Quantifying the Benefit of Artificial Intelligence in Scientific Research

Jian Gao[1,2,3], Dashun Wang[1,2,3,4*]

1. Center for Science of Science and Innovation, Northwestern University, Evanston, IL 60208
2. Kellogg School of Management, Northwestern University, Evanston, IL 60208
3. Northwestern Institute on Complex Systems, Northwestern University, Evanston, IL 60208
4. McCormick School of Engineering, Northwestern University, Evanston, IL 60208
*Correspondence Email: dashun.wang@kellogg.northwestern.edu

Abstract

The ongoing artificial intelligence (AI) revolution has the potential to change almost every line of work. As AI capabilities continue to improve in accuracy, robustness, and reach, AI may outperform and even replace human experts across many economically valuable tasks. Despite enormous efforts devoted to understanding AI's impact on labor and the economy, and its recent success in accelerating scientific discovery and progress, we lack a systematic understanding of how advances in AI may benefit scientific research across disciplines and fields. Here we develop a measurement framework to estimate both the direct use of AI and the potential benefit of AI in scientific research, by applying natural language processing techniques to about 87.6 million publications and 7.6 million patents. We find that the use of AI in research appears widespread throughout the sciences, growing especially rapidly since 2015, and papers that use AI exhibit an impact premium, more likely to be highly cited both within and outside their disciplines. While almost every discipline contains some subfields that benefit substantially from AI, analyzing about 5.3 million course syllabi across 15 broad scientific disciplines, we find a systematic misalignment between the education of AI and its impact on research, suggesting the supply of AI talents in scientific disciplines is not commensurate with AI research demands. Lastly, examining who benefits from AI within the scientific workforce, we find that disciplines with a higher representation of women or black scientists tend to see less benefit, suggesting that AI's growing impact on research may further exacerbate existing inequalities in science. As the connection between AI and scientific research deepens, our findings may have an increasing value, with important implications for the equity and sustainability of the research enterprise.

Keywords: Artificial intelligence; Scientific impact; Future of work; Research inequality; Computational social science