison tests**

| | Mean (Pre) | Mean (Post) | p-value | Effect size |
|---|---|---|---|---|
| **Self-efficacy** | 4.258 | 4.321 | 0.544 | -0.117 |
| **Outcome expectations** | 4.079 | 4.074 | 0.958 | 0.008 |
| **Vocational interest** | 3.281 | 3.193 | 0.3306 | 0.129 |
| **Carrer choice goals** | 3.316 | 3.461 | 0.128 | 0.349 |

A slight increase in self-efficacy score was observed between pre- (M = 4.258) and post-program (M = 4.321). However, the paired t-test revealed no statistically significant difference (p = 0.544), and the effect size (d = −0.117) indicated a negligible practical impact. These results suggest that the program had little to no effect on students' self-efficacy. Outcome expectations showed virtually no change, with pre- (M = 4.079) and post-program (M = 4.074) meaning nearly identical. The paired t-test confirmed the lack of significance (p = 0.958), and the effect size (d = 0.008) was negligible. For vocational interests, the mean score slightly decreased from pre- (M = 3.281) to post-program (M = 3.193), though the difference was not statistically significant (p = 0.331). The effect size (d = 0.129) was small, further suggesting a minimal impact of the program. Career choice goals were analyzed using the Wilcoxon signed-rank test due to a violation of normality. The mean scores increased modestly from pre- (M = 3.316) to post-program (M = 3.461). While the p-value (p = 0.128) did not reach the threshold for statistical significance, the rank-biserial correlation (r = 0.349) indicated a small-to-moderate effect size [20], [23], [24]. This suggests a potential trend toward increased career choice goals,

which may become more evident with a larger sample size [20]. The study hypothesized that participation in the summer program would lead to significant increases in self-efficacy, outcome expectations, vocational interests, and career choice goals. However, the findings revealed no statistically significant changes across the constructs. The first four hypotheses were rejected.

Across the four constructs, the results indicate no statistically significant changes from pre- to post-program. The negligible effect sizes for self-efficacy, outcome expectations, and vocational interests suggest that the summer program had minimal immediate practical impact on these aspects of career development. However, the small-to-moderate effect size observed for career choice goals indicates a potential trend toward improvement. While not statistically significant, this result suggests that participants may have developed clearer or stronger career aspirations, which could be further examined in future studies with larger and more diverse samples. The lack of significant changes, particularly for self-efficacy and outcome expectations, may be explained by the limited duration of the intervention. A two-week program may not provide sufficient time to foster measurable shifts in students' confidence or expectations. Another possible explanation for the limited change is that voluntary participation in this construction-related program may reflect a preexisting higher baseline of construction-related confidence and expectations, resulting in a smaller observable increase.

*3.2 Correlation analysis for both pre-and post-program*

The non-parametric method was used to analyze the correlations among the SCCT constructs due to the lack of normality and the ordinal nature of the data. A Spearman rank correlation analysis was conducted to assess the relationships between self-efficacy, outcome expectations, vocational interests, and career choice goals both before and after the summer program. Spearman's correlation stands out from parametric methodologies by not necessitating normality or linearity assumptions in the dataset, rendering it particularly suitable for analyzing small sample size where such assumptions may frequently be violated. By ranking the data and deriving the correlation coefficient from these ranks, the method diminishes the impact of outliers and extreme values that could skew findings in limited sample sizes [25].

3.2.1 Pre-Program Correlations

Before the program, several correlations were observed among the SCCT constructs. The strongest correlation was between vocational interests and career choice goals ($\rho$=0.503), as shown in the correlation heatmap (Figure 1), suggesting that fostering interest in construction-related activities was closely tied to students' development of career paths in the field. This finding highlights the critical role of vocational interests in shaping students' future career goals. The second strongest correlation was identified between outcome expectations and career choice goals ($\rho$=0.498). This relationship indicated that students with higher outcome expectations were

more likely to set stronger career choice goals, emphasizing the importance of outcome expectations in career planning. Similarly, self-efficacy showed a positive relationship with both outcome expectations (ρ=0.426) and career choice goals (ρ=0.434). These correlations suggested that students with greater self-efficacy tended to anticipate better outcomes and were more likely to have clear career choice goals. In contrast, the weakest relationship was between self-efficacy and vocational interests (ρ=0.151), indicating a limited direct influence of self-efficacy on students' vocational interests in construction-related careers. This weak association suggested that self-efficacy alone may not directly translate into an increased interest in the construction field, pointing to a potential gap in how students perceive the connection between their skills and interests.

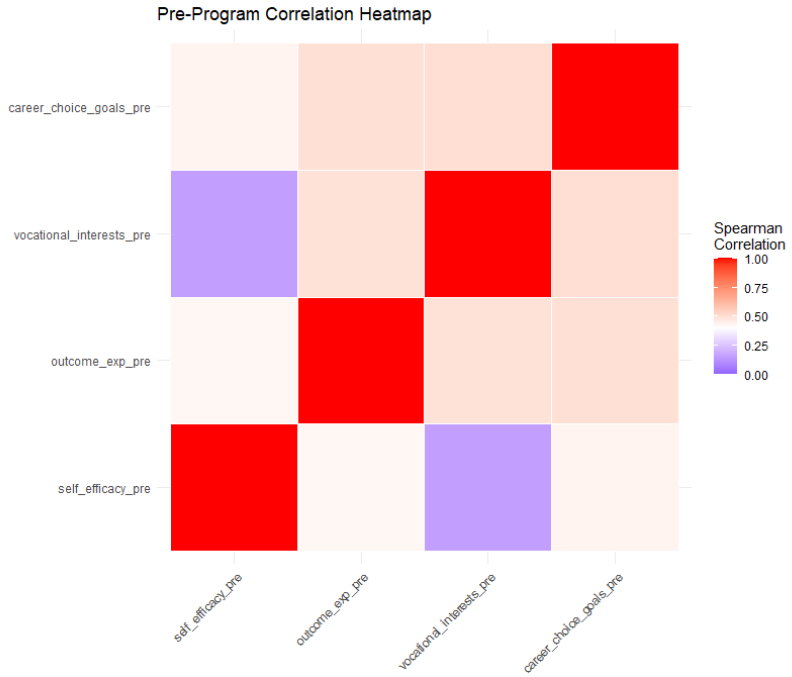


**Figure 1 Pre-program correlation heatmap**

3.2.2 Post-Program Correlations

The post-program analysis revealed several changes in the relationships among the constructs, suggesting that participation in the summer program influenced these associations (Figure 2). The strongest correlation remained between vocational interests and career choice goals (ρ=0.686), which became even stronger after the program. This enhancement highlighted the program's potential to align students' vocational interests with their career choice goals, underscoring its role in fostering clearer career pathways. Another notable improvement was observed in the correlation between self-efficacy and outcome expectations (ρ=0.588), which increased significantly after the program. This suggested that the summer program may have reinforced the relationship between students' self-efficacy and their outcome expectations. The program's activities likely provided students with opportunities to connect their skills to tangible

outcomes, strengthening this association. A moderate positive correlation was also identified between outcome expectations and career choice goals (ρ=0.510), reflecting the continued importance of outcome expectations in shaping career choice goals. Similarly, the correlation between self-efficacy and career choice goals (ρ=0.440) remained stable post-program, indicating that increased self-efficacy was still associated with stronger career choice goals. Despite these improvements, some relationships remained weak. The correlation between self-efficacy and vocational interests (ρ=0.105) did not show substantial change, suggesting that self-efficacy had a limited direct impact on students' vocational interests in construction careers, even after the summer program. Additionally, the correlation between outcome expectations and vocational interests weakened (ρ=0.222), indicating that the program may not have effectively bridged the gap between students' outcome expectations and their interests. This decline points to the need for more targeted efforts to connect outcome expectations with vocational interests.

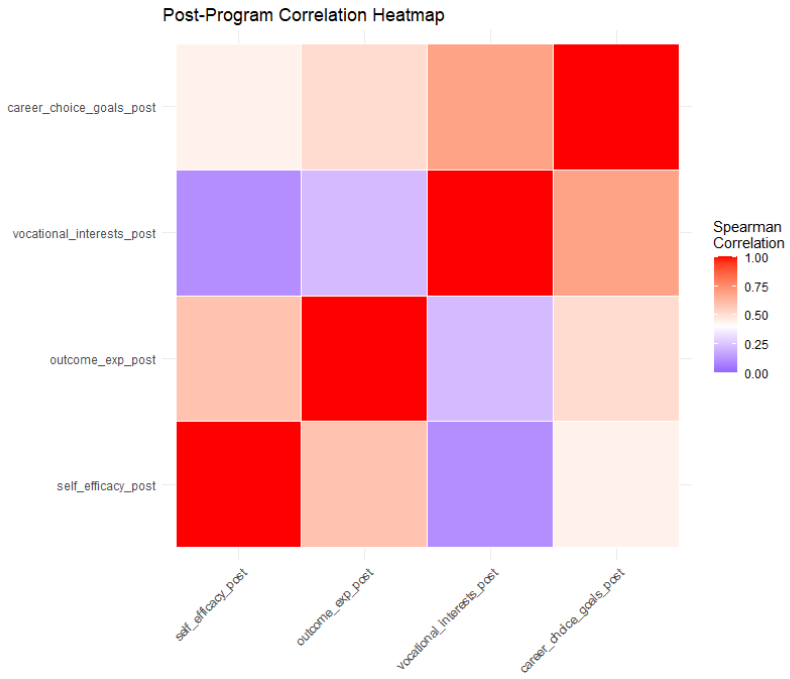


**Figure 2 Post-program correlation heatmap**

To sum up, these findings suggest that the summer program was partially successful in reinforcing certain relationships, particularly those tied to career choice goals. The stronger alignment between vocational interests and career aspirations highlights the program's potential to encourage students to connect their interests with specific career pathways in construction. Similarly, the strengthened relationship between self-efficacy and outcome expectations suggests that the program effectively fostered confidence and a sense of efficacy among students. However, the persistent weakness in the relationship between self-efficacy and vocational interests indicates a need for targeted strategies to actively cultivate interest in construction-related activities. Additionally, the weakening relationship between outcome expectations and

vocational interests suggests the need for program elements that directly address this gap. For instance, career exploration sessions could emphasize the long-term rewards of construction-related careers, such as financial stability, career growth, and opportunities for innovation. Future programs may also explore longer or more intensive summer programs to solidify these connections and produce more sustained impacts.

3.2.3 Correlations among constructs by gender (post-program)

To investigate whether gender-specific patterns existed in the correlations among SCCT constructs after participating in the construction-focused summer program, a series of Spearman rank correlation tests were conducted for male and female students. The results revealed distinct differences in how these constructs interacted within gender groups, highlighting the varying impacts of the program on male and female students (Table 3).

**Table 3 Summary of correlations tests results**

| | Correlations | Correlations (Male) | Correlations (Female) |
|---|---|---|---|
| **Self-Efficacy - Outcome Expectations** | 0.587 | 0.701 | -0.800 |
| **Self-Efficacy - Vocational Interests** | 0.105 | 0.160 | 0.775 |
| **Self-Efficacy - Career Choice Goals** | 0.440 | 0.459 | 0.259 |
| **Outcome Expectations - Vocational Interests** | 0.222 | 0.396 | -0.258 |
| **Outcome Expectations - Career Choice Goals** | 0.510 | 0.623 | -0.775 |
| **Vocational Interests - Career Choice Goals** | 0.686 | 0.795 | -0.333 |

From Evans (1996) [23], this study used the following correlation threshold: $|r|<0.20$: Very weak; $0.20\leq|r|<0.40$: Weak; $0.40\leq|r|<0.60$: Moderate; $0.60\leq|r|<0.80$: Strong; $|r|\geq0.80$: Very strong.

For male students, the post-program correlations generally aligned with or exceeded the non-gender-specific results. Self-efficacy exhibited a strong positive correlation with outcome expectations ($\rho=0.701$), larger than the general trend ($\rho=0.587$), indicating that confidence in abilities was a significant driver of outcome expectations for male participants. Similarly, vocational interests and career choice goals demonstrated a strong positive correlation ($\rho=0.795$), slightly higher than the general correlation ($\rho=0.686$), reflecting a robust alignment between interests and career aspirations. However, the relationship between self-efficacy and vocational interests remained weak ($\rho=0.160$), consistent with the general results ($\rho=0.105$). This suggested that for male students, self-efficacy did not directly impact vocational interest in construction-related careers, pointing to potential gaps in how confidence was connected to career interests.

In contrast, female students showed significant deviations from the general trends. Self-efficacy exhibited a strong positive correlation with vocational interests ($\rho$=0.775), far exceeding both the general ($\rho$=0.105) and male ($\rho$=0.160) results. This indicated that self-efficacy was a critical driver of vocational interest for female participants, suggesting that confidence in abilities played a more substantial role in shaping career interests in female group. However, several negative correlations emerged, highlighting potential misalignments among the constructs. Self-efficacy was strongly negatively correlated with outcome expectations ($\rho$=−0.800), and outcome expectations similarly showed a strong negative correlation with career choice goals ($\rho$=−0.775). These findings are counterintuitive, as one would generally expect higher confidence to foster greater outcome expectations, which in turn would lead to stronger career aspirations. A potential explanation for this unexpected result lies in the unique experiences and perceptions of female students within the program. It is possible that the construction-focused activities, while aimed at fostering self-efficacy, may not have adequately aligned with female students' expectations or career aspirations, resulting in a disconnect between these constructs. Additionally, the negative correlations could reflect variability within the female group, potentially amplified by the small and unbalanced sample size. The limited representation of female students in the sample likely increased sensitivity to individual variability, making it challenging to generalize the findings. Moreover, vocational interests and career choice goals exhibited a weak negative correlation ($\rho$=−0.333), in stark contrast to the strong positive correlation observed in the general results ($\rho$=0.686) and male results ($\rho$=0.795). The potential reason lies in the unequal distribution of male and female students. It potentially amplified outliers or variability within the smaller female subgroup, affecting the reliability of the observed correlations. A more balanced sample in future research is necessary to capture nuanced relationships and improve the generalizability of the findings.

Overall, the post-program correlations highlighted moderate to strong positive relationships among the constructs overall, particularly between vocational interests and career choice goals ($\rho$=0.686). However, the impact of the program on other constructs varied significantly by gender. Male students demonstrated consistent alignment between self-efficacy, outcome expectations, and career choice goals, suggesting that the program effectively reinforced these relationships in this group. In contrast, female students faced disconnects, particularly between outcome expectations and other constructs, which potentially limited the program's effectiveness in fostering cohesive career development pathways for them. For female students, more targeted strategies are required to align self-efficacy, outcome expectations, and career choice goals, directly linking confidence to tangible outcomes, and addressing stereotypes that may hinder the development of outcome expectations and career choice goals.

## 4. Conclusion

This study seeks to examine the immediate effects of a two-week construction-focused summer program on high school students' career attitudes toward construction, employing a modified SCCT framework. The construction-focused summer program did not produce statistically significant changes in self-efficacy, outcome expectations, vocational interests, or career choice goals. However, the small-to-moderate effect size observed for career choice goals suggests the potential for longer-term impact, particularly if the program is expanded or extended. These findings underscore the importance of sustained interventions that go beyond short-term programs to foster meaningful and lasting changes in students' career development, especially in underrepresented fields like construction. The gender-specific analysis revealed distinct patterns in the relationships among SCCT constructs after the program. Male students demonstrated strong and consistent alignment across self-efficacy, outcome expectations, and career choice goals, indicating that the program reinforced these relationships effectively for this group. In contrast, female students exhibited significant misalignments, particularly between self-efficacy, outcome expectations, and career choice goals, suggesting a need for targeted strategies to address these gaps. These results emphasize the importance of gender-responsive program designs that account for the unique dynamics and needs of male and female students, fostering equitable opportunities for career development.

This study is limited by its small sample size, which reduces the statistical power of the analysis and makes it challenging to detect subtle changes, particularly for constructs with small effect sizes. Furthermore, the unbalanced gender composition likely affects the observed trends, limiting the generalizability of the findings, especially for female students. Future research should prioritize recruiting larger and more balanced samples to better capture the nuanced impacts of informal learning interventions and support robust gender-based analyses.

Despite these limitations, this study offers valuable insights into the design of informal learning interventions aimed at engaging underrepresented groups and strengthening the broader construction workforce pipeline. By systematically evaluating construction-focused program impacts on critical SCCT constructs and highlighting gender-specific patterns, the research provides valuable direction for educators, program developers, and industry stakeholders committed to enlarging and diversifying the construction field. The findings underscore the importance of early and purposeful exposure to construction careers and the potential of counter-stereotypical strategies in fostering greater equity and inclusivity. While constrained by sample limitations, this research contributes to a growing body of evidence supporting the role of informal education in addressing labor shortages and promoting diversity in construction careers.

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