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Perceptions of Artificial Intelligence (AI) in the Construction Industry Among Undergraduate Construction Management Students: Case Study—A Study of Future Leaders

Jonghoon Kim ^{1,*} , Soomin Park ² , Sarah Moukhliiss ³, Kwonsik Song ⁴  and Dan Koo ¹

¹ Department of Construction Management, University of North Florida, Jacksonville, FL 32224, USA; dan.koo@unf.edu

² Department of Information Systems and Supply Chain Management, Howard University, Washington, DC 20059, USA; soomin.park@howard.edu

³ Department of Library, STEM Online Learning, University of North Florida, Jacksonville, FL 32224, USA; sarah.moukhliiss@unf.edu

⁴ School of Construction Management Technology, Purdue University, Indianapolis, IN 46202, USA; kssong@purdue.edu

* Correspondence: jongkim@unf.edu

Abstract: This study investigates the perceptions of artificial intelligence (AI) among undergraduate construction management students who are poised to become future leaders in the construction industry. As the industry increasingly adopts AI technologies to enhance project planning, design, site management, and safety, understanding students' attitudes toward these innovations becomes crucial. This research employs a mixed-methods approach, combining quantitative survey data with qualitative data to capture the students' insights on AI's potential applications, benefits, and challenges within the construction sector. Findings indicate that while students recognize AI's transformative potential to improve efficiency and safety in construction processes, they also express concerns regarding ethical implications, job displacement, and the necessity of new skills to effectively integrate AI into their future careers. Additionally, this study reveals a significant gap in students' knowledge about AI technologies and their applications in the construction industry. These insights underscore the importance of incorporating AI-focused curricula in construction management programs to better prepare students for the evolving landscape of the industry. Ultimately, this research contributes to the understanding of how the next generation of construction professionals perceives AI and highlights the need for educational institutions to adapt their programs to equip students with the competencies required for a technology-driven future.

Keywords: artificial intelligence (AI); undergraduate students; perception; construction industry



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1. Introduction

The construction industry is experiencing a profound transformation driven by rapid advancements in technology, particularly the increasing integration of artificial intelligence (AI) [1]. This technological revolution is reshaping traditional practices across various construction phases, including project planning, design, site management, and safety. As these innovations continue to evolve, the roles and responsibilities of future construction professionals are undergoing significant changes. Construction management students, who represent the industry leaders of tomorrow, must develop the skills and knowledge

necessary to navigate this shifting landscape. However, their perceptions of AI, its potential applications, and its implications for their future careers remain insufficiently explored [2].

Generative Artificial Intelligence (GAI) stands out as a transformative technology, significantly impacting the educational landscape and sparking considerable attention and debate [3–6]. With the increasing adoption of GAI, students have enhanced their problem-solving abilities and assignment completion efficiency, often reducing reliance on instructors for guidance [7]. However, this progress is accompanied by ethical challenges and academic integrity concerns, such as potential cheating and unequal access to software [8,9]. GAI applications span a wide range of domains, including speech, text, video, research, coding, and image generation.

The Architecture, Engineering, and Construction (AEC) industry, in particular, has witnessed substantial growth over the past decade, cementing its role as one of the most influential global markets. Employment in the U.S. construction sector steadily increased from 2011 to 2019 and demonstrated resilience during the COVID-19 pandemic, with unemployment impacts less severe than the overall average and employment levels rebounding to pre-pandemic figures.

Construction management graduates are regarded as future leaders in the implementation of artificial intelligence (AI) in construction due to their expected progression into managerial and decision-making roles. Their education and training provide them with expertise in project planning, resource allocation, and problem-solving, all of which are essential for integrating AI-driven technologies into the industry. As they advance into leadership positions, their perception of AI will play a crucial role in determining how quickly and effectively it is adopted [10].

If construction management graduates recognize AI as a valuable tool for improving efficiency, reducing costs, and enhancing safety, they are more likely to advocate for its adoption. This may involve supporting investments in AI-powered scheduling, cost estimation, safety monitoring, and automation. However, if they perceive AI as a disruptive force that threatens traditional practices or job security, they may resist its integration, leading to slower adoption rates. Their perception will also influence company policies, investment strategies, and collaborations with AI developers, ultimately shaping the future of AI in construction [11].

Understanding how undergraduate construction management students perceive AI is crucial for designing education and training programs that align with the industry's technological advancements. The adoption of AI in construction presents both opportunities and challenges, requiring professionals to adapt to new roles, acquire advanced technical skills, and integrate AI into their workflows. Future construction leaders must not only understand emerging technologies but also harness them effectively to drive industry progress.

Artificial intelligence, broadly defined as the ability of computers to learn, make decisions, and perform tasks characteristic of human intelligence, draws from disciplines such as mathematics, computer science, biology, psychology, and cybernetics. AI enables the development of algorithms and programs capable of solving problems autonomously. Despite employing approximately 7.22% of the global workforce, the construction sector continues to struggle with low labor productivity, resulting in significant waste of labor, materials, and financial resources. Given its substantial economic impact, the industry requires effective management practices to enhance productivity. Estimates suggest that improving productivity by 50.11% to 60.04% could generate an additional RUB 1.6 trillion in annual profits, further contributing to global GDP [12]. By fostering a positive perception of AI among construction management graduates, the industry can better position itself to leverage AI's potential, ultimately driving innovation, efficiency, and profitability.

AI encompasses nine major subfields, including knowledge-based systems, computer vision, robotics, natural language processing, automated planning and scheduling, optimization, and machine learning [2]. In educational contexts, AI primarily manifests through knowledge-based systems, automation, natural language processing, and adaptive learning—tools such as intelligent tutors, automated feedback systems, and grading mechanisms exemplify these applications [13]. These subfields are already influencing engineering education and faculty practices, with the potential to drive further innovation.

As GAI technologies advance, educators face pressing challenges, including ethical considerations [8,9], data privacy [14], and equitable access [15]. Critical questions arise about whether faculty should actively teach AI tools, restrict their use to uphold academic integrity, or establish regulatory guidelines to govern their implementation [6]. Addressing these questions will be pivotal in shaping the future role of AI in education and the construction industry.

2. Study Purpose and Objectives

This study aims to explore the perceptions of AI among undergraduate construction management students, assessing their awareness, understanding, and attitudes toward the use of AI in construction. By examining these perceptions, this research seeks to provide insights into how future construction professionals view the potential impact of AI on job roles and career trajectories within the industry. The findings will contribute to the broader discussion of how higher education institutions can better prepare students for the evolving demands of the construction sector, ensuring they are ready to lead in a technology-driven future.

The objectives of this study are to (1) understand students' awareness and knowledge of AI applications in construction; (2) examine their perception toward AI's potential impact on job roles, productivity, safety, and innovation in the industry; (3) assess how they feel to engage with AI technologies in their future use; and (4) identify any educational interests for AI-related training in Construction Management programs.

3. A Literature Review

This research will fill a gap in the existing literature by focusing on the next generation of construction managers, offering a perspective on how AI is perceived by those who will ultimately shape the future of the industry. The previous studies were reviewed based on the subjects for the following.

3.1. *Understanding of Artificial Intelligence (AI) Among Undergraduate Students*

The growing presence of Artificial Intelligence (AI) in various industries has prompted significant attention toward AI education, particularly at the undergraduate level. As AI technologies continue to reshape fields such as healthcare, finance, and engineering, it is critical for students in higher education to develop a robust understanding of AI's principles, applications, and ethical implications.

The increasing integration of AI into professional fields has underscored the importance of equipping undergraduate students with foundational knowledge of AI technologies. The growing demand for AI-literate professionals across industries emphasizes the need for AI education to become a central component of undergraduate curricula [16]. Students who possess a strong understanding of AI are more likely to succeed in tech-driven industries where automation, data analysis, and machine learning (ML) have become critical skills.

AI education also plays a crucial role in fostering interdisciplinary learning. As AI is applied across a wide range of fields—from computer science and engineering to business,

law, and the arts—undergraduate students benefit from understanding how AI can be leveraged within their chosen disciplines. Interdisciplinary approaches to AI education help students not only grasp the technical aspects of AI but also consider its ethical and social implications, promoting a well-rounded understanding of the technology [17].

Several studies have assessed the level of AI understanding among undergraduate students, revealing a wide spectrum of familiarity and competence. Findings suggest that students' comprehension of AI concepts often varies based on their academic background, exposure to technology, and the availability of formal AI education within their programs.

A survey conducted among undergraduate students in science, technology, engineering, and mathematics (STEM) revealed that students who majored in computer science or data-related fields generally had a stronger grasp of AI principles, such as machine learning, neural networks, and natural language processing [18]. These students reported higher confidence in their ability to apply AI techniques to solve real-world problems compared to their peers in non-technical disciplines. However, this study also found that even among STEM students, misconceptions about AI's capabilities and limitations were common, reflecting a need for more structured, comprehensive AI courses at the undergraduate level.

On the other hand, students in non-STEM disciplines such as social sciences, humanities, and business exhibited lower levels of AI understanding. One study found that many non-STEM undergraduates were unfamiliar with AI's basic functions and often viewed AI as an abstract, futuristic concept rather than a practical tool with current applications. Despite this, this study noted a high level of interest in AI education among these students, who recognized the growing relevance of AI across all fields. This indicates a gap in AI literacy that could be addressed through interdisciplinary AI courses tailored to students in non-technical majors [19].

Several barriers hinder undergraduate students from gaining a deeper understanding of AI. One significant challenge is the lack of access to formal AI coursework in many academic programs. AI-related courses are typically concentrated in computer science and engineering departments, leaving students in other fields with limited exposure to the subject. This lack of cross-disciplinary AI education restricts students from fully appreciating how AI technologies can be applied within their areas of study [20].

Additionally, technical complexity can act as a barrier, particularly for students without a strong background in mathematics, programming, or computer science. AI concepts such as algorithmic design, deep learning, and data analytics can be intimidating for students who are new to programming or lack technical expertise. This challenge is exacerbated when AI courses focus heavily on technical details without contextualizing how these technologies apply to broader, real-world problems [21].

Another barrier is the prevalence of misconceptions and fear regarding AI. This study found that many undergraduate students, particularly those outside of technical fields, held misconceptions about AI's potential to replace human jobs or its ability to operate autonomously without human oversight. Such misconceptions, fueled by media portrayals of AI, may discourage students from pursuing AI education or engaging deeply with the subject [22].

An emerging focus in AI education is the need to incorporate discussions about the ethical and social dimensions of AI. As AI technologies continue to influence various aspects of society, from privacy and security to decision-making and labor markets, it is crucial for undergraduate students to understand the broader implications of AI development. This study emphasized the importance of teaching undergraduates about AI ethics, particularly issues related to bias, transparency, and accountability in AI systems. Integrating ethical discussions into AI courses can help students critically evaluate the societal impact of AI technologies and consider responsible practices in AI development and deployment [23].

Scholars have argued that AI education should also explore topics like data privacy, algorithmic fairness, and the implications of AI on employment, preparing students to navigate the ethical challenges they may encounter in their future careers [24].

3.2. Artificial Intelligence (AI) Applications in Construction Industry

Artificial intelligence (AI) is increasingly transforming the construction industry, with its applications spanning various phases of project life cycles—from design to maintenance and operations. The integration of AI technologies into construction processes aims to enhance efficiency, reduce costs, improve safety, and deliver better project outcomes. Over recent years, AI's role in construction has evolved from theoretical research to practical applications, offering promising solutions to many of the industry's longstanding challenges [25].

One of the primary areas where AI has made significant strides in construction is in the design and planning phases. AI-powered design tools can generate numerous design alternatives, optimize structures for energy efficiency, and propose sustainable building solutions. This study has noted the use of AI-driven algorithms that enable architects and engineers to create complex structures that are not only visually innovative but also optimized for performance and cost. AI-enhanced building information modeling (BIM) systems further allow architects to simulate project outcomes in real time, helping stakeholders make more informed decisions during the design process [26].

Generative design, powered by machine learning (ML) algorithms, allows designers to input specific goals and parameters, such as material constraints or spatial requirements, and let AI generate the most efficient design solutions. As noted, this approach leads to more sustainable and cost-effective building designs while accelerating the planning process [27].

AI technologies are also increasingly applied to streamline construction project management. AI-powered systems can analyze large datasets to predict potential project delays, optimize resource allocation, and generate real-time solutions for unforeseen issues. The use of AI-based project management platforms enables improved scheduling accuracy, as AI algorithms analyze variables like weather conditions, worker availability, and material supply chains to adjust timelines and budgets dynamically.

Studies have demonstrated how AI can enhance decision-making capabilities for construction managers by processing real-time data from Internet of Things (IoT) sensors, cameras, and drones to detect inefficiencies and bottlenecks. AI-powered predictive analytics tools, for instance, help project managers anticipate risks such as equipment malfunctions or labor shortages, allowing them to implement proactive measures that mitigate delays and cost overruns [28].

Safety on construction sites is a critical concern, and AI technologies have been widely applied to enhance safety protocols. Computer vision, a subfield of AI, has become instrumental in monitoring construction sites, ensuring compliance with safety standards, and reducing the likelihood of accidents. Several studies highlight how AI-based surveillance systems can track worker movements, detect unsafe behaviors, and verify the use of personal protective equipment (PPE), such as helmets and harnesses [29,30].

Moreover, AI-driven safety monitoring systems, equipped with sensor technologies, can detect hazards like structural instability or gas leaks in real time, providing an additional layer of safety for workers. These systems help shift the focus of site safety management from reactive measures to proactive prevention, reducing the number of accidents and creating a safer working environment. AI has been pivotal in advancing construction automation and robotics, where machines are now capable of performing tasks that were once entirely dependent on human labor [31].

Furthermore, AI-enabled drones and autonomous vehicles are becoming more prevalent in the construction sector, performing tasks such as land surveying, material transportation, and structural inspections. These autonomous systems use AI algorithms to analyze construction site conditions and terrain, providing critical data that allow for more accurate project planning and monitoring. AI applications extend beyond the construction phase, with growing adoption in building maintenance and facility management. AI-based predictive maintenance systems utilize data from sensors embedded in buildings and infrastructure to monitor the condition of structural elements continuously. These AI systems can predict failures before they happen, enabling maintenance teams to address potential issues early and reduce the risk of costly repairs or downtime [11]. For instance, AI algorithms can detect cracks in concrete, corrosion in steel structures, or weaknesses in a building's foundation, which allows for timely interventions. In facility management, AI-powered platforms optimize resource usage, such as energy consumption, by adjusting HVAC systems, lighting, and water usage based on occupancy data.

3.3. Artificial Intelligence (AI)'s Potential Impact on Job Roles and Future Careers in Construction Industry

The construction industry is undergoing a significant transformation as AI technologies continue to gain traction. AI's potential to reshape job roles and create new career paths is profound, with implications for both the workforce and the broader industry. As automation, machine learning (ML), and other AI-driven technologies become more integrated into construction processes; traditional roles are evolving, and new, technology-centric positions are emerging. The recent literature explores how AI is impacting construction in terms of labor, project management, design, safety, and future careers [32].

One of the most notable impacts of AI in the construction industry is the automation of labor-intensive tasks. AI-powered machinery, such as robots and autonomous vehicles, is being increasingly utilized to perform repetitive, hazardous, or physically demanding tasks. Automation technologies such as AI-driven robots can carry out tasks like bricklaying, welding, and demolition with greater precision and efficiency than human laborers. This shift is expected to reduce the need for manual labor, particularly in lower-skilled roles, leading to potential displacement in certain job categories [30].

While there is concern about job displacement, AI is also creating new opportunities for workers with advanced technical skills. As robots and autonomous systems become more prevalent on construction sites, there is a growing demand for professionals who can design, operate, and maintain these systems. This shift emphasizes the need for reskilling and upskilling the construction workforce to meet the demands of an increasingly automated industry [29].

AI is also revolutionizing construction project management by enhancing decision-making and optimizing resources. AI-driven project management platforms can analyze vast amounts of data, allowing managers to make informed decisions about scheduling, budgeting, and resource allocation. AI tools can predict project delays, optimize timelines, and suggest alternative courses of action to avoid cost overruns. These capabilities are transforming the role of project managers, who must now be proficient in using AI technologies to improve project efficiency and outcomes [11].

However, rather than replacing human managers, AI is viewed as augmenting their capabilities. Project managers who can harness the power of AI tools will be able to focus on higher-level strategic tasks, such as stakeholder management and long-term planning, while delegating routine, data-driven tasks to AI systems. As a result, the future of project management in construction will require a combination of traditional leadership skills and technological proficiency [33].

AI also plays a transformative role in the design phase of construction projects. AI-powered software is capable of generating design alternatives, optimizing structural elements for efficiency, and improving sustainability. For example, machine learning algorithms can analyze vast datasets to propose designs that minimize material waste, reduce energy consumption, and enhance structural integrity [34]. AI's ability to optimize designs in terms of both aesthetics and functionality is driving a shift in the role of architects and engineers.

Architects and engineers are increasingly working alongside AI systems to co-create designs, which requires them to develop new skill sets in AI-driven design tools. This collaboration between AI and human professionals represents a major shift in the construction industry, where creative and technical expertise must now be complemented by a strong understanding of AI technologies [35]. The future of careers in construction design will likely involve a deeper integration of AI into the design process, requiring professionals to continuously adapt to new technological advancements.

AI's role in improving safety and risk management on construction sites is another area where a significant impact is anticipated. AI systems can monitor construction sites in real time, identifying potential hazards and ensuring compliance with safety regulations. For instance, AI-powered cameras and sensors can track the movements of workers and equipment, alerting supervisors to potential safety violations or dangerous conditions [36]. AI can also analyze past safety data to predict accidents and recommend preventive measures, shifting the focus of safety officers from reactive to proactive management [37].

The growing integration of AI in the construction industry is reshaping traditional roles and creating new career opportunities. AI specialists, data scientists, and robotics engineers are becoming essential contributors to construction projects, developing and managing AI-driven systems that enhance efficiency, safety, and design [38]. As AI becomes more embedded in safety protocols, construction safety officers will need to be proficient in using AI tools to monitor and mitigate risks. This shift is driving demand for professionals with expertise in both construction safety and AI technology, leading to the emergence of AI-driven safety management roles. The increasing reliance on AI is also transforming the skill sets required for construction careers, placing those who can integrate AI technologies—whether through data analysis, machine learning, or robotics—at the forefront of industry advancements [39].

4. Research Methods

This study utilized a quantitative analysis approach to analyze data collected from undergraduate students in the Department of Construction Management at a university located in the Southeastern United States. The data collection process incorporated a survey designed to capture both quantitative and qualitative insights, tailored to the nature of the questions.

The survey instrument was carefully developed and reviewed by the UNF Institutional Review Board (IRB) to ensure compliance with ethical research standards. Following IRB approval, UNF's Center for Instruction and Research Technology (CIRT) assisted in designing the survey using Qualtrics and facilitated its anonymous distribution to students within the Construction Management program.

A total of 99 responses were obtained, representing a diverse sample of freshmen, sophomores, juniors, and seniors. The survey comprised 18 questions grouped into five primary themes. Table 1 presents a detailed breakdown of the survey questions, categorized by theme and the corresponding analytical approach employed based on the question type.

Table 1. Categorize Questions and Analysis by Survey Questionnaires.

Categorize Questions	No.	Questions	Analysis by Question Type
General Demographic Data (Questions 1–3)	Q1	What best describes your gender?	Frequency counts and Percentages
	Q2	What is your year in school?	
	Q3	Are you a veteran student?	
Familiarity/Understanding of AI in Construction (Questions 4–6)	Q4	How familiar are you with artificial intelligence (AI) and its applications in construction engineering?	Frequency counts and Percentages
	Q5	Have you ever used AI-based tools or technologies in any of your construction-related coursework or projects?	
	Q6	How have you observed AI is currently being applied in the construction industry?	
Perceptions of AI’s Impact (Questions 7–9)	Q7	To what extent do you believe AI will impact the construction industry in the next 5–10 years?	Likert-Scale Analysis and Cross-Tabulate
	Q8	Which of the following areas do you think AI can most significantly improve in construction? (Select all that apply)	
	Q9	Do you think AI can help improve safety and reduce accidents on construction sites?	
Educational Interest in AI (Questions 10–12)	Q10	Would you be interested in learning more about AI applications in construction as part of your studies?	Frequency counts and Percentages
	Q11	Would you take a course focused on AI and machine learning in construction engineering if it were offered?	
	Q12	Do you believe understanding AI technology will be necessary for your future career in construction engineering?	
Challenges and Concerns (Questions 13–15)	Q13	What are the biggest challenges or concerns you associate with the use of AI in construction? (Select all that apply)	Likert-Scale Analysis and Cross-Tabulate
	Q14	Do you think AI will reduce the number of jobs available in the construction industry?	
	Q15	What kind of skills do you think would be important to learn in order to effectively use AI in construction? (Open-ended)	
Future of AI in Construction (Questions 16–18)	Q16	In your opinion, how will AI change the role of construction managers in the future?	
	Q17	Which AI technologies do you think will be most useful in construction in the next decade? (Select all that apply)	
	Q18	How do you feel about the potential for AI to create new opportunities in construction (e.g., new jobs, improved project efficiency, etc.)?	

For quantitative analysis, both descriptive statistics and inferential statistical methods were employed to explore differences in students’ perceptions of AI by year of study. Analysis of Variance (ANOVA) and descriptive data analysis were used to compare group means

across different student groups. ANOVA was applied to questions where comparisons were made between more than two groups (e.g., differences among freshmen, sophomores, juniors, and seniors). This analysis allowed for the examination of statistical significance in the observed group differences, providing insights into whether variations could be attributed to chance.

5. Findings and Results

The findings are based on survey responses collected from 99 undergraduate students enrolled in the Department of Construction Management at a university located in the Southeastern United States. This analysis incorporates frequency counts, percentages, and Analysis of Variance (ANOVA) to explore variations in perceptions of AI across students' academic years. Table 2 provides a descriptive analysis of the respondents' demographic and academic profiles. The majority of participants are male, accounting for 84% (84 students), while females represent 15% (15 students). This gender distribution aligns with trends in the Department of Construction Management and reflects broader industry patterns, where male representation has historically been dominant. A minor portion of data (1%) is missing due to one participant not specifying their gender.

Table 2. Student Profile.

		Frequency	Percent (%)
Sex	Male	84	84
	Female	15	15
	Total	99	99
	Missing	1	1
School year	Freshman	2	2
	Sophomore	4	4
	Junior	59	59
	Senior	35	35
	Total	100	100
Veteran students	Veteran	6	6
	Non-veteran	94	94
	Total	100	100

The sample includes students from all academic levels, with distribution as follows: freshmen (2%, 2 students), sophomores (4%, 4 students), juniors (59%, 59 students), and seniors (35%, 35 students). Juniors form the largest group, likely reflecting program enrollment patterns, while freshmen and sophomores constitute smaller segments of the population. Additionally, 6% (6 students) of the respondents are veterans, and the remaining 94% (94 students) are non-veterans.

To address the first objective, we examined students' awareness and understanding of AI applications in the construction industry. Table 3 shows students' familiarity and experience with AI in construction. Regarding familiarity with AI, students' self-reported knowledge levels varied significantly:

- 15% (15 students) indicated they were "Not familiar" with AI;
- 60% (60 students) described themselves as being "Somewhat familiar";
- 23% (23 students) considered themselves "Very familiar".

Table 3. Familiarity/Understanding of AI in Construction.

Familiarity	Not familiar	15	15
	Somewhat	60	60
	Very	23	23
	Total	98	98
	Missing	2	2
	Total	100	100
AI Usage Experience	Yes	55	55
	No	43	43
	Total	98	98
	Missing	2	2

These findings suggest that while the majority of students have at least a basic awareness of AI concepts, only a quarter feel highly knowledgeable. In terms of practical experience, 55% (55 students) reported having some level of experience with AI technologies, whereas 43% (43 students) indicated no experience. A small percentage (2%, two students) did not respond to this question.

This distribution underscores that over half of the respondents have had some exposure to AI, but there is a significant portion with limited or no practical experience. This suggests a need for greater integration of AI-related content into the Construction Management curriculum to ensure students are adequately prepared to engage with these technologies in professional settings.

The findings highlight disparities in students' familiarity and experience with AI, which may impact their readiness to incorporate AI into construction processes. Given the increasing importance of AI in the construction industry, the results emphasize the need to enhance educational opportunities and practical exposure to AI within the program. Addressing these gaps could foster a workforce better equipped to leverage AI-driven innovations effectively.

Table 4 summarizes students' perception of AI's potential impact on job roles, productivity, safety, and innovation in the industry, addressing this study's second objective. The mean score for Q7 is 3.77, indicating that, on average, students perceive AI as having a "Significant Impact" on the construction industry over the next 5–10 years. Similarly, the mean score for Q18 is 3.69, reflecting a generally positive outlook toward AI's potential to create new opportunities, such as generating jobs and enhancing project efficiency. These relatively high mean scores, coupled with slight negative skewness, suggest a strong overall optimism among students about AI's transformative potential and its future role in the industry.

Table 4. Students' awareness and understanding of AI applications in the construction industry.

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistics	Statistics	Statistics	Statistics	Std. Error	Statistics	Std. Error
Q7	98	3.77	0.810	−0.257	0.244	−0.352	0.483
Q9	98	2.66	1.015	0.178	0.244	−0.555	0.483
Q18	96	3.69	0.998	−0.436	0.246	−0.281	0.488

In contrast, the mean score for Q9 is 2.66, which falls closer to the “Neutral” point. This indicates that students are somewhat undecided about AI’s ability to improve safety and reduce accidents on construction sites. The higher standard deviation and flatter kurtosis observed for Q9 suggest a broader range of opinions, reflecting diverse perspectives and potential ambivalence on this topic. This uncertainty may stem from a lack of familiarity with or exposure to specific examples of AI applications in construction site safety.

Students express enthusiasm about AI’s broader impact on the construction industry and its potential to drive innovation and create opportunities. However, the mixed perceptions regarding AI’s role in improving safety highlight an area for further educational focus. Incorporating real-world examples and case studies into the curriculum could help address this gap by demonstrating how AI technologies are being used to enhance safety on construction sites effectively. Providing concrete evidence of AI’s safety applications may not only clarify its benefits but also inspire greater confidence among future construction professionals.

Skewness and kurtosis are statistical measures that describe the shape and distribution of a dataset. Skewness indicates the degree of asymmetry in the data. A positive skew means more respondents gave lower ratings, while a negative skew suggests higher ratings were more common. For example, in our study, Question 7 (AI’s impact on the construction industry) shows a slightly negative skew, indicating that most respondents are optimistic about AI’s future role. However, an absolute skewness value below 1 suggests the data are approximately symmetric and not significantly skewed [40].

Kurtosis measures the “tailenders” of a distribution or its tendency to produce extreme values. A high kurtosis indicates a sharper peak and heavier tails, meaning a greater likelihood of outliers. In our study, the kurtosis values for Question 18 suggest some variability in respondents’ views on AI’s ability to create new opportunities. While many see AI as beneficial for construction, some express concerns about job displacement or implementation challenges. However, an absolute kurtosis value below 3 suggests the data do not have excessive tails compared to a normal distribution [41]. In this study, the highest absolute values of skewness and kurtosis are 0.436 and 0.555, respectively. These values indicate that the dataset is approximately symmetric and does not exhibit extreme tails, aligning closely with a normal distribution.

In addition, to validate the assumptions of normality and homogeneity of variance, the Shapiro–Wilk test and Levene’s test were employed. The statistics from the Shapiro–Wilk tests were close to 1, indicating that the variables followed a normal distribution and, thus, failed to reject the normality assumption. Moreover, Levene’s tests were conducted to check for homogeneity of variance before ANOVA was used. The results failed to reject the assumption of equal variance, indicating that the variances of the groups were approximately equal; therefore, we proceeded with ANOVA.

5.1. Perception Difference by Sex

Students’ awareness and understanding of AI applications in construction would differ by sex, school year, and veteran status. The following section presents the results. Table 5 presents the results of the ANOVA test, which evaluates whether students’ awareness and understanding of AI applications in construction vary by gender. The test yielded a *p*-value greater than 0.05, indicating that the null hypothesis could not be rejected. This finding suggests no statistically significant difference in AI perceptions between male and female students.

These results indicate that gender does not play a substantial role in shaping attitudes toward AI within this sample. Both male and female students demonstrate similar levels of awareness and understanding of AI applications in the construction industry. This

consistency highlights a shared perspective among students, irrespective of gender, on the importance and potential impact of AI in their field.

Table 5. ANOVA test results: Perception Difference by Sex.

		Sum of Squares	d.f.	Mean Square	F	Sig. (p-Value)
Q7	Between Groups	0.172	1	0.172	0.261	0.611
	Within Groups	63.430	96	0.661		
	Total	63.602	97			
Q9	Between Groups	2.008	1	2.008	1.970	0.164
	Within Groups	97.880	96	1.020		
	Total	99.888	97			
Q18	Between Groups	1.601	1	1.601	1.617	0.207
	Within Groups	93.024	94	0.990		
	Total	94.625	95			

5.2. Perception Differences by School Year

Table 6 presents the ANOVA test results assessing whether students' awareness and understanding of AI applications in construction vary by academic standing. For ANOVA to produce meaningful results, each group must contain multiple cases to ensure sufficient within-group variance for comparison [42]. In this study, only one freshman participant was represented, which led to their exclusion from the analysis to meet these requirements.

Table 6. ANOVA test results: Perception Difference by School Year.

		Sum of Squares	d.f.	Mean Square	F	Sig.
Q7	Between Groups	2.439	2	1.219	1.976	0.144
	Within Groups	58.015	94	0.617		
	Total	60.454	96			
Q9	Between Groups	0.775	2	0.387	0.369	0.692
	Within Groups	98.669	94	1.050		
	Total	99.443	96			
Q18	Between Groups	2.119	2	1.060	1.059	0.351
	Within Groups	92.028	92	1.000		
	Total	94.147	94			

The ANOVA test yielded a p -value greater than 0.05, indicating that the null hypothesis could not be rejected. This finding suggests no statistically significant differences in AI perceptions across academic years. Students from different levels (e.g., sophomores, juniors, and seniors) exhibit similar attitudes and understanding of AI within this sample.

These results imply that academic standing does not substantially influence students' perceptions of AI in the construction industry. This shared perspective across school years highlights a consistent level of awareness and understanding of AI applications, regardless of students' progression within the program.

5.3. Perception Differences by Veteran Status

Table 7 presents the ANOVA test results examining whether students' awareness and understanding of AI applications in construction differ by veteran status. The ANOVA test yielded a p -value greater than 0.05, leading us to fail to reject the null hypothesis. This indicates no statistically significant difference in AI perceptions between veteran and non-veteran students. Thus, veteran status does not appear to significantly influence students' attitudes toward AI, as both groups in this sample demonstrate similar views on the topic.

Table 7. ANOVA test results: Perception Difference by Veteran Status.

		Sum of Squares	<i>d.f.</i>	Mean Square	F	Sig.
Q7	Between Groups	0.450	1	0.450	0.684	0.410
	Within Groups	63.152	96	0.658		
	Total	63.602	97			
Q9	Between Groups	0.000	1	0.000	0.000	0.993
	Within Groups	99.888	96	1.040		
	Total	99.888	97			
Q18	Between Groups	0.625	1	0.625	0.625	0.431
	Within Groups	94.000	94	1.000		
	Total	94.625	95			

The ANOVA test results across gender, school year, and veteran status indicate no statistically significant differences in students' awareness and understanding of AI applications in construction. P -values greater than 0.05 in each test led to failure to reject the null hypothesis, suggesting that factors such as gender, academic standing, and veteran status do not meaningfully influence students' attitudes toward AI. Overall, students in this sample, regardless of these demographic variables, share similar perspectives on AI in construction.

5.4. AI Technologies Preferences in Construction (Q17)

The most popular responses were related to AI-powered design and modeling software, with 13% of respondents selecting this option. Drones for surveying and site monitoring were also a popular choice, selected by 13% of respondents. The combination of multiple technologies suggests that respondents see value in integrating different AI solutions. The chi-square test results comparing Q17 responses with academic levels: the p -value of 0.2276 suggests that there is not a statistically significant relationship between academic level and technology preferences. Figure 1 shows the distribution of preferences for different AI technologies in construction, with clear bars and percentage labels for easy interpretation.

The analysis of Q17 has shown that there was no significant relationship between academic level and preferences for AI technologies in construction, as indicated by the chi-square test. The visualization effectively highlights the distribution of preferences, with AI-powered design and modeling software being the most popular choice.

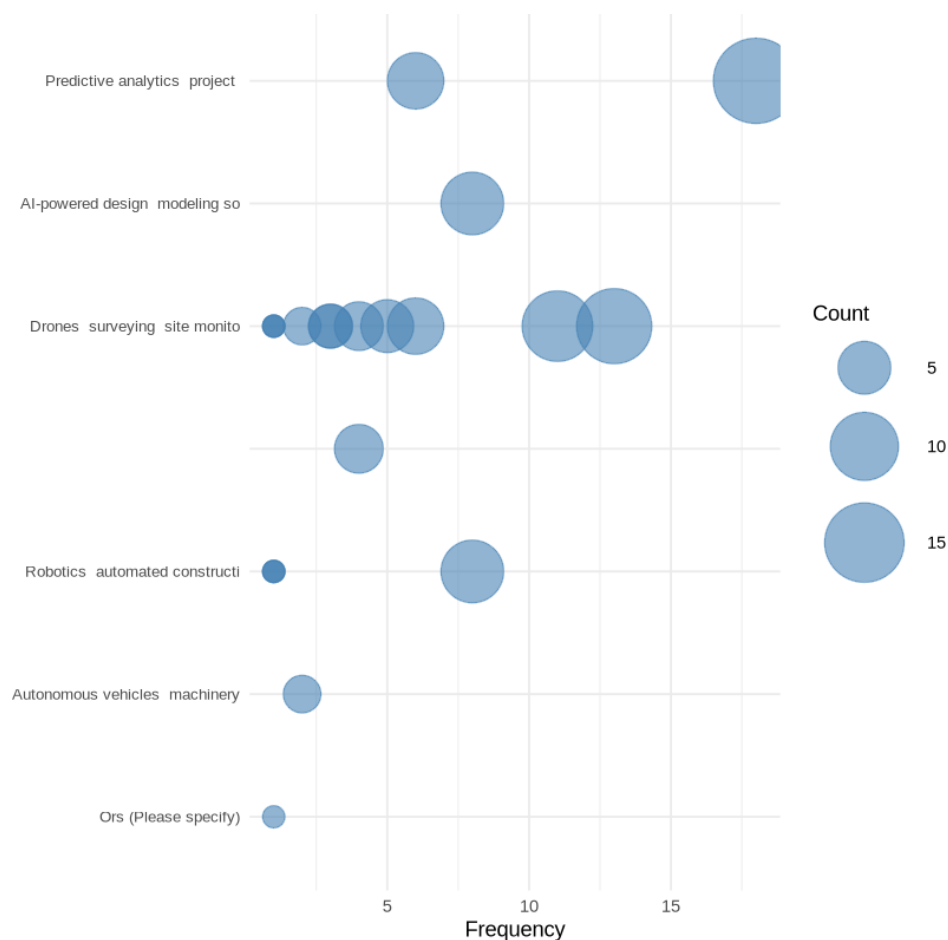


Figure 1. Distribution of preferences for different AI technologies in construction.

5.5. Interest on Course (Q10)

We assumed that students' awareness and understanding of AI applications in construction reflect differences in educational interest. Table 8 presents the results, with p -values for Q7 and Q18 below 0.05, indicating significant differences in educational interest based on students' perceptions of AI.

Table 8. ANOVA test results: Perception Difference by Interest Level on Course.

		Sum of Squares	<i>d.f.</i>	Mean Square	F	Sig.
Q7	Between Groups	18.413	2	9.206	19.354	0.000
	Within Groups	45.189	95	0.476		
	Total	63.602	97			
Q9	Between Groups	5.178	2	2.589	2.597	0.080
	Within Groups	94.710	95	0.997		
	Total	99.888	97			
Q18	Between Groups	8.194	2	4.097	4.409	0.015
	Within Groups	86.431	93	0.929		
	Total	94.625	95			

To identify the specific groups contributing to these differences, a Scheffé test was performed, with the results displayed in Table 9. The table displays the results of the Scheffé

test, categorizing students by their level of interest in AI applications in education: Group 1 reflects high interest; Group 2 has moderate interest, and Group 3 has no interest. In the “Differences” row, numbers in parentheses identify groups that are significantly different from the reference group (the group number outside the parentheses).

Table 9. Results of Scheffé Test.

Interest	Q7			Q18		
	1. very	2. somewhat	3. no interest	1. very	2. somewhat	3. no interest
Differences	1 (2,3)	2 (1,3)	3 (1,2)	1 (3)	2	3 (1)
N	50	41	7	49	40	7
Mean	4.12	3.54	2.57	3.92	3.55	2.86

For Q7, the mean values rise as interest levels increase, indicating that students with stronger perceptions of AI are also more eager to learn about its applications in construction. Similarly, Q18 results reveal that students with a pronounced interest in educational opportunities score higher in AI perception. This suggests that students with more positive perceptions of AI are also more motivated to pursue educational pathways focused on AI applications, pointing to a potential link between positive AI perceptions and academic engagement in related fields.

5.6. Intention to Take Course (Q11)

This study also assesses the differences in students’ intentions to take the course based on their level of awareness and understanding of AI applications in construction. Table 10 presents the results, with *p*-values for Q7, Q9, and Q18 below 0.05, indicating significant differences in students’ intentions to enroll in AI-related courses within the field of construction based on their perceptions of AI.

Table 10. ANOVA test results: Perception Difference by Intension Level to Take AI-related Construction Management Courses.

		Sum of Squares	d.f.	Mean Square	F	Sig.
Q7	Between Groups	8.543	2	4.272	7.371	0.001
	Within Groups	55.059	95	0.580		
	Total	63.602	97			
Q9	Between Groups	6.160	2	3.080	3.122	0.049
	Within Groups	93.728	95	0.987		
	Total	99.888	97			
Q18	Between Groups	7.845	2	3.923	4.204	0.018
	Within Groups	86.780	93	0.933		
	Total	94.625	95			

To pinpoint the specific groups contributing to these differences, a Scheffé test was conducted, and the results are displayed in Table 11. The table presents the Scheffé test results, categorizing students by their level of intention to enroll in AI courses within construction engineering: Group 1 represents those with no intention, Group 2 with moderate intention, and Group 3 with high intention. Except for Q7, no significant differences were observed among groups based on intention level.

Table 11. Results of Scheffé Test.

	Q7			Q9			Q18		
Intention	1. None	2. Maybe	3. Yes	1. None	2. Maybe	3. Yes	1. None	2. Maybe	3. Yes
Differences	1 (3)	2	3 (1)	1	2	3	1	2	3
N	13	29	56	13	29	56	13	27	56
Mean	3.08	3.69	3.96	2.92	2.97	2.45	3.31	3.37	3.93

For Q7, students with a high intention to pursue educational opportunities showed higher perception scores. This suggests that students with more positive perceptions of AI are more inclined to engage in educational pathways focused on AI applications in construction.

5.7. Necessity of AI Education (Q12)

We posited that students might differ in their perceptions of the necessity of AI education based on their views on AI. Table 12 shows that only the p -value for Q7 is below 0.05, indicating significant differences in students' perceptions of the necessity of AI education based on their views on AI.

Table 12. ANOVA test results: Perception Difference by Necessity of AI Education.

		Sum of Squares	<i>d.f.</i>	Mean Square	F	Sig.
Q7	Between Groups	10.653	2	5.327	9.557	0.000
	Within Groups	52.949	95	0.557		
	Total	63.602	97			
Q9	Between Groups	0.484	2	0.242	0.231	0.794
	Within Groups	99.404	95	1.046		
	Total	99.888	97			
Q18	Between Groups	2.233	2	1.116	1.124	0.329
	Within Groups	92.392	93	0.993		
	Total	94.625	95			

To identify the specific groups contributing to these differences, a Scheffé test was conducted, and the results are displayed in Table 13. The table displays the Scheffé test results. Students who perceive AI education as necessary demonstrated higher perception scores. This suggests that students with stronger perceptions of AI are more likely to consider learning AI applications to be important.

Table 13. Results of Scheffé Test.

	Q7		
Necessity	Yes	No	Not sure
Differences	1 (2)	2 (1)	3
N	75	7	16
Mean	3.92	2.71	3.50

6. Conclusions and Discussions

The findings of this study emphasize the critical need to reshape education and training for construction professionals in response to the expanding influence of AI in the industry. There is a growing demand for programs that combine construction expertise with AI proficiency, and universities are starting to address this need by integrating AI-focused curricula. Preparing students for an increasingly technology-driven construction industry will be essential to ensuring that the future workforce can thrive in an AI-enhanced environment. With AI rapidly reshaping job roles and opening new opportunities, individuals who are both adaptable and technologically skilled will be best positioned to succeed.

AI applications are already revolutionizing key areas of construction, including design, project management, site safety, automation, and facility management. The integration of AI allows construction companies to optimize workflows, reduce costs, enhance safety measures, and elevate the quality of their projects. With ongoing advancements in AI research, the technology's potential to transform the construction industry continues to expand.

Among undergraduate students, however, there is a varied understanding of AI, with notable disparities in AI literacy across different academic disciplines. Students in technical fields generally demonstrate a stronger grasp of AI concepts, while those in non-technical fields may lack a deeper understanding despite recognizing AI's relevance to their future careers. Barriers such as limited access to AI coursework, the technical complexity of AI, and common misconceptions impede students' engagement with the subject. Addressing these gaps in AI literacy is essential, particularly as AI's impact on job roles within construction is expected to be transformative. The automation of labor-intensive tasks, integration of AI in project management and design, and the emergence of new career paths highlight a future where AI plays a central role in the construction workforce. Though concerns about job displacement remain, AI also presents opportunities for those with advanced technical skills in areas like AI and robotics. The evolving industry landscape underscores the need for ongoing education and training to ensure that construction professionals are equipped with both traditional expertise and AI proficiency.

Overall, students exhibit a positive outlook toward AI. A majority expressed enthusiasm, with 57% identifying as "Somewhat Optimistic" or "Very Excited". Students' primary interest areas include AI-powered design and modeling software, robotics for automated construction tasks, and drones for site surveying and monitoring. This generally receptive attitude among future professionals suggests a promising landscape for AI adoption in construction. However, students also voiced practical concerns about AI integration, specifically related to job security and technical competency. Addressing these concerns through targeted education will be crucial to preparing students for an AI-enabled construction environment. Furthermore, students' focus on AI for technical and design applications rather than administrative functions indicates a practical and grounded understanding of AI's most valuable roles in the field.

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