The AI Revolution: A Double-Edged Sword for Academic Research

A Swiss data scientist recently asked ChatGPT – the revolutionary generative AI large language model – to write an essay about the "cycloidal inverted electromagnon." In the confident, authoritative voice that has become its hallmark, ChatGPT quickly generated an article that even included citations. One problem: The "cycloidal inverted electromagnon" does not exist.

The episode illustrates the paradox of the new era of generative AI that dawned with the introduction of ChatGPT. On the one hand, university research scientists and administrators acknowledge that there is immense potential for the technology across the academic research enterprise – from conducting research to managing administration and compliance to expanding funding opportunities.

On the other hand, there is tangible caution centered on the technology's shortcomings, limitations, and as-yet-unknown implications. It is already notorious for its confounding tendency to generate false answers confidently. There also have been widespread reports of bias, and for experts and researchers, ChatGPT presents theoretical and technical conundrums.

OpenAI, the company behind ChatGPT, recently pushed an update to the chatbot, GPT-4, that improves on the version that has stunned the world. Technology giants like Microsoft are already using GPT-4 to power select products and services, while others like Google have introduced their own chatbots to compete with ChatGPT.

For the research enterprise, these new developments signal an urgent need to understand and leverage the technology's power, even as it evolves. Generative AI is already having a profound impact on the conduct and administration of research and will affect research funding in the following ways.

Use in Conducting Research

Generative AI has developed and is used widely in the academic research community, so not surprisingly, academic researchers are actively applying it to the conduct of research.

- **Automated Literature Review:** The technology can automate the literature review process and analyze existing research and publications to provide valuable insights and identify knowledge gaps. With the current shortcomings and limitations, extensive human fact-checking remains critical. Increasingly, training for new research scientists will involve learning the new generative AI technology and how to apply it in the lab and the field effectively.

- **Publications:** Scientific journals are grappling with the impact of ChatGPT on current publication paradigms. Recent journals have banned listing AI software as contributing authors, and researchers are evaluating its use in the peer review process.

- **Data Analysis:** Generative AI can help researchers analyze large datasets and identify patterns and trends in the data, providing a summary of key findings to place focus on areas of further investigation. This capability will be valuable with closed datasets that have been cleaned and verified.

- **Clinical Research Applications:** Generative AI can potentially help identify and retain research participants, increase involvement in trials, and speed up time to translation. Recent advances include a drug designed entirely by AI and identifying new uses for existing drugs. With these advances, researchers have called for regulatory guardrails to protect against bias, and the FDA is creating guidance for AI usage in developing devices and pharmaceuticals.

Use in Research Administration

Generative AI can ease the administrative burden for administrators and Principal Investigators (PIs). The key to successful implementation is to develop use cases today and plan for tomorrow's technology. Generative AI can bring immense value to the management of research portfolios. However, like any tool, its effectiveness depends on well-informed users. Possible uses of generative AI in research administration include:
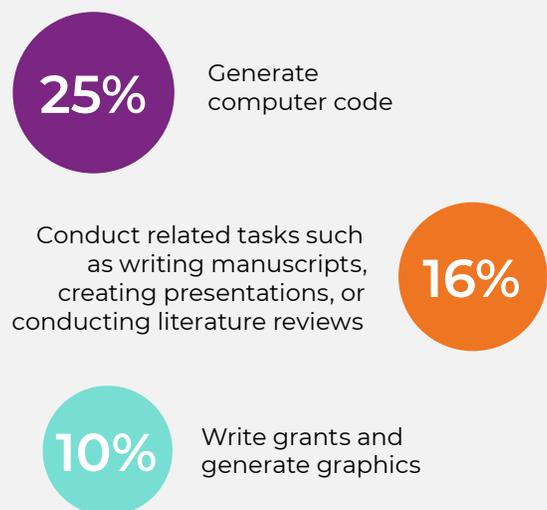
- **Grant Writing:** Generating a preliminary draft that follows specific formatting and style requirements. However, fact-checking and revision are required, given the high error rates. Eventually, universities will be able to create large data sets of successful proposals, major sponsor requirements, and other data that large language model generative AI applications can use to generate first drafts of grant proposals. While research operations currently use databases to inform grant-writing, generative AI will significantly enhance the process with new data and analytical capabilities.

- **Report Writing:** Creating drafts of progress or technical reports that synthesize existing

institutional systems data for evaluation and finalization by the research administrator or PI.

- **Compliance:** Automating compliance processes by monitoring regulatory changes, writing required reports, and identifying non-compliant activities; supporting compliance functions such as IACUC and AAALAC program reviews, AAHRPP accreditation preparation, and research misconduct investigations to ensure compliance; analyzing organizational-level research portfolios and separating relevant and irrelevant data.

- **Optimizing Workflows:** Automating routine tasks, such as retrieving data from various internal systems to prepopulate proposal submission forms and generate preliminary budgets. Pulling from live data sources to improve accuracy and reduce review touchpoints. And digesting recorded meetings to provide minutes.

Gaining Traction in The Field

To understand how the research community is using generative AI, Nature recently surveyed its readership. The results show that the percentage of respondents using AI tools to conduct specific tasks is gaining popularity:

25% Generate computer code

Conduct related tasks such as writing manuscripts, creating presentations, or conducting literature reviews **16%**

10% Write grants and generate graphics

Note: Results are based on a subset of 500 responses. Respondents were restricted to selecting one option.

- **Knowledge Management:** Capturing knowledge, making it easily accessible to relevant stakeholders. Institutions can track detailed information such as finalized budgets and contracts, allowing readily accessible universitywide data for new grant proposals or clinical trial submissions. Internally based generative AI can scrub patients' records for diagnosed diseases allowing institutions to align clinical trial submissions to match their patient population. As institutions look at more sophisticated and data-driven budget models, especially ones with multiple stakeholders (e.g., RCM), generative AI provides a valuable tool to consider operational costs (e.g., IRB protocol volume and type of protocols and staffing analysis).

Effects on Research Funding

Companies like OpenAI, Microsoft, Google, and Amazon have already mobilized billions of dollars in private investment for generative AI. University research operations can expect an increase in private research dollars into a range of related research interests with potential commercial applications.

Federal research dollars will also likely increase. For example, the National Institutes of Health is investing $130 million over the next four years to accelerate the use of AI by the biomedical and behavioral research communities. The principal AI research sponsors for over a decade have been the National Science Foundation, the Defense Advanced Research Projects Agency, and the National Institutes of Health.

Federal sponsors will be interested in a wide range of questions beyond the technology's underlying functioning and practical industrial applications. Potential areas of research inquiry include natural language processing, human-computer interaction, content creation, understanding human cognition and language, and AI ethics and safety.

A Transformative Technology Powered by Humans

According to former Secretary of State and National Security Advisor Henry Kissinger, former Google CEO Eric Schmidt, and MIT computer scientist Daniel Huttenlocher, this new reality could be as transformative as the invention of the printing press.

"The long-term importance of generative AI transcends commercial implications or even on-commercial scientific breakthroughs," they wrote in the Wall Street Journal. "It is not only generating answers; it is generating philosophically profound questions."

Seeking the answers to these and myriad other questions will be an area of extensive research activity for decades. However, the use of generative AI is here today and requires immediate attention to ensure that it is used appropriately for discovery.

Because generative AI ultimately requires a human being to make decisions about the credibility and quality of its product, it is equally important to educate and train professionals at all experience levels on how to use it. ChatGPT and other AI tools cannot generate new knowledge and concepts. They can generate language based on statistical methods that can be creative in outputs or synthesize existing information in new ways based on prompts, but they cannot create a new concept. At least for now, human experience, education, and training still trump machine learning.

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