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NSF-EEC: Impact of Generative Artificial Intelligence (GAI) on Engineering Education Practices

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We present findings from a project examining the impact of generative AI (GenAI) on engineering education. The use of GenAI has been expanding rapidly across all aspects of higher education including engineering. Its effect can be felt across both teaching and research with significant potential for both practices currently and into the future. Overall, our research findings show that faculty and educators are receiving ambiguous information and messaging about the use of GenAI for teaching and research. In addition, given the complicated and dynamic terrain of GenAI policies, educators have a high burden on them to evaluate different policies and then implement what works. We also found that many engineering educators are hesitant to use GenAI because they do not fully understand the technology and that there is a significant need to train faculty on the use of AI for engineering education, both from a pedagogical perspective but even from the content perspective, i.e. the use of AI within their disciplinary domain. Finally, our preliminary work with students shows that they have significant misconceptions about how GenAI actually works and are prone to trusting the output of the technology too positively. In the rest of this paper, we summarize findings from studies we have conducted so far and what we plan to present and discuss in our poster. We will also have additional new work to report by the summer.

Results related to GenAI policies at the institutional level: We analyzed GenAI policies and guidelines issues by 115 U.S. based higher education institutions classified as R1 universities [5]. We found that a majority of universities (N = 73, 63%) encourage the use of GenAI, with many offering detailed guidance for its use in the classroom (N = 48, 41%). Over half the institutions provided sample syllabi (N = 65,56%) and half (N = 58, 50%) provided sample GenAI curriculum and activities that would help instructors integrate and leverage GenAI in their teaching. Notably, the majority of guidance focused on writing, whereas references to code and STEM-related activities were infrequent, and often vague, even when mentioned (N = 58, 50%). Based on our findings we caution that guidance for faculty can become burdensome as policies suggest or imply substantial revisions to existing pedagogical practices.

Results related to research guidelines: We analyzed research guidance issues by 30 R1 institutions [3]. We found that guidance provided to researchers: (1) asked them to refer to external sources of information such as funding agencies and publishers to keep updated and use institutional resources for training and education; (2) asked them to understand and learn about specific GenAI attributes that shape research such as predictive modeling, knowledge cutoff date, data provenance, and model limitations, and educate themselves about ethical concerns such as authorship, attribution, privacy, and intellectual property issues; and (3)included instructions on how to acknowledge sources and disclose the use of GenAI, how to communicate effectively about their GenAI use, and alerts researchers to long-term implications such as over reliance on GenAI, legal consequences, and risks to their institutions from GenAI use. Overall, guidance places the onus of compliance on individual researchers making them accountable for any lapses, thereby increasing their responsibility.

Results related to syllabi guidelines in computing courses: We analyzed 98 syllabi from 54 R1 institutions [1]. We found that 1) most instructions related to GenAI use were part of the

academic integrity policy for the course and 2) most syllabi prohibited or restricted GenAI use, often warning students about the broader implications of using GenAI, e.g. lack of veracity, privacy risks, and hindering learning. Beyond this, there was wide variation in how instructors approached GenAI including a focus on how to cite GenAI use, conceptualizing GenAI as an assistant, often in an anthropomorphic manner, and mentioning specific GenAI tools for use. We discuss the implications of our findings and conclude with current best practices for instructors.

Results related to educators' perspective on GenAI: We surveyed 98 educators from engineering, computer science, and education who participated in a workshop on GenAI in Engineering Education to learn about their perspectives on using these tools for teaching and research [2]. We found that while the majority of participants were somewhat familiar with GenAI, reported use varied considerably. We found that educators harbored mostly hopeful and positive views about the potential of GenAI. We also found that those who engaged more with their students on the topic of GenAI, both as communicators (those who spoke directly with their students) and as incorporators (those who included it in their syllabus), tend to be more positive about its contribution to learning, while also being more attuned to its potential abuses. These findings suggest that integrating and engaging with generative AI is essential to foster productive interactions between instructors and students around this technology. Our work ultimately contributes to the evolving discourse on GenAI use, integration, and avoidance within educational settings. Through exploratory quantitative research, we have identified specific areas for further investigation.

Results related to students' use of GenAI: We analyzed data from 37 students enrolled in an undergraduate IT ethics course [4]. Findings reveal that students' definitions of GenAI differed substantially and included many misconceptions - some highlight it as a technique, an application, or a tool, while others described it as a type of AI. There was a wide variation in the use of GenAI by students, with two common uses being writing and coding. Students identified the ability of GenAI to summarize information and its potential to personalize learning as an advantage and reported two primary ethical concerns with using GenAI: plagiarism and dependency. They recognized that responses from GenAI applications are often untrustworthy and need verification. Overall, they appreciated that they could do things quickly with GenAI but were cautious as using the technology was not necessarily in their best long-term as it interfered with the learning process. In terms of aspirations for GenAI, students expressed both practical advantages and idealistic and improbable visions. They said it could serve as a tutor or coach and allow them to understand the material better.

Overall, research conducted through this project is establishing a baseline for GenAI use by engineering educators and the findings from our analysis of secondary and primary data analysis show that GenAI use is of high interest but as yet there are no standard guidelines for engineering educators. Our findings reveal that although institutional guidance is more pro-use, at the course-level the uptake is still guarded. We also found that there needs to be a lot more training for engineering educators to better understand the technology and how to use it effectively for pedagogical purposes. We have created some training programs and so far over 300 engineering educators have taken part in workshops on GenAI use that we have conducted at ASEE and other conferences.

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