How AI can reshape research institutions

Outline

AI in Research

- how is AI revolutionizing research in human behavior & societal dynamics?
- what impact do tools like ResearchRabbit, Elicit, and Humata have?
- are we fully exploring AI's potential in data analysis?
- what are the ethical and practical implications of AI in research?
- How should we determine the most beneficial applications of AI tools in research processes?

AI in Research

Research Workflow

1. Discovery
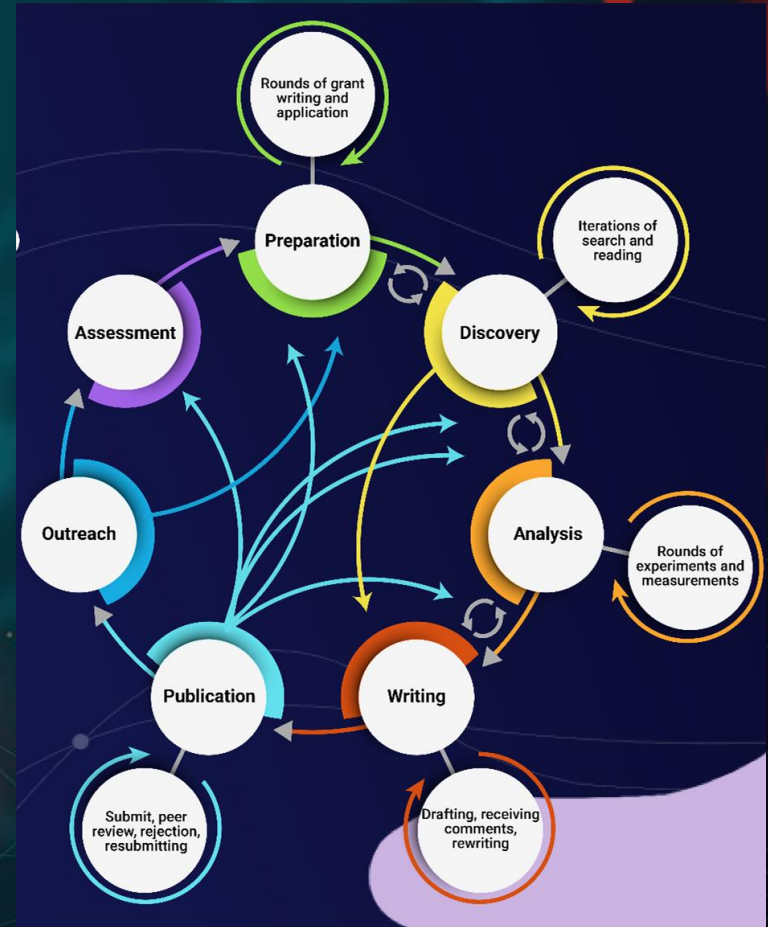2. Data Collection
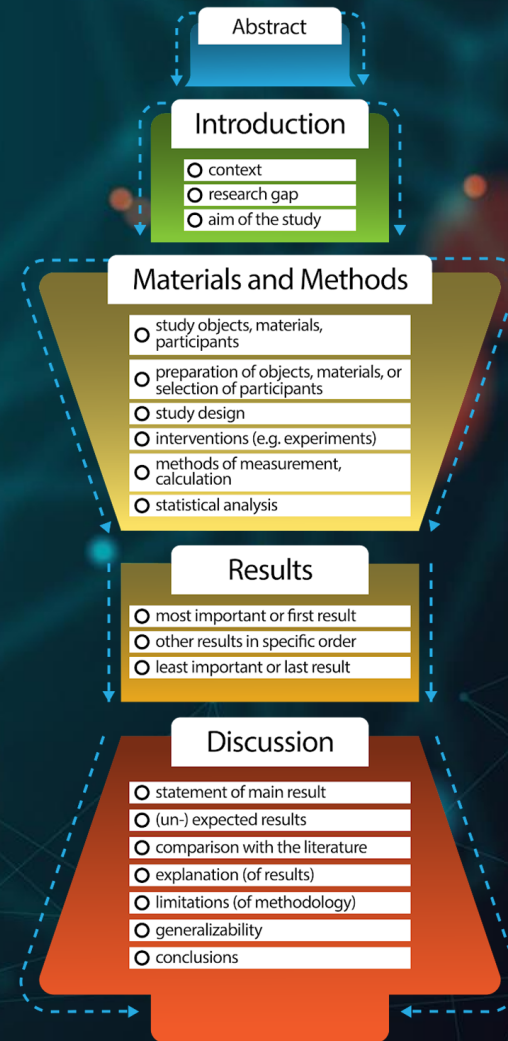3. Analysis
4. Writing
5. Publication
6. Outreach & Impact

University of Buffalo (2023), "Research Process"

AI in Research

A MULTI-CYCLIC, MULTI-ORDERED MODEL OF THE RESEARCH AND WORKFLOW, WITH LOOPS

University of Buffalo (2023), "Research Process"

AI in Research

Abstract

Introduction
- context
- research gap
- aim of the study

Materials and Methods
- study objects, materials, participants
- preparation of objects, materials, or selection of participants
- study design
- interventions (e.g. experiments)
- methods of measurement, calculation
- statistical analysis

Results
- most important or first result
- other results in specific order
- least important or last result

Discussion
- statement of main result
- (un-) expected results
- comparison with the literature
- explanation (of results)
- limitations (of methodology)
- generalizability
- conclusions

Singh, V., & Mayer, P. (2014). Doi: 10.1002/bmb.20815

Challenges for AI and AI in Research Institutions

1 Data Scarcity

2 Inconspicuous Synthetic Data

3 AI and Bias in Research

1. Data Scarcity

The challenge of data scarcity in training AI models underscores critical concerns regarding its performance:

1. Unpredictability
2. Fairness
3. Mitigating biases
4. Other ethical considerations

Operating on limited and potentially non-representative datasets can lead models to inadvertently learn and amplify existing inequalities in data.
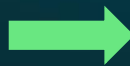
2. Inconspicuous Synthetic Data:
When data is thought to be Human-generated

Research institutions may **unconsciously use AI-generated data** resulting to a biased and insufficient output quality.

As exemplified by Amazon Mechanical Turk (AMT) and other third party platforms:

Hires low-paying crowdsourced workers to perform repetitive tasks

→

Train models for automation

2. Inconspicuous Synthetic Data:
When data is thought to be Human-generated

Mechanical Turk workers' income depend on the number of accomplished tasks, **33-46% of these workers use Large Language Models (e.g. ChatGPT)** to finish text production efficiently and have higher income (Veselovsky, Ribeiro, & West, 2023).

amazon
mechanical turk

AI-generated responses risk **trivial and lack of diverse human responses** and i**mpede development** of models.

3. AI and Bias in Research

A. **Biased Training Data**: Datasets might not account for **lived experience** or they might not be a representative of diverse populations.

> Example: Self-driving cars - less able to identify pedestrians with darker skin tones.

A. **Over Reliance on AI** can lead to outputs that researchers themselves don't understand.

> survey of 1,600 researchers by Nature (CITE): 69% said AI tools tend to build reliance on pattern recognition without understanding.

3. AI and Bias in Research

Wellcome Bioethics Lead, Carleigh Krubiner, notes that:

"On one hand, there's AI's potential for good. But there's also real danger of the misuse of some of these technologies, the more pernicious aspects of **reinforced bias and the 'black box of not understanding what's going on behind the technology** to generate outputs."

This lack of understanding could lead to a **lack of accountability**, eroding public support and trust in research in general.

Proposed Solutions

MITIGATING BIASES

Improving representation and accounting for lived experience in datasets.

RESEARCHER'S RESPONSIBILITY

Despite being red, Mars is very cold

AI ETHICS

Explainable AI & Constitutional AI

Data augmentation

EXPLAINABLE AI (XAI) & CONSTITUTIONAL AI (CAI)

Concerns on 'humanizing AI'

XAI	CAI
- Reduces binary answers of AI - Explains the reason behind its decision - Building trustworthiness, transparency, and confidence Example: AI proactively responds & explains why they decline harmful requests or offensive language (Bai et al., 2022a).	- Ensure safe, beneficial, and ethical AI systems - Pretrained constitutional principles - Enable AI to be ethical and constitutional without direct feedback Example: Case Repositories consist of "seed cases" or FAQs asked by people to an AI system. It generates variants of cases to account for variety and human feedback (Chen et al., 2023).
Developing a clear and understandable explainability AI system.	**Aligning AI with human values through Reinforcement Learning from Human Feedback (RLHF) and Reinforcement Learning (RL).**

MITIGATING AI BIASES IN RESEARCH

ONE WAY TO MITIGATE

Improve representation and accounting for lived experiences in datasets.

"Explaining to people why and how that data would be shared and used is important, especially for people who are digitally excluded."

TRANSPARENCY & TRUST

Anna Studman's interviews with people experiencing poverty or chronic health conditions showed that:
"The nuance of lived experience doesn't come through in clinical datasets"

Lack of trust in healthcare systems and institutions are evident in marginalized populations. Hence, the need to earn community trust in using health data.

Researcher's responsibilities in research

In any field of research, researchers must:

- **identify** and **reduce bias** in datasets
- account for **lived experience** in their data
- understand the **outcomes of their algorithms**
- consider the **applications** of their research

"AI is just a tool: it's only as good as the data it's trained on "
- Shuranjeet Singh, Lived Experience Consultant

AI IN HEALTH AND MEDICAL RESEARCH

DRUG DISCOVERY

AI could **shorten the drug discovery pipeline** and **reduce costs**

- - even for research areas with lower financial returns & lack incentives for investment (ex: **drug discovery for rare diseases,** those affecting low- & middle-income countries (LMICs)

- - Researchers able to **process data at speeds previously unimaginable**.

Priscilla Chan (Chan Zuckerberg Initiative): the revolution in technology could "**help scientists cure, prevent or manage all diseases by the end of this century.**"

HUMAN CELL ATLAS

An international research project is an effort to create a **reference map of all the cells in the human body**, which could **transform our entire understanding of biology** and health. With AI, researchers can **analyze vast amounts of genomic data in a fraction** of the time it would have taken in previous years.

OPEN DATA &
OPEN SCIENCE

"Open data and content can be freely used, modified, and shared by anyone for any purpose" (Open Knowledge Foundation, n.d.)

"Open science is the movement to make scientific research, data and dissemination accessible to all levels of an inquiring society" (FOSTER, n.d.)

Potential of Open Data and Open Science

1. Discovery and Innovation

2. Reproducibility

3. Justice / Fairness

Open Data: Quality over Quantity
(Sadiq and Indulska, 2017)

Dimensions of Quality Data:

DESCRIPTION ———————— **ACCURATE**

COMPLETE ———————— DESCRIPTION

DESCRIPTION ———————— **CONSISTENT**

Open Data: Quality over Quantity
(Sadiq and Indulska, 2017)

How can we ensure Quality Open Data?

1. Shared understanding of data quality dimensions
    a. Accurate, complete and consistent
2. Support for quality awareness
    a. Through multi- and cross-disciplinary teams spanning across researcher communities

AI in HEI, Learning, and Research

Higher Education Learning & Non-Research Professorial Work

1. HEIs' AI capability significantly affects students' self-efficacy and creativity;
2. HEIs' AI capability affects students' learning performance via 2 mediating variables: student creativity and self-efficacy

The findings of this study provide an entry point for HEIs to promote the application of AI from three aspects: Technical skills, Teaching application, and Collaborative competence.

AI in HEI, Learning, and Research

HEIs should also provide support for capital investment such as AI to improve the quality of education as they can be aided by generative AI tools.

AI in HEI, Learning, and Research

Crompton & Burke (2023) analyzed the trends in higher-learning research literature in the use of AI in education, 2016-2022:

- AI can be helpful in providing personalized learning assistance to students (small to large classes to MOOCs).

AI, Open data, and Open Science in Research Institutions
AI-generated Data in Research Institutions

- How essential is **real-world data** for improving AI model performance?
- Necessity for **rigorous tweaking and verification** of AI models
- AI-generated data in research institutions: what are its limits?
  - Quach (2022): AI data effective for **mid-Level complexity** tasks
  - AI's struggle with real-world complexity
- Why is **expert knowledge** vital for validating AI model results?

It is in our best interest to NOT gatekeep groundbreaking research and have it as information and open data which could be used by others to improve the country.

How can AI reshape Research Institutions?

1. open data and open science, as we integrate AI not just in our research institutions but also in HEIs & the country.

2. the quantity of data that AI can absorb and produce is limitless. <u>Hence, for AI to reshape research institutions positively is to produce quality, useful data</u>.

A promising phenomenon of open data: A case study of the Chicago open data project
(Kassen, 2013)

1. Promotion of civic engagement
- promotes **transparency and accountability** of the government
- creates a favorable environment for **proactive civic engagement**
    - creating applications using available datasets from the web-portal without any official permission
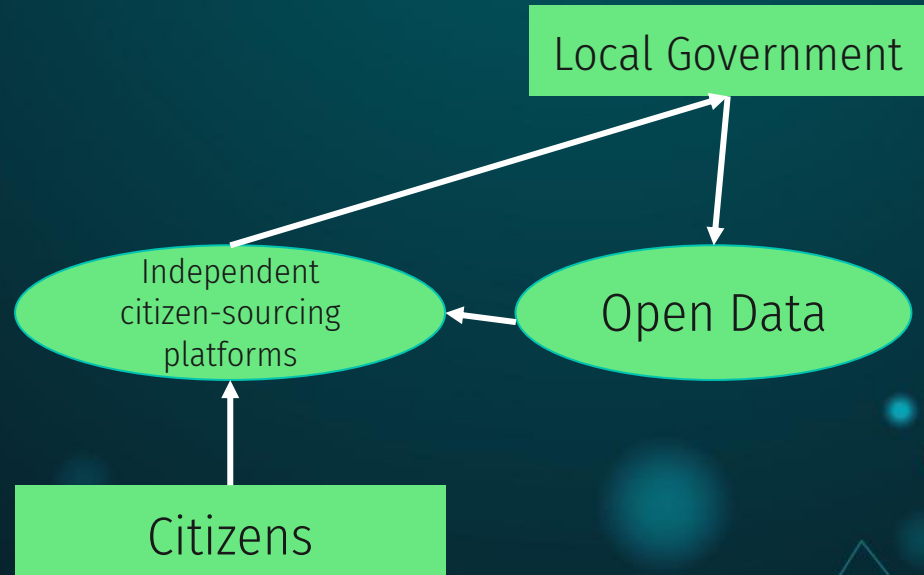
A promising phenomenon of open data: A case study of the Chicago open data project
(Kassen, 2013)

2. Promotion of developers' networks and standardization
   - This helps to further develop and improve universal tools and even successful layouts of the website design, i.e. promoting standardization of the realization procedures.

A promising phenomenon of open data: A case study of the Chicago open data project
(Kassen, 2013)

3. Identification of community needs
- Various statistical tools, personalization and filtering mechanisms embedded in the city open data portal help to **clarify community needs**
    - visualization of transportation issues
    - mapping of utility management
    - evaluating of political campaigns
    - social benefits
    - budget cuts

A promising phenomenon of open data: A case study of the Chicago open data project
(Kassen, 2013)

4. Importance of non-governmental sector

- Private non-profit sector
  - Can provide additional financial and technical assistance to the local government in realization of open government projects.
    - Grants and contests
- The partnership with a non-governmental sector offers a more flexible result-oriented way of decision-making with active participation of the local society.

The government, research institutions and civic society (NGOs, organizations) can have easier partnerships through utilization of open data and open science powered with AI.

Information must be free.

Yes to Quality Open Data!