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Attracting the Younger Generation to Architecture, Engineering, and Construction: A Perspective on How Workshops Create Interest Among 4th to 6th Graders

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The Architecture, Engineering, and Construction (AEC) industry is facing a significant workforce shortage due to an aging labor force and a lack of interest from younger generations. Despite numerous initiatives aimed at promoting Science, Technology, Engineering, and Mathematics (STEM), careers in the AEC fields are still undervalued and poorly understood, especially among younger students. This study addresses this gap by implementing two interactive AEC workshops for 4th to 6th graders in the Fresno Unified School District, exposing 95 students to hands-on learning and mentorship in the construction and architecture fields. The workshops included two sessions—an interactive lecture and a hands-on activity—designed to introduce career concepts and practical skills. Pre- and post-workshop surveys indicated a significant increase in interest in AEC careers, with the number of students expressing interest in construction management or architecture doubling. The data suggests that early exposure through school-based workshops can positively influence career aspirations and help mitigate future workforce shortages. By making AEC concepts accessible and engaging for younger audiences, the study demonstrates that targeted, early interventions can shift perceptions and inspire a new generation toward AEC fields. Expanding such initiatives to even younger age groups could further strengthen the pipeline of skilled professionals, ensuring the long-term sustainability of the AEC industry.

Keywords: Construction Management, Architecture, STEM Education, Outreach, Career Pathways

Introduction

The Architecture, Engineering, and Construction (AEC) industry plays a critical role in driving economic growth, technological innovation, and infrastructure development (Brozovsky et al., 2024). However, the sector faces significant challenges in recruiting, training, and retaining the next generation of professionals. According to a 2019 report by the Organization for Economic Co-operation and Development (OECD, 2019), careers in the construction industry do not align with the career aspirations of teenagers. Similarly, the 2022 report by the National Society of High School Scholars (NSHSS) indicates that the construction sector is not among the top ten expected career

paths for high school students. This trend poses a substantial challenge to the AEC industry, which is already dealing with an aging workforce and an impending leadership gap.

With 41% of the current construction workforce projected to retire by 2031, a skills shortage is imminent unless proactive measures are taken to inspire and equip the next generation of workers (Schultz, 2022). Addressing this issue is essential to ensure that the AEC industry maintains its current trajectory and adapts to evolving demands. This research focuses on the design and implementation of AEC workshops aimed at engaging upper elementary and middle school students. Research indicates that early exposure to diverse career pathways during formative years is crucial, as it enhances curiosity, increases intrinsic motivation, and develops essential soft skills in preparation for ever-evolving career landscapes (Alexandrov, 2024). The workshops leveraged hands-on activities, cutting-edge technology, and mentorship to attract and align younger generations' interests with careers in construction and architecture.

To enhance the engagement of the workshops, they were prepared, organized, and conducted by a collaboration of faculty and student assistants at the Fresno State Construction Management Department. The 4th to 6th grade students participated in workshops held at two schools in the Fresno Unified School District in California, USA. The aim of the workshops was to increase the number of students interested in pursuing career pathways in the construction, engineering, and architecture fields. The workshops were offered free of charge to all participating students, who were involved in two sessions: an interactive lecture session followed by a hands-on activity session. This study outlines the development, execution, and outcomes of the workshops, highlighting the importance of early exposure to architectural, engineering, and construction (AEC) careers through innovative, engaging, and community-oriented approaches.

Literature Review

The construction industry faces a substantial workforce shortage, exacerbated by the impending retirement of a major portion of its seasoned workforce. According to (Arnholz, 2021), 53% of experienced construction workers are expected to retire by 2036, which will create a significant skills gap in the industry. Surveys from the Associated General Contractors of America (AGC) and HR technology company Arcoro reveal that 94% of contractors report open positions for craft workers, while 92% have vacancies for salaried roles (AGC & Arcoro, 2024). The shortage is causing project delays, as 54% of contractors have encountered delays attributed to workforce scarcity (AGC & Arcoro, 2024). Moreover, the high rate of hiring difficulties, reported at 62%, is primarily due to a lack of qualified candidates, further exacerbated by challenges such as no-shows and failed drug tests. The construction industry’s dependence on skilled labor and an aging workforce heightens the urgency of addressing these shortages (Elbashbishy & El-adaway, 2024).

Despite advancements in technology, the need for a skilled workforce remains critical, as workers must operate both traditional and automated construction machinery (Holzer, 2022). The challenge of workforce scarcity has persisted for over a decade, with various studies identifying education, apprenticeship, and financial incentives as potential solutions for attracting a skilled workforce (Richer, 2021). Addressing these shortages not only requires immediate recruitment efforts but also a long-term strategy to shift public perceptions and create sustainable pipelines for new talent.

Research consistently shows that the negative perception of construction careers among the younger generation is a significant barrier to entry into the AEC fields (Ling & Ho, 2013). Traditional vocational pathways that once introduced skilled trades early on have largely disappeared in the U.S. educational system, leaving young people less aware of potential construction careers (Toppin &

Toppin, 2016). In the 2023 Workforce Survey Analysis, AGC and Autodesk highlighted the challenges of reintroducing trades into public education, noting the long-term effort required to rebuild robust vocational programs.

Additionally, cultural expectations around higher education have led to a perception that success is linked solely to a college degree, steering students away from hands-on trades (Muth, 2015). Studies in other industrialized nations, where apprenticeships are integrated into education systems, demonstrate that early exposure to trades significantly increases entry rates into construction fields (Parton, 2017). This insight underlines the importance of addressing these perception-based barriers early, even as public awareness campaigns emphasize the financial and personal rewards associated with construction careers.

The U.S. has prioritized STEM education initiatives to encourage students to enter science, technology, engineering, and mathematics fields, which could offer valuable insights for the AEC (architecture, engineering, construction) industry (Fagen, 2022). STEM education efforts, especially in grades K-12, have leveraged hands-on and field-based learning to engage students, fostering both content knowledge and positive attitudes toward these fields (Kaldi et al., 2011). In science and mathematics, hands-on activities have been shown to increase motivation, engagement, and interest among students, suggesting a potential model for the AEC sector to similarly employ hands-on learning (Haury & Rillero, 1994).

To mirror the success in STEM, construction-specific programs could integrate real-world applications of skills that students would use in AEC fields. This approach aligns with findings from informal learning studies, which emphasize the effectiveness of hands-on, context-rich experiences over traditional classroom-based learning (Mohr-Schroeder et al., 2014). Consequently, applying these proven strategies from STEM recruitment could help reshape youth perceptions of the AEC sector and increase early interest.

Hands-on learning has emerged as a key strategy for influencing students' interest in AEC careers, especially as formal classroom environments often lack the exposure necessary to spark interest in these fields (Bicer et al., 2015). Workshops, mentorship programs, and experiential learning opportunities that introduce students to construction and architecture through real-world problem-solving have shown promising outcomes. For example, studies on hands-on STEM activities in summer camps found that participation increased students' motivation and attitudes toward STEM fields (Drey, 2016).

Informal learning environments, such as workshops and career-based activities, allow students to make meaningful connections between classroom content and its application in the construction industry. By integrating AEC fields into these experiences, students are better able to envision a future in these careers and understand the range of opportunities available to them (Brophy et al., 2008). This approach not only builds interest but also provides practical skills and industry exposure, thus supporting students in making informed career choices.

Research shows that hands-on approaches, mentorship, and industry-focused workshops are essential for attracting the next generation of skilled workers to the construction sector. Programs that provide students with tangible experiences in AEC tasks, such as design and building projects, enable students to see the value of construction careers beyond traditional academic contexts. Building on this foundation, our research implemented interactive AEC workshops for 4th to 6th graders, integrating lectures with hands-on activities to assess their impact on students' career interests. By assessing students' pre- and post-workshop responses, we observed a significant increase in their interest in

AEC, affirming the effectiveness of experiential learning in shaping young students' career perceptions and aligning them with the diverse opportunities within the AEC fields.

Methodology

This study employed an iterative outreach and educational approach to assess the effectiveness of construction management and architecture workshops in creating interest and awareness among younger students about careers in architecture, engineering, and construction. The methodology consisted of several phases, including initial material preparation, outreach efforts, adjustments based on preliminary feedback, and a redesigned delivery model targeting elementary and middle school students.

The research team, composed of student assistants and faculty, initially focused on developing teaching and marketing materials to introduce students to construction management and architecture. Under the guidance of a faculty advisor, student assistants prepared content that included interactive lecture materials, hands-on activity instructions, and promotional flyers. Flyers were utilized not only to inform parents but also to legitimize the workshops and promote discussion between parent(s) and child about AEC industry careers. These materials were designed to engage students and introduce them to fundamental concepts in construction management, engineering, and architecture, with a particular emphasis on making the content accessible and engaging for younger audiences.

Then, the faculty members conducted outreach efforts to establish partnerships and deliver the workshops as part of summer programs. The initial pilot workshops were conducted in partnership with a college of engineering's existing summer workshops. However, the results were less impactful than anticipated. The majority of students, comprising junior high and high school students, had already expressed interest in engineering career paths, leading to limited engagement with construction and architecture-specific content. Feedback from students was minimal, and the majority of students attended the workshop annually based on parental encouragement rather than personal interest. Attendance numbers were also low, with fewer than fifty students participating.

In response to the mixed results and low engagement observed in the initial summer workshops, the team conducted a re-evaluation to identify alternative outreach strategies. It was concluded that a more effective approach might be to deliver the workshop directly to younger students in a school setting, where students are less likely to have predefined career aspirations. Faculty advisors collaborated with student assistants to revise the teaching and marketing materials to suit an elementary school audience. According to research, this is the right age to create awareness about careers, as early exposure helps foster curiosity and intrinsic motivation while broadening students' understanding of potential pathways (Alexandrov, 2024). This phase also included reaching out to local elementary schools to assess the feasibility and procedural requirements for implementing a construction management and architecture workshop in a school environment.

After establishing a partnership with two local schools, the team organized two one-day construction and architecture workshops for students. It included two separate workshops held at Fresno Unified School District schools. Each workshop was designed with two primary activities to keep students engaged and provide diverse hands-on learning experiences. In the morning, students from fifth grade were divided into two groups; one group attended an interactive seminar on foundational concepts in construction management and architecture, while the other participated in a hands-on project using LEGO sets to simulate real-world construction tasks. Midway through the session, the groups switched activities, allowing all students to experience both activities. The same structure was replicated for other grade students participating in the afternoon sessions. Each session was designed

to ensure that every student experienced both theoretical insights and practical activities. In total, the workshops engaged over 95 students across two workshops. The workshop structure was as follows:

- Session Design: In the morning, students were divided into two groups for a dual-format session. One group attended an interactive seminar focused on foundational concepts in construction management or architecture, delving into the theory behind project planning, team roles, and resource management. Meanwhile, the second group participated in a hands-on activity using specially selected LEGO sets to simulate project tasks in construction or architecture. Halfway through, the groups switched activities, ensuring each student gained both theoretical insights and practical experience.
- Replication for other Graders: In the afternoon, an identical session with another grade level was held, creating a uniform educational experience across different ages and learning stages. This structure promoted consistent learning outcomes while adapting to various grade levels' needs and interests.
- Pre- and Post-Workshop Surveys: To measure the workshop's impact and assess increased interest in AEC careers, students were asked to complete surveys before and after the session. These surveys captured shifts in students' interest in construction and architecture careers, providing valuable data on the workshop's effectiveness. The surveys included questions designed to measure both interest and knowledge, allowing the research team to assess quantitative and qualitative changes in student perceptions.
- Engagement and Motivation through Incentives: At the end of the workshop, students received small swag gifts related to construction management and architecture. These items served as a lasting reminder of their experience and fostered a positive association with the skills and knowledge gained during the session.

Results and Analysis

The transition to conducting construction management workshops and architecture workshops directly in local schools significantly improved outreach effectiveness. By holding these workshops within the school environment, the study reduced barriers such as financial hardship and transportation issues faced by participating students. This ensured that students from diverse backgrounds, including those from underprivileged communities, could participate without facing institutional obstacles. This approach increased accessibility and engagement, allowing students to explore career opportunities in the Architecture, Engineering, and Construction (AEC) industry in a familiar setting without logistical challenges.

Data from the workshops reveals a positive shift in student interest in the AEC industry. A comparative analysis of pre-and post-workshop survey results demonstrates a notable increase in the number of students expressing interest in construction-related careers. Prior to the workshop, only 7.1% of students indicated an interest in the AEC industry, as shown in Figure 1. Following the hands-on, interactive sessions, this figure doubled to 14.3%, as shown in Figure 2, suggesting that the workshop successfully ignited interest in construction management or architecture as an appealing and viable career path.

Furthermore, after attending the workshops, the percentage of students who were unsure about their career paths increased noticeably, from 8.2% before the workshops to 16.5% afterward. This shift highlights how the workshops encouraged students to reflect more deeply on their future careers and acknowledge any uncertainties they had. By introducing a range of new job possibilities, the workshops broadened students' perspectives and inspired some who were initially focused on other professions to reconsider opportunities within the architecture, engineering, and construction (AEC)

industry. This change suggests that exposure to construction management can enhance students' understanding of various career options, address common misconceptions, and present the construction field as an exciting, diverse, and rewarding career path worth exploring.

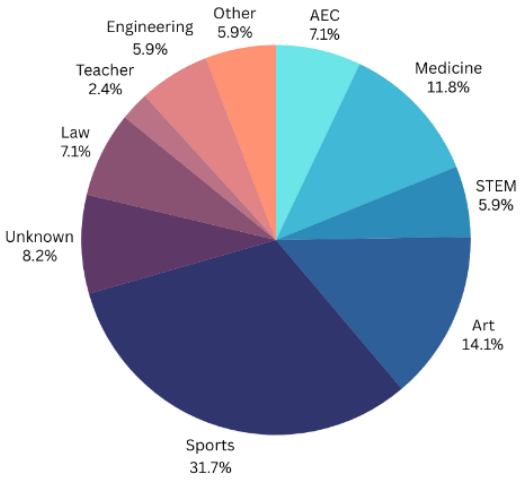

Figure 1. Pre-workshop survey

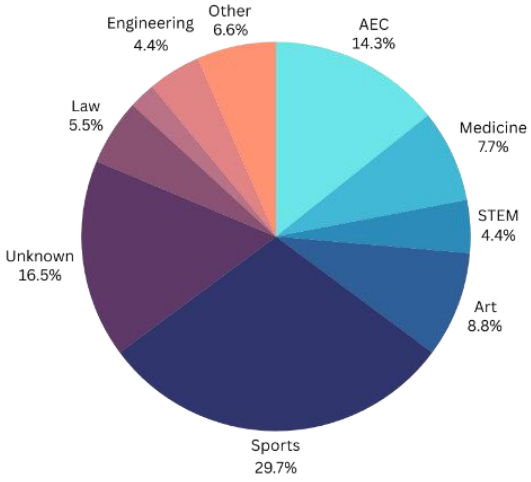

Figure 2. Post-workshop survey

To further understand the impact of the workshop on students' perceptions, students were asked to describe or illustrate their ideas about potential careers both before and after the session. Analysis of these responses shows a shift in career depiction, indicating increased curiosity and interest in construction and architecture. Notably, in some of the workshop sessions, there was a 5.8% increase in interest in AEC careers, starting from an initial 0% when no students raised their hands, while another session saw an increase to 8.9% from an initial 0%. In addition to that, the post-survey response, as shown in Figure 3, suggests that the workshop successfully introduced construction management and architecture as a viable career path to students who had previously not considered it.

Students who were previously uncertain about their future professions expressed newfound enthusiasm for roles within construction management, often noting the interactive LEGO activity as a memorable and informative experience that provided a "taste" of real-world construction planning and management tasks.

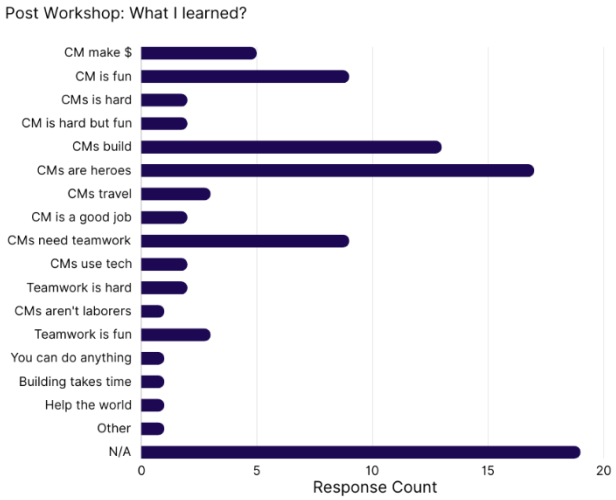

Figure 3. Student's response to post-workshop survey

The visual and descriptive drawings made by students, as shown in Figure 4, highlight that they not only learned about the field but also began to see construction management and architecture as careers that blend creativity, problem-solving, and hands-on involvement. As part of the workshop, students were asked to draw how they see themselves in their future careers. Those who developed an interest in AEC fields depicted themselves in roles like construction managers and architects, while others drew professions such as doctors with stethoscopes or athletes playing football. Such responses reflect a successful shift in perception, transforming construction from a potentially unknown or misunderstood field into an engaging and attainable career.

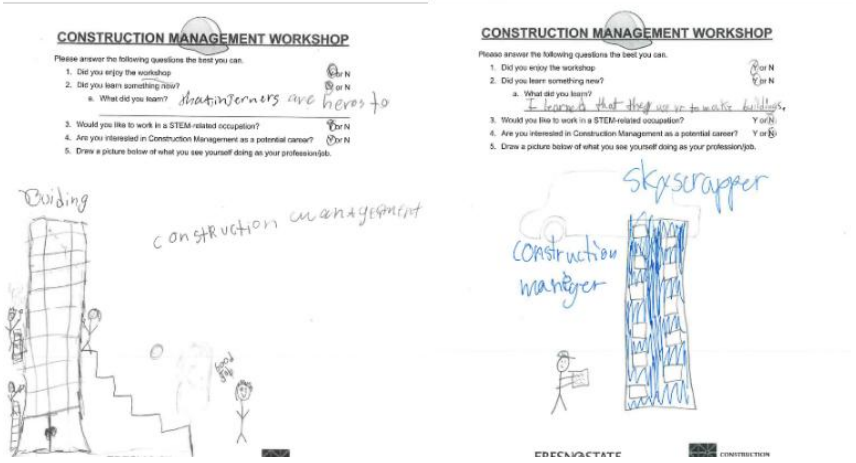

Figure 4. Student career depictions

Data Analysis Summary

The pre-and post-survey data reveal several key insights into the impact of the workshop on students' interest in the AEC fields:

- Increased Interest in AEC: Interest in construction management careers doubled, rising from 7.1% to 14.3% following the workshop.
- Shift in Career Uncertainty: The percentage of students uncertain about their career paths increased from 8.2% pre-workshop to 16.5% post-workshop. This rise suggests that the workshop introduced new career options, leading some students with previously defined career goals in other fields to reconsider their choices within AEC.
- Interest Gains Among Uninterested Groups: In groups where students initially had no interest in AEC careers—evident as no students raised their hands when asked if they wanted to be construction managers or architects—post-workshop interest rose to 5.8% and 8.9%, highlighting the workshop's potential to attract new interest.
- Enhanced Career Perceptions and Understanding of Construction Management: Post-workshop feedback indicates that students developed a more positive and realistic understanding of construction management. Many expressed enthusiasm for aspects like technology, financial rewards, and the creative problem-solving nature of the field, with comments such as "CM make $," "CM is fun," and "Teamwork is hard but fun." Students also acknowledged the challenges, noting that "CM is tough" and "Building takes time," which shows a balanced view of the profession's demands and rewards.

While these findings demonstrate the value of school-based workshops in broadening awareness and interest in AEC careers, they also suggest that introducing AEC concepts at the middle and high school levels may be somewhat late for some students who already have defined career plans. Targeting younger students could foster an early interest in AEC before career paths become firmly established, potentially creating a stronger pipeline of skilled, inspired young talent in response to workforce needs. The workshop's success in engaging initially uninterested students emphasizes the importance of early exposure, positioning AEC as a viable and rewarding career option.

Conclusion

The AEC industry is essential for economic growth and infrastructure development but faces significant challenges in addressing workforce shortages due to an aging labor force and a lack of interest from younger generations. Studies reveal a disconnect between high school students' career aspirations and their awareness of AEC opportunities, emphasizing the need to bridge this gap for the industry's sustainability. To address these challenges, school-based workshops were introduced to provide hands-on exposure to AEC careers while ensuring accessibility for students from diverse backgrounds. The workshop survey results indicated a significant rise in interest in AEC careers, with interest in AEC careers doubling from 7.1% to 14.3% post-workshop. Students also reported a deeper understanding of construction management and architecture, highlighting aspects like teamwork and financial rewards.

These results highlight the positive impact of early, targeted interventions in encouraging students to consider careers in the Architecture, Engineering, and Construction (AEC) fields. Future research should investigate the long-term effects of these workshops on students' career paths and assess their effectiveness when applied to different demographics or introduced at earlier educational stages. One limitation of this study is that it focused on a single school district and measured outcomes shortly

after the workshops. Expanding the study and monitoring its effects over a longer period could provide a clearer understanding of its effectiveness. Additionally, extending such hands-on workshops to younger educational levels could help address workforce gaps and support the development of the next generation of skilled professionals in the AEC industry.

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