

Artificial intelligence in e-commerce: automation, personalization, efficiency

Yanchuk Tetiana¹, Sharko Vitaliy²

Опубліковано	Секція	УДК
30.03.2025	Освіта/Педагогіка	004.8:339.138

DOI: <https://doi.org/10.5281/zenodo.15148589>

Annotation. The article provides a comprehensive analysis of the introduction of artificial intelligence in e-commerce with a focus on automation of operations, analytical tools and personalization of interaction with customers. The digital transformation of e-commerce determines the growing need for the introduction of innovative technologies that can not only optimize business processes, but also form an individual approach to each consumer. One of the key drivers of such changes is artificial intelligence (AI), which provides ample opportunities for automating operations, personalized communications and predictive analytics. The article analyzes the current directions of AI application in e-commerce, in particular: automatic order processing, intelligent inventory management, dynamic pricing, use of chatbots and recommendation systems. The concept of micropersonalization of interfaces and digital content based on cognitive thinking styles of users (visual, analytical, emotional-impulsive and logic-consistent) was first proposed. An adaptive model has been developed that integrates behavioral analytics tools, classification algorithms (K-means), deep learning (LSTM, CNN) and predictive optimization. A mechanism for ethical filtering of personalized content is proposed, which ensures compliance with the norms of responsible interaction with the user and the formation of trust in the brand. The proposed solution can be scalable for different e-commerce platforms. An interdisciplinary approach combining marketing, neural networks and behavioral economics was used. The methodological basis of the study was made up of interdisciplinary methods: system analysis, modeling of user behavior, content analysis, elements of cognitive psychology, machine learning, A/B testing of the effectiveness of models. The results of the research are of applied importance for digital marketing, UX/UI design and strategic planning, can be scaled into various e-commerce platforms, mobile applications and CRM systems. The proposed model combines innovation with practical suitability, promoting customer loyalty, conversion and competitiveness of e-commerce companies.

Keywords: cognitive styles, micropersonalization, adaptive interface, ethical filter, artificial intelligence, behavioral analysis, client experience, digital marketing, neural networks, personalized content.

¹ PhD in Economics, associate professor, Vasyl' Stus Donetsk National University, ORCID:<https://orcid.org/0000-0003-3901-7670>

² doctor of economics, professor, Vinnitsa Trade and Economic Institute DTEU, ORCID: <https://orcid.org/0000-0001-5830-8911>

Штучний інтелект в електронній комерції: автоматизація, персоналізація, ефективність

Анотація. У статті здійснено всебічний аналіз впровадження штучного інтелекту в електронну комерцію з акцентом на автоматизацію операцій, аналітичні інструменти та персоналізацію взаємодії з клієнтами. Цифрова трансформація електронної комерції зумовлює зростаючу потребу у впровадженні інноваційних технологій, здатних не лише оптимізувати бізнес-процеси, а й сформувавши індивідуальний підхід до кожного споживача. Одним із ключових рушіїв таких змін є штучний інтелект (ШІ), що надає широкі можливості для автоматизації операцій, персоналізованих комунікацій і прогнозової аналітики. У статті проаналізовано сучасні напрями застосування ШІ в e-commerce, зокрема: автоматичну обробку замовлень, інтелектуальне управління запасами, динамічне ціноутворення, використання чат-ботів і систем рекомендацій. Вперше запропоновано концепцію мікроперсоналізації інтерфейсів і цифрового контенту на основі когнітивних стилів мислення користувачів (візуального, аналітичного, емоційно-імпульсивного та логіко-послідовного). Розроблено адаптивну модель, яка інтегрує інструменти поведінкової аналітики, алгоритми класифікації (K-means), глибинного навчання (LSTM, CNN) та предиктивної оптимізації. Запропоновано механізм етичного фільтрування персоналізованого контенту, що забезпечує дотримання норм відповідальної взаємодії з користувачем і формування довіри до бренду. Запропоноване рішення може бути масштабованим для різних платформ e-commerce. Використано міждисциплінарний підхід, що об'єднує маркетинг, нейромережі та поведінкову економіку. Методологічну основу дослідження склали міждисциплінарні методи: системний аналіз, моделювання користувацької поведінки, контент-аналіз, елементи когнітивної психології, машинне навчання, A/B тестування ефективності моделей. Результати дослідження мають прикладне значення для цифрового маркетингу, UX/UI-дизайну та стратегічного планування, можуть масштабуватись на різні платформи електронної торгівлі, мобільні додатки та CRM-системи. Запропонована модель поєднує інноваційність із практичною придатністю, сприяючи зростанню лояльності клієнтів, підвищенню конверсії та конкурентоспроможності e-commerce компаній.

Ключові слова: когнітивні стилі, мікроперсоналізація, адаптивний інтерфейс, етичний фільтр, штучний інтелект, поведінковий аналіз, клієнтський досвід, цифровий маркетинг, нейромережі, персоналізований контент.

Introduction

Problem statement. Artificial intelligence (AI) is rapidly transforming e-commerce, becoming a strategic tool in increasing the competitiveness of companies. Growing volumes of online sales, changing consumer behavior, requirements for fast service and constant competition necessitate the digitalization of business processes. The use of machine learning algorithms, natural language processing (NLP), computer vision and predictive analytics allows companies not only to save resources, but also to create a unique customer experience. Although the market for innovative solutions is developing rapidly, enterprises face a number of barriers to AI integration: Financial constraints - small and medium-sized businesses often do not have access to high-tech solutions due to the cost of their implementation. Technical complexity - the integration of AI into the existing IT infrastructure requires qualified personnel and time. Lack of data culture - many companies do not have enough structured data, which limits the effectiveness of algorithms. Ethical issues and confidentiality - the collection and processing of personal data of customers causes risks of information leakage. Perception of technology - there may be concerns among workers about automation and possible job loss. That is why the study of the role of AI in e-commerce is extremely relevant both at the global level and in the context of the Ukrainian market.

Analysis of recent research and publications. Analysis of scientific and applied sources demonstrates a growing interest in introducing AI into e-commerce. Androshchuk G. O. [1] in his work analyzes the current trends in the development of artificial intelligence technologies, emphasizing their key role in the digital transformation of business, in particular in process automation and the construction of adaptive customer service models. Berdo R. S., Rasyun V. L., Velichko V. A. [2] consider ethical challenges associated with the use of AI, in particular issues of data privacy, algorithmic bias and transparency, directly related to e-commerce and personalization. Erfan E.A., Mushka D.V. [3] explore the role of information technology in procurement processes, emphasizing the importance of automation of logistics operations, which is relevant when implementing AI in e-commerce supply chains. Kalashnikova O. [4] focuses on the content of the concept of information technology in customs, which indirectly concerns the digitalization of business, transaction accounting and logistics in e-commerce. Kirlik N. Yu. [8] explores the impact of AI on logistics processes, in particular in terms of demand forecasting, route optimization and inventory management, which is critical for the efficient operation of online stores. Yanchuk Tetiana [6] in the monograph highlights the economic mechanism for introducing digital marketing as a strategic tool for the development of socio-economic systems, emphasizing the importance of AI in building flexible business models. The team of authors Yanchuk Tetiana, Dirkach Khristina [10] analyze modern personalization tools in digital marketing, in particular the role of AI in building an individual customer experience, which is the basis of competitiveness in e-commerce.

Highlighting previously unsolved parts of the general problem. Despite the presence of a significant number of studies on the introduction of artificial intelligence into e-commerce, most of them focus on individual functional aspects - automation or recommendation systems - without taking into account the cognitive specifics of the consumer. The issue of deep personalization of content based on cognitive thinking styles of users, as well as the role of ethical filters in building responsible interactions with the client, has not been sufficiently investigated. Existing approaches to personalization are often based only on demographic or behavioral data, not taking into account the individual characteristics of information processing, which limits the effectiveness of digital tools of influence.

Formulation of the objectives of the article (statement of the task). The article is aimed at a thorough analysis of the application of artificial intelligence in e-commerce with an emphasis on the possibility of automating operational processes, developing tools for personalizing communications with customers, improving the efficiency of the business model of the enterprise, as well as developing the concept of micropersonalization based on cognitive styles of consumers with ethical content filtering.

The task of the article: to analyze modern approaches to the use of AI in e-commerce; identify key areas of business process automation using artificial intelligence tools; explore the possibilities of personalizing customer experience through the introduction of intelligent recommendation systems; justify the need to adapt interfaces and content based on cognitive thinking styles of users; develop a micropersonalization model that takes into account individual behavioral preferences of users; propose a mechanism for ethical filtering of personalized content; assess the potential effect of implementing the proposed model in e-commerce using appropriate metrics.

Materials and methods of research

The study uses an interdisciplinary approach combining elements of digital marketing, machine learning, behavioral economics, UX/UI design and cognitive psychology. The main goal was to explore the impact of the integration of artificial intelligence (AI) algorithms into e-commerce, in particular in terms of personalizing customer interaction and improving the efficiency of business models.

Materials for analysis were:

- statistical data on the behavior of users of the e-commerce platform of auto parts (data collection during 4 months of the site's operation in Vinnitsa - from November 2024 to February 2025),

- Web resource analytics (Google Analytics, Hotjar, Meta Pixel, CRM-extracts),
- models of user interaction with a personalized interface (visual, analytical, emotional-impulsive, logical-consistent thinking),
- historical conversion data, average check, bounce rate, CTR banners, etc.

Research methods: system analysis - to build a common architecture of digital personalization processes using AI; content analysis - to study the interface content (banners, product descriptions, visual blocks) for compliance with the user perception style; observation and log-analysis - recorded data on clicks, residence time, scrolling speed, page depth; modeling user behavior - using LSTM networks (Long Short-Term Memory) to predict the sequence of actions, CNN (Revolutionary Neural Networks) to process visual content and clustering K-means to determine typical behavioral patterns; A/B testing - conducted a series of experiments with two versions of the interface (classical and micropersonalized).

Results

Presentation of the main material of the study. In today's digital environment, the integration of artificial intelligence (AI) into the field of e-commerce covers a wide range of processes that significantly change traditional business models. AI affects not only the technical side of the functioning of online stores, but also the customer experience, marketing, logistics and strategic planning. The three most important areas of integration are automation, personalization and analytics.

Automation is one of the most visible benefits of using AI in e-commerce. It can significantly reduce the time of routine operations, reduce the impact of the human factor and improve the accuracy and speed of data processing. Intelligent systems automatically process orders without operator participation - from the moment the customer makes a purchase to generating invoices, confirming delivery and updating the status of the goods; AI analyzes the level of stocks and can predict demand for specific goods, automatically forming orders to suppliers or replenishing internal reserves. This avoids both excess and shortage of products..

Chatbots and voice assistants (like ChatGPT, Dialogflow, Alexa) are able to respond to customer requests 24/7, solve common problems, provide background information, and even place an order. AI algorithms are able to automatically generate invoices, invoices, logistics reports, commercial offers, etc., which significantly reduces the burden on accountants and managers. For example, the integration of a chatbot into the interface of an online store allows the client to get advice, choose a product and place an order without the participation of an operator, which reduces staff costs and increases the speed of service.

One of the main factors in the success of modern e-commerce is the company's ability to provide the customer with exactly what he is looking for at the right time. It is here that AI demonstrates its strongest side - the ability to deep personalization. The system takes into account the goods that the user bought earlier, their cost, categories and frequency of repeated purchases. All this information allows you to create a full-fledged portrait of the buyer, determine his preferences and offer exactly those products that have a high probability of interest to him. This allows you to send push notifications or email suggestions exactly when the user is presumably online. Personalized recommendation systems, such as those from Amazon, Netflix, or Rozetka, demonstrate that more than 30% of sales can come from AI-generated recommendations. This increases not only the average check, but also the level of customer satisfaction.

AI opens up a new level of analytical depth for companies that want to make informed decisions based on a large amount of data. Thanks to predictive analytics methods, business

can not only respond to market changes, but also predict them. Based on historical data, weather, holiday periods, AI can predict an increase or decrease in interest in certain goods.

Algorithms detect repeated scenarios of behavior, which allows you to implement promotions or reminders in time (for example, about unfinished purchases). Integration with external sources (economic news, exchange rates, inflation) allows AI to take into account external factors for price formation or range change. Thanks to such systems, companies can: predict sales volumes for months ahead; to form an adaptive pricing policy; reduce the risks of excess purchases .

AI transforms e-commerce from within - from logistics to marketing. Its implementation allows not only to reduce costs and optimize processes, but also to create a flexible, adaptive and customer-oriented business model, which is a decisive factor in the world of high competition.

Here are the main directions of using AI in e-commerce.

Table 1

The main directions of AI use in e-commerce

Direction of use	Examples of solutions	Effect for business
Service automation	Chatbots, voice assistants (ChatGPT, Alexa)	Reduce staff costs
Personalization	Recommendation Systems (Amazon, Netflix AI)	Sales growth, customer loyalty
Data analysis	BI-systems with AI (Power BI, Tableau AI)	Accuracy of management decisions
Demand forecasting	Algorithms	Maximizing profits, reducing losses
Logistics forecasting	Predictive Analytics	Route and warehouse optimization

In today's digital environment, personalization has become a key element of competitive advantage for e-commerce. However, most of the implemented systems work according to unified templates that focus exclusively on the history of purchases, clicks or demographic characteristics. This approach often ignores the individual characteristics of information perception and decision-making, in particular, the cognitive thinking styles of the user.

That is why the introduction of a micro-personalization model is proposed, which is based on the classification of users by their style of information processing - visual, analytical, emotional-impulsive or logical-consistent. The first step in implementing this idea is to design a mechanism for collecting relevant data. Unlike classical tracking systems that capture only completed actions, the proposed approach focuses on small, often invisible to the user interactions with the interface - the speed of reading text, the time spent on individual elements of the page, the weight of scrolling, the movement of the mouse cursor, the frequency of pauses between clicks, as well as the relationship between text and visual content to which the user's attention is directed. After collecting these parameters, the data are processed and analyzed using a neural network model that was previously trained on a sample with marked cognitive styles. The model classifies users, giving each a probabilistic profile indicating the predominant type of thinking - for example, 70% visual, 30% analytical. To do this, you can use a combination of models such as LSTM (for analyzing behavior sequences), CNN (for visual elements) and clustering algorithms such as K-means to identify behavioral patterns.

After the formation of the cognitive profile of the user, the next step is the adaptation of the content of the site or advertising messages in real time. In the case of a user with visual thinking, the interface will display a greater emphasis on images, infographics, video reviews

and text minimization. On the contrary, the system will offer the analytical user detailed technical descriptions, characteristic tables, product comparison function, etc. For the impulsive user, it is advisable to form short emotional triggers with a limited supply in time, while the logical one is an emphasis on arguments, benefits and rational justifications.

An additional step is the integration of an ethical filter that analyzes the created personalized elements for compliance with the norms of ethical interaction. The algorithm evaluates whether advertising causes anxiety, does not manipulate fears (for example, "only today - otherwise you will lose the chance"), does not stimulate unhealthy impulsivity, especially in vulnerable groups of users. This increases the credibility of the platform, forms a long-term relationship with the buyer and contributes to the creation of a sustainable brand. At the final stage of implementation, a self-learning mechanism is introduced, in which the system evaluates the effectiveness of each personalized scenario. The assessment is carried out according to the following metrics: average time spent on the page, conversion to purchase, frequency of returns of goods, clickable banners and satisfaction ratio (CSAT). By determining which adaptive changes work best for each style of thinking, the system automatically updates the models, improving the result. The effectiveness of this approach is assessed through A/B testing between the standard version of the site and the micro-personalised version. The expected result is a 15-25% increase in conversion, a 10-12% decrease in failure rate and an increase in user satisfaction due to improved experience.

Let's display the micropersonalization model based on the user's cognitive styles.

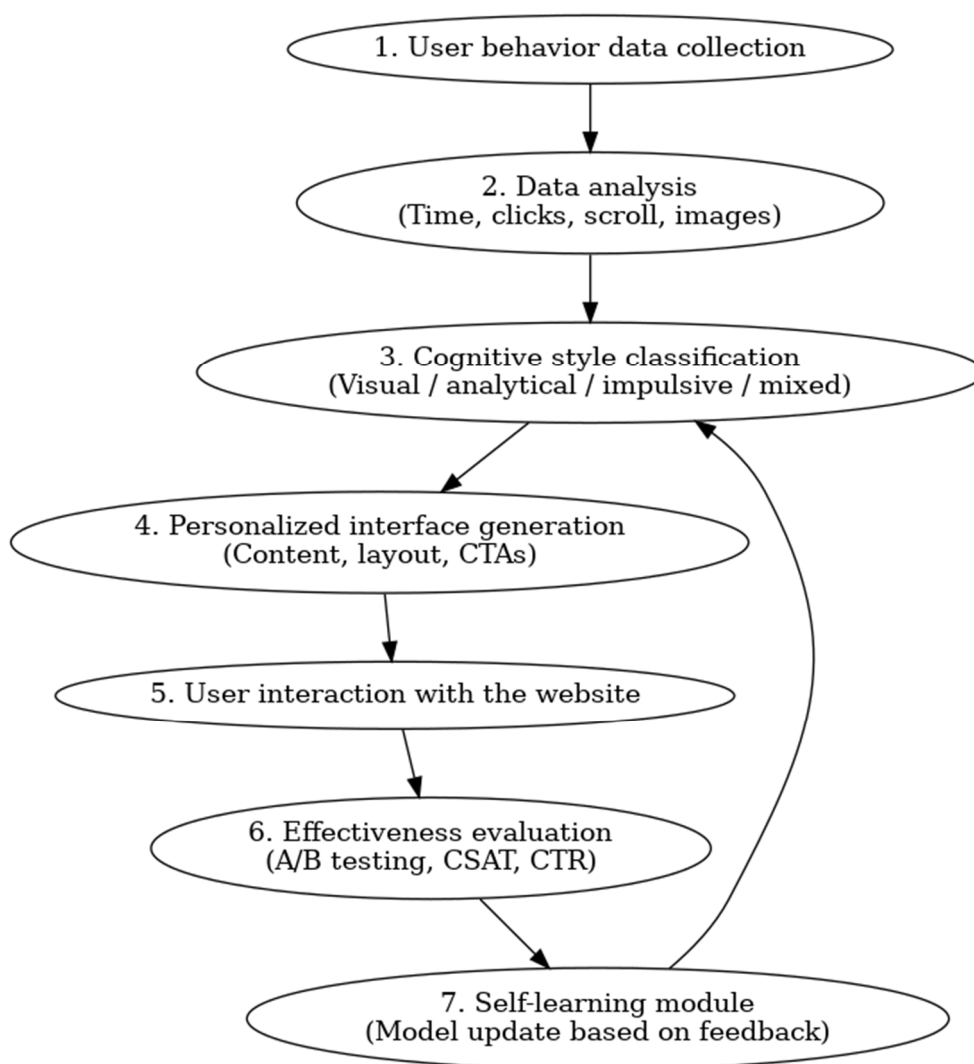


Fig. 1 Micropersonalization model based on the user's cognitive styles

The proposed model of micropersonalization based on cognitive styles in combination with ethical content filtering opens up new horizons for the development of not only e-commerce, but also the entire system of human interaction with the digital environment. It provides not only economic benefits but also adds a humanistic dimension to technological progress.

Assessment of the potential effect of the introduction of a micropersonalization model based on cognitive styles in the field of e-commerce on the example of an online store of spare parts and accessories for cars that are geographically located in Vinnitsa and have a website, social networks where they promote their products, indicates significant advantages both in terms of growth of commercial indicators and improvement of customer experience.

After the implementation of a personalized interface that adapts to the type of consumer (visual, analytical, impulsive or logical-consistent), there is an increase in conversion (the share of visitors who made a purchase) from 1.8% to 2.3%, which is an increase of 28% compared to the previous period. At the same time, the bounce rate decreased from 42% to 36%, which indicates a higher content relevance for the user from the first seconds of being on the site.

The average time spent on the site increased by 24% - from 2 minutes 30 seconds to 3 minutes 6 seconds, especially among users with an analytical and logical-consistent style of thinking who interacted with technical descriptions, comparison tables and reviews. These same groups showed a higher level of the average check - from 1340 UAH to 1515 UAH, which is explained by trust in information and the tendency to make balanced, informed decisions.

In the category of accessories (car organizers, chargers, rugs), where impulsive buyers are more likely to act, the introduction of short trigger blocks with discounts ("only today," "hit sales") in a personalized form increased the CTR of banners by 31% and led to an increase in the frequency of purchases in this category by 18%.

The number of repeated purchases (within 60 days) increased from 12.5% to 15.1%, which is associated with a positive customer experience and successful recommendations for related products (for example, the system recommends appropriate lamps after buying headlights, or grease after choosing a filter).

The decrease in the return rate from 6.8% to 5.9% was made possible due to a more accurate selection of goods based on the visual and functional preferences of the user (in particular, analytical buyers were shown the compatibility schemes of spare parts and OEM code tables).

Separately, it is worth noting the increase in user satisfaction (CSAT) based on the results of short surveys after the purchase: the share of positive ratings (4 and 5 stars) increased from 82% to 89%, and the number of reviews with comments - by 21%. So, the introduction of cognitively oriented micro-personalization in the e-commerce auto parts store allowed not only to improve key performance metrics (conversions, average check, repeat sales), but also to form a loyal customer base that trusts intellectual recommendations and returns for new purchases. This confirms the feasibility of scaling the developed model for other niche online businesses.

Conclusions

AI significantly changes approaches to e-commerce. Its use allows you to automate operations that reduce costs, offer each client a unique experience that increases sales, and receive relevant analytics for strategic planning. Most of all, those companies that have a developed digital infrastructure and are able to quickly adapt to innovation will benefit from the introduction of AI.

To effectively implement AI-based solutions, it is necessary to provide quality training for personnel, invest in data collection and structuring, and adhere to ethical and legal standards for data processing.

References

1. Androshchuk G.O. Technologies of artificial intelligence: tendencies of development. 2024. S. 6-17. URL: <http://openarchive.nure.ua/handle/document/13281>
2. Berdo R. S., Rasyun V. L., Velichko V. A. Artificial intelligence and its influence on the ethical aspects of scientific research in Ukrainian educational institutions. Academic visions. 2023 S. 1-10.
3. Erfan E.A., Mushka D.V. Information technologies in procurement. Economy and society. 2018. S. 349-353. URL: <http://dspace.msu.edu.ua:8080/jspui/handle/123456789/2437>
4. Kalashnikova O. The essence and content of the concept of information technology in state customs. Entrepreneurship, economy and law. 2018. P. 226-230. URL: <http://pgp-journal.kiev.ua/archive/2018/6/42.pdf>
5. Digital marketing and social networks. Management and entrepreneurship in Ukraine: stages of formation and problems of development. 2021. № 3 (1). URL: <https://science.lpnu.ua/sites/default/files/journal-paper/2021/jun/23786/menedzhment121-148-154.pdf>
6. Golovchuk Yu. O., Dybchuk L. V., Serednitskaya L. P. Content marketing as a strategy for market promotion and distribution of services. Economy and state. 2022. № 4. S. 69-75. DOI: <https://doi.org/10.32702/2306-6806.2022.4.69> .
7. How Ukrainian digital has changed for 5 years. sostav.ua, 2021. URL: <https://sostav.ua/publication/yak-zm-nyuvavsya-ukra-nskij-digital-vprodovzh-5-rok-v-90702.html>.
8. Kirlik N. Yu. "Artificial intelligence" and its use in logistics processes. Actual problems of the economy. 2021. P. 59-66.
9. Marchuk O.O. Digital marketing as an innovative management tool. Economy and society. 2018. № 17. P. 296-299. DOI: <https://doi.org/10.32782/2524-0072/2018-17-43> .
10. Yanchuk Tetiana Economic mechanism for the introduction of digital marketing as a strategic tool for the development of socioeconomic systems. Monograph: Science and education as the basis for the modernization of the world order 2024, Karlsruhe, Germany, December, 2024. DOI: <https://doi.org/10.30890/2709-2313.2024-35-00-026>
11. Yanchuk Tetiana, Dirkach Khristina. Personalization in digital marketing: tools and trends. Modern engineering and innovative technologies, Germany, Karlsruhe, Issue №36, December, 2024. DOI: <https://doi.org/10.30890/2567-5273.2024-36-00-070>