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# A Survey Assessment of Generative AI Impact on Construction Management Students' Competencies

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Humans need to be well-prepared for the new revolutionary technological era of generative artificial intelligence (AI) tools. Furthermore, humans in general, and students in particular, will rely on these AI tools in their daily activities, and consequently it is crucial to study the effect of these tools on students' competencies. Since the construction industry is critical for the economic growth of the United States, the construction management (CM) educational systems must adapt to integrate AI tools within their curricula and pedagogies to better prepare students for the future. In this study, the objective was to design and conduct a survey to collect perceptions of nine CM faculty members within a single CM undergraduate program to determine the impact of AI on CM students' competencies and skills. Based on the results, it may be concluded that the critical and logical thinking, in addition to communication competencies may be negatively affected. On the other hand, the results showed that the technical and professional competencies might be positively affected. In summary, the results were indicative and conclusive, and hence it is highly recommended to gather more data from CM professionals (educators and practitioners) for validation.

Keywords: Artificial Intelligence, Competencies, Construction Management, Curriculum, Pedagogy

## Introduction

There is a controversial debate about the reality of the generative artificial intelligence (AI) whether it is another wave of technology such as calculators, computers, and internet, or it is a threatening matter since it is replacing humans in the labor markets worldwide. The United Nations Educational, Scientific and Cultural Organization (2021) defines AI as "systems which have the capacity to process data and information in a way that resembles intelligent behavior, and typically includes aspects of reasoning, learning, perception, prediction, planning or control." Similarly, Stryker and Kavlakoglu (2024) define AI as "a technology that enables computers and machines to simulate human learning, comprehension, problem solving, decision making, creativity and autonomy." Since generative AI systems and tools possess these human-like capabilities and competencies, and humans will increasingly rely on them not just in their professional careers but in their daily activities, it is paramount to study the impact of these AI tools on the competencies of humans in general, and students and workforce in particular.

Economic development is commonly measured by the creation of profits and jobs for societies and, consequently, countries. As a result, job creation must be regularly monitored and evaluated in the

light of new technological advancements. According to Leopold (2025), technology is projected to be the most disruptive force in the United States' labor market. For instance, it is expected that technology will simultaneously create 11 million jobs while displacing 9 million others. The future of Jobs Report (2025) stated that 40% of US employers expect to reduce their workforce where AI automation is possible. Furthermore, 49% of US Gen Z job hunters believe that AI has reduced the value of their college education in the labor market according to a recent survey (Leopold, 2025). In addition, AI could replace more than 50% of the tasks performed by market research analysts and 67% of sales representatives, compared to 9% and 21% for their managerial counterparts (DellaVigna & Hatzius, 2023). Importantly, the AI could impact nearly 50 million US jobs in the coming years, whether by narrowing entry-level opportunities or by making specialized skills more accessible.

*Education and Students' Competencies*

The educational system is experiencing various changes and paradigm shifts to cope and adapt to AI development. For instance, during the generative AI era, traditional learning processes will fundamentally transform, since the acquisition of knowledge and educational curiosity will substantially change. This will lead to a remarkable impact on students' competencies and skills. Hence, educational entities must adjust to this revolutionary shift and be able to enhance competencies across disciplines, fostering curiosity, resilience, empathy, and adaptability (BenMessaoud, 2024). Educational competencies are manifold, and consequently, the impact of AI generative tools will differ. The skills required by the labor market will always change over time as shown in Figure 1 (adopted from Future Job reports, 2025). For instance, AI and big data skills are considered core, while programming is considered out-of-focus skills.

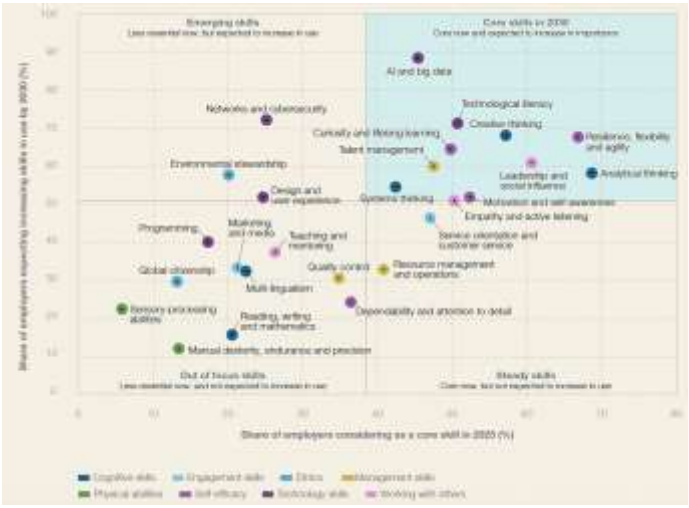


**Figure 1.** Skills map requirements for labor market (Future Job Reports, 2025)

According to the National Association of Colleges and Employers (NACE), the educational competencies can be classified into eight main categories as follows: career & self-development, communication, critical thinking, equity & inclusion, leadership, professionalism, teamwork, and technology (NACE, 2025). According to Eid et al. (2025), high-order cognitive skills will be improved after the integration of generative AI tools in educational system. Similarly, Tian & Zheng (2025) claimed that AI has a moderately positive impact on students' 4C skills (creativity, critical thinking, communication, and collaboration). Also, Krasniqi (2024) stated that AI tools improve

students' competencies related to engagement, but ethical competencies should be considered. In this context, it may be claimed that there is no concrete and comprehensive data regarding the impact of AI tools on the humans' and students' competencies.

It is important to state that the White House and federal agencies issued a memorandum for the heads of executive departments and agencies, dated April 2025, and entitled "Accelerating Federal Use of AI through Innovation, Governance, and Public Trust". However, there are no formal, unified national guidelines for implementing and adopting AI tools in the construction management (CM) undergraduate and graduate programs (The White House, 2025). In addition, although the federal infrastructure and CM guidelines already exist, there are no definitive and specific strategies and plans to adopt and regulate AI tools in the current curricula and pedagogies (U.S. Department of Transportation, 2025). That is why there is a growing need for a comprehensive, unified and collective overview and perception of the impact of AI tools across various fields.

In this study, a literature review was conducted, entailing a structured and comprehensive approach to identify research gaps. This literature review was based on reliable, credible, and commonly used academic databases, such as Google Scholar, and Scopus. The keywords used in the search engines were "construction management", "undergraduate student", "AI", and "competencies". Although the search showed around 97 published papers, none of them were directly relevant to the topic of this study and therefore were excluded during the filtration process after reviewing their abstracts. Specifically, some papers were focused on the adoption of AI tools in Master of Science programs to study their effect on the research competencies. Another study focused on a summer school training program for construction practitioners regarding AI application in the construction industry. The only paper that addressed the effect of AI on CM students' competencies focused solely on students' perceptions of AI tools.

### *Significance and Objectives*

Modern educational systems must change and integrate AI tools within their curricula and pedagogies to better prepare students for the future. According to BenMessaoud (2024), colleges and universities should play a pivotal role in integrating humans and AI tools by incorporating them within current curricula and pedagogies. Based on the literature review, there is a scarcity of data and published research papers regarding the impact of generative AI tools on undergraduate CM students' competencies.

The significance of this study lies in assessing the degree of consensus among CM faculty members regarding the impact of AI tools on student competencies. This will lead to a clearer vision of the required corrective strategies and actions that must be implemented in the educational system to adopt AI tools efficiently and in accordance with labor market requirements. The primary objective of this pilot study is to design and conduct a survey to collect perceptions from nine CM faculty members within a single undergraduate CM program. By determining the perceived degree of AI impact on CM students' competencies and skills, this collective data will enable the redesign and modification of curricula and pedagogies to better prepare the future workforce. The participants in this study include nine faculty members/instructors who teach various CM courses, including: construction documents, estimation, scheduling, project management, construction materials, construction contracts, finance, and the CM capstone.

## Methodology

For the sake of the survey, the eight categories developed by NACE were modified and restructured into six main categories as follows: core academics, professional and technical skills, communication and collaborations skills, ethical and social responsibility, innovation and adaptability, and lifelong learning and personal development competencies. The survey was designed to have six sections that can be summarized as shown in Table 1 with the corresponding tested competency/skill and number of questions assigned per each section. The core academic competencies tested can be listed as the following: (a) disciplinary knowledge, (b) critical thinking & problem solving, (c) research & inquiry, and (d) quantitative & analytical thinking. The professional and technical competencies were categorized as follows: (a) digital literacy & automation & BIM, (b) project documentation, (c) contracts & legal aspects, (d) project planning & scheduling, (e) cost estimating & budgeting, (f) health & safety regulations, (g) procurement & supply chain, (h) surveying & site analysis, (i) construction methods & equipment, (j) risk management, (k) resource management, (l) sustainability & environmental awareness, (m) structural and civil fundamentals. The communication and collaboration competencies were clustered in the survey as the following: (a) oral communication, (b) written communication, (c) teamwork skills, (d) leadership skills, (e) multilingual communication, and (f) cross culture collaboration. The creativity and innovation competencies were composed of the following: (a) ability to think outside the box, (b) ability to develop new ideas, (c) identify opportunities & business planning, (d) economical, financial & investment planning. The personal development and adaptability competencies can be listed as the following: (a) ability to set goals & manage time, (b) keeping up with the industry advancements & regulations, (c) adaptability & resilience, (d) understanding of mental & physical well-being practices. the ethical and social responsibility competencies in this survey were divided to the following: (a) ethical & reasoning skills, (b) recognizing & addressing moral dilemmas, (c) social activism & governance, and (d) community awareness & development.

**Table 1.** Survey sections and associated number of questions

| # | Section Title | # of Questions |
|---|---|---|
| 0 | Introduction | 2 |
| 1 | Core Academic | 10 |
| 2 | Professional & Technical | 1 |
| 3 | Communication & Collaboration | 1 |
| 4 | Creativity & Innovation & Entrepreneurial | 1 |
| 5 | Personal Development & Adaptability | 1 |
| 6 | Ethical & Social Responsibility | 1 |

Only the introduction section was designed to be multiple choice questions to collect general information (profession and years of experience). Importantly, all other sections were designed to be a Likert scale format, to measure the average response per each question and hence to reach a collective conclusion per each competence. The Likert scale rating was based on a 5-point range: very positive impact (VP), positive impact (P), neutral (N), negative impact (NG), very negative impact (VN), to assess the level of agreement and disagreement of responses as per Table 2.

**Table 2.** Evaluation Scheme

| | Level of Agreement and Disagreement | Range |
|---|---|---|
| 5 | Very positive impact/Strongly agree | 5.00 - 4.20 |
| 4 | Positive impact/Agree | 4.19 - 3.40 |
| 3 | Neutral | 3.39 - 2.60 |
| 2 | Negative impact/Disagree | 2.59 - 1.80 |
| 1 | Very negative impact/ Strongly disagree | 1.79 - 1.00 |

## Results

In this study, all the questions were answered by the CM faculty members, and hence, the response rate was 100%. Each section assessing various competencies and skills was analyzed and represented separately. The first section was concerned about collecting information about the years of experience. Most of the respondents (eight out of nine) had a +10 years of experience in the field of CM education, except one respondent with 5-10 years of experience.

**Table 3.** Questions of Core Academic Section

| Question | VP | P | N | NG | VN | Average |
|---|---|---|---|---|---|---|
| Q1. AI will have a positive effect on the ability of students to acquire disciplinary knowledge | 3 | 5 | | | 1 | 4.00 Agree |
| Q2. AI will help students grasp complex concepts at their own pace. | | 5 | 2 | 2 | | 3.33 Neutral |
| Q3. While AI can automate many analytical tasks, students must develop higher-order thinking skills to interpret AI-generated insights critically. | 6 | 2 | 1 | | | 4.56 Strongly Agree |
| Q4. AI will have positive effect on critical thinking and problem-solving competencies of students | | 2 | 2 | 3 | 2 | 2.44 Disagree |
| Q5. AI-driven research tools can accelerate data collection | 7 | 2 | | | | 4.78 Strongly Agree |
| Q6. AI-driven research tools will enhance analytical skills of students and their abilities to validate sources and detect biases | | 4 | 1 | 3 | 1 | 2.89 Neutral |
| Q7. AI-driven research tools will enhance students' abilities to validate sources and detect biases | 1 | 3 | 1 | 2 | 2 | 2.89 Neutral |
| Q8. AI-driven research tools will enhance and affect positively the research skills of students | | 3 | 4 | 1 | 1 | 3.00 Neutral |
| Q9. AI-assisted data predictive analytics will require students to develop deeper statistical and computational thinking | | 2 | | 5 | 2 | 2.22 Disagree |
| Q10. AI will affect positively the students' abilities in reasoning, data analysis, and logical thinking | | 3 | 3 | 2 | 1 | 2.89 Neutral |

The core academic competencies were analyzed and represented in Table 3. Also, Table 4 listed all the question related to professional and technical competencies for CM undergraduate student. The impact of AI tools on students' communication and coordination competencies was assessed and listed in Table 5 that is attached hereafter. In addition, the questions regarding creativity and innovation, personal development and adaptability, and ethical and social responsibility competencies and skills were listed in Tables 6, 7 and 8, respectively.

**Table 4.** Questions of Professional and Technical Competencies Section

| Q. How will the AI tools affect the professional & technical competencies of CM students | VP | P | N | NG | VN | Average |
|---|---|---|---|---|---|---|
| - Digital Literacy & Automation & Building Information Modeling "BIM" | 2 | 6 | | 1 | | 4.00 Agree |
| - Project Documentation | 4 | 2 | 2 | 1 | | 4.00 Agree |
| - Contracts & Legal Aspects | 4 | 2 | 1 | 2 | | 3.89 Agree |
| - Project Planning & Scheduling | 2 | 3 | 2 | 2 | | 3.56 Agree |
| - Cost Estimating & Budgeting | 3 | 2 | 2 | 2 | | 3.67 Agree |
| - Health & Safety Regulations | 3 | 3 | 3 | | | 4.00 Agree |
| - Procurement & Supply Chain | 2 | 3 | 3 | 1 | | 3.67 Agree |
| - Surveying & Site Analysis | 1 | 2 | 5 | 1 | | 3.33 Neutral |
| - Construction Methods & Equipment | 1 | 5 | 1 | 2 | | 3.56 Agree |
| - Risk Management | 3 | 2 | 2 | 2 | | 3.67 Agree |
| - Resource Management | 2 | 3 | 3 | 1 | | 3.67 Agree |
| - Sustainability & Environmental Awareness | 1 | 5 | 2 | 1 | | 3.67 Agree |
| - Structure & Civil Fundamentals | 0 | 3 | 4 | 2 | | 3.11 Neutral |

**Table 5.** Questions of Communication & Collaboration Section

| Q. How will the AI tools affect the communication & collaboration competencies of CM students | VP | P | N | NG | VN | Average |
|---|---|---|---|---|---|---|
| - Oral communication | | 1 | 3 | 3 | 2 | 2.33 Negative |
| - Written communication | 1 | | 2 | 4 | 2 | 2.33 Negative |
| - Teamwork | | 2 | 2 | 4 | 1 | 2.56 Negative |
| - Leadership | | 3 | 2 | 2 | 2 | 2.67 Neutral |
| - Multilingual communication | 2 | 1 | 3 | 2 | 1 | 3.11 Neutral |
| - Cross culture collaboration | 1 | 2 | 1 | 4 | 1 | 2.78 Neutral |

**Table 6.** Questions of Creativity & Innovation Section

| Q. How will the AI tools affect the creativity & innovation competencies of CM students | VP | P | N | NG | VN | Average |
|---|---|---|---|---|---|---|
| - Ability to think outside the box | | 3 | 1 | 3 | 2 | 2.56 Negative |
| - Ability to develop new ideas | 1 | 2 | 2 | 3 | 1 | 2.89 Neutral |
| - Identify opportunities & business planning | 2 | 4 | | 2 | 1 | 3.44 Positive |
| - Economical, financial & investment planning | 1 | 3 | 2 | 2 | 1 | 3.11 Neutral |

**Table 7.** Personal Development & Adaptability

| Q. How will the AI tools affect the personal development, lifelong learning & personal development competencies of CM students | VP | P | N | NG | VN | Average |
|---|---|---|---|---|---|---|
| - Ability to set goals & manage times | 1 | 5 | | 3 | | 3.44 Agree |
| - Keeping up with the industry advancements & regulations | 2 | 4 | 2 | 1 | | 3.78 Agree |
| - Adaptability & resilience | 2 | 2 | 1 | 2 | 2 | 3.00 Neutral |
| - Understanding of mental & physical well-being practices | 1 | 3 | 2 | 2 | 1 | 3.11 Neutral |

**Table 8.** Ethical & Social Responsibility

| Q. How will the AI tools affect the ethical & social responsibility of CM students | VP | P | N | NG | VN | Average |
|---|---|---|---|---|---|---|
| - Ethical & reasoning | | 4 | 1 | 3 | 1 | 2.89 Neutral |
| - Recognizing & addressing moral dilemmas | | 3 | 2 | 3 | 1 | 2.78 Neutral |
| - Social activism & governance | | 4 | 1 | 3 | | 3.13 Neutral |
| - Community awareness & development | | 3 | 3 | 3 | | 3.00 Neutral |

## Discussion

Based on Table 3, the first question showed that AI may have a positive impact on students' ability to acquire knowledge but on the other hand, question two showed that this enhancement may not related to complex concepts. The first two questions suggested that it would be worth to add another question about the significance of teachers/instructors in the learning process after the incorporation of AI in educational systems. In other words, it may be concluded that the role of teacher/instructor is on the edge and maybe replaced by generative AI tools. Importantly, based on the survey assessment, the results showed that the critical and logical thinking, and analytical and reasoning skills may be negatively affected by the AI tools. Therefore, this agrees with the definition of AI tools mentioned therebefore in the introduction that AI tools are capable of reasoning, creating and perception. Importantly, this finding is crucial since these competencies are required by labor market and hence corrective actions are needed promptly to accommodate these shortcomings.

As shown in Table 4, it is worth to mention that this question was concerned about the competencies of the students' not their performances. The results showed that the CM faculty slightly agreed that AI tools may have positive impact on students' technical competencies. This section may need other essay questions for respondents to explain the reasons behind how AI tools would positively affect the technical competencies and skills. It may be concluded that the respondents agreed that the oral and written communications and teamwork competencies will be negatively affected due to the usage of AI tools (as shown in Table 5). This is one of the important findings that should be investigated and validated further by more surveys.

Table 6 showed that the respondents agreed that "ability to think outside the box" of CM students will be negatively affected. This is one of the crucial competencies that need to be further investigated since the creation and innovation of CM students cannot be traded off while using the AI tools. On the other hand, the ability of students to "identify opportunities and business planning" may be positively affected. This may be since AI tools will help and facilitate students' ability to acquire more knowledge. Based on results in Table 7, the personal development and adaptability of CM students may be positively affected due to usage of AI tools. The ethical and social responsibility will require more investigation and assessment in later studies and surveys since the respondents did not agree whether there will be a positive or negative impact. This competency needs to be well addressed and assessed due to the significance of ethical and social perspective in students' academic and professional lives. As shown in Table 8, the responses were close enough to make it difficult to reach an overall conclusion. This topic is paramount not just for the for the academic integrity in specific and for the professional and human integrity in general.

Table 9 summarizes all the results obtained from the survey and categorize them based upon whether the respondents agreed that these competencies will be positive or negatively impacted. On the other hand, all competencies fall under the neutral/undecided column means that the responds answers were scattered and there was no agreement of the impact of generative AI tools on these competencies. in

summary, these findings were not in complete agreement with the findings of literature review. For example, this study showed that AI tools might have negative impact on creativity and critical thinking while according to Tian & Zheng (2025) claimed that AI tools would have a positive impact on creativity and critical thinking.

**Table 9.** Summary of Analysis

| Positive Impact | Neutral/Undecided | Negative Impact |
|---|---|---|
| Accelerate Data collection | Grasp complex concepts | Critical thinking & problem-solving |
| Acquire disciplinary knowledge | Analytical skills | Deeper statistical and computational thinking. |
| Digital Literacy & Automation & BIM | Research skills | Oral Communication |
| Project Documentation | Reasoning, data analysis, & logical thinking | Written Communication |
| Contracts & Legal Aspects | Surveying & Site Analysis | Teamwork skills |
| Project Planning & Scheduling | Structure & Civil Fundamentals | Ability to Think outside the Box |
| Cost Estimating & Budgeting | Leadership skills | |
| Health & Safety Regulations | Multilingual Communication | |
| Procurement & Supply Chain | Cross Culture Collaboration | |
| Construction Methods & Equipment | Ability to Develop New Ideas | |
| Risk Management | Economic, Financial & Investment Planning | |
| Resource Management | Adaptability & Resilience | |
| Sustainability & Environmental Awareness | Understanding of Mental & Physical Well-Being | |
| | Ethical & Reasoning Skills | |
| | Recognizing & Addressing Moral Dilemmas | |
| | Social Activism & Governance | |
| | Community Awareness & Development | |

## Conclusions

Generative AI tools are developing rapidly, leading to paradigm shifts across all fields, including educational systems. It is important to study the impact of AI tools on students' competencies within each sector and discipline separately because they might be affected differently. Therefore, it is crucial to understand the collective opinions and perceptions of CM faculty members on how these AI tools will impact the CM students' competencies and skills. This information will enable prompt adoption of mitigation strategies in teaching curricula and pedagogies. Based on the results of this study, it can be concluded that there is a pressing need for a comprehensive and collective overview of the impact of AI tools within each field to articulate the appropriate and prompt strategies and action plans in the educational system for advanced preparation of a competent workforce for the labor market. Also, it is worth mentioning that most responses agreed that critical and logical thinking, creativity, innovation, and communication and coordination competencies (written, oral and teamwork) could be negatively affected. On the other hand, the collective CM faculty members' perceptions suggested that generative AI tools might have a positive impact on technical and

professional competence. In addition, the results showed that no definite conclusion could be derived regarding the AI tools impact on adaptability, resilience, ethical and social responsibilities competencies. In summary, it is paramount to conduct these surveys on a national level to obtain and collect perceptions of CM professionals (educators and practitioners) on the impact of AI tools on students' competencies.

## Recommendations

Currently, there are no unified national guidelines to establish strategies and action plans to regulate and integrate the AI tools in the educational systems in general, or in current curricula and pedagogies in particular. Based on the results obtained from this study, it is recommended to validate these findings and conclusions through conducting more surveys to increase the sample size of faculty members and add CM practitioners for more reliable results. Specifically, more data need to be collected from various CM programs and schools to obtain a more comprehensive and conclusive understandings to formulate an effective framework for adopting AI tools within CM programs. Also, although the design of the survey for this study was formulated in a way not to include open-ended questions for procedural simplicity and easiness, it is recommended to include essay questions to give more space for discussion and explanation.

## Limitations

This research study represents the findings of a pilot survey focusing exclusively on the perceptions of CM faculty members. Therefore, the findings of this research study are limited by its sample size of nine faculty members within a single undergraduate CM program. More surveys are needed to increase the sample size of CM professionals for more generalized, comprehensive, and definite conclusions.

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