Paradigm Shift? Preliminary Findings of Engineering Faculty Members' Mental Models of Assessment in the Era of Generative AI

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Abstract

The emergence of generative artificial intelligence (GAI) has started to introduce a fundamental reexamination of established teaching methods. These GAI systems offer a chance for both educators and students to reevaluate their academic endeavors. Reevaluation of current practices is particularly pertinent in assessment within engineering instruction, where advanced generative text algorithms are proficient in addressing intricate challenges like those found in engineering courses. While this juncture presents a moment to revisit general assessment methods, the actual response of faculty to the incorporation of GAI in their evaluative techniques remains unclear. To investigate this, we have initiated a study delving into the mental constructs that engineering faculty hold about evaluation, focusing on their evolving attitudes and responses to GAI, as reported in the Fall of 2023. Adopting a long-term data-gathering strategy, we conducted a series of surveys, interviews, and recordings targeting the evaluative decision-making processes of a varied group of engineering educators across the United States. This paper presents the data collection process, our participants' demographics, our data analysis plan, and initial findings based on the participants' backgrounds, followed by our future work and potential implications. The analysis of the collected data will utilize qualitative thematic analysis in the next step of our study. Once we complete our study, we believe our findings will sketch the early stages of this emerging paradigm shift in the assessment of undergraduate engineering education, offering a novel perspective on the discourse surrounding evaluation strategies in the field. These insights are vital for stakeholders such as policymakers, educational leaders, and instructors, as they have significant ramifications for policy development, curriculum planning, and the broader dialogue on integrating GAI into educational evaluation.

1. Introduction

The advent of generative artificial intelligence (GAI) has heralded a new era in higher education, prompting extensive research and discussions, particularly concerning its impact on traditional assessment practices. Recent literature reveals the infancy of these impacts as technological development continues, characterized by diverse concerns and questions raised by stakeholders including administrators, policymakers, faculty members, and students. Our work contributes to this burgeoning discourse by focusing on engineering faculty members' mental models of assessment in the era of GAI and identifying patterns in who is already adapting.

The accessibility and capabilities of GAI have significantly influenced the landscape of higher education, sparking debates and studies on its potential and challenges. This trend is evident in the proliferation of studies assessing GAI's integration in various educational facets, particularly in assessment practices [1], [2], [3], [4], [5]. The existing literature, though in its nascent stage, has started to uncover several dimensions of GAI's influence on assessment, highlighting the transformative potential of GAI in education alongside ethical considerations and the necessity for responsible implementation strategies [6], [7], [8].

Herein, we present a portion of a larger study on engineering faculty members' mental models of assessment in the era of GAI. The overarching question for this study is:

RQ: How do engineering faculty members' responses to the arrival of GAI in their assessment practices vary based on their demographics?

By answering this research question, we aimed to explore if there are trending responses across certain demographics as a start of our study. The findings helped us understand our data's representativeness and who has been adapting GAI in assessment practices. In the following sections, we present the background, our methodology – an outline of our data collection and analysis plans, our preliminary findings based on participants' backgrounds, and discuss future work.

2. Background

The trend of the accessibility and capability of GAI has increased the number of studies and discussions about its impact on traditional assessment practices in higher education. In recent literature, we started to see the findings for various aspects of GAI from the standpoint of assessment practices [1], [2], [4]. We see that the existing literature is in its early years, and there are various concerns and questions that are being raised by administrators, policymakers, faculty members, and students. Smolansky et al. [4], for instance, conducted a survey involving both students and educators across two universities on attitudes across various assessment scenarios, with an emphasis on the need for bringing new assessment practices. Their findings showed moderate GAI usage, consensus on impacted assessment types, and concerns about academic integrity. Educators preferred adapted assessments that use GAI, fostering critical thinking, while students presented mixed feelings due to concerns about their loss of creativity. When Smolansky et al. [4] studied both stakeholders, they emphasized the importance of engaging stakeholders in assessment reform efforts to prioritize learning processes, higher-order thinking, and authentic applications in the era of GAI. The GAI has gained popularity in higher education; some instructors encourage transformative learning experiences with GAI, while skepticism of GAI regarding academic integrity has also surfaced [5]. On the other hand, a study examines the potential usefulness of GAI in changing faculty workload. Watermeyer and colleagues [9] conducted a survey of faculty members and found that instead of challenges, there is potential to offer relief or overburdened academics with GAI, disrupting the industrialization of academic work and reconnecting with scholarly work. They explained the ways GAI may help faculty members as "relief from bureaucratic burdens, support in conceiving of and starting research and writing projects, time for planning and operationalizing teaching plans, help in supporting students, time and energy to commit to continuing professional development, and intersecting all of these, help in surviving UK academia as a prestige economy" [9, p.15]

Other studies have also looked at different contexts in terms of GAI's impact on higher education and assessment practices and provided guidelines on how to approach GAI in higher education and assessment practices. Wang [5] conducted a literature review to explore the GAI's impact on higher education, presenting key opportunities and challenges. The authors discussed four strategies for higher education to embrace GAI: "establishing clear policies for GAI in higher education institutions," "revisiting assessment on higher education," "teacher professional

development," and "developing student literacy for responsible use of GAI" [5, p. 221,222]. Such strategies can guide administrators, policymakers, educational researchers, and instructors in navigating the growing use of GAI responsibly in higher education and assessments. Another study also found similar guidelines, though in a different context [10]. Specifically, the authors assessed the global response of the top 50 higher education institutions worldwide to adopt GAI tools in assessment practices and revealed that nearly half of these institutions have made public guidelines available. These guidelines addressed issues like academic integrity, advice on designing assessments, and communication strategies with students. The study ultimately advocated for the inclusion of GAI in the assessment landscape, calling for the development of GAI assessment literacy among instructors [10]. A recent systematic literature review also found the need for new skills, interdisciplinary teaching methods, and policy implications, highlighting GAI's transformative impact on school education that aligned with their findings in their literature review [2]. Following up on the review, Chiu [1] conducted a study to explore perceptions of AI from the teachers' point of view and found that tools such as ChatGPT have influenced schools, with the viewpoints of teachers being particularly significant, with concerning elements such as learning, teaching, assessment, and administration. In addition to faculty, there are studies that focus on student perceptions, and Farrelly and Baker [6] conducted a study on international students to understand the impact of GAI on their experiences and found issues like academic integrity, biases in AI models, and the disproportionate effects on international students among the participants. Based on the results, Farrelly and Baker [6] called for a balanced approach that addresses challenges and opportunities while ensuring equity, AI literacy, and ethical considerations in adopting AI technologies in higher education. All in all, these studies, situated in various contexts in higher education, have shown the perception and guidelines surrounding GAI, higher education, and assessment practices.

Ethics is one of the biggest concerns raised by researchers in higher education. This is partly explored by Kadaruddin's study on understanding the potential of GAI in transforming educational methods was explored in a study examining various GAI applications in education [8]. The review emphasized the benefits of GAI on personalized learning, interactive content creation, and adaptive assessments but also recognized the ethical concerns regarding data privacy, algorithmic bias, and the educator's role. The research calls for ongoing collaboration to ensure the ethical and equitable integration of GAI in educational settings [8]. Another study discussed the responsible and effective utilization of GAI tools in higher education, pointing out critical factors of AI integration, ethical issues in scientific publishing, and concerns related to equity and accessibility [7]. The authors advocated for a balanced and inclusive approach to incorporating GAI into education. Cotton and colleagues conducted a comprehensive study to explore opportunities, challenges, and ethical aspects of GAI [11]. They examined the potential advantages of increased student engagement and collaboration but also raised concerns about academic honesty and plagiarism. Strategies for policy development, training, support, and various methods to detect and prevent cheating were suggested to ensure the ethical and responsible use of GAI tools [11]. All in all, ethical concerns are a major discussion point in the use of GAI in higher education contexts.

There are studies that show the positive reinforcement of the use of GAI in education. For example, Tlili et al. [12] examined ChatGPT's role in education through social media discourse and educational scenarios. Their study uncovered a generally positive public sentiment with

enthusiasm for educational applications that is usually seen as encouragement for the use of GAI. However, issues like cheating, privacy concerns, and manipulation were identified in user experiences, emphasizing the necessity for research directions to ensure the safe and responsible adoption of GAI in education [12].

Overall, the integration and adaptation of GAI in higher education have led to extensive research and discussions over the past five years in our non-exhaustive review. These studies have explored the perspectives of educators and students, global responses from leading institutions, ethical considerations and implications for the responsible use of GAI, and challenges in assessment practices, and the transformative potential of GAI in education across the world. Collectively, these diverse studies contribute to the ongoing discourse on the impact of GAI tools on education and underscore the need for diverse and innovative approaches to embracing GAI technologies.

3. Methods

This study is a part of a bigger study that contains three phases, and this data was collected during the second phase (The Institutional Review Board (IRB) at Virginia Tech approved our protocol under the IRB 21-639 number). The larger study leverages multiple sources of data, and in this analysis, we use two of those sources: 1) an initial survey that gathered demographic data as well as data relative to mental models of assessment and 2) the first question from our event surveys which asked specifically about GAI and assessment.

3.1 Data Collection

Our target population of participants included engineering faculty members who work for US institutions. We created an initial pool of faculty members from various resources: department faculty lists for the top 50 engineering programs by size, engineering education journal author lists, and the list of PIs on NSF projects related to STEM education. People who responded and participated in the mental model survey were invited to an additional round of data collection, which included event surveys spread throughout the academic term. Although the event surveys were offered in three different participation types: online surveys, five-minute-long interviews, and five-minute-long recordings, they all asked the same questions. We offered three different formats to give an option to participants to choose the most convenient one for them. We aimed to increase the number of participants by offering various options. Salient to this analysis, we included respondents who taught at least one course during Fall 2023 while participating in this study because we aimed to observe if faculty members' opinions about GAI throughout the semester changed based on their experiences in classes. During Fall 2023, we asked them to answer our event survey questions at three different time points of the semester regardless of their choice of participation type. However, in this study we did not cover their perception changes throughout the semester. For this analysis, we extracted the only demographic information from the mental models survey and the responses from the first event survey to the question:

"Has the arrival of generative AI (e.g., ChatGPT) impacted your thinking on assessment or assessment practices?"

To increase participation and interest in our study, we compensated participants with a $25 gift card for completing the mental model survey and an additional $50 gift card for completing all three time-point surveys. Overall, the event survey was sent to 101 faculty members and 67 of them responded to our questions related to GAI (response rate = % 66.3).

3.2 Data Analysis

For this analysis, we aimed to see if there were any notable trends in engineering faculty members' responses to the question about generative AI and assessment based on their demographics and personal backgrounds. Demographic and personal background data include gender, race, ethnicity, position, the department they work for, number of years in their present position, etc. We matched participants' responses to the question regarding the impact of GAI (answers as Yes/No/Maybe/I am not sure). with their demographics and we analyzed if there were any similarities or differences regarding their demographics.

3.3 Limitations

As with all studies, our work has limitations. The representation of underrepresented groups is not diverse. For future data collection, we may consider increasing the diversity of race representation and purposefully recruiting underrepresented groups. Additionally, it is noteworthy that the sample sizes by department are relatively small, which may limit the breadth and depth of these insights. More extensive studies would be beneficial for a more detailed understanding and for drawing stronger conclusions about the impact of GAI across various engineering disciplines. Regardless of these limitations, our work offers initial insights into potential patterns worthy of further investigation.

4. Preliminary Findings with Participants' Profiles

Our study showed that more than half of the participants (n = 38) indicated that the arrival of GAI did not impact their thinking of assessment practices. Twenty-seven of the faculty members stated that the arrival of GAI did impact their thinking on assessment practices. Only two people indicated uncertain responses; one said, "Maybe," and another said, "I am not sure." We started descriptive analysis by looking at associations between participants' responses to the yes/no question and their self-identified gender. These results are shown in Table 1. While 57% of the participants (n = 38) identified as men, 35% (n = 24) were women. Two percent (n = 1) of participants were non-binary/third gender, 3% (n = 2) of them preferred to self-describe, and only one of them described themselves as a "Person" in their responses, while the other participant did not specify at all. Three percent (n = 2) of them preferred not to share their gender.

Based on races reported in the recruitment survey, the impact of GAI on assessment practices among engineering faculty members varied as shown in Table 2. Among 33 White participants, 17 self-reported no impact of GAI on their thinking on assessment practices, while 15 acknowledged an impact of the arrival of GAI on their thinking on assessment, and one was

Table 1. The number of participants' responses to the question "Has the arrival of generative AI (e.g., ChatGPT) impacted your thinking on assessment or assessment practices?" based on their genders

Gender	No	Yes	Maybe	I am not sure	# of participants	% of participants
Man	24	14			38	57
Woman	11	11	1	1	24	36
Non-binary/third gender	1				1	1
Prefer to self-describe		2			2	3
Prefer not to say	2				2	3

unsure. Among Asian participants, out of 21 respondents, 13 perceived no impact, seven indicated an impact, and one chose Maybe. Responses from individuals identifying as Hispanic, Latino, or Spanish origin (n = 6) indicated an even split, with three reporting no change and three acknowledging an impact. Among those identifying with multiple races (n = 3), all three reported no impact of GAI in their perspectives. Lastly, the single participant identifying as Middle Eastern or North African reported no change. These findings underscore that response patterns by race are similar.

Table 2. The number of the participants' responses to the question "Has the arrival of generative AI (e.g., ChatGPT) impacted your thinking on assessment or assessment practices?" across their race

Race	No	Yes	Maybe	I am not sure	# of participants	% of participants
White	17	15		1	33	49
Asian	13	7	1		21	31
Hispanic, Latino, or Spanish origin	3	3			6	9
Multiple races	3				3	4
Middle Eastern or North African	1				1	1
Another race or ethnicity not listed		1			1	1
Prefer not to disclose		1			1	1
NA	1				1	1

Table 3 shows participants' responses based on their home departments. The analysis aimed to identify potential department-specific responses to the integration and perception of GAI in educational practices. Focusing on the departments that had the first three highest numbers of total responses, participants from Mechanical Engineering recognized the influence of GAI with almost 32%. Electrical Engineering exhibited that 29% of faculty members indicated an impact on their thinking on assessment practices. Computer Science, a discipline inherently intertwined with technological advancements, showed around 33% of faculty members acknowledging the impact of GAI.

Table 3. The number of the participants' responses to the question "Has the arrival of generative AI (e.g., ChatGPT) impacted your thinking on assessment or assessment practices?" based on their home department

Home Department	No	Yes	Maybe	I am not sure	# of participants	% of participants
Aerospace Engineering	1	2			3	4
Biomedical Engineering	3				3	4
Chemical Engineering	2	1			3	4
Civil Engineering	3	2			5	7
Computer Engineering	1	2			3	4
Computer Science	6	3			9	13
Electrical Engineering	5	2			7	10
Electrical/Computer Engineering		1			1	1
Engineering Education	1	4			5	7
General Engineering	3	1			4	6
Industrial/ Manufacturing/ Systems Engineering	2	1	1		4	6
Mechanical Engineering	11	5			16	24
Other		3		1	4	6

The analysis of the impact of GAI on assessment practices across various academic positions reveals intriguing patterns shown in Table 4. Assistant Professors present a balanced view, suggesting a blend of openness and caution toward GAI integration, with seven of them saying Yes out of 18 participants. Associate and Full Professors exhibited more conservatism, indicating a cautious approach to adopting GAI in their established assessment practices. In contrast to the

professorial roles, Lecturers or Instructors responded that the arrival of GAI had impacted their thoughts on assessment in higher proportions.

Table 4. The number of the participants' responses to the question "Has the arrival of generative AI (e.g., ChatGPT) impacted your thinking on assessment or assessment practices?" based on their position/title

Position	No	Yes	Maybe	I am not sure	# of participants	% of participants
Assistant Professor	10	7	1		18	27
Associate Professor	11	4		1	16	24
Full Professor	11	4			15	22
Distinguished/Endowed/University Professor		1			1	1
Adjunct Professor		2			2	3
Lecturer/Instructor	1	6			7	10
Professor of Practice	1				1	1
Asso -Distinguished Prof- Lecturer		1			1	1
Associate Prof-Lecturer	1				1	1
Full-Distinguished Prof-Administration	1				1	1
Full Professor-Administrator	2				2	3
Research Associate-Adjunct Professor		1			1	1
Lecturer-Administration		1			1	1

In Table 5, we present participants' responses based on their years of work experience in their fields. Our data showed that the perception of GAI's impact is not strictly correlated with the years of experience. There is a recognition of the impact of GAI across all experience levels, suggesting an integration of GAI across different stages of educational careers. However, we see that more than half of the most experienced participants indicated GAI did not impact their thinking on assessment practices.

The findings in Table 6 underscore the role of GAI in different course settings. Participants who teach first-year engineering courses emerged as the most receptive to the influence of GAI, with 12 out of 20 respondents acknowledging its impact.

Table 5. The number of the participants' responses to the question "Has the arrival of generative AI (e.g., ChatGPT) impacted your thinking on assessment or assessment practices?" based on their years of experience

Experience in years	No	Yes	Maybe	I am not sure	# of participants	% of participants
Less than 1 year		1			1	1
4-6 years	8	6	1		15	22
7-10 years	11	7		1	18	27
11-15 years	4	4			8	12
More than 15 years	15	9			24	36

The preliminary findings of this study reveal perspectives among engineering faculty members regarding the impact of GAI on thinking in assessment practices. These findings align with recent literature emphasizing the transformative potential of GAI in education alongside ethical considerations and the need for responsible implementation strategies [5], [7], [8], [10], [11]. Our study indicates that faculty responses to GAI in assessment practices are not monolithic but vary based on demographics, departmental affiliations, and years of experience, among other factors we did not measure in this study.

Table 6. The number of the participants' responses based on the type of courses they teach

Course Type	No	Yes	Maybe	I am not sure	# of participants	% of participants
First-year engineering course	8	12			20	30
Capstone course	14	11			25	37
Laboratory course	14	9			23	34
Concept-heavy, fundamental and foundational course	33	18	1	1	53	79
Other	10	6		1	17	25

5. Discussion and Future Implications

This diversity suggests a complex interplay between personal, professional, and contextual factors in shaping educators' attitudes toward GAI. Since GAI has been developed widely in Computer Science, we expected to hear more Yes from people with Computer Science expertise.

Also, we thought people from Mechanical Engineering may think that GAI cannot solve their assessment due to the nature of the mathematical problems. However, the percentages from these departments were similar. These preliminary findings highlighted the need for tailored approaches and further exploration within each discipline to understand the potential of GAI in enhancing assessment practices effectively. This finding is critical as it underscores the importance of discipline-specific strategies when considering the integration of GAI in educational practices.

In addition, more experienced faculty members, who may be accustomed to traditional methods, showed a degree of skepticism towards GAI. This higher percentage of Lecturers and Instructors who reported openness to GAI may indicate a more flexible and adaptive approach to the incorporation of innovative technologies in assessment practices, possibly due to the nature of their teaching roles and the demand for keeping up with current trends to enhance student learning experiences. This finding resonates with the ongoing discourse on the need to balance traditional pedagogical methods with emerging technological trends [11]. However, we need to conduct our study with more samples to make any generalizations. Furthermore, the varied responses based on the type of courses taught (e.g., first-year engineering courses vs. capstone courses) indicate that the impact of GAI is not uniform across different educational settings. This suggests a need for a more nuanced understanding of how GAI tools can be effectively and responsibly integrated into different types of engineering courses.

Regarding specific courses, we found that people teaching first-year courses reported GAI was influencing thinking about assessment. This relatively high recognition might reflect the foundational nature of these courses, where incorporating innovative technologies could play a significant role in shaping early educational experiences. In contrast, Capstone Courses, often being the culmination of academic programs, showed a notable number of acknowledgments. This suggests that even in advanced stages of education, where comprehensive projects and practical applications are prevalent, the potential of GAI to influence and enhance educational practices is widely recognized. Concept-heavy, Fundamental, and Foundational Courses showed a conservative stance for their assessment practices. The intricate and theoretical nature of these courses might necessitate a more deliberate and cautious approach to integrating GAI, reflecting a blend of traditional pedagogical methods with emerging technological trends. Overall, the synthesis of the data reveals that the perception of the impact of GAI varies considerably across different course types. While courses at the beginning and end of academic programs showed higher acknowledgment rates, the integration in specialized and concept-heavy courses was more measured, underscoring the complex nature of assessment practices in the era of GAI.

Looking forward, our study opens several avenues for further research. One key area is exploring how different demographic factors, including gender, race, and years of experience, influence faculty members' attitudes toward GAI. Like existing literature that has shown benefits of exploring perceptions of different contexts [2], [5], [6], [10], this would provide deeper insights into the diverse mental models and potential biases that exist in academia regarding technology adoption. Moreover, there is a need for longitudinal studies to track the evolution of faculty members' attitudes toward GAI as they gain more exposure and experience with these tools. This would provide valuable insights into the dynamics of technology adoption in education and inform the development of targeted professional development programs, and like the current

conversation on GAI, potentially help inform policies on adoption and usage [5], [10]. This is our next step to proceed with a broader study.

Another important research direction can be investigating the impact of GAI on learning outcomes and student engagement in engineering education. As GAI tools become more prevalent, it is crucial to understand how they influence not just assessment practices but also students' learning processes and outcomes.

Finally, interdisciplinary collaborations involving educators, technologists, and ethicists are essential to address the complex challenges posed by GAI in education. Such collaborations can lead to the development of ethical guidelines, effective pedagogical strategies, and innovative assessment methods that leverage the potential of GAI while mitigating its risks. In conclusion, our study provides a preliminary reaction of faculty members to the arrival of the complex landscape of GAI integration in engineering education. As the field evolves, ongoing research and collaborative efforts are vital to harness the benefits of GAI while navigating its challenges in a responsible and ethical manner.

6. Conclusion

In this study, we aimed to examine how faculty members' responses to the impact of the arrival of GAI on their thinking about assessment practices vary based on their demographics and experiences. The preliminary findings underscored the diversity of faculty attitudes toward GAI that may be associated with factors such as their gender, race, disciplinary background, and years of experience in the field. The varied responses among faculty members reflect a broader conversation in the arrival of GAI about the balance between traditional assessment methods and innovative technological assessment practices. However, we see the need for further investigation with more samples to make broader inferences about the variations in faculty members' responses across their demographics. Furthermore, we are preparing to qualitatively analyze how and why the arrival of GAI impacted or did not impact their thinking on assessment practices for future work. As this study is part of a broader study, we believe that the insights gained from it can inform the development of future strategies to investigate future strategies and policies for integrating GAI into engineering education, paving the way for a more informed and adaptive approach to technology in assessment.

7. Acknowledgment

We thank all research participants who shared their time and experiences with us. This material is based upon work supported by the National Science Foundation (NSF) under Grant No. 211363. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the NSF.

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