Programmatic advertising: past, present and future. Bibliometric analysis.

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Abstract
Digital advertising investment has increased in recent years, with automated contracting models, programmatic advertising, search engines and social networks standing out. In this context, and taking into account the significant increase in artificial intelligence, the aim of this study is to carry out a bibliometric study on programmatic advertising, to determine its evolution, as well as future lines of research. For the bibliometric analysis, the first search generated 987 articles. After going through the exclusion and inclusion process, these articles were analysed in the selection phase, according to a variety of criteria. A total of 179 articles (from 2000 to 2023) have been analysed in both WoS and Scopus using Biblioshiny. The analysis identified the following main themes: 'artificial intelligence, digital advertising, sleeping giants, fake news, internet user, data protection, user privacy, real time, machine learning, social media'. Finally, this study suggests wider implications for industry and academia contributing to further scientific development in this field and that it can also be applied in the professional field. This study has allowed us to analyse articles in both WoS and Scopus, unified through the RStudio programme, and in this way has also allowed us to determine that although scientific production in this area has increased in the last 5 years, the rapid technological evolution and the irruption of generative artificial intelligence in the digital landscape, allows programmatic advertising to broaden its horizons and market niches.

Keywords

Programmatic advertising, Biblioshiny, Bibliometric, RTB, Digital Advertising

Introduction:

A rapid evolution in technological advances is taking place worldwide, driving a major change in the global number of Internet users. According to the latest data as of January 2023, global Internet users amounted to 5.16 billion (64.4% of the world's population), producing a 1.9% increase over the last year (Kemp, 2023). Digital information is consulted by users through different technological devices, increasing the use of smartphones and tablets compared to traditional computers. Globally, from January 2023 to January 2024, the market share of mobile devices is 58.22%, compared to 39.75% for computers.

If we also take into account the percentage of tablets, with 2.03%, the sum of both with respect to the computer justifies this change on the part of the user in the consumption of digital information and services in the last year (Gs.statcounter, 2024). In this context, in countries such as Spain, the digital channel is particularly relevant with respect to total media advertising investment, estimated at 60%. Among the most prominent are automated contracting models, programmatic advertising, search engines and social networks, with 72.3% of total advertising investment in digital media (IAB Spain, 2023). In the United States, the dates for ad spend in programmatic advertising are even more interesting, about 90% of all ad dollars being invested in digital displays in 2022. In addition, in that same year, 65.2% of programmatic video advertising spend will be framed on mobile devices (Yuen, 2022).

Despite the rapid evolution of programmatic advertising and its widespread use and potential for greater efficiency and effectiveness, the volume of academic research in this area remains low (Samuel et al., 2021; Kerr et al., 2023). The study conducted by focused on artificial intelligence advertising, but in which programmatic advertising is presented as a line of research within this topic. The aim of this study is to carry out a bibliometric study on programmatic advertising, to determine the estimated evolution of this technology-based advertising modality, in which sectors it is being applied most, which are the main players within the digital advertising ecosystem and which countries are leading research in this area, and to estimate the future research agenda by analysing the conceptual and thematic structure, taking into account the new scenario on *cookies* restrictions that is currently taking place.

Theoretical framework:

According to the definition of "programmatic advertising" provided by Garrido Pintado et al. (2018) define it as: "An automated system for buying advertising space. The process was originally conceived for online media and publishers, but is now making inroads into traditional media such as radio and television" (p. 265).

Algorithms can determine the terms of demand in real time and choose the most appropriate advertising inventory (Revoredo Palacios, 2021). Therefore, the advertiser's investment increases effectiveness and the audience receives more information in relation to their real interests (Sosa, 2021). We find the programmatic advertising offer, which are the tools where publishers offer all their available inventory (formats not yet sold) to advertisers on Supply Side Platforms (SSP), so that the same media can be connected to several SSP, to ensure the marketing of the available space through cascading sales, although as you go down the ladder of connected SSP, the price is lower (Rhuggenaath *et al.*, 2021).

The sophistication and increase in technological power makes it possible to specify with real-time bidding, *Real Time Bidding* (RTB), the choice of users, the frequency of impacts per user or the minimum time between visualisations for each one of them (Försch *et al.*, 2018). Some authors even state that it is a system that benefits lower budget advertisers, as it optimises their performance, compared to the results of the system in higher spending campaigns (Yang *et al.*, 2023). But automation does not solve the publisher's critical decisions to generate the best advertising performance for their medium. Ad inventory membership rules are critical (Li *et al.*, 2018) for the editors' result.

Demand

In the programmatic advertising demand side, there are tools called Demand Side Platforms (DSP), which allow advertisers to set their optimal budget, their economic bid (the price they are willing to pay) and the defined target (Qin, Yuan and Wang, 2017). Advertisers' contracts with demand aggregators (their bidding representatives) are based on two models: those based on cost per impression (CPM) or cost per click (CPC), depending on whether they aim to increase brand awareness or more direct sales of specific products and services through promotions (Ghoshal, Mookerjee and Sun, 2023).

Data

The aim of avoiding advertising saturation is the premise that justifies the need to connect content with individuals, one to one and in real time (Carrillo-Durán *et al.*, 2018). Therefore, user data is required. Data-driven business models are services that are apparently offered free of charge, i.e. without the consumer having to make a payment (Barrio Andres, 2022). This fact makes it possible that at some point in the session, the consumer will probably agree to register by providing some personal data.

In any case, this interest in personalising messages does not justify any technological advance that requires the data of individuals, as it must comply with the ethical and legal premises on the use of technologies and processes to make personal information and user behaviour data economically profitable (Gómez-Barroso and Feijóo-González, 2013).

This data on user profile and behaviour is an important asset on both sides of the supply-demand process. "The emergence of data aggregators, such as data management platforms as prominent third parties, illustrates the central role that data (...) plays in the effectiveness of the system". (Martínez-Martínez et al., 2017, p. 203).

In programmatic advertising, data is classified into three levels: primary, secondary and third party. Primary data is collected by media and providers directly, with their own processes, resources and permission from users. They are the most costly and difficult to obtain. Secondary are those exchanged by two actors in the sector, with coordinated interests. Third-party data are collected by specialised aggregators (DMPs or *Data Management Platforms*) and offered to buyers interested in them (O'Hara, 2016).

According to Busch (2016), the integration of data into programmatic buying management has optimised a number of functions, including improved efficiency, segmentation capabilities and campaign optimisation.

In programmatic, cookies do not collect information about names or e-mails, but they do provide two pieces of information that are analysed for the purposes of application by the Personal Data Protection Act, which are both user behaviour and IP number. *Cookies* are "a piece of text or information stored on a user's device that enables the collection of

information about the user's profile, preferences and behaviour" (Revoredo Palacios, 2021, p. 153).

Cookies

Among the most recent studies that have been carried out on programmatic advertising is that of Nunez-Barriopedro et al. (2023) whose main objective is to analyse the perceived usefulness and annoyance of programmatic advertising for users, and how it affects their privacy on the Internet from the point of view of *cookies*.

The use of *cookies* is increasingly restricted at the European level, since the General Data Protection Regulation was launched in 2018, which directly affected mobile apps, emails, websites and how cookies should not be consented to. It is a complex issue, which requires the intervention of regulators (Veale and Borgesius, 2022) since the RTB system is difficult to reconcile with these regulations. Therefore, since 2020, the cookies law has been implemented in different European countries, including Spain, in its Royal Decree Law 13/2012, of 30 March; based mainly on transparency, as the user must know in advance their options to accept or reject these permissions.

Methodology:

In this study, bibliometric methodology has been used to review studies on programmatic advertising research. The bibliometric approach is a quantitative tool to measure productivity and scientific merit in articles on a specific topic (Donthu *et al.*, 2021). This approach has been applied in communication and library science, which use statistical resources to evaluate previous scholarly work. These bibliometric reviews must develop, implement and publish rigorous and transparent processes (Paul *et al.*, 2021). This research has been developed in a four-phase process (Donthu et al., 2021; Hashemi et al., 2022; Paul et al., 2021) (Figure 1).

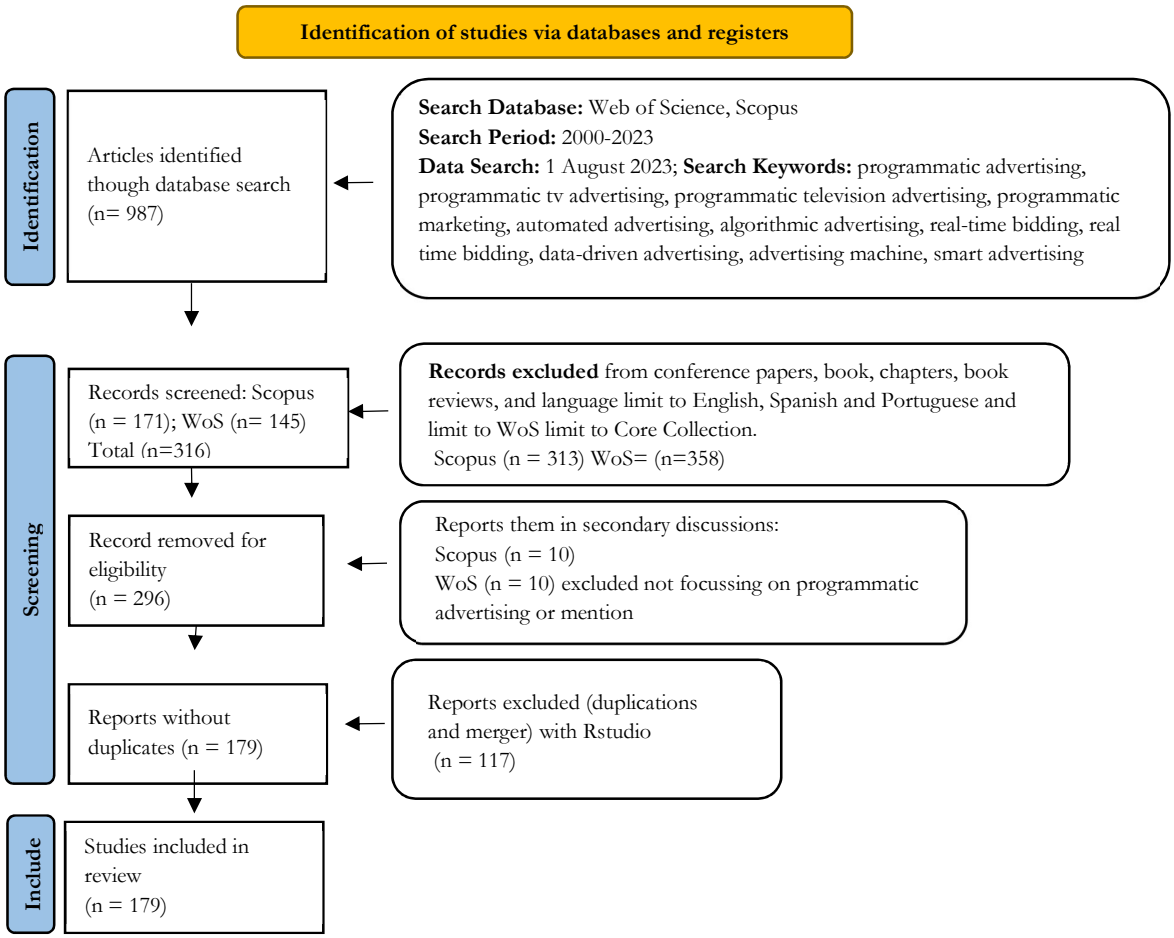
The research team used the Web of Science (WOS) and Scopus databases to collect articles for the bibliometric analysis. The PRISMA (Preferred Reporting Items for Systematic Review and Meta-analysis) review procedure was used to select articles from WOS. The three stages of the PRISMA review are identification, selection, and inclusion and exclusion criteria (Figure 1).

The first search generated 987 articles. After going through the exclusion and inclusion process, these articles were analysed in the selection phase, according to a variety of criteria, which allowed us to exclude a total of 296 articles. For the bibliometric analysis, the study selects research articles written in English, Spanish and Portuguese from the main collection of WoS and Scopus.

The study includes only articles related to communication, business, management and other interdisciplinary social sciences to support the relevance of data related to programmatic advertising research fields. The study considered articles from the last twenty-four years (2000 - 2023) to ensure quality, compactness and relevance to the topic. This leaves only 179 articles included for bibliometric analysis.

The analysis of the bibliometric research used Bibliometrix R software to perform the analysis, as well as to eliminate duplicates. This programme creates network connections from the article retrieved in WoS and Scopus, in addition to other resources, such as citation mapping, productivity, co-citations and co-occurrences of scientific papers (Dervis, 2019).

Figure 1. Flow chart showing the process of literature search and selection for bibliometric análisis.



Source: Own elaboration based on Moher et al. (2009)

Results:

Main results of analysis

Taking into account the articles obtained from the WoS and Scopus databases (Table 1), a more detailed analysis was carried out to determine their evolution over time in terms of scientific production, most relevant authors and countries, as well as the evolution of the main topics with respect to keywords.

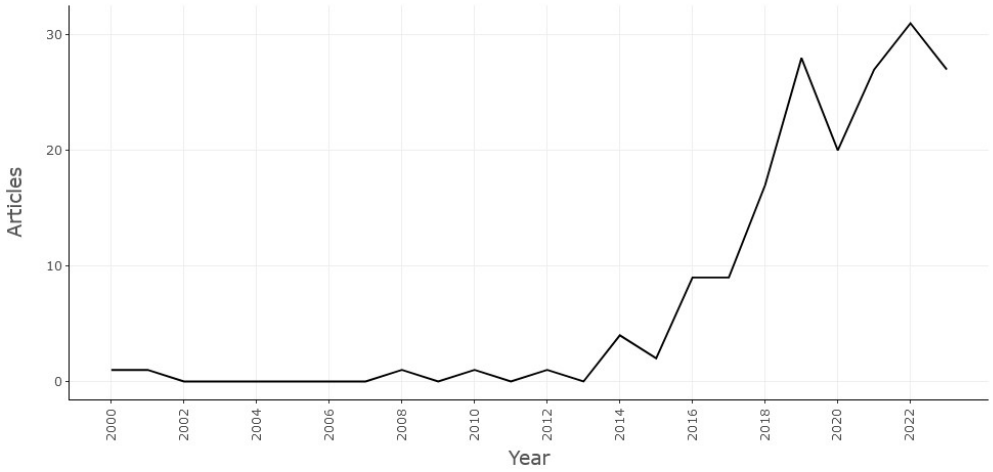
Table 1. Main Information

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	2000:2023
Sources (Journals, Books, etc)	129
Documents	179
Annual Growth Rate %	15,41
Document Average Age	4,32
Average citations per doc	9,257
References	8036
DOCUMENT CONTENTS	
Keywords Plus (ID)	625
Author's Keywords (DE)	621
AUTHORS	
Authors	445
Authors of single-authored docs	30
AUTHORS COLLABORATION	
Single-authored docs	33
Co-Authors per Doc	2,94
International co-authorships %	1,676
DOCUMENT TYPES	
Article	179

Source: Own elaboration based on Biblioshiny (2024)

Figure 2 shows that the scientific output on programmatic advertising at the international level has increased significantly since 2018 with a total of 17 articles, almost twice as many as in the previous two years, reaching the highest level of interest in 2022 (31 articles). Scientific interest in this topic in recent years has been increasing, with slight decreases in output, for example, in 2020.

Figure 2. Annual scientific production.



Source: Own elaboration based on Biblioshiny (2024)

If we take into account the evolution of citations during the production period, the highest number of citations occurs in 2019, coinciding with one of the periods of highest scientific

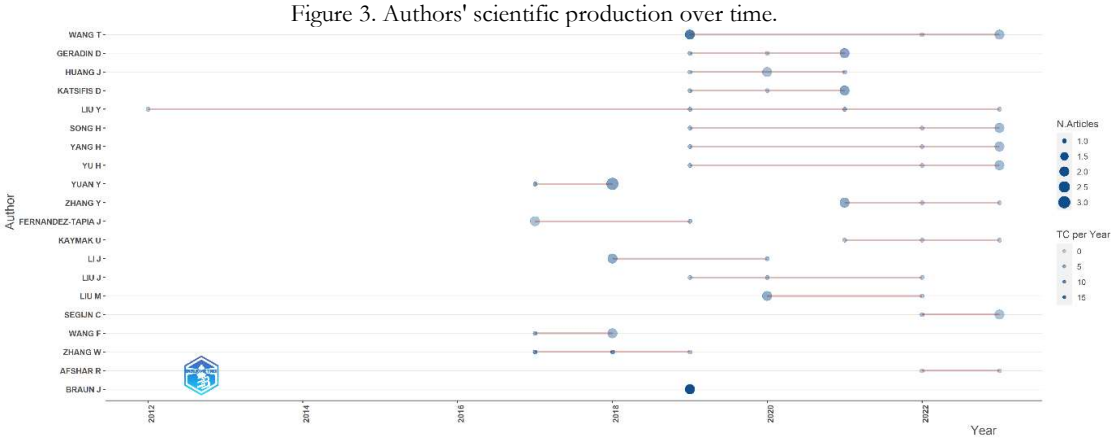
production. From 2013 onwards, there is a greater interest in citations of scientific articles on programmatic advertising, which decreases from 2020 onwards.

Most prolific authors

In terms of authors, considering the number of published papers on programmatic advertising, Wang T. (5) stands out as one of the most prolific. The other authors, Geradin D., Huang J, Katsifis D., Liu Y., Song H., Yang H., Yu H., and Yuan Y., follow with a total of 4 papers (Figure 3). However, if the number of fractional papers is taken into account, the author Fernández-Tapia J. leads the ranking with 2.3% followed by Geradin D., and Katsifis D., with 1.7% in both cases.

Regarding the authors' production over time, Liu Y. is the one who has been writing about programmatic advertising the longest, since he started in 2012 and has remained there, although his production and scientific impact is small compared to the rest of the authors. It can be observed that from 2019 onwards more authors started to appear publishing on this topic, and they have managed to keep up to date, as is the case of Wang T., Geradin D., Huang J., Katsifis D., Liu Y., Song H., Yang H., and Yu H.
It can be seen that there is not a high number of articles marked per author, but there is a significant number of citations.

Figure 3. Authors' scientific production over time.



Source: Own elaboration based on Biblioshiny (2024)

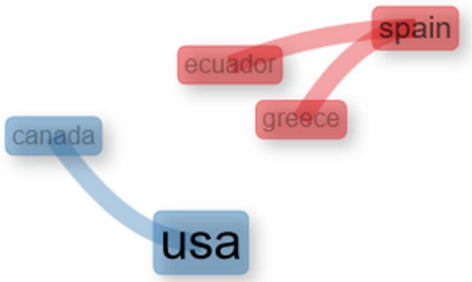
If we consider the authors with the greatest impact in terms of citations, Zhang W. from the University of Shanghai (109) stands out, followed by Wang J. from the University of London (105) and Onan A. from a Turkish University (99). In this ranking of the most cited authors there are three Spaniards, two from the University of Seville Palos-Sánchez P. (84), Martín-Velicia F. (84); and Saura J. (77), from the University Rey Juan Carlos of Madrid.

Most prolific countries

The collaboration of authors from different countries on the same article is very limited, as can be seen in Figure 4, and is only concentrated in two clusters, that of Spain, Ecuador and

Greece, and that of the USA and Canada. As for the countries with the highest scientific production, the most prominent are the USA, Spain and China. If we take into account the evolution of scientific production, the trend in the USA and China continues to increase, but in the case of England and Spain it does not show this trend.

Figure 4. Level of collaboration between authors of the same article and ranking of countries in terms of volume of scientific production.



region	Freq
USA	49
SPAIN	35
CHINA	31
FRANCE	17
UK	11
BRAZIL	10
GERMANY	8
CANADA	7
NETHERLANDS	7
INDIA	6

Source: Own elaboration based on Biblioshiny (2024)

Most prolific affiliations

From the point of view of the social structure of the main affiliations of the authors involved in the scientific production of this topic, it shows seven clusters of collaboration, among which the most prominent are: University College London, the University of Minnesota and the Institute of Automation. In terms of the number of articles published, the Institute of Automation in China and University College London in England stand out with a total of 6 articles, followed by Leonard de Vinci Pole University, the Complutense University of Madrid, the University of Minnesota and the University of Southern California.

Most cited articles

Among the most cited articles were topics related to big data in marketing decisions, display advertising, creativity and targeting, price and offer optimisation, as well as privacy and deception for profit and the business of journalism (Table 2).

Table 2. Detail of articles with the highest number of citations in wos and scopus

Authors	Year	Article title	Journal	Cited times, WoS Core	Times cited, Scopus
Onan, A	2016	Classifier and feature set ensembles for web page classification	JOURNAL OF INFORMATION SCIENCE	85	104
Braun, JA; Eklund, JL	2019	Fake News, Real Money: Ad Tech Platforms, Profit-Driven Hoaxes, and the Business of Journalism	DIGITAL JOURNALISM	68	83

Authors	Year	Article title	Journal	Cited times, WoS Core	Times cited, Scopus
Palos-Sanchez, P; Saura, JR; Martin-Velicia, F	2019	A study of the effects of programmatic advertising on users' concerns about privacy overtime	JOURNAL OF BUSINESS RESEARCH	57	80
Jabbar, A; Akhtar, P; Dani, S	2020	Real-time big data processing for instantaneous marketing decisions: A problematization approach	INDUSTRIAL MARKETING MANAGEMENT	51	63
Wang, J; Zhang, W; Yuan, S	2017	Display Advertising with Real-Time Bidding (RTB) and Behavioural Targeting	FOUNDATIONS AND TRENDS IN INFORMATION RETRIEVAL	50	66
Chen, G; Xie, PH; Dong, J; Wang, TF	2019	Understanding Programmatic Creative: The Role of AI	JOURNAL OF ADVERTISING	36	50
Vonderau, P	2019	The Spotify Effect: Digital Distribution and Financial Growth	TELEVISION & NEW MEDIA	36	45
Sayedi, A	2018	Real-Time Bidding n Online Display Advertising	MARKETING SCIENCE	36	45
Montgomery, KC	2015	Youth and surveillance in the Facebook era: Policy interventions and social implications	TELECOMMUNICATIONS POLICY	36	45
Celis, LE; Lewis, G; Mobius, M; Nazerzadeh, H	2014	Buy-It-Now or Take-a-Chance: Price Discrimination Through Randomized Auctions	MANAGEMENT SCIENCE	34	0
Ren, K., Zhang, W., Chang, K., (...), Yu, Y., Wang, J.	2018	Bidding Machine: Learning to Bid for Directly Optimizing Profits in Display Advertising	IEEE Transactions on Knowledge and Data Engineering		53

Source: Own elaboration (2024)

Most prolific sources

Taking into account the journals with the highest scientific production on programmatic advertising, "IEEE Access" stands out (8 papers), followed by "European Competition Journal" and "Journal of Advertising" (5 papers each).

Intellectual structure of the research "Programmatic Advertising".

Keyword analysis

From the point of view of keyword analysis, both the author's keywords from the point of view of frequency and those of the abstract have been taken as a reference to assess frequency and evolution over time. Figure 5 below shows a word cloud displaying the frequency as a function of the size of each word.

The concept "real-time bidding" is by far the most used term, followed by the study's own concept "programmatic advertising." Both concepts are used as "synonyms" in programmatic advertising research, although they are combined with many others, such as

"bidding strategy" and other synonyms that are not shown because they have been unified in the previous analysis of similar keywords to homogenise the words.

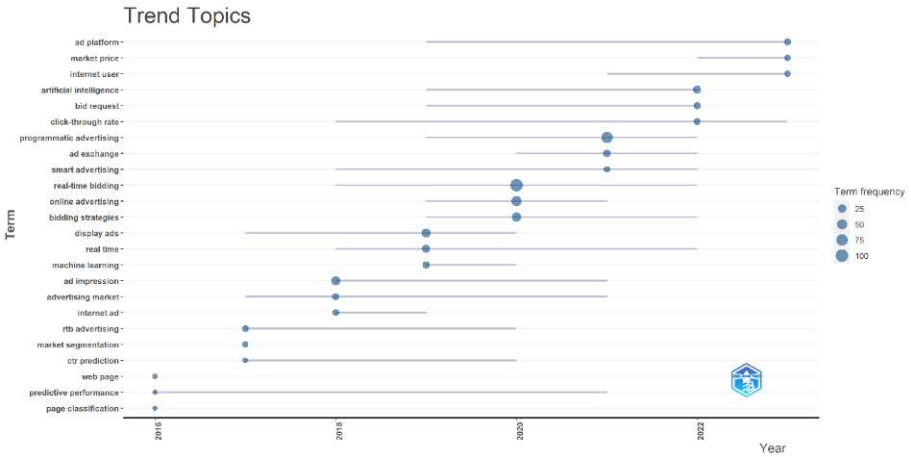
Figure 5 shows how both terms have been combined with other studies on "artificial intelligence", "privacy", "cookie", "big data", evolving into other areas of marketing more focused on automation and data.

Figure 5. Author keyword cloud.

Source: Own elaboration based on Biblioshiny (2024)

In the abstracts of the articles analysed, an analysis of the frequency of keywords in the annual trend of the topic has been carried out (Figure 6). The terms that show the highest frequency in addition to "programmatic advertising", which is the main search term, are "real-time bidding", "online advertising", and "bidding strategies", with the highest frequency concentrated in 2020 and 2021. If analysed from a timeline perspective, it is in 2019 when more terms related to this topic start to proliferate, such as "artificial intelligence", which also has its peak frequency of use in the year 2022. Among the most emerging and currently most used terms are "market price" and "internet user".

Figure 6. Trend of abstract keywords by year.



Source: Own elaboration based on Biblioshiny (2024)

Co-Word Analysis

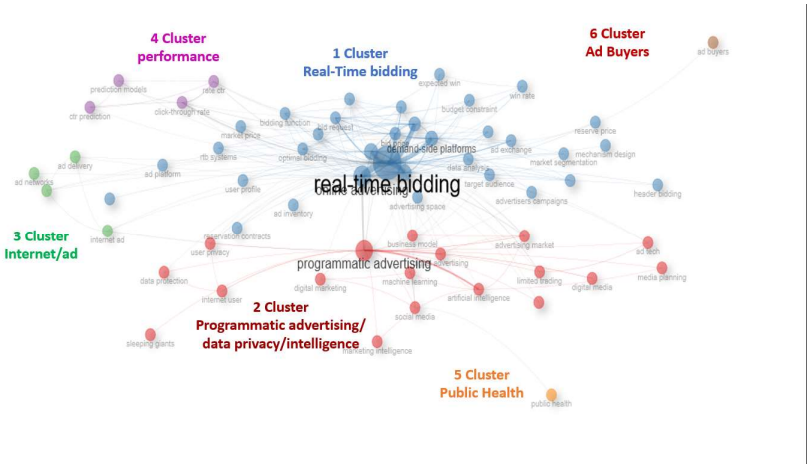
Co-word analysis is defined as the number of publications containing two keywords simultaneously and is one of the most commonly used methods in bibliometric studies (Whittaker, 1989).

Figure 7 shows the network clusters of the abstract keywords related to programmatic advertising. These clusters are divided into different coloured nodes representing a given study area. In this case, a total of 80 nodes have been obtained, divided into 6 clusters. As can be seen in Figure 7, cluster 1 (in blue) is the cluster with the highest number of words, with the top 10 words being: "real-time bidding", "online advertising", "bidding strategies", "ad impression", "display ads", "demand-side platforms", "ad exchange", "bid request", "bid price" and "ad platform".

These words therefore focus on the context of programmatic advertising, combining different strategies for its application, real-time betting and platforms for the use of the technology. The next cluster (in red) with the highest number of words is 2, in this case with "programmatic advertising" as the main keyword, combined with other terms such as "artificial intelligence", "machine learning", "social media", "internet user" and "data protection" among others.

In this group of words, we can therefore see how, from the purest definition of "programmatic advertising", it begins to be associated with concepts of artificial intelligence, internet user and even data protection, strengthening in this group the motor of the importance offered by this technology as a driver of digital business, but also the relevance of data and user protection. Lastly, it is worth highlighting in this cluster the concept of "Sleeping Giants", which is less strong and more distant, but no less important. This concept, translated into Spanish as "Sleeping Giants", refers to the fact that large companies sometimes do not know where they place their ads when they do so through programmatic advertising, and this is the reason for this movement. Finally, there are other clusters with fewer words, but very focused on other aspects of programmatic advertising, such as cluster 3 (in green) related to ad networks and ad spaces, cluster 4 (in purple) related to click-through rates and finally clusters 5 (in orange) and 6 (in brown) containing only one word, related to "public health" and "ad buyers" respectively.

Figure 7. Co-occurrence network abstract keywords.



Source: Own elaboration based on Biblioshiny (2024)

Trends and future avenues for research

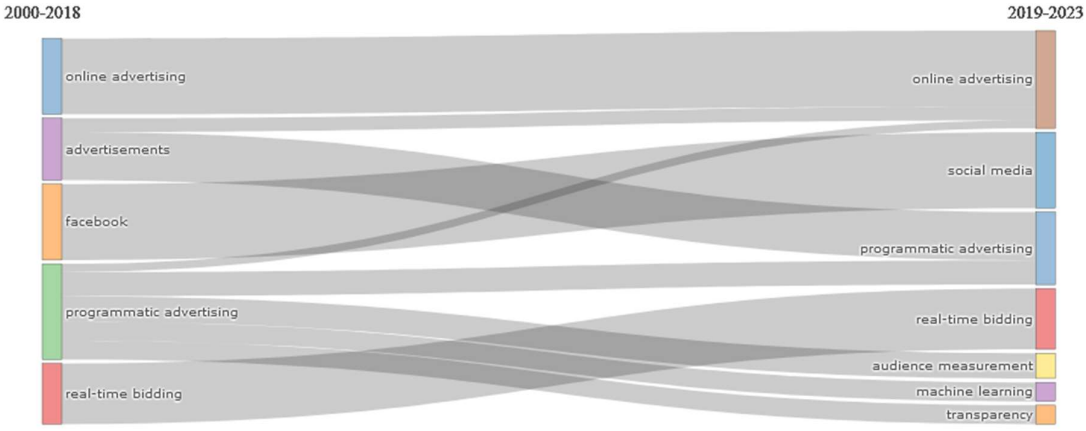
Developments in the themes

Thematic evolution allows us to see how a group of themes evolves over different sub-periods (Cobo *et al.*, 2011). As can be seen in Figure 8, the different solid lines shown in the graph indicate that the linked topics have the same name, i.e. either both topics are labelled with the same keywords, or the label of one topic is part of the label of the other. The curves that are formed show a volume based on the number of published papers related to each topic, and the thickness of the edges is proportional to the inclusion rate (Cobo *et al.*, 2011).

The vertical lines shown in Figure 8 correspond to the different sub-periods of the analysis. In this case it has been divided into two periods "2000-2018" and "2019-2023", since in 2018 there was an upturn in scientific production in this area. In each period, a group of keywords is shown vertically, represented in coloured blocks.

With regard to the analysis of this evolution, it should be noted that the keywords "online advertising" and "real-time bidding" do not undergo changes in research related to programmatic advertising in both periods analysed, however the concept "facebook" clearly evolves towards "social media" in the period 2019-2023, and the term that undergoes the most changes in both periods is "programmatic advertising" which is divided into "audience messurement", "machine learning" and "transparency". The term "advertisement" also evolves towards "programmatic advertising" in the second period (Figure 8).

Figure 8. Thematic evolution of authors' keywords (period 2000-2018/2019-2023).



Source: Own elaboration based on Biblioshiny (2024)

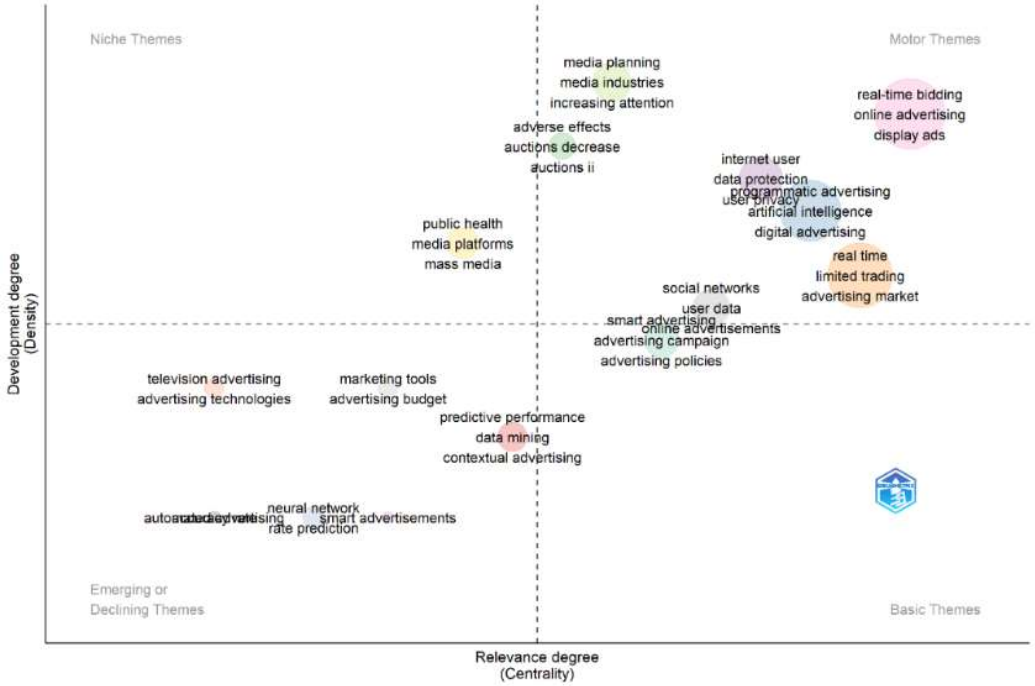
Strategic map

The strategy map can be used to investigate the trends of the main topics to be analysed in the future agenda, by studying the strategic quadrant that shows the density of these topics. Figure 9 shows the thematic map "programmatic advertising", taking as a reference the data set of the studies that have been carried out from 2000 to 2023. This map shows graphically the field of keywords indexed in both WoS and Scopus. As can be seen in Figure 9, each topic is represented by circles with colours and names based on the most frequent terms, in this case extruded from the abstracts.

This quadrant is made up of two axes that consider the degree of development (density) and the degree of relevance (centrality). In turn, the quadrants are divided into four main themes: niche, emerging or declining, drivers and finally the basic ones. In the case of the driving themes, it is worth noting that they are located in the upper right quadrant, and therefore have a high level of centralisation and density, which means that this quadrant concentrates the most consolidated themes and those of main interest in programmatic advertising research.

Figure 9 shows four main clusters of driving themes. The driving themes in this case are real-time bidding, online advertising and display ads. The second most important cluster is made up of programmatic advertising, artificial intelligence and digital advertising. The third cluster is related to the user and data protection, with themes related to the terms "internet user", "data protection" and "user privacy". The fourth cluster to be highlighted, closer to the axis of the basic themes is that of "real time", "limited trading" and "advertising market", as well as the fifth cluster, which is practically on the density axis, close to the basic themes of "social networks" and "user data". Finally, two clusters stand out as driving themes, but closer to the niche themes, such as "media planning", "media industries" and "increasing attention", together with the cluster of "adverse effects" and "auctions decrease".

Figure 9. Thematic map of abstract words (period 2000-2023).



Source: Own elaboration based on Biblioshiny (2024)

Discussion:

Given the rapid evolution that technology is undergoing, and that we are in the wave of the sixth industrial revolution (Hargroves and Smith, 2005) where artificial intelligence, big data, blockchain and nanotechnology are at a moment of great momentum and relevance.

The purpose of this study was based on investigating trends and patterns in the area of programmatic advertising research and articles have been obtained from 2000 to 2023 through bibliometric analysis in both WoS and Scopus, identifying a total of 179 articles once duplicates were removed and those that were not within the analysis criteria were excluded.

From the results obtained from the analysis, it is worth noting that the publications and citation impact of programmatic advertising have increased in the last 5 years (since 2018), although in 2020 it suffered a slight decrease in terms of citations, the trend is that it is still booming in terms of research. From the point of view of the analysis of the most productive and influential authors, we find Wang T. (5 publications).

In terms of authors' output over time, Liu Y. has been writing about programmatic advertising the longest, having started in 2012 and continuing to pursue this line of research, albeit with less impact than other authors. The most influential author with the highest number of citations is Zhang W. from Shanghai University (109 citations).

Among the most prolific countries in this area are the United States, Spain and China, although the trend in terms of the evolution of scientific production is increasing for the United States and China. Among the institutions with the highest production in this area are the Institute of Automation in China and University College London in England. Among the journals with the highest scientific production in this area are: IEEE Access, European Competition Journal and Journal of Advertising.

Other aspects analysed that indicate future lines of research on programmatic advertising are shown in the strategic diagram that groups the most important topics in the area into four quadrants according to their centrality and impact. In this analysis, Figure 9 shows that the driving themes are "real-time bidding", "online advertising", "display ads", "programmatic advertising", "artificial intelligence", "digital advertising", "internet user", "data protection" and "user privacy". Our joint keyword analysis, evolving themes analysis and strategy mapping analysis have enabled us to identify the main niche and trending themes that dominate research on programmatic advertising (Table 3).

Other niches that have not been detected in the strategic map but that have emerged as a "gap" in the existing literature and that are of interest in advertising investment is Digital Out of Home Advertising (known as "Digital Out of Home") (Ramachandran and Mandalia, 2021). According to IAB Spain (2024a) programmatic advertising in DOOH brings awareness, reach to key targets, flexibility to publish in real time, trust, hyper-localisation and movement through video.

Table 3. Proposed research lines

Trends/topics		**Proposed research questions**
Area	**Sub-area**	
programmatic advertising	artificial intelligence, digital advertising, sleeping giants, fake news	1. How does artificial intelligence, and in particular generative AI, influence this field and what improvements can it bring to the field of programmatic advertising?
		2. Are business professionals today ready to take on the new challenges of programmatic advertising as part of the business culture?
		3. Can brands be harmed by bad practices to attract clicks through fake news applied in the journalistic and advertising environment?
		4. Should brands partner with movements like Sleeping Giants to control where their ads are placed?
internet user	data protection, user privacy	1. How will the new third-party cookie removal law affect and to what extent will consumers tend to refuse to accept third-party *cookies* on websites?
		2. How will ads be personalised in real time in the face of user data protection and privacy issues that are increasingly on the rise in legal terms?
real time	advertising market, machine learning, social media	1. What will be the role of the machine learning algorithm in programmatic creative and what advantages can it bring to the market by combining the new potential of generative AI??
smart advertising	advertising campaign	1. Would users or retailers support the existence of a blockchain-based Intelligent Advertising Network with Accountability that Preserves the Privacy of user profiles?
		2. How could new tools be harnessed to drive an intelligent generation system of personalised copywriting that can automatically customise advertising content to fit the needs of individual consumers?
television advertising	advertising technologies	1. Can advertisers improve the effectiveness of their ad programmes by considering the relative placement of their ads to competing ads on television through programmatic advertising?
public health	media platforms, mass media	1. How are sectors initially banned by Google, such as tobacco or alcohol, advertised in programmatic advertising?

Source: Own elaboration (2024)

Furthermore, IAB Spain (2024b) concludes that investment in DOOH in 2023 was €124.4m, a growth of 22.4% compared to 2022. In this sense, new challenges are posed by the emergence of programmatic advertising in outdoor advertising, allowing outdoor campaigns to be personalised and segmented in real time.

Conclusion:

Programmatic advertising is such a broad field that a wide variety of keywords associated with this concept have been detected. This bibliometric study shows that the concept of programmatic advertising has evolved into a more diversified concept that includes other more specific concepts such as transparency, machine learning and audience measurement itself, as well as the concept of real-time bidding, which is one of the modes of programmatic buying, but not the only one (Garrido Pintado, Caerols Mateo and Garcia Huertas, 2018).

This analysis has also allowed us to determine that despite the fact that scientific production in this area has increased in the last 5 years, the rapid technological evolution and the irruption of generative artificial intelligence in the digital landscape, allows programmatic advertising to expand its horizons and market niches, as well as the need for professionals in the advertising industry to adapt to these technological changes with new ways of application in niche areas such as its application in media such as television, and even outdoor digital advertising.

Data protection and new legislation on cookies is another major driving theme for future lines of research. The main limitations of this study include the exclusion of those articles that did not fall within the search parameters set out in the methodological part, for example, only those from the main collection were selected in WoS. As part of future lines of research, it is proposed to complement this analysis with qualitative studies of experts in this field in order to broaden the future research agenda set by the more professional part in this area.

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