

EDITORIAL

Of Chatbots and Colonizers: A FUN Workshop Mini Symposium

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Chatbots and related technologies are predicted to become fixtures in our teaching. These tools scan information from the web or other sources and deliver content in textual summaries. ChatGPT4 and other AI products are surprisingly good at summaries of information and simple analysis, similar to what we often ask students to do as part of our teaching. They are poor at evaluation of information and citation of sources at the moment, but these tools are advancing rapidly. Use of these tools in the classroom generate important questions about how we handle content, understanding and skill development in the classroom, how information is curated, and the structure of information in our

discipline. Additionally, accessibility of these tools will be an issue moving forward since they have the potential to widen a technology divide even further. Through presentation and group discussion, this minisymposium highlighted how we might integrate these tools and craft new pedagogies that will continue to engage and challenge our students. We also discussed concerns about these tools in terms of inclusive pedagogy and decolonization of neuroscience.

Key words: generative AI, writing pedagogy, inclusive pedagogy

In the last year, generative AI (Large Language Models, LLM, or the interfaces commonly known as Chatbots) has exploded on the scene. These tools have large implications for how we use information because they can be queried through textual prompts on virtually any subject and can create textual summaries of information as well as code or images. Generative AI (gAI) models are based on neural networks which are trained on data sets which can then also serve as a source for interacting with the questions posed. Essentially, gAI is a statistical model to predict the most probable answer word by word based on the training data set (Wolfram 2022). The basic AI function sits at the center and interacts with multiple modules that interface with the database, language processing, and the user interface. Several companies have released versions of their generative AI programs into the digital environment with the most popular of these “chatbots” produced by Open AI with the program referred to as CHATGPT. Currently this program is deemed as the most powerful LLM for most purposes. For example, the current model GPT4 performs better than most students on the GRE, SAT, the Bar Exam, Advanced Placement tests and tests of creativity across a wide range of topics (Open AI 2023, Guznik, 2023). However, other companies have released similar tools such as Google (Bard) and Microsoft (Bing), which are connected to the internet as the dataset for queries.

The implications for higher education are multifold. Since text-based questions can be asked of the LLM and the answer is returned, in most versions, as text, students could use these tools to answer homework or exam questions or to write papers. Any assignment done outside of pen/paper could be a product of a LLM rather than the work of the student. Currently there is no way to accurately and reliably

detect use of these tools. But the concerns extend beyond this form of plagiarism to concerns about writing and answering as a process of inquiry and a loss of individual student work and voice in the process. Homework and other writing reflections are often used as scaffolding for more complex learning. If students can just query an algorithm for answers without understanding the process by which this occurs, how will that impair their ability to think, search for information, or evaluate information? Conversely, the ability of gAI Chatbots are used frequently by students as a “quick reference” as they are learning concepts. For example, student in an introductory neuroscience course could prompt an LLM to distill the explanation of large concepts such as equilibrium potentials, neurotransmitter release probability, or glutamate-mediate excitotoxicity. In doing so, students have access to a powerful resource to supplement explanations by the instructor and/or textbook. It is incumbent on instructors to wrestle with the extent to which this approach meets course learning goals, or potentially undermines the persistence that students gain through the iterative nature of studying from class notes and textbook resources. As Ethan Mollick, a Professor of Economics at the University of Pennsylvania, Wharton School of Business and author of the blog “One Useful Thing” states “The only bad way to react to AI is to pretend it doesn’t change anything”.

REVOLUTIONARY, OR JUST ONE MORE THING

There may be no way to pretend that AI does not change anything, but that does not mean it will, or should, change everything. First, some skepticism is in order. For a century, almost every new technology has come with claims of

revolutionary change. And yet, more often new technology was integrated into existing structures and pedagogies in ways that did not change the fundamentals. In 1913, for example, Thomas Edison was so excited by film that he said, “books will soon be obsolete in the schools.” After World War II, many thought the TV would replace campuses, including the Ford Foundation. In 2010, Bill Gates said that “five years from now on the Web for free you’ll be able to find the best lectures in the world. It will be better than any single university (Neem, 2019; Cuban 1986, Cuban 2001).

The ways in which AI will impact campuses also depend on the specific context of our time. Campuses are struggling in ways that make it more likely that AI will negatively affect student learning. Observers have documented that trends toward student disengagement and cheating have accelerated since the pandemic (McMurtrie, 2022; Davis 2023). These trends make it tempting for students to use AI in ways that allow them to evade hard coursework. Added to this is a longer-term trend in which more freshmen say that they are coming to college to prepare for a job than to learn about themselves and the world (Higher Education Research Institute [HERE]), 2022). Together, these factors suggest that students may be willing to use AI in ways that allow them to get their work done more quickly even if it has a negative impact on their intellectual growth. Faculty thus need to be attentive to these contexts as they respond to the potential costs and benefits of AI for higher education.

The big question professors need to ask themselves is how to ensure that students are provided opportunities to develop knowledge and skills, and to think critically about a course’s subject matter. The response to this question will differ between disciplines as well as from class to class. It is possible that in some courses, the bulk of student thinking takes place in gathering and analyzing data. In these cases, professors need teaching strategies that ensure that students are actively thinking during these phases of their work rather than using AI. In such situations, it is possible that the writing up of the final product matters less than the thinking done prior to writing. In other contexts—especially for the humanities and social sciences—writing is essential to the creative and critical thinking process. Research has demonstrated the benefits of writing to thinking and learning (for example, Graham et al., 2020) . In such cases, it is essential that students learn to use words well instead of relying on AI to craft their words—and their ideas—for them. The point is not that AI should or should not ever be used, but rather that professors should find ways to ensure that students are not enabled to bypass those activities that develop their skills and knowledge.

In addition to paying more attention to where the thinking happens within classes, professors will also need to think seriously about how to help students read more effectively in a world of AI-generated text. Given documented mistakes in AI, as well as the possibility that bad actors will make use of AI to spread falsehoods, students must be taught to analyze texts critically. They must be able to assess whether the evidence being used is accurate, and whether the conclusions being reached by any text is justified by the evidence. This requires both general and discipline-specific

reading strategies.

However, there are reasons for hope. Students are complex. The UCLA survey data that is often touted to assert that all students are career minded (see above) is not quite right. When you look at the data, while getting a job is the highest goal of incoming freshmen (81%), 75.8% also say that they hope “to gain a general education and appreciation of ideas.” Given all the ways that AI tempts students to evade learning, professors must tap into students’ latent but real excitement about the intellectual benefits of college. Professors need to convince students that the hard work of learning is worth it.

Even as history suggests warranted skepticism about the revolutionary implications of AI, that does not mean that professors should not be attentive to its impact. This is particularly true given that we inhabit a moment in which campuses are already struggling with student disengagement and other issues. Nonetheless, by focusing on what skills and knowledge we want students to develop, and ensuring that courses are structured so that students cannot automate those activities, professors can reform their courses in ways that encourage student learning and critical thinking.

GENERATIVE AI, IS IT THE NEW WEIRD?

As we consider the extent to which generative AI impacts pedagogy, we also must consider its impact on the culture and values of a classroom. The infusion of AI into the learning environment causes us to question the values of our classroom. As outlined in the prior section, these values include the involvement of writing in the research process but also extend to questions that challenge the definition of “independent” or “critical” thinking. Dr. Songyee Yoon, president and chief strategy officer of NCSofT, identifies this challenge to core principles as a form of digital colonialism whereby generative AI strikes at the heritages and/or values of various cultures (Yoon, 2023). Classroom instructors are members of multiple cultures including, but not limited to, their academic and disciplinary culture, their social/familial culture, and the cultures within their country of residence. Dr. Yoon identifies a high potential for digital colonialism specifically because the most prominent gAI models have been developed by companies based in the USA and places where gAI models are trained on predominantly Eurocentric and/or western worldview-based datasets (Chung and Kwack, 2023). This concept evinces a broader, though potentially less insidious, form of colonialism where forces of industry and economy challenge the values that shape academic programs. Training datasets rarely represent the nuance of the scientific process and primarily display the application and resource-based view of science rather than a theory-based viewpoint. It is our task, then, to determine the correct lenses through which we view natural language models and their associated chatbots.

In some circles, the current capability of generative AI models has been inevitable since the development of the first Turing machines (Turing, 1947; Sundaresan, 2023; David, 2023) In many ways, this conversation parallels Joseph Henrich’s analysis of western, educated, industrialized, rich, and democratic (WEIRD) societies

(Henrich, 2021). Henrich's thesis is that WEIRD societies are not the inevitable result of progress. Rather, they are the result of structural features of a dominant culture. Just as we should not view cultures across the globe through a hierarchical lens, we should not view generative AI as the current pinnacle of progress in computer engineering. Instead, we should examine the structures that create, spread, and promote the use of generative AI. Herein lies opportunity.

This moment provides spaces to interrogate the heritage of our disciplines and values of our classroom. In some instances, as with writing, we may decide to hold to our pre-gAI commitments. However, we may find in the process of investigation that there are historical values associated with inequity that need to be reimaged. As with any other technological tool, we must determine what it is in relation to us and whether this tool contributes to establishing equity in our disciplines and classrooms. Generative AI could be many things in our classroom, an expedient mechanism of cheating, a helpful learning aid for underprepared students, a timely opportunity to discuss the ethics of technology with our student, or a myriad of other options. We must consider how we view gAI. If we view this, or any other new technology, as a threat, that dictates a very different response than if we view it as a tool with utilitarian intent. We therefore must develop operating principles to inform our approach to generative AI. Below are four suggested actions toward this ideal:

1) Be a voice - the statistical nature of natural language models means that we have the ability to shape the input data. We must visibly advocate for appropriate use through publication. The gAI training datasets should represent the pluralism that enriches our society.

2) Do not rely on the language of violence – when we encounter threats, it is tempting to resort to phrases that evoke images of violence, war, and conflict. (... an arms race, ... rules of engagement, ... it attacks) However, this approach in the context of gAI may have the unintended consequence of humanizing AI while simultaneously dehumanizing the developers. Effective advocacy is built on relationships that allow our voices to shape future developments.

3) Leverage the best of the tool – As mentioned, gAI shines at certain tasks that are common in academia. This tool has the potential to streamline our work or open previously unavailable opportunities. For example, when teaching editing, an instructor could use a chatbot to produce multiple samples very quickly for students to analyze and edit. Most chatbots are also minimally proficient at programming, which could allow novices to access computational tools that would have previously taken specific training. Specifically in the context of programming, the ability of generative AI to write code means that students do not need to know how to develop a Leaky Integrate and Fire computational simulation *de novo*. This means that students can access tools that do not rely solely on the expertise of the instructor.

4) Model responsibility – instructors have a unique opportunity to model the iterative process of learning. In a moment when many students are more adept chatbot users

than the instructor, we should demonstrate the type of humility and responsibility that we want to develop in our students.

THE PROBLEM WITH gAI IS WITH OUR CULTURE AND OUR INFORMATION SYSTEMS

While generative AI may prove to be a useful tool for student learning, there are multiple challenges to implementing it in the classroom. The biases produced by gAI reflect our cultural biases in how information is organized and structured. To some extent, if biased information is used to construct these LLMs, then they will answer in ways that reflect that bias and reinforce the bias with each query. Garbage in, garbage out. News articles documenting such biases crop up regularly. One such example that might hit close to home is a query asking gAI to create images of professors in different disciplines (reddit, 2023) The images are overwhelming white, old, and bespeckled. A more alarming example is provided in an article in the New York Times 7/4/23 about generative AI handling of race (Small 2023). The biases that exist in generative AI responses to queries reflect the gender, racial and ethnic inequalities in production of knowledge, funding of grants and publication of knowledge, which in turn reflects the larger culture. These inequalities must be addressed within the culture and our field, but impact of these biases on our students must be addressed if we use these tools in our classrooms.

gAI tools often provide erroneous and biased information, so all answers composed by them must be subjected to rigorous evaluation (USC libraries, 2024). If you ask chatbots to cite their sources, these are often miscited or even made up. We don't even know what information these models were trained on or how they work. While there have been multiple discussions in the media about the lack of transparency about training sets, no one seem to be changing the current situation. So, while the chatbots provide general summaries of information, you really don't know where the information is coming from.

While identifying errors and bias may create a teaching opportunity, the tendency to just accept the information among our students will be high and it may be that students don't have the expertise to evaluate the outputs. The problem will be if students (or professors) take this information as authoritative at all. Students will have to navigate the norms in each classroom or discipline. For example, most gAI tools aren't able to access information in the field of neuroscience that is complete, accurate or up to date. Information is scattered and much of scientific information is behind pay walls associated with publishing companies. In a field as fast moving and revolutionary as neuroscience, LLMs will reflect a majority opinion or consensus from the data set that might not reflect current understanding or a cutting-edge idea. Since the LLM are probability based, their summaries amplify dominant narratives and may reinforce biases and stereotypes already in the system. Since these tools don't accurately reflect our state of knowledge in neuroscience or any discipline, gAI tools may disincentivize responsible risk taking in the knowledge generation process.

And finally, most gAI access requires some disclosure of information and for most programs, anything you enter can be reused in the database. So gAI represent a privacy concern for all users. Asking students to use these tools may create greater exposure of private information (Niels, 2023). Students and others seem ready and willing to give away information without a solid understanding of the risks. We have created a culture of free tools and pages of legal information that we just click to accept without reading. If the tools are free or available to students through their college or university, there will should be equal access to the tools and privacy concerns can be negotiated on an institutional level.

EFFECTIVE USES OF gAI

While there are valid concerns about the use of gAI as an intellectual shortcut, there are positive applications of these tools that could be leveraged pedagogically. In surveys, even if students think that using this technology is plagiarism, about 20% of them will use it anyway (Tyron Partners, 2023) Multiple surveys at Lafayette College suggest that most students are familiar with gAI tools and are using them to study or complete work. Other source also suggest students are already well versed in this technology (Chan and Hu, 2023; Coffey, 2023; Terry 2023; Colby 2023). In the future, employers may also expect some familiarity with these tools since they are expected to make some work tasks more efficient.

In the classroom, gAI can be used to allow students to brainstorm, gain a low-level understanding of a topic, or as part of an active learning strategies. We might ask students to a chatbot to explore a topic. For example, one could imagine asking students to synthesize the “sparkers vs. soupers” debate around the turn of the 20th century about how neurons transmitted information. A gAI tool will perform a search and integrate the information into a textual output. To be sure, students will still have to read and evaluate that output, but now in a composite form. These initial explorations can be supplemented by more traditional tools like web-based literature search and/or reading documents.

In addition, all of the major gAI chatbots allow students to input a document such as a journal article and use prompts to ask the bot about the contents of the paper. The chatbot then seeks out the information to answer the prompt, usually directing the student to a specific page in the document. Use of this tool may make the neuroscience primary literature more accessible to students learning to read and summarize scientific articles. Of course, once they figure out what is going on in the paper, they will still need to turn a critical eye to aspects of the paper itself.

gAI tools can also analyze data produced in student experiments and subject the data to simple statistical analysis or can create graphs of the data. Again, this aspect of the tool may lower the bar to understanding statistical or visual comparisons of data. gAI tools can be used to create code which could boost student confidence in being able to create the analyses or visuals they want. Importantly, this could allow students to access large neuroscience datasets such as those managed by the AIBS (<https://alleninstitute.org>) or NeuroData without Borders and

<https://www.nwb.org>). Of course, since gAI tools are used in a modular fashion, student can output information in particular formats, like a table, a brochure or a picture.

While we don't want students to turn in written work produced by a gAI instead of their own thoughts and ideas, gAI can help can smooth the transition from writing in informal language to the structured format of scientific writing. gAI can provide feedback on student writing to help students make changes that reflect their ideas in a particular academic style. In particular, the tool may be useful for students who have a different primary language, or students with disabilities. In addition to writing tasks, students can also ask gAI tools to write practice test questions or to explain subjects to them, much like a digital tutor. These tools could level access to information since the tool can distill the information into understandable forms for people who are neurodivergent or lack skill sets that allow them to gather the information themselves. For more information on pedagogical uses for gAI and examples of the prompts to carry out these uses and others, see Mollick and Mollick (2023).

In order to anticipate student use and to design assignments and student assessments using the gAI tools, we will need to set clear guidelines about how the tools are to be used in the syllabus and assignment handouts. Here is an example of a syllabus statement based on *Lance Eaton @leaton01 CU's Institutional Strategy for AI Generative Tools*

“There are situations and contexts within this course where you will be asked to use AI tools (generative AI (gAI), Large Language Models (LLM) or Chatbots) to explore how they can be used and how they might help in brainstorming about or understanding a given topic or reading. Outside of those circumstances, you are discouraged from using AI tools to generate content that will end up in any writing that is part of your evaluation in this course. In any work where using AI tools is permitted, you should clearly indicate what work is yours and what part is generated by the AI. In all other writing assignments, the work should be in your own words. We will be discussing use of these tools in class. If any part of this is confusing or uncertain, please reach out to me for a conversation before submitting your work.”

Giving students clear guidelines helps create a culture of communication and trust in the classroom. Syllabus statements can introduce AI tools into the classroom with an emphasis on how to use them positively. Acknowledgement of use of gAI tools by students and instructors is a good first step in generating that trust (Foltynek et al. 2023)

If gAI is introduced as one of several resources or tools that we use in our classroom work, then the teaching is centered on the human and their ideas rather than the tools. If the focus is on idea generation and the process of writing rather than a product produced for evaluation, then students will be less likely to use the tool in negative ways. Assignments can be developed that teach students to keep track of and document the development of ideas and sources whether or not LLMs are involved. Creating on-demand, in-class writing assignments will push students to

integrate and evaluate on the spot and keep the focus on the process and skills to achieve the outcome.

SUMMARY

Those who are willing to enter the fray of using gAI in the classroom must carefully assess its use. We need assessment of students' perspectives and attitudes. More importantly, we need a systematic understanding of how to use gAI tools to scaffold learning but retain the students' writing, voice and ideas as part of their authentic work. We need to assess whether the ways we are integrating these tools are meeting our student learning outcomes. An assessment issue that becomes especially important in the gAI era is how to evaluate collaboration; this is an issue in both group work and in the collaboration with machines that will become more common. So far, there is a dearth of literature on the assessment integration of LLMs into neuroscience pedagogy. In integrating these tools and assessing learning should we be comparing to current pedagogical practices? We also need to assess the diversity of use of these tools as well as whether they are a benefit to some students and not others.

In thinking about how we can teach and assess student learning with these tools, we will need to alter our mind set. We could teach the same skills and bar the new tools and assess the learning the same way, and for some classes there may be good reasons to do so. However, we could also embrace the tools in doing some of the work. Some believe these tools will raise the bar on what students will be able to learn and achieve. Regardless of whether faculty members embrace or reject gAI, they will need to identify where student thinking happens in their course or discipline and use class time and assignments in ways that encourage students to meet their goals.

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