Targeted and Personalized Online Advertising in the Age of Artificial Intelligence (AI): A Literature Review and Research Agenda

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Abstract

This study aims to provide a comprehensive evaluation of current machine learning (ML) algorithms employed in targeted and personalized advertising. It reveals key findings and conclusions from a wide range of sources, offering readers a concise summary. The study addresses the gap by identifying and analyzing the most significant machine learning-based targeting methods utilized in the recent studies. This helps readers understand the strengths and weaknesses of different approaches and keeps them up-to-date with the most recent advancements and best practices. Employing the PRISMA methodology, the review systematically examines existing literature on ML-driven targeted advertising. It identifies effective ML methods and strategies, presenting real-world examples to illustrate their practical implementation. Reviewing key findings from existing literature, the analysis identifies the most effective ML methods for targeted advertising. It also examines three research questions across three key dimensions: targeting, personalizing, and predicting customer preferences. This study proposes a novel theoretical framework that elucidates the application of ML in targeted advertising. Specifically, the study explores ML algorithms that enhance precision in each dimension. Key models include Long Short-Term Memory (LSTM) networks for analyzing historical customer data, Convolutional Neural Networks (CNN) for image recognition tasks, and Factorization Machines for capturing feature interactions in click-through rate (CTR) predictions. Additionally, traditional models such as logistic regression, decision trees, random forests, and support vector machines (SVM) are utilized for classification tasks, while unsupervised learning techniques like k-means clustering and hierarchical clustering facilitate user segmentation based on behavioral and demographic similarities. These models collectively enable marketers to derive actionable insights, optimize advertising content, and improve overall campaign performance. By consolidating key findings from existing literature on ML-driven targeted advertising, this study offers a valuable resource for understanding current trends and gaps. It also proposes future research directions, highlighting potential areas for further exploration, which can inspire new studies and innovations in the field.

Keywords: Artificial Intelligence; Machine Learning; Marketing Optimization; Targeted Advertising; Personalized Advertising.

1. Introduction

Online advertising, a dynamic marketing segment, utilizes the internet's reach and interactivity to deliver targeted promotional messages to potential customers. Advertisers leverage user segmentation to tailor ads based on demographics, interests, behaviors, and purchasing patterns, ensuring relevance and engagement. Given that,

advancements in AI pave the way for personalized ad delivery. AI is a fascinating and cutting-edge technology rapidly transforming the marketing and advertising industry (Huai, 2021). AI encompasses a body of techniques designed to imbue machines with the capability to perform tasks typically associated with human cognition, such as learning, reasoning, and interacting with the environment. Integrating artificial intelligence into the advertising industry is not merely about applying AI technology but also about revolutionizing and reshaping the advertising landscape. This AI-driven transformation will not only optimize existing advertising practices but also redefine the industry's future trajectory (Zhao et al., 2022). Furthermore, AI has enabled employing automation and facilitation techniques to streamline critical advertising key functions such as identifying customer needs and preferences, customer segmentation, developing targeted campaigns, content personalization, and measurement improvement. Meanwhile, AI is rapidly evolving and becoming more accessible to businesses of all sizes (Ford et al., 2023). Moreover, AI integration is also rapidly transforming the global business landscape, becoming an increasingly integral component of successful marketing strategies (Ngai & Wu, 2022). Moreover, AI methodologies present a practical avenue for expediting the digital transformation process within the advertising sector. The rapid development of social networks necessitates the strategic integration of AI for advertisement identification and optimization. AI offers novel solutions to address longstanding challenges within the traditional advertising industry (Shi & Wang, 2023). AI can target ads to the right people at the right time (Ijaz et al., 2021), (Haleem et al., 2022), This can enhance a business's ability to connect with its target demographic in a more optimized and efficacious manner. Additionally, AI is revolutionizing marketing by providing powerful tools for personalized experiences, real-time customer needs analysis, and efficient campaign optimization by analyzing real-time data and adjusting targeting, bidding, and creative elements (Amalraj Victoire et al., 2023). AI can potentially develop intelligent machines and apparatuses capable of exhibiting human-like cognitive functions and responsive behaviors, improve the effectiveness of marketing campaigns, analyze data, understand customer behavior, make predictions, and personalize marketing messages (Haleem et al., 2022), (Ciuchita et al., 2023). Marketers can use AI algorithms to understand customers, target them more effectively, and personalize the customer experience. Moreover, AI serves as an auxiliary tool within brand marketing, facilitating the evaluation of marketing campaign effectiveness and subsequent refinement of targeting strategies. ML the subset of AI, empowers marketers to deliver relevant content, personalize user experiences, and gain insights into competitor strategies, leading to increased customer satisfaction and improved marketing performance (Choi & Lim, 2020), (Makalesi et al., n.d.). Here, we explore a selection of these applications: Google Ads empowers advertisers to optimize their campaigns across various platforms and target audiences. This optimization extends to the selection of keywords, crafting of ad copy, and image selection for each campaign (Joni Salminen et al., 2022). Amazon and its Prime Air initiative leverage drone technology to automate the shipping and delivery process. Domino's Pizza is pioneering the use of autonomous vehicles and delivery robots for last-mile delivery solutions. Red Balloon utilizes the Albert AI marketing platform to facilitate customer discovery and acquisition efforts. Macy's On Call program implements natural language processing (NLP) to provide in-store customers with a personalized virtual assistant experience. Lexus partnered with IBM Watson for the creation of their television commercial scripts, titled "Driven by Intuition." Affectiva, through the application of effective analytics, analyzes consumer emotions during commercial viewings. Replika, a chatbot powered by machine learning, offers emotional support to consumers by mimicking their communication styles. It is further postulated that AI will exert a significant transformative influence on the future landscape of marketing (M.-H. Huang & Rust, 2021). Netflix leverages AI to personalize content recommendations for each user. This system analyzes user interactions with the platform, including viewing history and preferences. By processing vast datasets of user behavior, the ML algorithms identify patterns and correlations, enabling them to recommend content that aligns with individual user interests. This personalized recommendation engine is a significant driver of content discovery on the platform, with research suggesting that a majority of user-selected content stems from these ML-powered suggestions (Jain & Aggarwal, 2020). As discussed, ML algorithms analyze user information such as gender, age, interests, and other factors to deliver relevant ads and can also be used to detect microtrends and even anticipate trends. This information can be used to make strategic decisions about marketing campaigns (Kuang, 2022). The integration of ML within advertising strategies has the potential to significantly reduce wasted expenditure in digital advertising campaigns (Ziakis & Vlachopoulou, 2023). ML also influences the future of digital marketing because it leverages the power of IoT and connected devices, this means that ML can be used to deliver even more personalized and relevant ads to users, based on their real-time behavior and environment (Dumitriu & Popescu, 2020). The integration of ML in social media platforms such as Instagram, Twitter, and Facebook could automate tasks, monitor social media activities, and revolutionize brand marketing strategies (Borges et al., 2021). Based on the research, the projected growth of ML in the social media market is substantial,

with estimates indicating an increase from $633 million in 2018 to over $2.1 billion by 2023 (Gupta et al., 2023). The main contributions of this study include providing a comprehensive and accessible literature review from January 2017 to March 2024, classifying the top 46 highly relevant articles to address the three research questions, and investigating the results across three key dimensions: Personalizing, Targeting, and Predicting Customer Preferences.

2. Research Questions

This study conducts a review of the existing literature on ML-based targeted advertising strategies. The review focuses on three primary research questions in three key dimensions of "targeting", "personalizing", and "predicting customer preferences" outlined below:

RQ1- What are the key findings from a systematic review of the extant literature exploring the current landscape of ML applications employed within targeted advertising strategies?

RQ2- Which ML-based targeting methods in the recent literature review have been the most effective for targeted advertising?

RQ3- What are the future research directions in using ML to target and personalize ad content for individual users?"

3. Research Methods

This review contributes significantly to a holistic understanding of how ML is currently being leveraged within targeted and personalized advertising strategies. Firstly, the review comprehensively examines the existing scholarly literature on ML-driven targeted advertising. Secondly, it identifies critical research gaps within the current body of knowledge, encompassing strategic approaches, tactical implementations, methodological frameworks, and underlying theoretical foundations. Finally, the review proposes a future research agenda, outlining potential areas for further investigation in the realm of ML-based targeted advertising.

3.1. Search strategy

This systematic review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency and methodological rigor (Moher et al., 2010) to ensure the quality of the review process and minimize bias. To address the aforementioned research questions, a three-stage process was employed to identify relevant studies systematically. The initial stage involved a comprehensive review of the existing literature about the research topic. This literature search was conducted across multiple academic databases, including Scopus, IEEE Xplore, and Web of Science. Following the initial stage, the process entails the selection of pertinent keywords to facilitate the retrieval of relevant documents. The keywords applied are; (("Artificial Intelligence") and ("Marketing Optimization"), ("Artificial Intelligence") and ("Targeted Advertising"), ("Machine Learning") and ("Marketing Optimization"), ("Machine Learning") and ("Targeted Advertising")). The third stage involved data collection and subsequent refinement to ensure its suitability for the investigation. Table 1 presents an overview of the proposed document typologies and other selection criteria employed in this study.

Table 1. Literature review's selection criteria

Selection criteria		
1	Keyword	Artificial Intelligence, Machine learning, Marketing optimization, Targeted advertising
2	Subject area	All
3	Source	Article title; Abstract; Keyword
4	Time frame	January 2017 – March 2024
5	Document typology	Research article; Conference paper; Conference review; Literature review

3.2. Inclusion and exclusion criteria

Following the retrieval of search results from databases aligned with the keywords outlined in Table 1, a systematic evaluation is conducted using predefined inclusion and exclusion criteria to identify relevant studies for further analysis. To comprehensively understand the current research landscape, this systematic review employed deliberately broad inclusion criteria for the literature search. A detailed breakdown of all inclusion and exclusion criteria is presented in Table 2.

**Table 2.** Inclusion and exclusion criteria

No	Criterium	Included	Excluded
1	Language of publication	English	Non-English languages
2	Publication date	All publications available	-
3	Data description	Studies employing data with well-documented characteristics	All publications that lack a clear data description
4	Geographic location	No limitation to one country	_
5	Study population	All-encompassing yet representative	Studies characterized by non-representative samples
6	Key findings	All relevant scopes and studies	All no relevant scopes and studies
7	Paper status	Open Access	Closed Access

4. Result

4.1. Study Selection

In this section, we meticulously followed the PRISMA protocol for reporting articles to determine their relevance to the study's objectives (Moher et al., 2010). A total of 183 papers were selected for the screening round. This stage involved a critical analysis of the retrieved literature, with a focus on systematically extracting and integrating their key findings to provide a comprehensive understanding of the research landscape. After removing duplicate items (n = 33), Following the initial screening of abstracts, 150 studies were selected for full-text evaluation. Studies lacking full-text availability or those not retrieved during the retrieval process were excluded based on the criteria of "unavailable full text" or "not retrieved" (n = 26). After the screening process, a total of 78 records were removed during the eligibility process. Studies falling outside the scope of the research topic were excluded from the dataset during the selection process. The exclusion criterion employed in these cases was "thematic irrelevance." (n = 30). Consequently, studies that lacked an overt focus on AI-powered targeted advertising within content were excluded. This selection process adhered to the criterion of "content irrelevance" (n = 48). Finally, 46 articles were adopted for further investigation. A four-phase flow diagram illustrating the search protocol employed in this study is shown in Fig. 1.

Figure 1. PRISMA flow chart of the literature search process
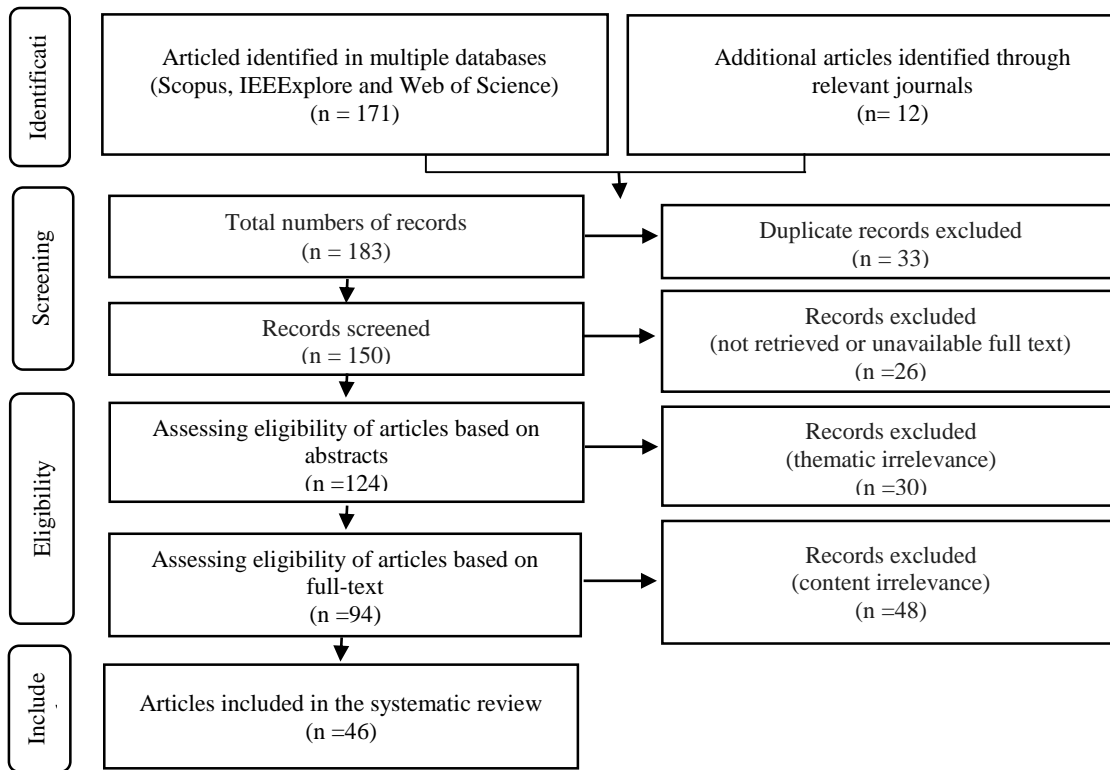
This section delves into the theoretical underpinnings that informed the research approaches employed in the analyzed articles. Table 3 presents a curated selection of seminal studies exploring the application of ML within the domain of targeted marketing and advertising. Table 3 details the employed methodologies, outlining the utilized variables and presenting the key findings for each study.

Table 3. Significant Applications of ML in Targeted Marketing

No	Author/s	Year	Title	Variables	Key Findings
1	Ijaz Ul Haq, Muhmmad & David, Tolu	(2021)	Role of machine learning in online advertising	•Advertising •Machine learning	CTR prediction models, such as Factorization Machines and Neural Networks (Ijaz et al., 2021).
2	Haleem A, Javaid M, Asim Qadri M, Pratap Singh R, Suman R	(2022)	Artificial intelligence (AI) applications for marketing: A literature-based study	•Artificial Intelligence •Marketing •Advertising	The emergence of AI, particularly through the application of ML in digital marketing. Programmatic advertising platforms revolutionized targeted advertising by enabling real-time bidding on highly relevant ads for specific audience segments (Haleem et al., 2022).
3	Jin-A Choi, Kiho Lim	(2020)	Identifying machine learning techniques for classification of target advertising	•Advertising •Machine learning	Linear Regression, Naive Bayes, and Support Vector Machine are used to predict age, gender, and personality attributes for personalized advertising. Max-margin averaged perceptron, logistic regression with L1 and L2 regularization, and boosted decision trees are employed for learning algorithms in user profiling (Choi & Lim, 2020).

Table 3. Significant Applications of ML in Targeted Marketing (*Continued*)

4	Nour Sadeq, Ghalia Nassreddine, Joumana Younis	(2023)	Impact of Artificial Intelligence on E-marketing	• Marketing • Artificial Intelligence	VIF Regression is commonly used in ML for analyzing and optimizing marketing campaigns (Nour Sadeq, 2023).
5	Huang M, Rust R	(2022)	A framework for collaborative artificial intelligence in marketing	• Artificial Intelligence • Marketing • Advertising	ML algorithms can generate seemingly intelligent output without needing knowledge, relying on big data, computing power, and the right algorithms (M. H. Huang & Rust, 2022).
6	Yolanda Masnita, Jati Kasuma Ali, Angginta Zahra, Nicholas Wilson, Wegig Murwonugroho	(2023)	Artificial intelligence in marketing: literature review and future research agenda	• Artificial Intelligence • Marketing	Deep Learning Technologies personalize recommendations of places of interest and explore new locations. Text Mining and Machine Learning Algorithms are applied in various sectors to identify profitable customer segments (Yolanda Masnita, 2023).
7	Yulin Chen	(2023)	Comparing content marketing strategies of digital brands using machine learning	• Marketing • Artificial Intelligence • Machine learning	The 3 main algorithms used were Random Forest, XG boost, and AdaBoost to avoid overfitting and produce accurate results (Chen, 2023).
8	Liye Ma, Baohong Sun	(2020)	Machine learning and AI in marketing – connecting computing power to human insights	• Machine learning • Marketing • Artificial Intelligence • Advertising	Revolutionized marketing research by machine learning methods such as Decision trees, artificial neural networks, and support vector machines (Ma & Sun, 2020).
9	De Mauro A, Sestino A, Bacconi A	(2022)	Machine learning and artificial intelligence use in marketing: a general taxonomy	• Marketing • Artificial Intelligence	Decision trees, decision forests, logistic regression, SVM, neural networks, kernel machines, and Bayesian classifiers are applied in supervised learning tasks for spam classification, face recognition, and text classification (De Mauro et al., 2022).
10	Zhao H, Lyu F, Luo Y	(2022)	Research on the effect of online marketing based on multi-model fusion and artificial intelligence in the context of big data	• Advertising • Marketing • Artificial Intelligence	XG Boost technology classifies the multitask fusion model, leading to better results in advertising and marketing campaigns (Zhao et al., 2022).
11	Ford J, Jain V, Wadhwani K, Gupta D	(2023)	AI advertising: An overview and guidelines	• Advertising • Artificial Intelligence • Marketing	Predictive modeling analyzes data to predict future outcomes, aiding in personalized ad targeting and content recommendations. GANs generate realistic images and videos for ads, enhancing visual content creation and engagement (Ford et al., 2023).
12	Plangger K, Grewal D, de Ruyter K, Tucker C	(2022)	The future of digital technologies in marketing: A conceptual framework and an overview	• Marketing • Artificial Intelligence	Marketing mechanization involves the use of ML to go beyond traditional metrics, enabling marketers to assess, evaluate, and forecast customer behavior more effectively (Plangger et al., 2022).

Table 3. Significant Applications of ML in Targeted Marketing (*Continued*)

13	Shi B, Wang H	(2023)	An AI-enabled approach for improving advertising identification and promotion in social networks	• Advertising • Artificial Intelligence	The GABP (Genetic Algorithm and Back Propagation) neural network model is crucial for optimizing advertising strategies and predicting click-through rates in advertising applications (Shi & Wang, 2023).
14	Huang M, Rust R	(2021)	A strategic framework for artificial intelligence in marketing	• Artificial Intelligence • Marketing • Advertising	Clustering algorithms are used for customer segmentation to identify distinct groups based on behavior and preferences (M.-H. Huang & Rust, 2021).
15	Jain P, Aggarwal K	(2020)	Transforming marketing with artificial intelligence	• Artificial Intelligence	The implementation of AI in customer experience fosters the development of personalized marketing strategies, potentially leading to enhanced campaign performance (Jain & Aggarwal, 2020).
16	Huifeng Guo, Ruiming Tang, Yunming Ye, Zhenguo Li, Xiuqiang He	(2017)	Deep FM: a factorization-machine based neural network for CTR prediction	• Machine learning	Introduces Deep FM, integrating Factorization Machines (FM) and Deep Neural Networks (DNN) for improved CTR prediction (Guo et al., 2017).
17	Geru, Marius & Micu, Angela-Eliza & Capatina, Alex & Micu, Adrian	(2018)	Using artificial intelligence on social media's user-generated content for disruptive marketing strategies in e-commerce	• Marketing	Utilizing machine learning algorithms, such as K-means clustering, on user-generated data from social media can lead to disruptive marketing strategies (Geru, 2018).
18	Ebrahimi P, Basirat M, Yousefi A, Nekmahmud M, Gholampour A, Fekete-farkas M	(2022)	Social networks marketing and consumer purchase behavior: the combination of sem and unsupervised machine learning approaches	• Advertising	Unsupervised machine learning algorithms, specifically hierarchical cluster analysis (HCA) and K-means, cluster different consumer groups based on attributes like age, education, and social media usage (Ebrahimi et al., 2022).
19	Kshetri N, Dwivedi Y, Davenport T, Panteli N	(2023)	Generative artificial intelligence in marketing: applications, opportunities, challenges, and research agenda	• Marketing • Advertising • Artificial Intelligence	GAI tools like ChatGPT and GPT-4 and their role in generating ad copy variations, visuals for ads, personalized ad content creation, enhancing customer engagement, and driving conversions (Kshetri et al., 2023).
20	Mostafa Kamal, Tarek Aziz Bablu	(2023)	Machine learning models for predicting click through rates on social media: factors and performance analysis	• Machine Learning • Marketing	Various ML models such as logistic regression, decision trees, random forests, support vector machines, and neural networks are compared for their effectiveness in CTR prediction (Kamal & Bablu, 2022).
21	Joni Salminen, Bernard J. Jansen	(2022)	How feature changes of a dominant ad platform shape advertisers' human agency	• Advertising • Marketing • Machine learning • Artificial Intelligence	Automation through ML streamlines ad placements, targeting, and optimization, saving time and resources while enhancing campaign efficiency (Joni Salminen et al., 2022).

Table 3. Significant Applications of ML in Targeted Marketing (*Continued*)

22	Akter S, Dwivedi Y, Sajib S, Biswas K, Bandara R, Michael K	(2022)	Algorithmic bias in machine learning-based marketing models	•Machine learning •Artificial Intelligence •Marketing	ML-based predictive analytics and recommendation systems to accelerate marketing processes by identifying niche customers and enabling targeted multi-channel campaigns (Akter et al., 2022).
23	Maddodi C, Upadhyaya P	(2023)	In-app advertising: a systematic literature review and implications for future research	•Artificial Intelligence •Machine learning •Advertising •Marketing	Support Vector Machines (SVM), Random Forest, Gradient Boosting Machines, and Neural Networks can be utilized for predictive modeling and optimization in advertising. clustering algorithms like K-means or hierarchical clustering can help in segmenting audiences for targeted advertising campaigns (Maddodi & Upadhyaya, 2023).
24	Ratchford B	(2020)	The history of academic research in marketing and its implications for the future	•Machine learning •Advertising •Marketing	Crucial roles of machine learning techniques, such as support vector machines and clustering in discrimination and classification (Ratchford, 2020).
25	Xiong W, Xiong Z, Tian T	(2022)	Who to show the ad to? Behavioral targeting in internet advertising	•Machine learning •Advertising	ML methods such as Support Vector Machines (SVM) are used for training conversion models in online advertising campaigns. ML-based behavioral targeting can significantly improve Ad campaign effectiveness (Xiong et al., 2022).
26	Gao B, Wang Y, Xie H, Hu Y, Hu Y	(2023)	Artificial intelligence in advertising: advancements, challenges, and ethical considerations in targeting, personalization, content creation, and ad optimization	•Artificial Intelligence •Advertising •Machine learning	ML algorithms in different pillars such as audience segmentation, contextual targeting, personalization, RTB, and Ad optimization (Gao et al., 2023).
27	Ziakis C, Vlachopoulou M	(2023)	Artificial intelligence in digital marketing: insights from a comprehensive review	•Machine learning •Artificial Intelligence •Advertising •Marketing	ML algorithms are being developed to optimize bidding strategies and budget allocation in advertising, ensuring maximum reach and impact while minimizing resource wastage (Ziakis & Vlachopoulou, 2023).
28	Hocutt D	(2024)	Composing with generative AI on digital advertising platforms	•Machine learning •Artificial Intelligence •Advertising •Marketing	The integration of ML in targeted advertising such as user profiling, Ad personalization, and automated Ad placement (Hocutt, 2024).
29	Lee G, Lee K, Jeong B, Kim T	(2024)	Developing personalized marketing service using generative AI	•Artificial Intelligence •Marketing •Advertising	Persuasive personalized AI-generated messages (Lee et al., 2024).

Table 3. Significant Applications of ML in Targeted Marketing (*Continued*)

30	Ciuchita R, Gummerus J, Holmlund M, Linhart E	(2023)	Programmatic advertising in Online retailing: consumer perceptions and future avenue	• Advertising • Artificial Intelligence • Marketing • Machine learning	Programmatic Advertising (PA) is an automated big data system used by organizations, mainly retailers, to bid for personalized online advertising placement (Ciuchita et al., 2023).
31	Kuang A	(2022)	Construction of personalized advertising accuracy model based on artificial intelligence	• Advertising • Artificial Intelligence • Marketing	Transformation of AI in personalized advertising strategies such as media integration, market adaptation, user-centric approach, and data precision (Kuang, 2022).
32	Huai J	(2021)	Explore the digital transformation path of the advertising industry in the era of artificial intelligence	• Artificial Intelligence • Advertising	Revolutionizing the advertising industry by leveraging digitalization, combining creativity with technological advancements, emotional engagement group attention, and data-driven decision-making (Huai, 2021).
33	Gupta M, Kumar R, Sharma A, Pai A	(2023)	Impact of AI on social marketing and its usage in social media: A review analysis	• Artificial Intelligence • Machine learning • Advertising	AI techniques in social media marketing, digital advertising, and customization of advertising experiences (Gupta et al., 2023).
34	Boyko N, Kholodetska Y	(2022)	Using artificial intelligence algorithms in advertising	• Machine learning • Advertising • Artificial Intelligence • Marketing	ML algorithms in advertising such as logistic regression, decision tree, XG boost, and clustering (Boyko & Kholodetska, 2022).
35	Amalraj, Victoire T, Karunamurthy A, Subitsha B, Kevin A	(2023)	Leveraging artificial intelligence in marketing and advertising: unleashing the power of advanced technologies	• Artificial Intelligence • Marketing • Advertising • Machine learning	Highlight the ML techniques in marketing and advertising such as customer segmentation, personalization, predictive analytics, and Ad optimization (Amalraj Victoire et al., 2023).
36	Argan M, Dinc H, Kaya S	(2023)	Artificial intelligence (AI) in advertising: understanding and schematizing the behaviors of social media users	• Marketing • Advertising • Artificial Intelligence • Machine learning	The importance of creative content, personalization, and targeting in a new era of technology (Argan et al., 2022).
37	Makalesi A, Aydın S, Gökhan, Nalbant K, Kelimeler A, Zeka Dijital, Pazarlama Y	(2023)	The significance of artificial intelligence in the realms of marketing, advertising, and branding inside the metaverse	• Advertising • Artificial Intelligence • Marketing	AI is transforming organizations by enhancing customer service, personalization, and accelerating product innovation through data-driven insights (Makalesi et al., n.d.).

Table 3. Significant Applications of ML in Targeted Marketing (*Continued*)

38	Arasu B, Seelan B, Thamaraiselvan N	(2020)	A machine learning-based approach to enhancing social media marketing	•Artificial Intelligence • Machine learning •Marketing	Text mining, ML integration, and analysis using WEKA algorithms (Arasu et al., 2020).
39	Bhatt C, Bangwal D, Purohit U, Chauhan R, B P A, Singh T	(2023)	Behavior analysis using user's search history through machine learning	•Machine learning	ML algorithms and NLP techniques are used to analyze user search behavior trends (Bhatt et al., 2023).
40	Sánchez-Fernández P, Baca Ruiz L, Pegalajar Jiménez M	(2023)	Application of classical and advanced machine learning models to predict personality on social media	•Machine learning	ML methods like naïve Bayes and artificial neural networks can be used to predict personality traits on social media (Sánchez-Fernández et al., 2023).
41	Ngai E, Wu Y	(2022)	Machine learning in marketing: A literature review, conceptual framework, and research agenda	•Machine learning •Advertising •Marketing •Artificial Intelligence	Supervised learning algorithms and NLP enhance customer interactions and product recommendations. ML technologies are applied to advertising management, demand prediction, and chatbots in marketing (Ngai & Wu, 2022).
42	Borges A, Laurindo F, Spínola M, Gonçalves R, Mattos C (2021)		The strategic use of artificial intelligence in the digital era: Systematic literature review and future research directions	•Marketing •Artificial Intelligence •Advertising •Machine learning	Machine learning can assist in assigning customer sentiments to online reviews, helping businesses understand customer needs and maintain competitive advantages (Borges et al., 2021).
43	Dumitriu D, Popescu M	(2020)	Artificial Intelligence Solutions for Digital Marketing	•Artificial Intelligence •Marketing	The study proposed the 4-step model for personalized marketing determining relevant keywords using tools like Google Keyword Planner and Google Trends (Dumitriu & Popescu, 2020).
44	De Bruyn A, Viswanathan V, Beh Y, Brock J Von, Wangenheim F	(2020)	Artificial Intelligence and Marketing: Pitfalls and Opportunities	•Artificial Intelligence •Marketing •Advertising •Machine learning	ML algorithms such as deep neural networks like multilayer perceptron, convolutional, and recurrent neural networks are commonly used for targeting and Ad optimization (De Bruyn et al., 2020).
45	Yang Y, Zhai P	(2022)	Click-through rate prediction in online advertising: A literature review	•Advertising •Machine learning •Artificial Intelligence	The paper discusses Logistic regression (LR) and its usage for multi-feature CTR prediction. LR explores factors affecting user response behaviors toward advertising (Yang & Zhai, 2022).
46	Raphael J, Madhusudana, Rao N, Bindu A, Gao X	(2022)	Clustering-based Factorization Machines for Advertisement Click prediction	•Machine learning •Advertising	The paper discusses the importance of feature interactions and feature importance in CTR prediction systems. ML techniques are used for advertisement click prediction to predict the likelihood of a user clicking on an advertisement (Raphael et al., 2022).

Table 4 presents the top ten reviewed articles, sorted by citation count.

Table 4. Top 10 Highly Cited Articles

No	Author/s	Year	Title	Main focus of the article	Total citations
1	Huifeng Guo, Ruiming Tang, YunmingYe, ZhenguoLi, Xiuqiang He	2017	Deep FM: a factorization-machine based neural network for CTR prediction (Guo et al., 2017)	DeepFM, a neural network model that predicts click-through rates (CTR) by learning feature interactions without extensive feature engineering. It aims to enhance recommender systems and online advertising by accurately estimating user click behaviors. The effectiveness of DeepFM is demonstrated through experiments on real-world datasets.	2,452
2	Huang M, Rust R	2021	A strategic framework for artificial intelligence in marketing (M.-H. Huang & Rust, 2021)	The article focuses on the strategic roles of AI in marketing, including its types and applications in market analysis and customer engagement. It discusses challenges like privacy concerns and emotional recognition limitations. The need for a balanced approach between data-driven and theory-driven marketing is also emphasized.	776
3	Borges A, Laurindo F, Spínola M, Gonçalves R, Mattos C	2021	The strategic use of artificial intelligence in the digital era: Systematic literature review and future research directions (Borges et al., 2021)	The article focuses on the integration of AI into business strategies, exploring its benefits, challenges, and potential for value creation. It analyzes how AI supports decision-making and enhances engagement while identifying gaps in existing research.	512
4	Haleem A, Javaid M, Asim Qadri M, Pratap Singh R, Suman R	2022	Artificial intelligence (AI) applications for marketing: A literature-based study (Haleem et al., 2022)	The article specifically examines how AI enhances marketing through personalized content, predictive analytics, and improved targeting in digital advertising, while also addressing challenges related to data usage and skill disparities in the industry.	381
5	De Bruyn A, Viswanathan V, Beh Y, Brock J Von, Wangenheim F	2020	Artificial Intelligence and Marketing: Pitfalls and Opportunities (De Bruyn et al., 2020)	The main focus of the article is to analyze the technical challenges and opportunities of implementing AI in marketing, particularly emphasizing the methodologies of deep learning and the critical need for effective knowledge transfer mechanisms.	207
6	Dumitriu D, Popescu M	2020	Artificial Intelligence Solutions for Digital Marketing (Dumitriu & Popescu, 2020)	The main focus of the article is to analyze the current impact of artificial intelligence on digital marketing processes, particularly through a four-step model for keyword identification and its implications for SEO strategies.	92
7	Akter S, Dwivedi Y, Sajib S, Biswas K, Bandara R, Michael K	2022	Algorithmic bias in machine learning-based marketing models (Akter et al., 2022)	The main focus of the article is to analyze algorithmic bias in machine learning-based marketing models by identifying its sources, such as design, contextual, and application biases, and proposing a framework for dynamic algorithm management to mitigate these biases.	86
8	Kshetri N, Dwivedi Y, Davenport T, Panteli N	2023	Generative artificial intelligence in marketing: applications, opportunities, challenges, and research agenda (Kshetri et al., 2023)	The article explores the mechanisms by which Generative AI (GAI) impacts marketing activities and outcomes, focusing on personalization, insight generation, and content creation. It discusses GAI's role in fostering creativity within marketing, how professionals can work alongside GAI to promote creativity, and the implications for organizations, marketing management, professionals' training, and marketing pedagogy. Additionally, it highlights the potential benefits of GAI in enhancing efficiency, productivity, and the quality of written materials, images, and videos.	85

Table 4. Top 10 Highly Cited Articles (*Continued*)

9	Ngai E, Wu Y	2022	Machine learning in marketing: A literature review, conceptual framework, and research agenda (Ngai & Wu, 2022)	The main focus of the article is to conduct a literature review of academic journal studies on ML in marketing applications. The article proposes a conceptual framework for ML applications in marketing based on the 7Ps marketing mix and identifies the various ML tools and technologies that support these applications.	69
10	Arasu B, Seelan B, Thamaraiselvan N	2020	A machine learning-based approach to enhancing social media marketing (Arasu et al., 2020)	The article explores how ML tools can enhance social media marketing (SMM) by analyzing consumer behavior and preferences. It highlights the use of the Waikato Environment for Knowledge Analysis (WEKA) to provide actionable insights for marketers, improving their effectiveness and decision-making.	68

Figure 2 illustrates the significant contributions of four key variables: Advertising, Machine Learning, Marketing, and Artificial Intelligence. Notably, Marketing and Artificial Intelligence stand out, each contributing 26%, highlighting the holistic approach of integration.

Figure 2. presents the top ten reviewed articles, sorted by citation count

Contribution by variables
- 25% Advertising
- 23% Machine learning
- 26% Marketing
- 26% Artificial Intelligence
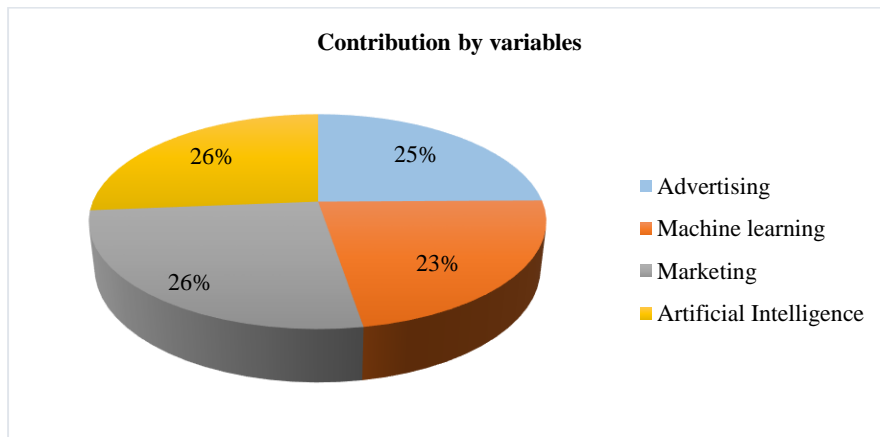
5. Discussion

Informed by a comprehensive review of the extant literature, this study proposes a novel theoretical framework that elucidates the application of ML in targeted advertising. This framework underscores the 3 key dimensions by which ML strategies can be leveraged to enhance targeted advertising effectiveness. A visual representation of the study's thematic structure is presented in Figure 3.

This study contributes to the field by providing insights into the roles of ML in enhancing marketing strategies and optimizing customer experiences. Furthermore, it sheds light on the application of ML algorithms within various targeted advertising domains. While the literature review identified existing research on ML applications within business contexts, the findings suggest an exploration of this intersection by academic scholarship. To address this, the following section presents the results of the investigations into research questions 1 (RQ1) and 2 (RQ2) in 3 key dimensions.

Figure 3. Thematic map of targeted advertising dimensions by using ML

5.1. ML Integration in Targeted Advertising

ML tools analyze vast amounts of data to understand consumer behavior, including sentiment analysis, purchase patterns, and engagement metrics. It also enables personalized marketing by creating individualized experiences for customers through targeted messaging, product recommendations, and tailored offers (M. H. Huang & Rust, 2022), (Nour Sadeq, 2023). As noted, ML is increasingly being used to support consumer-brand relations and enrich marketing strategies (Chen, 2023). ML algorithms enhance customer experience by providing personalization, quality service, and hassle-free experiences. Companies are increasingly leveraging ML to glean deeper customer insights, predict future demand patterns with greater accuracy, and optimize the delivery of customer service experiences (Borges et al., 2021). Following that, ML algorithms are revolutionizing the marketing landscape by enhancing its accuracy and facilitating real-time decision-making capabilities. (Maddodi & Upadhyaya, 2023). User segmentation, a cornerstone of marketing and online advertising, involves partitioning a large user base into smaller, more homogenous groups. These groups are defined by shared characteristics such as demographics, interests, behaviors, or purchasing patterns. ML algorithms, like k-means clustering, hierarchical clustering, decision trees, and random forests, play a pivotal role in this process. By analyzing user data encompassing behavior, preferences, and demographics, these algorithms facilitate customer segmentation for targeted advertising. The result is a multifaceted benefit: enhanced user engagement, increased customer satisfaction, and ultimately, improved revenue generation (Guo et al., 2017), (Ratchford, 2020). Additionally, ML algorithms can tackle numerous inherent challenges. Unsupervised learning methods like the K-means algorithm are used for clustering and segmenting information. The K-means method divides assertions into clusters iteratively, offering insights for marketing segmentation (Ma & Sun, 2020). ML models such as clustering algorithms can group users based on demographic similarities for targeted Ad delivery (Maddodi & Upadhyaya, 2023), (Boyko & Kholodetska, 2022). Moreover, K-means clustering is employed to segregate search history data into clusters based on similarities in search phrases and frequency, aiding in behavior analysis. Each cluster represents a unique subset of search activity, allowing for tailored content recommendations and targeted marketing strategies. By analyzing the traits of each cluster, suggestions for personalized content and marketing can be derived (Bhatt et al., 2023). The use of unsupervised machine learning algorithms based on Python libraries used to cluster consumers based on behavior and demographic attributes can significantly impact social media advertising. By identifying distinct consumer groups through clustering, marketers can tailor their advertising strategies to target specific segments more effectively. The utilization of the K-means clustering algorithm is a popular unsupervised algorithm. K-means identifies centroids and allocates data points to the nearest cluster while keeping centroids as small as possible (Argan et al., 2022). Taking a more technical approach, VIF Regression is a fast regression algorithm for large data sets. It is also a valuable tool for detecting multicollinearity issues in regression analysis, aiding in the selection of independent variables and enhancing model performance (Nour Sadeq, 2023). VIF Regression addresses multicollinearity and can be utilized in advertising for analyzing and optimizing marketing campaigns. By assessing the correlation between different advertising variables, such as channels, demographics, or messaging, VIF Regression can help marketers identify the most effective advertising strategies and allocate resources

efficiently to maximize the impact of their campaigns (Plangger et al., 2022). Support Vector Machines (SVM) are commonly used in advertising for training conversion models in online advertising campaigns. In the context of behavioral targeting (BT), SVMs are employed to classify users as either "converters" or "non-converters" based on their online behavior data (Xiong et al., 2022). In the context of targeted advertising, LSTM models can be used to analyze historical customer data to predict future behavior, segment customers based on their preferences and purchase patterns, personalize advertising content and recommendations for individual customers, and optimize Ad placement and timing to maximize engagement and conversions (De Bruyn et al., 2020).

5.2. *ML Integration in Personalization*

Personalized advertising is recognized as a vital component in enhancing users' receptivity to advertisements, leading to increased consumer engagement throughout the advertising process. ML empowers crafting personalized marketing content and offers tailored to each segment's specific needs and preferences. Moreover, ML algorithms can generate personalized recommendations for influential customers, suggesting products or services that align with their behavior and preferences (Gao et al., 2023). The contemporary digital business environment necessitates a shift from aggressive marketing tactics toward content-driven strategies. Generating relevant and original content fosters two-way communication with target audiences, fostering a more receptive and engaged consumer base (Geru, 2018). Personalization encompasses the tailoring of products or services to cater to the specific preferences, needs, and demands of individual customers. Machine learning algorithms used in personalization include image recognition, speech recognition, and NLP. These algorithms enable real-time editing of advertising content based on consumer behavior (Argan et al., 2022). The development of personalized marketing services has been significantly influenced by the application of Large Language Models (LLMs) such as OpenAI's ChatGPT and GPT-3. These models leverage natural language processing and Generative Artificial Intelligence (GAI) to create tailored marketing messages based on individual characteristics and preferences (Lee et al., 2024). Complementing the use of LLMs, recommender systems for personalization also leverage ML methods such as Collaborative Filtering (CF) and Content-Based Filtering (CBF). In these techniques, algorithms analyze item characteristics and user preferences to recommend items that share similar attributes with those previously favored by the user (Yolanda Masnita, 2023). The emergence of GAI has introduced a transformative tool within the marketing content creation domain. GAI's capabilities empower marketers to expedite the ideation and development stages of novel marketing content, potentially leading to increased efficiency and cost reductions (Hocutt, 2024) (Kshetri et al., 2023). GAI tools like ChatGPT use advanced algorithms to analyze user behavior, preferences, and interactions. Furthermore, GAI leverages natural language processing and create personalized content and targeted marketing campaigns (Sánchez-Fernández et al., 2023). Unsupervised machine learning algorithms, including hierarchical cluster analysis (HCA) and K-means clustering, facilitate the segmentation of consumers based on behavioral similarities without requiring predefined labels (Ebrahimi et al., 2022). For instance, the proliferation of large, digital-native companies, such as Google, Netflix, Spotify, Facebook, and Uber, has fostered a landscape ripe for the application of ML technologies. These companies leverage ML algorithms to develop platforms and applications that exhibit a nuanced understanding of user needs. By analyzing user data and identifying patterns, these platforms can personalize suggestions and recommendations based on individual user interests. A recent study indicates that approximately 84% of marketing agencies are actively implementing ML projects within their workflows. This trend is further corroborated by reports suggesting that 75% of large companies have witnessed a 10% improvement in customer satisfaction as a result of integrating ML functionalities (De Mauro et al., 2022).

5.3. *ML Integration in Predicting Customer Preferences*

Click Through Rate (CTR) prediction in online advertising involves forecasting whether a user will click on a specific advertisement. This is typically done by analyzing user and ad data to predict CTR. Various machine learning models such as LSTM, CNN, FNN, and Deep FM, are used for CTR prediction .Evaluation metrics like precision, recall, F1-score, and accuracy are commonly employed to assess the performance of these models. Feature engineering, model interpretability, and automatic feature learning techniques are key areas of focus for improving CTR prediction accuracy and efficiency (Yang & Zhai, 2022). Machine learning plays a significant role in CTR prediction, with models like Factorization Machines showing promising results in capturing feature interactions and improving prediction accuracy (Raphael et al., 2022). Expanding upon the aforementioned models, logistic regression, decision trees, random forests, support vector machines, and neural networks also represent prevalent choices for CTR prediction. Each of these models possesses distinct strengths and characteristics that contribute to their effectiveness

in this domain (Kamal & Bablu, 2022). WEKA (Waikato Environment for Knowledge Analysis) is an open-source, platform-independent collection of machine learning algorithms for data mining tasks. It supports various data file formats, including ARFF, CSV, LibSVM, and C4.5, and offers a user-friendly interface for data preprocessing, classification, regression, clustering, and association rule learning. These functionalities make WEKA a valuable tool for researchers and practitioners to explore and experiment with different machine-learning models for CTR prediction and other data analysis tasks (Arasu et al., 2020).

6. Conclusion

The integration of Artificial Intelligence (AI) in online advertising is revolutionizing the industry by enabling personalized ad delivery, optimizing marketing strategies, and enhancing customer engagement through advanced data analysis and automation. This transformative shift not only improves the effectiveness of advertising campaigns but also positions AI as a crucial element in shaping the future of marketing. This study aimed to investigate the comprehensive influence of machine learning (ML) on the development and implementation of targeted marketing and advertising strategies. Through a systematic literature review employing the PRISMA methodology, the research explores the multifaceted impact of ML on these strategies. Specifically, the study focuses on identifying and analyzing the most prevalent ML tools and algorithms used in targeted and personalized advertising campaigns. This analysis addresses research questions in three key dimensions: targeting, personalizing, and predicting customer preferences. The findings suggest that leveraging ML can enhance the effectiveness of targeted advertising and improve marketing outcomes. This advancement will enable advertisers to create even more targeted and personalized ad experiences, ushering in a new era of advertising that is more relevant, engaging, and effective. The integration of ML in targeted advertising leverages sophisticated algorithms and predictive models to analyze consumer behavior and optimize marketing strategies. By using advanced techniques such as Support Vector Machines, k-means clustering, LSTM, collaborative filtering, and natural language processing, marketers can achieve precise user segmentation and tailor content to individual preferences. This data-centric approach not only enhances the relevance of marketing communications but also significantly improves engagement metrics and conversion rates. Additionally, robust evaluation metrics like precision, recall, and F1-score enhance model interpretability, thereby optimizing feature interactions and improving prediction accuracy. This technical framework enables marketers to implement dynamic, data-driven strategies, maximizing engagement and conversion efficiency in targeted advertising campaigns. However, the study's reliance on existing literature may limit the generalizability of the findings. Future research should consider empirical studies to validate the identified trends and tools across different generations and with new ML algorithms. By addressing critical gaps in current research and exploring new research directions, this study aims to contribute to the ongoing evolution of AI-driven marketing strategies, ultimately enhancing the precision, personalization, and overall effectiveness of advertising efforts.

7. Research Gap and Future Research Suggestions

This study aims to identify the efficacy of various machine learning-based targeting methods for targeted advertising, as reviewed in recent scholarly literature by formulating research questions. Through the review of recent studies, the most effective machine learning algorithms have been identified. By systematically categorizing these optimal tactics and algorithms into three dimensions—Targeting, Personalization, and Customer Preferences Prediction—this study successfully addresses the identified research gap. Future research should focus on the application of advanced ML techniques in personalized online advertising to examine their impact on Generation Z's satisfaction. This topic is closely related to the current study and can help identify existing gaps. Additionally, this study aimed to gain a comprehensive understanding of the implementation of ML algorithms in targeted advertising by analyzing research conducted over the past 7 years. To deepen the knowledge on this topic, it is recommended that future authors integrate studies spanning a timeframe of more than 7 years.

Table 5. Future Research Agenda

Topic	Potential Questions
The Impact of ML-Based Targeted Ads on Generation Z's Perceptions and Attitudes.	Do personalization and targeted ads impact generation Z's privacy concerns?
	How do targeted ads compare to non-targeted ads in their influence on generation Z in terms of customer persuasion, brand awareness, and customer purchasing behavior?

Conflict of interest

The authors declare that they have no conflict of interest.

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