Issues Posed by Generative AI for Teaching and Learning

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Introduction

As you ponder the possibilities of generative AI in your specific teaching context, both for good and ill, there are many matters to reflect on and address, including the following: course policies regarding the use of generative AI; the legal and ethical appropriateness of using generative AI for teaching and learning; the accuracy of the content and views expressed by generative AI; and the pedagogy of using generative AI.

Below you will find seven important issues or considerations for each of us to keep in mind in our teaching as we respond to generative AI:

1. Course policies - student use of AI
2. Plagiarism detection
3. FERPA, privacy, and choice
4. Accuracy and biases of output
5. Reinvigoration of your teaching and students' learning
6. Cultivation and growth of 21st century skills
7. Effective prompting through prompt engineering

Issue #1: Course Policies - Student Use of AI

Summary

Many have said artificial intelligence will disrupt many aspects of society. With generative AI, these disruptions may extend to our ideas and assumptions on academic integrity Whatever expectations or policies regarding the use of generative AI a faculty member ultimately adopts and uses in teaching a course, students should come to receive and understand them clearly and early in the course, through explicit syllabus statements and discussions in class. Instructors may like to consider inviting students to contribute to the formulation of these expectations and policies.

Academic Integrity and Policies

One of the most dominant concerns regarding generative AI is its effects on academic integrity. With tools like ChatGPT able to compose meaningful and clear work that students can submit as their own, many may wonder and worry about whether generative AI may account for much of the content appearing in submissions. A recent survey indicates that most institutions and departments have not yet developed guidelines and policies regarding when and how students can use generative AI, if at all (Surovell, 2023). Given the widespread lack of institutional guidance, faculty members have faced the task of articulating and describing their own policies.

As per the Standard of Conduct, the University of Missouri System has decided to leave to each individual faculty member or their departments the decision of whether students can use generative AI in their coursework. The default policy is that if an instructor does not explicitly allow the use of generative AI, it is forbidden. With this policy, the University of Missouri System has decided that each individual instructor is best equipped to judge and decide what role generative AI should play in students' learning, if any.

Consider your own teaching context: What policies involving generative AI would ensure students achieve the set learning outcomes and objectives and build 21st century skills, such as creativity and communication (Vivekanandan, 2019), while still being realistic and offering opportunities for students to learn new technologies?

Whatever policy is adopted, a faculty member may like to at least integrate the following two processes into the instruction. These processes will give students explicit guidelines regarding the use of generative AI in their studies:

- **Syllabus statements:** The syllabus for a class should include a section discussing generative AI and indicate any standards or guidelines for both appropriate and inappropriate use thereof. This section should clearly define the border between the two to ensure students understand what the instructor expects. It is essential to identify and describe the contexts (when, where, how, why, and for what) students can use generative AI in the course.
- **A discussion early in the course:** In addition to developing a syllabus statement, instructors should engage students in a conversation about generative AI. Rather than lecturing them, invite them to share how they could most effectively use generative AI while maintaining responsibility for and actively participating in their learning.

Something that you may like to do is use the discussion with students to generate the syllabus statement. In other words, you could collaborate with students in each course you teach to develop the expectations and policies surrounding the use of generative AI. Involving students in the process of determining these policies (and perhaps others in the course) "fosters student ownership in the classroom and responsibility among the students for their behaviors" (Nollmeyer, 2018).

Sample Syllabus Statements

As you consider your own policy to include in your syllabus, please rest assured: Various syllabus statements about generative AI have come to exist and become publicly available across higher education (Texas A&M University Center for Teaching Excellence). These syllabus statements, which individual faculty members have developed in the absence of institutional mandates, range from the absolute restriction of generative AI to the enthusiastic embrace of it.

No Use Permitted Whatsoever

- "Intellectual honesty is vital to an academic community and for my fair evaluation of your work. All work submitted in this course must be your own, completed in accordance with the University's academic regulations. You may not engage in unauthorized collaboration or make use of ChatGPT or other AI composition software" (Princeton University).
- "Since writing, analytical, and critical thinking skills are part of the learning outcomes of this course, all writing assignments should be prepared by the student. Developing strong competencies in this area will prepare you for a competitive workplace. Therefore, AI-generated submissions are not permitted and will be treated as plagiarism" (The University of Iowa).

Use Permitted under Certain Circumstances and in Certain Contexts

- "We recognize that there are a variety of AI programs available to assist writers. AI programs are not a replacement for human creativity, originality, and critical thinking. Writing is a craft that you must develop over time to develop your own individual voice as a writer. However, within limited circumstances, and with proper attribution, AI programs may be used as a tool" (Bryant University).
- "There are situations and contexts within this course where you will be asked to use AI tools to explore how they can be used. Outside of those circumstances, you are discouraged from using AI tools to generate content (text, video, audio, images) that will end up in any student work (assignments, activities, responses, etc) that is part of your evaluation in this course. Any student work submitted using AI tools should clearly indicate what work is the student's work and what part is generated by the AI. In such cases, no more than 25% of the student work should be generated by AI. If any part of this is confusing or uncertain, please reach out to me for a conversation before submitting your work" (University of Colorado).

Broader Use Accepted within Certain Guidelines

- "AI is allowed with attribution: Use of AI tools, including ChatGPT, is permitted in this course for students who wish to use them. To adhere to our scholarly values, students must cite any AI-generated material that informed their work (this includes in-text citations and/or use of quotations, and in your reference list). Using an AI tool to generate content without proper attribution qualifies as academic dishonesty" (University of Massachusetts Amherst).
- Use of AI tools, including ChatGPT, is permitted in this course for students who wish to use them. To be consistent with our scholarly values, students must cite any AI-generated material that informed their work and use quotation marks or other appropriate indicators of quoted material when appropriate. Students should indicate how AI tools informed their process and the final product, including how you validated any AI-generated citations, which may be invented by the AI. Assignment guidelines will provide additional guidance as to how these tools might be part of your process for each assessment this semester and how to provide transparency about their use in your work" (The University of Iowa)

You will find further sample syllabus statements from Temple University and the University of Tennessee, Knoxville. For more information about how students could cite generative AI tools, please review this page from the Modern Language Association and this page from the American Psychological Association.

Issue #2: Plagiarism Detection

Summary

One of the more common responses to generative AI so far has been to use detection software. However, such tools present issues and challenges. We may need to reconceptualize and transform our ideas about plagiarism and academic honesty in response to generative AI. Missouri Online offers a sprint, a short asynchronous professional development opportunity for faculty, on academic integrity that considers the causes of cheating and how to prevent it, but here we will primarily consider AI-plagiarism detection software and what it means for learning and teaching.

AI Detection Software

Rather than adopting and implementing clear guidelines for the use of generative AI, faculty members may seek a policy of restricting and forbidding its use. In addition, they may resort to AI detection software (Caren, 2023). While these tools may offer a seemingly convenient solution to the question of academic integrity in this new age, they also present issues:

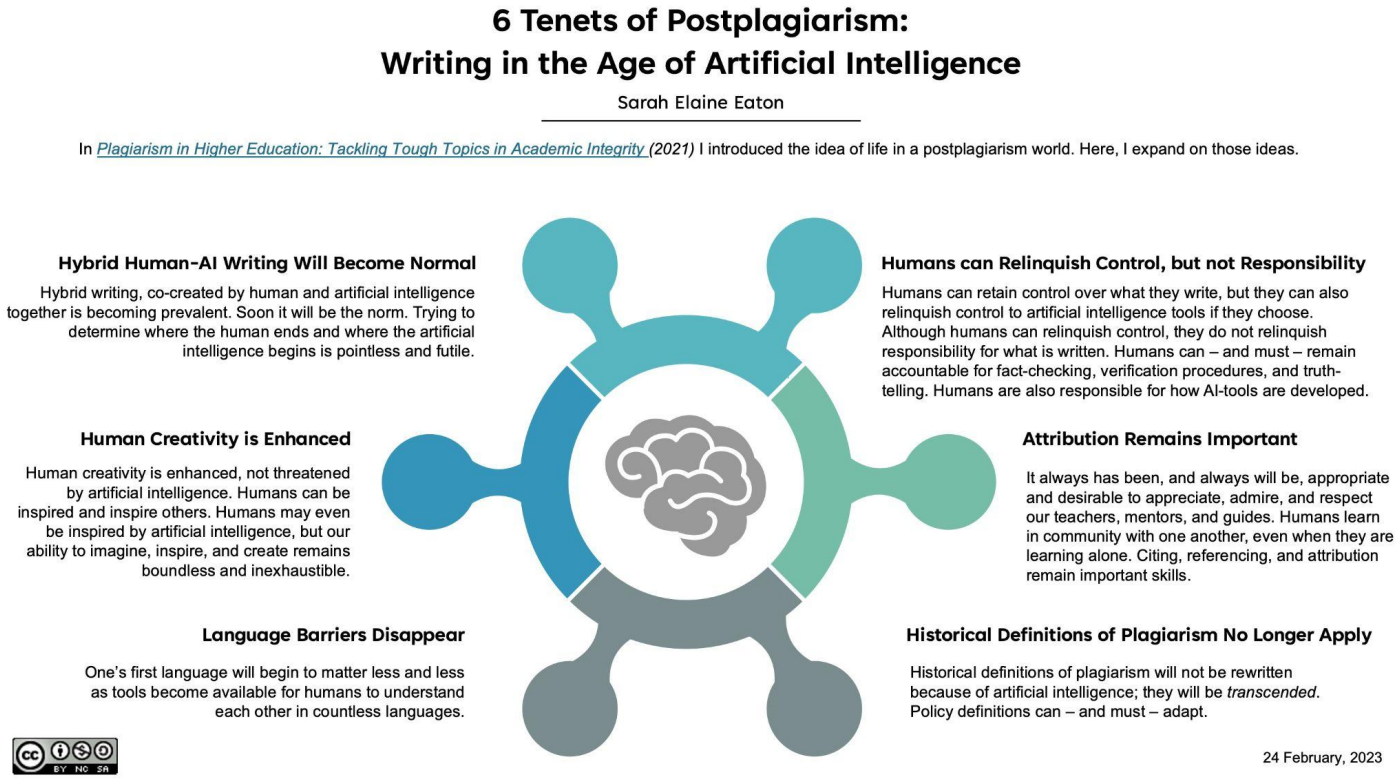
- Such solutions may identify false positives, wrongly imperiling some students' academic studies (Fowler, 2023).
- The formulaic writing style of non-native writers as they develop CALP, cognitive academic language proficiency, may resemble the writing style of generative AI, leading to further false positives (Liang et al., 2023).
- "New AI language models are more powerful and better at generating even more fluent language, which quickly makes our existing detection tool kit outdated" (Heikkilä, 2023).

You may learn more about issues with AI detectors here. Given all this, "there is little actual scientific evidence to show that AI-generated text can be effectively detected" (Eaton, 2023). With the advent of generative AI and the problems with detecting it, we must perhaps evolve and change our ideas of what constitutes academic integrity and plagiarism.

For a long time, academic integrity involved writing original content and citing any other sources used. The expectation with academic writing has been to respect and acknowledge the work of others as distinct while also presenting one's own insights and conclusions. In other words, academic integrity has generally involved treating ideas with an individualistic attitude: They are the property of a single individual or group of individuals.

Reconsidering Plagiarism and Academic Honesty

This definition of academic integrity becomes more problematic once one encounters the chimera that is a student's work produced with assistance and contributions from generative AI. With the power of generative AI, Eaton (2023) describes the possibility of academia needing to transition into a postplagiarism world. Below you will find an infographic she produced to describe the six characteristics of a postplagiarism world.



Please view the above image in higher resolution here.

As provocative as the idea of a postplagiarism world may seem, it remains clear that we must adjust our approach to and provide more clarification about academic integrity. Students are likely more confused than we are about these expectations, in which the slightest and most innocuous use of generative AI (to revise and edit a draft written entirely by the student) could constitute academic misconduct. The conversation needs to change.

Supporting Students in This Brave New World

"We argue that it is time to shift this narrative in favor of one highlighting a distributed accountability when it comes to academic misconduct—that is, leaders,

administrators, educators, and students are to share the responsibility. Educational bodies and institutions should therefore allocate adequate resources to support staff and students deal effectively with Generative AI-related challenges and optimize opportunities presented by its tools" (Lim et al., 2023, p. 9).

Regardless of one's own response to Eaton's six tenets (2023) and the concept of "distributed accountability" proposed by Lim et al. (2023), it is clear we must all anticipate and respond to the use of generative AI by our students. Whether we approve or disapprove of any use of generative AI and whether we plan to use detection software or not, we must communicate to our students our expectations and policies.

Scenario

Students have submitted their final research essays for the semester in a course on the economics of globalization. This essay, in which they must present and analyze a positive or negative economic effect of globalization, is one that many students decide to ask ChatGPT to outline for them, Grammarly to proofread for them, and Quillbot to refine for them. However, students still have conducted all the research and thoroughly engaged with the content. Once these students submit their work, you receive an alert that their work has been identified as possibly being generated by AI. How do you respond to this information? If you learned of the process they used, would you consider their work plagiarized or not, and why would you take such a position?

1. **Red light (unacceptable):** It is clear students have offloaded much of the "thinking" for this assignment to generative AI. Therefore, the work they have submitted does not meet your standards and expectations for their learning.
2. **Yellow light (uncertain/ambiguous):** While you do not mind the use of generative AI for stages later in the writing process (revision and editing, for example), you believe students should still take ownership of and be responsible for higher-order considerations in their work (content and ideas, for example). Therefore, you may like to discuss with them appropriate use cases and inappropriate use cases with generative AI.
3. **Green light (acceptable):** Students are still "learning" in your eyes: They are engaging with the content and receiving guidance and feedback from a partner in the writing process. Though generative AI may play a role in the workflow of students, it is clear they are still achieving the learning outcomes.

Issue #3: FERPA, Privacy, and Choice

Summary

Though such new technologies as ChatGPT and Claude could play a role in the workflow of both students and the instructor, it is important to keep the law in mind. One specific matter is ensuring that the work of students is not shared with third parties without their consent. As per the Family Educational Rights and Privacy Act, parties without a legitimate academic interest should not receive access to students' academic records without approval. Therefore, instructors *should not*:

1. Require students to use third-party generative AI tools.
2. Upload or copy and paste the work of students into generative AI tools without consent from each individual student.

If you give students the option to use generative AI as part of their learning, please also design your instruction such that students who decline to use such services can enjoy and benefit from a comparable learning experience.

Background and Context

Under FERPA, or the Family Educational Rights and Privacy Act, educational institutions receiving federal funding must ensure the privacy of students' academic records. Such institutions of learning "must have written permission from the...eligible student in order to release any information from a student's education record" (U.S. Department of Education, n.d.). It is possible that requiring students to use ChatGPT may share academic records and other PII, or personal identifying information, with OpenAI and its third-party vendors. The same may also hold true for other generative AI applications. Unless the user has disabled chat history with the service (OpenAI, 2023), any information shared with ChatGPT will contribute to its evolving LLM (large language model), the corpus of text that it uses to generate responses to human prompts. "What we do know is that any information shared with ChatGPT or other OpenAI programs in an educational setting can then be shared by that program elsewhere" (Turner, 2023).

Principles to Keep in Mind

In light of the legal requirements of FERPA and the uncertainty surrounding precisely what happens with the data shared with OpenAI or other companies, there are two fundamental principles to keep in mind:

- **Faculty should refrain from mandating that students use generative AI for an activity or assignment.** While you can certainly allow and invite students to use generative AI in your directions, you should not require students to use

these services, nor should you penalize them for declining to do so. In addition, you should clearly communicate to and discuss with students the inherent privacy risks associated with using these tools for learning purposes.

- **Faculty should avoid using any content from, or discussing any specific concerns about or communications with, students with generative AI without the students' explicit consent.** It is also important for faculty to remain mindful of and abide by FERPA while using generative AI for teaching purposes. After all, research has found educators use ChatGPT more than students do (The Walton Family Foundation, 2023). Faculty may turn to generative AI for a variety of purposes: to give feedback on the results section of a Master's thesis, to compose an email response to an undergraduate student asking for an extension on assignment due to a family emergency, and more. In these situations, **by copying and pasting students' work or communication with you into a separate generative AI tool, you are violating FERPA**: You are disclosing students' academic records and/or PII to a third party to which the student did not consent. It is essential that instructors refrain from importing students' work or communication into generative AI, from using third-party generative AI tools to analyze and give feedback on students' work, and from sharing academic records and/or PII about students to expedite their workflow.

Ensuring Equity and Student Choice

For students who decline to use generative AI for one reason or another, instructors should ensure equity and universal design in the learning experience. In other words, if students using tools like ChatGPT or Google Bard would receive a considerable academic advantage from using generative AI, it is essential you craft and integrate avenues for other students to enjoy similar opportunities. For example, you could teach an art history course and direct students to use DALL-E to produce artificially generated artwork and then share them in a discussion forum to review and discuss the characteristics and hallmarks of various movements, such as Impressionism or Cubism. In this event, you must offer students a similarly effective avenue for reviewing the schools virtually, such as by downloading and sharing images from elsewhere.

If you are to ask students to use generative AI as part of their learning, please also consider the pricing associated with some of the services. For example, only the paid version of ChatGPT uses the most recent model of GPT, GPT-4, while the free version uses an older version. Though the paid version may offer access to a more robust and powerful LLM, it costs twenty dollars a month, something that can come to constitute a considerable expense for students. Given rising concerns about the

affordability of a college education, you are advised to refrain from mandating the use of paid tools.

Please also note that faculty are advised and encouraged to only ask students to use the technology tools vetted and approved by the University of Missouri System for learning and teaching purposes. Should you mandate that students make use of another application or service that has not received approval, you accept the risks and potential liability in the event of a data breach or similar event. With Simplified Tuition, you may not be able to require students to purchase unauthorized software.

Scenario

You teach an introductory computer science course and have directed students to ask ChatGPT to generate the HTML code needed to create, maintain, and update a professional portfolio, which will serve as the final assignment. Students will then analyze, critique, and update the code produced before building their own HTML portfolio. A student privately messages you her concerns about using this service: Uncertain what ChatGPT does with the data she shares, she worries about the risks.

How do you respond to these concerns she has raised? Should you inform her she is exaggerating the privacy and safety risks of using ChatGPT and expect her to proceed to use the service? Should you acknowledge her reservations and offer an alternative activity? What should you do?

Issue #4: Accuracy and Biases of Output

Summary

Though many of us may treat and view generative AI as an "expert" due to the datasets on which it has been trained, it is not: The internet, which often serves as the source of much if not all of a tool's LLM, is not intrinsically an expert on any topic, as we all know. Generative AI can only generate content based on patterns it has detected, and it cannot appraise or determine the accuracy or social impact of what it creates. Only humans are capable of fully assessing the quality of material and of empathizing with others. Only we can understand. Therefore, in integrating and using generative AI as part of students' learning and workflow, you should take the time to encourage and scaffold for students the critical engagement and use of these tools. There are two fundamental and necessary components of such critical engagement and use:

1. AI literacy skills, which includes prompt engineering
2. Social awareness and engagement (to identify biases and prejudices toward various groups)

The latter concern does not receive much attention in discussions about teaching students to use generative AI. However, developing this awareness will enable students to not only more effectively and comprehensively assess and judge the output of generative AI but will also foster and invite the development of empathy, something currently in decline (American Psychological Association, 2019) but increasingly needed in our complex and dynamic society.

Accuracy of Output

Generative AI can create text based on what it has learned through its large language model. However, as the case study above demonstrates, it cannot assess the accuracy, validity, and truthfulness of the content it produces. As ChatGPT itself observed in discussing what generative AI cannot do, it cannot:

- Guarantee complete accuracy and reliability in generated content.
- Distinguish between real and generated content in all cases.

Generative AI merely uses its LLM to produce text relevant to the prompt from users. Often that output uses correct and true information borrowed from the web. Sometimes, though, that output contains "hallucinations." The Kennesaw State University School of Data Science and Analytics (2023) states, "For the most part, when people talk about an AI hallucination, they mean that a generative AI process has responded to their prompt with what appears to be real, valid content, but which is not." Hiller (2023) found that in response to a prompt about teaching with technology in a science class, ChatGPT produced six citations, five of which were fake. This pattern of numerous false citations likely persists in the work generative AI may produce for students.

Though it is possible that generative AI will improve and gain effectiveness against producing hallucinations, for the time being faculty should teach students AI literacy skills. Key among these is the ability to analyze and critique the output from generative AI for quality, accuracy, and correctness. If students are working on a research project, such as the legal brief assignment described in the scenario below, it is important to ask and remind students to corroborate and check any citations or studies presented by generative AI.

Some argue that because of the possibility of hallucinations, students should not exclusively rely on generative AI for sources and citations for an assignment (Wellborn, 2023). Instead, students should review and check any citations or summaries created by generative AI for accuracy. Though generative AI may provide a basis for the discussion at hand, students should corroborate and expand on it. The technology is rapidly progressing in this area (Tay, 2023).

Biases of Output

Generative AI simply analyzes a prompt and then "parrots" an answer back from its LLM (large language model). "The model (for ChatGPT) was trained using text databases from the internet. This included a whopping 570GB of data obtained from books, webtexts, Wikipedia, articles and other pieces of writing on the internet. To be even more exact, 300 billion words were fed into the system" (Hughes, 2023). If some biased or prejudiced sources are present among the training data and contribute to the construction of the LLM, then those biases or prejudices may appear once again in the output from generative AI.

It is also important to note that not including substantial content from or with certain perspectives or demographic groups in the training data may also produce biased content. Such content "can manifest in a myriad of ways, ranging from gender bias, racial and ethnic bias, socioeconomic bias, cultural bias, content bias, and ideological bias in terms of political, philosophical, and religious perspectives" (Trivedi, 2023, p. 23). Ultimately, generative AI may reinforce and perpetuate social marginalization. The research so far has established two relevant and urgent concerns:

- **Marginalization of conservative perspectives in the viewpoints generated by LLMs:** "Models trained on the internet alone tend to be biased toward less educated, lower income, or conservative points of view. Newer models, on the other hand, further refined through curated human feedback tend to be biased toward more liberal, higher educated, and higher income audiences" (Myers, 2023). For example, the latest GPT model (GPT-4) relies on and uses RLHF (Reinforcement Learning from Human Feedback) (Malhotra, 2023). Because of this, conservatives have voiced and raised concerns about the potential bias displayed in the output of generative AI. ChatGPT has been found to display a "pro-environmental, left-libertarian ideology" (Hartmann et al., 2023). By asking questions related to the political compass test, Rutinowski et al. (2023) reached a similar conclusion: "ChatGPT seems to hold a bias towards progressive views" (p. 1). A study by Santurkar et al. (2023) also determined that the perspectives expressed by LLMs sharply diverged from those held by various demographic groups in the United States.
- **Dated and dangerous stereotypes based on gender and race, especially in images generated by AI:** These concerns about bias also extend to artificially generated images. A Bloomberg analysis (Nicoletti & Bass, 2023) found that Stable Diffusion, an image generator driven by artificial intelligence, placed men with lighter skin tones in higher-paying jobs and women and individuals with darker skin tones in lower-paying or domestic jobs. Social stratification in these images was found to be higher than exists in the data from the Bureau

> of Labor Statistics. In addition, "more than 80% of the images generated for the keyword 'inmate' were of people with darker skin, even though people of color make up less than half of the US prison population, according to the Federal Bureau of Prisons" (Nicoletti & Bass, 2023).

The research has established that generative AI may create content with bias across multiple modalities. Therefore, **faculty should draw students' attention to these issues and invite students to appraise and review generative AI's output for biased viewpoints or inaccurate and harmful stereotypes**. Students should approach the content they receive from generative AI with a critical and socially engaged eye. With conservatives often expressing concerns about their views being marginalized on college campuses and with students becoming more diverse and non-traditional as society changes, it is important for us to treat them all with respect and to acknowledge when generative AI may fail them.

Scenario

You teach an online course on constitutional law for the University of Missouri School of Law. You have asked students to select a clause within a constitutional amendment of their choice, generate a hypothetical legal case, and then compose a corresponding legal brief describing the relevant precedents associated with the clause and/or amendment and established by the United States Supreme Court. This legal brief must cite specific decisions, discuss how the Supreme Court's understanding of the clause and the amendment may have evolved over time, and develop an argument about how this understanding applies to and informs the case at hand.

You receive a legal brief from a student about the Equal Protection Clause of the Fourteenth Amendment, discussing how its role in society has expanded from its passage to the present day. However, as you review the brief, you notice something: In addition to including cases like *Brown v. Board of Education*, *Obergefell v. Hodges*, and others, the legal brief contains citations for cases you do not recognize at all. You begin doing research and realize these cases do not exist. They never happened. Concerned, you confront the student. Once you do so, the student admits that she relied on ChatGPT to write a good portion of the legal brief and did not bother to check if all the included cases were actually real.

You decide that while the student will lose points on the "relevant case law" section of the rubric, this could serve as a learning experience for her and others. What would you like to tell her and her fellow students?

Note: Actual events inspired this scenario.

Issue #5: Reinvigoration of Your Teaching and Students' Learning

Summary

Generative AI will and should challenge all of us to change how we teach and how students learn. With new technologies, the opportunity emerges for us to innovate and experiment, creating fresh and engaging learning experiences for students. If properly designed, structured, and implemented, the use of generative AI by students could potentially contribute to and enrich their learning. As we consider the future of teaching and learning with generative AI, please keep in mind the following:

- **Our role in the classroom, physical or virtual:** Heeding the trite, either/or dichotomy of the "guide on the side" versus the "sage on the stage," we should practice humility, take a both/and approach, and remain open-minded about the role we may come to play in students' learning experience in this new world filled with AI and its contributions to education.
- **The importance of focusing on the journey:** Using a process-centered approach to teaching and learning will guarantee that we design potent learning experiences. By concentrating more on the journey, we can offer more structured, meaningful, and active activities and assignments for students that foster metacognition and reflection, encourage students to take ownership of their learning, allow for more formative assessments, and ensure students do not come to depend on generative AI exclusively.

Divergent Metaphors of Teaching and Learning

It is among the most pervasive cliches in teaching: We should aspire to serve as a "guide on the side" rather than the "sage on the stage." With the advent of the internet, students could obtain information and knowledge with ease and convenience, and so teachers faced the challenge of moving from delivering knowledge to creating and sustaining learning experiences. Now that generative AI has emerged, we must further embrace that role as a guide on the side. After all, generative AI can:

- Step beyond search engines, which merely present available content and information of relevance to a topic, to synthesize and produce content and information.
- Offer feedback and clarification on content and information.

Notwithstanding concerns about accuracy, if correctly guided and prompted, generative AI could effectively teach a student about the causes of the decline of the Roman Empire or produce an essay about the differences between dark matter and dark energy. It seems that with delivering information, evaluating work, and creating content, generative AI could potentially replace the work of the teacher and student.

For this reason, much of the conversation about generative AI approaches learning as a sort of factory in which the teacher offers information and instructions in a top-down manner and students must work in isolation to manufacture a product. However, with the potential of generative AI, we perhaps can no longer view ourselves as experts depositing knowledge in the minds of students, demonstrating and adhering to what Paulo Freire (1993) calls a "banking model of education." Instead of conforming to such a model, in which we serve as the "sage on the stage," we should view ourselves as conductors, "guides on the side," facilitating a symphony of learning, in which students use instruments that include but are not limited to generative AI to create something beautiful and memorable.

Why Educators Still Matter

Though theoretically valid, concerns about generative AI supplanting the work of teaching and learning ultimately approach students with a limited conceptualization of what takes place in the physical or virtual classroom. Generative AI cannot perform certain tasks and cannot accomplish certain hallmarks of good teaching. Please review what generative AI cannot do and identify where educators could still play a role in the learning experience of students. Unlike (and according to) generative AI, only educators can offer students the following:

- **Intuition and empathy:** Human teachers can establish emotional connections with their students, creating a supportive and empathetic learning environment. They have the capacity to sense and respond to the emotional and social dynamics within a classroom. They can gauge the mood of the students, detect signs of distress, and provide appropriate support. This intuition and empathy are essential for fostering a positive and inclusive learning environment.
- **Creativity and improvisation:** Teachers often need to think on their feet, adjusting their lesson plans or explanations in real-time based on students' reactions and questions. They can employ creative teaching techniques, analogies, and examples to enhance understanding and engagement, tailoring their approach to the specific needs of the students.
- **Motivation and inspiration:** Human teachers can inspire students and instill a passion for learning. Through their own enthusiasm, storytelling, and real-life experiences, they can ignite curiosity and encourage students to explore subjects beyond the curriculum.

- **Mentorship and guidance:** Human teachers often serve as mentors and role models for students, offering guidance not only in academics but also in personal growth, career choices, and character development. They can provide valuable advice, share wisdom, and nurture the holistic development of their students.
- **Social and interpersonal skills:** Teaching involves social interactions, and human teachers possess the ability to navigate and facilitate these interactions effectively. They can foster collaboration, communication, and teamwork among students, promoting social skills and emotional intelligence.
- **Ethical decision-making:** Teaching involves making ethical decisions in various situations, such as handling sensitive topics, addressing student behavior, and respecting diverse perspectives. Human teachers can exercise judgment, empathy, and moral reasoning to navigate these complexities. In other words, they can engage in critical thinking and reflection (reflection will also play a critical role in how students will learn with generative AI).

Process-Centered Teaching

Educators can demonstrate why they matter still in the classroom by taking a process-centered approach, in which we demonstrate an investment in the learning journeys of students. One of the most common concerns with generative AI's impact on education is that students will rely on it to produce much if not all of the product they submit. If a student is asked to write a research essay or some code to execute a task, he or she may turn to ChatGPT or Bing for some of the content, only to then expand on and change some of it. With generative AI playing a significant role in the ultimate submission, educators naturally have concerns about the extent to which students have engaged with the assignment and concepts at hand and achieved the learning outcomes set.

Notice: We are focusing on the ultimate work the student turns in for a grade and nothing that has taken place beforehand. The conversation about generative AI often focuses on the destination. Educators express concern that by using generative AI, students will "teleport" to the destination without doing the hard work of actually journeying cognitively toward it. However, underlying and unacknowledged in these worries is that educators may often focus exclusively on the destination in their pedagogy and not guide and facilitate students' journeys in reaching it. It is a universal cliche: Life is about the journey and not the destination.

The same applies to learning and the work we would like to see from students. **Generative AI may challenge us to focus more on the journey of students. In other words, we may adopt a process-centered approach rather than a product-centered one in our teaching.** What are the differences between

product-centered teaching and process-centered teaching? Please review the table below, adapted from White (1991), that discusses how these approaches diverge from one another in their pedagogy, their epistemology, their curricula, and their power dynamics.

Differences between Product-Centered and Process-Centered Teaching

Product-centered teaching	**Process-centered teaching**
Pedagogy: What is the heart of teaching and learning? Focus on what is to be learnt Emphasis on subject Learning directed externally	*Pedagogy: What is the heart of teaching and learning?* Focus on how it is learnt Emphasis on process Learning directed internally and self-fulfilling
Epistemology: Where does knowledge come from? Knowledge external to the learner Knowledge from determination by authority	*Epistemology: Where does knowledge come from?* Knowledge internal to the learner Knowledge from negotiation between learners and teachers
Curriculum: Where does the content to be learned come from? Content from subject matter expert Content: gift to learner from teacher or knower	*Curriculum: Where does the content to be learned come from?* Content from learner Content: what the learner brings and wants
Power dynamics: Who has power and control over teaching and learning? Teacher as decision-maker Objectives defined in advance Assessment by achievement or by mastery Doing things to the learner	*Power dynamics: Who has power and control over teaching and learning?* Learner and teacher as joint decision-makers Objectives described afterwards Assessment in relationship to learners' criteria of success Doing things for or with the learner

You may notice that adopting a process-centered approach also calls for you to reconceptualize and reinvigorate our role and approach as an educator. However, you may wonder: How exactly may product-centered and process-centered teaching affect how students use generative AI?

- **Product-centered teaching and generative AI's ensuing role in learning:** It is important to note here that for many major assignments, the instructor may provide an introduction to it for the class, answer some questions through a Q & A, and then leave students to work on and complete it in isolation until the

due date. Focusing primarily on the product that students will submit, this approach neglects to provide students the scaffolding and structure to move forward and thrive with the project. This absence of structured guidance to facilitate movement forward leaves students on their own and the door open to the potentially excessive use of generative AI, impacting students' learning. After all, generative AI can create the entire product in question with some guided prompting.

- **Process-centered teaching and generative AI's ensuing role in learning:** With a more process-centered approach, in which the teacher accompanies, guides, and equips students in their learning, students will engage in more deliberation and contemplation about their work. In addition, students will experience and enjoy numerous activities and interactions that facilitate their progression through their learning and foster metacognition. After all, "process is much harder to fake" (Dietz & Keys, 2023). Though it is likely (and acceptable) that students will turn to generative AI throughout the process, students will not rely on but rather collaborate with tools like ChatGPT and Duet AI.

Instructional Strategies for Process-Centered Teaching

Some strategies to cultivate a process-centered approach that would accommodate and acknowledge the role generative AI could play, include:

- **Reflections and discussions** on one's personal experience with and attitudes toward a topic throughout (before, while, and after working on a project)
- **Gathering and synthesis of research** on a topic to identify themes and insights that generative AI may lack (annotated bibliography, etc.)
    - A tool like PowerNotes could support and facilitate this process well. Please note that PowerNotes is currently only available for the University of Missouri flagship campus in Columbia.
- **One-on-one conferences** with students to discuss a project
- **Critiques of the output from generative AI** for various stages in the process (brainstorming, outlining/planning, drafting, revising, and editing)
- **Expression across multiple modalities** (outlining or planning through creating a slideshow or infographic, doing peer review through podcasts, etc.)
- **Other activities (KWLs, etc.) and classroom assessment techniques (CATs)**, or formative check-ins (Iowa State Center for Excellence in Learning and Teaching, n.d.)
    - KWLs: Students identify what they *know* and what they *want to know* at the beginning of a unit or project. At the end of the unit or project, students then articulate and describe what they have *learned*.

Scenario

The Problem

Throughout your career so far, you may have used a top-down approach to teaching environmental biology: deliver lectures and then assess how well students have learned the content through exams. This approach concentrates on the product (the achievement of the learning outcomes) and not on the process (the students' engagement with and exploration of contemporary issues at the intersections of biology and sustainability). You have relied on a familiar and comfortable routine for your curriculum for years now: deliver content, whether by traditional lecture for face-to-face sections and through video for asynchronous online sections, and ask students to reflect on and discuss the concepts at hand, either through think-pair-shares or discussion forums. You then ask students to complete open-book assessments, such as quizzes or tests, to demonstrate their learning.

It has come to your attention that a significant portion of your students are now using ChatGPT for assistance during these open-book exams, even though you have told them to rely on the digital textbook and authoritative websites. You believed offering open-book assessments would allow students to focus on higher-order thinking about matters involving biodiversity and sustainability, but it now seems your students may no longer bother to engage with the concepts as deeply or critically as they previously had. Instead, students are now merely relying on ChatGPT for information about the sixth mass extinction and the Anthropocene, information they then build on or modify to answer the essay questions. You begin to wonder: Should you change how you teach, and, if so, how?

The Solution

You decide to reduce your reliance on traditional, unidirectional teaching practices, such as the lecture, partially. With the cornucopia of information available on the internet and through generative AI, students can locate and find information and ideas about the sixth mass extinction and other topics. Approaching your work as a guide on the side rather than the sage on the stage, you create structured opportunities for students to use the internet and generative AI to learn more about, create content regarding, and reflect on these matters in small groups. Students can then share their findings, insights, and learning with the remainder of the class through presentations and other strategies.

Altogether, the change you have implemented is embracing inquiry-based learning: You have changed the class such that it now frequently challenges students to learn about a specific topic or issue, either individually or collaboratively, and then share their findings with the class. Students are invited and encouraged not only to use

insights from generative AI but also to corroborate and expand on them through finding and integrating relevant academic research.

Issue #6: Cultivation and Growth of 21st Century Skills

Summary

As we design learning experiences that allow and accommodate the use of generative AI, we must remember to reinforce and build students' skills in communication and collaboration. We must also encourage and invite creativity and innovation through offering more choices, more modalities, and more open-ended assignments and activities. One last important consideration in this regard is that we should strive to summon students to higher levels of Bloom's Taxonomy. With a well-designed curriculum, generative AI could support students' in learning to communicate more effectively, in stretching their imaginations and creative muscles, and in facilitating higher-order thinking.

Defining, Teaching, and Assessing 21st Century Skills

"To participate effectively in the increasingly complex societies and globalized economy that characterize today's world, students need to think critically, communicate effectively, collaborate with diverse peers, solve complex problems, adopt a global mindset, and engage with information and communications technologies, to name but just a few requirements" (Vivekanandan, 2019). While we may not explicitly account for these 21st century skills in developing our learning outcomes and curriculum, we should consider how our teaching will cultivate and contribute to the growth of them.

However, the question may naturally and inevitably arise: How can we ensure students grow in these skills and do not offload the work of communication, creation, and thinking critically to tools like ChatGPT, Claude, or Duet AI in full? Authentic or alternative assessments and activities can play a substantial role in ensuring students still practice and build these 21st century skills while potentially using generative AI. Many different authentic or alternative assessments and activities exist and may help with meeting the challenges and answering the pedagogical questions posed by generative AI.

In addition, there are some authentic or alternative assessments and activities that can deliberately and conscientiously call for the use of AI. Below you will find some suggestions for authentic or alternative assignments and activities that both include the use of generative AI and ensure students remain active in their learning and practice some key 21st century skills, including communication/collaboration,

creativity/innovation, and critical thinking. After we consider these suggestions, we will relate them to a scenario of teaching an environmental biology course.

Communication and Collaboration

Here are some examples of assignments and activities, suggested by ChatGPT. Teachers can use these strategies and others to foster and invite communication and collaboration among students, who may leverage generative AI as part of their learning and workflow.

- **Collaborative writing:** Assign students a writing task where they work together to create a piece of written content related to their discipline. They can use generative AI to generate ideas, prompts, or even assist in the writing process, taking turns contributing and editing the content.
- **Presentation and debate:** Assign students a topic or issue within their discipline, and have them prepare and deliver presentations to the class. After each presentation, encourage a debate where students can ask questions, challenge viewpoints, and engage in constructive discussions using generative AI-generated content as reference material.

Creativity and Innovation

Here are some examples of assignments and activities, suggested by ChatGPT. Teachers can use these strategies and others to cultivate and encourage creativity and innovation among students, who may leverage generative AI as part of their learning and workflow.

- **Content creation using multimedia:** Instead of traditional essays or presentations, encourage students to produce content with multimedia created with generative AI tools. They can incorporate AI-generated text and visuals, interactive elements, and multimedia components to communicate their ideas creatively, capturing the attention and imagination of the audience. You will find a discussion of Microsoft Designer, one tool that would support this, here (Dvorak, 2023).
- **Data visualization with AI:** Task students with creating dynamic and visually appealing data visualizations using generative AI. They can use AI algorithms to analyze large datasets from their discipline and generate visual representations that communicate complex information in innovative ways. Students can explore different visualization techniques, colors, and interactive features to make their data visualizations engaging and creative.

Critical Thinking

Here are some examples of assignments and activities, suggested by ChatGPT. Teachers can use these strategies and others to call for and bring about critical

thinking and problem-solving among students, who may leverage generative AI as part of their learning and workflow.

- **Argumentation and debate:** Assign controversial topics or issues for students to research and develop arguments. Encourage them to critically analyze the strengths and weaknesses of different perspectives, fact-checking, comparing, evaluating, synthesizing, and using AI-generated information from various tools to support their claims while also considering its potential limitations.
- **Reflection and self-assessment:** Incorporate regular reflection activities where students can assess their own critical thinking skills, including how effectively they use AI tools. Encourage them to identify areas for improvement and develop strategies for enhancing their critical thinking abilities.

Scenario

In the environmental biology course you teach, you have decided to accept and embrace the use of generative AI by students as part of their learning. However, how can you ensure students still practice and build 21st century skills while making use of tools like ChatGPT and Google Bard? Below you will find some examples of possible ideas and strategies.

Communication and Collaboration

You have introduced the HIPPO acronym that identifies the causes of ongoing defaunation: habitat loss, invasive species, pollution, population growth, and overharvesting. Students then join teams, in which they must work together to learn more about their assigned cause from the HIPPO acronym.

As students engage with one another to learn more, they not only rely on ChatGPT for common perspectives (and potential misconceptions) but also locate and use peer-reviewed research and other authoritative sources for more accurate and reliable insights and information. After gathering further information, students collaborate on a shared presentation on the graphic design app Canva. They are working together to develop the materials they will share with the class through a Panopto video recording of the aforementioned slideshow. Through this activity, students learn to collaborate effectively with others and to use written, oral, and visual communication strategically to convey information and ideas.

Creativity and Innovation

You have decided to transform your curriculum and design a multigenre research project (Langstraat, n.d.) that will play a key role in students' learning this semester. Students will select an ongoing issue in environmental biology, such as defaunation. Then they will do research on that topic, gathering and analyzing sources, and then

use themes or ideas from their sources to create a multigenre research project. This multigenre research project will not explicate but rather render the topic at hand (Romano, 1995): Students will not explain it but rather bring it to life through various artifacts, such as first-person diary entries from or podcast interviews with affected species, infographics featuring statistics, or PSA videos to hypothetically share on social media.

While composing these artifacts, students will use ideas and possibilities produced by generative AI tools but will have to apply and compose them across various genres. Being asked to compose these various artifacts, even with input from generative AI, will challenge students to use their imagination. While practicing communication in these various genres, students will also become familiar with the discourse and best practices for each modality.

Critical Thinking
To conclude the unit on the sixth mass extinction in your environmental biology course, you decide to eliminate the test and replace it with an alternative assessment: a reflective portfolio in which students must keep video diaries for a week and then reflect on how their actions each day may contribute to or prevent ongoing defaunation. Students cannot rely on ChatGPT or other tools for this as much as they would have for a generic essay about the topic, and the assignment forces them to grapple with and analyze how current human systems as a whole cause defaunation. Students will engage with higher levels of Bloom's Taxonomy (Armstrong, 2010): applying what they have learned about HIPPO, analyzing and evaluating the environmental impact of their own actions, and synthesizing these observations to identify how they as individuals and human systems altogether could change to better support ecosystems.

Issue #7: Effective Prompting through Prompt Engineering

Summary

As students use generative AI for the purposes discussed above, we must provide explicit instruction and structured guidance in crafting and submitting effective prompts. Called "prompt engineering," this process will ensure that when generative AI may play a role in students' learning, they can use it to achieve desired results.

Four Elements of an Effective Prompt

An effectively written prompt should contain the following four elements, though they may do so to varying degrees:

- **Instruction:** the task assigned to the generative AI tool. Some examples include:
    - Chained prompting: posing follow-up questions or prompts
    - Self-critiques of output: asking generative AI to review or critique its own previous output
- **Context:** additional information about the "situation" surrounding the output
    - Identifying the rhetorical situation: explicitly articulating the purpose, audience, and genre of the output
    - Being specific and detailed with prompt
- **Input data:** further information in the input to generative AI
- **Output indicator:** specification of the output desired output
    - Indication of preferred writing style (Flesh-Kincaid reading levels, amount of technicality and jargon, etc.) and length (one paragraph, a five-paragraph essay, etc.) of output
    - Request for certain presentation format (through tables, lists, outlines, etc.)
    - Use of a prompt previously created by generative AI (created in response to your asking it for a prompt you will later use)

Some Tips for Writing Prompts

What are some simple and effective strategies for creating an effective prompt? Here are some tips that you may like to share with students so that they can use them in their workflow with generative AI.

1. Start simple.
2. Break down complex tasks.
3. Use clear instructions.
4. Separate elements.
5. Specify details of output, such as length.
6. Be precise.
7. Focus on what to do.

Scenario

You have asked students to use Claude, ChatGPT, or any program of their choice to compare and contrast various coding languages in your computer science course. However, as you circulate around the room, you find many students consider the responses vague and perhaps even meaningless: The output lacks concrete details, according to many. You decide to bring the class back together to discuss the importance and value of chained prompting, in which students take an iterative approach to achieve the output they desire. In addition, you explain the importance

of offering specific contexts as part of the input to generative AI, so that there is a more meaningful situation for Claude or ChatGPT to consider and discuss.

Conclusion

As generative AI comes to play more of a role in the world, it is natural for us to worry and wonder about how it will affect the learning of students. There is understandable concern, anxiety, and frustration on the part of faculty. However, generative AI could amount to less of a threat and more of an opportunity with thoughtful and effective pedagogy.

This document is not an absolute and comprehensive guide to navigating the use of generative AI by students in your teaching. Instead, it is only a starting point for you to begin to contemplate how to adjust your policies and pedagogy. **As you begin to consider how to best integrate generative AI in your teaching, please do not hesitate to discuss and brainstorm your ideas and concerns with Missouri Online. You are welcome to reach out to an instructional designer at teaching@missouri.edu.**

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