Інформаційні технології

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THE COGNITIVE FACTOR IN THE CONTEXT OF SUCCESSFUL WEBSITE PERSONALIZATION

Summary. *Studying the cognitive factor in website personalization is an integral part of creating effective, user-oriented digital products. It helps to increase the convenience, satisfaction and commercial success of resources, which makes this aspect especially relevant in the face of growing competition and requirements for high-quality UX.*

Key words: *website, personalization, information, consistency, information technology.*

Today, understanding the cognitive factors in website personalization is crucial for improving the user's interaction with the resource. The cognitive processes - perception, attention, memory, and thinking - determine how a user interacts with website content. By considering these processes, we can create a more user-friendly and relevant interface that enhances the user experience (UX).

Understanding the cognitive characteristics of users can help to tailor the content of a website to their preferences and level of comprehension. This can reduce the time spent searching for information and reduce cognitive load. A personalized approach that takes into account these cognitive factors can also create a more user-friendly and intuitive interface, increasing user engagement and reducing the bounce rate.

Cognitive features play a significant role in the speed and accuracy of decision-making when selecting products or services online. Personalization based on these features helps simplify the process, increase user trust, and improve conversions.

Different users have different cognitive preferences and styles. Analyzing these factors allows us to segment the audience and provide personalized solutions for each group. The main goal of studying cognitive factors is to understand the unique ways in which users perceive, process information, and make decisions. This knowledge can be used to create a more effective and tailored experience on the site, by adapting the interface, content, and navigation to suit the cognitive needs of each user. This approach reduces cognitive load, improves usability, and increases engagement.

The main goal of the website is to provide optimal conditions for the user to quickly and effectively perceive information and make informed decisions during their interaction with the site. To achieve this goal, various methods are employed to study the cognitive factors involved in personalization.

One of the primary methods is analyzing user behavior. This involves tracking user clicks, time spent on the page, and navigation patterns, which helps to understand how users process and perceive information. Additionally, usability testing is conducted to directly observe users as they perform tasks on the site, identifying any cognitive challenges they may encounter.

Cognitive interviewing is a method used to understand the thought processes and motivations of users during their interaction with a website. Questionnaires and surveys are also used to gather data on the subjective perceptions of information and preferences. Eye tracking technology allows us to identify attention zones and areas with high cognitive load, while A/B testing helps determine the most effective design and structure options for the website in terms of cognitive perception.

Measuring cognitive load using scales like NASA-TLX allows us to assess the mental stress experienced by users. By combining these methods, we can create personalized interfaces that take into account users' cognitive characteristics to improve their experience and efficiency.

The theoretical basis for this research is drawn from the fields of user experience (UX) and human-computer interaction (HCI). Additionally, data analysis and machine learning techniques are used to identify behavioral patterns and user preferences, which form the basis for the development of the product.

The main methods of personalization include segmenting users based on demographic, geographical, and behavioral characteristics. Behavioral targeting is based on a user's history of interactions. Contextual personalization takes into account the device, time, and location. Adaptive personalization changes the interface and offers in real-time based on user actions.

Data collection and analysis technologies, such as cookies, web analytics, databases, machine learning, and artificial intelligence, are used to implement personalization. Some popular tools include Google Analytics, Adobe Target, and our own recommendation systems.

The practical significance of personalization is evident in the way market leaders use it. For example, Amazon selects products based on a customer's purchase history, while Netflix recommends movies according to their preferences. Google adapts search results based on the user's needs. These techniques increase engagement, conversion rates, and customer loyalty.

However, personalization also raises concerns about privacy and ethics. Legislation such as the General Data Protection Regulation (GDPR) limits the collection and use of personal information. To address these concerns, researchers are working on creating transparent and explainable AI models that protect user privacy. As a result, personalization remains a growing field with a

strong scientific and technical foundation. It is being used to improve interactions and business performance.

To gain a better understanding of the research issues, it is helpful to briefly consider the history of website development.

The development of websites began in the early 1990s with the introduction of the World Wide Web by Tim Berners-Lee in 1989. The first website, launched in 1991, was a simple page with text and links created using HTML (Figure 1).

Rank	Website	Category	Change	Avg. Visit Duration	Pages / Visit	Bounce Rate
1	google.com	Computers Electronics and Technology > Search Engines	=	00:10:35	8.36	29.53%
2	youtube.com	Arts and Entertainment > TV Movies and Streaming	=	00:22:59	9.69	25.03%
3	facebook.com	Computers Electronics and Technology > Social Networks and Online Communities	=	00:11:15	10.57	31.89%
4	baidu.com	Computers Electronics and Technology > Search Engines	=	00:07:36	8.01	33.46%
5	twitter.com	Computers Electronics and Technology > Social Networks and Online Communities	=	00:10:12	10.78	31.39%
6	instagram.com	Computers Electronics and Technology > Social Networks and Online Communities	=	00:06:49	11.35	36.42%
7	wikipedia.org	Reference Materials > Dictionaries and Encyclopedias	+1	00:03:52	2.98	58.30%

Fig. 1. The list of the most visited sites around the world

In the 1990s, websites were static and were created manually using HTML and CSS. The content changed rarely, and tables were used for the arrangement of elements. The design remained simple due to limitations in technology.

In the late 1990s, programming languages such as JavaScript and PHP appeared, bringing dynamism and interactivity to websites. These languages allowed content to be changed without reloading the page, and made it possible to work with databases.

In the 2000s, dynamic web applications such as AJAX and frameworks became popular. These applications improved user interaction and replaced static websites. CMS systems like WordPress also developed to help create and manage content.

From the 2010s onwards, the focus shifted towards responsive design, which is designed to work on mobile devices. HTML5 and CSS3 were used with advanced multimedia capabilities. Frontend frameworks like React, Angular, and Vue have also become more important. Server technologies like Node.js have also grown in importance.

Today, website creation is a complex process that involves design, programming, optimization, and personalization with the goal of providing ease of use and quick interaction. This process reflects the evolution of Internet technologies and the ever-changing needs of users.

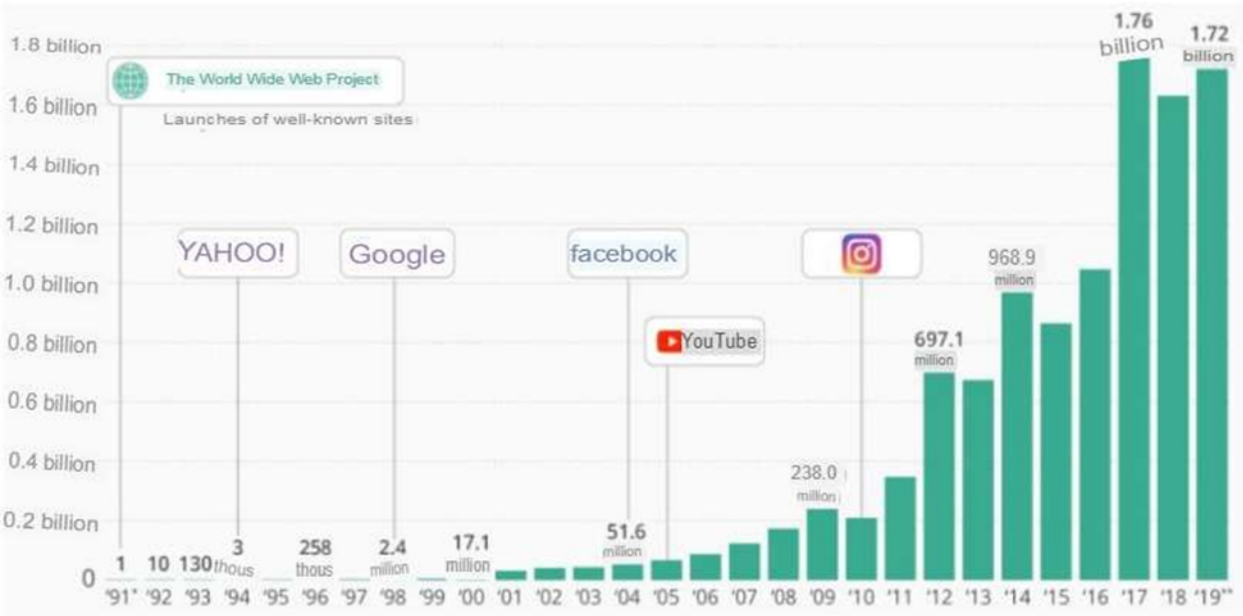

Fig. 2. Global dynamics of website development [3]

The main concepts in studying the cognitive aspect of website personalization involve the entire range of a user's mental processes, including perception, attention, memory, thinking, and decision-making. These factors influence how a person interacts with a web resource.

An important concept in web design is cognitive load, or the amount of mental effort needed to process information on a website. Minimizing this load can increase the effectiveness of personalization by helping users better understand and remember content.

Information perception plays a crucial role in how users interpret visual and textual elements on a site. This affects their understanding and retention of content. To make the most of this information, designers should consider a user's cognitive abilities and preferences when selecting content and creating an interface that encourages repeated interactions. Attention is another important factor in personalization. It determines which elements on the site users focus on. Personalization should aim to attract and maintain attention on key information to maximize its impact. User models can be used to create tailored experiences based on a visitor's cognitive characteristics and preferences. These models can help inform design decisions and ensure that the site adapts to each individual user's needs.

Decision-making is a process of choosing actions on a website. Personalization aims to simplify this process by improving navigation and providing relevant recommendations. This is done by taking into account heuristics and cognitive errors, which show frequent patterns and distortions in user behavior. This helps to create more effective personalized interfaces.

Usability and cognitive accessibility reflect the convenience and understanding of the site for different users. Cognitive accessibility takes into account the cognitive characteristics of users, allowing you to create personalized experiences focused on their real capabilities and needs. This increases the comfort, satisfaction, and effectiveness of the interaction with the website.

As mentioned above, website personalization is a process of adapting the content, interface, and offerings of a website to the individual characteristics

and behaviors of each user in order to enhance the user experience and improve website effectiveness.

Several basic personalization techniques can be used individually or in combination, in our opinion.

One such technique is personalization based on user behavior. This involves analyzing the user's interactions with the website, including which pages they visit, how long they spend there, and which products they add to their cart or purchase. Based on this information, personalized recommendations are generated, such as similar products, special offers, or personalized promotions. This approach makes the content more relevant to the user and increases the chances of conversion. This method is commonly used and has proven to be effective.

The second method is to use geolocation. The website determines the user's location based on their IP address or other methods and adapts the content based on the user's region. This could include displaying current news, local prices, active promotions, nearby stores, or delivery services. Geolocation improves the relevance of the information and enhances the user experience, especially for services that have regional restrictions.

The third way is demographic personalization. When collecting information about age, gender, language, and other demographic characteristics, the user receives content, design, and offers tailored specifically to their group. For example, a website can show different products and promotions for men and women, or adapt the language and style of communication to the age of the audience.

The fourth method is personalization through profile creation and registration. The user specifies their preferences, interests, and personal data, which the system then uses to select content, store interface settings, order history, and generate personalized recommendations. Having an account allows

for a deeper analysis of behavior and a more precise adjustment of each user's experience [1, p. 99].

The fifth method is real–time adaptation. Here, the site reacts to user actions right during the session, changing offers, visible sections, content, and design. For example, if a visitor spends a long time browsing a certain section, the system automatically offers additional materials or discounts, which increases engagement.

The sixth method is integration with social networks. Large platforms can use data from user profiles and social media activity to better understand their interests and connections, helping to personalize content beyond the site. This also allows for more relevant advertising and offers based on user behavior.

Another important aspect of personalization is retargeting, which involves displaying advertising banners and offers based on a user's past activity on a website or the internet in general. This can be done through personalized ads that are tailored to the user's needs.

Personalization also extends to the website's interface. By changing the location of elements, using different colors, adjusting the menu structure, and considering user preferences, the website can become more user-friendly, reducing the time it takes to find information and improving the overall experience.

Next, briefly discuss the main challenges of website personalization. Data collection is complicated by privacy regulations (GDPR, CCPA) and the lack of high-quality data, leading to inaccurate personalization. Technical challenges include integrating analysis systems (CRM, analytics), which require resources and can put a heavy load on servers during real-time data processing. The relevance of content suffers from errors in determining user preferences, leading to inappropriate recommendations. An overabundance of personalization can be annoying.

The user experience is negatively impacted by the "creepy valley" effect, which creates a sense of being monitored, and inconsistencies in the interface across different devices. This can lead to ethical concerns and distrust, as users may not feel confident in the security and transparency of the site's data usage.

Testing and scaling can be challenging, as it is difficult to cover all possible personalization scenarios for diverse audiences, and large-scale algorithms are required for processing large volumes of data.

To address concerns about data collection, it is essential to use transparent practices. This means obtaining explicit consent from users for data use and clearly communicating the purpose of data collection through privacy policies. Anonymized data should be used to comply with regulations like the GDPR and CCPA.

Improving data quality can be achieved with analytics tools like Google Analytics and Mixpanel, as well as collecting feedback through surveys. Technical difficulties can be resolved by leveraging cloud platforms like AWS and Google Cloud for server scalability and optimization. Personalization can be simplified with the use of ready-made tools such as Dynamic Yield and Optimizely.

To make your content more relevant, use machine learning and audience segmentation to tailor it to individual users. Conduct A/B tests to verify your recommendations and avoid oversaturation by limiting the number of personalized elements on each page. For example, limit them to 2-3 per page. To enhance the user experience, create a consistent interface that works well on all devices and test it thoroughly on different platforms using responsive design.

To address the "creepy valley" effect, it is important to explain how the data is used. For example, a notification could say, "We recommend this based on your viewing habits". To increase trust, it is essential to publish clear data usage policies and provide users with control (personalization settings).

To simplify the testing and scaling process, start with smaller segments and use automated platforms like Salesforce and HubSpot. Gradually expand the reach as you gain more experience. Balance personalization with privacy to maintain user trust and effectiveness.

Overall, by considering the cognitive factors in website personalization, you can create a more engaging experience for users.

First, this is due to adapting the presentation of information to individual characteristics of perception, memory, and attention, which helps avoid overload and makes it easier to assimilate content. It's also important to create a user-friendly and intuitive interface that reduces cognitive load and makes navigation more convenient. Personalization should consider the speed of perception and volume of data provided, allowing for gradual disclosure of information and use of interactive elements.

Recommendations and suggestions on the website should be based not only on behavioral data, but also on cognitive preferences. This approach increases the relevance and motivation of the user, building trust and loyalty towards the resource. It reduces stress during interaction and improves the overall user experience.

At the same time, it is necessary to conduct systematic analysis and testing in order to timely adjust personalization based on the changing cognitive characteristics of the audience. The integration of the cognitive factor is a crucial element in successful personalization. It contributes to increased website effectiveness and user satisfaction.

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