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SoTL in Process

Preparing Educators and Students at Higher Education Institutions for an AI-Driven World

ABSTRACT

The rapid advancement of artificial intelligence technologies, exemplified by systems including Open AI's ChatGPT, Microsoft's Bing AI, and Google's Bard (now Gemini 1.5Pro), present both challenges and opportunities for the academic world. Higher education institutions are at the forefront of preparing students for this evolving landscape. This paper examines the current state of AI education in universities, highlighting current obstacles and proposing avenues of exploration for researchers. This paper recommends a holistic approach to AI integration across disciplines, fostering industry collaborations and emphasizing the ethical and social implications of AI. Higher education institutions are positioned to shape an educational environment attuned to the twenty-first century, preparing students to be informed and ethical contributors in the AI-driven world.

KEYWORDS

generative AI tools, AI integration in higher education, skills gap in AI education, AI-driven workforce, complex task generation

INTRODUCTION

Generative Artificial Intelligence (GenAI) operating through Large Language Models (LLM), such as ChatGPT, impacts teaching and learning due to its performance in single task response generation. The sudden emergence of ChatGPT in November 2022 caught instructors in higher education by surprise and has engendered conversations about academic integrity and the ethical use of LLMs in the classroom and academic research. Could GenAI be a useful co-pilot or partner for students learning new concepts? Would GenAI allow instructors to cognitively offload mundane tasks or supersede them by creating lesson plans, rubrics, and curriculum maps? Should GenAI be tasked with creating literature reviews for research projects? This paper proposes that educators and researchers consider how GenAI can be applied to scholarly research so complex end-to-end task generation saves time or performs better on mundane operations. Directing GenAI to perform multimodal tasks such as creating PowerPoint presentations, text-to-video, video-to-text, audio-to-video, or video-to-audio may be harmless cognitive offloads. However, is this also true of literature reviews for scholarly research? ChatGPT and Microsoft CoPilot, as well as a host of similar tools, can now search, summarize, and even curate numerous databases in a few minutes. Where do we as academics, educators, and researchers place the limit?

OpenAI's Customizable Generative Pre-Trained Transformer (ChatGPT), Microsoft's CoPilot, and Google's Gemini are each capable of multimodal prompts that change how scholarly research occurs. GenAI tools can search, summarize, and compare data from a variety of source types including

PDFs, images, video, audio, and code. More recently, image-generation tools such as ChatGPT's DALL-E have been used to create original images from prompts (including the cover image for this article). Beginning in 2022, GenAI tools began achieving single-task benchmarks in controlled research environments. Bommarito and Katz (2022), for example, demonstrated that ChatGPT-3.5 could pass the Uniform Bar Examination using responses to straightforward single-task prompts or knowledge-based questions. The bar examination in the U.S. typically demands seven years of higher education, including three years of law school. Gilson et al. (2022) assessed ChatGPT's capabilities in answering questions from the United States Medical Licensing Examination (USMLE). The study revealed that the GenAI tool achieved a performance level comparable to that of third-year medical students. Similarly, Kung et al. (2022) examined ChatGPT's performance on the USMLE and arrived at congruent findings and conclusions. Even initial studies by researchers on early iterations of GenAI tools, such as ChatGPT-3, concluded that this GenAI tool was capable of writing or co-writing relatively coherent academic papers, newspaper articles, and media content. Due to these results, researchers encouraged educators to shift their attention towards enhancing students' creativity and critical thinking abilities by designing AI-involved learning tasks to engage students in solving real-world problems (Alshater 2022; Pavlik 2023; Rudolph, Tan, and Tan 2023; Zhai 2022).

Definitions box: What is a Large Language Model?

A Large Language Model (LLM) is a sophisticated algorithm designed to understand, interpret, generate, and respond to human language in a way that is both contextually and semantically meaningful. It is built on a computational foundation known as a neural network, which is a type of computational architecture inspired by the functioning of the human brain. This network is trained on vast amounts of text data, enabling it to learn language patterns, nuances, and structures.

A unique aspect of the current generation of LLMs is their scale, including the size of their neural networks and the volume of data they have been trained on. This scale allows the model to achieve an unprecedented level of language understanding and generation. It can perform a wide range of language tasks, such as translation, summarization, answering questions, and even creative writing and generation of novel prose or poetry. However, despite their sophisticated language capabilities, LLMs do not possess understanding in the human sense and can generate misleading, biased, or incorrect information if not properly guided or supervised.

Thus, it is clear that even the initial iterations of GenAI tools performed surprisingly well when asked straightforward, information-based questions. These findings resulted in instructors performing assessment makeovers, adding "authentic assessment" aspects that engaged students to apply their personal lived experiences to learning as a means of avoiding academic dishonesty. Although the applications of GenAI in the classroom have evolved significantly since the first public release of ChatGPT-3, the implications to the scholarship of teaching and learning (SoTL) are ongoing and may be further-reaching than the classroom, as SoTL researchers can now utilize GenAI tools to query multiple databases, archives, and search engines simultaneously and generate research questions, text, and images rapidly.

Just as ChatGPT-4 replaced earlier iterations of ChatGPT and is now capable of end-to-end complex task completion, that is, prompts that allow GenAI to perform tasks "behind-the-scenes" to complete more complex or multimodal tasks, SoTL inquiry is also poised for change. As Earle Abrahamson noted in April 2023, how close is the future where scholarship is written, submitted, and

reviewed by forms of GenAI? How would we judge the value of scholarly research on teaching and learning if human participation was at the level of prompt generation and output supervision? Since GenAI lacks sentience and true inspirational creativity, human researchers may need to adapt their thinking towards complex prompt engineering when working with GenAI. For example, we cannot simply ask future forms of GenAI to solve the climate crisis in a single-task question, unless we are prepared for unintended consequences from single-task or straight-shot answers (i.e. the shortest possible distance from point A to point B), such as wholesale and indiscriminate power outages or perhaps the extinction of humankind, which may come as a result of GenAI's univariate analyses and solutions to complex problems. To avoid these unwanted outcomes, higher education institutions need to equip students, who are our future prompt engineers, with the skills necessary to navigate and thrive in an evolving GenAI landscape. Higher education institutions also need to support researchers, including SoTL researchers, as they adapt and find new ways in which research processes change as a result of GenAI.

FINDINGS

The role of AI in teaching and research

The integration of GenAI into the educational process may hold significant potential for transformative pedagogical practices, learner enrichment, and investigative inquiry. GenAI can serve as a tool for personalized learning and a catalyst for rapid advancements in the research process. Research, particularly in areas of the social sciences that previously involved very large time investments, may now be performed so quickly that investigators, including those engaging in SoTL, will be able to enter a phase of hyper-research previously available only to computational-based science. While GenAI can adapt to the individual needs of learners, it can also summarize data from different perspectives extremely quickly. Through machine learning algorithms, GenAI can adapt, learning needs of learners and researchers and providing customized resources, feedback, and assessments, much like a sparring partner. In boxing parlance, a good sparring partner only challenges you as far as you are ready, thus incrementally improving your abilities. The same can be true of research using GenAI that asks questions within a desired framework if prompted correctly. For instance, this approach can help educators identify patterns in the written work compared with instructor feedback to an entire cohort or a whole school, providing educators with valuable insights into student performance and learning patterns. This insight can enable them to tailor their teaching strategies to better meet their students' needs (Pitso 2023).

However, significant disclaimers need to be applied to the use of GenAI tools. In terms of literature reviews and much of social sciences research, it remains to be seen how the unprecedented speed and scale of GenAI tools will handle the collection of real-time data. This has depended largely on the protocols or limits humans put in place regarding GenAI use. Thus, just as instructors are now able to use GenAI to create lesson plans, make presentations and videos, summarize large data sets, and even create exam questions, academics will need to judge the quality of output when evaluating articles for publications where GenAI tools have been used. For example, literature reviews performed by GenAI pose a particular problem if a scholarly publisher is also using GenAI to determine source reliability. This has broad implications for the advancement of knowledge in virtually every field. Nevertheless, experimentation with GenAI will no doubt continue. Higher education institutions may find uses for these tools for curriculum mapping, assessing prior learning across institutions, and creating personalized feedback protocols for student work based on patterns of dozens or hundreds of previous students' work. If GenAI can be taught to check the alignment between learning outcomes, classroom activities, and assessments, is it then possible to have GenAI tools design individualized

learning programs, vary the length of instruction, level of difficulty, and map these to industry specifications? How SoTL keeps up, and how human instructors fit into this course design scenario, are two other key questions researchers, instructors, and administrators may need to consider. In this manner, is it possible that one's SoTL research application or publication is accepted based upon a GenAI's review of all similar project outcomes? Would that determination account for ongoing but unfinished research in a given field?

Complex task generation is the key to such developments, and it is already upon us. Recently, ChatGPT released an expanded version that allows users to create their own personalized GPT capable of performing multiple tasks simultaneously, tailored to the user's specifications and prior usage. Applications for SoTL in this use case are interesting and potentially risky if crucial steps are rendered invisible to scholars, especially if they are unaware or unable to follow (through code-reading) the work processes of the GenAI to determine whether a step was skipped in the first place. In other cases, due to biases in training data, it may be almost impossible to determine. For example, consider an ethical review process where GenAI is used to generate the implications to a group of individuals being studied, but in which the GenAI tool has an undetected built-in bias. Such a study, if allowed to move forward, could have detrimental effects on the individuals studied, the groups they represent, and the credibility of the researchers.

Current state of generative AI in higher education

The integration of GenAI in higher education has been a topic of interest for the past decade, beginning with the advent of advanced neural network models and accessible machine learning software (Bender et al. 2021). Before the release of the current generation of LLMs, artificial intelligence (AI) education in universities was primarily concentrated in computer science, engineering, and related fields (Qadir 2022; Zhai et al. 2021). Students in these programs were introduced to the principles of machine learning, neural networks, and natural language processing, the foundational technologies behind today's LLMs (Zhai et al. 2021). The strengths of the current approach to GenAI education lie in its rigorous technical training and its ability to equip students with the skills needed to develop and refine these technologies. Computer scientists have a deep understanding of the algorithms and data structures that underpin AI; however, the vast majority of GenAI users tend to search for immediate solutions via engineered prompts. The narrow approach of the latter group raises ethical, social, and economic implications for the continued use of GenAI, including as a tool for researchers. As GenAI advances, offering text-to-video, video-to-text, audio-to-video, video-to-audio, text-to-image, image-to-text, video generation, audio generation, and coding, the ethical issues around privacy, authorship, authenticity, and open-source data become more pronounced.

Universities have taken different approaches to integrating GenAI into their curriculum. Since GenAI entered the academic domain through a "side door," resulting from its sudden release into the public domain, issues of academic integrity in higher education were the first challenge to be widely acknowledged. This caused a rush to create policy on GenAI use for faculty and students (Anselmo, Kendon, and Moya 2023; Boston University 2023; Brown 2023; Chapman University 2023; Nipissing University 2023; Stanford University 2023; University College London 2024; University of Toronto 2023). It is worth noting that policies around the use of GenAI have been requested by faculty caught unawares and unprepared in the classroom, while at the same time, instructors have rarely been consulted on these policies, which are often drawn up rapidly by university administrations. Among those scholars looking closely at the impacts of GenAI, Dr. Sarah Eaton recommends engaging with GenAI as part of the learning process rather than attempting to bar it from campuses (Eaton 2022;

Eaton and Anselmo 2023). For example, the University of British Columbia (UBC) in Canada has started using GenAI as a teaching tool in various disciplines, ranging from computer science to the humanities (Fletcher 2023). In the UBC Department of Computer Science, GenAI is currently being applied to help students understand complex algorithms and data structures. In the UBC Department of English language and literatures, these tools have reportedly been used to analyze literary texts and generate creative writing.

Several American universities have also begun experimenting with integrating GenAI assistants into their online and in-person courses. For instance, the Georgia Institute of Technology has integrated an AI-powered teaching assistant known as Jill Watson into several online courses (Goel 2023). Jill Watson uses natural language processing to answer students' questions, providing timely and accurate responses, and can be easily duplicated and adapted for new courses. These examples of intelligent tutoring systems (ITS), which engage students in topic-based contextual and cultural background learning, allow teaching to focus on complex topics rather than basic concepts. Another example is the University of Michigan's use of ECoach, an AI-powered personalized adaptive learning (PAL) model that provides students with scaffolded feedback, resources, and study strategies, helping them to navigate their courses more effectively (University of Michigan n.d.). An evaluation of ECoach found that it improved student performance and reduced achievement gaps, which may be relevant to improving outcomes for first-generation students and students from lower-income backgrounds (Chen et al. 2022). Despite the availability of these higher education-specific systems tailored for learners and adaptable to specific courses, publicly available GenAI tools, such as CoPilot, ChatGPT, and Gemini mean that students are also able to access an additional layer of highly flexible and customizable GenAI tools at any time. For instance, students can customize ChatGPT to focus on specific worldviews, end goals, or data sets and to search the Internet for additional materials through prompt engineering and role-playing.

In the near future, higher education instructors can expect students to use customized GenAI tools to perform tasks continually without being individually prompted to do so. Trends such as these have paved the way for changes to SoTL practices. The next iteration of GenAI may allow a researcher to set their customized GenAI tool to spend a pre-determined amount of time (possibly paid for with usage tokens, a potential source of disadvantage for researchers from lower-income countries) to search for and analyze data while writing and updating notes, summaries, and even the final paper itself. How far away are we from researchers using GenAI tools to search for the best-fit publication to support a specific reference or claim, or to generate hypotheses or research ideas after reading all the relevant published materials in each field?

By contrast, Dwivedi et al. (2023) considered a wide variety of disciplines and investigated the opportunities, challenges, and implications, as well as the important research questions raised by the emergence of GenAI, noting that research is still a human-centric process, not a robot-centric one. Yet, despite institutions of learning—including publishers and academic conferences—moving towards policies to limit or control the use of GenAI, it still resides with individuals to make ethical choices when using GenAI. Adjustments to assessment in the age of GenAI include focusing on process rather than achieving "the answer," embedding self-reflections into the process, and focusing on authentic assessment. The model applied to student assessment may also be applied to SoTL, implying it will change the nature and method of the inquiry process.

While higher education institutions are busy crafting policies for GenAI use at their institutions, it is less clear where academic publishers stand on the subject. Within a short order of the release of ChatGPT in November 2022, citation formats were developed for using GenAI tools. Key shared concepts amongst these policies include directing researchers to give credit to GenAI tools

whenever used. As technology advances, it would be unsurprising to find the cost of using customized AI tools preventative, thus growing the already problematic financial divide between researchers at large, well-funded institutions and those at community colleges, between students and researchers from higher-income and lower-income countries, and between students from higher and lower socioeconomic backgrounds. For example, how much faster would well-funded institutions perform research, write, and publish if their scholars managed customized and continuous GenAI search-and-write tools? What would the future of SoTL look like under these conditions?

The path ahead for higher education institutions

The integration of GenAI into higher education, and especially into SoTL, requires engagement and intensive study across institutions. Higher education institutions will need to plan the integration of these tools without impeding upon faculty autonomy. A comprehensive integration could be horizontal (enveloping an extensive array of disciplines including humanities, arts, and social sciences) and vertical (permeating various levels of study from foundational to advanced courses). It also should involve leaders within academic communities. By adopting an inclusive approach, higher education institutions can guarantee that researchers (and students as future researchers), irrespective of their specific field of study, acquire a fundamental and practical understanding of GenAI, its multifaceted applications, and its transformative potential. A new literacy is essential for preparing students to navigate a world increasingly influenced by GenAI technologies, ensuring they are well-versed in leveraging GenAI to solve complex problems in various fields rather than perpetuating them.

Higher education institutions began their interactions with GenAI tools by altering assessments in the classroom. One such low-barrier learning opportunity involved the use of "authentic assessment" in non-disposable assignments (NDAs) that leverage students' lived experiences and intersect with course content (Moreno 2023a; Moreno 2023b). ChatGPT, for instance, can help organize a student's thoughts and ask pertinent questions to achieve deeper reflections, but it cannot write such an assignment on its own, or at least not convincingly. More research into GenAI and authentic assessment is needed to understand whether this assessment style is an appropriate use of GenAI tools, meeting key criteria for student learning. Meanwhile, higher education institutions could consider incorporating ethics and social implications of GenAI tools into their curricula (Akgun and Greenhow 2022; Chan 2023; Fourtané 2022; Southworth et al. 2023). As GenAI technologies become increasingly pervasive, researchers must understand the ethical, social, and economic implications of these technologies. Workshops on artificial intelligence and ethics can equip users with the skills to navigate the complex, emerging changes to the moral landscape, preparing them for the ethical challenges they may encounter in their future careers.

However, the integration of GenAI into the academic sphere is not without its challenges. These include technical issues, such as the need for robust IT infrastructure and data privacy concerns, as well as pedagogical issues, such as the risk of over-reliance on technology and the potential for these tools to perpetuate existing educational inequities. Another potential barrier is resistance to change, both from faculty and students. To overcome this barrier, higher education institutions could proactively engage in a change management process, involving all relevant stakeholders in the planning and implementation. In particular, engaging with students, instructors, and administrators in curriculum planning, policymaking, and goal setting for the integration of GenAI is necessary to ensure student confidence in the coming sea changes in academic instruction.

CONCLUSIONS

GenAI appeared suddenly and took higher education institutions by surprise. Instructors, researchers, administrators, and students have rapidly adapted their behaviors in the learning environment as GenAI continues to disrupt a priori methods of assessment and learning processes. Overall, GenAI has the potential to make impactful changes in learning and for learners. However, an overlooked area of further potential resides in SoTL. While students often engage with the GenAI to find "the answer" to their questions or use GenAI as a co-pilot in the learning process, researchers and instructors are now beginning to use GenAI to ask the questions, to delve into the ways curriculum is created, how lessons are planned, how research may be conducted, and how data can be gathered and analyzed using GenAI tools. Just as GenAI offers a greater benefit to developers than it does users, researchers may stand to gain more than student users if they learn to wield GenAI correctly.

In the early months of the "AI revolution," a common refrain on university campuses repeated by baffled professors, exhausted instructors, and excited students was that "GenAI was here to stay." Upon reflection, although honest, this refrain obscures a critical insight into the nature of GenAI: it is in constant evolution, iteration, and flux. Indeed, the GenAI tools available last week, last month, and last year resemble each other only at the surface level; the internal machinery and training datasets they use to improve and build upon earlier models grow exponentially with each iteration, bulwarked by billions of real-time queries from millions of users around the globe. Who knows what the forthcoming iteration of GenAI tools will look like next week?

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DISCLOSURE

Generative AI technology (ChatGPT – DALL-E) was used to create the cover image for this article.

ETHICS

This research did not involve any ethical considerations, as it was based solely on publicly available data and did not entail any interventions or interactions with human subjects.

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