AMERICAN SOCIETY FOR MICROBIOLOGY | JMBE Journal of Microbiology & Biology Education

Curriculum

Beyond boundaries: exploring a generative artificial intelligence assignment in graduate, online science courses

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ABSTRACT Generative artificial intelligence (GAI) offers increased accessibility and personalized learning, though the potential for inaccuracies, biases, and unethical use is concerning. We present a newly developed research paper assignment that required students to utilize GAI. The assignment was implemented within three online, asynchronous graduate courses for medical laboratory sciences. Student learning was assessed using a rubric, which rated students' effective integration and evaluation of GAI-generated content against peer-reviewed research articles, thus demonstrating their critical thinking and synthesis skills, among other metrics. Overall rubric scores were high, suggesting that learning outcomes were met. After field testing, we administered a 16-item survey about GAI utilization, contribution to learning, and ethical concerns. Data (n = 32) were analyzed, and free-response answers were thematically coded. While 93.8% of respondents found the GAI-generated content to be "very good" or "excellent," 28.1% found inaccuracies, and 68.8% "strongly agreed" or "agreed" that GAI should be allowed to be used as a tool to complete academic assignments. Interestingly, however, only 28.1% "strongly agreed" or "agreed" that GAI may be used for assignments if not explicitly authorized by the instructor. Though GAI allowed for more efficient completion of the project and better understanding of the topic, students noted concerns about academic integrity and the lack of citations in GAI responses. The assignment can easily be modified for different learning preferences and course environments. Raising awareness among students and faculty about the ethical use and limitations of GAI is crucial in today's evolving pedagogical landscape.

KEYWORDS generative artificial intelligence, graduate courses, assignment, online education, health professional education

The rapid development of generative artificial intelligence (GAI) has caught many in the higher education community off guard, as it offers disruptive potential. GAI, a form of machine learning, uses patterns from extensive training data to create new content that can span several modalities, such as text, images, or music (1). Companies, such as OpenAI, claim that training data primarily consist of publicly available information from the internet, licensed third party information, and information that users and human trainers provide (2).

The widespread adoption of GAI in education has sparked much deliberation about its risks and rewards. GAI offers substantial advantages to educators by automating tasks such as generating multiple choice questions, grading essays, and summarizing student feedback (3). Advocates emphasize its potential to enhance accessibility, provide personalized feedback, and explain complex concepts benefiting students with learning disabilities or language barriers (1, 4–6). Personalizing the educational experience empowers students to learn at their own pace, adapt content delivery to accommodate diverse learning preferences, and access extensive information quickly, thus improving their efficiency and studying skills (1, 4, 7, 8).

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The authors declare no conflict of interest.

Received 24 July 2024
Accepted 13 October 2024
Published 4 November 2024

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However, these benefits do not come without concerns. First, while the responses may seem legitimate, one of the limitations of GAI models is that content is plausible sounding but may be incorrect and is termed hallucinations due to their lack of grounding in factual truth training (1, 9). Addressing these issues is challenging because a more cautious model would be unable to answer certain questions (9). Despite appearing knowledgeable and coherent, GAI lacks comprehension or knowledge of the content it produces, and its outputs may infringe upon intellectual property (10). Additionally, GAI may perpetuate biases present in its developers or training data sets (11), exacerbating systemic discrimination and the legitimization of biases. There are also serious misuse concerns, including using GAI for fraudulently claiming the work as one's own—a concern that many educators are currently grappling with. Students may be motivated to overuse GAI to quickly complete assignments without having to do any critical thinking, collaboration, or problem solving of their own, detracting from their own development (1, 4, 7, 8, 12). The underlying algorithms may also limit the diversity of opinions if certain information or responses are more likely to be returned to users (7, 8).

While integration of GAI into academic assignments is becoming an area of growing interest, research is only emerging on students' perceptions of GAI utilization, with scarcity of widely shared assessments using GAI that may serve as benchmarks for others (1, 13, 14). Although there is no consensus on acceptable usage, student and educator input is vital in paving the way forward for responsible utilization of GAI in the context of education. Thus, we present the development of an assignment leveraging GAI. Following its initial implementation in three 15-week online asynchronous graduate courses, we conducted a survey to explore the utilization and student perceptions of GAI tools to better inform future use of GAI in assessments. Briefly, the assignment required students to (i) utilize GAI to research an assigned condition/disease and (ii) verify or refute GAI-generated content using scientifically supported resources. The assignment was revised from a previous assignment utilized in earlier iterations of the same courses in which students were only required to conduct research on an assigned condition/disease without using GAI. Given that the conditions/diseases are well-documented in the literature, it was suspected that it would not be particularly challenging for graduate-level students to complete the assignment and that they also may use GAI to complete it if unauthorized. Therefore, the purpose of the revised assignment presented here was to allow students to learn about their assigned condition/disease as well as the capabilities and limitations of GAI by requiring them to verify and refute the content generated by GAI with scientifically validated research.

Intended audience and prerequisite student knowledge

This assignment is designed primarily for graduate students enrolled in online, asynchronous medical laboratory science programs whose learning objectives include the ability to collect, evaluate, and synthesize knowledge from existing scientific research. Aligned with the American Society for Clinical Pathology (ASCP) examination guidelines for medical laboratory scientists, students are taught about diseases and other conditions of the human body in these courses and must have sufficient knowledge of the course material to understand the learning objectives and assignment prompt (15). However, no prior working knowledge of GAI or specific GAI platforms is required. The prerequisite technology skills expected of the students is familiarity with the use of word-processing applications and the ability to access peer-reviewed literature.

Learning time

Students are not timed during this assignment and are allowed 7 days to complete this take home assignment. However, we estimate that most students will complete this assignment within 4–6 h. The follow-up survey was estimated to take an additional 15 min to complete.

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Learning objectives

Upon completion of this activity, students will be able to:

1. Utilize generative AI (GAI) to conduct research about an assigned condition/disease.
2. Verify or refute content from GAI using scientifically backed resources.
3. Present information about a current clinical trial for their assigned disease/condition.

This assignment complements the associated content lectures and other activities the students were engaged in during the coursework.

PROCEDURE

Materials

The required material for this assignment was access to a laptop or computer, the internet, and Microsoft Office or another similar application. In addition, since we expected students to effectively use primary literature, it necessitated electronic access to the university library, which is available freely to all students. The assignment instructions (Appendix I), written assignment grading rubric (Appendix IIA), presentation grading rubric (Appendix IIB), and follow-up survey questions (Appendix III) can be found in the supplemental material. GAI platforms are publicly available for use online with free registration.

Student instructions

Students will use this activity to learn about the capabilities and limitations of GAI in two different contexts: to conduct research on an existing, well-documented condition and to verify or refute the content provided by GAI through scientifically validated research. To address the learning outcomes, students were assigned a disease or condition and asked to use GAI to investigate various aspects of the condition. Students were allowed to choose any GAI program of their choice and told to prompt GAI to limit the response for each question to one page if the responses were too long.

After compiling the GAI-generated content in a document, understanding that GAI-generated content can be incorrect, misleading, or even biased, the students were asked to verify or refute its accuracy using scientifically backed resources and annotate the GAI-generated content. Students were asked to highlight peer-reviewed articles that corroborated or were different from the GAI-generated content. Upon completion of the written assignment, recognizing the limitations of GAI in keeping pace with molecular advances, students were asked to present a summary of a recent or ongoing clinical research study focused on their assigned disease/condition through VoiceThread. VoiceThread is an online platform that allows students to upload multimedia presentations and receive feedback from their instructors and peers.

Faculty instructions

Each student was assigned a disease for the assignment, but faculty could encourage students to identify and work on diseases of their interest to promote greater student agency. We recommend that the faculty plan to assign this activity toward the end of the course, when students have sufficient understanding of the content to be suspicious of significant errors or inconsistencies in GAI responses. Specific research prompts should be chosen that are relevant to the course content: for example, microbiology students should focus research on microbial illness, while genetics students would benefit most from research prompts about genetic conditions. Since our online courses have estimated workload requirements, the faculty should reduce additional assignments while conducting this activity. In addition, we provided students with a brief sample of what verifying the content would entail by including in the instruction the responses we

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got from GAI for a disease and how we verified the information. Figure 1 is an example of how a student addressed learning objective 2 and can also be used by faculty as instructions for students to complete part of the assignment.

Suggestions for determining student learning

We developed a grading rubric to determine if students met the desired learning objectives. Student learning was assessed using a rubric, which rated their effective integration and evaluation of GAI-generated content against peer-reviewed research articles, thus demonstrating their critical thinking and synthesis skills, among other metrics. Students were also provided written feedback on their submission by the faculty.

Sample data

Sample data are provided in the "Evidence of student learning" section of the discussion. An example of a student response to the assignment showing student confirmation/dispute of the GAI-generated content is provided in Fig. 1.

Safety issues

There are no safety issues associated with this assignment as students completed the assignment in their personal learning environment. Institutional Review Board approval was received under GW IRB #NCR235428.

DISCUSSION

Field testing

We conducted this activity with 49 students, all of whom were enrolled in one to three asynchronous, online graduate science courses in the Spring and Summer 2024 semesters. There are no specific prerequisites for these courses, and typically students enroll in these courses in their first or second semester in the program of study. Following completion of the assignment, students were asked to reflect on their

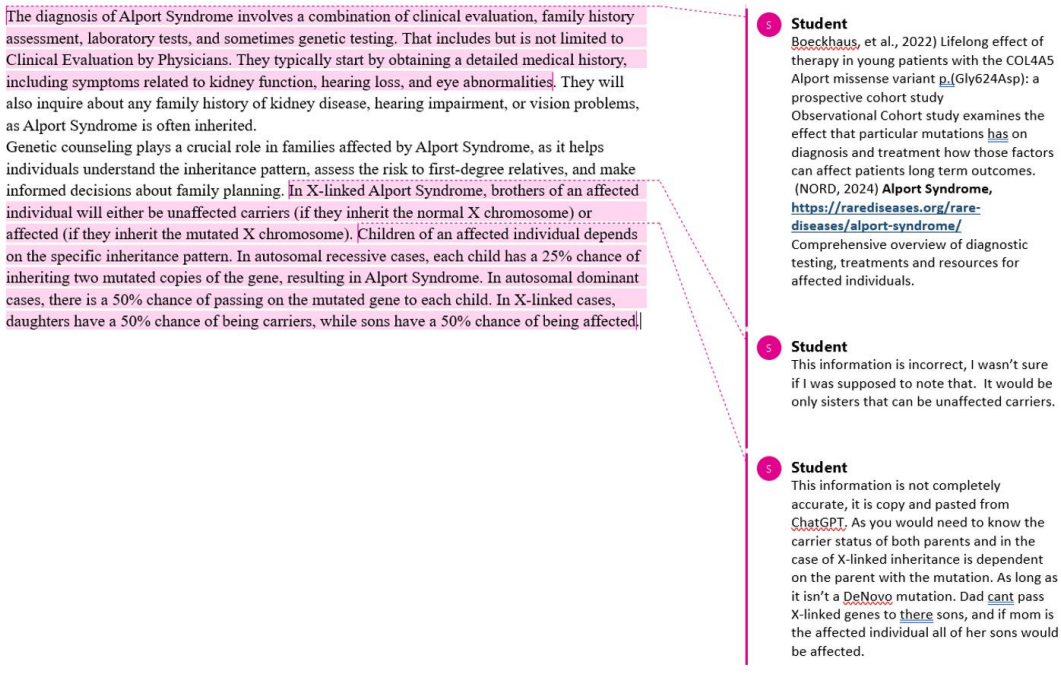


FIG 1 An example of a student response to the assignment explaining their review of the GAI-generated content.

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TABLE 1 Age stratification of participants

Age range (yrs)	No. of participants
19–25	5
26–30	11
31–35	3
36+	13

experience and complete a 15-min survey in Qualtrics (GW IRB #NCR235428) about the perceived impact of the assignment and use of GAI on their learning, as well as their opinions of GAI use in similar academic settings. Students were informed of the opportunity to participate in the study through an announcement posted in the Learning Management System Blackboard. Participation was voluntary, with students being provided two bonus points in their final exams upon completion of the survey. Study responses were anonymized, with only age collected for demographic stratification during the survey (Table 1). Thirty-two (32) unique students participated in this survey, with 24 of those 32 submitting additional answers to free-response questions. Since multiple students were enrolled in more than one course offering this assignment, they were allowed to submit only one survey response.

Student perceptions of the assignment were determined through analysis of survey responses. After responses were recorded, response data were stratified by age, and Likert-type items were analyzed with descriptive statistics. Free-response answers were initially reviewed and coded for meaning, then reviewed in an iterative process among study researchers to ensure common understanding. Coded results were then calculated as proportions of total respondents to calculate basic statistics. Incomplete data were excluded from the analysis.

A majority (62.5%) of students did not have any prior familiarity with GAI, and the most commonly used GAI platform was ChatGPT (81.3%), followed by Microsoft Copilot (9.4%). While 65.6% agreed that their understanding of the assigned disease was enhanced due to the assignment, only 37.5% stated that the quality of their submission was improved by GAI use. In addition, 78.1% of students agreed or strongly

TABLE 2 Select free-response quotes from students

Question	Response
In what way do you believe the use of GAI in this assignment may impact your future study habits?	GAI or general artificial intelligence is a useful tool for providing guidance to students in answering their assignment questions. However, it is important to remember that GAI should only be relied upon as one source of information. The reproducibility of information and sources cannot be guaranteed as it is highly dependent on the prompts given to the GAI. It is recommended that students verify the information provided by GAI with other sources and critically evaluate the accuracy and reliability of the information before incorporating it into their assignments.
	I may utilize the information to formulate background on the topic and gain a better understanding of where to direct my research.
	It will have no impact on study habits. I am old school and I don't trust GAI.
What, if any, ethical concerns do you believe arise from using GAI for this type of an assignment?	I think that use of GAI has the potential to perpetuate plagiarism and false information, especially if the content is not verified or checked. The verification of source content takes the most time anyway.
	None of the information GAI provided to me had citations/credit to the authors who published the information it provided. It required additional work to find peer reviewed documents to confirm the information it provided and provide due credit to the authors who worked hard on the material.
	I do not feel there were any ethical concerns, especially since the information had to be "fact checked."
Please provide any additional feedback you may have regarding the assignment, including how it may be improved.	I had trouble at first knowing exactly what to do, as I thought I was going to have to use the information to write a paper, but I feel that was from my own bias from my previous experiences as I have never had an assignment like this. I think the example helped the most, I think that is when I understood more of what the assignment was looking for. I would say to use a variety of examples to show as it would probably be new for most people?
	I really liked the assignment overall. I think it could be a good idea to have students prepare a reflection with specific examples of their experience (errors they found, etc.).

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agreed that the use of GAI saved them time in completing their assignment. Only 6.3% reported significant challenges with GAI during the assignment. Overall perceptions of GAI-provided information were positive, with 93.7% of students describing the quality of information as excellent or very good. When asked how they would feel about defending the content generated by GAI, most students responded that they would feel somewhat confident (71.9%) or very confident (15.6%). While 68.8% agreed that GAI should be allowed as a tool to complete academic assignments, only 28.1% of students agreed that GAI is permissible to use for open-book academic assignments without explicit authorization from their instructor.

Free-response results showed that students shared several perceptions about generative AI. When asked how the use of GAI in this assignment may impact study habits, of the 28 students who responded to the free-response questions, five students each responded favorably that GAI is helpful, that it saved time or increased bandwidth for related work, that it could facilitate basic understanding, and that it could provide a general direction for further research. Four students each mentioned GAI convenience and the need to verify information. Interestingly, four students stated that they did not trust GAI citing similar concerns about GAI use, including the risk of plagiarism/academic dishonesty and difficulty citing findings from GAI responses. Of the 24 students who provided feedback about the assignment itself, eight stated that they would like clearer instructions, and six stated that they found the experiment interesting and/or enjoyable. As shown in Table 2, students had varied opinions about the accuracy of GAI responses and the appropriateness of GAI use for academic research assignments without explicit faculty permission.

Evidence of student learning

Forty-nine (49) enrolled students across the three courses completed the written assignment. Of those, student scores ranged from 65 to 100, with an average score of 97.3%. All 49 students completed the VoiceThread presentation assignment, with scores ranging from 80 to 100 (average score 99.4%). The most common reasons students lost points were for deficiencies in the performance measures to "adhere to APA format, use proper grammar and cite sources" (10.2%) and to "effectively integrate findings from peer-reviewed articles into analysis of the disease, demonstrating critical thinking and synthesis skills" (8.16%). The means and standard deviations of the rubric rating scales aligned with the learning objectives are provided in Table 3.

TABLE 3 Means and standard deviations of student performance by learning objective

Learning objective	Assessment measure	Mean score (%)	Standard deviation (%)
Utilize generative AI (GAI) to conduct research about an assigned condition/disease.	Rubric item: What is the disorder?	100.0	0.0
	Rubric item: What is the molecular/genetic basis of the disorder?	99.5	3.5
	Rubric item: How is the disorder diagnosed?	100.0	0.0
	Rubric item: Effectively integrate findings from peer-reviewed articles into analysis of the disease, demonstrating critical thinking and synthesis skills.	97.5	9.1
Verify content from GAI using scientifically backed resources.	Rubric item: Find and summarize the purpose and key take-away of a minimum of five peer-reviewed articles published after 2021 that confirm the content generated by GAI.	96.5	14.3
	Rubric item: APA format, grammar, and citations	96.0	13.7
Present information about a current clinical trial for their assigned disease/condition.	VoiceThread Presentation Grade	99.4	4.9

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Possible modifications

Several modifications are possible for future iterations of this assignment. This assignment could be used for in-person as well as online, synchronous courses by narrowing the scope of the assignment and scaffolding it to integrate GAI-assisted research into individual or small group presentations on assigned topics during class sessions. For different courses, the research question being asked can be altered so that it is tailored to specific content. For traditional undergraduates already familiar with academic research, utilizing specific GAI prompts closely aligned with their coursework might be a useful strategy. For microbiology students, the content might be related to infections and diseases, while a psychology student may explore various mental health conditions. For learners with less familiarity with academic databases, providing tutorials and guides that outline how to access and use the resources will make the process more accessible. This assignment can also be used as role-playing scenarios where students can act as researchers, clinicians, or GAI content developers to discuss their findings. In addition, to accommodate various learner preferences, this assignment can be submitted in multiple formats including presentations. While it is not necessary for future implementers of this activity to disseminate a follow-up survey like the one used in our field testing, students may benefit from an additional prompt to process and reflect on their experience leveraging GAI to conduct research for the assignment.

ACKNOWLEDGMENTS

This work was not funded.

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ETHICS APPROVAL

This study was approved by the GW Ethics Committee under IRB #NCR235428.

ADDITIONAL FILES

The following material is available online.

Supplemental Material

Student instructions (jmbe00127-24-s0001.docx). Student instructions for the assignment.
Student survey (jmbe00127-24-s0002.docx). Survey questions for students.
Grading rubric (jmbe00127-24-s0003.docx). Assignment grading rubric.

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Presentation rubric (jmbe00127-24-s0004.docx). Presentation grading rubric.

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