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Anton Zhuk,
Oleh Yatskyi

THE USE OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN E-COMMERCE MARKETING

The object of this research is the use of artificial intelligence (AI) and machine learning (ML) in e-commerce marketing strategies. Traditional e-commerce marketing approaches often lack a personalized customer experience and find it difficult to adapt to changing consumer behavior. The integration of artificial intelligence and machine learning offers a solution to these problems, enabling real-time marketing initiatives and data analysis.

Studies have shown that the use of artificial intelligence and machine learning in e-commerce marketing has led to improved customer relationship management, increased operational efficiency, and more customer-centric advertising strategies. In addition, technologies such as visual search, virtual personal shoppers, and real-time product targeting have changed the e-commerce landscape by providing interactive and personalized shopping experiences. Artificial intelligence and machine learning algorithms analyze vast amounts of customer data to identify patterns, preferences and trends, enabling e-commerce businesses to conduct targeted marketing campaigns and optimize product offerings. Using advanced technologies, companies can streamline operations, increase customer satisfaction and stay ahead of the competition in the digital marketplace. This data suggests that integrating artificial intelligence and machine learning into e-commerce marketing strategies can benefit businesses by improving customer engagement, increasing sales, and gaining a competitive advantage. However, a successful implementation requires access to quality data, a robust AI infrastructure, and ongoing monitoring and optimization to ensure effectiveness and relevance in a dynamic marketplace.

Keywords: *artificial intelligence, machine learning, e-commerce marketing, personalized customer experience.*

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1. Introduction

The modern information age opens up a wide range of new opportunities, innovative software and technological advances that can be applied to marketing. These advances not only offer new tools, but also force companies to adopt more creative and dynamic approaches to stay competitive in a rapidly evolving marketplace.

Today's creativity in business is largely driven by the development of information and communication technologies. These technologies have a profound impact on the business environment, changing the way companies operate and interact with their customers. ICT enables businesses to access huge amounts of data, improve communication channels and implement sophisticated marketing strategies that were previously unimaginable.

In many countries, AI and ML are being actively integrated into e-commerce marketing, which helps to improve decision-making, optimize pricing strategies, and increase the effectiveness of marketing campaigns. For example, research of [1] shows that American companies actively use AI to personalize marketing and automate processes, which significantly increases customer satisfaction and boosts sales. European companies, as noted by author of [2], focus on the ethical aspects of AI use and data security, which are key factors in building consumer confidence. Chinese companies, as described by author of [3], use AI to analyze consumer behavior in real time, which allows them to respond quickly to changes in market conditions and effectively adjust marketing strategies. Indian companies, studied by Mittal School of Business, Lovely Professional University, are actively implementing AI in e-commerce to automate marketing processes and improve personalized customer experience [4]. And companies mentioned by author of [5], focus on developing innovative AI-based solutions that help to optimize logistics processes and reduce costs.

For Ukrainian companies, the experience of other countries can be useful in the following aspects: implementation of proven technologies and approaches that have proven their effectiveness, access to the most advanced AI and ML developments, and the opportunity to learn from successful cases. However, there are also disadvantages to consider: differences in economic conditions and regulatory requirements, limited resources for implementing high-tech solutions, and cultural peculiarities that may affect the perception of new technologies.

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Ukrainian scientists have already made several important steps towards integrating AI and ML into e-commerce marketing. Research is underway to develop models for optimizing marketing campaigns, automating processes, and improving the personalization of customer experience.

Research in the area of AI and ML integration into e-commerce marketing has significant prospects, as it will increase the effectiveness of marketing campaigns, optimize companies' costs, increase customer satisfaction and loyalty, and provide a competitive advantage in a rapidly developing market.

Addressing data security and ethical concerns is vital as the use of AI and ML grows. Research to mitigate risks ensures compliance with privacy regulations and builds consumer trust. Continuous research keeps businesses competitive by integrating the latest technological advances.

The *scientific goal* of this study is to develop a comprehensive model of AI and ML integration into e-commerce marketing. This involves identifying the mechanisms by which AI and ML influence consumer behavior, marketing effectiveness, and sales optimization. In addition, the study aims to identify methods of effective application of AI and ML technologies to improve personalized customer experience, automate marketing processes, and enhance data-driven decision-making in e-commerce.

The *practical aim* of this research is to provide practical ideas and strategies that e-commerce companies can implement to leverage AI and machine learning technologies. This will allow companies to improve operational efficiency, reduce costs, and increase customer satisfaction and loyalty. In addition, the research findings help companies optimize their marketing campaigns, predict market trends and maintain a competitive advantage in the rapidly evolving digital marketplace.

2. Materials and Methods

This study adopts an exploratory approach to examine the use of artificial intelligence (AI) in e-commerce. The research objectives are outlined to guide the study process and provide insights into the impact of AI on the e-commerce industry.

The study relies on secondary data obtained from various sources, including academic articles, Google Scholar, websites, journals, and other relevant publications. Using the available literature and research papers, the researchers gather a comprehensive view of the subject matter. This approach allows the researchers to explore different perspectives, case studies, and empirical findings related to artificial intelligence and its impact on e-commerce.

3. Results and Discussion

Artificial intelligence (AI) is a branch of computer science aimed at mimicking human thinking and functionality, covering learning, planning, and problem solving. Nowadays, AI has become an integral component of the technology sector, penetrating almost every industry. Its ubiquitous presence extends to everyday devices such as mobile phones, televisions, and electronic gadgets, as well as to industries such as education, healthcare, entertainment, and gaming.

However, one of the sectors that is being impacted the most by AI is e-commerce. E-commerce platforms are using AI in a variety of areas, including personalized reminders for shopping lists, notifications of promotions and discounts, and improved product recommendations. The integration of AI enables e-commerce businesses to expand their customer base, optimize product offerings, and improve the overall user experience.

In addition, e-commerce businesses are introducing new methods of interacting with potential customers through chatbots, customer-generated feedback mechanisms, etc. Artificial intelligence facilitates targeted customer engagement, allowing companies to effectively communicate with the right audience.

At the same time, customers benefit from AI-driven e-commerce portals with features such as intelligent visual and voice search, as well as improved after-sales service. Thus, the symbiosis of AI and e-commerce technologies brings mutual benefits, contributing to increased customer satisfaction and driving innovation in the digital marketplace.

Machine learning (ML) is often used synonymously with AI, but there is a significant difference between the two. While AI encompasses the broader concept of «thinking» machines – from robots in science fiction to self-learning computer code developed in both industry and academia – machine learning (ML) focuses on practical applications that are driving significant progress in real-world domains. ML is based on the principle that instead of explicitly programming machines to perform certain tasks, it is possible to provide them with data and let them derive rules on their own [6].

This approach involves simulated experimentation, where machines analyse data sets using algorithms that can adapt. By learning from the data provided, these algorithms are adjusted to process subsequent information more efficiently. In essence, ML facilitates the development of systems that can improve their performance over time due to continuous exposure to data.

Neural networks are algorithmic models structured as a progressive arrangement of nodes, each exchanging information with each other, thus extracting increasingly accurate meaning and value from data as it passes through the network. Their complex and interconnected architecture allows them to process data in a much more complex way than conventional linear algorithms, making them adept at drawing intelligent conclusions from huge, complex and unstructured data sets [7].

The term «neural network», often abbreviated as NN, is a more accurate descriptor for what is technically known as artificial neural networks (ANNs). This terminology is derived from the network of biological neurons found in the brain of animals, which serves as the inspiration for machine learning that attempts to replicate and mimic it. By mimicking the interconnected nature of biological neural networks, artificial neural networks aim to achieve complex learning capabilities similar to those found in natural cognitive processes [8].

Deep learning, a subset of artificial intelligence (AI), uses multiple layers of artificial neural networks to process data in increasingly complex ways. This allows for more accurate classification, enabling more sophisticated pattern recognition. These capabilities are key in today's AI applications, making deep learning a cutting-edge and highly dynamic area of research.

In deep learning, stacks of neural networks are stacked on top of each other to form so-called deep learning architectures. These architectures allow for the extraction of high-level features from raw data, facilitating the development

of advanced AI models capable of solving complex problems with extreme accuracy and efficiency. Thus, deep learning represents a cutting edge in AI research, constantly pushing the boundaries of what is possible in artificial intelligence.

Natural Language Processing (NLP) technology focuses on the development of machines capable of understanding human speech. Given that verbal communication is more natural for humans than writing computer code, it makes sense that machines with their superior computing capabilities should learn to adapt to us by understanding and speaking our language, and not vice versa.

AI plays a crucial role in NLP by identifying patterns, subtle nuances, and everyday or non-standard language use in the vast diversity of human languages. Thanks to machine learning (ML), NLP systems are able to interpret and understand what we are trying to convey. Examples of ML-based NLP applications can be seen or heard in action through virtual assistants such as Apple's Siri, Microsoft's Cortana, and Amazon's Alexa [9].

Moreover, NLP technology is not limited to virtual assistants, but also extends to various other applications, including language translation, sentiment analysis, text summarization, and chatbots. By using NLP, these systems improve user experience, simplify communication processes, and ensure the seamless integration of human and machine intelligence in various fields.

The e-commerce model outlines the strategy adopted by a company to achieve profitability in the online sphere. In the dynamic environment of e-business, numerous terms and subcategories have emerged to cover different aspects of online commerce. These include content providers, auction platforms, and business-to-consumer (B2C) online retailers. In general, e-commerce business models can be classified into the following types:

– *Business-to-business (B2B)* is the exchange of goods or services between companies, such as transactions between manufacturers and distributors or distributors and retailers. In contrast to business-to-consumer (B2C) or business-to-government (B2G) transactions, B2B transactions are exclusively between companies, not between businesses and individual consumers.

In a B2B business model, a company sells its products to an intermediary buyer, who then sells them to the end consumer. For example, a distributor may place an order through a company's website and then sell the final product to a consumer who visits the distributor's retail outlet. Prominent examples of B2B companies include IBM, Hewlett Packard (HP), CISCO, and Dell [9].

Online platforms such as Chemconnect.com and chemdex.com are examples of B2B models, as they facilitate transactions between two firms in a virtual marketplace. These platforms bring together companies looking to buy or sell goods or services, simplifying the procurement process and facilitating efficient business-to-business transactions.

– *B2C, short for Business-to-Consumer*, describes a model in which businesses interact with individual customers via the Internet.

In B2C transactions, companies sell their products or services directly to end consumers rather than to other companies. As part of the B2C business model, a company has a website through which customers can browse and purchase products on the platform. After selecting a product, the customer places an order on the website, and the business organization receives an email notification. The organization then fulfils the order by shipping the product or goods directly to the customer.

The B2C model, often referred to as web retailing or e-commerce, covers a wide range of online activities, including e-shopping and information search, such as looking up train schedules. Additionally, interactive games delivered over the Internet also fall under the category of B2C transactions, highlighting the diverse nature of online consumer interactions.

– *Customer-to-Business (C2B)*, also known as *Consumer-to-Business*, is a relatively new e-commerce business model. It involves individual customers taking the initiative to offer products and services to companies that are willing to buy them. This model stands in contrast to the traditional B2C model, where businesses sell goods or services directly to consumers.

One of the first platforms to introduce the C2B model was Elance, which facilitated transactions where sellers could advertise their skills and potential buyers could post projects they needed completed. Similar websites, such as PeoplePerHour and Guru, work in the same way, allowing individuals to sell their services to companies looking for specific expertise or solutions.

– *Customer-to-Customer (C2C)*, or *Consumer-To-Consumer*, e-commerce involves electronic transactions between individuals, often conducted through a third-party platform. One common model is online auctions, exemplified by platforms such as eBay, where individuals can list items for sale and others can bid to purchase them. Auction sites typically charge sellers a fee for using their services, acting primarily as intermediaries that connect buyers and sellers.

In C2C transactions, these platforms act as intermediaries, matching buyers with sellers, albeit with limited control over the quality of the goods offered. However, they do make efforts to prevent the sale of illegal products, such as counterfeit CDs or DVDs. In addition, websites operating under the C2C business model allow individuals to sell assets such as real estate, vehicles, or rent out space by posting their ads on the platform. The platform may or may not charge a fee for its services. Potential buyers can then view the ads and make purchases directly from other users.

– *Business-to-Government (B2G)* e-commerce involves businesses supplying goods and services to government agencies or organizations. This covers a variety of activities, including providing military, police, healthcare and educational institutions with the goods and services they need to operate. In addition, businesses often compete for contracts in the online environment by offering services on behalf of the government, such as collecting taxes and providing public services.

B2G transactions facilitate the exchange of information, services and products between businesses and government agencies through online platforms. These platforms serve as digital marketplaces where businesses can interact with government agencies, bid for contracts, and provide essential services to support government functions and public welfare.

Application of AI in E-Commerce. The combination of artificial intelligence technologies with e-commerce operations has resulted in smarter and more personalised online shopping experiences for consumers. From personalized product recommendations to intelligent chatbots that provide real-time assistance, AI is changing the way businesses interact with their customers digitally. In addition,

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AI-powered algorithms allow e-commerce platforms to analyze huge amounts of data, extract useful insights and tailor offers to individual preferences, thereby increasing customer acquisition and retention.

In addition to customer-facing applications, AI is also revolutionizing internal e-commerce operations by streamlining processes such as inventory management, pricing optimization, and fraud detection. By using machine learning algorithms, companies can more accurately predict demand, optimize supply chain logistics, and reduce risks, ultimately leading to greater operational efficiency and cost savings.

In e-commerce, chatbots have become an invaluable tool for improving customer service. These AI-powered conversational agents communicate with users via SMS or chat, effectively mimicking human interaction to understand and quickly satisfy customer requests and preferences [9].

The integration of image recognition technology has revolutionized search functionality on e-commerce websites. Intelligent visual search platforms allow users to search for products using images rather than text, which makes for a more intuitive and efficient shopping experience [10]. A prominent example is Pinterest's visual search feature, which allows users to select a product from any image on the web and has Pinterest show similar products using sophisticated image recognition algorithms.

Voice search functions are becoming increasingly popular in online shopping, gradually replacing traditional text search. With the development of voice recognition technologies, the accuracy of voice search has significantly improved, leading to a shift towards more natural and conversational interaction. This trend is exemplified by popular voice-controlled personal assistants such as Apple's Siri-based HomePod and Amazon's Alexa-based Echo. Users can use voice commands to search for products, place orders, and perform other tasks effortlessly. Research shows that by 2020, approximately half of all searches will be conducted through voice interfaces, which underscores the growing importance of voice search in the e-commerce environment [9].

Effective assortment planning is crucial for retailers to create an engaging shopping experience and optimize their assortment in line with changing consumer preferences. Given the dynamic nature of consumer behavior, retailers need to constantly improve their pricing strategies and product offerings to remain competitive in the marketplace. Intelligent assortment tools provide retailers with real-time information and analytics that allow them to adapt their pricing strategies and product mix accordingly. By analyzing the assortment and pricing strategies of competitors, retailers can improve their approach to remain market leaders. Prominent examples of assortment tools include Market Track and Competitive Knowledge Services, as well as platforms such as Upstream Commerce, which use advanced AI, data mining, semantic analysis and image recognition technologies to collect and analyze data from various retail websites [11].

AI-driven e-commerce virtual assistants serve as software agents capable of providing comprehensive business support and technical services. Often referred to as «chatbots», these virtual assistants can perform a wide range of tasks and provide services to both individuals and businesses. The recent introduction of Lenovo's CAVA virtual assistant is indicative of the growing competition in this area, which aims to compete with well-known platforms such as Google Now and Cortana. Leveraging the power of AI-based deep learning, CAVA includes advanced features such as face and voice recognition to help with efficient data management and multitasking. Common functions performed by virtual assistants in e-commerce include the following:

– Providing exceptional customer service.
– Manage order processing.
– Facilitating exchanges and returns.
– Perform routine website maintenance tasks.

E-commerce companies are looking to replicate the personalized shopping experience of brick-and-mortar stores in the online sphere by providing customers with a seamless way to find products. Artificial intelligence technology can help by offering personalized product recommendations, discounts and promotions to online shoppers in real time.

Augmented Reality (AR) allows e-commerce customers to visualize products or use services in their own environment, enabling them to make informed purchasing decisions. Using AR technology, customers can virtually browse products, which increases the likelihood of choosing the most suitable product.

In online shopping, customer reviews play an important role in building trust. However, the prevalence of fake reviews can undermine consumer confidence. Artificial intelligence can solve this problem by identifying and reducing the number of fraudulent reviews. Amazon, for example, uses AI algorithms to combat fake product reviews by prioritizing verified purchase reviews and identifying useful reviews based on user feedback.

Artificial intelligence enables the delivery of customer-centric advertising tailored to individual preferences and behaviors. In addition to product recommendations, AI can be applied in various areas of e-commerce, including order fulfilment, customer segmentation, sentiment analysis, and predictive marketing strategies [7].

Integrating AI into the e-commerce sector brings significant effects and benefits. Below is an explanation of how AI adoption is impacting the e-commerce industry.

AI is revolutionizing customer relationship management in the e-commerce industry. Maintaining a loyal customer base is crucial for every business, regardless of size. AI technology gathers valuable insights into customer preferences by analyzing past purchases and frequent interactions. Using AI applications, businesses can access detailed information such as specific shopping patterns, target market demographics, lifestyles, and household data.

By deploying automated tasks for employees, organizations can improve operational efficiency and effectively target their desired market. Among the various applications of artificial intelligence, chatbots play a crucial role in helping customers solve complex issues and answer common queries. Such automation not only simplifies work, but also helps to develop the skills of employees to better meet the needs of the target audience.

Understanding and satisfying customer needs is paramount for any business. Artificial intelligence is revolutionizing e-commerce by enabling businesses to analyze customer preferences and diverse tastes through data analysis. This enables e-commerce platforms to effectively tailor their offerings to customer preferences.

Artificial intelligence technology enhances the visual search experience for customers by allowing them to upload images of their preferred products. Advanced AI algorithms analyze these images to identify specific product attributes

such as brand, style and color. Based on this analysis, shoppers are provided with relevant product recommendations.

In a world where time is at a premium for many consumers, the idea of having a personal shopping assistant is attractive. Traditionally, cost has been a barrier to accessing such personalized assistance. However, with AI-driven virtual personal shoppers, this barrier is significantly reduced. Using AI, companies can offer customers personalized shopping advice at a fraction of the traditional cost [12].

Practical implications. The results of this study can be used to significantly improve e-commerce marketing strategies. In particular, companies can integrate artificial intelligence and machine learning algorithms to automate marketing processes, improve the accuracy of targeted advertising campaigns, and personalize customer experience. This will reduce costs, increase efficiency, and improve customer satisfaction.

Limitations of the study. One of the main limitations of this study is the availability and quality of data required to train AI models. In addition, companies must have the appropriate infrastructure and technological support to implement such solutions. Data privacy and security issues must also be taken into account, as the use of such technologies may raise concerns among customers about the protection of their privacy.

Impact of martial law. The conditions of martial law in Ukraine had a significant impact on the research. In particular, changes in the education system and the transition to distance learning have made it difficult to access the necessary resources and equipment to conduct experiments. Legislative changes and the unstable economic situation also affected the ability to implement certain stages of the study, which requires more flexible and adaptive approaches to research tasks.

Prospects for further research. Further research could be aimed at improving artificial intelligence and machine learning algorithms to be even more accurate in predicting consumer behavior and optimizing marketing strategies. It is also important to explore new methods of ensuring data privacy and security in the context of using advanced technologies in e-commerce. Another promising area is the study of the impact of various factors, such as cultural differences and regional peculiarities, on the effectiveness of AI and ML-based marketing strategies.

4. Conclusions

The article shows that AI is becoming increasingly common in the e-commerce industry, but it still has room to grow. It allows companies to offer a more personalized experience to their customers by analyzing huge amounts of data and targeting offers according to individual preferences. E-commerce retailers are using artificial intelligence to analyze market demand more effectively and collaborate with other organizations to develop sophisticated solutions. The impact of AI technology on the e-commerce sector is expected to be significant in the coming years, transforming the way people shop and search online. However, alongside the benefits, the integration of AI into e-commerce may also lead to the creation of new roles in data science, machine learning and technology. Nevertheless, there are concerns about the potential displacement of individuals who do not have the necessary skills to adapt to this technological shift.

The study shows the widespread adoption of artificial intelligence and machine learning technologies in various areas of e-commerce marketing. From personalized product recommendations and predictive analytics to customer segmentation and dynamic pricing strategies, AI and ML are revolutionizing the way businesses interact with customers and optimize marketing efforts. In addition, AI-powered tools such as chatbots, visual search, and virtual assistants are improving the customer experience and streamlining marketing operations.

These results highlight the transformative potential of AI and machine learning in e-commerce marketing. The widespread adoption of these technologies signifies a shift towards data-driven decision-making and automation, enabling companies to better understand customer preferences, anticipate market trends, and deliver personalized experiences. The success of AI and ML in e-commerce marketing can be attributed to their ability to analyze huge amounts of data, identify patterns, and adapt to changing market dynamics in real time.

The results of this study are important for both practitioners and researchers in the field of e-commerce marketing. In practice, companies can use artificial intelligence and machine learning technologies to optimize marketing strategies, improve customer experience, and drive sales growth. By harnessing the power of AI, companies can gain a competitive advantage in an increasingly digital marketplace. Theoretically, this study contributes to the growing knowledge base at the intersection of AI, ML, and e-commerce marketing by shedding light on emerging trends, best practices, and future research directions.

Quantitative assessments of the impact of AI and ML on key performance indicators such as conversion rates, customer retention, and revenue generation will provide valuable insights into the tangible benefits of these technologies. Furthermore, a comparative evaluation of AI-based marketing campaigns and traditional marketing approaches can further clarify the benefits and limitations of AI and ML in e-commerce marketing.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

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Data availability

Data will be provided upon reasonable request.

Use of artificial intelligence.

The authors confirm that they did not use artificial intelligence technologies when creating the presented work.

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✉***Anton Zhuk,*** *Postgraduate Student, Department of Mathematical Sciences, Zaporizhzhia National University, Zaporizhzhia, Ukraine, e-mail: antonzhuk.ukraine@gmail.com, ORCID: https://orcid.org/0009-0001-2726-8862*

Oleh Yatskyi, *Postgraduate Student, Department of Mathematical Sciences, Zaporizhzhia National University, Zaporizhzhia, Ukraine, ORCID: https://orcid.org/0009-0009-4270-2522*

✉*Corresponding author*