

Bibliometric Review of Applications of Deep Learning in Marketing: Advances in Resources and Top Trend Analysis

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Abstract

Marketers are compelled to come up with innovative ways to meet customer expectations while maximizing their available resources. In order to do this, marketers are using artificial intelligence and machine learning and especially deep learning. This research conducts an analysis by using bibliometric methods, at deep learning literatures in marketing. Using a bibliometric approach, 235 articles published in 2017–2022 were collected from journals indexed in the Scopus database. Multiple software (R studio, Excel, and Biblioshiny) were employed to analyse the data. The occurrence of publications were determined by year, publication source information and authors, journals, countries, institutions, thematic maps, and current trends of topics, clear, and reliable as a result of this technique. At the end of the report, the findings and a strategy for future study are summarised and discussed. In marketing research, there is a growing interest in deep learning. This article is both instructive and supplementary, since it covers the majority of marketing's fundamentals.

Keywords: Bibliometrics, marketing, deep learning, advertising, recommender systems, machine learning

1. Introduction

Bibliometric analysis, an approach that is both common and rigorous, may be used to investigate and evaluate significant amounts of scientific data. It makes it possible to dissect the subtle shifts in a particular discipline. However, the implementation of this methodology in the field of marketing is still relatively young, and in many cases, it is not fully developed. Massive objective occurrences of keywords and subjects provide the backbone of bibliometric analysis, but the interpretations of this data are frequently based on

a mix of objective and subjective judgments developed by well-informed approaches and processes [1].

A more tailored experience may be delivered to customers by using deep learning to analyse their data. Because marketing is a data-driven activity, it's conceivable that AI will eventually surpass humans in this field [2]. The underlying technology underpinning deep learning is improving in its ability to mine large datasets for hidden patterns and insights. It's not hard to picture a future in which businesses are able to combine massive amounts of data to better understand their customers' wants and needs and then use that knowledge to gain an edge in the marketplace. The use of technologies that use deep learning to improve the efficiency of the sales process has been more popular recently. This is being implemented by many marketing and sales teams in order to create a higher return on investment. Deep learning might also assist to improve the likelihood of interacting with a potential audience in the most efficient method possible, which would ultimately result in an increased conversion rate over the course of time. Techniques from machine learning are now being used in an effort to enhance the sales process. This tactic is becoming more popular among companies as they seek to increase their return on investment. There is some evidence to suggest that machine learning may aid in increasing the chances of interacting with a target audience in a manner that raises the possibility of a sale being made [3].

1.1 Research questions

RQ 1: What is the bibliometric key factor of Deep Learning in Marketing?

RQ2: To what extent has deep learning been studied and what are the current hot topics in its marketing applications?

1.2 What is deep learning?

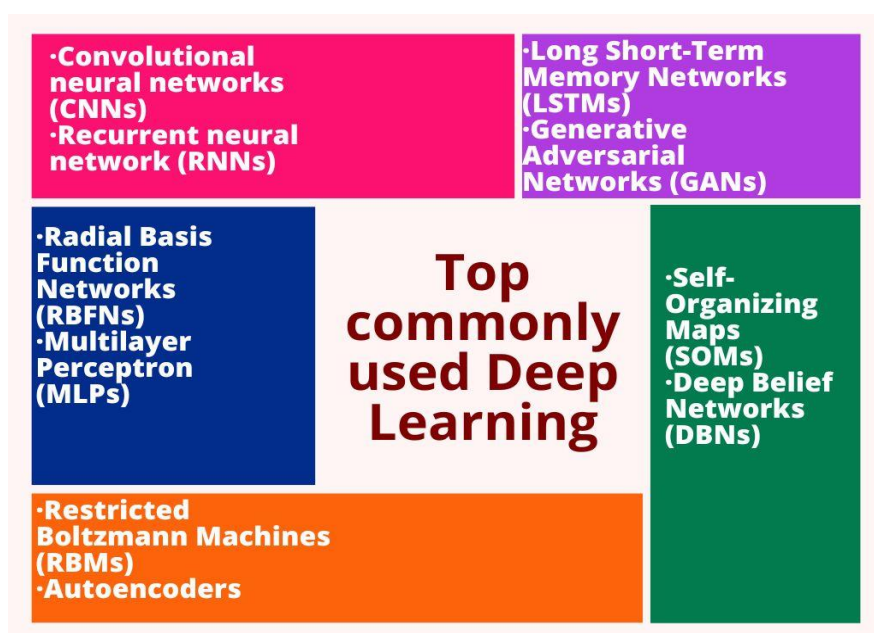
Deep Learning is a subfield of machine learning. It is a large neural network where a computer model learns to classify things based on what it sees, hears, or reads. Deep learning models can get as accurate as the humans and sometimes can even do better. Using a large set of labelled data and neural network architectures with many layers, models are trained.

1.3 Deep Learning Applications in marketing

Table 1 depicts the popular fields in marketing research topics with deep learning.

Table 1. Popular fields in marketing

Subjects	
Big data Analytics in marketing	Consumer Behavior Analysis
Natural Language Processing & Chatbots	Direct marketing
Digital marketing and recommender systems	Products Demand Forecasting
Social Media Marketing	Click-through rate prediction
Marketing Strategy	Customer services
Sentiment Analysis	E-Commerce Marketing
Advertising	Customer satisfaction
Market Research	Interactive Marketing
Retail Marketing	Sales forecasting
Potential business partner recommendation	Market basket analysis
Personalized Item Recommendation	Predicting customer churn/Customer attrition
Demand Forecasting Model	Consumer Trust
Products	Customers' purchase behavior
Mobile marketing	Branding
Product replacement	Strategic marketing
Marketing intention detection	Improving shopping experience
Content Marketing	Shoppers' purchasing intention

**Figure 1.** Top commonly used Deep Learning techniques

2. Data Collection

Figure 2 depicts the step by step data analysis process.

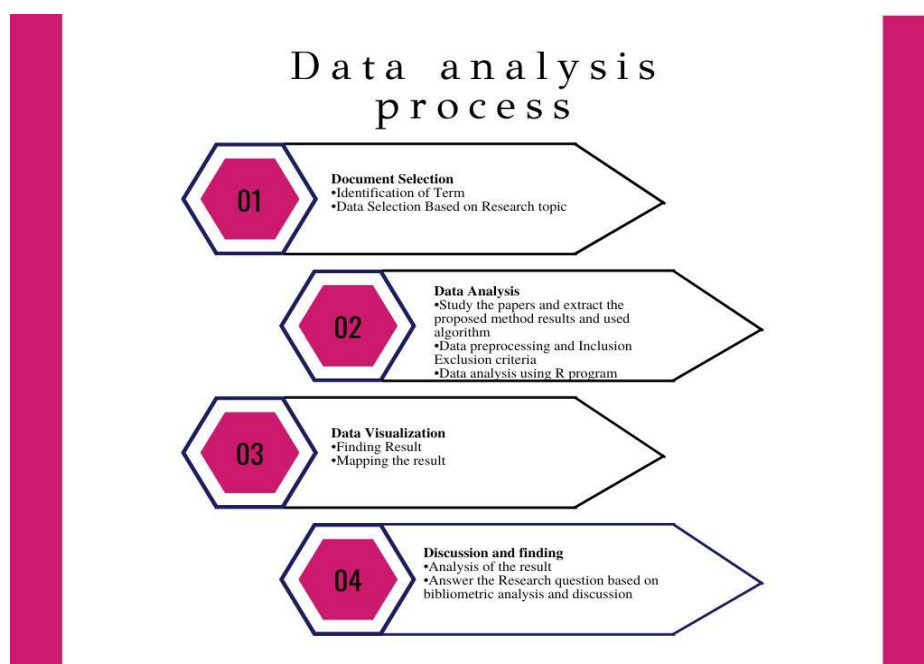


Figure 2. Data Analysis Process

2.1 Search Strategy

Bibliometrics can retrieve from the following services: Scopus, Web of Science platform, Journal Google Scholar Metrics, and PubMed. Scopus database, a well-known database is used for this study. A bibliographic search is a series of activities aimed at locating and retrieving documents relating to a specific subject. The goal of these activities is to optimize knowledge status that is perceived to be either incomplete or inappropriate in some way. A bibliographic search could be defined in a more general sense as a series of activities. The search needs to have more than just the most fundamental search abilities for the searches to be successful [4].

2.2 Data Analysis Tools

Bibliometrics inverts the conventional approach to statistical analysis of large amounts of data. Bibliometrics [5] is the quantitative examination of scholarly writings like journal articles and the citations that support them. As an adjunct to R studio, Biblioshiny is the go-to tool used [6]. Microsoft Office Excel 2019, developed by Microsoft Corporation and headquartered in Redmond, Washington, United States, was used to manage and analyse

the characteristics of the publications. It was put to use for the aim of visual analysis of the author's contributions and the countries involved. In order to create a co-citation network and conduct a density visualization study, the clustering approach was used.

2.3 Inclusion Exclusion criteria

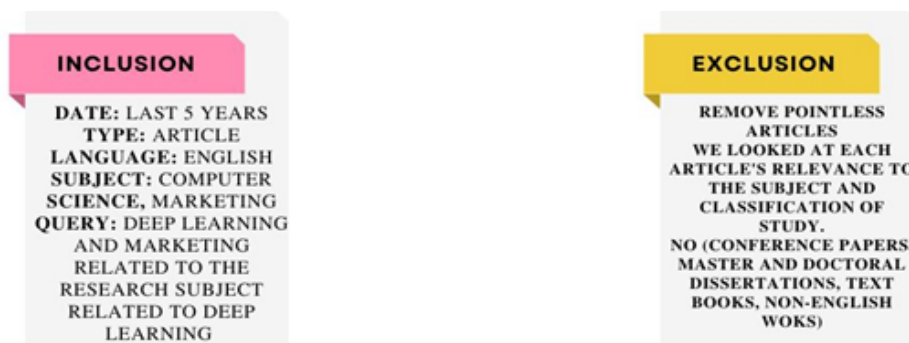


Figure 3. Inclusion Exclusion Criteria

2.4 Word Cloud Field Keyword Plus

A tag cloud is a visual representation of text data that is often used to portray keyword metadata. It is a helpful approach to express significant information in a concise manner since it can be seen at a glance. Fig. 3 is a word cloud for deep learning frequent words in marketing manner. The more often a certain word occurs in a given source of textual data, the larger and bolder it will appear in the word cloud.



Figure 4. Word Cloud

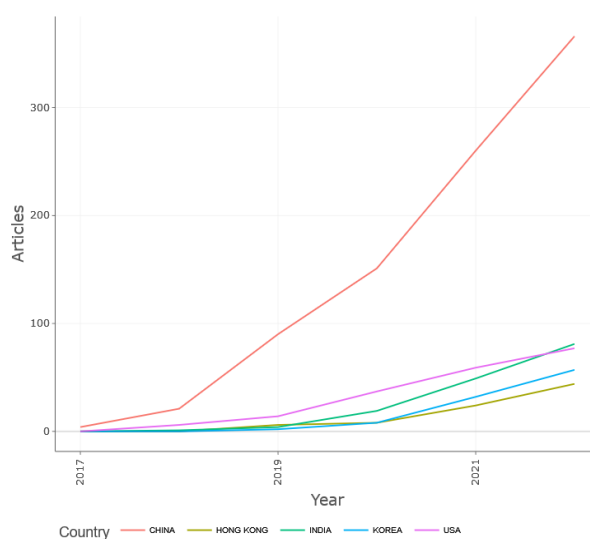
3. Bibliometric Study Approach and Tools

The database contains 235 papers from 127 sources, and the period of collection is 2017-2022. The average number of citations per document was 10.43 and 662 authors were identified from 235 documents. The annual growth rate is 88.82%, and international co-authorship is 33.19%. Biblioshiny and R-studio have been used in this section.

Table 2. Main Information about Data

Description	Results
Main Information about Data	
Timespan	2017:2022
Sources (Journals, Books, etc)	127
Documents	235
Annual Growth Rate %	88.82
Document Average Age	1.2
Average citations per doc	10.43
References	10745
DOCUMENT CONTENTS	
Keywords Plus (ID)	1459
Author's Keywords (DE)	673
Authors	
Authors	662
Authors of single-authored docs	25
AUTHORS COLLABORATION	
Single-authored docs	25
Co-Authors per Doc	3.3
International co-authorships %	33.19

3.1 Countries' Production over Time

**Figure 5.** Countries' Production over Time

Diverse countries and economies contribute differently to the ever-increasing volume of published literature in the world. The publishing output of any country or economy demonstrates that the historically dominant producers have contributed the most to the global publishing industry. China had significant growth rate and the biggest publishing growth in 2017.

3.2 Most Cited Countries

The data came from articles that were published in Scopus during the years 2017 and 2022, and China is the most cited country with 685 citations.

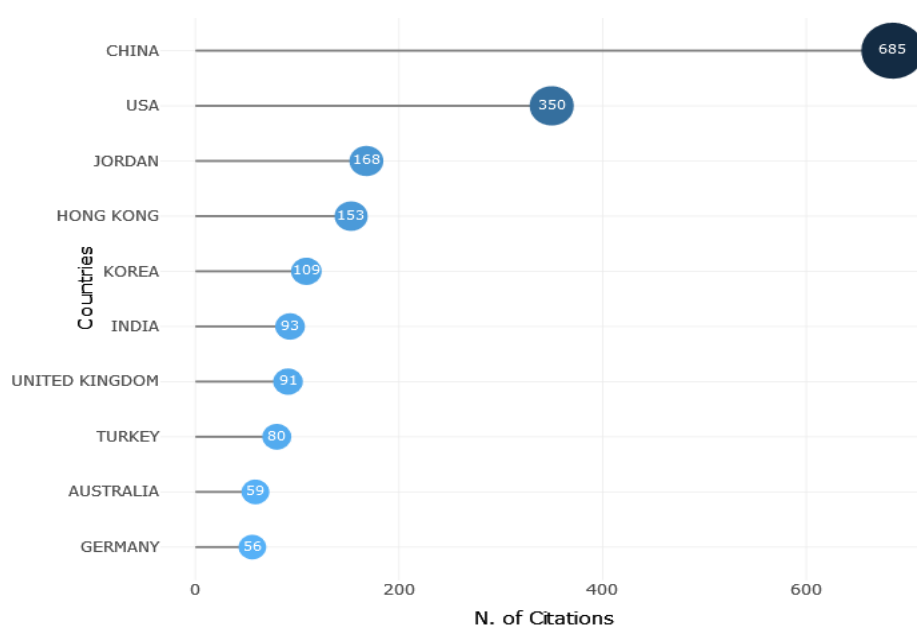


Figure 6. Most Cited Countries

3.3 Country Scientific Production

In the global breakdown of the research articles that have been done on the applications of deep learning in marketing, a substantial amount of academic investigation has been carried out and published. Because of the sheer number of publications emanating from each country, their respective nations have been given a representation in the form of colour patterns. A list of the top 10 nations in terms of the number of scientific papers that they have contributed to the overall total was provided. China is the nation that has produced the most documents overall, with 366 papers. India is in close pursuit with China and now holds the second-place with 81 papers, while United States is in third place with 77 papers. Following closely, Spain with 25 papers is in the third place, and then is Australia with 20 papers. South Korea comes in the 57th place on the list of countries when compared to others.

3.4 Most Relevant Affiliations

It is probable that those doing research may find the information presented here useful in discovering a reliable source in this field as well as getting publications that are relevant to the job that they are doing. Figure 7 presents a breakdown and explanation of the distribution of scientific materials according to the institutions or links involved.

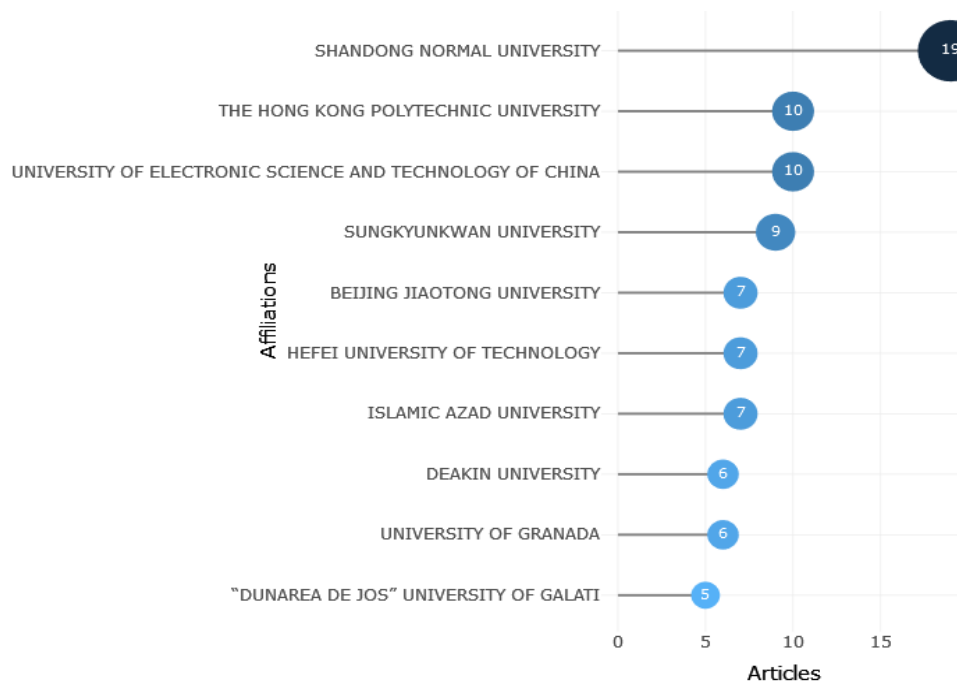


Figure 7. Most Relevant Affiliations

The data indicate that 10 different institutions have done the most work related to the topic of the study. The Shandong Normal University is a prestigious institution for higher education that can be found in China and takes the first place. It is widely recognised as the preeminent organisation for the production of research publications on deep learning machine learning and marketing. The institution has produced 19 document papers, and its location in China makes it the second most represented affiliate when it comes to the production of scientific resources. In addition, there are educational institutions like the The Hong Kong Polytechnic University in Hung Hom that have generated ten publications. Universities in China are other examples of places that fall into this category. University of Electronic Science and Technology of China is found in the list with 10 publications. Nine publications were created by Sungkyunkwan University in South Korea. The Beijing Jiaotong University, Hefei University of Technology, and Islamic Azad University are the most recent universities to publish papers in deep learning applications in marketing. Each of these universities has seven publications [7].

3.5 Corresponding Author's Country

Figure 8 provides additional information on the nationality of the associated author. The resulting graph reveals that China, USA, and South Korea are among the nations that have the highest Multiple Country Publication (MCP) counts of scientific papers that discuss the applications of deep learning in marketing. According to the findings of this investigation, China, USA, and South Korea are all examples of Single Country Production (SCP). These are the countries that have been most influential in the development of deep learning in marketing.

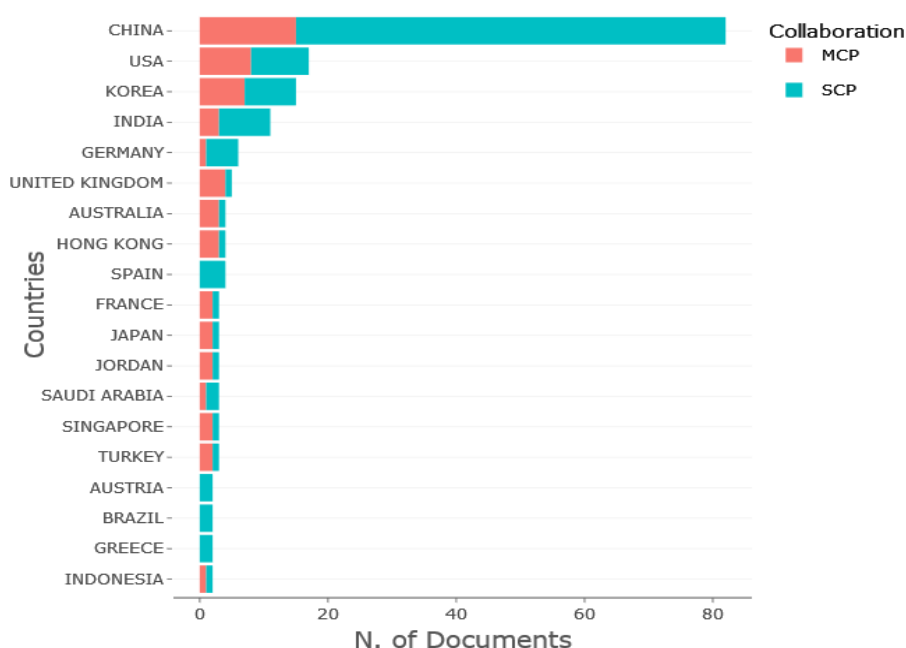


Figure 8. Corresponding Author's Country

3.6 Citation Analysis

The average citation per document is 10.43.

3.7 Co-occurrence Network

To begin building a co-occurrence network from a corpus of texts, an undirected graph is formed. The words in a vocabulary are represented as nodes in the graph, and the connections between them by edges. Co-occurrence networks are useful for displaying the connections between words in a corpus of texts and for mining data from those connections. By way of illustration, a co-occurrence network might be used to identify the words most often associated with a target keyword.

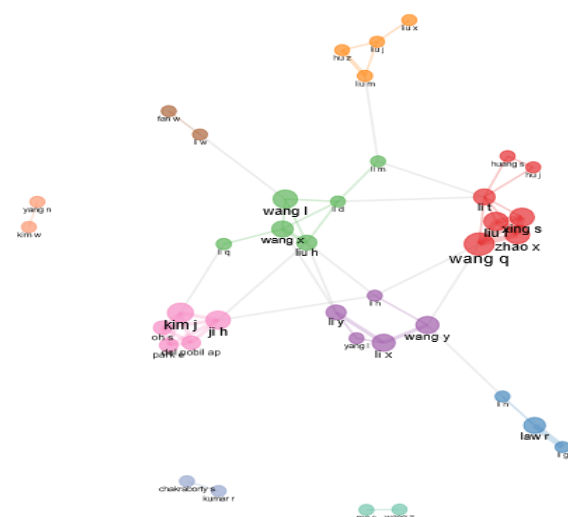
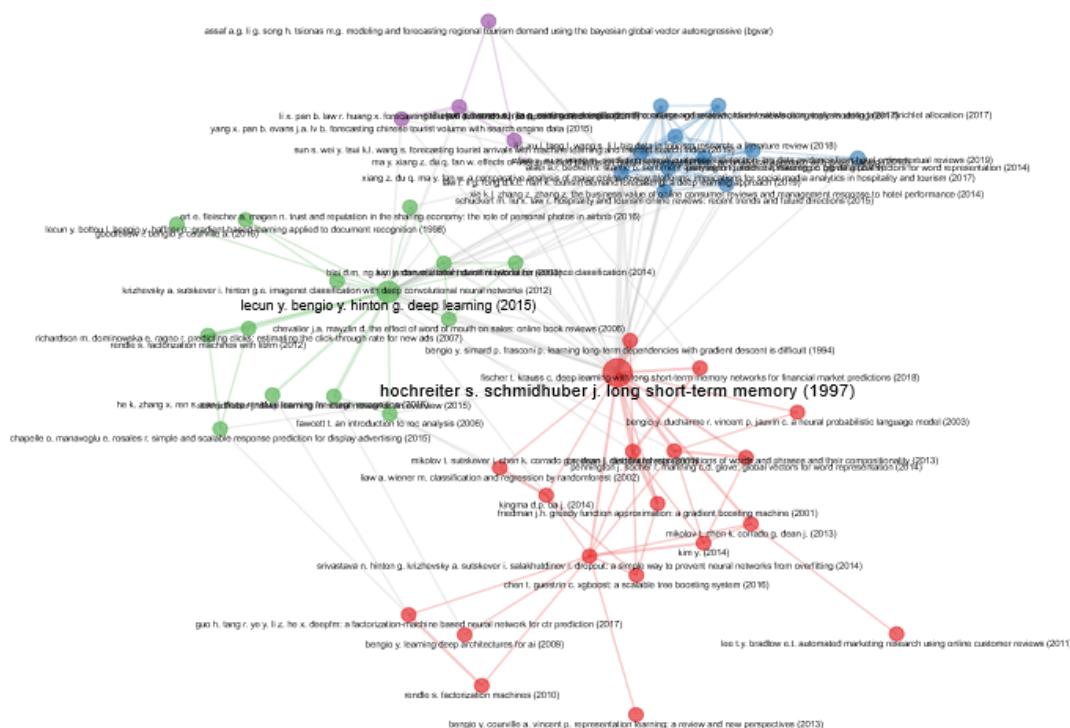


Figure 9. Co-occurrence Network

3.8 Co-citation Network

In the realm of publications, the first two articles include Hochreiter s. Schmidhuber j. (1997) with betweenness of 717. This was accomplished by the invention of a cutting-edge, highly-effective gradient-based approach dubbed Long Short-Term Memory (LSTM). LSTM is able to learn to bridge minimal temporal gaps for a period of more than 1000 discrete-time steps by imposing continuous error flow via constant error carousels inside the specialized units.



3.9 Trend Topics

Bibliometric examination of the academic literature with regard to the topic, matter in the distributions of the academic content.

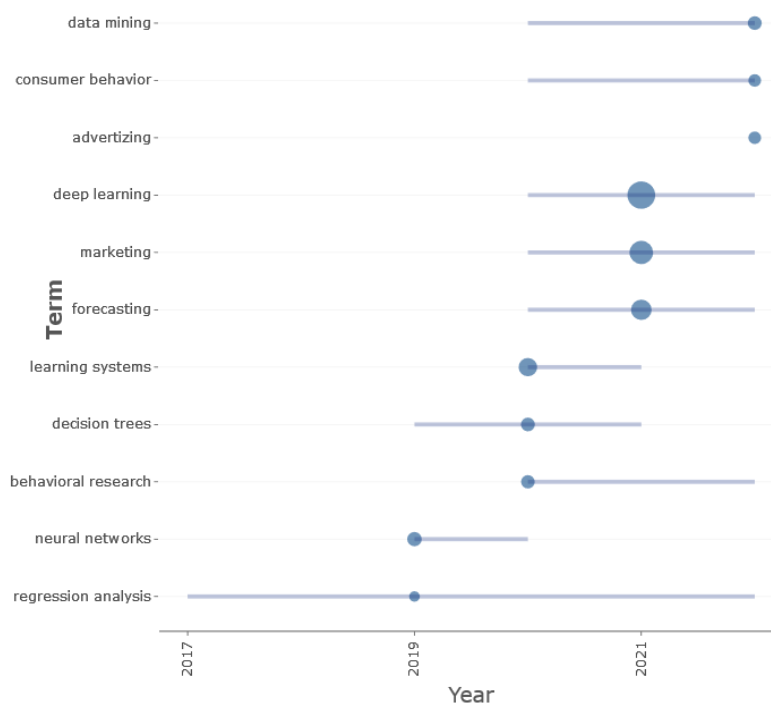


Figure 11. Trend Topics

This investigation makes it possible to obtain information on the publishing patterns of authors who acknowledge that their work is a part of bibliometric study as well as the phrases that they use in their work because it enables the gathering of this information on the phrases that authors use in their work. Figure 11 illustrates some of the hottest trends in deep learning applications now being used in marketing. The topics that are available to investigate change from year to year.

3.10 Thematic Map filed keywords plus

A “thematic map” is a kind of map that focuses on a single overarching idea or issue as its principal point of interest. This type of map is often referred to as a “thematic” map. A thematic map draws attention to the ways in which a certain subject or distribution varies throughout different regions of the globe. The bibliometric technique of theme mapping is used to provide a rough outline of the intellectual framework of a subject. The latter method analyses the predominant subjects, themes, and trends in academic discourse within a particular field by making use of a co-occurrence network of terms [5].

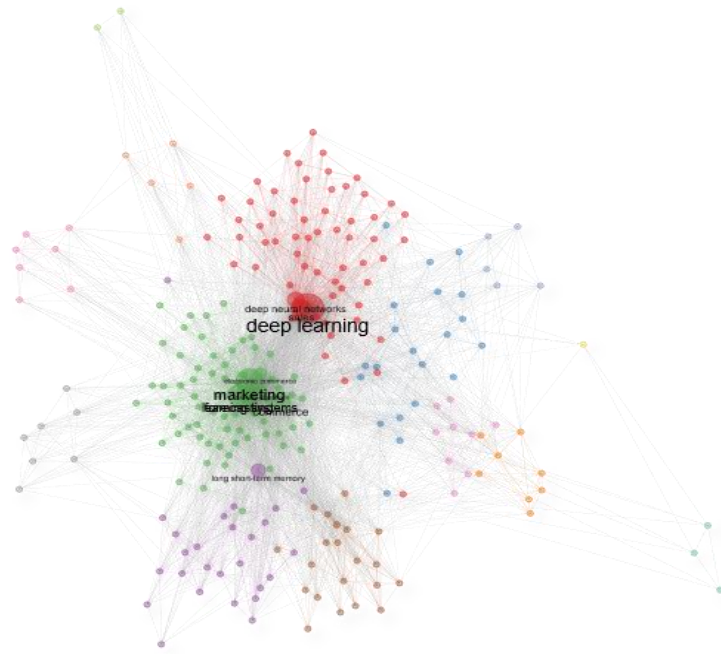


Figure 12. Thematic Map filed Keywords Plus

3.11 Thematic Evolution

This section outlines the development of the papers' overarching themes from 2017 to 2022. Based on figure 13, a conclusion may be drawn that the progression of the papers' central themes may be broken down into two distinct time periods. Bibliometrics will begin using the topic map as of the first period beginning in 2022 in order to construct the intellectual foundation of a subject. The latter is an evaluation, using a word co-occurrence network, of the topics, themes, and trends that predominate academic dialogue in a certain discipline, concentrating on the crucial phrase.

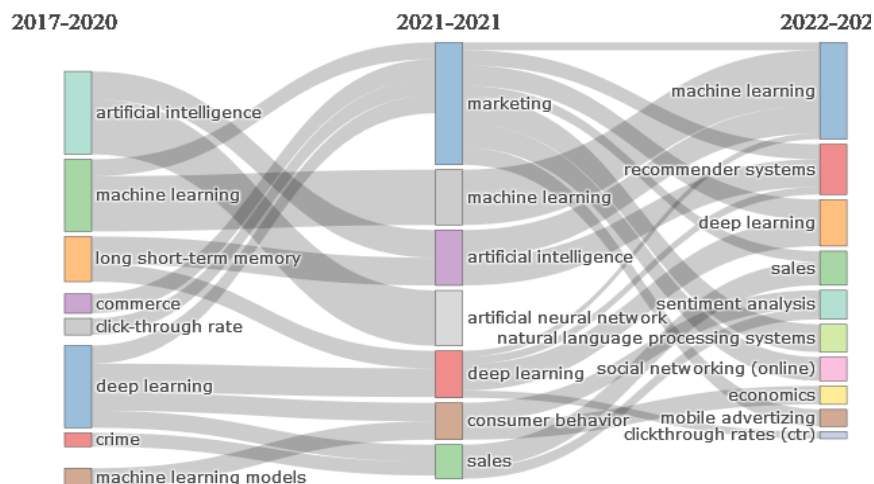


Figure 13. Thematic Evolution

3.12 Three Field Plots

Fig. 14 presents the connectedness between the journal, the country, and keywords. It was created to depict the proportion of the participation of each country with a specific journal and topic represented by the keyword.

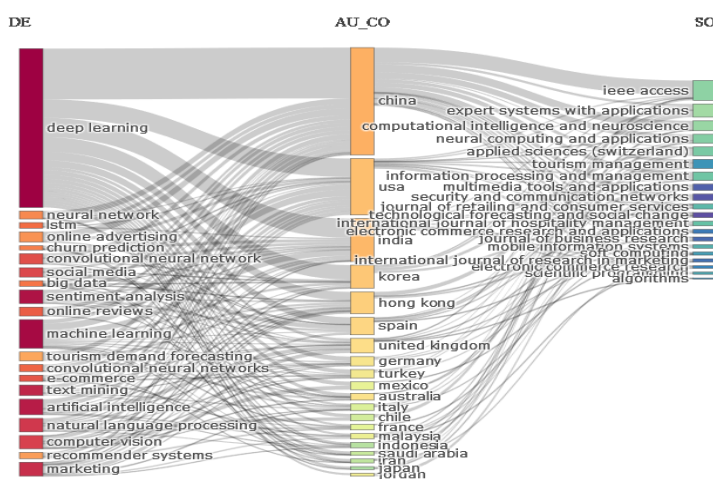


Figure 14. Three field plots

3.13 Tree Map Analysis Keywords Plus

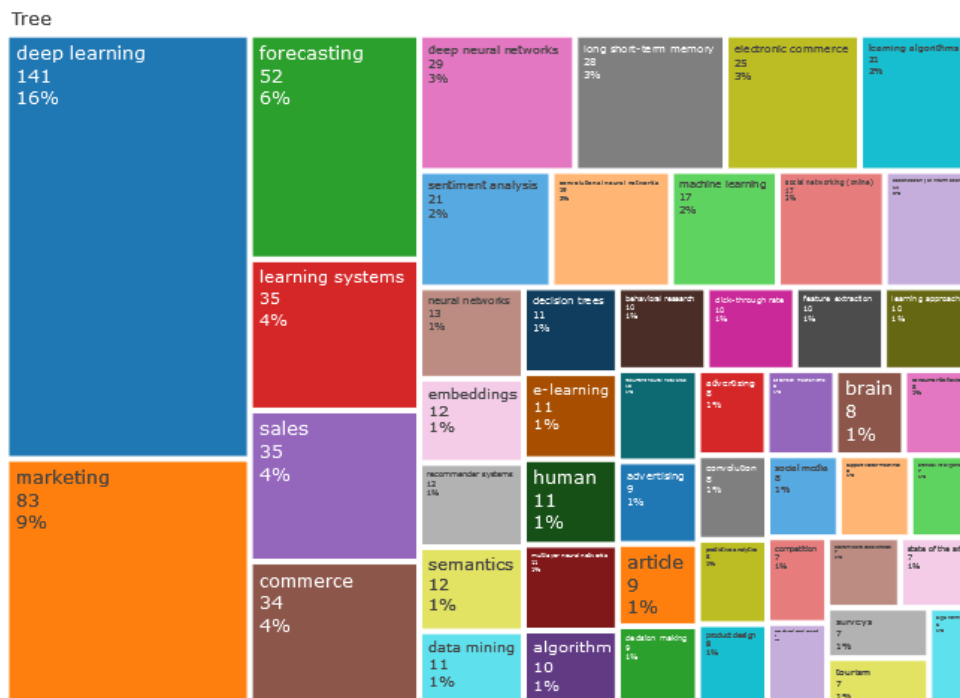


Figure 15. Tree Map Analysis Keywords Plus

Figure 15 depicts the Keyword Plus tree map utilized in this investigation. The analysis found that the authors of the articles used keywords to emphasize the importance of

the phrase in the publications. The words that are significantly bigger than the others indicate how often the authors use that specific word. Based on Figure 15, it can be concluded that the term "deep learning" has the most significant magnitude in this study, as it was used 141 times. This implies that the authors utilized it as their major forecasting term throughout their paper.

3.14 Factorial Analysis

The conceptual structure map that is being utilized in this study is evaluated using Multiple Correlation Analysis (MCA), which is seen in Figure 16. As a result, the authors of this study have identified a distinction between two groups that may be supported by statistical evidence. The red cluster draws attention to the significance of the concept of "deep learning" both inside the cluster and as the primary subject of the research. Other aspects, such as those connected to advertising and ecommerce, are also given a lot of weight in this analysis. According to the findings of the red cluster, participation from the community is an essential component of sentiment analysis and state-of-the-art method. In addition, the second grouping is represented by the cluster of blue berries. When applied to the topic of advertising, the word "regression analysis" shines up as the most important idea included inside the blue cluster. The marketing needs to place a higher importance on these instances of algorithms, such as conservation and protected areas, for example. Because of this, the blue cluster also places an emphasis on the park's function as the primary location for marketing.

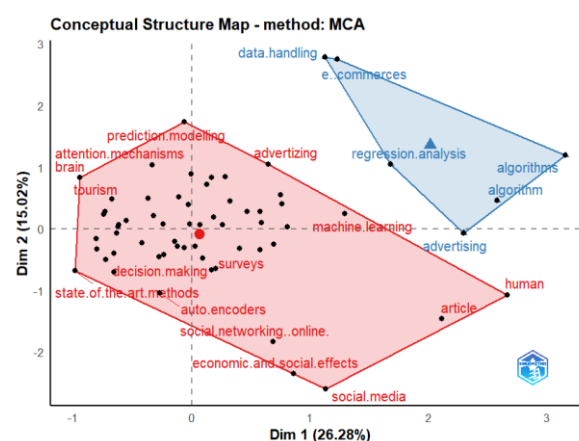


Figure 16. Factorial Analysis

4. Conclusion

This research presents a big data research landscape based on an assessment of journal papers published between 2017 and 2022 that were sourced from the Scopus

database. This analysis provides a deeper dive into the existing literature on the topic of deep learning in marketing. Bibliometric studies of research on big data have showed the distribution of research output (across nations, authors, and institutions), the publishing of journals, the most popular articles, and the top trend analysis. These statistics have the potential to be used by funding organisations as well as early-career researchers. This is due to the fact that it indicates the institution in the area that is engaged in the most research activities. The preceding five years have seen consistent expansion, and it seems that this pattern will continue into the foreseeable future. Presumably, this is being done in an attempt to catch up to the most economically developed countries in the globe. The comparison of the effectiveness of various deep learning algorithms within the framework of the areas of marketing has to be the primary focus of research in the years to come.

Author contributions: All authors listed have made a substantial, direct, and intellectual contribution to the work and have approved it for publication.

Data Availability Statement: Scopus

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