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FORMATION OF OPTIMAL VARIANTS OF THE DESIGN PROCESS FOR INTERACTIVE ELECTRONIC PUBLICATIONS IN THE MEDICAL INDUSTRY AND COMPARATIVE EVALUATION OF THEIR RELIABILITY

The article is devoted to the development and substantiation of a methodology for forming optimal variants of the design process for interactive electronic publications oriented toward the medical industry. The evolutionary path of scientific publishing to modern multimedia interactive platforms is analysed, and the specifics and critical requirements for information resources in the healthcare sector are systematized.

Keywords: electronic publications; medical industry; interactivity; design; reliability; evaluation; artificial intelligence.

Introduction

Creating optimal variants of the electronic device design process can be a complex task, especially when it is necessary to compare their reliability. Various methods can be used for this purpose, such as requirements analysis, modelling, and testing. When making decisions regarding optimal variants, it is important to consider both technical and economic aspects. Attention should also be paid to possible technical limitations and product requirements.

As part of the evolutionary process, it is important to conduct comparative evaluation of different design variants to determine the most optimal one in terms of cost, quality, and other important criteria. Comparative analysis methods may include mathematical models, cost-effectiveness analysis, expert assessments, etc.

The process of forming optimal variants of the electronic publications design process and evaluating their reliability requires a systematic approach and consideration of many factors. Optimal variants of the electronic publications design process can be formed based on different methodologies and approaches, taking into account their specifics [1–5].

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Contemporary research emphasizes that for the medical industry, information reliability is the highest priority. This means not merely accuracy, but also clinical relevance, evidence-based foundation, and expert verification. Many publications draw attention to the necessity of minimizing 'false-negative' results (i.e., omissions of important information) in decision support systems, which is reflected in the choice of optimization strategies (for example, sensitivity maximization) [6, 7].

The involvement of medical professionals (practitioners) in the design process (co-creation, co-design) is key to ensuring clinical significance and usability. This allows for the creation of publications that meet the real needs of physicians, nurses, and other specialists.

The application of artificial intelligence (AI) and machine learning (ML) are becoming increasingly important tools for optimizing the design process and for improving the actual content of electronic publications. This includes: natural language processing (NLP) and deep learning for analysing large clinical data sets (electronic medical records, scientific articles) to identify patterns, extract important information, and automatically generate content or recommendations [8–11].

Despite significant contributions, comprehensive research on the scientific and methodological foundations of designing interactive scientific publications, taking into account cognitive, technological, and informational aspects, remains insufficiently studied.

The aim of the article is to systematize and scientifically substantiate approaches to the design and improvement of interactive electronic scientific publications in the medical industry, aimed at optimizing mechanisms of scientific communication and enhancing the efficiency of knowledge assimilation.

Methods

The design of electronic publications for the medical field, particularly ophthalmology, requires a special, highly specialized approach that takes into account the specifics of the field, related to visual information, high-precision diagnostic data, and the need to ensure maximum content reliability.

Effective development of electronic medical resources is based on adherence to a number of critical aspects:

1. Specialization and content quality: publications must contain high-quality, relevant, and expert-verified information, including diagnostic images (fundus, OCT, angiography) with high resolution and discrimination capacity, as well as current clinical protocols and pharmaceutical databases.

2. Visualization and interactivity: to ensure quality user experience (UX), it is necessary to implement zooming functions (magnification of fine details), interactive 3D models, and surgical video tutorials. The user interface (UI) must be intuitive, minimalistic, and provide ease of navigation.

3. Technological reliability and security: the choice of platform (web or mobile application) must ensure offline access to key materials and rapid transmission of large volumes of graphic data through

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high-performance servers. Compliance with data protection and privacy standards (particularly HIPAA and GDPR) is also critically important.

4. Currency and reliability: content reliability is ensured through multi-level expert review and mandatory references to authoritative scientific sources. Systematic information updates and version control functionality for dynamic data must be provided.

Results and discussion

Successful design of electronic publications for the medical field requires a comprehensive methodological approach that combines modern interactive technologies with the highest standards of scientific and clinical reliability. Since ensuring the reliability and validity of medical electronic publications depends on their structure and perception, further analysis focuses on the cognitive foundations of design, architectural principles of information organization, and methodological approaches to implementing modern technologies.

Contemporary approaches to creating interactive scientific publications are based on a deep understanding of human cognitive processes. The fundamental basis of these approaches is Paivio's dual coding theory (Paivio, 1986), which demonstrates that the human brain processes verbal and visual information in parallel through different channels. This means that multimedia elements in scientific publications do not merely embellish text, but activate both information processing channels, which significantly improves the understanding of complex scientific concepts and their retention.

Neuroscientific research additionally confirms the value of interactive elements in scientific texts. When a reader interacts with interactive components, the prefrontal cortex of the brain is activated, which is responsible for working memory and executive functions. This explains why interactive elements not only attract attention but also promote deeper analysis and critical thinking.

However, interactivity can become an obstacle if the principles of cognitive load are not considered. Cognitive load theory warns against overloading the reader with information and proposes optimization strategies: segmentation of complex information into smaller blocks, gradual content disclosure according to user needs, use of visual cues to guide attention, and personalization of complexity level depending on the reader's background.

The design of information architecture for interactive scientific publications requires a special approach due to the specifics of scientific information (Fig. 1). Unlike popular texts, scientific information is characterized by high conceptual density, complex interdisciplinary connections, and the need for precise references and verification.

Hierarchical content organization should reflect faceted classification, which allows for structuring multidimensional scientific data. This means that the same information can be organized according to different criteria: by chronology, by topic, by methodology, or by complexity level. Such organization enables the reader to find

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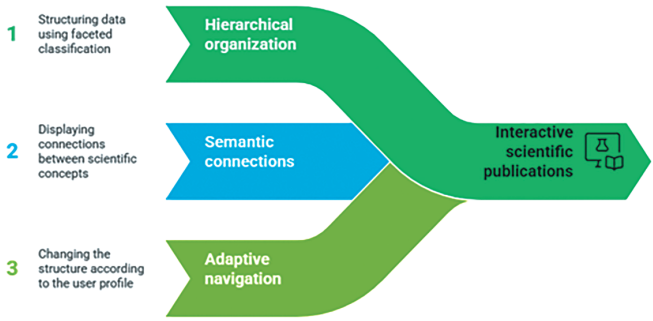

Fig. 1. Principles of designing information architecture for interactive scientific publications taking into account the specifics of scientific information

information through various pathways, according to their research needs.

Semantic connections between publication elements are created through the use of ontologies—formal descriptions of conceptual relationships between scientific concepts. This allows the system to automatically suggest relevant materials, display connections between different concepts, and support interdisciplinary research.

Adaptive navigation represents a dynamic change in interface structure according to user profile. The system analyses reader behaviour, their academic background, and content interaction history to personalize information presentation.

Methodological Approaches to Implementing Modern Technologies:

Artificial Intelligence in the Service of Scientific Publications

The integration of artificial intelligence and machine learning technologies is revolutionizing the way readers interact with scientific content. Content personalization is carried out through sophisticated recommendation algorithms that analyze user behavior, their academic profile, and interaction history with different types of content. The mathematical model of such personalization takes into account similarity between users, content popularity, and its relevance for a specific reader:

$$R(u,i) = \alpha \cdot sim(u,v) + \beta \cdot pop(i) + \gamma \cdot relevance(u,i), \quad (1)$$

where R(u,i) is the recommendation rating of element i for user u, sim(u,v) is user similarity, pop(i) is element popularity, relevance(u,i) is relevance.

Automatic annotation becomes possible thanks to Natural Language Processing (NLP) methods. These technologies are capable of generating metadata, extracting key concepts, creating automatic abstracts, and even suggesting tags for publication categorization. This significantly reduces the burden on editors and authors while improving the searchability and accessibility of scientific content.

Intelligent search moves from simple keyword matching to understanding query context. Semantic search analyses user intent, synonyms, context, and connections

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between concepts, which allows finding relevant information even with imprecise or incomplete queries.

Semantic Technologies and Linked Data

The application of Linked Open Data principles and ontologies ensures machine-readability of scientific content. This means that computer systems can automatically process, analyse, and establish connections between different publications. The formal model of semantic annotation includes a resource, ontology concept, property, and linguistic marker, creating a structured description of scientific content:

$$A = (R, C, P, \lambda), \qquad (2)$$

where A is annotation, R is resource, C is ontology concept, P is property, λ is linguistic marker.

Integration with external databases allows enriching publications with additional information from international scientific repositories, citation databases, and specialized collections. Automatic establishment of connections between publications helps identify trends, influential works, and promising research directions.

Big Data in Scientific Content Analysis

Big data analysis opens new possibilities for understanding patterns of scientific information consumption. Research on how readers interact with different types of content allows optimizing publication structure, improving user experience, and predicting future research trends. Personalized recommendations become more accurate through analysing the behaviour of large groups of users with similar interests and needs (Fig. 2).

Blockchain as a Guarantor of Trust in Scientific Publishing

The implementation of distributed ledger technologies addresses critical trust issues in scientific publishing. Copyright protection

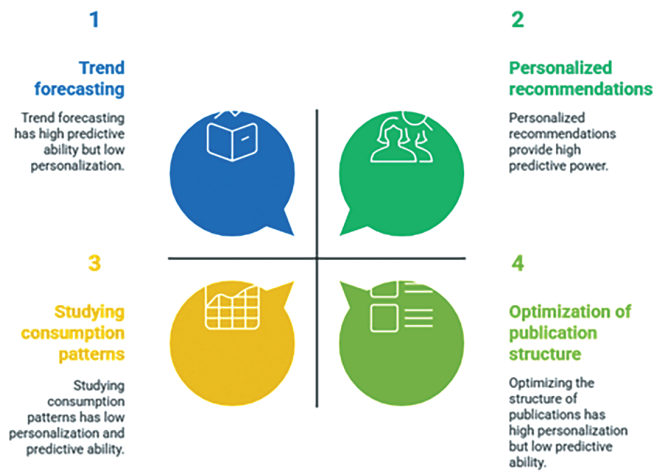

Fig. 2. Big Data analysis capabilities for optimizing scientific publications and knowledge assimilation processes

is ensured through creating an immutable record of authorship and publication date. Transparency of the review process is achieved through an open system where all stages of quality assessment can be tracked and verified.

Data verification guarantees the integrity of scientific data throughout the entire publication lifecycle. Decentralized publications offer an alternative to traditional publishing models, potentially reducing costs and increasing the accessibility of scientific information.

The contemporary landscape of tools for creating interactive scientific publications includes specialized platforms, each addressing specific needs. Jupyter Notebooks allow creating interactive computational publications where code, results, and explanations are integrated into a single document. Scholastica offers comprehensive solutions for creating multimedia journals with support for video, animations, and interactive diagrams.

One of the biggest challenges is the lack of unified standards for interactive formats. This complicates content exchange between different platforms and can lead to technological fragmentation. Ensuring compatibility across different devices and platforms requires additional efforts from developers and can increase development costs.

Performance optimization becomes critically important when working with large data volumes, especially when dealing with interactive visualizations of complex scientific data. Security issues include protection against unauthorized access and modification, which is particularly important for scientific data.

The economic challenges of implementing interactive scientific publications are significant. Initial development costs can amount to 50–200 % of traditional publication costs. The need for staff retraining, continuous technical support, and development of new monetization models creates additional financial burdens. New monetization models include subscriptions to premium features, micropayments for access to specialized content, and experimental approaches such as tokenization of scientific achievements.

Ensuring long-term preservation of interactive scientific publications presents unique technological challenges. Unlike static texts, interactive elements depend on software, operating systems, and hardware that are constantly changing.

Preservation strategies include emulation of software environments, migration of content to new formats, encapsulation of all dependencies in archives, and standardization through the use of open formats. An extended metadata schema should include detailed information about all interactive elements, their technical characteristics, and dependencies.

The future of interactive scientific publications is closely linked to the development of immersive technologies. Virtual reality opens possibilities for three-dimensional visualization of complex scientific data, allowing researchers to ‘immerse themselves’ in molecular structures, astronomical objects, or historical reconstructions.

Augmented reality allows overlaying digital information on real objects, which can revolutionize practical disciplines. Holographic

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displays and neural interfaces represent more distant but potentially transformative technologies.

Generative artificial intelligence models can automatically create scientific texts, visualizations, and even hypotheses. Quantum computing promises to accelerate the processing of complex scientific data. Federated learning will enable collaborative algorithm training without transferring sensitive data, while explainable artificial intelligence will make recommendation algorithms more transparent and understandable (Fig. 3).

The implementation of interactive scientific publications promises to accelerate review processes, improve the quality of scientific education, enhance interdisciplinary collaboration, and democratize access to scientific knowledge. These changes can fundamentally transform the way scientific research is conducted, published, and consumed.

Conclusions

The conducted research has made it possible to formulate scientific and methodological foundations for the design and improvement of interactive electronic scientific publications for medicine industry. The main results include:

1. A conceptual model of an interactive scientific publication based on the principles of cognitive psychology, information architecture, and modern technologies.

2. A methodological approach to integrating AI, semantic technologies, and blockchain to optimize scientific communication processes.

3. A system of criteria for evaluating the effectiveness of interactive scientific publications, including metrics of cognitive load, usability, and learning effectiveness.

4. Recommendations regarding technical implementation, economic models, and legal support for innovative publishing solutions.

5. A forecast for the development of the field of interactive scientific publications, taking into account trends in immersive technologies and artificial intelligence.

Prospects for further research lie in developing specific algorithms

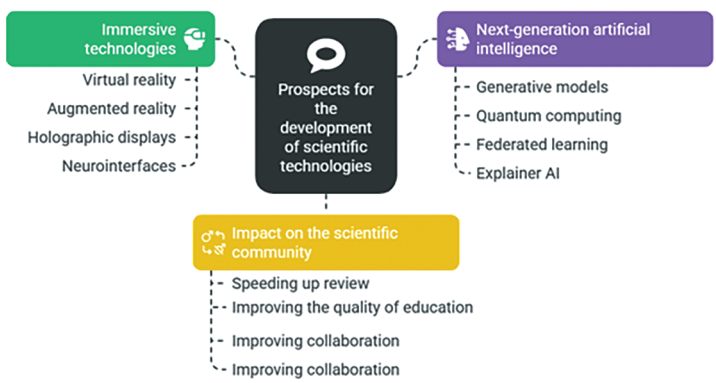

Fig. 3. Future directions for the development of scientific electronic publications and their transformative impact on scientific activity

for personalizing scientific content, creating standards for interactive scientific formats, and empirically investigating the effectiveness of different types of interactivity for scientific knowledge assimilation.

The research results are of significant importance for the development of publishing, improving the efficiency of scientific communication, and optimizing learning processes in higher educational institutions.

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Стаття присвячена розробці та науковому обґрунтуванню комплексної методології формування оптимальних варіантів процесу проєктування інтерактивних електронних видань, спеціально орієнтованих на медичну галузь. У роботі систематизовано специфіку та критичні вимоги до інформаційних ресурсів у сфері охорони здоров'я, зокрема щодо точності діагностичних зображень, клінічної релевантності контенту та необхідності експертної верифікації медичної інформації.

Особливу увагу приділено детальному висвітленню етапів проєктування електронних медичних видань з фокусом на підвищенні достовірності та надійності даних, що є критично важливим для медичних застосувань, де помилки можуть мати серйозні наслідки для здоров'я пацієнтів. Розглянуто когнітивні засади проєктування, що базуються на теорії подвійного кодування та принципах когнітивного навантаження, які забезпечують оптимальне сприйняття та засвоєння складної медичної інформації.

Всебічно досліджено науково-методичні засади впровадження інноваційних технологій у процес створення медичних електронних видань. Детально розглянуто застосування елементів штучного інтелекту для персоналізації контенту, автоматичного анотування та інтелектуального пошуку; семантичних технологій та онтологій для забезпечення машиночитаності та встановлення зв'язків між публікаціями; блокчейн-технологій для гарантування авторських прав, прозорості рецензування та верифікації даних. Проаналізовано можливості використання великих даних для аналізу патернів споживання наукової інформації та оптимізації структури видань.

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Результати дослідження формують концептуальну основу для подальшого розвитку адаптивних інтерактивних ресурсів, орієнтованих на специфічні потреби медичних працівників різних спеціальностей та пацієнтів. Запропоновано рекомендації щодо технічної реалізації, економічних моделей монетизації та стратегій довгострокового зберігання інтерактивного контенту. Визначено перспективи розвитку сфери інтерактивних медичних видань з урахуванням тенденцій імерсивних технологій, генеративного штучного інтелекту та квантових обчислень.

Ключові слова: електронні видання; медична галузь; інтерактивність; проєктування; достовірність; оцінювання; штучний інтелект.

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