Exploring Undergraduate Students' Utilization and Perceptions of Generative AI in Engineering: Insights from an Introductory Statics and Mechanics of Materials Course

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***Abstract*—This research paper examines how students utilize generative Artificial Intelligence (GenAI) both in and outside an introductory Statics and Mechanics of Materials course, utilizing an interactive online textbook hosted through Top Hat. The textbook features its own GenAI, called ACE, which is trained exclusively on course materials from the textbook. Researchers conducted, recorded, and transcribed six focus group interviews. Responses were analyzed into a report on each student's experience. Several key themes emerged from the focus groups, including both positive aspects, such as using ACE as a virtual tutor, and negative aspects, such as having ACE attempt to answer questions on their behalf. While this raised concerns regarding academic integrity, the responses showed that those who misused GenAI became aware of their wrongdoing and adjusted their usage to aid in learning. Students cited various reasons for changing negative habits, including developing an awareness of the potential harm of building a dependency, recognizing that GenAI was inferior to human interaction when seeking help, and being aware of AI's limitations in providing reliable knowledge. As a result, students recognized the need for in-person instruction to master a subject. The self-reported data suggests that when used appropriately, GenAI can enhance student comprehension of course material; however, when misused, it may hinder students' study habits and learning. Findings suggest that educators should consider implementing instruction on the ethical, practical, and effective use of GenAI as opposed to banning it. This multifaceted approach would minimize potential academic integrity violations while maximizing academic benefits.**

***Index Terms*—GenAI, Top Hat ACE,**

I. Introduction

In recent years, Generative AI (GenAI) has become a worldwide phenomenon, most notably LLMs. LLMs are trained on vast data sets composed of text and code and have shown outstanding proficiency in summarizing large documents efficiently, translating languages, and explaining topics [2]. One particularly popular LLM, OpenAI's ChatGPT, was released to the public free of charge in late November of 2022, and by January, it had accumulated 100 million users and 590 million visits [3]. Seeing OpenAI's success, other LLMs were released by major companies such as Google and Microsoft shortly after. The application of LLMs is ever-increasing in its capabilities, as they are actively breaking language barriers, generating hyper realistic videos, innovating industries, and revolutionizing education through their ability to employ transformers, which process input data all at once, making them faster and more efficient than other models that process data step by step [4]. Greatly impacted by this technological advancement is education, as GenAI plays a pivotal role in the accessibility of receiving help [5].

In education, GenAI proves itself beneficial by helping with research, writing, text summaries, and, most importantly, personalized learning [5]–[7]. Instructors have long wanted a way to ensure each student's learning experience meets their needs, but with the implementation of GenAI, what seemed impossible is now just a step away [8, 9]. With instructors recognizing this, it caused a sharp rise in GenAI usage in educational institutions in 2023 [9]. A few applications of GenAI in personalizing a student's learning experience can be classroom simulation, feedback comment generation, learning resource recommendation, and evaluation of texts, images, and translation [7, 8]. Surprisingly, it is estimated that over two-thirds of evaluation tasks (such as summarizing or comparing multiple texts and analyzing text, tables, and images) will be affected by LLMs within the next five years [10]. Although it can provide

many positive educational aspects, it is far from perfect [11].

LLMs are still relatively new, and many users are questioning the reliability of LLM-generated content, and the increasing involvement in education raises concerns about students learning incorrect information [6, 12]. Across 25,000 interviews worldwide, 86% of people felt that they had fallen victim to misinformation on the internet. The widespread sources of misinformation are data that GenAI can access and relay to a user needing help [13]. As stated above, LLMs excel in language and writing, but the complexity of STEM-related fields challenges the precision of responses. This would require instructors to ensure the LLM's content is accurate, reliable, and aligned with the desired lesson [14]. Although, as time moves forward, it is predicted that the algorithms will improve and minimize issues of fabricating information and pulling information from nonscientific sources [7]. Stemming from this, the positive or negative impacts are difficult to measure, as traditional metrics such as standardized test scores or course grades may not capture the effects of GenAI usage [12]. LLMs' effects on modern-day education, for better or worse, raise questions of ethics.

Educators around the world debate whether access to GenAI should be restricted. One side acknowledges that it can provide quick and easy answers to questions, but the issue is that it does not improve students' critical thinking and problem-solving skills. Following that, banning GenAI entirely would mean employing restrictions on different search engines, such as Google and Bing, as they all have free access to GenAI. This would have to be in effect on every student's phone, tablet, or laptop, making it nearly impossible in practice. If enforcing a ban is unrealistic, then instructors must inform students that GenAI is an inferior mode of learning, proven by examining general brain anatomy [5, 15]. With emotion playing a vital role in brain activity, it is seen that LLMs such as ACE, which are restricted to text generation, produce minimal emotional engagement and connection. This leads to it falling short of a student interacting with an instructor, as the instructor can provide a personal and emotional conversation, allowing the brain to prioritize this information for memorization for improved recall [15, 16]. Other forms of LLMs can generate images and videos, while not perfect, this advancement could impact education a great deal, potentially adding a higher level of emotional engagement, but remains primarily unstudied [21]. The majority of these results stem from observations, but how do the students feel it affects their learning environment, and what are the best ways to implement it to satisfy the students' needs?

Since GenAI is relatively new, there is a lack of research on its proper application in engineering education. Minimal research is conducted from students' first-hand experience with GenAI usage and the physical and mental impacts [17]. The research in this study focused on how students perceived GenAI usage, as well as any potential adverse effects GenAI had on the students, as well as negative impacts on their learning, and how they overcame it to improve their learning experience.

II. Methodology

Students in an introductory-level engineering course, Statics and Mechanics of Materials I, were invited to participate in a semi-structured focus group about their use of GenAI within the course. This course was administered through Top Hat's online platform to provide an interactive textbook and a feature that allowed the professor to customize the interactive assignments [18]. Top Hat also offers GenAI, known as ACE, which is trained solely on the course's materials. Instructors used the interactive textbook as training data for ACE and allowed the students to use ACE to create a versatile learning environment.

This class had two sections with 193 students total; from that population, 46 students voluntarily participated in these focus groups. The six focus group interviews lasted one hour each, during which the moderators posed four questions related to the topic and encouraged student responses. A teaching assistant for the course and the professor moderated the first two focus groups (n = 9 and 9). The remaining four were moderated exclusively by the graduate student researchers (n = 7, 7, 5, and 8) to invite the students to be honest when discussing their usage of GenAI. Presented below are the questions asked in the focus groups:

1) *How did you find yourself using GenAI, and why?*
2) *Did you prefer using GenAI to get help instead of seeking help via office hours, the course email, or peers?*
3) *What do you think are the pros and cons of using GenAI in this course?*
4) *For students who used Top Hat's ACE and Chat GPT): Which GenAI do you prefer? Top Hat ACE, which is limited to the textbook, or ChatGPT, which has access to the whole internet?*

The focus groups were recorded and transcribed via Panopto and checked by the researchers for accuracy. The researchers evaluated the focus groups and investigated how students used GenAI and the potential side effects associated with increased usage. The responses to Question 1 were analyzed, inductively coded, and organized into reappearing themes that emerged regarding what the students used GenAI for in their coursework in accordance with the methods outlined in Creswell [1]. When a theme was identified in a student's response, it was marked with the corresponding descriptor. When a student's response fell into one of the categorical themes, that student was marked with the designated descriptor and not marked again for that descriptor to prevent repeated themes. The number of students marked for each theme was then divided by the total number of students in the focus groups, giving a percentage of students who used GenAI for that specific theme. Additionally, the student responses were individually analyzed by taking all the times a student spoke and analyzing them to create a unique report of how that individual used GenAI and their opinions. Researchers also

took note of the students who stated they had used GenAI in any unethical manner and marked them for unethical usage. Of the students marked with unethical usage, each individual was analyzed to determine if they had stopped misusing GenAI and why. This analysis focused on whether students misused GenAI, how their habits changed, and their views on office hours compared to GenAI for assistance.

III. Results and Discussions

The Results and Discussion section is divided into four subsections. Section III-A discusses the general uses of GenAI within the course. In contrast, Sec. III-B debates the moral standing of GenAI usage in the classroom. This subsection is divided into two more sections: students' reports of building an over-reliance on GenAI, and students' reports of a lack of stimulation when interacting with GenAI. Section III-C discusses the untrustworthy responses and answers that GenAI delivers. Finally, Sec. III-D distills the key findings in the analysis.

A. General Usage

The focus groups highlighted various positive themes about how students incorporate GenAI into their coursework. Table I summarizes the main themes found and provides definitions. These themes were previously established in the work of Wyszynski et al. [19].

TABLE I
Theme Definitions

CODE	CATEGORICAL DESCRIPTION
Conceptual Understanding	Student asks generative AI for conceptual help to deepen understanding, explain, clarify, or rephrase content for better comprehension.
Methodology	Student asks generative AI to determine a method for completing a statics problem.
Practice Problems	Student uses generative AI to create course-related practice or example problems.
Find Solution	Student directly asks the coursework question to be answered by generative AI.
Convenient	Student positively comments on the ability to immediately get assistance remotely due to GenAI
Unreliable	Student comments that generative AI is not always correct, fails to understand a problem, or responds in a confusing manner.

Students began turning to GenAI for assistance, indicating that it could supplement or replace office hours due to its 24/7 accessibility and immediate feedback. Responses to Question 1 were thematically organized, revealing two significant themes: methodological and conceptual aid. Methodological assistance accounted for 41.86% of the student responses. Conceptual assistance appears in 24.41% of the student responses. For example, a student who used GenAI for methodological assistance commented:

> *I would use it on the homework to redirect myself when I felt like I was not getting off on the right foot. I would ask Top Hat's GenAI ACE, How would I solve for this quantity in this problem, and it would take me back to the basics and make sure I was thinking about the right process before I tried again.*

As the discussion proceeded, other students agreed while emphasizing the convenience of GenAI simultaneously. One of its most appealing characteristics is its ability to provide instantaneous feedback wherever the user is. One student explained:

> *[I] just needed help and didn't want to walk all the way up to office hours, it was just simple, so very convenient.*

Students across the focus groups supported this, continuing to discuss how comfortable it was to get help from GenAI from their own homes. Using GenAI to find formulas, equations, and summarize textbook readings can drastically increase work efficiency. One group of students who benefited from this instantaneous assistance was commuters, who explained that the only time they had available for homework was at night, when instructors did not hold office hours. GenAI offers more than a convenient way of assistance, as students use it to help with exam preparation.

In addition to the convenience, students have been using GenAI to help them study and manage their time. Some study methods include generating practice problems and personalized study content based on the student's strengths and weaknesses. Regarding time management skills, a student noted:

> *AI is very useful to me for time management, as I am pretty bad with it, so the way I get around bad time management is when I am down to the last second on something. It comes in handy for me personally; it gets me out of between a rock and a hard place.*

Students who have difficulties starting their work on time often turn to GenAI to help them efficiently complete the assignment. Although there are many benefits to students using GenAI, a deeper exploration revealed significant ethical concerns regarding its misuse and increasing over-reliance.

B. Ethical Implications

Researchers inquired with students and then analyzed their responses to determine if they had used GenAI unethically. Across all focus groups, 52.17% of students admitted to using GenAI unethically, such as attempting to get solutions to homework problems. In particular, the instructor sat in the first two focus groups, and only four of the eighteen students admitted to using GenAI unethically. In the remaining focus groups, when the professor was absent, 71.43%, 71.43%, 80.00%, and 66.67% of the students admitted to misusing GenAI, respectively. A stark contrast existed in student behavior between groups with the instructor present versus

those without. Using GenAI as a cheating aid poses many threats to the student's performance, as a student described their experience of this in another university-level class:

> *I would use it a lot for surface integrals or triple integrals and once we got to spherical coordinates, and I could get through the homework, but then I would not understand it in the slightest for exams, and I would do really bad on the midterms.*

This improper use can impact an exam grade and prevent long-term academic progression by building a reliance on GenAI to solve problems for them.

Once people become reliant on a tool, it can no longer be defined as a tool but instead as something the student depends on. GenAI has become a crutch for many students who want to get information or an answer instantly. One student described that an unforeseen consequence of the reliance on GenAI is a growing fear of seeking and asking for help from the professor or teaching assistants. GenAI is slowly replacing the need for a student to take the initial step to reach out and build a connection with the instructional staff since no physical interaction is needed when communicating with GenAI. Fault can fall on both the student and the instructional staff, as the student needs to build a positive relationship with their instructional staff, and the instructional staff needs to foster an inviting learning environment.

When instructional staff create a hostile learning environment, students feel reluctant to ask questions during office hours, fearing judgment from the professor's uninviting tone or actions, especially affecting women in STEM [20]. A student who did not pass Calculus I described their experience:

> *The way she taught was very difficult for no reason, she taught Calculus I almost as if you were a professional at it. I put a lot of effort in. I was in the MAC (Math Assistance Center) 24/7, and they got sick of me.*

As the course got progressively harder throughout the semester, their reliance on GenAI as a less stressful way to receive help increased. However, when they retook the class with a professor who fostered a welcoming environment, this student not only noticed their reliance on GenAI decreasing but also an improvement in class performance and effort.

There are many differing opinions on whether GenAI should be banned to prevent negative situations from occurring or manifesting into future issues. Question 3 of the focus group interviews aimed to investigate students' insights on the positives and negatives of GenAI usage. As previously outlined, the pros of GenAI include its convenience and multitude of ways to be used, such as, but not limited to, tutoring assistance, studying, and time management. The cons include unreliability, dependency, and limited stimulation, which proved significant enough for students to re-evaluate their usage.

Contrary to instructors' beliefs, students were aware of their unethical usage and potential harm to their learning experience. Based on the analysis of the reports generated from each student's usage, it proved that 91.66% of those who misused GenAI stopped their unethical practices. Three key reasons were associated with why an individual decided to stop using GenAI irresponsibly. The majority, 58.33%, of students positively changed how they use GenAI due to the fear of harmful side effects of misuse. Another 20.83% stopped using GenAI due to its unreliability in engineering, while 12.50% of students turned to office hours instead. Additionally, 4.17% of students used GenAI only for non-exam-related content, and the final 4.17% did not elaborate on how they had changed their usage.

More than half the students expressed fear of long-term damage impacting their learning processes, so researchers divided it into two categories: dependency and limited stimulation. Dependency refers to a student negatively commenting on an over-reliance on GenAI. At the same time, limited stimulation is defined as the student negatively commenting that using GenAI is less stimulating than in-person learning.

1) Dependency: Continuing into the idea of developing dependency, multiple students noted this as a deterrent to improper GenAI usage—according to the responses to Question 3, 30.30% of students who answered stated that dependency is a con that ultimately led them to more positive uses. A student who saw negative effects on their test-taking skills noted:

> *I would use Co-Pilot a lot to try and understand Calculus III problems, and it would get them right, then when I would get to the exam, I would be like, oh shoot, I forgot how to do them.*

As the focus group continued, this student's responses were tracked and analyzed to examine how they had re-evaluated and changed the intentions of use. When asked if they had the option to keep GenAI in the course, this student noted:

> *I would probably choose the AI course just because I know I have double access now so I can not only go to professors and TAs, but I also just for simple questions or even problem understanding when I don't have time to go, I can ask the tool.*

The student used the word "tool" to describe GenAI and described it as a potential backup to office hours when they cannot attend office hours.

Aside from the students who had to make a judgment call, many individuals avoided usage to eliminate the possibility of over-reliance on GenAI. A student covered this topic, stating:

> *I was adamant against using it because of Question number 3, pros and cons, I do not want to be dependent on it.*

Students supported this, with some further elaborating on "learning debt," which is described as derived from dependency on GenAI.

Students supported the avoidance of what one student referred to as learning debt. This student explained how they needed to finish one task at a time. If it is close to a deadline, they will use GenAI to finish the assignment quickly by finding the solutions, postponing learning the content for later. As this cycle continues, the student gains learning debt, defined as the accumulation of poorly understood material caused by procrastination and over-reliance on shortcuts such as GenAI, which needs to be paid off similar to financial debt before a certain period of time, designated as the date of the exam.

One student spoke about learning debt differently, stating that it allows them to prioritize one task over another while proactively planning when to go back and pay off their debt. They stated:

> *...using Chat[GPT] to just do the homework problems, but it is not like you cannot study that content later if you want, it is not going to tank your grade.*

Researchers thought it worth mentioning that lenient deadlines could decrease the need to prioritize one assignment over another, minimizing the need for GenAI and improving time management. However, if the student keeps "lending" to pay their already accumulated "learning debt," i.e., they abuse extended deadlines, then they will find themselves in the same situation.

Circling back to the students who had re-evaluated their use due to dependency, one individual referred to as "Scoots" labeled learning debt as harmful. Scoots made a commendable change, now using GenAI as an online tutor, which is one of the most impactful pros but also has its downsides. He described his thoughts as:

> *I feel that in any given subject, AI can get you from a 30% understanding to a 70% or 80% understanding. It can't get you from 0% to 30%, or 80% to 100%, simply because you have to know when it is wrong. Then, once you're at such an advanced level, it is not going to finalize your knowledge on that piece... at the end of the day, it's not going to fully develop your knowledge in any given subject because it's just not as smart as peers or yourself.*

Another student complimented Scoot's statement, mentioning that GenAI assumes you are all-knowing on the matter. This brings to light the trouble one might have trying to gain the initial knowledge of a subject from a GenAI platform. Not only did it have a limited range of practical help, but it was also less stimulating than in-person help.

2) Lack of Stimulation: Human interaction offers an impactful learning experience as answers can contain emphasis and emotion, and a natural conversation will occur. Regarding the responses to Question 3, 39.39% of students frequently noted that reading or copying information off a computer screen is far less mentally stimulating and more challenging to recall. A student elaborated on this point by stating:

> *I feel like that active process of either going out and seeking someone or going to the textbook and writing things down is a lot better than just being a zombie and copying and pasting into different web browsers and just looking at it that way.*

Many others noted this student's description of "being a zombie " as emotionless and continued to elaborate on how GenAI cannot receive and reciprocate human emotions like an instructor can. Office hours involve instructors who can put an emotional aspect into their responses, leading to a higher recall of information. Referencing the study on *The Influences of Emotion on Learning and Memory* pioneered by Chai M. Tyng [15], without interacting on an emotional level with another human, a person will not convert the information as well into long-term memories. This proves that the superior form of assistance is office hours due to the higher level of engagement when compared to using GenAI. 12.50% of students would support this statement after ending their unethical use of GenAI by turning to office hours. Across all focus groups, 58.70% of students instinctively went to office hours for help, and the remaining 41.30% of students immediately went to GenAI for assistance. One student who stated they impulsively went to GenAI for help described their experience as such:

> *[O]ne of the cons is when I use AI to help me versus office hours when I am doing homework or have a conceptual question, it is easier for me to recall what a person told me, like what the steps are, like when I physically saw it being done on a board versus what I learned from reading it off my computer screen and writing it down.*

For a student who habitually turned to GenAI for assistance, they spoke poorly about it. Similarly, other students had identical philosophies, so Question 2 explored the differences in depth.

Question 2 aimed to provide insight into the most convenient and helpful option for help. When asked to compare GenAI to office hours on a scale of helpfulness, 80% of the students who answered claimed that office hours provided a more helpful experience. When students were prompted to compare the two in terms of convenience, 94.44% of students stated that GenAI was more convenient. Finally, considering all potential factors, 82.60% of students stated that they would prefer to go to office hours for any course-related matters, particularly the course in this study, which offers many teaching assistants for a diversified range of hours and personalities.

Students who preferred attending office hours mentioned the reasoning being course-specific content. In contrast, GenAI teaches mainstream methods, skipping over personalization and better insight into exam content, as professors and teaching assistants write exams, not GenAI. One student, when comparing office hours and GenAI, stated:

> *There's probably tons of ways to solve different*

problems and ChatGPT will just give you the general way to go about it. Office hours might offer shortcuts you can take... so it offers tips and tricks that really help.

In addition to offering potentially more efficient routes to take, having the diversity of multiple teaching assistants allows the student to choose between different teaching styles and personalities. In contrast, students indicated that GenAI's interface remains fundamentally the same across different AI platforms, lacking diversity.

Further elaborating on comparing the two, office hours enable an instructional staff member to read students' expressions, indicating if they understand the material. One student reported:

If I got really stuck on a topic or an idea, if I tried asking the AI, it would just repeat back the definition or something like that to me. Whereas if I went into office hours, the person could look at me and understand where exactly I'm stuck on it and what my incorrect thinking is and fix it.

When a student is stuck, GenAI cannot help without precise guidance, which the student, in their current state of understanding, would be unable to provide. Other students amplified this idea by adding that when using GenAI, one has to trust or fact-check everything it produces. This unreliability is another reason students stopped using GenAI to find solutions.

C. Unreliability

This facet of GenAI−unreliability−led many students to cease use entirely, but those who continued to use it implemented a more practical approach. A student who continued to use GenAI described modifying their use around the fields which GenAI excels:

...maybe just the way I was plugging it in, but for Linear Algebra is very good at that, but then it was really bad at Statics questions, is what I found, so I found it was better to ask content questions to it, which I thought was helpful.

Many other students supported this statement, emphasizing that GenAI can excel in some STEM-related fields, such as Linear Algebra. Still, the complexities of engineering heightened concerns of reliability. Once again, these concerns highlight students being cognizant of the potential damage unethical GenAI usage can do to their learning experiences. Students also complained that ACE was unreliable, but not because it provided incorrect answers.

Although ACE was limited to the textbook, providing proper help with conceptual and methodological questions is within its range of capabilities. Students commented that rather than giving incorrect answers or guidance, ACE tended to chase its own tail, not giving a definitive answer. One student noted:

...and I am say I did this and that, but this didn't work, what is going wrong. Then ACE continued to say "you're on the right track." So its just like talking to a wall and it says nothing back to you.

This trend was common when students described their experience with ACE. To uphold its primary role in providing assistance rather than solutions, ACE has a set number of conversational turns before it begins to divulge the answer associated with the problem in question. This will be a topic of discussion in future works as the researchers aim to improve the interactions between students and ACE.

Very few students (two) in this study did not claim to use GenAI more positively after experiencing it. However, they did stop using it to directly find solutions to exam-related content to avoid potential harm to their exam scores. Only 4.17% of students stated they now only use GenAI to find answers to non-exam-related content; this highlights several points, beginning with the content provided. Individuals brought up the overwhelming course load within an engineering program and how non-exam-related content is not a priority. One student elaborated on this:

...when I started that assignment at 11:30, I used ChatGPT, and I think I can figure it out later, but not right now.

For example, the final exam did not contain content on torsion, but was a topic of homework. This student indicated that they used GenAI to do their homework assignment since it was not going to affect their exam performance.

Since there is abundant emphasis on achieving high exam grades, students tend to concentrate on studying the material centered around the exam solely. In doing so, they have a shaky foundation for performing well throughout the course. This raises the question of how an instructor can incorporate or distribute all the learned content across exams more effectively to avoid influencing students to use GenAI on what was referred to as "busy work."

D. Take-aways

The results derived from the focus groups provided valuable insight into how students use GenAI, particularly for those who initially misused it and chose more ethical and effective approaches. GenAI, although having its many upsides, such as general help related to coursework and extraordinary convenience, comes with the controversy of moral guidelines. Although potentially harmful, students demonstrated self-awareness of their wrongdoings and willingness to redirect their actions. Some students chose to use it as a 24/7 tutor. In contrast, others decided not to use it after realizing that GenAI is unreliable in engineering, the harmful side effects of misuse, or simply a new preference toward office hours. Students actively making positive changes to their learning experience should help shape policies and decisions related to the usage of AI inside and outside of the classroom.

IV. Conclusion

GenAI raises various ethical concerns for university policymakers regarding the education environment.

Instructors commonly believe that many students will abuse a tool if given the opportunity. Since GenAI can be used in many ways by students towards their education, banning its use appears to be an easy remedy against unethical uses. However, this reflex does not consider the positive learning uses that a student can undertake when using GenAI.

While presenting a brief overview of how students use GenAI in conjunction with an engineering course, this study provided a deeper insight into why students re-evaluated their actions. Typical usages of GenAI by students included assistance with conceptual questions, methodological questions, generating personalized practice problems, and studying content. Not only did it initially draw them away from attending office hours, but it also restricted them from seeking help from the instructional staff. GenAI, initially being a 24/7 tool, quickly turned into a 24/7 crutch, leading to many users' poor time management and study habits. As students began experiencing an ever-growing dependency, they noticed how it simultaneously impacted other aspects of their education. Students commented that this growing over-reliance branched into the accumulation of learning debt and limited mental stimulation, which led to a poor learning experience. Throughout the semester, nearly all the students became aware of the harmful effects of GenAI and redirected their usage to impact their learning positively. Results highlighted the different reasons students redirected or cut off their usage of GenAI.

Students who used GenAI improperly stopped using it entirely or began treating it as a tutor. Realizing the harm it had done to their education greatly impacted the students' views on GenAI. They described becoming self-aware of building an overreliance on GenAI or the extensive use of building up learning debt. Others noted that the unreliability of GenAI in engineering applications was significant enough to move in a different direction, along with students shifting their preferred mode of assistance to office hours.

The main takeaway lies in students being able to regulate their AI usage responsibly without needing outside assistance. By the end of the semester, nearly all students who had noticed detrimental effects on their education quickly matured and made better use of GenAI. Additionally, just under half of the students in this study self-reported that they had not used GenAI in an unethical manner. Policymakers should think carefully about using GenAI in their schools before making any significant decisions, as it has been shown that students use GenAI in a helpful manner, such as a tutor. Furthermore, of the students who initially used GenAI unethically, over 90% switched to positive uses after seeing their performance in their courses negatively affected. GenAI also lacks reliability in engineering applications. Rather than banning this tool, recommending training on incorporating GenAI into coursework can influence students to proceed with positive usage without going through the learning curve of discovering the difference between efficient and abusive AI usage.

V. Future Work

The researchers plan to further train Top Hat's GenAI, ACE, with more data from the class and solutions to coursework-related questions and frequently asked questions. At the end of the semester, researchers will ask students to report their opinions on whether they thought Top Hat's ACE was helpful as it only has access to verified information provided by the professor, or if they preferred to stick to AI models such as ChatGPT, which has access to most of the data on the internet. The self-reported data will also provide feedback on possible ways to improve a student's experience with Top Hat ACE.

The researchers will also ask students to elaborate on their preference for using Top Hat ACE or office hours as a tutor. The results of this study will focus on the decision students make between human interaction and digital interaction. Analyzing the reported data will corroborate ways to improve Top Hat ACE and offer potential ways to enhance students' experience during office hours.

Finally, the researcher will assess the student inputs into Top Hat ACE throughout the semester, and the similarity between course content and user inputs will be assessed to determine if students are copying and pasting assigned questions into the chatbot. It aims to investigate whether students are using GenAI honestly or using it to find shortcuts. Not only does this answer the question, but it also reveals whether students are self-reporting their usage accurately.

References

[1] J. W. Creswell et al., *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*, Pearson, 2015. ISBN: 978-0-131-36739-5.

[2] Razafinirina, M. A., Dimbisoa, W. G., & Mahatody, T. (2024). Pedagogical alignment of large language models (LLM) for personalized learning: A survey, trends and challenges. Journal of Intelligent Learning Systems and Applications, 16(4), 448–480. https://doi.org/10.4236/jilsa.2024.164023

[3] Milmo, D., & Agency. (2023). ChatGPT reaches 100 million users two months after launch. The Guardian. https://www.theguardian.com/technology/2023/feb/02/chatgpt-100-million-users-open-ai-fastest-growing-app

[4] Kaur, P., Kashyap, G. S., Kumar, A., Nafis, M. T., Kumar, S., & Shokeen, V. (2024). From text to transformation: A comprehensive review of large language models' versatility. arXiv.

[5] Duckworth, A. Ungar, L. (2023). Don't ban chatbots in classrooms — use them to change how we teach. Los Angeles Times. https://www.latimes.com/opinion/story/2023-01-19/chatgpt-ai-education-testing-teaching-changes

[6] Kasneci, E., Sessler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., Gasser, U., Groh, G., Günnemann, S., Hüllermeier, E., Krusche, S., Kutyniok, G., Michaeli, T., Nerdel, C., Pfeffer, J., Poquet, O., Sailer, M., Schmidt, A., Seidel, T., Stadler, M., & Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. Learning and Individual Differences, 103, 102274.

[7] Altorfer, F. C., Kelly, M. J., Avrumova, F., Rohatgi, V., Zhu, J., Bono, C. M., & Lebl, D. R. (2025). The double-edged sword of GenAI: Surpassing an expert or a deceptive "false friend"? The Spine Journal. https://doi.org/10.1016/j.spinee.2025.02.010

[8] Chu, Z., Wang, S., Xie, J., Zhu, T., Yan, Y., Ye, J., Zhong, A., Hu, X., Liang, J., Yu, P. S., & Wen, Q. (2025). LLM agents for education: Advances and applications. arXiv.

[9] Guettala, M. Bourekkache, S. Kazar, O. & Harous, S. (2024). Generative Artificial Intelligence in Education: Advancing Adaptive and Personalized Learning. Acta Informatica Pragensia, 13(3), 460-489.

[10] Head, C. B., Jasper, P., McConnachie, M., Raftree, L., & Higdon, G. (2023). Large language model applications for evaluation: Opportunities and ethical implications. New Directions for Evaluation, 2023(178–179), 33–46.
[11] Alkamli, S. Al-Yahya, M. & Alyahya, K. (2024). Ethical and Legal Considerations of Large Language Models: A Systematic Review of the Literature. 2024 2nd International Conference on Foundation and Large Language Models (FLLM), 576-586.
[12] Pîrjan, A., & Petroșanu, D.-M. (2024). Exploring large language models in the education process with a view towards transforming personalized learning. Journal of Information Systems & Operations Management, 18(2), 125–171.
[13] Spur, B. (2019). Fake News: A Global Epidemic Vast Majority (86%) of Online Global Citizens Have Been Exposed to it. Brand Spur. https://brandspurng.com/2019/06/12/fake-news-a-global-epidemic-vast-majority-86-of-online-global-citizens-have-been-exposed-to-it
[14] Yelemarthi, K. Dandu, R. Rao, M. Yanambaka, V.P. & Mahajan, S. (2024). Exploring the Potential of GenAI in Shaping Engineering Education: Opportunities and Challenges. Journal of Engineering Education Transformations, 37, 439-445.
[15] Tyng, C. M., Amin, H. U., Saad, M. N. M., & Malik, A. S. (2017). The influences of emotion on learning and memory. Frontiers in Psychology, 8, 1454.
[16] Salah, M. Abdelfattah, F. Alhalbusi, H. Mukhaini, M. (2023). Me and My AI Bot: Exploring the 'Alholic' Phenomenon and University Students' Dependency on GenAI Chatbots - Is This the New Academic Addiction? Research Square.
[17] Qadir, J. (2023). Engineering Education in the Era of ChatGPT: Promise and Pitfalls of GenAI for Education. 2023 IEEE Global Engineering Education Conference (EDUCON), 1-9.
[18] M. Barry et al., *Statics and Mechanics of Materials: An Example-based Approach*, Top Hat, 2020. ISBN: 978-1-77412-230-3.
[19] J. F. Wyszynski et al., "ACE up your sleeve: An Analysis of Student Generative AI Usage in an Engineering Statics Course," in ASEE 2025.
[20] M. Barry et al., "Breaking Barriers and Building Confidence: Unleashing the Power of Digital Tools and Gender-Balanced Teams in Engineering Education," in 2024 IEEE Frontiers in Education Conference (FIE), pp. 1-8, 2024.
[21] Korepanova, A et al., "Meaningful Use of Generative AI in Visual Arts Education," 2024 IATED, ISBN: 978-84-09-59215-9.