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How to Apply AI in Sustainability Research Project

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Abstract: *The paper outlines conceptual ideas for the application of AI in sustainability research projects. As integration of AI in research is still in its early stages AI is announced to have significant potential in research processes. Although the authors consider that AI should not be used for its own sake. AI can automate tasks, recognize topics, and identify emerging trends which can significantly improve research efficiency and accuracy. However, challenges such as data bias and ethical considerations must be addressed. In conclusion, the implementation of AI in sustainability research projects requires a collaborative approach between human intellect and AI capabilities and "Garbage in, Garbage out" (GIGO) has to be remembered in the application of AI tools.*

1. INTRODUCTION

As a more conceptual-driven and theory-attracted researcher the main question of "how to apply AI" cannot be answered straightforwardly. Using AI in research does not have to be for the sake of AI itself. Wagner et al. (2022) have objectivity to familiarize researchers with trends in using AI in different stages of the research process, mainly literature review. They concluded that the theme of AI in research is in its early stage of development. And it is proposed a research agenda for AI-based literature reviews (AILRs). It is confirmed also by Lund and Wang (2023) that further research ought to be conducted to fully understand how AI can be effectively applied in research (Lund & Wang, 2023). In conceptual-based articles, the issue with AI is a matter of upper sophistication as these papers exclude the already known and predefined structure of scientific research. Empirical findings are a significant base but also field works and other observations can be taken into consideration. The conceptual paper merely stands for the author's creativity and other intellectual skills. Without a doubt, artificial help can have a valuable contribution.

The current paper will outline how AI can be applied to recognize topics and ideas. Because, specifically for conceptual papers, argument ideas cannot be derived from traditional data but require the author to assimilate and combinate any kind of evidence from already developed concepts and theories (Hirschheim, 2008).

2. AI DEVELOPMENT IN ACADEMIC RESEARCH

The relentless pursuit of innovation in AI has led to the development of advanced models with sophisticated language capabilities, transforming academic practices fundamentally (Kenwright, 2024). AI-driven tools now enhance processes like literature reviews, manuscript preparation, and reference management, simplifying academic research while allowing researchers to focus on deeper exploration and innovation within their fields (Thompson et al., 2023).

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AI's natural language processing (NLP) capabilities enable swift, comprehensive literature reviews, highlighting trends, research gaps, and thematic connections (Roberts, 2023). These tools uncover hidden patterns within vast datasets, identifying new research avenues and forecasting developments in various disciplines. Additionally, machine learning algorithms power personalized research recommendations by analyzing individual preferences and past work, suggesting relevant articles, conferences, and collaborators to foster interdisciplinary innovation (Khabib, 2022). Semantic search features deliver precise, context-aware results, while AI-generated knowledge graphs illustrate complex relationships between concepts, providing a holistic understanding of research areas (Mohammed et al., 2023).

The exponential growth of research publications has reshaped academia, with platforms like Scopus and Web of Science evidencing this surge. This information overload makes staying updated on developments increasingly challenging, as filtering through extensive datasets for impactful research becomes more difficult. Traditional approaches, such as manual searches or keyword-based methods, often fall short. Variations in terminology can exclude relevant studies in keyword searches, while manual methods struggle with the sheer volume of research outputs. The integration of AI into academic workflows marks a transformative shift, unlocking new opportunities for exploration and discovery (Chen et al., 2020). By utilizing AI's potential, researchers can advance their endeavors, blending human creativity with technological innovation to redefine knowledge creation.

Despite the advantages, the widespread use of AI tools introduces potential risks. Reviewers and editors must remain vigilant to ensure these tools do not compromise scientific integrity (Jaiswal & Arun, 2021). Balancing the benefits of AI with the need to preserve rigorous scientific discourse is essential. Responsible use requires careful oversight to maintain the quality and reliability of academic work in the face of rapid technological progress (Garbuio & Lin, 2021). Moreover, ethical challenges such as data privacy, algorithmic biases, and transparency must be addressed to ensure equitable and trustworthy use of AI in academic research.

3. DRAFTING APPLICATIONS OF AI IN THE SUSTAINABILITY RESEARCH PROJECT

Looking for topics and ideas is a broadly managed challenge. As Hoffman and Hancock (2017) note, AI significantly enhances the process of search, leveraging capabilities to combine texts through extensive databases using specific keywords and questions, thereby identifying pertinent articles more accurately than traditional search methods. Moreover, AI streamlines the research process by summarizing key findings and extracting crucial evidence and concepts from the empirical findings, which is a time-saving effort.

Beyond that, AI analyzes large datasets of research articles to identify emerging trends and future directions within specific disciplines (Duymaz & Tekin, 2024). This trend analysis is pivotal for researchers aiming to stay ahead of the curve and identify under-explored areas or potential literature gaps. AI also plays a crucial role in uncovering hidden connections and fostering interdisciplinary collaboration by linking disparate research topics.

AI's capability extends to aiding researchers in understanding complex concepts through the analysis of a wide array of articles on a given topic (Donmez et al., 2023). This aids in forming a comprehensive view of various interpretations and related concepts within a field. AI can further assist in formulating research questions and hypotheses by identifying unexplored or conflicting areas of research, potentially sparking new avenues for innovative research (Ginting et al., 2023).

Additionally, AI enhances the discoverability of research and cohesive knowledge organization. Some initial steps of how to apply AI in recognition of topics and ideas for my conceptual paper are:

(i) Define my Research Focus:
- Brainstorm Broadly: Before diving into the AI, spend some time brainstorming potential research areas or questions. Write down anything that sparks your interest within your field.
- Refine and Narrow: Once there is a broad list, choose a specific area or question you'd like to explore further. This provides a starting point for the AI tool and ensures that the research will stay focused.

(ii) Select the Right AI Tool:
- Considering the Needs: Different AI content generators have varying strengths (Table 1).

(iii) Craft a Tailored Prompt:
- Start with Background: Briefly introduce your chosen research area or question.
- Specify my Request: Clearly state how the AI can assist.

(iv) Analyze and evaluate the AI Outputs:
- Relevance Assessment: Carefully evaluate whether the generated ideas or topics align with your initial research focus.
- Accuracy Check: Do not blindly accept information, especially empirical findings from quantitative papers.
- Completeness Understanding: Recognize that AI outputs are a starting point, not a finished product. Have to be conducted further research to develop strong arguments, linkages and evidence.

(v) Leverage AI for Deeper Exploration:
- Targeted Analysis: Once a list of potential topics is ready, the AI tool can delve deeper into specific areas.
- Refine Research Question: With AI research questions might become more refined or even shift direction entirely. This is a natural part of the research process.

(vi) Maintain a Critical and Curious Mind.

Table 1. Potential AI tools

AI Tool	Category	Specific Uses
Scholarcy	Literature Review & Knowledge Management	Summarizes & extracts key information, identifies figures & tables, recognizes concepts, citation management
Scite	Literature Review & Citation Management	Analyzes articles, checks citation accuracy, visualizes citation landscape, suggests citation formats
Research Rabbit	Literature Review & Discovery	Research paper discovery & organization, categorized collections ("research Spotify")
Elicit	Literature Review & Trend Analysis	Analyzes articles to identify research gaps, trends, and connections between topics
Consensus	Literature Review & Knowledge Synthesis	Compiling information from research & peer-reviewed articles offers a comprehensive understanding of a topic
OpenRead	Reading & Comprehension	Interactive platform for engaging with academic formats, Q&A systems, "Paper Espresso" for faster literature reviews
ChatGPT	Large Language Models (LLMs) for Creative Exploration & Brainstorming	Generates different creative text formats to brainstorm research ideas and explore diverse angles within your study area.
Gemini	Large Language Models (LLMs) for Creative Exploration & Brainstorming	Offers strong text generation and integrates with Google Scholar for research-oriented brainstorming.

Source: Own research

All in all, for my sustainability research projects AI still looks dim. "Garbage in, Garbage out" (GIGO) has to be remembered in the application of the aforementioned AI tools. AI requires serious self-reflection.

4. FUTURE RESEARCH DIRECTIONS

The future of AI in sustainability research holds transformative potential, set to revolutionize discovery and innovation. A major focus will be enhancing the accuracy and transparency of AI models used to identify research topics and ideas. By improving the explainability of AI-generated insights, researchers will develop greater trust in the technology while gaining a deeper understanding of the reasoning behind its recommendations (Liu et al., 2021).

As AI technology advances, it will likely lead to the creation of specialized tools tailored to the unique demands of various disciplines. These tools will integrate domain-specific knowledge to provide researchers with precise and effective support. For example, legal researchers could benefit from AI systems designed to analyze legal documents, while biologists could use AI to unravel complex protein structures. The scope for such tailored solutions is virtually limitless.

Rather than replacing researchers, AI is poised to foster a collaborative dynamic where human and machine intelligence complement one another. While AI excels at processing large datasets and uncovering patterns, researchers will continue to apply critical thinking to interpret results, pose meaningful research questions, and devise innovative solutions. This integration of AI into research workflows will create a more comprehensive and efficient research experience, empowering researchers to achieve greater outcomes. The future of research, therefore, lies in the synergy between human intuition and AI's vast capabilities.

5. CONCLUSION

AI in sustainability research presents a valuable opportunity to explore, synthesize, and address global challenges. By automating time-consuming tasks such as literature reviews and data extraction, AI allows researchers to dedicate more time to complex analysis and creative problem-solving. AI-powered tools excel at analyzing large datasets with greater accuracy and depth than traditional methods, resulting in more comprehensive and insightful research outcomes (Chen et al., 2020).

One of AI's greatest strengths lies in its ability to uncover hidden patterns and relationships within data, leading to the identification of new research questions, unexplored areas, and innovative solutions (Golan et al., 2023). However, the effectiveness of these tools depends significantly on the quality and representativeness of the data used to train them. Biases in training data can influence AI outputs, potentially resulting in skewed findings or overlooked opportunities (Lund & Wang, 2023).

While AI can significantly enhance sustainability research, researchers must approach its use with caution and balance. They should remain critical of AI outputs and mindful of limitations, such as the potential for bias and the need for high-quality data. Additionally, access to advanced AI tools remains a challenge for researchers at institutions with limited resources, posing a barrier to equitable participation in sustainability research.

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