Impact of Artificial Intelligence on Advertising: A Bibliometric Analysis

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This paper presents a bibliometric analysis examining the impact of Artificial Intelligence (AI) on advertising. Using data from the Web of Science Core Collection spanning 2014 to 2024, the study investigates citation patterns, prolific authors, universities, publishers/journals, and trends in publication year-wise.Results indicate a significant increase in research interest from 2018 onwards, with a notable surge in publications in 2022. Top contributing countries include the USA, with a focus on computer science, business economics, engineering, and communication fields.Co-authorship and bibliographic coupling analyses reveal influential authors and interconnected research works. Keyword co-occurrence analysis highlights central themes such as AI, machine learning, digital marketing, and advertising.The study's limitations include its reliance on Web of Science data and exclusion of unpublished works. Future research could encompass broader databases and diverse publication types. Overall, this analysis offers insights into AI-driven advertising trends, aiding researchers and industry professionals in understanding evolving research directions.

Keywords: AI in advertising; AI-driven marketing; artificial intelligence; digital marketing Machine Learning, Digital Advertising Bibliometric Analysis.

1. Introduction

A new era has been brought about by the rapid growth of artificial intelligence (AI) in many

areas, especially marketing. As AI technologies advance, they will be able to examine large datasets, spot patterns, anticipate outcomes, and more could even make choices with little assistance from humans. With its dynamic nature and reliance on real-time data, digital marketing may greatly benefit from artificial intelligence. Artificial Intelligence (AI) is a rapidly gaining traction in business, allowing companies to monitor and analyze real-time data to promptly address client needs (Wirth, 2018). AI offers vital consumer knowledge of consumer behavior, which is essential for drawing in new business and keeping existing clients. AI drives the customer's next action, redefining the entire experience (Tjepkema, 2019). Artificial intelligence (AI) techniques are helpful in figuring out what customers want and setting future directions (Shabbir, 2015).

Nonetheless, the connection between artificial intelligence and marketing has been the focus of several studies, and the quick development of both disciplines calls for ongoing research. Artificial intelligence (AI) has drastically changed and revolutionized marketing by being used in changed commercial processes and ushered in a new era of innovation and expansion in business tactics. The function and effects of AI in modern marketing were extensively studied by Chintalapati and Pandey (2022) who emphasized the technology's transformational potential. They highlighted integrated digital marketing, content marketing, expGkikas 2019eriential marketing, marketing operations, and market research as the five main functional topics in marketing where AI has been widely used in their systematic literature analysis.

The use of AI in advertisements has been the subject of extensive research (Marinchak et a 2018), although the majority of these studies just list or describe the social media material that is influenced by AI. As one instance, certain academics map the possible relationship by outlining the state of AI applications in digital marketing at the moment (Gkikas 2019), (Theodoridis 2019). These scientists only address the possible applications of AI in relation to different aspects of social media marketing, but (Gkikas 2019). An further one explains how AI and machine learning approaches have affected the sales and marketing industry (Siau 2017).

Moreover, only a small number of researchers conducted qualitative study to summarize the important themes in the field of AI and social media and review the literature (Yang 2018). Similarly, in an effort to lower the risk associated with the results of AI implementations, some scholars compiled a list of the major applications of AI in marketing (Jarek 2019). Hardly any study has been recently conducted which has done a bibliometric analysis. This study offers bibliometric indicators and structured analysis can help researchers to pave a way for the further research directions in this area. Bibliometric tools like number of research publications, Prolific authors and publication houses, most cited articles and authors, Co-authorship, bibliographic coupling which analyses reveal influential authors and interconnected research work along with Keyword co-occurrence analysis to highlight the central themes of research.

2. Research Questions

RQ1: What are Citation Patterns, year wise publications, Prolific authors, universities, Publishers/Journals, where the research in this area has been done.

RQ2: What are number of publications and changes in publication year wise, yearwise

publication with their citations.

RQ3 What are various clusters based on citation network, Co-citation, bibliographic coupling and Keyword co-occurrence.

RQ4 What are the trends and methodology adopted, and to find the research gap to analyze and suggest future areas of research for the chosen keywords

3. Material and Methods

Data Collection

The data was collected using web of Sciencecore collection [tm]. The following indexes were used to collect the data: Science Citation Index Expanded (2014to present), Social Sciences Citation Index Arts & Humanities Citation Index (2014 to present), Conference Proceedings Citation Index-Social Science & Humanities (2014 to present), Book Citation Index-Science (2014 to present), Book Citation Index-Social Sciences & Humanities (2014 to present), and Emerging Sources Citation Index (2015 to present). The impact factor continues to be the most prominent index easily accessible, which is why the WoS database was selected (Falagas et al. 2008). Each of these indexes was created using data from the Thomson Reuters online database, which includes scholarly articles and author biographies. Without using a language or chronological filter, an advanced search was conducted using the following research terms: AI OR Artificial Intelligence OR Machine Learning in Title and Advertising OR Digital Marketing in Title and Abstract. This Advance research process returned with total of 341articles with dates of publication between 2014 and 2024.

Data Analysis

The Study gives bibliometric analysis for the researches done in the area of advertisement, have linkages with Artificial Intelligence or Machine Learning. A bibliometric analysis is frequently used to determine the quantitative shifts in a given field of study, the publication pattern on a specific subject, and the publication propensity within a given field (Lee and Hew, 2017; De Bakker et al., 2005). For professionals and specialists interested in evaluating such research work, the analysis's findings provide timely, relevant, and practical information (Duque Oliva et al., 2006). Another benefit of bibliometric analysis is that it enables the objective, quantitative study of a certain discipline (Merigo et al., 2015).

As mentioned above about the data collection, 341 documents were extracted in which bibliometric analysis were performed. Additionally, a classification of these papers is given according to the following criteria: the most prolific authors, the most prolific countries and institutions, the journals with the most publications, the year that a publication was published, the most cited papers, co-authorship network analysis, inter-country co-authorship network analysis, and keywords co-occurrences network analysis. The VOS Viewer 1.6.9 program was used for co-authorship network analysis, inter-country co-authorship network analysis, and keywords co-occurrences network analysis. A free program called VOSviewer is used to make maps from network data. It also facilitates the exploration and visualization of these maps.

4. Results and Findings

The historical progression of the published articles

The development of research output on AI and marketing from 2004 to 2024 is depicted in Figure 1. The topic seems to be in its early stages in the first years, from 2004 to 2017, with only three or four articles published annually. This implies that the subject may have been new or not well known in the scientific world during this time. But by 2018, there was a noticeable increase in interest, as shown by the articles more than tripling to ten. With 21 articles published in 2019, this momentum carried over, showing a consistent increase in research interest and contributions. The pattern continued in 2020 with an additional increase to 32 articles. Subsequently, 2021 saw a notable increase in publications, with 54 articles, indicating that either the field has gained significant interest or certain breakthroughs have prompted additional research. This increase became even more noticeable in 2022, when there were 88 items recorded, more than double the number from the year before.The surprise came the next year 2023, as the number of papers published were less to that of 2022, 66 articles published which studied impact of AI on advertising. The cumulative count of the research articles published ever saw an increasing trend from the year 2020, splurge was seen in 2022.
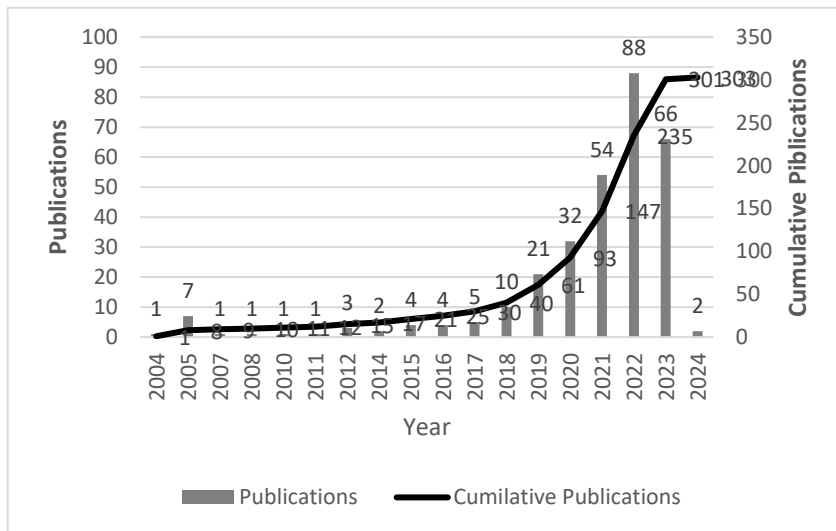

Catgories in WoS and Publication:As artificial intelligence is a multidisciplinary concept that is widely used in various fields, its publications are also in varied journals. Through the performance analysis in the bibliometric study, the top 10 categories in the WoS database were identified, from where most of the research studies come from. Most of the research articles that have key words like AI, advertising, machine learning, and the impact of AI on advertising fall under the Business category that is 82. Other categories like computer science information systems, computer science artificial intelligence, engineering, electrical, electronic, and communication also have significant numbers, viz. 59 53, 49, and 44, respectively. Although the scope of artificial intelligence is broad, publications in other areas like telecommunications, computer science interdisciplinary application, management, computer science theory methods, and computer science software engineering also have a good number of publications, namely 23, 20, 18, 15, and 12, respectively.
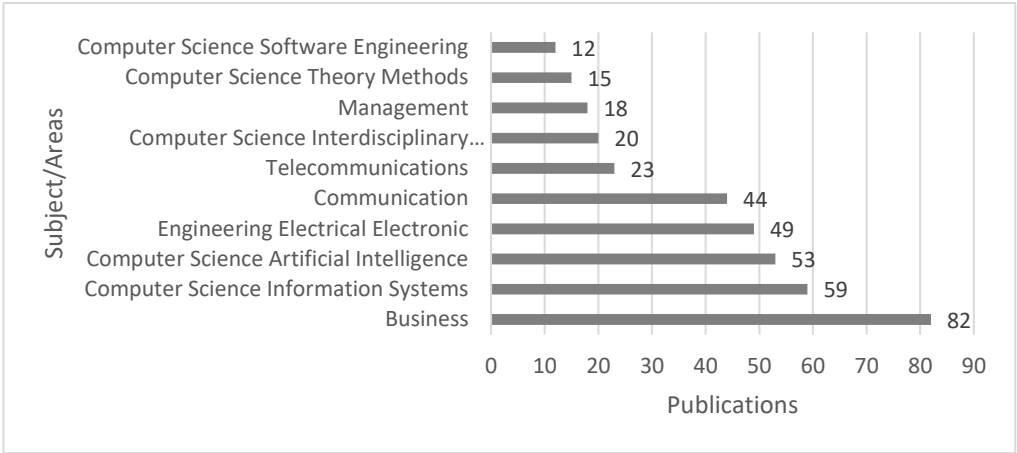
Most prolific journals

Analysing the journals that have published most of the articles related to artificial intelligence and advertising, the criteria given was journal that have published at least 3 articles, sothere were 46 publishing houses which contributed atleast 3 articles in this area. Most significant contribution was from Journal of Advertising, contributing 17 articles, International Journal of advertising with 14 articles. IEEE access journals had 10a articles published articles related to AI and advertising. Other prominent journals contributing the research in this field were Lecture notes in AI, Sensors, frontiers in psychology publishing 5 articles in this area.
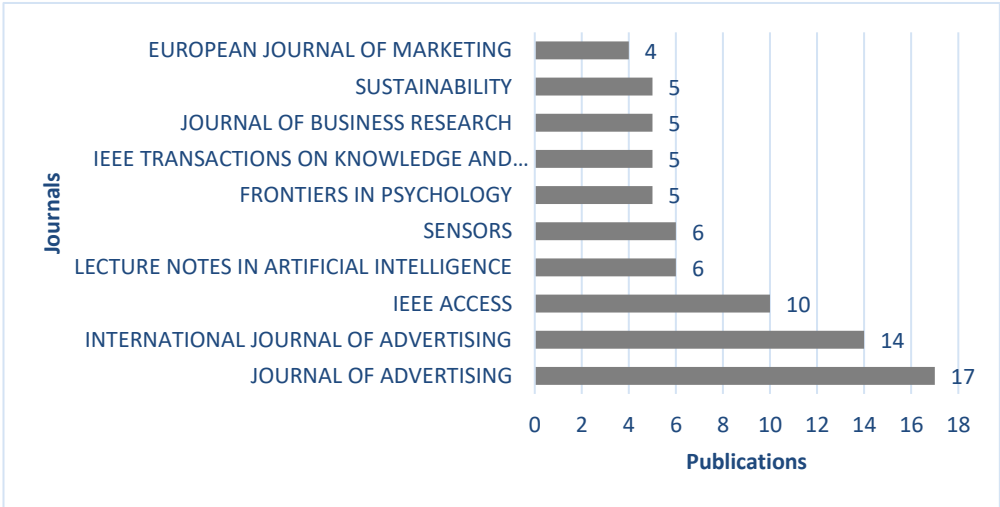

Most Prolific Countries

The research articles in this field were contributed by 69 different countries. Top 10 countries has been shown in the figure below. These 69 countries has their active involvement in research on the AI and digital marketing area. USA leads with total of 94 article.
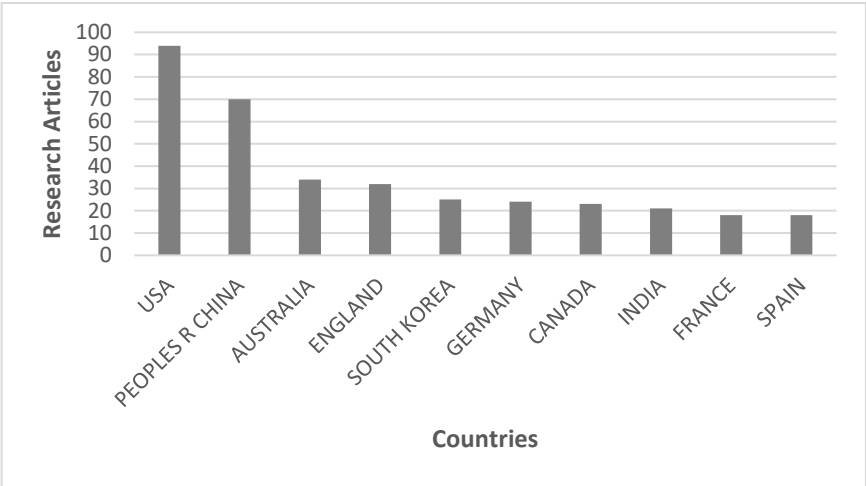
Most prolific research areasThe majority of the 310 publications that have been published about artificial intelligence and advertising ,117come from the field of computer science. This is expected given that AI technologies are developed and extensively studied within computer science departments. By contrast, Business Economics has 96 publications, followed by Engineering (63), and Communication (44). There were 23 papers in the telecom field. likely explores how telecommunications infrastructure and technologies intersect with AI-powered advertising platforms, such as targeting advertisements based on mobile user data or leveraging network resources for ad delivery. The involvement of other fields such as psychology, science technology, chemistry, operations research, and social science underscores the interdisciplinary nature of AI and advertising research. These contributions may focus on diverse aspects such as user psychology, technological innovations, chemical applications in ad materials, operational efficiencies, and societal impacts. Overall, the data suggests a multidisciplinary approach to understanding the complexities and opportunities presented by AI in the realm of advertising, with each field offering unique perspectives and insights. This collaborative effort is essential for advancing knowledge and addressing challenges in this rapidly evolving domain.
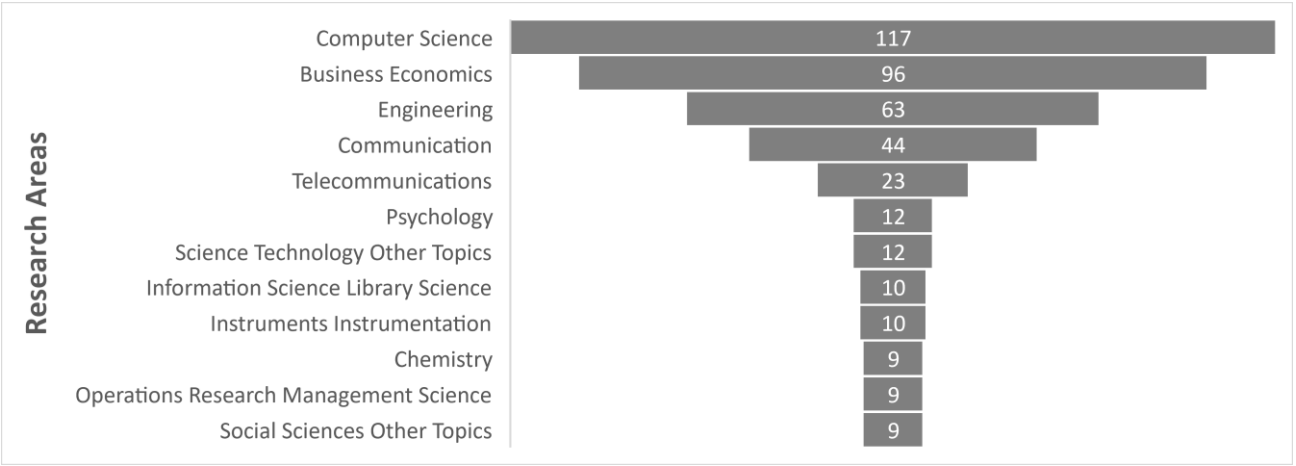
5. Scientific Analysis:

Co-authorship Citation Analysis – Organization wise:

The study has identified the top 10 most cited Organizations, as given in the table below. Using vos-viewer software the co-citation analysis has been done, taking organization as a base. the number of documents is one indicator of research productivity, the number of citations per document provides insight into the impact and influence of an organization's research output. MIT stands out in this analysis with a significantly higher number of citations per document, indicating the high impact of its research in the academic community..MIT had the highest number of citations (627) among the top 10 organizations, despite having fewer documents compared to other universities. This suggests that MIT's research output is highly impactful, with each document attracting a significant number of citations. Both UCL and the University of Amsterdam had a similar number of citations, with 284 and 283 citations respectively. Despite having the same number of documents, their citation counts indicate a strong impact of their research outputs.Queensland University of Technology had a slightly lower number of citations (111) compared to the top three organizations, despite having a higher number of documents (9 articles). This suggests that while the university produces a considerable amount of research, its impact, in terms of citations per document, may be relatively lower compared to MIT, UCL, and the University of Amsterdam.

Organization	documents	citations
Mit	4	627
Ucl	4	284
univ Amsterdam	5	283
univ Victoria	7	177
swinburneunivtechnol	7	111
queenslandunivtechnol	9	97
michigan state univ	6	87
kings coll London	6	85
shanghai int studies univ	3	81
wuhanuniv	6	76

Intercountry Co-authorship Network:

The analysis aimed to understand which countries' authors engage in the most cross-border collaborations. The intercountry authorship network map depicted 23 countries within the dataset. Utilizing VOS viewer software, it was found that the USA exhibited the highest number of citations and co-authorships, evident by the prominence of its cluster in the network map, characterized by thicker lines connecting it with other countries. The USA emerged as the central player, exhibiting extensive partnerships with countries like England, Australia, Canada, and China. The network map revealed six clusters, with a red cluster being the largest, comprising seven countries including Greece, Italy, Malaysia, Poland, South Korea, Spain, and Taiwan, indicating significant collaboration. Another noteworthy cluster was green, containing five countries. Overall, the findings emphasize the global nature of scientific research, the leadership role of the USA, and the importance of international collaboration in advancing research agendas.
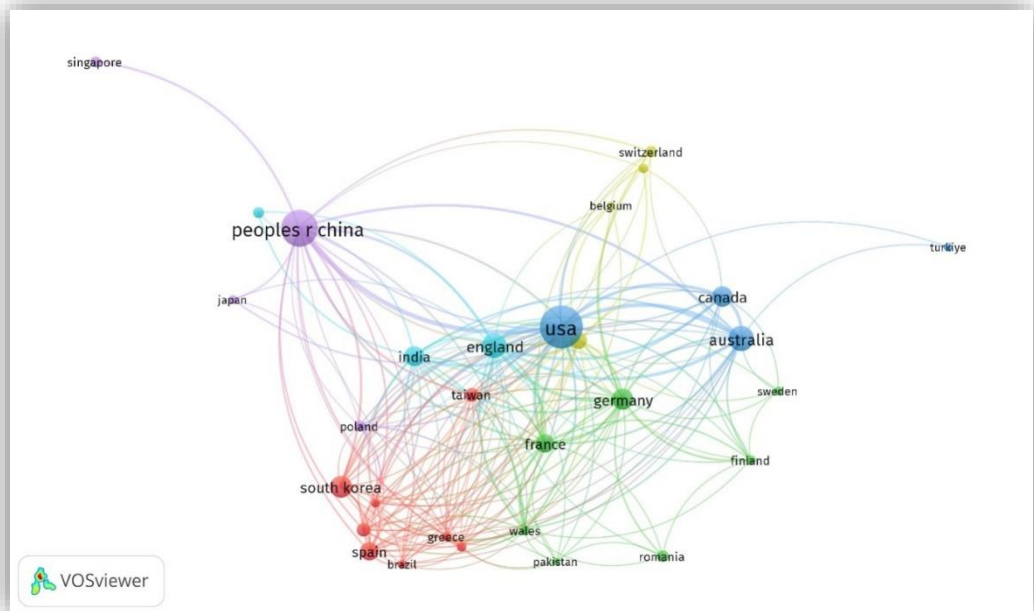
Authorwise Co-citation Analysis:

The figure below provides an insightful visualization of collaborative patterns among authors within the realm of AI and Advertising. Utilizing VOSviewer software with a citation threshold set at a minimum of 10 citations, this network encapsulates the contributions of 68 authors across 7 distinct clusters.Remarkably, Clusters 1 (marked in red) and 2 (in green) stand out with the highest number of items, each boasting 17 elements. This abundance signifies the extensive interconnectedness among authors within these clusters, indicating robust collaboration and shared research interests.

Notably, the visual prominence of certain authors, particularly Sunder and Dwivedi, is evident through the size of their respective circles within the network. Sunder, in particular, emerges as a central figure, denoting significant influence and prolific contributions to the field.

Overall, this visualization offers a nuanced understanding of authorwise collaboration dynamics, shedding light on key figures, prominent clusters, and the interconnected nature of research efforts in the intersection of AI and Advertising.
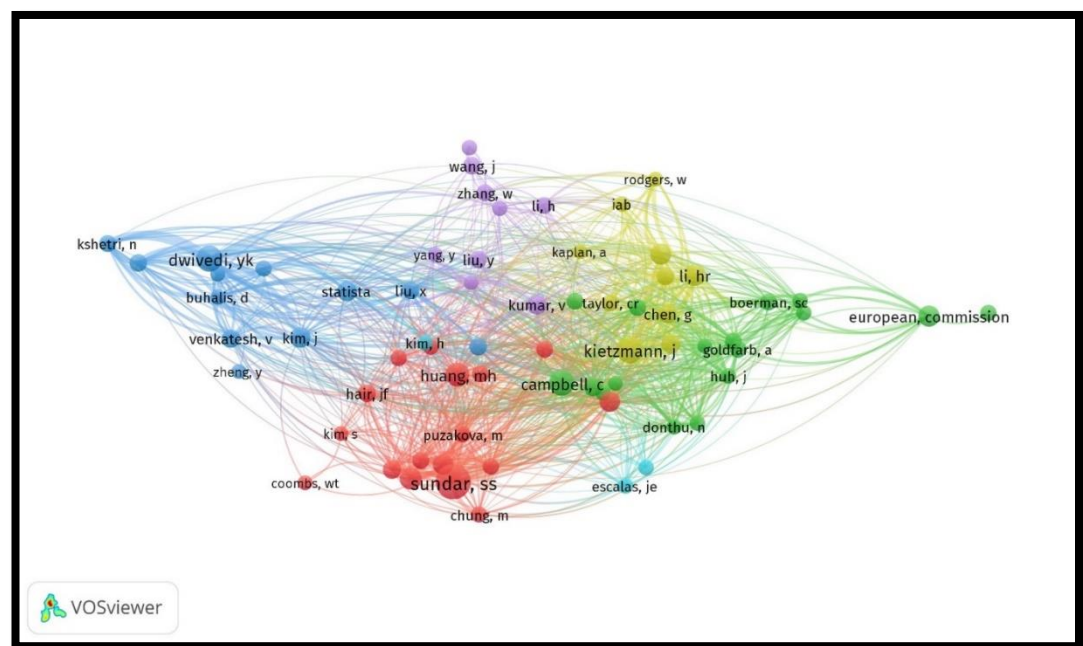
Co-citation references network

Bibliographic Coupling Documentwise

Bibliographic coupling is referring to the connectivity of objects is measured on the basis of the number of references they share. The strength of their relatedness (coupling) becomes more when a document receives more citations. It provides the similarities of the two works' subject matter in the form of documents, source, author, organization, and countries Out of total 303 documents, it was further filtered based on highest number of citations. The minimum number of citation was capped (10) and finally 193 meets threshold of the cap were retrieved. The overall frequency of bibliographic coupling has shown in the table and the figure given below. The frequency of bibliographic coupling indicates how often documents are interconnected based on shared references. The top 10 most linked documents are listed below, along with their respective citation counts:

Sr. No.	Document	Citations
1	dwivedi (2021)	436
2	coley (2018)	353
3	dwivedi (2022)	312
4	luo (2019)	309
5	lambrecht (2019)	213
6	nadarzynski (2019)	203
7	wang (2016)	177
8	thompson (2018)	127
9	kietzmann (2018)	119
10	lewinski (2014)	88

These documents represent the most influential and interconnected works within the domain of AI and advertising, based on the strength of their bibliographic coupling. The high citation

counts of certain documents suggest their significant impact and influence within the research community. Authors and works such as Dwivedi (2021), Coley (2018), and Luo (2019) appear to be central to the network, indicating their pivotal role in shaping research trends and discussions. Further analysis of these highly coupled documents could reveal common themes, methodologies, or theoretical frameworks that are widely referenced and cited in the literature. Understanding bibliographic coupling patterns can help researchers identify seminal works, track research trends, and explore the intellectual structure of the field. Overall, bibliographic coupling analysis provides valuable insights into the interconnectedness and influence of research documents within the domain of AI and advertising, facilitating a deeper understanding of the scholarly landscape and guiding future research directions.
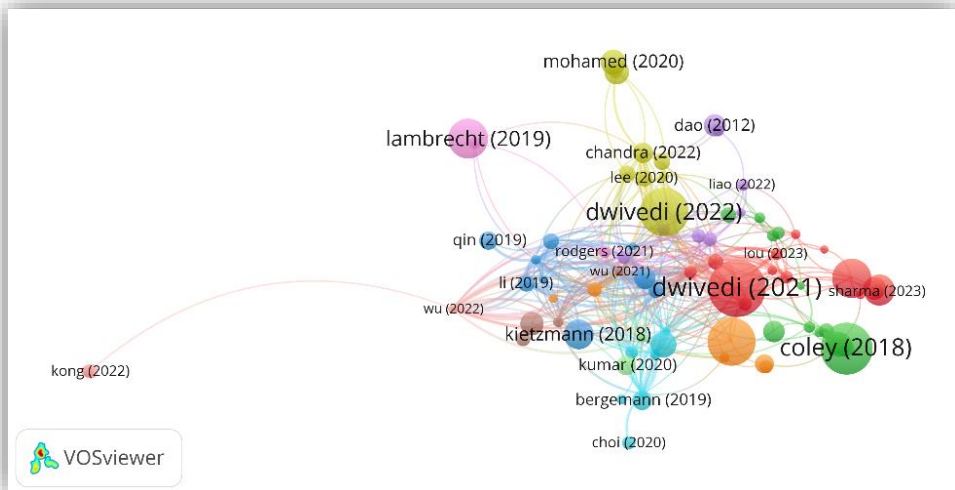

Co-occurrence of Key words:

The purpose of the keyword co-occurrence network analysis is to identify the keywords that have been used most frequently by different publications using different keywords by the research papers taken in this study. This type of analysis aids in gaining insight into the subjects and issues on which the researchers have mostly concentrated. Using a text-mining method, VOSviewer creates a map where the distance between terms indicates how linked the different keywords are to one another (Laudano et al., 2018). The stronger the relationship between two or more terms, the smaller the distance that appears between them. The co-occurrences in the publications were examined to ascertain the relatedness of the terms (Van Eck et al., 2010).

In the Figure below the keyword co-occurrence network map is presented. There were total 1812 keywords in the data set. Only 62 keywords were selected which appeared 5 or more times in the data set. The map shows the different keywords connected to each other with various lines.

The lines represent that these keywords have co occurred with each other in various papers in the data set. Upon further analysing the network map in the VOSviewer software, it was found

that Artificial Intelligence is the most frequently occurring keyword, indicating that AI is a central theme in the dataset. It suggests that many studies within the dataset focus on the application, impact, or implications of artificial intelligence in various contexts, including advertising and marketing. Although similar to "Artificial Intelligence," the hyphenated version may represent a specific usage or context within the dataset. Its co-occurrence with "Artificial Intelligence" suggests consistency in the theme but possibly different emphases or perspectives. Impact is another keyword which occurs about 30 times. Indicates that many studies within the dataset are concerned with assessing or discussing the impact of various factors, potentially including AI, machine learning, advertising, and social media. There are other keywords which are synonyms of Artificial Intelligence also occurs significantly like machine learning, Deep learning, Model etc. Advertising, Social Media, online advertising are other keywords which has got an impactful occurrences he keyword co-occurrence analysis highlights the prominent themes and topics within the dataset, providing insights into the interconnectedness and focus areas of research related to artificial intelligence, advertising, and related fields.
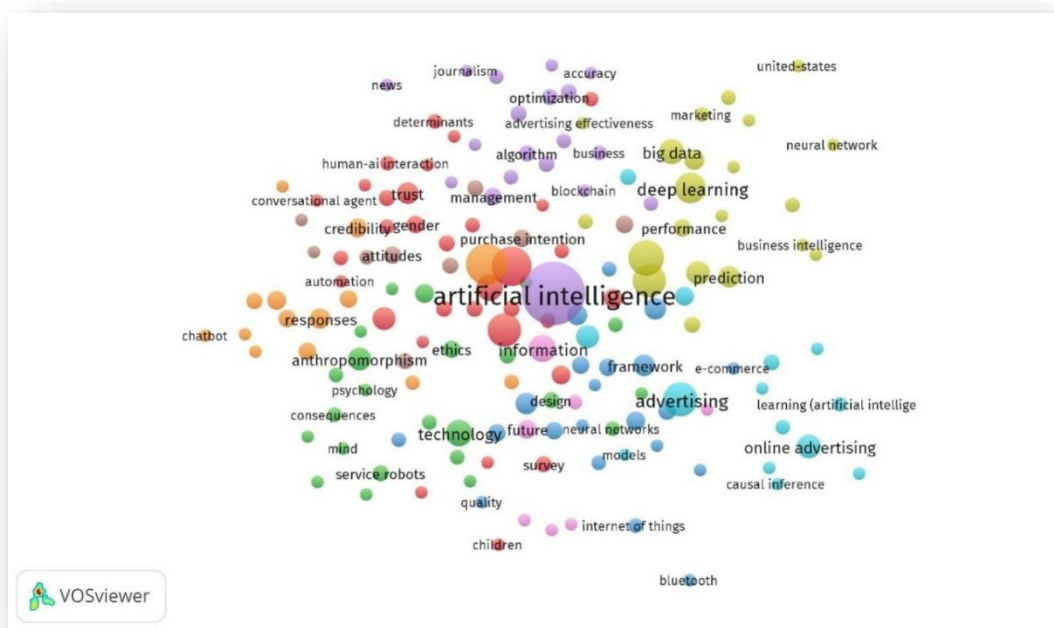
6. Conclusions, limitation and further developments:

This study makes it possible to comprehend artificial intelligence's application and effects in the advertising industry more effectively. Academicians and advertising professionals alike will find the study and information valuable for the advancement of research in AI and advertising. Thus, the study provides a summary of the literature in the domains of artificial intelligence and advertising. Through performance analysis and science mapping, a number of

bibliometric analysis tools were used to assess the performance of the scientific production. To determine the productivity ratio (total publications) and the relevance (citation analysis) of authors, nations, and journals, performance analysis was carried out. In addition to offering a deeper look at the data, bibliographic coupling and keyword cooccurrences also provided guidance for using keywords in research papers.

Additionally, this study has several limitations that may serve as a guide for further research. First, the study's time span was extended from January 2004 to January 2024. Future research with an even broader scope can be done. Second, the Web of Science database was the only one searched for papers in this study, suggesting that research articles published in journals outside of WoS were excluded from analysis. In the future, comparable analysis can also be performed using another database, such as Scopus.Another drawback is that the data set was primarily sourced from WoS, and it does not contain unpublished papers, PhD theses, master's and doctorate dissertations, or research on the application and effects of artificial intelligence on advertising. Thus, information can be gathered from all of these sources in future research, and the outcomes of those analyses can be compared to those of current one.

Taking into account all of the aforementioned restrictions, it can be said that this study is lacking in a few areas. Nonetheless, it is still thought that thorough bibliometric analysis is offered, and this study contains a large number of significant research publications. This can assist academics and professionals who are approaching this subject and plan to do a thorough investigation and summarize the body of existing scientific material. The research findings can be used by academics and scholars to inform future investigations, and policymakers can use this as a starting point to support studies on artificial intelligence and advertising.

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