JUTLP
Journal of University Teaching & Learning Practice

Student Use, Performance and Perceptions of ChatGPT on College Writing Assignments

Thomas A. Mennalla[a] and Princy S. Quadros-Mennalla[b]

[a] Western New England University, United States of America; [b] Westfield State University, United States of America

Abstract

ChatGPT is a generative chatbot that conversationally responds to prompts using content mined from the internet. In a very short time, ChatGPT has disrupted many industries, including education. However, the risks and dangers of this technology remain to be seen; for example, students can use ChatGPT dishonestly on writing assignments. Education currently lacks a clear understanding of students' perspectives and intentions around this technology. In this study, undergraduate students from a comprehensive university were briefed on ChatGPT, given guidelines for its use, encouraged to use this tool on their written assignments and surveyed for their opinions on ChatGPT. We found that a small number of students chose to use ChatGPT and there was no grade difference between students using and not using this tool. Additionally, thematic analysis of student survey responses revealed that while some students viewed ChatGPT as an idea generator and improvement tool for written assignments, others saw it as a way to create submissions for class assignments, potentially infringing on academic integrity. The majority of students felt that ChatGPT should be allowed in college classes and intend to use ChatGPT on future assignments. Finally, most students share misconceptions about ChatGPT, including that it is a source of information and a search engine. Given the rapid rates of adoption of this technology, and its enormous potential for integration across sectors, it is incumbent on educators to deliberately guide and train our students with this tool, while keeping our students' perspectives and intentions in mind.

Editors

Section: Educational Technology
Editor in Chief: Dr Joseph Crawford
Senior Editor: A/Prof Michael Cowling

Publication

Received: 28 July 2023
Revision: 3 January 2024
Accepted: 1 February 2024
Published: 28 February 2024

Citation

Mennella, T. & Quadros-Mennella, P. (2024). Student Use, Performance and Perceptions of ChatGPT on College Writing Assignments *Journal of University Teaching and Learning Practice, 21*(1).

Introduction

The development and release of OpenAI's ChatGPT in November of 2022 signified a revolution in technology, swiftly amassing an unparalleled user base and dramatically impacting many industries. Within two months, ChatGPT amassed 100 million active monthly users, with an average of 13 million unique daily users throughout the month of January 2023 (Hu, 2023). This rate of adoption was unprecedented for any new technology, dwarfing other mega-online services at that point in time. For comparison, it took TikTok and Instagram nine months and two and a half years, respectively, to reach 100 million unique users (Hu, 2023). Since the release of ChatGPT, other significant generative artificial intelligence (GAI) tools have emerged including Bard (Google), Claude (Anthropic) and others (Ali *et al.*, 2023). While these GAI tools differ in the nuances of their training datasets and algorithms, all are natural language processing (NLP) chatbots. The widespread adoption of GAI stirred debates about ChatGPT's benefits and risks for education. This paper explores the effect of ChatGPT on student performance and captures student perspectives of this technology.

With the explosive growth of ChatGPT and other GAI platforms, reports of applications, successes, cautions and concerns quickly emerged around the use of these tools (Bahrini *et al.*, 2023). In the business sector, GAI platforms can assist in supplier selection and evaluation, risk management, and, as an echo chamber of societal perspectives, demand forecasting. In politics, ChatGPT is expected to assist in voter outreach and policy analysis/explanation, and for the military, it can optimize logistics and help develop more effective training (Bahrini *et al.*, 2023). Reports of ChatGPT passing licensing and certifications in many professions supports its relatively high degree of competency (Ray, 2023).

Despite the widespread adoption and application of ChatGPT across industries, the greatest disruption - both positively and negatively - by ChatGPT may be in education. These disruptions range from concerns that students will use ChatGPT to cheat/plagiarize, to instructors embracing this technology as an all-powerful teachers' assistant (Mennella, 2023). As a teacher's assistant, ChatGPT can produce instructional content, assessments, and feedback on student work (Bahrini *et al.*, 2023). Crawford *et al.* (2023a) highlight the varied perspectives of GAI in education and note that cultivation of a sense of moral character in students is likely the best defence against the prospect of cheating with or misuse of ChatGPT. They and others suggest that GPT-3, a subsequent model to ChatGPT trained on 45 terabytes of data, can be used by teachers and students alike for creating essay plans, completing grammar checking, or generating suggestions for key content curation (Crawford *et al.*, 2023a; Zhou, 2023). Crawford *et al.*, (2023a) propose that ChatGPT can provide students with a sense of control and autonomy over their writing, contrasting the risks of students cheating with ChatGPT with its strong potential for enhancing the learning experience.

A meta-analysis of over 20 years of literature on AI demonstrates that the majority of AI and machine learning inventions are in the domains of computer engineering, software engineering, and medical science disciplines, while comparatively little research exists for education pedagogy, design and/or educational technologies (Okagbue *et al.*, 2023; Webb *et al.*, 2020). This disparity has resulted in a divide between these industries in understanding the use and potential

applications of GAI (Okagbue *et al.*, 2023). Chief among the challenges associated with understanding the application of GAI in education are: (1) a lack of in-depth knowledge regarding GAI by educators, (2) a lack of infrastructure supporting GAI in educational institutions, (3) the lack of GAI-driven curricula, and (4) the lack of comprehensive institutional policies around GAI (Okagbue *et al.*, 2023).

However, the implications of GAI go beyond teacher preparedness and institutional support since these technologies are already being used extensively in many aspects of education. In higher education, over 78% of ChatGPT applications were used for content creation and editing by both students and instructors (Mogavi *et al.*, 2023). In K-12 education, ChatGPT was most used in learning language skills and for personalizing the student learning experience (Mogavi *et al.*, 2023). Analysis of social media platforms frequented by educators (e.g., FaceBook, Twitter, LinkedIn) found most posts that referenced ChatGPT centred on teachers using this tool for productivity (73.19%) and efficiency (63.02%), and discussions around ethics (48.51%) (Mogavi *et al.*, 2023). Educator perspectives of ChatGPT are similarly varied with the majority holding either positive or mixed views while only 32% have negative or neutral opinions (Mogavi *et al.*, 2023). Furthermore, a considerable portion of surveyed students were aware of GAI and its benefits, and a majority agreed with statements that AI-enhanced grammar, outlining, and language translation tools were valuable in improving their writing processes (Malik *et al.*, 2023).

A recent rapid review by Lo (2023) showed that ChatGPT performs well in a variety of subject domains including economics, programming and on general higher-order critical thinking skills. Additionally, ChatGPT can effectively augment student learning by answering questions, summarizing information, and facilitating collaboration. By checking student comprehension, assisting students in drafting papers, and providing general feedback on student work, ChatGPT can work as a virtual tutor, enhancing student academic performance (reviewed in Lo, 2023). Despite these benefits, Lo (2023) also cautions that immediate action is needed to address the impact of ChatGPT on the college classroom and to prepare our curriculum for this change. The novelty, power, and explosive adoption of ChatGPT has left education scrambling for a strategic direction necessary to cope with this societal disruption.

There are two broad perspectives regarding the purported role of higher education in and for society: (1) that higher education prepares graduates for the workforce, or (2) that institutions of higher education should be striving to make better contributions to society via the new knowledge it acquires (Chan, 2016). What both perspectives share, and central to higher education's mission, is the embracing of societal shifts that impact the workplace of tomorrow. As disruptive innovations overtake society, higher education must integrate them throughout its curricula. GAI, and specifically ChatGPT, is one such transformative innovation. Despite its nascence, the potential of GAI is considerable, promising significant enhancements in productivity and cost reductions across various industrial sectors. As AI continues to evolve and improve, its integration into the workplace is inevitable.

To help educators reach a consensus on this tool and better prepare our students for tomorrow's workplace, research on ChatGPT should include the impact of this technology on students and their perspectives of it (Crawford *et al*., 2023b). The present study, conducted at a comprehensive

university in the northeast United States, examines the impacts of ChatGPT on student performance and provides an assessment of students' perspectives on this revolutionary technology. Students were made aware of ChatGPT and given citation guidelines for using this tool in their writing assignments. Performance on these assignments was compared between students who chose to use ChatGPT and those who did not. Additionally, students were surveyed for their opinions of ChatGPT. The results shed light on the potential impact that ChatGPT can have on student writing and provide a window into what students are thinking about GAI and its impact on their academics.

Literature

Technical Workings of ChatGPT and other GAI Tools

ChatGPT, Bard, Claude and other recently released GAI chatbots are all iterations of NLP platforms that differ in their algorithms (e.g., ChatGPT uses a transformer probabilistic model, described below, while Claude uses cognitive modelling) (Ruslan, 2023). The hallmark feature of all pretrained foundation models, such as ChatGPT, is the use of incredibly large amounts of data to train a general model for tasks and downstream applications (Zhou, 2023). The “GPT” in ChatGPT is an acronym for generative pretrained transformer and it was trained on both language and code-based datasets mined from the internet. One of the more unique features of ChatGPT is another round of training that involved human feedback to fine-tune the platform (Ray, 2023; Zhou, 2023). This fine-tuning of the responses generated by ChatGPT includes putting barriers against responses that could be harmful, hurtful, or culturally inappropriate (since such content is often found in ChatGPT’s internet-based training dataset). However, many users have been able to circumvent these safeguards by asking ChatGPT to assume personas or via other creative bypasses (Gupta *et al.*, 2023).

“Transformers”, as they apply to GAI such as ChatGPT and Bard, are a type of neural network that assigns weighted values to knowledge/information as responses are generated by the tool. As an over-simplification, NLPs like ChatGPT generate their responses by scouring their datasets of ‘knowledge’ mined from the internet to assign a probability for the best, most likely next word or string in the context of the response being generated (Zhou, 2023). For example, if a response is being generated that contains the string “the United States of”, the GAI will assign a very high probability to inserting “America” as the next term because it finds “America” following that initial string in a very high percentage of the text on which it was trained. It is in this way that ChatGPT and other NLPs are echo chambers of society, giving back to us responses that are culled from what people have already created and published online, regardless of its credibility.

The Ethics of AI in Education

Machine learning coupled with predictive analytics, as described above, can result in an impressive array of ‘knowledge’ about any given person. Horvitz & Mulligan (2015) noted that machine learning’s capabilities reveal limitations of current privacy rules in the US. Most existing privacy laws are focused on textual and semantic content and are outdated, as machine learning can infer new meaning within and across contexts, as well as expose secrets and facilitate social

sorting (Horvitz & Mulligan, 2015). As such, when planning how to ethically integrate GAI into education, one must consider a range of facets including student privacy, academic integrity, institutional policy, strategies for encouraging students to use GAI tools responsibly and not irresponsibly, and ways in which institutions can promote embracing this technology holistically (Sullivan *et al.*, 2023).

In a recent study, surveyed students had relatively low knowledge, experience, and confidence in using GAI, however, student confidence in using GAI increased with experience (Kelly *et al.*, 2023). Students from science and engineering disciplines generally reported more overall awareness, experience, and confidence in using GAI, compared to their peers in healthcare studies, who reported the lowest rates of the same variables (Kelly *et al.*, 2023). As all students become more aware of and confident in using these technologies, another significant risk becomes over-reliance on technology (as seen in other industries), undermining the development of important critical thinking skills (Fuchs, 2023).

The questionable accuracy of ChatGPT and other GAI chatbots is also an ethical concern. The accuracy of these tools depends heavily on the quality, diversity, and complexity of datasets on which they were trained, as well as the quality of the prompts provided by the user (Fuchs, 2023). Ideally, students and educators would learn about the use, strengths, and limitations of GAI in appropriate and ethical ways through their institution. However, existing data currently suggests that students are instead more likely to learn about GAI through social media (Kelly *et al.*, 2023). Thus, there is an urgent need for institutions to plan the ethical integration of GAI deliberately and proactively into their curricula. As part of this process, colleges and universities should involve students in GAI integration to address their unique needs and preferences and ensure that digital literacy education, including AI tools, is a part of the curriculum (Fuchs, 2023; Rudolph, *et al.*, 2023).

Strengths, Weaknesses, Opportunities and Threats of AI

Like all major technological disruptions and innovations, AI offers both incredible advances and potential drawbacks. In a recent SWOT analysis of the potential for AI to address developmental goals in civics and governmental affairs, Palomares *et al.* (2021) noted that for AI to offer its greatest and safest potential, it must be: (1) used and leveraged with other relevant technologies, (2) preceded by the digital transformation of the sector with which it will be used, and (3) trained on vetted, curated and appropriate datasets. Additionally, the adoption and integration of AI across sectors is likely premature and rushed. Existing data suggests that AI is being integrated into industries that are otherwise not up to date and are lacking relevant technologies; these industries lack a workforce trained for managing AI, and current AI tools are sometimes being trained on poorly aligned and/or curated datasets (Huang, 2021). In such cases, AI may make matters worse in many industries due to premature adoption and integration, serving as a cautionary tale for the adoption of GAI by education. Additional risks for industries that are leveraging this technology, including education, are a lack of transparency (as the basis of its recommendations are rarely clear), cybersecurity risks (i.e., the possible breach of individual data), data bias, and an overreliance on this technology, resulting in a workforce that may be ill-equipped to cope with a failure of the tool (Bahrini *et al*., 2023).

Many challenges and opportunities for the integration of GAI into higher education were identified by a recent meta-analysis (Neumann *et al.*, 2023). Opportunities included GAI-powered virtual tutoring for students, giving them 24/7 access to educational resources, idea generation for both students and instructors, and the ability to further leverage other pedagogical innovations such as flipped and active learning strategies (Neumann *et al.*, 2023). These strategies facilitate adaptive learning, which allows students to acquire real-world experience building on each student's individualized existing knowledge, potentially beyond the classroom (Rasul *et al.*, 2023).

Challenges to incorporate GAI into curricula include students being unaware of proper usage of and/or policies around GAI, too much inconsistency around each instructor's use and expectations regarding GAI, increased instructor workload in preparing for and integrating GAI into their curricula, and the rapid evolution of GAI capabilities, making such integrations a moving target for both students and educators (Neumann *et al.*, 2023). Furthermore, the inability of ChatGPT to evaluate and/or reinforce graduate-level skillsets or learning is another shortcoming. Graduate skills such as critical thinking, problem-solving, collaboration, and teamwork require some level of real-world experiences, contextual inputs, and social interactions that ChatGPT cannot fully support (Rasul *et al.*, 2023). The overuse of ChatGPT, and the passivity that it allows, could hinder achieving some learning outcomes. Deep learning and mastery benefit from active engagement with learning materials, social interactions between students, and problem-solving and it requires that students construct meaning through reflections on their experiences, all things that GAI may inhibit (Rasul *et al.*, 2023).

GAI, ChatGPT, and Education

Despite the potential issues that accompany embracing GAI, it is far more likely that ignoring will do our students a greater disservice, as they will not be prepared for a workforce that will have undoubtedly integrated AI. A single automation (robot or AI) per thousand workers measurably lowers employment rates and wages (Rainie & Anderson, 2017). To prepare students for the AI world of tomorrow, the Pew Research Center highlights five themes that higher education should embrace: allow training programs to rapidly evolve and adapt to innovations in the workplace, cultivate 21st century skills, capabilities and attributes, develop new credentialing systems to facilitate self-directed learning programs, acknowledge that 21st century workplace needs will likely not be met by training programs until after 2026, and accept that jobs will diminish (Rainie & Anderson, 2017). Clearly, AI is rapidly changing the workplace and requires new skills and experiences.

GAI and ChatGPT are new and powerful technologies that have widespread implications for education. Perhaps prematurely, GAI appears to have integrated itself into society in a way that demonstrates it is here to stay, and it is the obligation of educators to weave GAI into our curriculum to prepare students for their tomorrow. However, the perspective of students is needed as educators begin to realign their curricula deliberately and carefully to include GAI. How do students use ChatGPT and what are their plans for its use in their academics? What impact does ChatGPT have on student academic performance? And what are students' perceptions of this tool? These are the questions that the present study sought to address to provide instructors with the perspective needed for curricular decision-making in the context of GAI and ChatGPT.

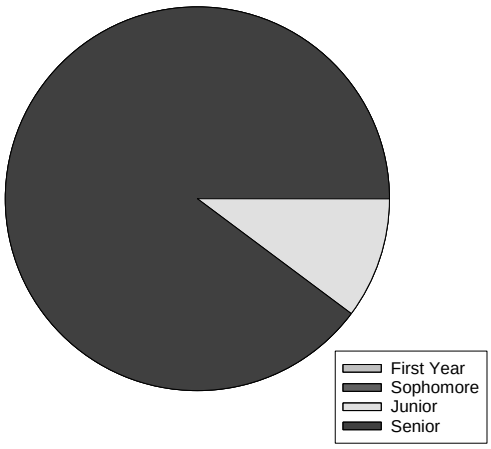
Method

Participants

49 undergraduate students from a nationally ranked comprehensive university in Massachusetts in the United States of America, volunteered to participate in this study. The study was approved by the university's Institutional Review Board (IRB) and students were compensated with a nominal amount of extra credit. First and second year students enrolled in sections of General Biology II and General Biology II Lab, and juniors and seniors enrolled in the upper-level health sciences elective Molecular Genetics and Human Genetic Disorders, all taught by one of the authors, were eligible to participate. All students were made aware of the study and those choosing to participate completed an informed consent.

The academic major distribution of the participating students was: 27% pharmacy, 24% health sciences, 16% biology, 8% health studies, 6% pre-occupational therapy, 6% pre-physician's assistant, 6% neuroscience, 4% forensic sciences, and 2%, representing a single student, was a criminal justice major. Figure 1 shows the distribution of participating students by academic year. All participants were traditionally aged undergraduates. Demographics on gender were not collected in this study.

Figure 1:
The distribution of academic year for students participating in the study.



34 students were first year, 5 students each were sophomores, juniors, and seniors.

Procedure

All three courses featured written papers. For the general biology lab, these were two lab reports where students explained the experiments conducted the previous week. These assignments followed the traditional format of a lab report with introduction, methods, results, and discussion sections. For the General Biology II lecture section, the assignment was a capstone reflection essay, where students selected a topic from a list provided by the instructor, researched this topic

and related it to the content learned in lecture. The assignment in the upper-level health sciences elective was a research paper focusing on a genetic disorder that was selected by the student and approved by the instructor. All papers shared the requirement of outside research on a topic, and all were graded using rubrics provided to the students at the start of the semester.

After briefly explaining ChatGPT to all students and inviting them to use this tool on their written assignments, guidelines were provided for its use. These ChatGPT citing guidelines are explained extensively elsewhere (Mennella & Fell-Kurban, 2023). Briefly, all ChatGPT-generated content used by students was to be quoted and cited with a sequential in-text citation formatted as "(ChatGPT, #)", where the number (#) represented the sequential incidence of the citation. ChatGPT generated content used verbatim was indicated with double quotes ("_") while paraphrased and edited content was single quoted ('_'). After the traditional references page at the end of the report, an additional "ChatGPT Citations" page was to be added. On this page, entries corresponding to the in-text citation numbers were provided indicating the date the ChatGPT content was generated, the prompt used to generate that content, and at least one source that validates the content provided. This last component is referred to as "fact-checking" and compels the student to research and validate the information provided by ChatGPT. Students discovered to be using ChatGPT without following these citation guidelines would be found in violation of academic integrity policies and receive a zero on their paper, but all students were invited to use ChatGPT as much as they wanted if these citations guidelines were followed.

Measures

To receive the incentivizing extra credit, all participating students were required to complete a survey that sought to understand the impact of GAI tools like ChatGPT on educational practices and student attitudes towards this technology's role in academic integrity and assistance. This survey asked participants for their demographic information (students' names, majors, and academic years to contextualize responses), comfort level with both collegiate and scientific writing, and familiarity and opinions on ChatGPT prior to and during Spring 2023 (inquiring about its utility in writing, role as a search engine, an AI tool, a source of information, and potential for misuse in assignments). Additional items on the survey inquired about student's use of ChatGPT on writing assignments, reasons for its use or non-use and willingness to use it in the future. Finally, open-ended questions targeting student's perceptions of ChatGPT inquired about their personal definitions of ChatGPT, opinions on whether it should be allowed in academic settings, and any additional comments or insights students wish to share about ChatGPT. Survey questions are provided in Appendix I.

Analysis

Statistical analyses compared scores from students who used ChatGPT and those who did not. In the elective course, only one student chose to use ChatGPT and so no statistical comparisons were conducted. The scores from the other lecture course written assignment and the first lab report were not normally distributed. Therefore, Mann-Whitney U tests were conducted. The scores from the second lab report were normally distributed and a two-tailed t-test was used. Statistical analyses were also conducted comparing (1) students' rating of awareness of ChatGPT

before versus during the Spring 2023 semester and (2) students' rating of comfort with college writing and scientific writing between those that used ChatGPT versus those that did not. None of the datasets were normally distributed and therefore Mann-Whitney U tests were conducted.

In addition to these statistical analyses, a thematic analysis was conducted for the free responses from three questions on the survey: (1) students' opinions for what they thought ChatGPT was, (2) students' reasons for using or not using ChatGPT on their assignment(s) and (3) students' reason for using ChatGPT or not in the future. Again, students were separated by those who used ChatGPT (14 students) and those who did not (35 students), regardless of course. Free response statements were uploaded into ChatGPT requesting identification of themes as the prompt. Themes identified by ChatGPT were then verified manually and the number of responses within each theme was tallied and percentages of total number of students (14 using or 35 non-using) were calculated.

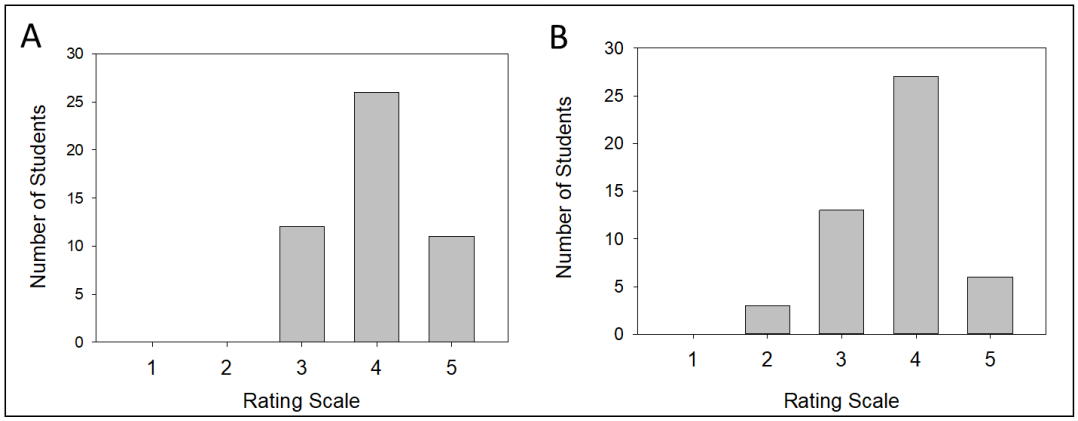
Results

Student Perceptions of College Writing Assignments and Familiarity with ChatGPT

Students were surveyed near the end of the Spring 2023 semester about their overall comfort with writing assignments. 26 out of 49 participants rated their comfort as a 4 with college-level writing, with an overall mean of 3.98 and 27 out of 49 participants rated their comfort as a 4 for scientific writing with an overall mean of 3.73 (Figure 2). All participants in the study, except one, were science majors.

Figure 2.

Student comfort with writing assignments.



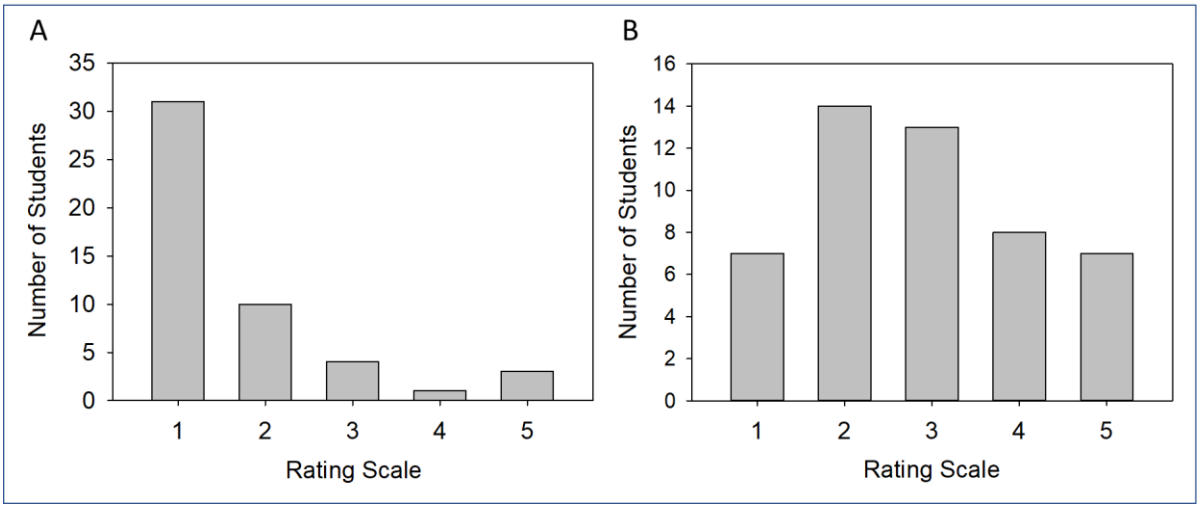
Students were asked to self-report their comfort with (A) college-level writing, in general, or (B) scientific writing, on a scale of 1 (not comfortable at all) to 5 (very comfortable).

In addition, students' familiarity with ChatGPT was surveyed, retrospectively before the Spring 2023 semester, and during the Spring 2023 semester. Mann Whitney U test revealed a significant difference in ratings between the retrospective rating compared to during Spring 2023, $U = 1758$,

p<.001. The median rating prior to Spring 2023 was 1 while the median for During Spring 2023 was 3 (Figure 3).

Figure 3.

College students rated their familiarity with ChatGPT prior to and during the Spring 2023 semester.



Students were asked to rate their familiarity with ChatGPT, (A) retrospectively prior to the Spring 2023 semester and (B) after 12 weeks into the Spring 2023 semester, on a scale of 1 (not familiar at all) to 5 (very familiar).

Student Usage of ChatGPT and Impacts of ChatGPT on Student Performance

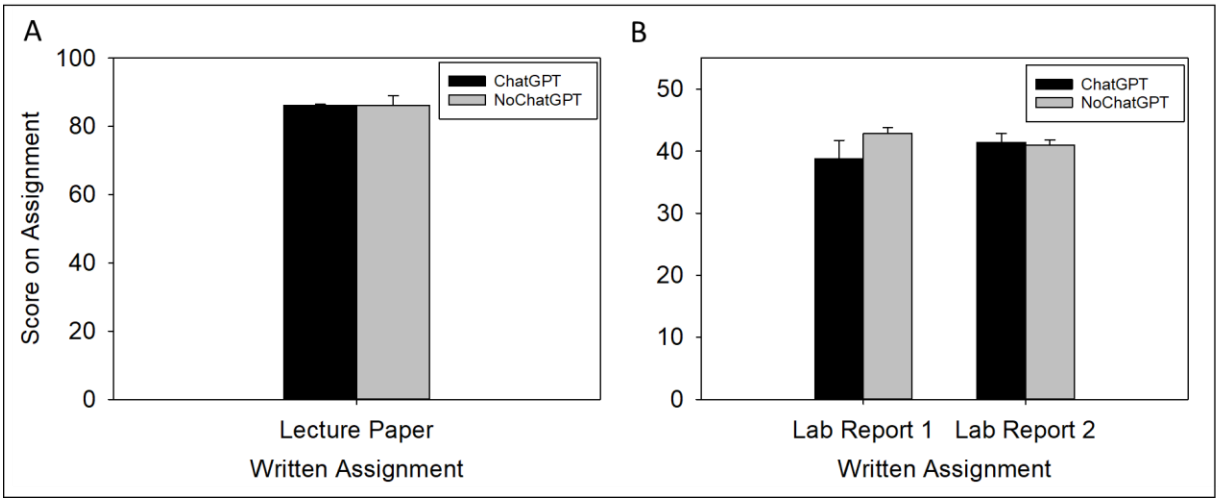
While 49 students were part of this study, some students were enrolled in multiple courses assessed in this study and General Biology II Lab included two lab reports. Therefore, there were 90 individual assignments for which students could potentially use ChatGPT, distributed across one research paper in the General Biology II lecture, the lab reports in General Biology II lab, and one research paper in the upper-level elective.

While 14 out of 49 total students (28.6%) used ChatGPT, these students cited the use of ChatGPT on 14 of the 90 potential assignments (approximately 15.5%). On the survey, students self-reported ChatGPT usage on 15 assignments, suggesting that it was used but not cited on at least one assignment. ChatGPT-generated content was used on 10 General Biology Lab reports, four General Biology lecture reflection papers, and on one upper-level elective research paper. Students who chose to use ChatGPT had no self-reported difference in their comfort with college level or scientific writing compared to students who did not use ChatGPT (College writing: U = 355.5, p = .903; Scientific writing: U = 369.5, p = .641).

Statistical comparisons of scores were conducted for each assignment, between students who used ChatGPT and those who did not. Mann Whitney U testing revealed no significant difference between students who chose to use ChatGPT and those who did not on the General Biology lecture assignment (U = 17.0, p = .61; Figure 4), and on the first General Biology II lab report (U = 63.0, p = .207; Figure 4). Lastly, a t-test comparing the performance of students on the second General Biology II lab report between those who used ChatGPT and those who did not also revealed no significant difference ($t_{(31)}$ = .178, p = .86; Figure 4). Only one student in the upper-level elective course chose to use ChatGPT and therefore no statistical comparisons were possible. The one student scored 49.5 out of 75 points while the mean score for students who chose to not use ChatGPT was 63.56 out of 75 points (SEM = 4.256, data not shown).

Figure 4.

A comparison of student performance with and without ChatGPT.



Performance of first- and second-year students who elected to use ChatGPT and those who did not on (A) a written assignment in a first-year General Biology II lecture course and (B) two lab reports in a first-year General Biology II Lab course. Mean scores of students who elected to use ChatGPT are represented as black bars while means scores of those who elected to not use ChatGPT are represented as grey bars. Error bars represent standard error of mean. Mann Whitney U and t-tests of each comparison revealed no significant difference in performance between those who elected to use ChatGPT and those who did not for any written assignment.

Student Opinions and Perspectives on ChatGPT

Students were asked their opinions regarding whether ChatGPT usage should be allowed in college courses, as well as their perceptions of the use and purpose of ChatGPT. 40 (81.6%) out of the 49 students expressed that “college instructors should allow students to use ChatGPT on writing assignments”. 13 out of the 14 students who used ChatGPT agreed that ChatGPT use should be allowed. Only 8 (22.8%) of the 35 students who did not use ChatGPT felt that ChatGPT should not be allowed in college courses, while 27 (77.2%) believed it should be allowed.

Out of 49 students, 21 students (42.9%) responded that they intended to use this tool in the future, in their college coursework (if allowed by the instructor), 22 students (44.9%) responded "maybe" indicating uncertainty of using ChatGPT in the future, and 6 students (12.2%) responded that they would not use ChatGPT in their future coursework. 12 students (85.7%) out of the 14 who elected to use ChatGPT intended to do so again, while 2 (4%) students answered "maybe". All six students (17.2%) responding "no" to future ChatGPT use were from the cohort of 35 students who did not use ChatGPT in this study. In the cohort who did not use ChatGPT, 20 (57.1%) were unsure of their future use of ChatGPT and nine students (25.7%) had intentions of using ChatGPT on their college coursework sometime in the future, if allowed.

Finally, students were asked to indicate their opinions/perceptions of ChatGPT both prior to and during the Spring 2023 by selecting phrases from a provided list. A majority of students retrospectively reported having no opinion of ChatGPT prior to the Spring 2023 semester (Table 1). The second-most common response was that ChatGPT is "an AI chat tool". This lack of an opinion agrees with the overall lack of student familiarity with ChatGPT observed in Figure 3. By the end of the Spring 2023 semester, having no opinion of ChatGPT was the second-least prevalent response (Table 1). Instead, the most common responses were that ChatGPT is "a source of information", "an AI chat tool", "a powerful search engine" and that ChatGPT "helps me with my writing".

Table 1. *Number of students who selected various statements in the survey regarding their opinions and perceptions of ChatGPT retrospectively prior to Spring 2023 and during Spring 2023*

Statement	**Number of Students Who Selected Statement**	
	Prior to Spring 2023	*During Spring 2023*
1. It is a source for information	7	30
2. It is an AI chat tool	15	25
3. It is a powerful search engine	12	22
4. It helps me with my writing	6	17
5. It is a way to "cheat" on assignments	6	10
6. It does the actual writing for me	2	9
7. I had no opinions of ChatGPT	30	6
8. Other	4	5

Thematic analysis of students' responses to open response questions.

Students were prompted to provide free responses elaborating on some of their opinions and perspectives in the survey (Appendix I). ChatGPT was then used for thematic analysis. Themes generated by ChatGPT that represented less than 10% of student responses were either consolidated into other closely related themes or were not reported below.

To the prompt "*Please briefly and in your own words describe what ChatGPT is, in your opinion*", four to six themes emerged. For the 14 students who used ChatGPT, 43% saw it as an information generator (i.e., ChatGPT is an AI tool that aids in generating content, answering questions, and providing information). 29% felt ChatGPT was useful for assistance in their writing and as a research tool, though not as a primary source due to inaccuracy. Another 29% indicated ChatGPT served as a multipurpose AI chatbot. Approximately 21% of students reported that ChatGPT was a tool for essay writing and idea generation, as well as an AI-driven search engine. Finally, 14% believed that ChatGPT was not a credible source and cautioned against using ChatGPT due to randomness or lack of accuracy of the information it provided. For the 35 students who did not use ChatGPT, two-thirds saw it as useful for AI-powered writing assistance, that it could be used to write essays based on prompts or key words, and slightly less than one-third believed that ChatGPT could be used for research and synthesis (i.e., ChatGPT is an AI search engine or research tool that gathers information from the internet and synthesizes it into coherent responses). Approximately 14% shared that ChatGPT could be used for learning and as a versatile tool for idea generation, while 11% had moral, ethical or integrity considerations expressing caution when using ChatGPT to complete assignments or as a tool to bypass academic or personal effort or responsibilities.

To the prompt "*Please explain why you did or did not use ChatGPT in your writing assignments*", five themes emerged. For the 14 students who used ChatGPT, 57% used it for idea generation and writer's block while half used the tool as a source of information and efficiency, indicating that ChatGPT was helpful in identifying information related to their assignment, increasing efficiency in assignment completion, and helping them manage their time better. 36% used ChatGPT for writing structure and formatting, 21% of students were hesitant to use ChatGPT, but tested it and found it helpful in writing technical sections of their assignments, and 14% used ChatGPT for summarizing and paraphrasing information. For the 35 students who did not use ChatGPT, one-third expressed comfort with writing and a preference for independent work. These students were comfortable with their own writing skills and preferred using writing to improve skills and learning. Use of ChatGPT was seen as undermining creativity, learning, and skill development. Approximately 29% had a trust in their personal ability to produce high-quality work over ChatGPT and expressed a preference for their own research skills. Nearly 26% shared a lack of familiarity with the tool and/or had concerns around plagiarism, academic integrity, and course policy, voicing worries about plagiarism using ChatGPT for assignment content or did not use ChatGPT because of course policy or perceived professor disapproval. Finally, 11% of students who did not use ChatGPT saw it as taking up additional time for content cross-verification.

To the prompt "*Please explain why you would or would not use ChatGPT on future assignments*", seven themes emerged. For the 14 students who used ChatGPT, slightly more than one-third perceived that ChatGPT was fast and efficient in providing information, generating useful comments quickly and allowing users to grasp information faster than primary sources. Approximately 29% reported that ChatGPT provided information that was similar to credible sources, suggesting its reliability. Approximately 21% of students found ChatGPT to be a useful resource to both counteract writer's block or generate inspiration for a paper and, in time constrained circumstances, allow users to meet deadlines quickly and easily. Nearly 14% shared that ChatGPT was useful for gathering information and providing structure to thoughts prior to

putting them on paper. 14% of respondents perceived that ChatGPT had a positive impact on their grade, attributed to faster completion of better written assignments, and saw ChatGPT as a motivation tool, helping users learn how to rephrase their own writing to improve comprehension. For the 35 students who did not use ChatGPT, 29% expressed willingness to experiment in future classes based on its usefulness, 26% acknowledged benefits of ChatGPT particularly in generating ideas, helping with starting points, assisting in citation, or acting as a reference tool for information, while 20% expressed concerns around academic integrity and doubts regarding accuracy of information provided or a lack of familiarity with tool. Approximately 17% of students expressed preference for controlling their own work and not relying on AI tools, while another 17% indicated that ChatGPT would be useful in initiating or gathering information, with the goal of using additional reliable sources. Lastly, 11% of respondents expressed limitations in the quality of content generated by ChatGPT, deterring them from using its outputs and had concerns about using ChatGPT with regards to academic integrity.

Discussion

Given the rapid growth and rates of adoption of ChatGPT across sectors, and its abrupt integration into society, most educators have either embraced or shunned this tool (Mogavi *et al.*, 2023). Both positions are likely premature. First, we have yet to fully understand the potential of GAI in the classroom, as its use in education is still relatively new. Furthermore, this tool continues to evolve, and new features are added to it routinely. Most importantly, we are not fully aware of students' perceptions and intentions with ChatGPT, nor do we understand its impact on their academic performance. It was the goal of the present study to shed some light on this latter aspect of the unknown: student perceptions and performance. Students in three courses taught by one of the authors were invited to use this tool as extensively as they wished on written assignments. Students were surveyed to assess their opinions and perceptions of GAI as well as to gauge their future intended use of this tool.

A Minority of Students used ChatGPT with No Impact on Performance

Despite being made aware of the potential benefits of ChatGPT, students used this tool on only 15% of 90 total submissions, demonstrating a reluctance to incorporate GAI into their academics. Additionally, there was no relationship between discomfort with either college writing or scientific writing and using ChatGPT. This reticence by students to use GAI is reflected in many of their free response themes analysed above, namely, concerns around implications for academic integrity, a lack of confidence in the accuracy of GAI-generated content, and an overall lack of familiarity with the technology. Interestingly, there is ample evidence that the "digital native" generation is not nearly as comfortable with digital technology as many believe (Kennedy, 2008). While very comfortable with technologies that they use regularly, younger generations are equally reluctant to use novel technologies as older generations (Kennedy, 2008).

Of the students surveyed in this study who elected to use ChatGPT, the largest thematic reason for that use was as an idea generator and to thwart writers' block, which are arguably valid and productive uses of the tool. Another common theme was that ChatGPT helped students to organize their thoughts and writing. Conversely, half of ChatGPT-using students used it to

generate information/content and to make the writing process more efficient. This hints at the risks and concerns of out-sourcing student thought, creativity and critical thinking summarized above. For students who did not use ChatGPT, the most prevalent theme for non-use clustered into reasons reflecting their comfort and trust in their own writing and research skills, rendering ChatGPT unnecessary.

Most importantly, using GAI had no significant impact on students' writing assignment performance in any of the courses. In fact, in each analysed course, regardless of whether they used ChatGPT or not, grades were statistically similar on all writing assignments. However, this is confounded because we are unaware of how students using ChatGPT would have scored on these assignments without the tool. It remains possible that ChatGPT use boosted the scores of this cohort, leveling performance across students. If true, this raises the issues of social justice and equity in education. If ChatGPT allows some students who might otherwise struggle with college-level writing to excel at levels equal to their non-struggling peers, should they not be allowed to use these tools to achieve that equity? Conversely, would the equalizing effect of GAI mask struggling students and prevent instructor intervention and remediation? Education must engage in conversations around the implications of integrating GAI into our curricula to address these questions and implement policies that are fair and equitable for all students.

Students are Becoming Rapidly Familiar with AI and Intend to Use it in the Future

At the start of the Spring 2023 semester, a clear majority of student were unfamiliar with GAI tools, agreeing with Kelly *et al*. (2023). After twelve weeks of that same semester, student self-reported familiarity with ChatGPT increased. Not surprisingly, as ChatGPT gained popularity in the media and in society, it was also doing so among our students. Additionally, a striking majority of all students believed that ChatGPT use should be allowed in college coursework. Furthermore, approximately 88% of students answered 'yes' or 'maybe' regarding their own future use of ChatGPT on college assignments (if allowed by the instructor). Even among students who did not use ChatGPT in this study, over 75% plan to use, or may use, ChatGPT in the future.

Among students who used ChatGPT, their reasons for using it again in the future align with their reasons for using it here: gains in speed and efficiency of completion, idea generation and information curating. Interestingly, students who did not use ChatGPT expressed a greater willingness to experiment with the technology and an appreciation for the content that ChatGPT can generate. It is important to note that these student opinions may be somewhat biased by GAI being allowed in these courses. The instructor's encouragement for students to use ChatGPT could have influenced student perceptions that such usage was beneficial and should be allowed. Some non-using students expressed concern with surrendering control of their writing and the potential for infringement of academic integrity. This agrees with the findings of Malik *et al.* (2023) where students expressed concerns about GAI's impact on their creativity, critical thinking skills, and ethical writing practices, as well as fearing the loss of originality and innovation, an over-reliance on the technology, and that they were assuming undue risk of misinformation, inaccuracy and unintentional plagiarism being present in their submitted work.

Our findings here align somewhat with surveys of college-aged students by Singh *et al.* (2023) that found a majority were somewhat familiar with GAI tools. Additionally, half of their students

had not used these tools for academic purposes and over one quarter felt that GAI had a negative impact on their academics (Singh *et al.*, 2023), similar to what we observed.

Although we may have time to deliberate curricular integration of ChatGPT, that window of opportunity will likely be brief. Students are rapidly becoming aware of ChatGPT; most feel its use should be allowed in academics, and most intend to use it. Education must move swiftly to reach a consensus regarding our strategies for using and integrating ChatGPT into our courses. By becoming informed and trained on GAI, as educators, we can learn its capabilities and limitations, identify assessment strategies to reduce academic integrity issues and create innovative pedagogical experiences (Dempere *et al*. 2023). Faculty should be embracing GAI chatbots as powerful teaching and research tools to prepare for this inevitable future (Dempere *et al*. 2023).

Student Perceptions of ChatGPT are Misinformed

As a generative pretrained transformer platform, ChatGPT is a societal echo chamber that uses a probabilistic algorithm to determine the next best word or string within the given context of a response, doing so with a dataset mined from the internet. In an academic context, two things that ChatGPT should not be identified as, due to its societal echoing algorithm, are “a source of information” or “a search engine”. Troublingly, these are the two most common identifiers that students associated with ChatGPT in this study. Furthermore, in their free responses describing ChatGPT in their own words, the most prominent theme emerging from students who used ChatGPT was that it was an information generator (43%). Again, ChatGPT merely collates and curates societal dispositions that exist on the internet. It is not an independent source of information. Interestingly, the perspectives of students who did not use ChatGPT are similar to their GAI-using peers but reflect some wariness. In this cohort, two-thirds of free responses describing ChatGPT cluster into the theme that ChatGPT is an AI tool that can be used to write essays based on prompts or key words, hinting at some recognition of potential academic fraud or plagiarism.

Borji (2023) has recently catalogued numerous errors by ChatGPT in areas such as reasoning, logic, math, coding, facts, discrimination, grammar, ethics, and even errors in humour. ChatGPT also fabricates references and sources, providing correctly formatted citations for publications that do not exist (McGowen *et al.*, 2023; Walters & Wilder, 2023). Again, ChatGPT is not a search engine and it is not a reliable source of information. Yet, as students become more familiar with GAI, it is these two attributes that students most commonly associate with ChatGPT. Our data show that students do not seem to understand what GAI is, what is does well, nor what it does poorly. These misconceptions and this lack of understanding will not only muddy the waters for students within their curricula, but also serve them poorly as they graduate and venture out into an AI-infused world for employment.

Conclusion

This study was conducted at a fairly non-selective, private comprehensive university in the United States where higher education functions as an administrative market or quasi-free market system (Geiger, 2004). While the nuances of the results that we report here may not be directly translated

to other more-selective institutions in the United States or to other higher education systems in other countries, we remain confident that our core findings apply to most students due to the alignments of our findings with those of other recent studies (Singh, *et al*., 2023; Strzelecki, 2023).

While educators and institutions have adapted to the presence of GAI, students remain troublingly misinformed as demonstrated by Kelly *et al.* (2023) and the present study. This void in understanding has unfortunately been filled by misinformation, as students are getting little to no consensus instruction on this tool. Our results demonstrate that, for now, few students appear to be using ChatGPT, even when they are allowed to do so. Furthermore, the use of ChatGPT either has no effect on student performance on writing assignments or may level the playing field by bringing up students who otherwise struggle with writing. Students are becoming familiar with ChatGPT and related GAI tools, and despite many misconceptions around this technology, they plan to use it in future academic endeavours. Fortunately, students can be coaxed towards being comfortable adopting new technologies such as GAI. Students are more likely to use technologies like ChatGPT when they have high levels of "performance expectancy" (i.e., a clear idea of what GAI can and cannot do for their learning) and their frequency of use can contribute to the development of habitual behaviour (Strzelecki, 2023). Higher education needs only to create the conditions and context for the proper and guided use of GAI and then students are likely to follow.

A near-future is very likely where we will want our students to embrace and use ChatGPT to be ready for an AI-infused workplace. Their reticence to use such technologies, if it continues, could be detrimental to students' developing the proficiency with AI tools that jobs may soon require. However, given that educational changes are often slow (Kezar & Eckel, 2002) and GAI is still very new, we need time for the deliberate integration of AI into the curricula of higher education. Institutions require time to develop well-informed GAI adoption strategies, update existing technology infrastructure to support equitable student use of these tools, and provide professional development for instructors around the use of GAI (O'Dea & O'Dea, 2023). One benefit of students currently avoiding GAI use is that it gives higher education some time to plan these integrations.

Some impactful efforts have already been made for integrating GAI into higher education curricula. At a medical school in Japan, a workshop model was employed where faculty and students were organized into groups focusing on two related questions: (1) How does GAI affect undergraduate medical education curricula? and (2) How should medical school curricula be reformed to address the impact of GAI? (Shimizu *et al*., 2023). A SWOT analysis on emergent themes revealed positive impacts of GAI integration such as enhanced teaching and learning efficiency and improved access to information, while negative impacts included reduced independent thinking. The authors recommended that incorporating GAI literacy, ethical considerations, and compliance into the curriculum was critical (Shimizu *et al*., 2023). Acun & Acun (2023) integrated GAI into the history curriculum at Hacettepe University in Ankara, Turkey. Students directly engaged with GAI under instructor supervision and these engagements were designed to enhance and augment learning by creating a more immersive experience. While most students adapted and exceled in this GAI-enhanced environment, issues arose regarding the accuracy of GAI-generated responses (Acun & Acun, 2023). To address this, the authors

developed and reported a 'Reference-Check Protocol', a safeguarding technique that emphasizes the accuracy of GAI's responses and the maintenance of academic integrity (Acun & Acun, 2023). Finally, Halaweh (2023) offers an innovative approach where students using ChatGPT or similar GAI chatbots follow clearly defined policies which include submitting student-written reflection notes that briefly describe their use of ChatGPT, as part of their assignment. Despite the recent release of GAI and its rapid evolution, pockets of good and impactful work are being done across the globe to deliberately adopt these technologies into the classroom.

Given the role that higher education, its curricula, and its instructors play in preparing students for society, we and others believe that adapting our curricula to encompass and leverage GAI is essential (Lodge *et al*., 2023). We must provide guidance and instruction on GAI usage, equipping our students for an AI-integrated future. Doing so aligns with the broader mission of higher education – to prepare graduates for the emerging realities of the future workplace.

Conflict of Interest

The authors disclose that they have no actual or perceived conflicts of interest. The authors disclose that they have not received any funding for this manuscript beyond resourcing for academic time at their respective universities.

Appendix I

Survey questions administered to participating students.

1. Full name:

2. Major:

3. Year: (First Year, Sophomore, Junior, Senior)

4. How would you rate your overall comfort with writing assignments in college, in general? (one star = not comfortable at all; five stars = very comfortable)

5. How would you rate your overall comfort with scientific writing assignments in college, specifically? (one star = not comfortable at all; five stars = very comfortable)

6. How familiar were you with ChatGPT prior to this Spring 2023 semester? (one star = not familiar at all; five stars = very familiar)

7. What were your opinions of ChatGPT prior to the Spring 2023 semester? (Check all that apply)

    it is a powerful search engine

    it helps me with my writing

    it does the actual writing for me

    it is a source for information

    it is a way to "cheat" on assignments

    it is an AI chat tool

    I had no opinions of ChatGPT prior to the Spring 2023 semester

8. How familiar were you with ChatGPT during the Spring 2023 semester? (one star = not familiar at all; five stars = very familiar)

9. What were your opinions of ChatGPT during the Spring 2023 semester? (Check all that apply)

    it is a powerful search engine

    it helps me with my writing

    it does the actual writing for me

    it is a source for information

    it is a way to "cheat" on assignments

    it is an AI chat tool

    I had no opinions of ChatGPT during the Spring 2023 semester

10. Did you use ChatGPT for your paper assignment(s) in Dr. Mennella's class this semester? (Yes, No)

For students who answered ‘Yes’ to Question 10:

11. In which course? (BIO-108, BIO-118, HS-390)

12. Please explain why you did or did not use ChatGPT in your writing assignments.

13. Would you use ChatGPT in future writing assignments (if allowed by the instructor)? (Yes, No, Maybe)

14. Please explain why you would or would not use ChatGPT on future assignments.

15. Please briefly and in your own words describe what ChatGPT is, in your opinion.

16. Do you believe that college instructors should allow students to use ChatGPT on writing assignments? (Yes, No)

17. Why or why not?

18. Please provide any additional comments related to ChatGPT that you would like to share.

For students who answered 'No' to Question 10:

11. Please explain why you did or did not use ChatGPT in your writing assignments.

12. Would you use ChatGPT in future writing assignments (if allowed by the instructor)? (Yes, No, Maybe)

13. Please explain why you would or would not use ChatGPT on future assignments.

14. Please briefly and in your own words describe what ChatGPT is, in your opinion.

15. Do you believe that college instructors should allow students to use ChatGPT on writing assignments? (Yes, No)

16. Why or why not?

17. Please provide any additional comments related to ChatGPT that you would like to share.

References

Acun, C., & Acun, R. GAI-Enhanced Assignment Framework: A Case Study on Generative AI Powered History Education. https://gaied.org/neurips2023/files/48/48_paper.pdf

Ali, A. H., Alajanbi, M., Yaseen, M. G., & Abed, S. A. (2023). Chatgpt4, DALL· E, Bard, Claude, BERT: Open Possibilities. *Babylonian Journal of Machine Learning*, *2023*, 27-28. https://doi.org/10.58496/BJML/2023/003

Bahrini, A., Khamoshifar, M., Abbasimehr, H., Riggs, R. J., Esmaeili, M., Majdabadkohne, R. M., & Pasehvar, M. (2023, April). ChatGPT: Applications, opportunities, and threats. In 2023 Systems and Information Engineering Design Symposium (SIEDS) (pp. 274-279). IEEE. http://dx.doi.org/10.1109/SIEDS58326.2023.10137850

Borji, Ali. (2023). A Categorical Archive of ChatGPT Failures. 10.21203/rs.3.rs-2895792/v1.

Chan, R. Y. (2016). Understanding the purpose of higher education: An analysis of the economic and social benefits for completing a college degree. *Journal of Education Policy, Planning and Administration*, *6*(5), 1-40. https://scholar.harvard.edu/roychan/publications/understanding-purpose-higher-education-analysis-economic-and-social-benefits

Crawford, J., Cowling, M., & Allen, K. A. (2023). Leadership is needed for ethical ChatGPT:Character, assessment, and learning using artificial intelligence (AI). *Journal of University Teaching & Learning Practice*, *20*(3), 02. https://doi.org/10.53761/1.20.3.02

Crawford, J., Vallis, C., Yang, J., Fitzgerald, R., O'Dea, C., & Cowling, M. (2023). Editorial: Artificial intelligence is awesome, but good teaching should always come first. *Journal of University Teaching & Learning Practice*, *20*(7). https://doi.org/10.53761/1.20.7.01

Dempere J., Modugu K., Hesham A., & Ramasamy L. K. (2023) The impact of ChatGPT on higher education. *Frontiers in Education, 8*, 1206936. https://doi.org/10.3389/feduc.2023.1206936

Fuchs, K. (2023). Exploring the opportunities and challenges of NLP models in higher education: is Chat GPT a blessing or a curse? *Frontiers in Education,* 8, 1166682. https://doi.org/10.3389/feduc.2023.1166682.

Geiger, R. L. (2004). Market coordination of higher education: The United States. In Markets in Higher Education: Rhetoric or Reality? (pp. 161-183). Dordrecht: Springer Netherlands.

Gupta, M., Akiri, C., Aryal, K., Parker, E., & Praharaj, L. (2023). From chatgpt to threatgpt: Impact of generative ai in cybersecurity and privacy. *IEEE Access, 11,* 80218-80245. http://dx.doi.org/10.1109/ACCESS.2023.3300381

Halaweh, M. (2023). ChatGPT in education: Strategies for responsible implementation. *Contemporary Educational Technology, 15*(2), ep421. https://doi.org/10.30935/cedtech/13036

Horvitz, E., & Mulligan, D. (2015). Data, privacy, and the greater good. *Science*, *349*(6245), 253-255. http://dx.doi.org/10.1126/science.aac4520

Hu, K. (2023, February 2). *ChatGPT sets record for fastest-growing user base*. Reuters. https://www.reuters.com/technology/chatgpt-sets-record-fastest-growing-user-base-analyst-note-2023-02-01/

Huang, W., & Fan, Z. (2021). Innovation and Coordination a SWOT Analysis of Artificial Intelligence Industry in Guangdong Province. *E3S Web of Conferences*, *235*, 03050. http://dx.doi.org/10.1051/e3sconf/202123503050

Kelly, A., Sullivan, M., & Strampel, K. (2023). Generative artificial intelligence: University student awareness, experience, and confidence in use across disciplines. *Journal of University Teaching & Learning Practice 20(6)*, 1-16. https://doi.org/10.53761/1.20.6.12

Kennedy, G. E., Judd, T. S., Churchward, A., Gray, K., & Krause, K.-L. (2008). First year students' experiences with technology: Are they really digital natives? *Australasian Journal of Educational Technology*, *24*(1). https://doi.org/10.14742/ajet.1233

Kezar, A., & Eckel, P. D. (2002). The effect of institutional culture on change strategies in higher education: Universal principles or culturally responsive concepts? *The Journal of Higher Education*, *73*(4), 435–460. https://doi.org/10.1080/00221546.2002.11777159

Lo, C. K. (2023). What is the impact of ChatGPT on education? A rapid review of the literature. *Education Sciences*, *13*(4), 410. http://dx.doi.org/10.3390/educsci13040410

Lodge, J. M., de Barba, P., & Broadbent, J. (2023). Learning with Generative Artificial Intelligence Within a Network of Co-Regulation. *Journal of University Teaching & Learning Practice*, *20*(7). https://doi.org/10.53761/1.20.7.02

Malik, A. R., Pratiwi, Y., Andajani, K., Numerstayasa, I. W., Suharti, S., Darwis, A. & Marzuki. (2023). Exploring artificial intelligence in academic essay: Higher education student's perspective. *International Journal of Educational Research, 5*, 100296. https://doi.org/10.1016/j.ijedro.2023.100296

McGowan, A., Gui, Y., Dobbs, M., Shuster, S., Cotter, M., Selloni, A., Goodman, M., Srivastava, A., Cecchi, G. A., & Corcoran, C. M. (2023). ChatGPT and Bard exhibit spontaneous citation fabrication during psychiatry literature search. *Psychiatry Research*, *326*, 115334. https://doi.org/10.1016/j.psychres.2023.115334

Mennella, T. (2023, January 18). *Why banning ChatGPT in class is a mistake*. Campus Technology. https://campustechnology.com/articles/2023/01/18/why-banning-chatgpt-in-class-is-a-mistake.aspx

Mennella, T., & Fell-Kurban, C. (2023, February 3). *Is ChatGPT redefining plagiarism? We need new rules for giving credit where credit is due*. BAM! Radio Network. https://www.bamradionetwork.com/is-chatgpt-redefining-plagiarism-we-need-new-rules-for-giving-credit-where-credit-is-due/

Mogavi, R. H., Deng, C., Kim, J. J., Zhou, P., Kwon, Y. D., Metwally, A. H. S., Tlili, A., Bassanelli, S., Bucchiarone, A., Gujar, S., Nacke, L. E., & Hui, P. (2023). Exploring user

perspectives on chatgpt: Applications, perceptions, and implications for ai-integrated education. *Journal of Computers in Human Behavior: Artificial Humans. http://dx.doi.org/*0.13140/RG.2.2.15524.86401/1

O'Dea, X., & O'Dea, M. (2023). Is artificial intelligence really the next big thing in learning and teaching in higher education? A conceptual paper. *Journal of University Teaching & Learning Practice*, *20*(5). https://doi.org/10.53761/1.20.5.05

Okagbue, E. F., Ezeachikulo, U. P., Akintunde, T. Y., Tsakuwa, M. B., Ilokanulo, S. N., Obiasoanya, K. M., Ilodibe, E. C., & Ouattara, C. A. T. (2023). A comprehensive overview of artificial intelligence and machine learning in education pedagogy: 21 Years (2000–2021) of research indexed in the scopus database. *Social Sciences & Humanities Open*, *8*(1), 2590-2911. https://doi.org/10.1016/j.ssaho.2023.100655

Neumann, M., Rauschenberger, M., & Schön, E. M. (2023). "We Need To Talk About ChatGPT": The Future of AI and Higher Education. 2023 IEEE/ACM 5th International Workshop on Software Engineering Education for the Next Generation (SEENG). https://doi.org/10.25968/opus-2467

Palomares, I., Martínez-Cámara, E., Montes, R., García-Moral, P., Chiachio, M., Chiachio, J., ... & Herrera, F. (2021). A panoramic view and swot analysis of artificial intelligence for achieving the sustainable development goals by 2030: progress and prospects. *Applied Intelligence*, *51*, 6497-6527. http://dx.doi.org/10.1007/s10489-021-02264-y

Rainie, L., & Anderson, J. (2017, May 3). The future of jobs and jobs training. Pew Research Center. https://www.pewresearch.org/internet/2017/05/03/the-future-of-jobs-and-jobs-training/

Rasul, T., Nair, S., Kalendra, D., Robin, M., de Oliveira Santini, F., Ladeira, W. J., ... & Heathcote, L. (2023). The role of ChatGPT in higher education: Benefits, challenges, and future research directions. *Journal of Applied Learning and Teaching*, *6*(1). https://doi.org/10.37074/jalt.2023.6.1.29

Ray, P. P. (2023). ChatGPT: A comprehensive review on background, applications, key challenges, bias, ethics, limitations and future scope. *Internet of Things and Cyber-Physical Systems, 3,* 121-154*.* http://dx.doi.org/10.1016/j.iotcps.2023.04.003

Rudolph, J., Tan, S., & Tan, S. (2023). ChatGPT: Bullshit spewer or the end of traditional assessments in higher education? *Journal of Applied Learning and Teaching*, *6*(1). https://doi.org/10.37074/jalt.2023.6.1.9

Ruslan, Q. (2023, August 21). *A comprehensive comparison of CHATGPT, Bard, and claude: Unlocking the power of Ai Language models.* Medium. https://medium.com/@qzgufran/a-comprehensive-comparison-of-chatgpt-bard-and-claude-unlocking-the-power-of-ai-language-models-bde9ec700a

Shimizu, I., Kasai, H., Shikino, K., Araki, N., Takahashi, Z., Onodera, M., Kimura, Y., Tsukamoto, T., Yamauchi, K., Asahina, M., Ito, S., & Kawakami, E. (2023). Developing Medical Education Curriculum Reform Strategies to Address the Impact of Generative AI: Qualitative Study. *JMIR Medical Education*, *9*, e53466. https://doi.org/10.2196/53466

Singh, H., Tayarani-Najaran, M. H., & Yaqoob, M. (2023). Exploring Computer Science Students' Perception of ChatGPT in Higher Education: A Descriptive and Correlation Study. Education Sciences, 13(9), 924. https://doi.org/10.3390/educsci13090924

Strzelecki, A. (2023). To use or not to use ChatGPT in higher education? A study of students' acceptance and use of technology. *Interactive Learning Environments*, 1-14. http://dx.doi.org/10.1080/10494820.2023.2209881

Sullivan, M., Kelly, A., & McLaughlan, P. (2023). ChatGPT in higher education: Considerations for academic integrity and student learning. *Journal of Applied Learning and Teaching*, *6*(1). https://doi.org/10.37074/jalt.2023.6.1.17

Walters, W. H., & Wilder, E. I. (2023). Fabrication and errors in the bibliographic citations generated by ChatGPT. *Scientific Reports*, *13*(1), 14045. https://doi.org/10.1038/s41598-023-41032-5

Webb, M. E., Fluck, A., Magenheim, J., Malyn-Smith, J., Waters, J., Deschênes, M., & Zagami, J. (2021). Machine learning for human learners: opportunities, issues, tensions and threats. *Educational Technology Research and Development*, *69*, 2109-2130. https://doi.org/10.1108/14676370310455332

Zhou, C., Li, Q., Li, C., Yu, J., Liu, Y., Wang, G., Zhang K., Ji, C., Yan, Q., He, L., Peng, H., Li, J., Wu, J., Liu, Z., Xie, P., Xiong, C., Pei, J., Yu, P. S., & Sun, L. (2023). A comprehensive survey on pretrained foundation models: A history from BERT to ChatGPT. *arXiv.org, arXiv:2302.09419*. https://arxiv.org/pdf/2302.09419