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Artificial Intelligence Integration and Social Innovation: Interdisciplinary Research Trends Aligned with the Sustainable Development Goals

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Abstract

This study investigates the integration of Artificial Intelligence (AI), Machine Learning, Natural Language Processing (NLP), and Prompt Engineering into the social sciences and their impact on collaborative networks, thematic developments, and research trends aligned with the Sustainable Development Goals (SDGs). Utilizing bibliometric analysis and topic modeling, the research analyzes a dataset of 389 publications from the Web of Science (WoS) database, spanning the last decade. The findings highlight significant growth in interdisciplinary research at the intersection of these technologies and social sciences, with notable contributions in management, business, and environmental studies. The study identifies key themes such as AI-driven innovation in product development, progress in the energy sector, and the use of AI in educational and healthcare environments. It highlights AI's transformative potential in promoting sustainable development, while also stressing the significance of addressing ethical concerns and ensuring responsible application. This research contributes to a deeper understanding of how AI and related technologies are reshaping the social sciences and their role in achieving global sustainability goals.

Keywords: artificial intelligence integration, sustainable development goals, social innovation

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Yapay Zekâ Entegrasyonu ve Sosyal İnovasyon: Sürdürülebilir Kalkınma Amaçlarıyla Uyumlu Disiplinlerarası Araştırma Eğilimleri

Öz

Bu çalışma, Yapay Zeka (YZ), Makine Öğrenimi, Doğal Dil İşleme (NLP) ve Prompt Mühendisliği'nin sosyal bilimlere entegrasyonunu ve bu teknolojilerin işbirlikçi ağlar, tematik gelişmeler ve Sürdürülebilir Kalkınma Amaçları (SKA'lar) ile uyumlu araştırma eğilimleri üzerindeki etkilerini incelemektedir. Bibliyometrik analiz ve konu modelleme yöntemlerini kullanan araştırma, son on yılı kapsayan Web of Science (WoS) veri tabanından elde edilen 389 yayını analiz etmektedir. Bulgular, bu teknolojilerin sosyal bilimlerle kesişiminde disiplinlerarası araştırmalarda önemli bir büyüme olduğunu ve özellikle yönetim, işletme ve çevre çalışmaları alanlarında kayda değer katkılar yapıldığını ortaya koymaktadır. Çalışma, YZ'nin ürün geliştirmede yenilikçi uygulamaları, enerji sektöründeki ilerlemeler ve eğitim ile sağlık alanlarındaki kullanımı gibi ana temaları belirlemektedir. Araştırma, YZ'nin sürdürülebilir kalkınmayı desteklemedeki dönüştürücü potansiyeline vurgu yaparken, etik kaygıların ele alınmasının ve sorumlu bir şekilde uygulanmasının önemine de dikkat çekmektedir. Bu çalışma, YZ ve ilgili teknolojilerin sosyal bilimleri nasıl yeniden şekillendirdiği ve küresel sürdürülebilirlik hedeflerine ulaşmada oynadığı rol hakkında daha derin bir anlayışa katkı sağlamaktadır.

Anahtar Kelimeler: yapay zeka entegrasyonu, sürdürülebilir kalkınma amaçları, sosyal inovasyon

1. INTRODUCTION

Artificial Intelligence (AI) has increasingly been recognized as a transformative force across various domains, including the social sciences (Cao, 2022). Its integration into these fields promises to revolutionize not only how research is conducted but also how data is analyzed and how insights are applied in real-world contexts (Davenport and Ronanki, 2018). AI's ability to process large volumes of data with speed and accuracy has opened new avenues for researchers, enabling them to uncover patterns and relationships that were previously difficult, if not impossible, to detect using traditional methods. The application of AI in social sciences extends beyond mere data analysis; it also fundamentally alters the way research questions are framed, and hypotheses are tested (Floridi et al., 2021). For instance, machine learning algorithms can model complex social phenomena, offering predictive insights that can guide public policy, economic strategies, and social interventions (Longo et al., 2024). This predictive capability is particularly valuable in areas like sociology, economics, and political science, where understanding human behavior and societal trends is crucial (Padmaja vd., 2024).

Scholars such as Brynjolfsson and McAfee (2017) have highlighted the disruptive nature of AI, suggesting that it can lead to significant advancements in decision-making processes, particularly in management and business strategies. AI-driven tools can optimize operations, improve resource allocation, and enhance strategic planning by providing decision-makers with real-time, data-driven insights (Iansiti and Lakhani, 2020). This shift towards AI-assisted decision-making is reshaping industries, driving efficiencies, and creating competitive advantages for businesses that successfully integrate these technologies into their workflows (Batarseh et al., 2021). Moreover, the evolution of AI within social sciences is expanding the toolkit available to researchers and practitioners, enabling them to address complex global challenges such as climate change, health crises, and social inequality (Brynjolfsson and McAfee, 2017). For example, AI-powered models can simulate the impacts of various policy decisions on different social groups, allowing policymakers to anticipate potential outcomes and make more informed decisions (Janiesch et al., 2021). In healthcare, AI is being used to predict disease outbreaks and personalize treatment plans, thereby improving patient outcomes and optimizing the use of resources (Mocanu et al., 2016). The potential of AI to drive innovation and sustainable development within social sciences is further amplified by its ability to facilitate interdisciplinary research (Bessen, 2019). AI bridges the gap between disciplines, allowing for the integration of insights from fields such as computer science, engineering, economics, and psychology. This interdisciplinary approach is essential for tackling the multifaceted challenges of the 21st century, where solutions often require a combination of technological, economic, and social perspectives (Arute et al., 2019). As AI continues to evolve, its applications within the social sciences are expected to grow, offering even more sophisticated tools and methodologies. These advancements will likely drive further innovation, enabling social scientists to explore new research frontiers and contribute to sustainable development in more impactful ways. The transformative potential of AI in the

social sciences is vast, and its ongoing integration will undoubtedly lead to significant changes in how it is understood and addressed the complex issues facing society today.

The purpose of this study is to explore how the integration of AI, Machine Learning, NLP, and Prompt Engineering into the social sciences has influenced collaborative networks, thematic developments, and the emergence of research trends aligned with the Sustainable Development Goals (SDGs). Specifically, the study seeks to identify key trends, thematic areas, and influential contributors that shape the intersection of AI, management practices, and sustainable development. This study makes a significant contribution to the literature on the application of artificial intelligence (AI) in social science research, while focusing on the impact of these technologies in relation to the Sustainable Development Goals (SDGs). The SDGs provide a strategic framework for addressing global social, economic, and environmental challenges, and understanding AI's potential contributions to achieving these goals is of critical importance (Vinuesa et al., 2020). AI's capabilities in data analysis, decision-making processes, and policy development have not only transformed interdisciplinary research in social sciences but also offer innovative solutions for addressing SDGs (Brynjolfsson and McAfee, 2017). This study aims to fill a gap in the literature by emphasizing how AI integration can play a crucial role not only in academic advancement but also in achieving global sustainability objectives (Floridi et al., 2021). By examining these aspects, the study aims to understand how AI-driven innovations are fostering new research paradigms and accelerating sustainable corporate transformation, ultimately contributing to global sustainability efforts. The paper is structured to provide a comprehensive exploration of AI's transformative role in social sciences, beginning with an introduction that outlines the study's purpose and scope, emphasizing AI's potential to revolutionize research methodologies and real-world applications. The literature review then examines existing research on AI's impact on collaborative networks, thematic developments, and the alignment of research trends with the SDGs. The methodology section details the research design, including data collection and the analytical tools employed, such as bibliometric analysis and topic modeling. The findings section presents the results of the analysis, focusing on the key trends, thematic areas, and contributors in AI-driven innovation, particularly in relation to sustainable development goals. In the discussion, the findings are interpreted within the broader research context, highlighting how AI has influenced collaborative networks and research trends in the social sciences, and how these developments contribute to sustainable corporate transformation. The paper concludes with a summary of key insights, recommendations for future research, and a discussion of the ethical considerations and challenges associated with AI integration, emphasizing the importance of responsible and sustainable implementation.

2. BACKGROUND

Artificial Intelligence (AI) has emerged as a transformative force across various domains, fundamentally reshaping how research is conducted, data is analyzed, and insights are generated. Within the social sciences, the integration of AI, alongside technologies such as

Machine Learning, Natural Language Processing (NLP), and Prompt Engineering, has not only enhanced traditional research methodologies but has also introduced new paradigms for understanding and addressing complex social phenomena. As these technologies continue to evolve, their impact on the development of collaborative networks, thematic areas of study, and emerging research trends has become increasingly significant, particularly in the context of advancing the Sustainable Development Goals (SDGs) (Obermeyer et al., 2019). Several studies have demonstrated the contributions of AI technologies to areas such as healthcare (SDG 3), education (SDG 4), and sustainable industry and innovation (SDG 9) (Vinuesa et al., 2020). However, research addressing the combined impact of these technologies across different sectors is more limited, and this paper aims to fill that gap. The need to examine the intersection of these emerging technologies within the SDG framework stems from the growing recognition that achieving global sustainability goals requires innovative and interdisciplinary approaches. AI, Machine Learning, NLP, and Prompt Engineering offer transformative tools in areas such as data analysis, decision support systems, and system optimization, accelerating progress towards these goals. However, their responsible integration necessitates careful consideration of ethical concerns and societal impacts (Floridi et al., 2021).

2.1. The Role of AI in Transforming Social Science Research

AI's integration into the social sciences goes beyond enhancing existing research methods; it fundamentally alters the way research questions are framed, hypotheses are tested, and findings are interpreted. Traditional research often involves manual data collection and analysis, which can be labor-intensive, time-consuming, and prone to human error (Tan et al., 2023). AI, however, offers the capability to process vast datasets with speed and precision, enabling researchers to uncover patterns and relationships that were previously undetectable using conventional methods.

For instance, machine learning algorithms have become indispensable in modeling complex social phenomena, offering predictive insights that guide public policy, economic strategies, and social interventions (Obermeyer et al., 2019). These algorithms excel in identifying subtle patterns in data, making them invaluable in fields like sociology, economics, and political science, where understanding human behavior and societal trends is essential. This predictive capability is particularly relevant in addressing the dynamic and multifaceted challenges posed by global issues such as climate change, public health crises, and social inequalities. Scholars like Brynjolfsson and McAfee (2017) have highlighted AI's potential to revolutionize decision-making processes, particularly in management and business strategies. AI-driven tools optimize operations, improve resource allocation, and enhance strategic planning by providing decision-makers with real-time, data-driven insights (Li et al., 2024). This shift towards AI-assisted decision-making is not just reshaping industries but is also driving efficiencies and creating competitive advantages for businesses that successfully integrate these technologies into their workflows (Vinuesa et al., 2020).

2.2. AI's Influence on Collaborative Networks and Interdisciplinary Research

The integration of AI into social sciences is fostering the development of new collaborative networks and interdisciplinary research initiatives (Regona et al., 2024). These networks are crucial for addressing global challenges that require coordinated efforts across multiple sectors and disciplines (Ditlev-Simonsen, 2022). AI-powered tools, such as NLP and Prompt Engineering, enable researchers to analyze vast amounts of textual data—from social media posts to academic publications—thus facilitating the dissemination of knowledge and the formation of new research communities. This interconnectedness is especially pertinent to the SDGs, as it supports the development of innovative solutions that align with global sustainability efforts (Weber, 2023). For example, AI-driven platforms can connect researchers from different fields, allowing them to collaborate on projects that span multiple disciplines, such as environmental science, economics, and public health (Vinyals et al., 2019). These platforms not only enhance the efficiency of research but also promote the cross-pollination of ideas, leading to breakthroughs that might not be possible within a single discipline. Moreover, AI is enabling the creation of global research networks that are more inclusive and diverse (Xie et al., 2018). By lowering the barriers to collaboration—whether geographical, financial, or disciplinary—AI is democratizing access to knowledge and fostering a more equitable distribution of research opportunities (Rockström et al., 2009). This is particularly important in the context of the SDGs, where achieving global sustainability requires contributions from all regions and sectors of society.

2.3. Thematic Developments and Emerging Research Trends Aligned with SDGs

AI's influence on thematic developments within the social sciences is evident in the emergence of research trends that increasingly align with the SDGs. The SDGs encompass a broad range of global challenges, from poverty and hunger to climate action and sustainable economic growth (Noble, 2018). AI's ability to analyze complex datasets and model intricate systems makes it a powerful tool for advancing research in these areas (Vinuesa et al., 2020). For instance, in the energy sector, AI is being used to optimize power grids, reduce energy consumption, and integrate renewable energy sources more effectively (Mocanu et al., 2016). These advancements contribute directly to SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action) by promoting more efficient and sustainable energy systems (Regona et al., 2024). Similarly, in agriculture, AI-driven precision farming techniques are helping to reduce water usage and increase crop yields, aligning with SDG 2 (Zero Hunger) and SDG 12 (Responsible Consumption and Production) (Černevičienė and Kabasinskas, 2024). In the realm of education, AI is playing an increasingly important role in personalizing learning experiences, improving educational outcomes, and making education more accessible. AI-driven tools can adapt to the needs of individual learners, providing customized content and support that enhances the learning process. This capability is particularly valuable in promoting SDG 4 (Quality Education) and reducing educational inequalities by ensuring that all learners, regardless of their background, have access to high-quality education (Regona et al., 2024). The

healthcare sector is another area where AI is making significant contributions. AI is being leveraged to improve diagnostic accuracy, personalize treatment plans, and predict disease outbreaks, all of which contribute to better health outcomes and align with SDG 3 (Good Health and Well-Being) (Regona et al., 2024). AI's ability to process large amounts of medical data quickly and accurately allows for earlier detection of diseases and more effective treatment strategies, ultimately improving patient outcomes and reducing healthcare costs.

The integration of AI, Machine Learning, NLP, and Prompt Engineering into the social sciences has significantly influenced the formation of collaborative networks, the evolution of thematic areas, and the emergence of research trends that are aligned with the Sustainable Development Goals (Regona et al., 2024). These technologies have not only enhanced research methodologies and enabled more sophisticated analyses but have also facilitated the development of innovative management strategies and sustainable business practices. As these fields continue to evolve, ongoing research and dialogue will be essential to ensuring that AI is used responsibly and effectively to achieve the SDGs and drive positive social change (Ditlev-Simonsen, 2022). As AI continues to develop, its impact on the social sciences and its potential to drive global sustainability efforts will only increase. The ongoing exploration of these dynamics is crucial for understanding how AI-driven innovations can accelerate progress toward achieving the SDGs and fostering a more equitable and sustainable world. By addressing the ethical challenges and ensuring that the benefits of AI are widely shared, the integration of these technologies into the social sciences can lead to transformative outcomes that contribute to the well-being of society.

3. RESEARCH METHOD

The integration of Artificial Intelligence (AI), Machine Learning, Natural Language Processing (NLP), and Prompt Engineering into the social sciences represents a significant advancement in how research is conducted, analyzed, and applied. This study seeks to explore the influence of these emerging technologies on the development of collaborative networks, thematic areas, and research trends, particularly in relation to the Sustainable Development Goals (SDGs). By systematically examining a curated selection of high-impact literature from the Web of Science (WoS) database, this research aims to identify key trends, influential works, and collaboration patterns that have emerged within this interdisciplinary field over the past decade. Through the application of bibliometric analysis and topic modeling, the study provides a comprehensive overview of the current state of research at the intersection of innovation in social sciences and advanced technological research, offering insights into the evolving dynamics of this rapidly expanding area.

3.1. Data Collection

The study seeks to identify key trends, influential works, and collaboration patterns within this interdisciplinary field. Data for the study was exclusively collected from the Web of Science (WoS) database, selected for its comprehensive coverage of high-impact journals across

multiple disciplines, including social sciences and technology. A targeted search strategy was employed to gather relevant literature, using a carefully constructed query designed to capture publications at the intersection of innovation in social sciences and advanced technological research. The search query used was: "TS=("innovation" AND ("social sciences" OR "interdisciplinary" OR "conceptual")) AND TS=("AI" OR "machine learning" OR "natural language processing" OR "prompt engineering")."

Table 1. The methodological summary

Unit of Analysis	Co-authorship Network, Keywords, and Thematic Topics
Type of Analysis	Bibliometric Analysis and Topic Modeling
Period of Analysis	Last 10 Years
Query String	TS=("innovation" AND ("social sciences" OR "interdisciplinary" OR "conceptual")) AND TS=("AI" OR "machine learning" OR "natural language processing" OR "prompt engineering")
Total Number of Articles	389

The key components and scope of the bibliometric and topic modeling analysis as seen Table 1 conducted in this study. It provides a summary of the methodological approach, including the unit of analysis, the type of analysis employed, the period of analysis, the specific query string used in the Web of Science database, and the total number of articles retrieved. This table serves as an overview of the study's design, detailing how the data was collected, what was analyzed, and the scope within which the analysis was performed. The query combined terms related to innovation in social sciences with those related to AI, machine learning, NLP, and prompt engineering to encompass a broad range of interdisciplinary research. The search was restricted to peer-reviewed articles, conference papers, and review papers to ensure the inclusion of high-quality research. Publications from the last ten years were included to focus on recent developments and current trends. The choice of a 10-year timeframe in this study is critical to capturing the rapid evolution of artificial intelligence (AI) applications, particularly as they have become increasingly integrated into social science research. Over the past decade, AI technologies such as Machine Learning, Natural Language Processing (NLP), and Prompt Engineering have experienced significant advancements, making this period especially relevant for analyzing interdisciplinary research trends. The timeframe allows for a comprehensive examination of the most recent developments, reflecting the transformative impact of AI on both methodology and practice in various fields. By focusing on this specific window, the study can trace the historical trajectory of AI's integration into social sciences while highlighting its alignment with the Sustainable Development Goals (SDGs). Furthermore, considering the exponential growth of AI-driven innovations, a 10-year period provides sufficient scope to observe meaningful trends, collaborations, and thematic shifts, thereby enhancing the overall quality and relevance of the research. Only English-language publications were selected to maintain consistency in the data and ensure global accessibility.

The search results from Web of Science were exported in RIS format, which includes detailed metadata for each publication. The following key elements were extracted: titles, to determine the focus of each publication; authors and affiliations, to map collaborative networks and identify key contributors and institutions; keywords, to capture the thematic focus of the collected literature; abstracts, to summarize the content and relevance of each publication; and citation data, to assess the impact and influence of each work within the research community. After the data extraction, a thorough data cleaning process was conducted to ensure the accuracy and consistency of the dataset. Author names were normalized to correct for variations and ensure consistent attribution across different publications. Duplicates were identified and removed to prevent the double counting of publications. Synonymous keywords were merged and standardized to improve the clarity and accuracy of the keyword analysis. Institutional affiliations were standardized to accurately reflect the collaborative relationships.

The search query implemented in Web of Science was used to retrieve relevant publications, which were then employed to construct a co-authorship network. The cleaned dataset was used to build a co-authorship network, where nodes represented individual authors and edges represented co-authorship relationships. Keyword data was also used to map the thematic areas of research within this interdisciplinary field.

4. FINDINGS

The findings of this study provide a comprehensive examination of the intersection between Artificial Intelligence (AI), Machine Learning, Natural Language Processing (NLP), and Prompt Engineering within the social sciences, particularly focusing on their alignment with the Sustainable Development Goals (SDGs).

The constructed network and thematic analysis were performed using bibliometric techniques. Centrality measures, such as degree and betweenness centrality, were used to identify influential authors and collaborative hubs. The frequency and co-occurrence of keywords were analyzed to identify major research trends and emerging topics within the field. Ethical considerations were strictly adhered to throughout the data collection and analysis process. All data were obtained from publicly available academic publications in Web of Science, ensuring no private or sensitive information was accessed. All sources of data were properly cited and acknowledged to respect intellectual property rights. The data collection process from Web of Science provided a solid foundation for analyzing the intersection of innovation in social sciences with AI, machine learning, NLP, and prompt engineering. The systematic approach ensures that the findings are based on a comprehensive and reliable dataset, contributing to the overall credibility and validity of the study.

By utilizing a combination of bibliometric analysis and topic modeling, the study uncovers significant trends, influential contributors, and thematic areas that have emerged over the past decade. These findings illuminate how the integration of these advanced technologies has influenced collaborative networks, shaped research agendas, and driven innovation across

multiple domains within the social sciences. The analysis reveals not only the growing academic interest in these technologies but also their critical role in advancing global sustainability efforts. In this section, it is presented the key findings, organized into several thematic areas, each offering insights into the evolving dynamics of this interdisciplinary field.

Treemap Chart 1. Web of Science categories

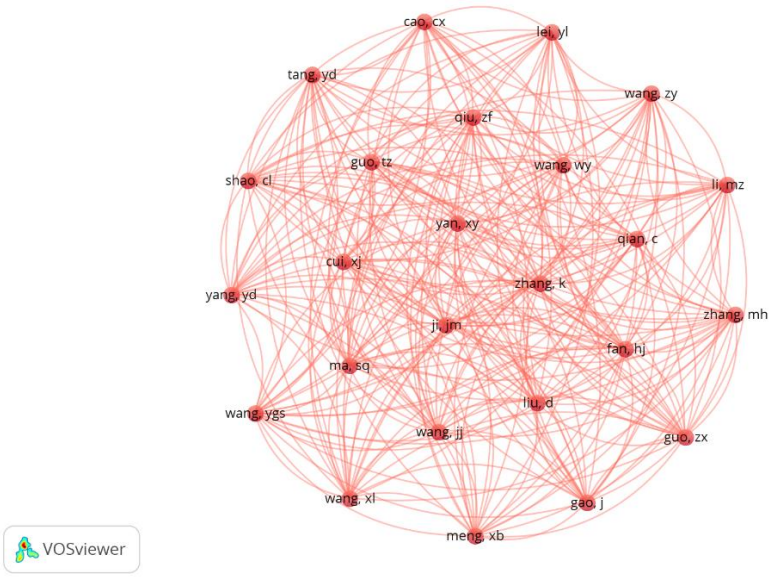
The treemap seen as Chart 1 visualization provides a detailed overview of research activity across various academic fields within the dataset, reflecting the interdisciplinary nature of studies at the intersection of AI, Machine Learning, NLP, and Prompt Engineering within the social sciences. The size of each rectangle represents the volume of publications in each category, indicating the relative prominence of each field. Notably, the Management category emerges as the most significant, with 68 articles, highlighting its centrality in studies that explore the integration of AI into management practices and its implications for collaborative networks and thematic developments aligned with the Sustainable Development Goals (SDGs). This suggests that management is a key area where AI-driven innovation is being applied, particularly in understanding and enhancing business models in a technologically advanced context.

Following closely is the Business category, with 53 articles, reflecting the critical role of business-related research in the interdisciplinary exploration of AI technologies. The prominence of this category indicates a significant interest in how AI, machine learning, and related technologies are transforming business practices and strategies, particularly in terms of aligning them with global sustainability efforts as outlined by the SDGs.

The treemap visualizations reveal that management and business-related research are at the forefront of integrating AI within social sciences. This prominence suggests that AI is being increasingly leveraged to enhance business models, improve strategic decision-making, and optimize management practices across various sectors. The alignment with the SDGs,

particularly those related to industry, innovation, and infrastructure (SDG 9), indicates that these AI-driven innovations are not only transforming traditional business practices but are also contributing to sustainable industrial growth and technological advancement.

Graph 1. Co-Authorship network in AI and social sciences research



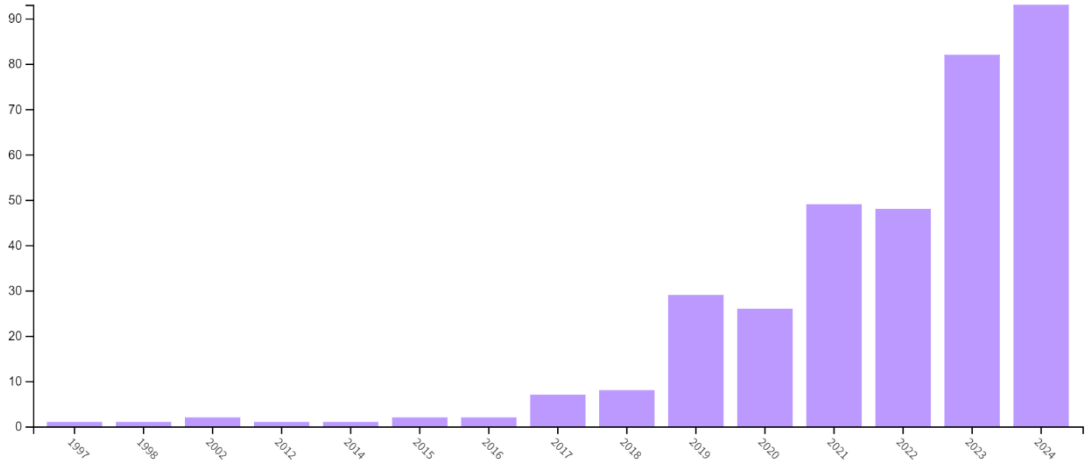
The co-authorship network visualization seen as Graph 1 reveals a highly centralized structure, with key researchers like Tang, YD, Wang, ZY, and Cao, CX playing pivotal roles in the academic community. These individuals are central to collaborative efforts, driving research in AI and social sciences. The dense connectivity across the network indicates a robust collaborative environment, where frequent co-authorship promotes rapid idea exchange and interdisciplinary innovation. Visible clusters within the network suggest specialized research groups focusing on niche areas of AI applications in social sciences. Researchers such as Lei, YL and Guo, TZ also serve as crucial connectors between these clusters, facilitating broader interdisciplinary collaboration. The network also highlights potential opportunities for expanding collaboration, particularly between less connected nodes. Strengthening these connections could enhance the diversity and impact of future research efforts in this field. Overall, this visualization underscores the importance of collaboration in advancing the intersection of AI and social sciences, with key researchers and dense networks driving innovation and knowledge sharing.

Substantial research activity is also evident in various branches of computer science, with Computer Science Information Systems and Computer Science Interdisciplinary Applications each represented by 34 articles. This highlights a strong focus on the application of AI and machine learning within computer science, suggesting that interdisciplinary approaches are essential for understanding the broader implications of these technologies across multiple domains, including their impact on social sciences.

Additionally, the Environmental Sciences category, with 30 articles, and Environmental Studies, with 27 articles, underscore the importance of environmental research in the context of sustainable development and the impact of AI-driven technologies on the environment. The Green Sustainable Science Technology category, with 25 articles, further emphasizes the growing focus on sustainability, reflecting the integration of AI in efforts to achieve SDG-related objectives, particularly those related to environmental sustainability and responsible consumption.

The treemap also highlights the relevance of Information Science Library Science, with 32 articles, in supporting research and knowledge dissemination, particularly in the context of managing and analyzing large datasets generated by AI-driven research. Finally, Computer Science Theory Methods, with 24 articles, indicates ongoing interest in the foundational aspects of computer science, underscoring the importance of theoretical and methodological advancements in driving AI research within the social sciences.

Bar Chart 1. Final publication year



The bar chart seen as bar chart 1 provides a clear visualization of the distribution of research publications over time, offering insights into the evolving academic interest in the intersection of AI, Machine Learning, NLP, Prompt Engineering, and social sciences. The data spans several decades, highlighting significant trends in the frequency of academic output related to these interdisciplinary areas and their alignment with the SDGs.

In the early years, from 1997 to around 2015, the chart shows minimal research activity, with few publications recorded annually. This suggests that the integration of these advanced technologies into the social sciences was still in its nascent stages, with limited focus within the academic community. The emergence of these technologies as critical tools in social sciences had not yet gained widespread attention, reflecting their early stages of development and application.

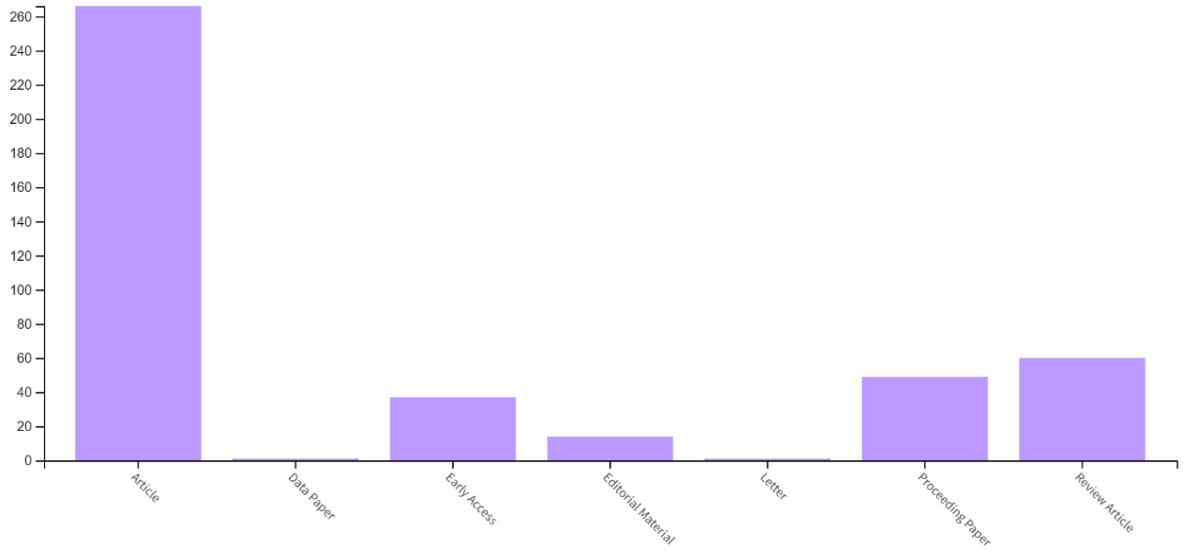
A noticeable shift begins to occur from 2016 onwards, where the chart reflects a gradual increase in the number of publications. This period marks the growing interest in the application of AI and related technologies within social sciences, driven by their potential to address complex social issues and enhance theoretical frameworks. The increasing trend suggests that researchers began to recognize the value of these tools in contributing to the SDGs, particularly in areas such as sustainable development, education, and health.

The most significant growth in research activity is observed from 2020 onwards, with a steep increase in the number of publications, particularly in 2021 and 2022. This rapid expansion can be attributed to the accelerating adoption of AI and machine learning across various domains, including social sciences, as well as the increasing availability of data and the development of sophisticated computational methods. The surge in publications reflects the central role that these technologies have come to play in academic discourse, particularly in their application to SDG-related challenges.

The years 2023 and 2024 represent the peak of research activity within the dataset, with the highest number of publications recorded. This indicates that the intersection of AI, social sciences, and the SDGs is currently at the forefront of academic research, underscoring its critical importance and widespread interest among scholars. The continued growth in publications suggests that this area of study is not only relevant but is also expanding rapidly, driven by ongoing technological advancements and their application in solving complex social problems.

Although the analysis period spans 10 years, focusing on the most recent 5 years reveals the growing integration of AI, Machine Learning, NLP, and Prompt Engineering in social sciences. Specifically, during the 2019-2024 period, there has been rapid progress in AI technologies, playing a critical role in developing innovative solutions in fields such as management, education, healthcare, and sustainable development. This period also shows a significant increase in the number of academic publications, strengthening interdisciplinary collaborations and broadening the scope of research on AI's impact on social sciences. Since 2019, the acceleration of technological advancements has enabled researchers to apply AI more effectively and develop solutions aligned with global sustainability goals. Therefore, while the analysis covers 10 years, focusing on this recent period provides a clearer understanding of current trends and the transformative processes driven by these technologies.

Bar Chart 2. Research areas

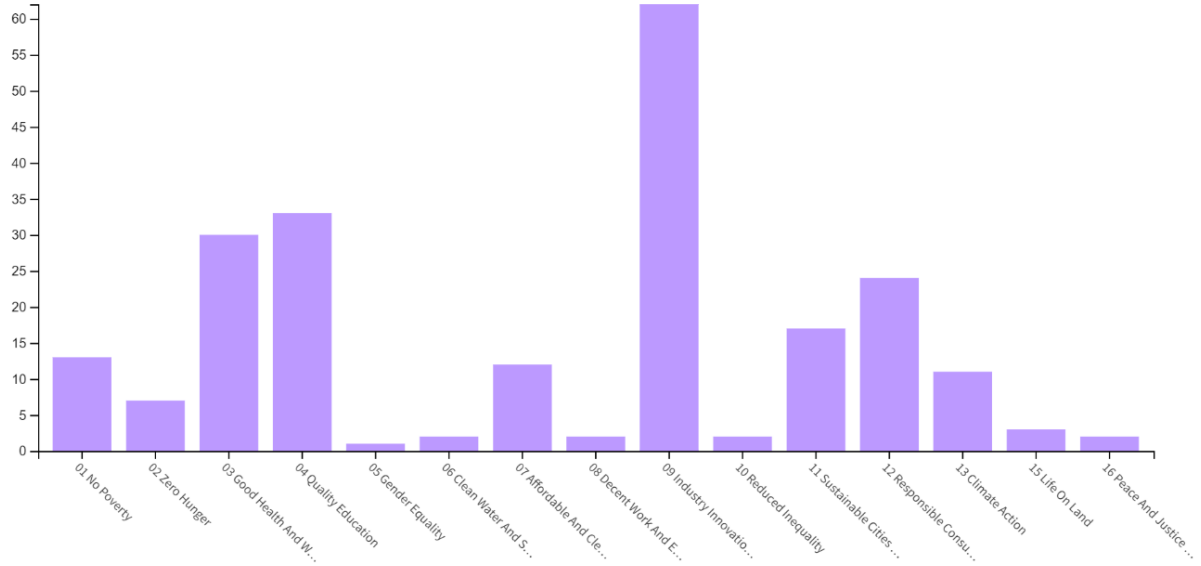


Bar Chart 2 illustrates the distribution of document types within the dataset, providing insights into the nature of the scholarly output in the field. The most prominent category is Articles, which constitute a significant majority with 266 records, representing 68.38% of the total dataset. This dominance of articles indicates that traditional research papers are the primary medium for disseminating findings related to the integration of AI, Machine Learning, NLP, and Prompt Engineering into the social sciences and their alignment with the SDGs. The substantial volume of articles reflects the depth and rigor of scholarly work being conducted in this area. Review Articles follow as the second most common document type, with 60 records, accounting for 15.42% of the dataset. The presence of review articles suggests a strong focus on synthesizing existing research, which is crucial for identifying trends, gaps, and future directions in the interdisciplinary intersection of AI and social sciences. Proceeding Papers make up 12.60% of the dataset, with 49 records, indicating the importance of conferences as venues for presenting new research developments and fostering academic collaboration.

Early Access documents, with 37 records (9.51%), highlight the urgency and timeliness of research in this rapidly evolving field. The presence of Editorial Materials (14 records, 3.60%) and Letters (1 record, 0.26%) reflects the diversity of discourse within the field, encompassing shorter, opinion-based contributions that add to the richness of academic dialogue. Data Papers, with just 1 record (0.26%), indicate that while data sharing is recognized, it is not yet a predominant form of publication within this dataset.

In summary, the chart reflects a robust engagement with traditional scholarly articles and reviews, complemented by a meaningful presence of conference proceedings and other document types, demonstrating the multifaceted nature of academic output in this interdisciplinary domain.

Bar Chart 3. Academic focus on SDGs in AI-Driven research



Bar Chart 3 illustrates the alignment of research publications within the dataset with various United Nations Sustainable Development Goals (SDGs), providing insights into the areas where research is most concentrated and reflecting the priorities of the scholarly community in addressing global challenges through the integration of AI and related technologies.

Industry, Innovation, and Infrastructure (SDG 9) emerges as the most prominent goal, with 62 records, representing 15.94% of the dataset. This indicates a strong emphasis on advancing technological infrastructure and innovation, which is critical for sustainable industrial growth and the development of resilient infrastructure. The prominence of this goal suggests that researchers are particularly focused on how AI and related technologies can drive innovation and contribute to sustainable economic development.

Quality Education (SDG 4) follows closely, with 33 records (8.48%), highlighting the importance placed on improving educational outcomes. Research in this area likely focuses on the integration of AI and machine learning into educational practices, enhancing access to quality education, and reducing inequalities in educational opportunities.

Good Health and Well-Being (SDG 3) is also well-represented, with 30 records (7.71%). This reflects ongoing research efforts aimed at improving health outcomes through the application of AI and machine learning in medical diagnostics, treatment, and public health initiatives. The focus on health and well-being underscores the potential of AI to contribute to global health improvements.

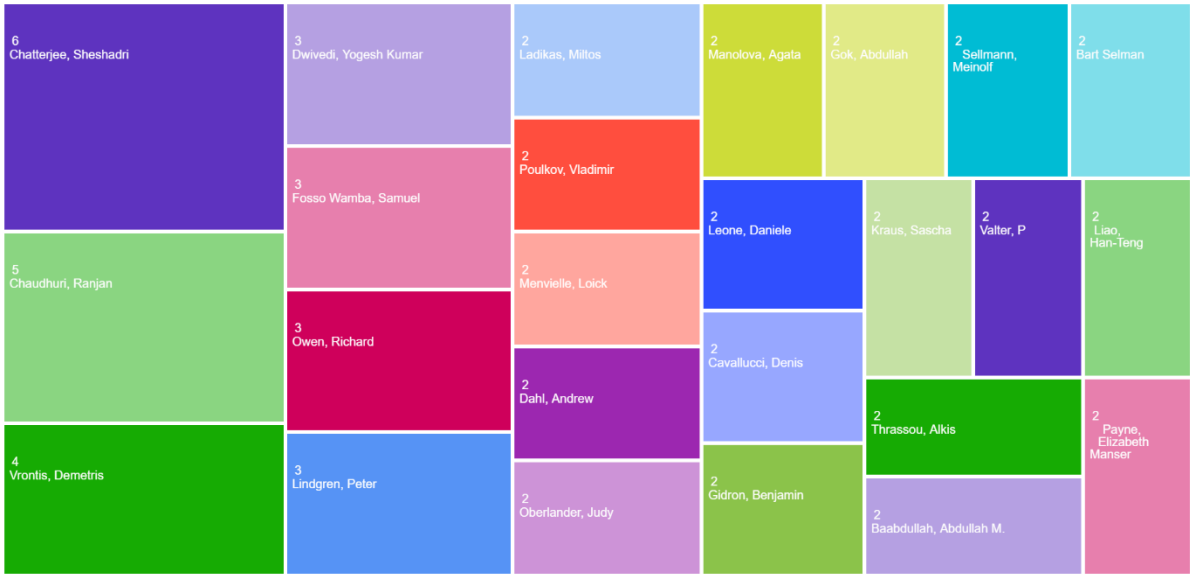
Responsible Consumption and Production (SDG 12) accounts for 24 records (6.17%), indicating a focus on sustainable practices in production and consumption. Research in this area is crucial for addressing environmental challenges and promoting sustainability in economic

activities, reflecting the alignment of AI-driven innovation with environmental sustainability goals.

Sustainable Cities and Communities (SDG 11), with 17 records (4.37%), underscores the importance of developing sustainable urban environments. Research in this domain may explore the role of AI in urban planning, smart cities, and the integration of green technologies to create more livable and resilient communities.

Other SDGs, such as No Poverty (SDG 1), Affordable and Clean Energy (SDG 7), Zero Hunger (SDG 2), Climate Action (SDG 13), and Life on Land (SDG 15), have fewer records, reflecting a more specialized or emerging focus within the dataset. Notably, Gender Equality (SDG 5) and Peace and Justice Strong Institutions (SDG 16) are represented by very few records, suggesting potential areas for further research development. In summary, Bar Chart 3 reveals that research within the dataset is predominantly aligned with goals related to industry, education, health, and sustainable consumption. These areas represent key focal points for the academic community as they work towards addressing the multifaceted challenges encompassed by the SDGs.

Tree Map 2. Top contributing researchers in the field of innovation and emerging technologies



Tree Map 2 visualizes the distribution of research contributions among different scholars within the dataset, providing insight into the most prolific authors and their relative impact. The size of each rectangle corresponds to the number of publications attributed to each researcher, indicating their level of contribution to the field.

Sheshadri Chatterjee emerges as the most prominent contributor, with six publications, making up approximately 1.54% of the total dataset. This positions Chatterjee as a key figure in the research domain, reflecting significant influence and active engagement in scholarly work related to the study's focus areas.

Following Chatterjee, Ranjan Chaudhuri holds five publications, representing 1.29% of the dataset. Demetris Vrontis is also a notable contributor with four publications (1.03%), further indicating a strong involvement in the field. These researchers appear to play pivotal roles in advancing the understanding and application of the interdisciplinary areas covered in the dataset.

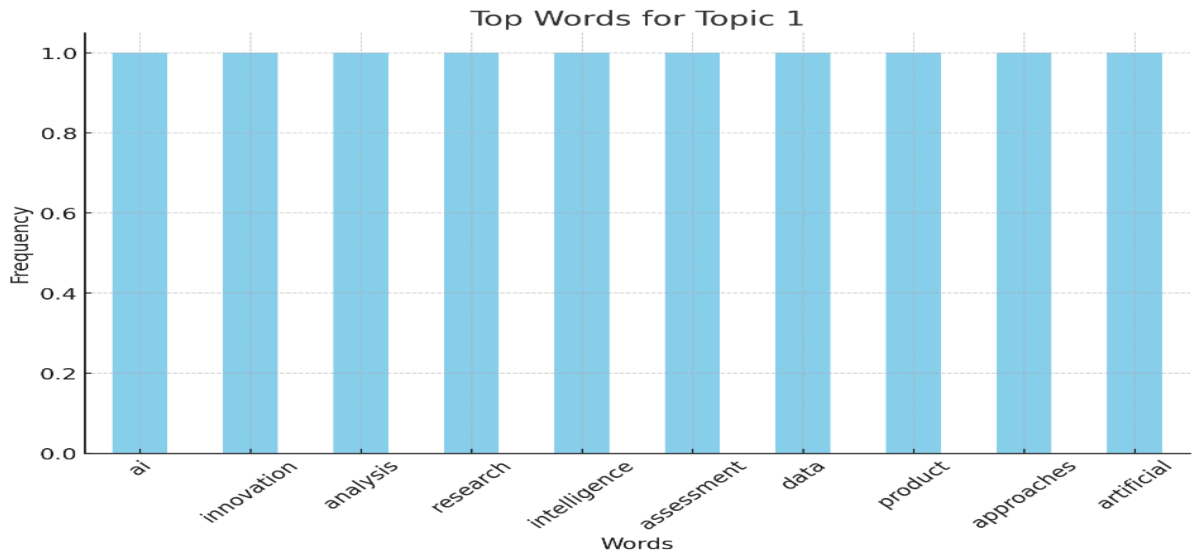
Several researchers, including Yogesh Kumar Dwivedi, Samuel Fosso Wamba, Richard Owen, and Peter Lindgren, each have three publications, accounting for 0.77% of the dataset. Their work, while slightly less extensive than that of the top contributors, still represents significant contributions to the academic dialogue in this area.

The treemap also displays numerous other researchers, such as Miltos Ladikas, Vladimir Poulkov, and Loick Menvielle, each with two publications. These contributions, while smaller in volume, indicate a breadth of research activity and collaboration across different institutions and geographic regions.

In summary, the treemap provides a clear visualization of the leading contributors in the dataset, highlighting the researchers who have made the most significant impact. The visualization reflects the collaborative nature of the research field, with multiple scholars contributing to the advancement of knowledge in the interdisciplinary intersection of innovation and emerging technologies.

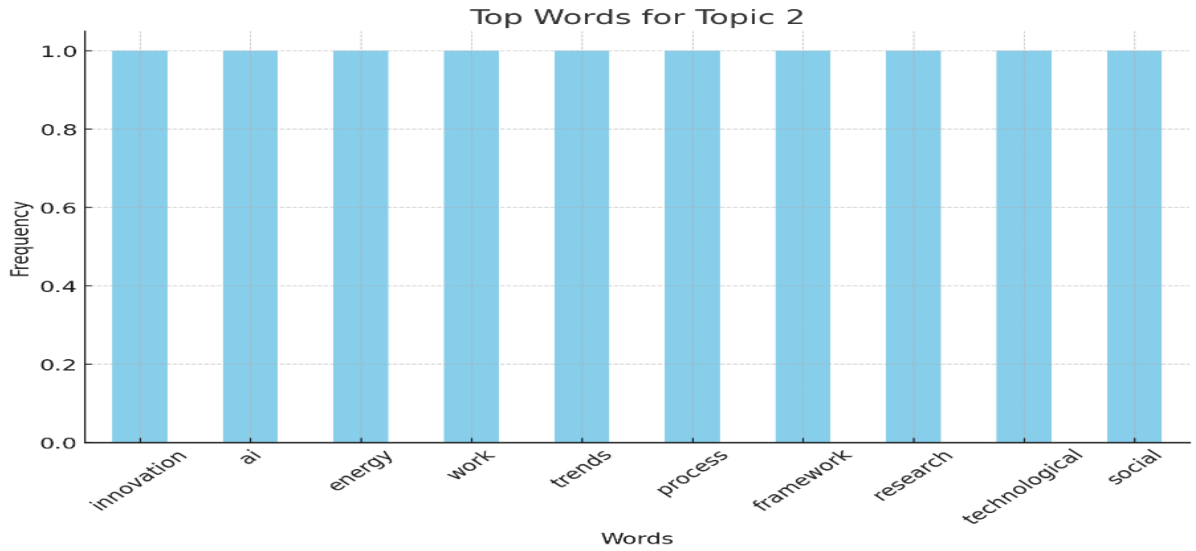
The topic modeling analysis conducted in this study aims to explore the intersection of artificial intelligence (AI) and innovation within the context of social sciences and emerging technologies. The analysis identified five key themes that highlight the role and impact of AI across various domains, including product development, energy, social research, corporate applications, design, and learning environments. The following sections provide a detailed examination of these themes.

Bar Chart 4. Topic 1: AI and innovation in product development and data assessment



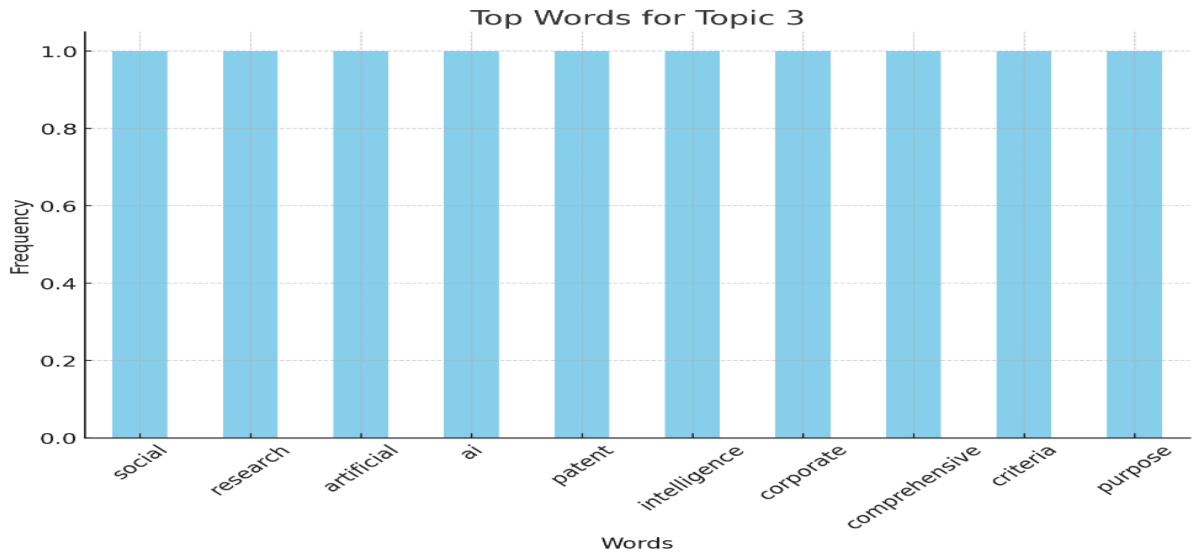
The first topic, as seen bar chart 4, identified by the analysis is characterized by keywords such as "AI," "innovation," "analysis," "research," "intelligence," and "data." This topic appears to focus on the intersection of artificial intelligence (AI) with innovation, particularly in the context of product development and data assessment. The emphasis on "product" and "approaches" suggests that this theme revolves around the application of AI to enhance product design and development processes. Additionally, the presence of terms like "assessment" and "analysis" indicates a strong focus on utilizing AI for evaluating data and conducting rigorous research. This topic reflects the growing importance of AI in driving innovation and efficiency in both product development and data-driven research methodologies.

Bar Chart 5. Topic 2: Innovation, energy, and technological trends



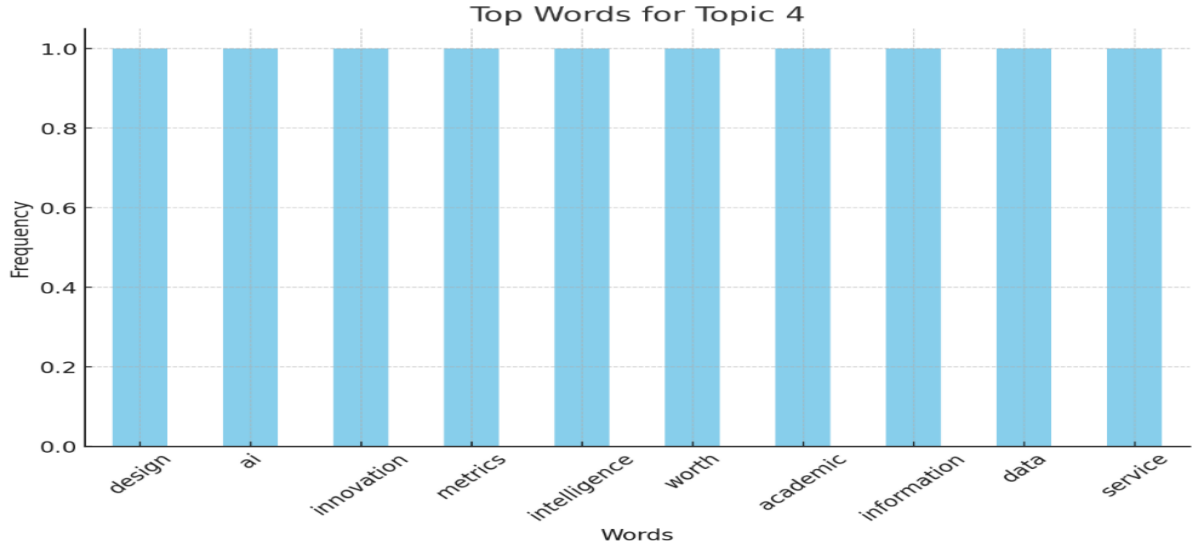
The second topic, as seen bar chart 5, is defined by terms such as "innovation," "AI," "energy," "work," and "framework." This topic centers on the role of AI in driving innovation within the energy sector, as well as in broader technological and social processes. The inclusion of words like "trends" and "framework" suggests an emphasis on understanding and shaping emerging trends through structured methodologies. The term "work" points to the potential impacts of AI on labor and organizational processes. Overall, this topic highlights the dynamic interplay between AI-driven innovation and its implications for technological advancements and social structures, with a particular focus on energy-related applications.

Bar Chart 6. Topic 3: AI in social research and corporate settings



The third topic, as seen bar chart 6, revolves around the application of AI in social research and corporate environments, as evidenced by keywords like "social," "research," "artificial," "AI," and "corporate." The inclusion of "patent" and "criteria" suggests that this topic also covers the strategic and intellectual property aspects of AI, particularly in corporate settings where patents and innovation strategies are critical. The term "comprehensive" indicates that the research in this area may involve holistic and rigorous approaches to integrating AI into social and corporate frameworks. This topic reflects the increasing integration of AI into both social science research and corporate practices, with a focus on innovation and strategic development.

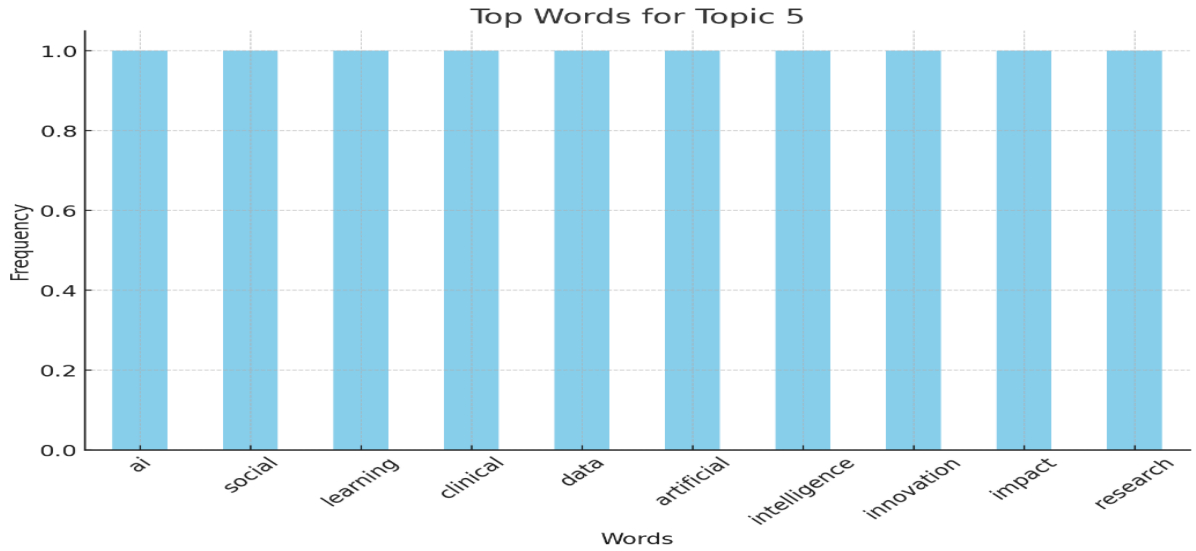
Bar Chart 7. Topic 4: Design and metrics in AI innovation



The fourth topic, as seen bar chart 7, is characterized by terms such as "design," "AI," "innovation," "metrics," and "academic." This theme focuses on the design aspects of AI, including the development of innovation metrics and the academic contributions to this field.

The presence of words like "information," "data," and "service" suggests a focus on the practical applications of AI in information systems and service-oriented technologies. The emphasis on "worth" indicates an interest in evaluating the value and impact of AI innovations within academic and professional contexts. This topic underscores the significance of design thinking and metric development in the advancement of AI technologies, particularly in their academic and service-based applications.

Bar Chart 8. Topic 5: AI in social and clinical learning environments



The fifth topic as seen bar chart 8, defined by keywords such as "AI," "social," "learning," "clinical," and "data," centers on the application of AI in educational and clinical settings. The inclusion of terms like "artificial," "intelligence," and "impact" points to the role of AI in driving innovation in these environments, with a particular emphasis on learning outcomes and clinical practices. This topic likely reflects research focused on the transformative potential of AI in enhancing educational processes and healthcare delivery, particularly through data-driven approaches. The focus on "impact" and "research" suggests an ongoing effort to evaluate and optimize the benefits of AI in these critical areas.

In summary, as seen table 2, the topic modeling analysis provides a comprehensive overview of the key themes that define the intersection of AI, social sciences, and emerging technologies. These themes highlight the multifaceted impact of AI on various domains, from product development to education and healthcare, and underscore the importance of aligning AI-driven innovations with the Sustainable Development Goals.

Table 2. Top words for the five identified themes in AI research

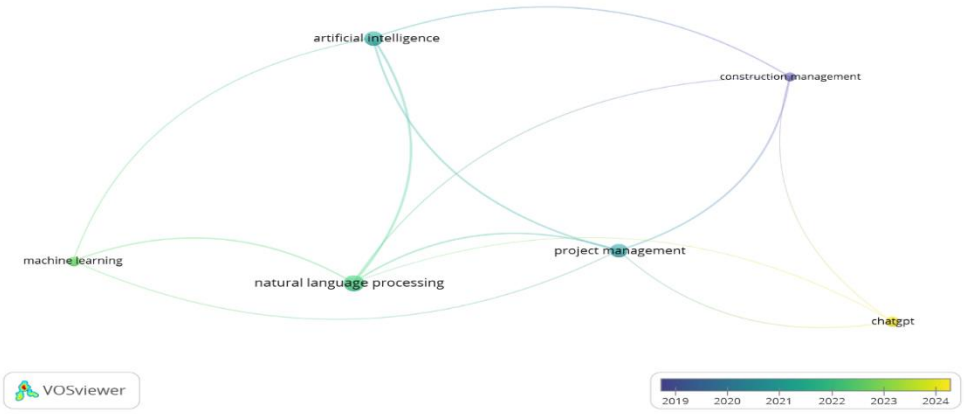
Topic	Top Words
Topic 1: AI and Innovation in Product Development and Data Assessment	AI, innovation, analysis, research, intelligence, data, product, approaches, artificial
Topic 2: Innovation, Energy, and Technological Trends	AI, innovation, energy, work, framework, trends
Topic 3: AI in Social Research and Corporate Settings	AI, social, research, artificial, corporate, patent, criteria
Topic 4: Design and Metrics in AI Innovation	AI, design, innovation, metrics, academic, information, data, service, worth
Topic 5: AI in Social and Clinical Learning Environments	AI, social, learning, clinical, data, artificial, intelligence, impact, research

These five key themes, as seen table 2, are directly related to the Sustainable Development Goals (SDGs). AI's role in innovation for product development and data assessment aligns with SDG 9 (Industry, Innovation, and Infrastructure), while its applications in energy and technological advancements support SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action). The use of AI in social research and corporate settings contributes to SDG 8 (Decent Work and Economic Growth) and SDG 10 (Reduced Inequalities). AI's involvement in design and innovation metrics connects to SDG 4 (Quality Education) and SDG 9. Finally, AI in social and clinical learning environments supports SDG 3 (Good Health and Well-Being) and SDG 4, transforming both education and healthcare systems.

5. DISCUSSION and CONCLUSION

The research question posed in this study "How can the integration of Artificial Intelligence (AI) into social sciences drive innovative management strategies and business models that align with the Sustainable Development Goals (SDGs), and how can this interaction accelerate sustainable corporate transformation?"is directly addressed through the findings from the bibliometric and topic modeling analyses. The study provides significant insights into how AI, as an emerging technology, intersects with social sciences to influence innovation, particularly in the context of management practices, business models, and sustainable development.

Graph 2. The keyword co-occurrence network



The keyword co-occurrence network Graph 2 highlights the evolving relationships and trends among key research topics in AI and its applications from 2019 to 2024. The focus on the 2019-2024 period in the keyword co-occurrence network, rather than a full 10-year span, stems from the rapid advancements in AI-related research during these years. Key technologies such as Machine Learning, Natural Language Processing (NLP), and ChatGPT have seen significant developments, with AI applications expanding into practical domains like project and construction management. Had a 10-year period been analyzed, the earlier years might not have captured these emerging trends as clearly, particularly the rise of ChatGPT in 2023-2024. By concentrating on the last five years, the analysis highlights the most relevant breakthroughs and innovations, showcasing the growing importance of AI in real-world applications. Artificial Intelligence (AI) emerges as the most central and connected keyword, underscoring its foundational role in the research landscape. Closely linked to AI are Machine Learning and Natural Language Processing (NLP), which are essential subfields that drive AI's implementation across various domains. The emergence of ChatGPT as a prominent keyword in 2023 and 2024 reflects a cutting-edge development, with researchers increasingly exploring its applications, particularly in Project Management. This indicates a shift in focus toward practical uses of AI in management and construction-related fields. The color gradient from blue to yellow illustrates the temporal evolution of these topics, with earlier research concentrating on core AI technologies, while more recent studies are delving into newer, application-specific innovations. This map provides a clear snapshot of the dynamic and interconnected nature of AI research, emphasizing both the enduring significance of foundational technologies and the growing interest in their practical applications. This study has provided a comprehensive examination of how AI integration within social sciences can drive innovative management strategies and business models, particularly in alignment with the Sustainable Development Goals (SDGs). The findings indicate that AI is playing a transformative role in these domains, not only by enhancing traditional practices but also by fostering new methodologies and applications that contribute to sustainable corporate transformation.

The significant representation of computer science categories, including information systems and interdisciplinary applications, further underscores the critical role that AI plays in contemporary research. These findings highlight the interdisciplinary nature of AI's impact, where technological advancements are being integrated into social sciences to address complex challenges, such as sustainable development and environmental protection. The substantial focus on environmental sciences within the dataset reflects a growing recognition of the need for AI-driven solutions to address global environmental challenges, aligning with SDGs related to sustainability and responsible consumption.

The analysis of publication trends shows a marked increase in research output at the intersection of social sciences and emerging technologies, particularly in the last few years. This surge underscores the growing centrality of AI in academic discourse and its role in driving innovation across various domains. The presence of a diverse range of document types, including review articles and proceeding papers, indicates a dynamic and rapidly evolving research landscape where AI's potential is being explored and applied in increasingly sophisticated ways.

The topic modeling analysis further elucidates how AI is being utilized across different sectors to drive innovation and transformation. The themes identified—ranging from AI's role in product development and data assessment to its impact on social research and corporate practices—illustrate the multifaceted nature of AI's influence. In particular, the focus on design, metrics, and practical applications of AI highlights the ongoing efforts to integrate AI into academic and professional contexts. These efforts are aimed at optimizing AI's benefits, ensuring that its applications are aligned with broader goals of sustainability and societal well being.

The interdisciplinary nature of this research, with significant contributions from fields such as management, business, computer science, and environmental sciences, underscores the broad impact of AI across various sectors. The alignment of research with the SDGs further emphasizes the societal relevance of AI-driven innovation, as scholars and practitioners alike seek to leverage AI to address global challenges and promote sustainable development.

This study has several limitations. First, the data was solely sourced from the Web of Science (WoS) database, potentially missing relevant publications from non-indexed journals and other academic sources, leading to a partial representation of the research landscape. Second, the reliance on bibliometric analysis and topic modeling comes with inherent limitations, such as potential biases in citation data and the oversimplification of thematic analysis due to the assumption of word independence. Third, the study's narrow focus on the intersection of AI and social sciences, particularly in management, business models, and sustainable development, may overlook other critical areas of AI application. Finally, the timeframe of 2014 to 2024 might limit the understanding of long-term trends and the broader evolution of AI in social sciences, suggesting that a longer temporal scope could provide deeper insights. To address the study's limitations, future research should expand data sources beyond Web of Science to

include databases like Scopus, IEEE Xplore, and Google Scholar, capturing a broader range of publications and emerging trends. Incorporating grey literature and non-indexed journals would also enhance the comprehensiveness of the analysis.

A mixed-methods approach, combining quantitative bibliometric analysis with qualitative content analysis, is recommended to provide a deeper and more nuanced understanding of AI's integration into social sciences. Future studies should also explore other AI applications, such as in policy development, ethical considerations, and social equity, areas not covered in this study. Extending the timeframe beyond 2014-2024 would allow for a better understanding of long-term trends and the evolution of AI's impact. Additionally, research should focus more on the ethical and societal implications of AI, ensuring responsible implementation. This could guide the development of best practices and policies for AI use in social sciences, ultimately contributing to a more comprehensive understanding of AI's transformative role.

Overall, the study highlights the transformative potential of AI in driving innovation within social sciences and emerging technologies. As these fields continue to evolve, future research should focus on further exploring the practical applications of AI, particularly in areas such as education, healthcare, and sustainability. Additionally, there is a need for continued efforts to integrate AI into traditional research methodologies, ensuring that its benefits are maximized across disciplines while addressing the ethical and societal implications of its widespread adoption. This approach will be crucial for advancing knowledge, driving innovation, and achieving sustainable corporate transformation in alignment with global development goals.

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