Enhancing Career Readiness Skills for Engineering Students with Artificial Intelligence

Lina H. Kloub
School of Computing
University of Connecticut
Storrs, CT, USA

Christina Smith
School of Computing
University of Connecticut
Storrs, CT, USA

Faiyhaa-Sydra Saulat
School of Computing
University of Connecticut
Storrs, CT, USA

***Abstract*—Career readiness is a vital aspect of engineering education, aligning with the National Association of Colleges and Employers (NACE) core competencies that are essential for students' professional success. Skills such as communication, problem-solving, and teamwork are central to these competencies, preparing students for effective participation in the workforce. The increasing role of Artificial Intelligence (AI) in education presents new opportunities to enhance these skills beyond traditional coursework. AI-powered tools, including adaptive feedback systems and collaborative platforms, offer personalized learning experiences that foster the development of these career competencies in engineering students. This paper explores how AI can be leveraged to support career readiness, arguing that its integration into engineering curricula can significantly enhance students' communication, problem-solving, and teamwork abilities. By examining the growing role of AI in education and its alignment with NACE competencies, this research highlights its transformative potential in preparing students for successful careers in engineering.**

***Index Terms*—AI, Artificial Intelligence, NACE, career competencies, Engineering Education**

I. Introduction

In today's competitive and fast-evolving job market, career readiness has become a fundamental aspect of higher education. For engineering students, developing skills that extend beyond technical knowledge is essential for success in the workplace. The National Association of Colleges and Employers (NACE) has identified eight core competencies that are integral to students' professional development and are essential for their transition from academic settings to the workforce. These competencies include: career and self-development, communication, critical thinking and problem-solving, equity and inclusion, leadership, professionalism, teamwork, and technology management. These competencies are designed to provide students with the necessary skills to thrive in a diverse, technology-driven workplace[9].

Among these competencies, *communication*, *problem-solving*, and *teamwork* stand out as particularly crucial for engineering students. Effective communication is vital for engineers who must regularly explain complex technical ideas to both technical and non-technical audiences[15]. Problem-solving skills are at the core of engineering practice, requiring students to think critically and apply creative solutions to real-world challenges. Teamwork is equally important, as engineers often collaborate in multidisciplinary teams to achieve common goals. These three competencies not only help students perform better academically but also prepare them for the demands of the modern workforce[2].

Despite their importance, these competencies are often underemphasized in traditional engineering curricula, which tend to prioritize technical knowledge and problem-solving techniques[14]. This gap presents a challenge for educators who aim to prepare students for successful careers in an increasingly interdisciplinary and AI-driven job market . In recent years, the role of Artificial Intelligence (AI) in education has begun to offer new opportunities to address this gap. AI-powered tools, such as adaptive feedback systems, collaborative platforms, and virtual learning environments, have the potential to enhance students' learning experiences by offering personalized instruction and real-time feedback, helping them develop the skills needed for career success.

This paper argues that the integration of AI into engineering curricula can significantly enhance career competencies by providing students with the tools they need to develop these skills in a personalized, efficient, and engaging manner. By leveraging AI, educators can create learning environments that simulate real-world situations, offer instant feedback, and foster the development of essential soft skills alongside technical knowledge. This integration will better prepare engineering students for the challenges they will face in their careers, ensuring that they are equipped with the communication, problem-solving, and teamwork skills demanded by employers. Ultimately, AI tools can not only enhance the technical abilities of students but also cultivate the career competencies required to thrive in an AI-driven workforce.

II. Alignment with Workforce Needs

The rapid advancements in technology and automation are reshaping the expectations of employers. According to a report by the World Economic Forum, nearly 50% of all employees will need reskilling by 2025 due to the integration of AI and digital transformation in the workplace [2]. The growing reliance on AI-driven decision-making, virtual collaboration, and real-time data analysis has increased the demand for professionals who possess not only technical expertise but also strong communication, problem-solving, and teamwork skills. Employers seek candidates who can effectively collaborate

with AI systems, make informed decisions, and contribute meaningfully to complex projects.

By integrating AI-powered learning tools into engineering curricula, educational institutions can better equip students with these essential career competencies. AI has the potential to bridge the gap between theoretical knowledge and practical application, ensuring that graduates are well-prepared to navigate the evolving job market.

III. Overview of NACE Core Competencies

The National Association of Colleges and Employers (NACE) has identified eight essential career readiness competencies that are critical for students' transition from academia to the professional world. These competencies serve as a framework for developing the skills necessary for workplace success across various industries, including engineering. The eight NACE competencies are:

- **Career and Self-Development**: Engaging in continuous learning, self-reflection, and professional growth.
- **Communication**: Clearly and effectively exchanging information with diverse audiences.
- **Critical Thinking and Problem-Solving**: Analyzing issues, making decisions, and overcoming obstacles.
- **Equity and Inclusion**: Demonstrating awareness and inclusivity in diverse environments.
- **Leadership**: Recognizing personal and team strengths to achieve common goals.
- **Professionalism**: Exhibiting ethical behavior, responsibility, and effective work habits.
- **Teamwork**: Collaborating with others to achieve shared objectives.
- **Technology Management**: Adapting to and effectively utilizing technology in the workplace.

While all eight competencies are crucial for career readiness, this paper focuses on three key areas—*communication, problem-solving, and teamwor*k—which are particularly important for engineering students. These competencies not only align with the expectations of modern employers but also directly influence engineers' ability to collaborate, innovate, and contribute effectively to their organizations.

A. Communication Competency

Communication is a fundamental skill for engineers, as they must convey complex technical concepts to both technical and non-technical audiences. Engineers regularly engage in writing reports, delivering presentations, and collaborating with diverse stakeholders, including clients, project managers, and policymakers. A lack of strong communication skills can lead to misunderstandings, project inefficiencies, and reduced effectiveness in multidisciplinary environments [4]. According to NACE, employers consistently rank communication as one of the top skills they seek in job candidates [9]. In an AI-driven world, tools such as AI-powered writing assistants, speech analysis software, and virtual presentation platforms can help students refine their written and verbal communication skills.

AI tools enable engineering students to visualize and communicate ideas through images, diagrams, and models. At Cornell University, students in the Fiber Science and Apparel Design program have incorporated AI-generated imagery into their projects, enabling them to visually communicate their design concepts more effectively[19]. Through this approach, students not only refined their ability to use AI as a tool for visual storytelling but also gained a deeper understanding of its strengths and limitations. Similarly, at the University of Leeds, students in the MA Advertising and Design program were encouraged to use generative AI to enhance their creative ideation processes[11]. With such tools, students become more confident and creative in illustrating their engineering ideas.

Beyond visual communication, AI tools have been instrumental in improving public speaking and verbal communication skills. At Maastricht University, students utilized VirtualSpeech, an AI-powered virtual reality platform, to practice public speaking in immersive, real-world scenarios[20]. The platform provided students with simulated audience interactions, real-time feedback on speech delivery, and constructive suggestions for improvement. This application of AI helped students build confidence and refine their presentation skills, which are essential for engaging diverse stakeholders in professional settings. Similarly, researchers at University of Memphis developed AutoTutor, an intelligent tutoring system that engages students in natural language dialogues. By simulating human-like conversations, AutoTutor fosters students' ability to articulate technical content effectively, enhancing both their written and verbal communication competencies[12].

The impact of AI on communication also extends to academic writing and self-assessment. At University of Iowa, faculty have explored the use of generative AI tools to assist students in revising and critiquing their written work. These tools help students generate and compare ideas, improving their ability to critically analyze and refine their own writing. This iterative feedback process has proven to be an effective method for strengthening students' analytical and communication skills[10]. Additionally, at University of Murcia, an AI-powered chatbot named "Lola" has been implemented to assist students with inquiries related to campus resources and academic services. By providing instant responses and structured guidance, allowing students to interact more effectively with institutional support systems[13].

These case studies highlight the growing role of AI in enhancing communication competency among students. Whether through visual storytelling, public speaking simulations, intelligent tutoring systems, or AI-assisted writing tools, universities are leveraging AI to help students develop essential communication skills. As AI continues to evolve, its applications in education will further support students in articulating complex ideas with clarity and confidence, ultimately preparing them for the demands of the modern workforce.

B. Problem-Solving Competency

Problem-solving is at the heart of engineering practice. Engineers are often required to analyze complex challenges,

identify solutions, and implement effective strategies. Employers value candidates who can demonstrate critical thinking and adaptability in real-world situations [7]. AI can enhance problem-solving skills by providing students with dynamic problem-based learning environments, adaptive learning platforms, and AI-driven simulations that challenge them to develop innovative solutions in real time. Additionally, AI can assist in debugging code, optimizing designs, and automating data analysis, making problem-solving more efficient.

AI presents dynamic, real-world problem scenarios that significantly enhance engineering education. Adaptive coding platforms, for instance, utilize AI to create personalized learning experiences by adjusting the complexity of problems based on individual student progress. This approach encourages learners to develop problem-solving skills in contexts that closely mirror real-world challenges. Similarly, AI-powered engineering simulations allow students to experiment with virtual models, providing a safe environment to test theories and understand the impact of various variables, thereby deepening their comprehension of complex engineering tasks. These AI-driven tools provide students with immersive, adaptable problem-solving experiences that reflect the complexity of real-world engineering challenges[22].

Several AI-powered tools have been instrumental in fostering critical thinking among engineering students. Physics-Informed Neural Networks (PINNs) integrate physical laws into machine learning models, enabling the efficient resolution of complex differential equations—a process particularly beneficial in resource-intensive scenarios[21]. Platforms like Galaxy.ai offer AI-driven solutions to engineering challenges, adapting to various fields and streamlining problem-solving processes. Additionally, Autodesk's Generative Design tool employs AI to explore numerous design alternatives based on specified constraints and goals, allowing engineers to rapidly iterate and optimize designs, thereby promoting innovative problem-solving[6].

The integration of AI into engineering curricula has become a focal point for many universities aiming to enhance problem-solving skills among their students. Institutions are increasingly incorporating AI-powered tools such as virtual labs and analytics platforms to train students in data-driven decision-making. For example, University of Florida has integrated AI across its academic spectrum through the "*AI Across the Curriculum*" initiative. This comprehensive approach involves hiring over 100 AI-focused faculty members across all 16 colleges, ensuring that AI literacy permeates disciplines from engineering to the humanities [5]. This infrastructure enables students to engage in hands-on learning, applying AI methods to analyze complex datasets, simulate real-world scenarios, and develop innovative solutions to pressing challenges. By embedding AI into diverse courses, University of Florida cultivates an environment where students enhance their critical thinking and problem-solving skills, preparing them to navigate and address multifaceted issues in their respective fields. Similarly, the Massachusetts Institute of Technology (MIT) offers specialized programs that integrate AI into engineering education, bolstering students' problem-solving competencies. The "*Machine Learning, Modeling, and Simulation: Engineering Problem-Solving in the Age of AI*" program provides a hands-on approach to understanding computational tools essential for modern engineering challenges. This program bridges traditional engineering skills with contemporary machine learning and data science principles. Participants engage in real-time applications of these methods, working on projects that require the modeling and simulation of complex systems [3]. By utilizing this learning process, it leads to an enhancement of their ability to address intricate engineering problems through AI-driven solutions, fostering engineer's adept at utilizing cutting-edge technologies to innovate and solve real-world issues. Overall, the importance of integrating AI tools into higher education extends beyond technical proficiency, it equips students with essential skills to navigate and solve complex challenges effectively. AI-driven tools facilitate group dynamics, ensuring that every student contributes effectively to problem-solving scenarios. As noted in "Exploring the Potential of Artificial Intelligence in Addressing Pedagogical Challenges and Improving Group Work Quality in Higher Education" by Dalarna University, AI tools can effectively address these challenges by providing individualized feedback and fostering improved communication and collaboration among team members[17]. Using AI allows educators to transform the way problem-solving is taught and learned, which empowers students with the skills and strategies needed to tackle complex challenges effectively.

C. Teamwork Competency

Engineering projects typically require collaboration among professionals from various disciplines, making teamwork an essential competency. Effective teamwork involves active listening, conflict resolution, and shared decision-making, all of which contribute to a productive work environment [16]. Employers prioritize candidates who can demonstrate the ability to work effectively in teams, particularly in remote and hybrid work environments [9]. AI-powered collaboration tools, such as intelligent project management systems and AI-driven feedback mechanisms, can facilitate more effective teamwork by providing real-time assistance, tracking team dynamics, and ensuring balanced participation [17].

One notable example is the Saturn Parable Simulation at Wharton Interactive, which immerses students in a simulated space mission requiring critical decision-making, leadership, and problem-solving. This interactive environment fosters teamwork by providing immediate, tailored feedback that strengthens communication and collaborative problem-solving skills. By analyzing student behavior and performance data, AI systems within the simulation offer personalized feedback and facilitate seamless group collaboration[17]. Research from Dalarna University highlights the effectiveness of AI tools in addressing pedagogical challenges, demonstrating that AI-driven interventions can enhance group dynamics by providing individualized feedback and improving communication among team members.

At MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL), researchers have developed an AI assistant that functions as a team coordinator, managing both human and AI agents to ensure task and goal alignment[18]. This system actively monitors team members' actions, infers their plans, and assesses mutual understanding based on pre-established beliefs. When discrepancies arise, the AI intervenes by reconciling conflicting beliefs, guiding actions, and prompting clarifying questions. Tested across diverse, high-stakes environments—including search-and-rescue operations, critical medical procedures, and strategic decision-making scenarios—this AI-driven coordination model has demonstrated its ability to enhance team project management and overall efficiency.

As AI continues to evolve, its role in facilitating teamwork and improving group collaboration in higher education is expected to expand further. Institutions seeking to enhance teamwork development should consider integrating AI-based solutions that provide personalized feedback, support decision-making, and optimize project management.

IV. Challenges and Considerations

While AI tools offer transformative benefits in enhancing career competencies such as communication, problem-solving, and teamwork, their integration into engineering education comes with several challenges and considerations. These challenges must be acknowledged and addressed to ensure that AI-driven learning experiences are equitable, effective, and aligned with best practices in higher education.

One of the primary concerns is the unequal access to AI resources. Many AI-powered educational tools require substantial computing power, subscription fees, or institutional support, which may create barriers for students from underprivileged backgrounds. Institutions must consider providing subsidized access to AI platforms or integrating open-source alternatives to ensure inclusivity in AI-driven education[8].

Another major consideration is ethical concerns, particularly regarding data privacy, AI bias, and academic integrity. Many AI-powered platforms collect and analyze student data to personalize learning experiences, raising questions about how this data is stored, shared, and protected[1]. Universities must implement clear policies on data privacy and responsible AI use to safeguard students' information. Additionally, AI systems can inherit biases from their training data, leading to potentially unfair or inaccurate recommendations. Addressing this issue requires continuous evaluation of AI algorithms and promoting AI literacy among students so they can critically assess AI-generated outputs.

Furthermore, the risk of over-reliance on AI tools is another challenge that educators must consider. While AI can enhance learning experiences, it should complement—not replace—critical thinking, creativity, and interpersonal skills. Overdependence on AI-generated solutions may hinder students' ability to develop independent problem-solving and decision-making abilities. To counter this, educational institutions should design AI-integrated curricula that encourage students to verify and critically evaluate AI outputs rather than accepting them at face value.

V. Conclusion

The increasing role of AI in engineering education presents a unique opportunity to enhance career competencies, particularly in communication, problem-solving, and teamwork. As AI tools continue to advance, they offer engineering students innovative ways to refine their skills, engage in dynamic learning experiences, and bridge the gap between academia and industry expectations.

By integrating AI-powered tools such as writing assistants, virtual presentation platforms, adaptive learning systems, and intelligent collaboration tools, educators can provide students with personalized feedback, immersive problem-solving scenarios, and real-time teamwork enhancements. These AI-driven learning experiences align with NACE career competencies, preparing students to succeed in an evolving job market where collaboration with AI systems is becoming increasingly essential.

However, to maximize the benefits of AI integration, institutions must also navigate challenges such as access disparities, ethical concerns, and potential over-reliance on AI systems. By implementing thoughtful AI policies, faculty training programs, and responsible AI literacy initiatives, universities can create a balanced approach that leverages AI as a complement to traditional learning methods rather than a substitute.

In conclusion, AI-driven education has the potential to transform career readiness for engineering students, equipping them with not only technical expertise but also the essential soft skills that employers seek. As AI continues to shape the future of work, its strategic integration into engineering curricula will be a crucial step in preparing students for the demands of an AI-enhanced workforce.

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