Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #46541

WIP - An Exploratory Approach to Introducing Generative AI into a Large-scale Engineering-focused General Education Course

Dr. Brian P Kirkmeyer, Miami University

Brian Kirkmeyer is the Karen Buchwald Wright Senior Assistant Dean for Student Success and Instructor in the College of Engineering and Computing at Miami University in Oxford, Ohio. His background includes BS, MS and PhD degrees in Materials Science and Engineering, and has focused his teaching on global inquiry and engineering design within heavy metal music and culture. He is active in broadening access in engineering and computing, and in particular for women and the LGBTQ+ community.

An Exploratory Approach to Introducing Generative AI into a Large-scale Engineering-focused General Education Course

Abstract

The primary motivation for this study is to discover the general level of familiarity and functional understanding of generative artificial intelligence (GenAI) chatbots by students in an engineering-focused liberal education course with a large enrollment of over 300 students during the Fall 2024 semester. Learning this would help address feedback from employers of graduates from Miami University in Oxford, Ohio, USA, indicating that these graduates need to begin their careers with a basic acquaintance with GenAI tools so that they can apply them to their work. To adequately prepare graduates, educators must raise the floor on how they use GenAI in their pedagogy, in both the major courses as well as general education. It is a difficult demand of instructors because of the very fast developmental pace of GenAI and large-learning models (LLMs), and the race by these developers to win the market with their specific tool. An opportunity arose to introduce GenAI as soon as possible into the author's primary course offering, and potentially accelerate students' learning curves as steeply as GenAI is developing. Within the tested course, essay assignments were altered in order to introduce students to a basic utilization of GenAI as a learning tool, as well as its ability to provide critical analysis of another writer's work. The altered essay assignments address a specific prompt designed to connect directly to the course's Learning Outcomes, so the expectation is that it contributes to students meeting those Outcomes. The requirement for students is to (1) write their own essay response to the assignment's prompt, (2) develop their own prompt to ask one or more GenAI chatbots to write an essay about, (3) examine the GenAI-written essay in comparison to their essay, and (4) critique the GenAI essay to discuss quality and accuracy of information. This paper will present anonymized student critiques in a qualitative way, and draw conclusions as to the effectiveness of this basic approach to introducing GenAI into student assessments. This study is standalone and preliminary; it is not planned to be part of a broader research program.

Background

Over the past few years, text-based chatbots based on Generative Artificial Intelligence (GenAI) large language models (LLMs) have soared in both public availability and usage [1] [2]. The most popular of these, ChatGPT, has grown in popularity at growth rates never seen in the internet age [3]. This growth has driven advances in usability and functionality, while also raising questions of legal ethics and morality [2]. The consistent viewpoint is that GenAI is here to stay and humans need to adapt to this new reality. Educators have shifted from awe of GenAI's capabilities, to fear of academic integrity spiraling out of control, to recognition of how valuable GenAI can be to the educational process if harnessed properly [4] [5] [6]. Employers seek to stay ahead of the competition as they want newly-hired graduates able to use GenAI right out of the gate [7] [8] [9], paying them more in return [10].

The challenges seem to be multifaceted, but there is one definitive area where there is convergence between academia and industry. As valuable as GenAI tools are, educators need to be equipped to help students learn critical and strategic thinking skills, such that graduates are able to manage and lead via GenAI utilization and are thus more valuable to employers [6] [10] [11]. The technology of GenAI has been booming, while academia has been relatively slow to respond. Universities and colleges are highly procedural regarding approving curricula, and are restricted to being organized around semesters and quarters. Both of these situations limit the agility needed to keep up with the proliferation of GenAI. In a similar vein, at least one study has shown that students are not yet demanding that universities rush to include GenAI [9]. In fact, conversations with high schoolers strongly indicate that their schools not only do not introduce GenAI to them, but impose severe and threatening consequences for using GenAI for even the most rudimentary tasks [12]. Nevertheless, adapting to GenAI needs to happen rapidly, and young adults need to be brought up to speed on this tool. This means that barriers and hesitance must be overcome, and introducing GenAI must happen at the individual instructor and/or course level first.

The genesis of the study detailed in this paper occurred at the 2024 ASEE Annual Conference in Portland, Oregon, USA, in June 2024. The author attended a talk about GenAI [13] with a colleague, and chatted over lunch about the implications of it for the host institution. It was believed by the author that the general education course that he teaches would be an excellent candidate for introducing basic GenAI-focused assignments in a simple way. Given that the course serves the entire university's student population and not just a small subset of majors, and is large enough in enrollment to identify possible learning trends, a study was developed to allow sharing of the results to a broader audience. Finally, since the author is the creator of and only instructor for the course, there was deemed to be adequate agility to develop and deploy the GenAI content for the Fall 2024 semester, just eight short weeks after the conclusion of the Conference. This work should complement the studies presented at the 2024 ASEE Annual Conference in disciplines ranging from programming to civil engineering that suggest benefits from utilizing GenAI to enhance learning and critical thinking among students [14] [15] [16] [17] [18] [19] [20].

Goals

The goals of introducing Generative AI to this group of students are twofold: to better understand their general knowledge of and proficiency with chatbot tools, and try different methods to build knowledge in the AI space. If this approach works in the chosen course, then it could lead to creating GenAI learning methods in more advanced courses in their majors. While this would be part of greater efforts at the host institution to benchmark our STEM curricula as a whole, this study is a standalone one that aims only to provide a snapshot on where academia is in its understandings and utilizations of GenAI .

A possible upshot of this study is to address academic integrity concerns of many faculty, instructors, and even students [9] at the host institution. If implementing a simple GenAI methodology can shift the mindset to "how can students use AI to learn necessary skills" from "did students use AI to cheat to find an answer", then it both advances student development and potentially saves institutions time and effort pursuing academic integrity claims.

Additionally, this study's use of chatbots is expected to provide insight into how they can be used to improve students' critical thinking skills. Those skills are assessed in the grades on the assignment and course, and would be applicable to later courses that students take. Recent publications have found strong evidence that the proper use of GenAI in college-level classrooms promotes a deeper engagement with the subject matter of a course, stimulates dialogues in a more interactive way, and encourages critical reflection on information [21] [22] [23] If this study demonstrates a simple way to take college students from their high school's fearmongering about GenAI to starting a journey toward engagement with and critical thinking about topics they encounter, then it will benefit all of students, departments, universities, and future employers.

Approach

This study was undertaken at Miami University (Oxford, Ohio, USA) in a general education course designated as CEC266, "Globalization and Engineering in Heavy Metal Music" (subject code CEC stands for College of Engineering and Computing). The course examines how engineering problem solving and design thinking manifests within music gear, creation, and distribution, in combination with a sociopolitical global historical perspective of the heavy metal music genre. While the course itself has been offered since the Fall 2010 semester, only the Fall 2024 semester offering of the course was analyzed, since this is the only semester that the methodology was implemented. There were 321 students enrolled in the course during this semester, from which 158 students (49%) both consented to use their assignment responses and granted FERPA access to them. It is important to note that this class roster was made up of students from across the university, with 38% of students from the College of Engineering & Computing, while 62% came from the university's other Colleges and Schools. Two essay assignments out of five assigned were chosen to include the GenAI component that is being analyzed in this paper. The students' grade on those assignments was not considered in the analysis for this paper, nor were any demographics of the students per the IRB approval for the study.

The first essay assignment of the semester asked the following: "Write a 1-2 page essay to compare and contrast the development of heavy metal music in its primary countries of origin…How has the circulation of global phenomena (e.g. economic, religious, social, technological) impacted individuals and groups in these originating countries?". The assignment required a 1-2 page essay written by the students on the subject, and integrated within the

assignments' prompts were the Learning Outcomes that the students needed to address to earn points on the assignments.

After writing their own essay for the assignment, students then were asked to "compose a prompt question or statement that you think will allow your chosen Generative AI tool to address this question", and submit that prompt as part of their overall submission. The next part of the assignment was to use that prompt to have their chosen chatbot generate an essay, with the specific chatbot noted in the section title for that part of their submission.

Finally, students were asked to write a critique of each chatbot's essay, citing at least one instance of how it was "correct" relative to what they wrote as well as learned in class meetings, and at least one instance of how the chatbot essay was "incorrect" relative to what they wrote and learned in class meetings. This critique was concluded by having students state how they would modify their prompt question to the chatbot to get it to produce a more "correct" essay. The entirety of their submissions was thus comprised by their own essay, their prompt for the chatbots, the chatbots essay, and their critique of the chatbot essay with the suggested modified prompt to improve the response. Each assignment submission was graded for the needs of the course to demonstrate how they met its Learning Outcomes (LOs).

For the purposes of this study, the students' critique responses were categorized by (1) which chatbot they used, (2) what their overall impression (positive, neutral, or negative) was of the chatbot's essay relative to the prompt they gave it, (3) how they would improve their prompt based on what the chatbot got primarily correct or incorrect, and (4) their familiarity with GenAI prior to this assignment. The instructor of the course determined these categorizations based on the information required for the critiques per the grading rubric for the assignment, and on the overall tone of writing in each submission. Items (1), (3), and (4) were required items in the grading rubric for the assignment; item (2) was interpreted from the words the students used and the impression they gave to the instructor, using over 15 years of grading experience of students' work in this specific course.

The author sought and received IRB approval to use the course-required responses for the purposes of estimating how proficient students from across the university were with chatbots and GenAI. This was done by determining which chatbot each participating student used and their overall impression of the essay that the chatbot generated, along with the relative accuracy of the essay's content based on the prompt that the student used for the chatbot. The students' identity and grades were not used at all in the study, nor was any demographic information about the students.

Findings

Essay Assignment 1 is directly tied to the first Learning Outcome of the course, and in fact quotes portions of it. For the purposes of the assignment's grade, students needed to have directly addressed how they are meeting the Outcome. For the purposes of the current study, their essay serves as the basis for comparison with the chatbot's essay. Their critiques of the chatbot's essay provided the bulk of the information for the following findings.

In terms of which chatbot was used, 53% of students did not specify which one they used, while 38% of students used ChatGPT, 6% used Copilot, 2% used Gemini, and a single student used each of Snapchat AI, Meta AI, and EditPad.org's AI tool. This means that 80% of students that specified a chatbot used ChatGPT. Based on the writing style of the essays and tendencies of the different chatbots, the author estimates that it is likely that approximately 80% of all of the students used ChatGPT as their chosen chatbot.

Regarding overall impression of their chatbot's writing, 88% of students had a positive impression of the chatbot's essay, with 12% of students having a neutral response, and 0% of students having a negative response. ChatGPT was given a 97% positive impression by students, Copilot was given a 77% positive impression, and Gemini was given a 66% positive impression, though the latter two chatbots have low overall usage that renders these percentages insignificant.

Pertaining to how students would improve their prompt to get a more correct response from the chatbot, 29% would be more specific in their prompt, 20% would better target the topics to cover, 3% would better indicate the timeframe for the chatbot to adhere to, 3% would indicate a word limit rather than a page limit, and 33% did not address this item; the balance of improvements (14%) did not fit any of these categories and were single-instance suggestions.

As part of their critiques, students independently commented a number of consistent messages about the chatbots' essays. These direct student quotes from critiques include phrases such as "vague in some parts of its writing", "avoids specifics", "repeats the prompt heavily", "glaring lack of personality", "…a lengthy essay with little substance", and "…uses a lot of intellectual words to fill in random spaces". The students also regularly mentioned that they felt that asking the prompt in a different way, or with more specific direction, would help the chatbot provide a more accurate essay. In a substantial number of critiques, the students referred to their own sources of information beyond just the course-based materials to comment about something that the chatbots composed, and often referred to a context provided in their own essay submissions.

Finally, with regard to prior familiarity with GenAI and chatbots, very few students (about 4%) addressed this issue in their critiques. There was an even split between students who

reported that they had previously used chatbots and those whose first experience with chatbots was in this assignment.

Discussion

As stated above, 80% of students that reported which chatbot they used cited using ChatGPT. This is not a surprise given that ChatGPT has been reported as the fastest-growing consumer application in history and has received a substantial amount of media coverage [2] [3]. It was a bit more surprising that Gemini was only used by 2% of students, as the host institution is a Google user and Gemini is Google's chatbot. One reason for this disparity is likely the familiarity of students with the longer-existing ChatGPT chatbot, since it is regularly seen as the first publicly-available chatbot [2]. Another reason could be the earlier availability of a free version of ChatGPT, whereas Gemini required a user license until later in the semester than the assignment was completed by students. Since the rationale of a student using a particular chatbot over another is not a goal of this study, there is no need for further comment on the topic.

It is also interesting that such a large percentage of students (88%) reported a positive impression of the chatbots' essays, especially compared to how few students (2%) reported having previous experience with GenAI. This suggests that this particular group of students is largely inexperienced with chatbots and LLMs, a finding echoed in broader surveys. [9] Such surveys are consistent with the vast majority of interactions that the author has had with students over the author's 18+ years of academic advising, student success efforts, and related pedagogy. Simply put, the students don't know what they don't know about GenAI, and when their eyes are opened to it, they are highly impressed. If a high percentage of students were regular users of chatbots, the author's expectation would be more neutral or even negative impressions of them, as well as more informed prompts for the chatbots to respond to.

Some of the more common student comments about the chatbots' essays were repetitiveness of topics, lack of details, and verboseness, yet also better-than-expected grammar and intelligent-sounding prose. Many students also commented that the chatbots did not adhere to the length limits that they gave in their prompts, though also stated after the fact that the chatbots may not have the same sense of length in terms of pages as humans do, and so would ask for word or character limits in their next iterations of prompts. The author feels that this is an important development for students' familiarity with GenAI and chatbots. They are not a one-and-done tool, but rather are highly interactive as well as iterative. By learning this fact about chatbots, students will be better equipped to interface with them in the future and use them more effectively. In this sense, the students will absolutely be meeting the demands of employers once they begin having professional work experiences in co-ops, internships, or full-time employment.

The students learned that chatbots respond very specifically to the prompt that is used and the parameters that are included in that prompt, and in a few cases realized that adding information or specific search parameters helped tailor the chatbot response. The chatbots are information synthesizers as much as they are anything else. They follow grammar rules to construct sentence and paragraph responses that people can read and utilize, even if they are a student in their first undergraduate course. Those sentences and paragraphs can become redundant, repetitive, wordy, or vague when the prompt's parameters are either overly vague or restrictive. In addition, the chatbots do not have human-like nuance to make their essays more engaging to read; they simply report back what they find in a prescribed way.

The author also believes that due to the students' seeming inexperience with chatbots and the iterative nature of using them effectively, students in general are not using the chatbots to cheat nearly as frequently as conversations with other instructors would suggest. This does not mean that students do not use the chatbots to attempt to cheat; it means that instructors may have a misconception about how often widespread cheating via chatbots occurs.

Integrating chatbots into assignments in the manner demonstrated in this study can very effectively help students meet learning outcomes and develop better critical thinking and analytical skills. For engineering and STEM students, this is crucial to being able to ask appropriate questions to probe into the problems that societies and people face, and develop technological solutions and new products or processes. [8] In past years of requiring these essay assignments in the course, prior to using GenAI, it was less clear and obvious that the students were reflecting on their own work and seeking ways to improve it. Introducing the chatbot element to the assignments provides a more defined feedback loop, and integrates the engineering design cycle more intentionally into how they complete the assignments. As such, utilizing the tool is deemed by this author as being a great success in this course for these students.

The author understands that these discussions are based on approximately half of the enrolled students granting permission to examine their work on one single assignment in one single course. This is a potential limitation to the study's broader implications, even though the population of participating students is much larger than some of the referenced studies [22] [23]. Preliminary examination of a similar GenAI approach on a second assignment in this course, with a different targeted Learning Outcome, suggests that the same pool of students apply what they have learned in the current study to their own future work in the course. That is promising to the skill development of a substantial number of students in the GenAI space, and is encouraging to learn how quickly they can apply new knowledge.

There are a couple of other possible limitations to this study that are worth mentioning. The instructor may have inadvertently misinterpreted the tone of some responses in assessing their

positive or negative views of the chatbots' essays, though the author does not believe this to be a significant likelihood given the directness of most of the responses. As mentioned above, this study is based on a single assignment in a single course, so further iterations of the work would help provide context over a longer timeframe. This is planned for future offerings of the course, as well as a more direct continuation of the methodology within the semester to allow students to experience prompt engineering with the chatbots. Within the context of this course and the experience of the students, the study is believed to be successful by the author, and definitely worth continuing by the instructor.

Summary and Conclusions

With respect to the goal of introducing Generative AI to this group of students to better understand their general knowledge of and proficiency with chatbot tools at this moment in time, the author believes that students are largely inexperienced with GenAI. That makes it critical to begin introducing them to these tools as soon as possible, and in as many courses and related experiences as possible. This will lead to greater critical thinking skills in all students, and particularly those like engineers and computer scientists that use iterative problem-solving methodologies. Even though this study is a standalone "where are we now" examination, the author believes that it provides a baseline about chatbot usage that serves the host institution's greater efforts to benchmark the STEM curricula and improve educational methods via these tools.

The simply-stated goal at the start of this paper, asking "does this approach work in this type of course", is simply answered with a definite "yes". Based upon the experiences in this course in Fall 2024, a continuation of using GenAI with more proper iterative development opportunities for students is vital. This includes carrying through the prompt development from assignment to assignment throughout the semester, and introducing more of a feedback loop for students to demonstrate development and improvement rather than using a one-time-only approach. An extension of this basic understanding is to be able to create learning methods for students to advance their knowledge of Generative AI during their college years in their more advanced courses.

As far as the secondary goal of addressing academic integrity concerns of many faculty and instructors at the host institution, the author believes that they are overstated at this time. Students simply have not developed the familiarity with chatbots and the prompts to get the most out of them, which severely limits the savvy and nuance needed to effectively cheat. The students may reach that point, given enough time and opportunities to develop such skills, but the vast majority of students do not seem to be there yet. At this point, there are more low-hanging-fruit methods to be academically dishonest if they choose to be. Perhaps using GenAI can actually stem the attempts to cheat by making it harder to do. That is a question for a different study.

References

[1] S. Lock, "The Guardian," 5 December 2022. [Online]. Available: https://www.theguardian.com/technology/2022/dec/05/what-is-ai-chatbot-phenomenon-chatgpt-and-could-it-replace-humans. [Accessed 10 January 2025].

[2] A. Nyst, "Search Engineering Journal," 9 October 2024. [Online]. Available: https://www.searchenginejournal.com/history-of-chatgpt-timeline/488370/. [Accessed 3 January 2025].

[3] K. Hu, "Reuters," 2 February 2023. [Online]. Available: https://www.reuters.com/technology/chatgpt-sets-record-fastest-growing-user-base-analyst-note-2023-02-01/. [Accessed 3 January 2025].

[4] L. L. Cochran, "The Hill," 24 December 2024. [Online]. Available: https://thehill.com/homenews/education/5060341-2025-ai-artificial-intelligence-k-12-schools/. [Accessed 3 January 2025].

[5] M. T. Nietzel, "Forbes," 3 January 2025. [Online]. Available: https://www.forbes.com/sites/michaeltnietzel/2025/01/01/the-year-ahead-in-higher-ed-five-trends-to-watch-in-2025/. [Accessed 3 January 2025].

[6] K. Palmer, "Inside Higher Ed," 19 December 2024. [Online]. Available: https://www.insidehighered.com/news/tech-innovation/artificial-intelligence/2024/12/19/how-will-ai-influence-higher-ed-2025. [Accessed 3 January 2025].

[7] Z. Amos, "Technode Global," 26 April 2024. [Online]. Available: https://technode.global/2024/04/26/employers-want-college-grads-with-ai-experience-but-colleges-havent-caught-on/. [Accessed 3 January 2025].

[8] K. Gurchiek, "Society for Human Resource Management," 20 February 2024. [Online]. Available: https://www.shrm.org/topics-tools/news/technology/employers-want-new-grads-with-ai-experience--knowledge. [Accessed 3 January 2025].

[9] A. Mowreader, "Inside Higher Ed," 3 October 2024. [Online]. Available: https://www.insidehighered.com/news/student-success/life-after-college/2024/10/03/are-ai-skills-key-part-career-preparation. [Accessed 3 January 2025].

[10] C. Crist, "Higher Ed Dive," 28 May 2024. [Online]. Available: https://www.highereddive.com/news/employers-more-likely-to-offer-interviews-higher-pay-AI-skills/717129/. [Accessed 3 January 2025].

[11] B. Leckrone, "Best Colleges," 24 July 2024. [Online]. Available: https://www.bestcolleges.com/news/business-education-ai-skills-employers/. [Accessed 3 January 2025].

[12] Anonymous, *Personal conversations*, 2025.

[13] J. M. Pitarresi, "Leveraging Generative AI for Engineering Course Development: Save Yourself Time and Improve Student Learning," in *2024 ASEE Annual Conference & Exposition*, Portland, OR, USA, 2024.

[14] D. Abril, S. Duran-Ballen and M. A. Guerra, "WIP: Generative AI to Support Critical Thinking in Water Resources Students," in *ASEE Annual Conference and Exposition*, Portland, OR, USA, 2024.

[15] I. Guala, D. Abril, M. A. Guerra and S. Duran-Ballen, "Pilot Study - Development of Critical Thinking in Construction Engineering Students Aided by Artificial Intelligence," in *ASEE Annual Conference and Exposition*, Portland, OR, USA, 2024.

[16] S. Vidalis, R. Subramanian and F. Najafi, "Revolutionizing Engineering Education: The Impact of AI Tools on Student Learning," in *ASEE Annual Conference and Exposition*, Portland, OR, USA, 2024.

[17] L. Mohandas and N. Mentzer, "Students' Perception and Use of AI Tools in a First-Year Design Thinking Course," in *ASEE Annual Conference and Exposition*, Portland, OR, USA, 2024.

[18] H. Jack and Y. Yan, "The Use of Chatbots in Engineering Including Critical Thinking and Problem Definition," in *ASEE Annual Conference and Exposition*, Portland, OR, USA, 2024.

[19] A. Cortez and P. D. Schmelzenbach, "Integrating ChatGPT in an Introductory Engineering Undergraduate Course as a Tool for Feedback," in *ASEE Annual Conference and Exposition*, Portland, OR, USA, 2024.

[20] A. Konak and C. J. S. F. Clarke, "Augmenting Critical Thinking Skills in Programming Education through Leveraging ChatGPT: Analysis of its Opportunities and Consequences," in *ASEE Annual Conference and Exposition*, Portland, OR, USA, 2024.

[21] Q. a. H. R. Abbas, "ResearchGate," January 2025. [Online]. Available: http://doi.org/10.13140/RG.2.2.28659.03364. [Accessed 2025].

[22] P. Premkumar, M. Yatigammana and S. Kannangara, "Impact of Generative AI on Critical Thinking Skills in Undergraduates: A Systematic Review," *The Journal of Desk Research Review and Analysis*, vol. 2, no. 1, pp. 199-215, 2024.

[23] A. Kanan, "Examining the Impact of ChatGPT on Academic Performance Among Students at Moulay Ismail University," July 2024. [Online]. Available: http://doi.org/10.13140/RG.2.2.32943.75689.