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Using Artificial Intelligence (AI) Tools in Construction Safety Course

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Industry 3.0 and 4.0 have shown the integral use of information technology (IT) in various fields including the construction industry and academia. Recently, artificial intelligence (AI) tools crept in and so the academia embraced it in ways that needed to be productive in the learning efforts. Specifically, ChatGPT made everyone rethink how to engage with the tool positively as plagiarism issues were rife. Therefore, this research examined the use of AI tools among students in the construction safety course with the objective of determining the use of ChatGPT in answering assignments towards student grades. A survey questionnaire was distributed to 50 students about using AI tools such as ChatGPT in assignments. Data gathered were analyzed using SAS on Demand. Results showed that most students were aware of ChatGPT, and they used it in answering various assignments, especially writing assignments. It was recommended that the course assignments be revised to reflect effective use of AI tools for future courses. This research contributed to the overall body of research and knowledge related to AI use in academia and the construction industry.

Keywords: Artificial Intelligence (AI); Construction Industry; Construction Safety; Information Technology

Introduction

According to the Global Construction Report 2030, the construction industry is expected to grow by about 90% to $20 trillion worldwide by 2030 with US and China as leaders (Sharma and Gupta, 2025; Robinson, 2025). This growth comes with many challenges especially in the field of construction safety where many fatalities are recorded every year (Lee et al., 2025).

According to the recent statistics, the United States Bureau of Labor Statistics (2023) reported construction fatalities to be 1056. An increasing fatality rate was shown from 12.3-13.0 deaths per 100,000 full-time equivalent employees during the year 2022-23, which was about 5 times higher than the reports from non-construction industry sectors. Feng et al. (2015) noted that the problems arising from construction injuries could result in 5-10% of project cost which could deter project success.

To prevent the construction injuries/accidents from happening and reducing the eventual economic losses to the dynamic workforce, there is need for improved ways to enhance construction project

safety observances. Current practices such as job hazard/safety and environmental analysis, hazard registers have been in use due to their proven performance and effectiveness as reported by safety managers' practical tools (Choi and Koo, 2023) but there seems to be a gap in their usages across the construction safety environment. Could a good construction site safety program be the solution?

Innovative approach to safety management system has seen a rise in the application of artificial intelligence (AI) technology in the construction safety environment. Adopting AI into safety management presents avenues for improved functionalities for instant construction risk identification, prediction of accidents, and streamlining processes for better safety indices (Fagarasian, 2025; Vemuri et al., 2022)**.** Arising technologies for improving construction safety such as smart cameras, Internet of things (IoT), sensors, and drones enable continuous monitoring of project sites for better accident prevention measures (Fagarasian, 2025; Vemuri et al., 2022). AI is a part of these technologies, and they work in togetherness for better project safety outcome.

Adopting AI technologies in the construction field means that the academic field is also affected as much because students must master the art and science of the technologies for their eventual applications in the construction industry. In as much as AI tool (i.e., ChatGPT) was abhorred in the academic setting when it first came into use by students, it later gained traction as was shown in the USA (Novac, 2023). In fact, some schools clearly banned the use of AI in their course work but with the developments over time, it later became acceptable tool to be used in academic settings. A specific case was in New York public school system rejecting ChatGPT in January 2023 and then accepting it three months later (Novac, 2023). As such, AI has formed the everyday buzzword for everyone in both academic and construction field. The idea is to use it constructively rather than destructively where you make AI do the work for you and replacing human thinking or intelligence rather than making human thinking supreme in anything requiring good output.

In the academic setting, the use of AI tools has been encouraged for positive uses where students have been advised to use AI tools for idea gathering (for example) for better understanding and synthesis of information. But this has not been the case and there seems to be a lag in this phase. Thus, this research examined the use of AI tools among students in the construction safety course with the objective of determining the use of ChatGPT in answering the assignments towards their semester grades. Most importantly, it assessed the level by which students used AI tools in assignments which included tests, homework, and a semester project which was a site-specific safety plan project which mimicked the construction industry approach to enhancing safety in jobsites.

Literature review section follows and it addressed AI specifically by defining it and its application in construction safety with special focus on ChatGPT in academic setting.

Literature Review

Defining Artificial Intelligence (AI)

Various studies have examined the use of AI tools in construction safety with the goal of lowering occupational risks and enhanced jobsite safety and security (Lee et al., 2025; Cheng et al., 2025). In various research, AI had been defined as a field of computer science that deals with creating smart machines that perform roles that are meant for human intelligence such as experiential learning,

recognizing patterns, understanding natural language, otherwise called natural language programing (Sharma and Gupta, 2025), and also involves robotics, computer vision (CV) and knowledge based systems (Rabbi and Jeelani, 2024). The process involves machine learning which is training algorithms to learn from data and predict outcomes. Such can be used in project planning to inform costs, schedules, estimates and safety in ways that significantly impact project outcomes (Ellis, 2025). Awuzie and Moghayedi (2024) and Obi et al. (2025) refers to AI as simulated human intelligence in machines that are programmed to find solutions, think, learn and act like people. AI has also been defined as the ability of machines to learn, make decisions, and perform tasks that are usually accomplished through human intelligence and the associated disciplines are computer science, cybernetics, biology, mathematics, and psychology (Obi et al., 2025; Haleem et al., 2022).

Studies posit that AI uses data and algorithms to enable machines to perform over time without the need for programming every time and that it has been used widely in various industries for innovation, accuracy, efficiency, quality control and overall value improvement (Obi et al., 2025; Vukovic et al, 2025). These uses show the adaptability and transformative capability of AI across different fields. The construction industry has not been an exception, especially in the field of construction safety where there have been technological advancements where AI adoption is significant in enhancing safety indices of construction companies (Polmear and Simmons, 2022).

Artificial intelligence (AI) and Construction Safety

Industry 3.0 and 4.0 have shown the integral use of information technology (IT) in various fields whereby the construction industry and academia have not been exempted. Specifically, Industry 3.0 focused on process automation with IT and computers at the forefront in creating digital systems while industry 4.0 focused on AI, IoT, big data, etc., for real time operations. Since the construction industry is the most hazardous field with high incidence of fall accidents (Cheng et al., 2025; Huang & Hinze, 2003), it is paramount that fatalities are identified and reduced through improved methods using ideas from Industry 3.0 and 4.0, even simultaneously if possible. According to Occupational Health and Safety Administration (OSHA), construction worker fatalities were about 50% of all fatalities in USA in the year 2021 (Han et al., 2025; Maali et al., 2024). Work heights, environmental conditions, equipment used in jobs, personal protective equipment (PPE) usage, actual knowledge of safety and action of workers present high risks of accidents. Also, there has been instances of human error being mentioned as major factor contributing to jobsite accidents (Fu et al., 2024; Hasanzadeh et al., 2017). These problems of project safety can be addressed with AI integration in projects.

AI algorithms will allow for real time visualization of construction project sites and the workers thereby making it easy for prompt detection of potential hazards and providing preventive measures for possible accidents or injuries. Also, AI tools can analyze project data such as past project accidents and be able to see patterns that can inform future safety avenues for prevention of repeat accidents. These can also lead to improved worker training and change of work processes for better safety index. AI powered robots and drones can also inspect project sites thereby reducing probability of accidents and increasing overall jobsite efficiency (Rabbi and Jeelani, 2024). Computer vision techniques such as object detection and activity recognition can be pivotal in safety management systems as they can improve hazard detection, worker monitoring and site surveillance, thereby removing the traditional method of manual project site inspection by safety managers and therefore improving project safety performance as well as cost, time/schedule and overall productivity (Lee et al., 2025).

These processes are key to advancing safety in the construction industry, and academic settings could respond to these through encouraging use of AI tools in coursework. AI tools such as ChatGPT, Gemini, etc., are prevalent and their use in the academia to enhance safety is critical especially for those construction management students who are getting ready to get into the construction industry.

Use of AI tools (e.g., Chat GPT) in Education Sector

Various studies have shown that large language models (LLMs) have transformed the construction industry and academia (Wang and Fan, 2025; Leathem et al. (2025). The emergence of advanced generative AI tools such as ChatGPT has posed opportunities and challenges especially in the academia (Javaid et al., 2023). In fact, educators are seeing an increasing use of these new tools that are revolutionizing how students think, learn, collaborate and advance in their academic ladder.

Some studies have shown favorable outcomes in the use of AI tools. Lyu et al. (2024) study showed a positive relationship between the use of generative AI tools and academic achievement of students. Joshi et al. (2023) explored the use of ChatGPT among computer science students especially on their learning experience and showed a positive outcome especially with the enthusiasm it brought to the students. Wang and Fan (2025) assessed the effectiveness of ChatGPT in improving student's learning performance, learning perception and high order thinking. The outcome showed that ChatGPT had a large positive impact on improving learning performance and moderately positive impact on enhancing learning perception and fostering high level thinking. On the other hand, some studies have shown some doubting the efficacy of these tools. Arora et al. (2024) examined LLMs utilization by students and found out that in as much as the tools could be useful to students, their effectiveness and ethical observances in their usages could compromise outcomes. Issues about plagiarism, quality of the generated information, overreliance and lack of critical thinking could hinder deep learning of students especially for construction students as shown by Leathem et al. (2025). But despite the downside, these tools have the latitude to change education sector if proper training and education are put in place to improve student learning.

As such, a study was conducted to examine the use of AI tools in the construction safety course at undergraduate level with specific objective of determining the use of ChatGPT. The following research methods were adopted.

Research Methods

Aim and Objectives

The aim of the research was to examine the use of AI tools among students in the construction safety course with the objective of determining the use of ChatGPT in completing assignments towards semester grades. The end goal was to ensure that students use AI tools positively in their academic work and to enhance their safety idea developments as they get into the construction industry. An online survey questionnaire was used to collect data from students since students were already available in the class for the Spring 2025 semester of study. The data in the form of questionnaire feedback would aid in formulating the research findings and subsequent generalization.

Survey Questionnaire Design and Administration

As part of achieving the aim and objective of the research, an online survey questionnaire was administered to the construction students via Qualtrics survey software. Prior to its administration, four students (n = 4) were asked to be involved in a pilot study which tested the validity and reliability of the questionnaire items. Cronbach's alpha statistics tested the reliability of the data items with an alpha estimate of 0.87 implying that the survey questionnaire items were reliable.

The survey questionnaire was distributed to about 50 students, and it consisted of open-ended and multiple-choice questions. One part of the questionnaire had questions focusing on the respondents' demographic data such as gender, level of study, and cumulative GPA. Some other questions also required students to rate the level of writing requirement, the type of AI tools they used from the list of Gemini, ChatGPT, Claude and others, and to classify what aspect of the course assignment they used AI tools. These entailed quizzes, toolbox talk assignment, tests and final project which was a site-specific safety plan involving writing various safety guidelines for a project. The other part of the questionnaire had questions requiring the respondents to rate if they thought the AI tools were useful, or not, on a binary scale (yes/no) and to rate the level of usefulness if at all they used the tools on a 6-point Likert scale; Not helpful, Slightly helpful, Neutral, Helpful, Very helpful and Not applicable.

The research used both convenient and random sampling methods. Convenient sampling method was used to select the research participants who were students in the construction safety course in spring 2025, and then they were sent the survey where they would randomly take part in the research by voluntarily completing the survey. The convenient sampling method was used since it focused on finding those who were available for the research (Levy and Lemeshow, 2013), and it was an easier data collection method which incurred lower cost and less time (Chandler and Shapiro, 2016).

The online survey questionnaire link was distributed to the students at the conclusion of the spring 2025 semester. All respondents were assured of confidentiality and anonymity in their feedback, and this was communicated clearly in the instructions to the survey questionnaire. To further improve the response rate, respondents were informed that their feedback would help in advancing the knowledge base in the field as well as redefining the course in future.

Data Analysis

The quantitative data analysis utilized SAS on Demand statistical tool (SAS, 2026). The descriptive statistical analysis results utilized measures of central tendency and dispersion that consisted mostly of percentages. The main purpose of these analyses was to determine the level of use of the AI tools in the construction safety course. Qualitative data were analyzed and reported.

Results and Discussion

Demographics, Cumulative GPA and Level of Education

Twenty-two (22) students responded to the survey questionnaire. This sample size (n = 22) was considered adequate as required by parametric or univariate statistical analyses and tests for adequate statistical power. Usually, 20 is the minimum sample size.

Of the respondents who completed the survey, 67% were males while 28% were females and the rest (6%) preferred not to say. They were mostly undergraduate seniors (78%) and juniors (22%) considering their academic level of study. This indicates that the sample was from a population of students who were mostly higher in their academic ladder and had gone through construction internships and were knowledgeable about construction safety and therefore was believed to provide reliable data for better generalizability of the research findings. This was supported by the fact that their cumulative GPA was high with majority of them (89%) at 3.0 and above GPA showing high mastery in their area of study and thus demonstrating greater knowledge with quality data gathered.

When asked about the level of writing requirement in construction safety course, about 67% stated it was middle level followed by 20% saying it was low level while 13% thought it was high level of writing requirement. All the students (100%) felt that they needed no more writing resources to complete assignments beyond the ones they were already provided by the course instructor.

Type of AI tools used to Complete the Course Assignments

When asked about the type of AI tools they used to complete the course assignments, Table 1 summarized the results.

Table 1. Type of AI tool used in completing assignments in construction safety course (N = 22).

Tool	ChatGPT	Claude	Gemini
Frequencies(*f*)	18	2	6
Percent (%)	82	9	27

From Table 1, it is evident that students used multiple AI tools and out of those tools they used during the semester, ChatGPT was the most used followed by Gemini and Claude in that order. Those that used other tools said they used Grammarly as shown in Figure 1. Given the high frequency of ChatGPT use among students, there is a need to promote its positive and constructive application in the construction field. The extensive use of this tool in coursework suggests that such practices could carry over into professional settings as students transition into the workforce.

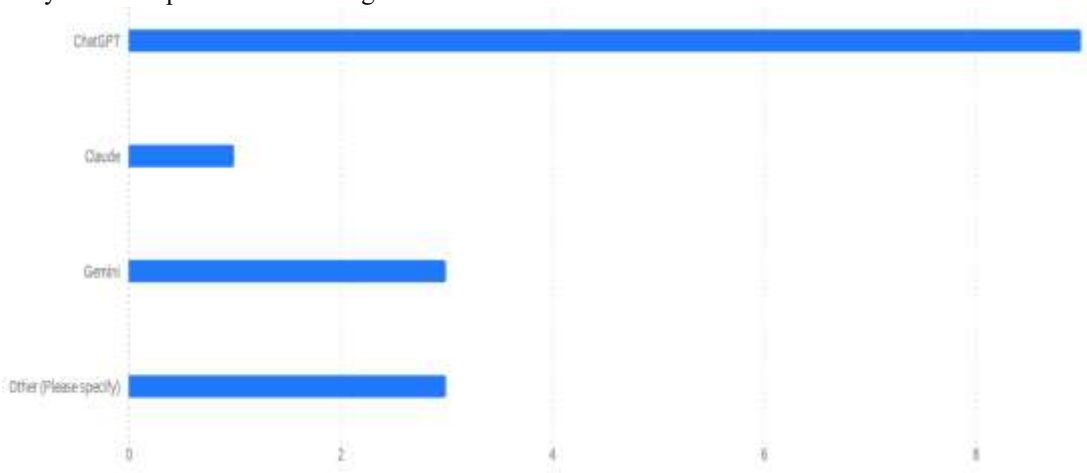

Figure 1. Type of AI tool(s) utilized.

Relative use of AI in Assignments with related Importance and Usefulness

When respondents were asked to indicate where they most frequently used AI tools in their construction safety course assignments, the site-specific safety plan course project recorded the highest usage as shown in Figure 2. The nature of assignments consisted of quizzes, tests, toolbox talk assignment, discussion board post, safety project part 1 which required students to develop the outline of the safety plan as a group, safety project part 2 which involved peer review of the completed group write-up of the safety plan, safety project part 3 which was individual write up requiring students to take all feedback and revise the safety plan for the final finished product, and a section stating that they never used any AI tool. Figure 2 gives the summary of the results.

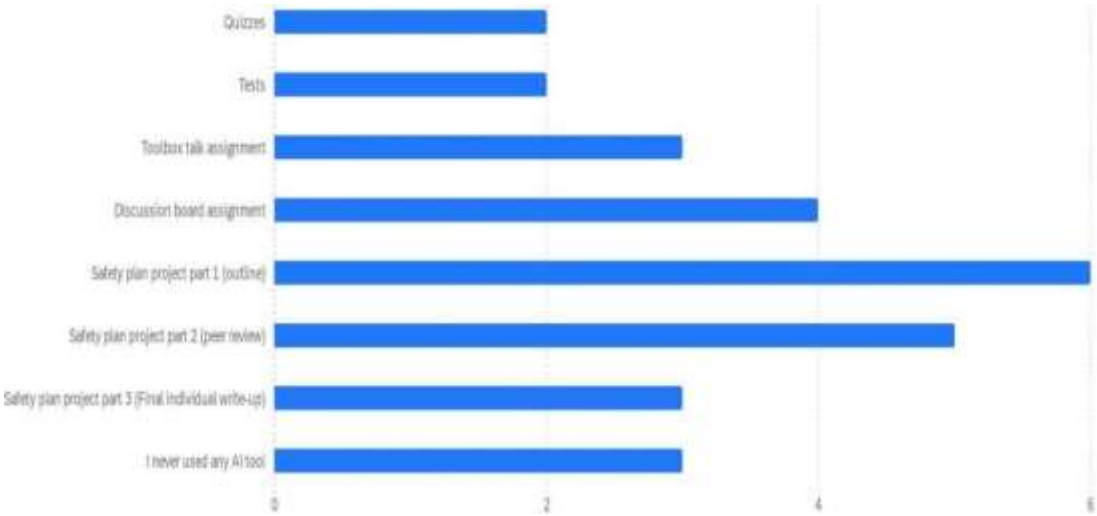

Figure 2. Course assignments where AI tool was utilized.

In Figure 2, the respondents mentioned AI tools to be useful (91%) while 9% stated that it was not useful in completing the course assignments. In fact, 60% of respondents stated AI tool was very helpful, 30% stated it was helpful while 10% were neutral to the use of AI tool in executing the various course assignments as can be seen in Figure 2. Site specific safety plan course project accrued the most in the use of AI tools which aligned with the overall accident prevention program in the overall project safety as shown by most studies in the literature review.

Frequency of AI Use in Academic Assignments

When asked how often the students utilized AI tools in their construction safety assignments on a three (3)-point Likert scale of; always = 3, sometimes = 2 and never using AI =1, an approximate of about 7% of the students stated that they always used AI tools in assignments which was mostly ChatGPT, about 64% of them stated sometimes using it while 29% of them stated that they never used AI tools in the course assignments. Those who used it asserted that AI tools helped them in better understanding the various topics and that was the main reason for using those tools in completing their course assignments.

Conclusion

Industry 3.0 and 4.0 had shown the fundamental use of IT in various fields whereby the construction industry and academia were never left out in the development of things. The emergence of AI in academia brought efforts to ensure positive use of AI for eventual successful outcome in the end. Specifically, ChatGPT made everyone rethink how to engage with the tool positively as plagiarism issues were rife. Therefore, this research examined the use of various AI tools utilized in construction safety courses with the main one being ChatGPT in focus. Literature review highlighted various ways it could be used in construction safety which was mostly centered on accident prevention. Students prepared a site-specific safety plan course project which could be applied in construction projects at the end of the semester. This aligned with the requirement of the construction industry regarding overall safety observances for construction projects. There were also other assignments, tests and quizzes which were part of assessments for students.

The results indicated that students used AI tools particularly ChatGPT in many ways in their academic assignments, with the highest usage observed in the construction site safety plan course project, and so the construction education program needed to find ways to ensure that AI tools such as ChatGPT are used constructively or positively to enhance students learning as well as improving the construction industry developments especially on areas of safety focusing on accident prevention. This is because the development of a comprehensive and effective safety plan is a prerequisite for a good construction safety and accident prevention program which will ultimately contribute to improved safety index as measured by experience modification rate (EMR) of less than 1.00 where 1.00 is the industry standard.

This study contributes to the growing research studies on the application of AI in construction safety particularly in the context of construction education. It was recommended that course delivery and assignments should be revised to reflect effective use of AI tools in future coursework. Although the study is limited by a relatively small sample size, it provides a valuable foundation for examining construction safety programs in academic settings. Improved education and training translate into better safety observances in the construction industry when students transition smoothly with safety knowledge from academia into the construction industry. Future studies may include conducting a study with larger sample size and integrating the viewpoints of construction industry personnel on how they use AI tools in writing their construction project safety plans and overall execution of safety at their construction workplaces. Also, future research could examine the effect of academic AI tools usage and practical application in construction safety management in the construction industry.

References

Arora, N., Chakraborty, I. & Nishimura, Y. (2024). Revolutionizing Marketing Research with a Large Language Model: A Hybrid AI-Human Approach. http://dx.doi.org/10.2139/ssrn.4683054

Awuzie, B. & Moghayedi, A. (2024). Harnessing 4IR/5IR technologies for improved procurement and delivery. In *Routledge Handbook of Construction Project Procurement and Delivery* (pp. 371-390). Routledge. Accesses on March 20 2026 from https://www.taylorfrancis.com/chapters/edit/10.1201/9781003351269-25/harnessing-4ir-5ir-technologies-improved-procurement-delivery-bankole-awuzie-alireza-moghayedi

Chandler, J. & Shapiro, D. (2016). Conducting clinical research using crowdsourced convenience samples. *Annual Rev Clinical Psychology*, 12:53–81.

Cheng, M. Y., Vu, Q. T. & Yang, L. K. (2025). Multidimensional fall risk assessment for the real-time monitoring of construction site Worker safety. *International Journal of Construction Management*, 1-31.

Choi, D. & Koo, C. (2023). Impact of personal characteristics on learning performance in virtual reality-based construction safety training-Using machine learning and SHAP. *Korean Journal of Construction Engineering and Management*, *24*(6), 3-11.

Ellis, G. (2025). The rise of AI in construction. Retrieved from https://www.autodesk.com/blogs/construction/ai-construction/ on March 18 2026.

FĂGĂRĂȘIAN, V. I. (2025). Work Safety in Construction and the Impact of Artificial Intelligence (AI). https://doi.org/10.2478/picbe-2025-0268

Feng, Y., Zhang, S. & Wu, P. (2015). Factors influencing workplace accident costs of building projects. *Safety science*, *72*, 97-104. https://doi.org/10.1016/J. SSCI.2014.08.008

Fu, H., Tan, Y., Xia, Z., Feng, K. & Guo, X. (2024). Effects of construction workers' safety knowledge on hazard-identification performance via eye-movement modeling examples training. *Safety Science*, *180*, 106653.

Haleem, A., Javaid, M., Qadri, M. A., Singh, R. P., & Suman, R. (2022). Artificial intelligence (AI) applications for marketing: A literature-based study. *International Journal of intelligent networks*, *3*, 119-132. https://doi.org/10.1016/j.ijin.2022.08.005

Han, Y., Chen, M., Li, N., Ji, M., & Wang, X. (2025). Digital twin in construction safety management: Recent advances, challenges, and future directions from 4M1E perspective. *Safety Science*, *192*, 107006.

Hasanzadeh, S., Esmaeili, B., & Dodd, M. D. (2017). Measuring the impacts of safety knowledge on construction workers' attentional allocation and hazard detection using remote eye-tracking technology. *Journal of management in engineering*, *33*(5), 04017024.

Huang, X. & Hinze, J. (2003). Analysis of construction worker fall accidents. *Journal of construction engineering and management*, *129*(3), 262-271.

Javaid, M., Haleem, A. & Singh, R. P. (2023). A study on ChatGPT for Industry 4.0: Background, potentials, challenges, and eventualities. *Journal of Economy and Technology*, *1*, 127–143. https://doi.org/10.1016/j.ject.2023.08.001

Joshi, I., Budhiraja, R., Dev, H., Kadia, J., Ataullah, M. O., Mitra, S., Kumar, D. & Akolekar, H. D. (2023). ChatGPT in the Classroom: An Analysis of Its Strengths and Weaknesses for Solving Undergraduate Computer Science Questions. *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1*. https://api.semanticscholar.org/CorpusID:258417916

Leathem, T., Wetzel, E., Farrow, C. B. & Umer, M. (2025). Exploring the Impact of Large Language Models on Building Construction Students: A Pilot Study. *Proceedings of Associated Schools of Con*, *6*, 142-152.

Lee, Y., Kang, G. Kim, J., Yoon, S., & Jeon, J. (2025). Generative AI-driven data augmentation for enhanced construction hazard detection. *Automation in Construction*, *177*, 106317.

Levy, P. & Lemeshaw, S. (2013). Sampling of Populations: Methods and Applications, John Wiley and Sons, 4th edition.

Lyu, W., Wang, Y., Chung, T. R., Sun, Y. & Zhang, Y. (2024). Evaluating the Effectiveness of LLMs in Introductory Computer Science Education: A Semester-Long Field Study. *ArXiv*,*abs/2404.13414*. https://api.semanticscholar.org/CorpusID:269292966

Maali, O., Ko, C. H. & Nguyen, P. H. (2024). Applications of existing and emerging construction safety technologies. *Automation in Construction*, *158*, 105231.

Novac, D (2023). Why US schools are blocking ChatGPT? Retrieved from https://learningenglish.voanews.com/a/why-us-schools-are-blocking-chatgpt-/6914320.html on March 18 2026.

Polmear, M. & Simmons, D. R. (2022). Industry perspective on the role of visualization technology in construction safety training. *International Journal of Construction Education and Research*, *18*(4), 352-373.

Rabbi, A. B. K. & Jeelani, I. (2024). AI integration in construction safety: Current state, challenges, and future opportunities in text, vision, and audio-based applications. *Automation in Construction*, *164*, 105443.

Robinson, G. (2015). Global construction market to grow $8 trillion by 2030: Driven by China, US and India. *Global Construction*, *44*, 8–10. Accessed on March 19 2026 from https://www.cvf.or.kr/uploads/bestpractice/GC2030_Press_Release.pdf

SAS® On Demand for Academics (SAS, 2026). Retrieved on March 19 2026 from https://welcome.oda.sas.com/

Sharma, V. C. & Gupta, J. K. (2025). Artificial Intelligence in Construction: Multi-Stakeholder Strategies for Future Development. *International Journal of Construction Education and Research*, 1-25.

U.S. Bureau of Labor Statistics, Census of Fatal Occupational Injuries (CFOI) 2023 Summary, Washington, DC, USA, https://www.bls.gov/news.release/archives/ cfoi_12192023.pdf (accessed on March 15 2026).

Vemuri, N., Thaneeru, N. & Tatikonda, V. M. (2022). AI-Driven Predictive Maintenance in the Telecommunications Industry. Journal of Science & Technology (India)**.** https://doi.org/10.55662/jst.2022.3201

Vuković, D. B., Dekpo-Adza, S. & Matović, S. (2025). AI integration in financial services: a systematic review of trends and regulatory challenges. *Humanities and Social Sciences Communications*, *12*(1), 1-29. https://doi.org/10.1057/s41599-025-04850-8

Wang, J. & Fan, W. (2025). The effect of ChatGPT on students' learning performance, learning perception, and higher-order thinking: insights from a meta-analysis. *Humanities and Social Sciences Communication, 12* (621). https://doi.org/10.1057/s41599-025-04787-y