BOARD #104: Work-in-Progress: Uncovering AI Adoption Trends Among University Engineering Students for Learning and Career Preparedness

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Dr. Oenardi Lawanto is a professor in the Department of Engineering Education at Utah State University, USA. He received his B.S.E.E. from Iowa State University, his M.S.E.E. from the University of Dayton, and his Ph.D. from the University of Illinois at Urbana-Champaign. Dr. Lawanto has a combination of expertise in engineering and education and has more than 30 and 14 years of experience teaching engineering and cognitive-related topics courses for his doctoral students, respectively. He also has extensive experience in working collaboratively with several universities in Asia, the World Bank Institute, and USAID to design and conduct workshops promoting active-learning and life-long learning that is sustainable and scalable. Dr. Lawanto's research interests include cognition, learning, and instruction, and online learning.

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Dr. Cassandra McCall is an Assistant Professor in the Engineering Education Department at Utah State University (USU). Her research focuses on the intersections of disability, identity formation, and culture and uses anti-ableist approaches to enhance universal access for students with disabilities in STEM, particularly in engineering. At USU, she serves as the Co-Director of the Institute for Interdisciplinary Transition Services. In 2024, Dr. McCall received a National Science Foundation CAREER grant to identify systemic opportunities for increasing the participation of people with disabilities in engineering. Her award-winning publications have been recognized by leading engineering education research journals at both national and international levels. Dr. McCall has led several workshops promoting the inclusion of people with disabilities and other minoritized groups in STEM. She holds B.S. and M.S. degrees in civil engineering with a structural engineering emphasis.

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Michaela Harper is a doctoral student at Utah State University, pursuing a Ph.D. in Engineering Education. She holds a Bachelor's degree in Environmental Studies, focusing on STEM and non-traditional education approaches, and a Master's degree in Engineering Education, where she explored faculty perspectives on Generative Artificial Intelligence (GAI). Michaela's current research delves deeply into the effects of disruptive technologies on engineering education, driven by her passion for uncovering the foundational nature of phenomena and applying an exploratory and explanatory approach to her studies. Her work aims to illuminate how technological advancements reshape educational landscapes through student and faculty engagement.

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Wade Goodridge is a tenured Associate Professor in the Department of Engineering Education at Utah State University. His research lies in spatial thinking and ability, curriculum development, and professional development in K-16 engineering teaching.

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Daniel Kane is a third-year Ph.D. student in the department of engineering education at Utah State University. His research interests include spatial ability, accessibility for students with disabilities, artificial intelligence in education, and enhancing electric vehicle charging system infrastructure. Daniel has

contributed significantly to the development of the Tactile Mental Cutting Test (TMCT) which is a significant advancement in assessing spatial ability for blind and low-vision populations. His research has helped inform teaching methods and develop strategies for improving STEM education accessibility. Currently, he is studying how AI tools are utilized by students across USU's colleges to optimize their educational value. Daniel has also served as president of the ASEE student chapter at USU where he initiated outreach activities at local K-12 schools and promoted student engagement in research.

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Abstract

This work in progress study explores self-reported data on AI use by university engineering students. The purpose of this study is to investigate how students are utilizing AI technologies and to understand their views on the role of AI in their future. Advances in technology and the emergence of AI tools have attracted attention from academia, research, and industry. The rapid growth of deep learning technologies has changed the landscape in the work environment, and universities may need to adapt to keep pace. Dynamic changes in the workplace have accelerated as these AI technologies are being leveraged to complete tasks. Current trends show that the workforce is increasingly demanding higher skill levels, including specialized AI skills. Formal education in AI basics could be crucial for future career readiness.

Over 150 engineering students reported their demographics, including age, race, gender, year in school, and if they identify as having any form of disability. The primary research question that guiding this work is: How does the adoption of AI technologies for learning vary across demographic groups among university engineering students? This research explores the ways in which undergraduate and graduate students at a major R1 land-grant university in the western United States interact with AI tools.

Preliminary findings suggest that freshman engineering students are less likely to have used AI technologies than those later in their college careers, and students closest to entering the workforce are the ones with the most exposure to these technologies.

Overall, this study highlights how exposure to AI technologies may vary by amount of time in university studies and by attitudes toward adoption of new AI technology. Further insight into these attitudes may be essential in preparing engineering students for a rapidly evolving workplace. This work in progress study explores self-reported data on AI use by university engineering students.

Introduction

Advances in technology have created a unique environment for learning at the university level. AI-driven tools present immediate opportunities that can be shaped for learning in engineering education. These tools are rapidly advancing, and educators should use this opportunity to prepare for and anticipate these changes in academia [1], [2], [3]. Joseph and others put forth that AI has the capability to transform and completely change the way we teach and learn [4]. Edali and others described the many ways in which Chatbots can enhance the university experience, particularly by assisting in research, in locating relevant studies, and in managing citations [5]. These findings are predictive of the types of changes engineering education will be able to embrace moving forward. The integration of AI tools needs to be done with careful attention to

their limitations so that students understand the boundaries when working with this innovative technology [6]. Having hands on experience with the limitations of AI tools is going to be critical for students [7]. AI tools can be helpful as students learn and work on engineering design projects [8]. The survey distributed in this study was designed to measure students' perceived usefulness and trustworthiness of AI tools [9]. This study will help us evaluate the ways in which engineering students interact with AI tools and identify processes that could aid students in their learning and prepare them for use of AI tools in industry [10].

The Study

Data Collection

Data were collected from over 150 engineering students over the age of 18 using a web-based survey that was emailed to all (e.g., graduate and undergraduate) students enrolled at a single University in the Mountain West region of the United States. Demographic questions collected background information that included highest degree completed, GPA, year in school, age, race, gender, and disability status. The first group of items asked respondents about their prior use of AI tools, and intent to use them in the future. Students were asked the sorting question: Have you ever used disruptive technologies, such as Chat GPT, to aid your learning? Those that answered "yes" were asked questions about the probability of using AI in the future. Students who reported having used AI in the past were asked how likely they were to use AI for completing future learning tasks (intend to reuse), how likely they were to use it for the same task (predict reuse), and if they had considered using it to complete other, yet similar, learning tasks (consider reuse). The second group of items asked students about their motivational strategies for learning [11]. Their overall perceptions of AI use, training, application in their chosen fields and continued use of AI. Specifically, respondents were asked if they thought a course in AI basics would be beneficial, if AI courses would be helpful, and if they thought there was a need for careful management of AI technology. Students were asked if they thought AI was competent and if they were hopeful about having AI available in their courses. They were also asked if they thought AI was useful overall.

Respondents were categorized by year in school (e.g., freshman, senior), degree program (undergraduate or graduate), and major. For the purpose of this work-in-progress paper, only students enrolled in engineering programs were considered for analysis. The dataset was cleaned, and incomplete surveys were removed, resulting in 131 engineering students in the final dataset. The full survey took about 15 to 20 minutes to complete.

Data Analysis and Results

The majority of the survey had 7-point Likert scale items coded on the same scale for analysis purposes. Other items were situated on a 0 to 10 scale, for example, "On a scale of 0 to 10, how much do you support or oppose AI development in your field of study?" There were dichotomous variables, for example, asking if students have used AI to aid in learning or if they intend to use AI to aid in their learning in the future. Most of the statistical tests were done with

Chi-Square comparisons of these coded variables and descriptive analysis of the coded quantitative data.

This work-in-progress paper shows a distinction between Freshmen and Senior engineering students. The gap we found between Freshmen students and Senior engineering students was significant when looking strictly at AI use. As shown in Table 1, the Chi-Square test showed a significant difference between Freshmen engineering students and Seniors (p=0.025). This is based on the sorting question that asked if students had used AI tools to aid in their learning (use to aid learning). Students who identify as having a disability may use AI technology less than their engineering student peers (p=0.061). The survey asked for highest degree of completion (e.g., high school students, undergrad, graduate). High school completion students, more than any other group, said they believe AI is a technology that requires careful management (manage carefully). This group in Table 1 under the Degree Completed demographic is composed of undergrads who have not graduated.

Table 1 Chi-Square results in using AI tools to aid learning and managing AI tools carefully

		χ^2 Tests		
Item	Demographic	**χ^2 Value**	**Df**	**p**
use to aid learning	Univ. Seniors vs. Freshmen	7.38	2	0.025
	GPA in school	10.50	4	0.033
	Identify as having Disability	3.51	1	0.061
manage carefully	Degree Completed	41.01	28	0.053

Overall, about two thirds of the engineering students said they use AI tools to aid learning (see Table 2 for frequencies).

Table 2 AI use by Engineering Students

AI use	**Counts**	**% of Total**
Yes	86	65.65 %
No	45	34.35 %

The survey took students who reported “no” to using AI to aid learning to another question asking if they intend to use AI in the future, results are in Table 3. The low use in this group is interesting. If they have not yet used AI it appears that they are reluctant to use it in the future.

Table 3 Reported "no" to AI use to aid learning

AI use intent	Counts	% of Total
Yes	5	11.11 %
No	40	88.89 %

A chi-square test showed findings where gender made a difference. Men reported that they felt AI was competent, X^2 (6, N = 131) = 14.8524, p = 0.021., felt hopeful about having AI available in their classes X^2 (10, N = 131) = 17.2778, p = 0.068. and also thought they would use AI tools in their future field of work X^2 (10, N = 131) = 17.8624, p = 0.057. Other interesting findings were the reuse questions outlined above. Men were significantly more likely to report a tendency to reuse AI technology than women on every question asked about reuse of AI (see Table 4). There was a significant difference in race as well. White engineering students reported they intended to reuse AI for solving tasks in the future (see Table 4).

Table 4 Plans to reuse AI by gender and by race

		χ^2 Tests		
Item	Demographic	**χ^2 Value**	**Df**	**P**
intend to reuse	Gender	19.5617	6	0.003
predict reuse		20.2873	6	0.002
consider reuse		16.3804	6	0.012
intend to reuse	Race	27.4139	12	0.007
predict reuse		11.3421	12	0.5
consider reuse		16.0166	12	0.19

Discussion

The data analyzed in this work-in-progress paper answered the primary research question: How does the adoption of AI technologies for learning vary across demographic groups among university engineering students? In this study we checked the alignment of the survey variables against the collected demographic information. Not all participants reported prior or current use of AI. When considered with responses of students who previously had used or currently use AI, this data offers some intriguing insights on how students predict or anticipate their use. The responses to these questions help us drill down into what students think about AI use and how willing they are to repeat use of AI tools. The data collected in this study helps us get a view into the student impression of AI-driven tools and that information presents immediate opportunities to inform engineering education progress. As described by [3] we can see the timeliness of this

study and the need for advancing AI tool use strategies in academia. The changes to how students learn may be driven by student interest and perceived benefits of the new technology. The analysis conducted in this study provides insights into the percentage of students using the technology and the adoption of AI tools during their university experience; however, more work is needed to unpack the nuanced reasons why and how students choose to use or continue to use, discontinue use, or avoid adoption of AI based tools altogether.

Study Progress and Future Work

There are many questions that could be investigated by future work. For example, how much access do students have to AI technology and training in AI technology. More research should be done on defining the needs of industry and identifying necessary preparations in engineering education to adequately meet the needs for AI integration. Women tend to shy away from AI reuse this raises a lot of questions. Have their initial experiences been negative? Do they find it inconvenient? Do they have access to the technology? Future research could help define why there is a hesitancy for women to reuse AI tools. There are many aspects of the integration of AI tools into the university experience that will need continued exploration. Identifying the needs of industry should be key in developing this new learning environment.

Gaining an understanding of how AI is impacting engineering education at the University level from a student perspective is interesting. The findings from this work indicate that new students starting their higher education journeys in engineering have little experience or exposure to AI tools prior to entering college. This may be of value in designing first-year curriculum and raises questions regarding if, when, and how AI training should be integrated into engineering curricula. Higher-level engineering students, on the other hand, reported using AI technology more often than their freshmen colleagues, indicating that they may adopt these tools to become more prepared for meeting the needs of industry; however, further research is needed to explore this potential reason for adoption. Knowing that more the 65% of engineering students have used AI technologies we can see that education in engineering is changing. How we anticipate these rapid changes will be of upmost importance in engineering programs at every university.

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References

[1] H. Al-Juboori and G. Noonan, "Leveraging the Power of Digital Immersive Technologies to Enhance Engineering Education and Learning," *2024 IEEE Glob. Eng. Educ. Conf. EDUCON Glob. Eng. Educ. Conf. EDUCON 2024 IEEE*, pp. 1–5, May 2024, doi: 10.1109/EDUCON60312.2024.10578667.

[2] S. Isaac Flores-Alonso *et al.*, "Introduction to AI in Undergraduate Engineering Education," *2023 IEEE Front. Educ. Conf. FIE Front. Educ. Conf. FIE 2023 IEEE*, pp. 1–4, Oct. 2023, doi: 10.1109/FIE58773.2023.10343187.

[3] B. A. Becker, P. Denny, J. Finnie-Ansley, A. Luxton-Reilly, J. Prather, and E. A. Santos, "Programming Is Hard - Or at Least It Used to Be: Educational Opportunities and Challenges of AI Code Generation," in *Proceedings of the 54th ACM Technical Symposium on Computer Science Education V. 1*, Toronto ON Canada: ACM, Mar. 2023, pp. 500–506. doi: 10.1145/3545945.3569759.

[4] G. V. Joseph, A. P., A. T. M., D. Jose, T. V. Roy, and M. Prasad, "Impact of Digital Literacy, Use of AI tools and Peer Collaboration on AI Assisted Learning: Perceptions of the University students.," *Digit. Educ. Rev.*, no. 45, pp. 43–49, Jun. 2024, doi: 10.1344/der.2024.45.43-49.

[5] M. Edali, A. Milad, H. Saad, Z. Sahem, T. Alajaili, and A. Elkamel, "ChatGPT and Artificial Intelligence (AI) Massive Transformation of Trainers' Education Sector Revolutionizing How Students Learn," in *Proceedings of the International Conference on Industrial Engineering and Operations Management*, Dubai, UAE: IEOM Society International, Feb. 2024. doi: 10.46254/AN14.20240340.

[6] C. Spreitzer, O. Straser, S. Zehetmeier, and K. Maaß, *Mathematical Modelling Abilities of Artificial Intelligence Tools: The Case of ChatGPT.*, vol. 14, no. 7. 2024, p. 698. doi: 10.3390/educsci14070698.

[7] V. Venkatasubramanian, "Teaching Artificial Intelligence to Chemical Engineers: Experience from a 35-year-old Course," *Chem. Eng. Educ.*, vol. 56, no. 4, Art. no. 4, Oct. 2022, doi: 10.18260/2-1-370.660-130423.

[8] E. Ambikairajah, T. Sirojan, T. Thiruvaran, and V. Sethu, "ChatGPT in the Classroom: A Shift in Engineering Design Education," *2024 IEEE Glob. Eng. Educ. Conf. EDUCON Glob. Eng. Educ. Conf. EDUCON 2024 IEEE*, pp. 1–5, May 2024, doi: 10.1109/EDUCON60312.2024.10578884.

[9] S. Al-Natour, I. Benbasat, and R. T. Cenfetelli, "The effects of process and outcome similarity on users' evaluations of decision aids," *Decis. Sci.*, vol. 39, no. 2, pp. 175–211, 2008, doi: 10.1111/j.1540-5915.2008.00189.x.

[10] M. Teng *et al.*, "Health Care Students' Perspectives on Artificial Intelligence: Countrywide Survey in Canada," *JMIR Med. Educ.*, vol. 8, no. 1, p. e33390, Jan. 2022, doi: 10.2196/33390.

[11] P. R. Pintrich, D. A. F. Smith, T. Garcia, and W. J. Mckeachie, "Reliability and Predictive Validity of the Motivated Strategies for Learning Questionnaire (Mslq)," *Educ. Psychol. Meas.*, vol. 53, no. 3, pp. 801–813, Sep. 1993, doi: 10.1177/0013164493053003024.