

THE IMPACT OF WEBSITE INFORMATION LABELLING ON INFORMATION QUALITY ON THE WORLD WIDE WEB

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Purpose: Identification of the potential impact of informational labels used on websites on information quality, with particular emphasis on their semantic and syntactic characteristics.

Methodology: The study was conducted based on a comparative analysis of informational labels (contextual links, headings, navigation system elements, index terms) on websites from three sectors: public services (gov.pl), e-commerce (allegro.pl), and education (uni.opole.pl). For each type of label, semantic and syntactic features were determined, as well as their influence on selected information quality criteria.

Findings: Key semantic characteristics (unambiguity, relevance, contextuality) and syntactic characteristics (hierarchy, formatting, stylistic consistency) of informational labels were identified. Their impact on such information quality characteristics as accessibility, consistency, timeliness, relevance, completeness, and usability was demonstrated. The highest level of information quality is achieved through the synergistic combination of precise semantics with an appropriate presentation structure. The identified information quality characteristics on websites are consistent with universal models, which confirms their validity in design practice.

Research limitations: Limiting the analysis to three sectors (public services, e-commerce, education) narrows the possibility of fully generalizing the results. Further research requires an in-depth analysis of the impact of labels on user experience in different cultural and linguistic contexts.

Practical implications: The study indicates the necessity of systematic auditing and optimization of labelling systems as part of a comprehensive information quality management strategy for websites. It is important to maintain semantic and syntactic consistency of labels throughout the system and to adapt them to the needs of users.

Originality/value: This publication provides a comprehensive analysis of the impact of informational labels on information quality on websites, combining the perspective of information architecture with quality management. The work is addressed to both practitioners designing websites and theorists dealing with information quality in the digital environment.

Keywords: informational labels, information quality, information architecture, websites, information management.

Category of the paper: research paper.

1. Introduction

In the academic literature, the concept of information labelling appears across numerous scientific disciplines. Within the domain of information quality management, M.J. Eppler (2006, p. 368) defines labelling as: “Adding informative and concise titles to information items so that they can be more easily scanned, browsed, or checked for relevance. Labels should indicate the type of information (e.g., definition, example, rule) and its content (e.g., safety issues)”. Contemporary research confirms the pivotal role of labelling systems in various digital contexts. L. Chen and H. Miyake (2021) demonstrated that labels based on hierarchical semantics significantly improve the efficiency of product categorization in e-commerce. Meanwhile, H. Ghalavand and A. Nabiolahe (2024) identified key criteria for health information quality on social media, such as credibility, timeliness, completeness, transparency, comprehensibility, accessibility, and usability. These proposed criteria align with the functions of labels. Credibility ranked second, which in practical terms translates to the use of precise informational labels for source evaluation. In a technical context, M. Krzesaj (2022) documented the implementation of tools and auto-verification mechanisms for labels (e.g., metadata tags, sitemaps), which enhance, among other aspects, the completeness of information on websites. The National Institute of Standards and Technology (NIST, 2022) emphasizes the growing importance of standardizing cybersecurity labels as a component of building user trust in software.

In the context of enhancing information quality within organizations, informational labels function as metadata describing the characteristics of information – an essential prerequisite for ensuring its transparency, credibility, and usability. M.J. Eppler identifies labels as one of the instruments of information integration, constituting an element of a broader information quality assessment system. Assigning labels to information objects primarily serves a signaling and defining role, specifying their meaning, type, and facilitating rapid access to a given content fragment. Labels may take the form of document headings, article tables of contents, or defined entries (such as names of chapters or subchapters). They significantly minimize the time required to analyze content, the meaning of which may be important from the perspective of a potential information consumer and their needs, for example, the subject of an email message or an entry defined in an online encyclopedia.

The principles of labelling, involving the skillful selection of appropriate substitutes for an information object, were described and applied in the concept of Information Mapping by R.E. Horn (1989). Horn presented the concept of Information Mapping, which constitutes a comprehensive approach to information structuring and is closely related to such fields as information visualization, information architecture, graphic design, information design, and data analysis. With the advancement of information technologies, this method has found application in user experience design, graphical interfaces, and knowledge management

systems. The methodology emphasizes recipient needs, content structuring, and logical organization of information by dividing content into smaller, more digestible blocks and their hierarchical arrangement. The method involves breaking information into small, easily assimilated parts. Each part is then assigned a clear, descriptive label, ensuring that each segment contains only essential information (relevance), which maintains uniform structure and format throughout the information object (consistency).

In the process of website design, labelling – according to L. Rosenfeld, P. Mougille and J. Arango (2017, pp. 79-80) – constitutes one of the four subsystems of information architecture: the information organization system, the labelling system, the navigation system, and the search system. These form the key elements of information architecture in website development. Effective organization, labelling, navigation, and search functions support the fulfillment of user needs, help to understand context, and facilitate efficient movement within the system. The information organization system creates logical structures that hierarchize data to increase their accessibility and comprehensibility for users – a crucial element of architecture that improves orientation within the system. The labelling system uses precise descriptors assigned to content elements to identify, categorize, and aid navigation. The navigation system includes menus, links, navigation buttons, and other elements that facilitate movement between sections of the website. The final element is the search system, which eliminates the need for manual browsing of complex structures, optimizing access paths to specific resources. Effective search is vital when users seek specific information without the need to browse the entire system structure.

Within information architecture, information quality plays a fundamental role in the functionality of a website. The literature identifies several common characteristic of information quality that are repeatedly highlighted by leading researchers in this field. The most frequently cited include: accessibility, completeness, timeliness, comprehensibility, consistency, unambiguity, relevance, and usability. Table 1 presents the definitions of these characteristics along with their authors.

Table 1.

Key Characteristics of Information Quality: Definitions and Theoretical Model Authors

Information Quality Characteristic	Definition	Key Authors
Accessibility	Information easily accessible to the user, critical for both producers and consumers.	Kahn, Strong, Wang (2002); Eppler (2006); Gupta (2000)
Completeness	Contains all necessary data to accomplish a task.	Kahn, Strong, Wang (2002); English (1999); Stvilia et al. (2007)
Currency/Timeliness	Regularly updated, impacting usability and decision-making accuracy.	Kahn, Strong, Wang (2002); Floridi (1999); Stvilia et al. (2007); Eppler (2006)
Understandability	Communicated in a clear and legible manner.	Kahn, Strong, Wang (2002); Eppler (2006); Stvilia et al. (2007)
Consistency	Free of contradictions, with logically interconnected elements.	Kahn, Strong, Wang (2002); English (1999); Stvilia et al. (2007); Eppler (2006)

Cont. table 1.

Unambiguity	Interpreted in a single way, without risk of misinterpretation.	Kahn, Strong, Wang (2002); Eppler (2006); Stvilia et al. (2007)
Relevance	Aligned with user needs and task context.	Kahn, Strong, Wang (2002); Floridi (1999); Stvilia et al. (2007); Gupta (2000); Eppler (2006)
Usability	Supports user goals and is easy to apply in practice.	Eppler (2006); Kahn, Strong, Wang (2002); Gupta (2000)

Source: own elaboration.

The presented characteristics are considered key in most contemporary models of information quality and form the basis for evaluating information in both information systems and websites. Recent studies also emphasize the importance of systematically improving information quality on websites through the use of specialized tools that directly influence these characteristics (Krzesaj, 2022). M. Krzesaj (2024) demonstrated the significant impact of organizational schemes (alphabetical, chronological, geographical, thematic, task-based, and hybrid) on eleven key information quality attributes. However, despite the documented importance of information organization systems, a significant research gap remains regarding the influence of labelling systems – one of the four fundamental subsystems of information architecture – on the quality of presented content. This gap is particularly evident in the context of analyzing the semantic and syntactic properties of informational labels and their specific impact on individual information quality characteristics in the online environment. In light of this identified research gap, the following research questions were formulated:

- What semantic and syntactic characteristics define different types of informational labels (contextual links, headings, navigation system elements, index terms) on websites?
- How do the identified semantic and syntactic characteristics of informational labels influence specific information quality criteria?
- Are there differences in the characteristics of informational labels across sectors (public services, e-commerce, education), and what are their causes?
- Which characteristics of informational labels have the strongest impact on key information quality attributes in the online environment?

The aim of the study is to identify the impact of informational labels used on websites on information quality, with particular emphasis on their semantic and syntactic characteristics. Each type of label was characterized in terms of its semantic and syntactic attributes, and its influence on selected criteria for assessing information quality was examined. The identified characteristics do not constitute a closed set. To achieve the research objective, a comparative analysis method of informational labels based on a qualitative approach was employed. The choice of this method was driven by the need to deeply understand the relationships between label characteristics and information quality, which required detailed contextual and semantic analysis. The study was conducted in three stages:

- Identification and categorization of labels on selected websites.
- Analysis of semantic and syntactic characteristics in terms of meaning, structure, and visual presentation.
- Mapping the impact on information quality by defining the relationships between label characteristics and information quality criteria.

Following a theoretical introduction to information labelling and information quality, the classification and definitions of informational labels on websites are presented. Subsequent sections provide a detailed analysis of four types of labels: contextual links, headings, navigation system elements, and index terms. Each analytical section includes a characterization of semantic and syntactic features along with the identification of their impact on information quality criteria. The article concludes with a summary and findings that outline theoretical and practical implications as well as future research directions.

2. Definition and Classification of Informational Labels on Websites

In academic literature, definitions and classifications of labelling are closely linked to information architecture models and content quality criteria. The labelling system in the information architecture of websites plays a pivotal role in ensuring usability and intuitiveness. Labelling refers to the process of assigning names or labels to resources, categories, sections, or functions within a website's informational system (Rosenfeld et al., 2017, pp. 119-120). Labels act as signposts that help users navigate the website and identify content. Their use enables effective information delivery while minimizing space consumption on webpages. In the context of information architecture, informational labels primarily take textual, graphical, or multimedia forms (Rosenfeld et al., 2017, pp. 124-134). Despite the increasingly visual nature of the internet, text labels remain dominant in classifying and organizing content on websites.

Rosenfeld et al. (2017, pp. 124-134) distinguish the following types of text labels: contextual links, headings, navigation system options, index terms. In the realm of web usability, J. Nielsen (2000, pp. 78-79) emphasizes their critical informational role in accelerating the evaluation of a webpage or its sections. These labels serve as linguistic representations of specific information fragments or functions, enabling users to orient themselves within the content structure and access desired data. Text labels thus fulfill a dual function: semantic (communicating content meaning) and syntactic (organizing content), making them indispensable components of information architecture. The subsequent sections of this publication analyze contextual links, headings, navigation system elements, and index terms across three domains:

- Public services (gov.pl).
- E-commerce (allegro.pl).
- Education (uni.opole.pl).

For each label type, semantic and syntactic characteristics are defined, along with their impact on selected information quality criteria.

3. Informational Labels as Contextual Links

Informational labels in the form of contextual links (hyperlinks) are characterized by a distinct structural specificity. Their purpose is to support navigation by directing users to related informational resources. These labels are not created within a systematic hierarchy but emerge ad hoc when the content author establishes a connection between the text and another informational element. Their semantic representation is strictly dependent on the context in which they are embedded. The meaning of embedded links is defined by the anchor text, i.e., the visible part of the hyperlink, which significantly impacts information quality in terms of usability. High semantic quality means the link accurately reflects the content of the resource it leads to. A well-constructed narrative context naturally guides users to destinations aligned with their expectations and informational needs.

The semantic properties of contextual links primarily concern their unambiguity, contextual relevance, accuracy, transparency, and credibility. The label's precision must unambiguously indicate the target content. For example: on gov.pl, a link titled "Check your PESEL number" (pl. „Sprawdź swój numer PESEL”) clearly signals a verification function. Another link, "Apply for an ID card" (pl. „Złóż wniosek o dowód osobisty”), precisely communicates the redirection's purpose. A link embedded in text must integrate with the topic's context to enhance thematic relevance. For instance, a tax-related article should link to the PIT-37 form (gov.pl). In e-commerce, semantic alignment with user intent is critical. A link like "See similar products" (pl. „Zobacz podobne produkty”; allegro.pl) not only aids navigation but also adds value by contextually expanding choice options.

Labels that precisely describe the link's purpose avoid ambiguity. Generic terms like "Click here" (pl. „Kliknij tutaj”) reduce transparency, whereas descriptive texts like "View class schedule" (pl. „Zobacz harmonogram zajęć”) on university websites enhance clarity. Such semantics explicitly indicate user expectations (e.g., file downloads, form access). Similarly, "Check shipment status" (pl. „Sprawdź status przesyłki”; allegro.pl) unambiguously communicates the link's function. Clear, precise formulations minimize confusion, while vocabulary tailored to the audience's expertise improves comprehension in specialized contexts.

Beyond syntactic correctness and visual aesthetics, a key semantic feature is the credibility of the source. Links to authoritative sites (e.g., government portals, universities) increase user trust, unlike those directing to unsecured or disreputable pages. For example: links to public institutions (e.g., gov.pl) reinforce security and reliability. Reputable e-commerce platforms (e.g., allegro.pl) align with user expectations for transactional integrity. Thus, contextual links to credible sources enhance content perception and are vital for maintaining information quality.

Table 2.
Semantic Analysis of Contextual Links

Example Link (Website)	Semantic Analysis
“Apply for 800+” (pl. „Złóż wniosek o 800+”, gov.pl)	Unambiguous link, indicates the function (application submission), relates to the context of family benefits.
“Check if you need to file a PIT” (pl. „Sprawdź, czy musisz rozliczyć PIT”, gov.pl)	The link contains a question addressing real user needs – topical relevance.
“Check vehicle registration rules” (pl. „Sprawdź zasady rejestracji pojazdu”, gov.pl)	Directs to an authoritative government source – ensures user trust in credible content.
“Buy and pay” (pl. „Kup i zapłać”, allegro.pl)	Imperative form, clearly indicates the function – immediate purchase action.
“Delivery and payment” (pl. „Dostawa i płatność”, allegro.pl)	Noun-based description of a thematic category – facilitates quick access to specific information.
“Check class schedule” (pl. „Sprawdź plan zajęć”, uni.opole.pl)	Comprehensible link, relates to organizational functions – semantically aligned with student expectations.
“USOS System” (pl. „System USOS”, uni.opole.pl)	Proper name of the system, understood by the target group – environmental semantic specificity.
“Offer for international candidates” (pl. „Oferta dla kandydatów zagranicznych”, uni.opole.pl)	Precise identification of the target group and content type – semantic accuracy and personalization.
“Study regulations – download PDF” (pl. „Regulamin studiów – pobierz PDF”, uni.opole.pl)	Official university website – high credibility.

Source: own elaboration.

Based on the examples of links presented in Table 2 and their semantic analysis, key characteristics of information quality can be identified: unambiguity, relevance, credibility, comprehensibility, personalization, and timeliness. Contextually well-embedded semantic links increase user satisfaction, reduce the time required to locate content, and support intuitive navigation within the website. Depending on the sector, link semantics may be more formalized (e.g., in public services), transactional (e-commerce), or informational-organizational (education).

The syntactic characteristics of contextual links relate to the grammatical and syntactic structure of the anchor text, as well as their visual presentation. From a linguistic perspective, an effective contextual link should be concise, legible, and grammatically correct. Rapid recognition of a link’s meaning is enabled by short descriptions of 1-4 words (content conciseness). Verbal and nominal forms are preferred:

- Verbal structures (e.g., “Download” (pl. „Pobierz”), “Check” (pl. „Sprawdź”), “Sign up for training” (pl. „Zapisz się na szkolenie”)) provide clear calls to action.
- Nominal forms (e.g., “Registration form” (pl. „Formularz rejestracyjny”), “Terms of purchase” (pl. „Warunki zakupu”)) identify objects or informational categories.

Interrogative sentences (e.g., “How to obtain an ID card” (pl. „Jak uzyskać dowód osobisty”, gov.pl)) align with user mental models (e.g., student, taxpayer). In e-commerce, imperative forms like “Buy now” (pl. „Kup teraz”) or “Add to cart” (pl. „Dodaj do koszyka”) prompt immediate action. In education, phrases combining document or system names (e.g., “Registration form,” “USOS System”) reflect institutional communication styles.

The syntax of contextual links should also be considered in conjunction with visual hierarchy. Visual hierarchy refers to the way links are highlighted in the text (formatting) and their arrangement according to importance and function on the page. Elements of this hierarchy include text color, underlining, font size, placement within the text structure, and buttons as links. Using appropriate fonts and spacing, or distinguishing links with a different color, prevents the user from feeling overwhelmed and increases recognizability. Inserting a link directly into the content, in a place consistent with the narrative flow, is much more effective than placing it in the website footer. For example, after explaining a procedure on gov.pl, this shortens the navigation path. The traditional way to highlight an informational link is to underline the link text. Formatting links increases their accessibility—standard indicators include underlining and the color #0000EE. An example is the “Buy now” link (pl. „*Kup teraz*”, allegro.pl), distinguished from others by its orange color. Increasing the font size of a link determines its prominence in the user’s perception, as seen in “Add to cart” (pl. „*Dodaj do koszyka*”, allegro.pl). Placing links within textual structures—such as headings, paragraphs, bulleted lists, or numbered lists—enhances user attention. For instance, a link embedded in the “For Candidates” section (pl. „*Dla kandydatów*”, uni.opole.pl) improves discoverability. Another visual element is button-style links, exemplified by “Log in to ePUAP” (pl. „*Zaloguj się do ePUAP*”, gov.pl), which combine textual and graphical components to emphasize functionality.

The quality of contextual link labels can be enhanced by implementing three key elements: explanatory text, clear headings, and an unambiguous website purpose. A prime example of this practice is the contextual link labels on the gov.pl portal, which incorporate all the above elements. The website defines its target audience groups (e.g., *for citizens* (pl. *dla obywatela*), *for entrepreneurs* (pl. *dla przedsiębiorcy*), *for officials* (pl. *dla urzędnika*)) and uses intuitive headings such as “*Drivers and Vehicles*” (pl. „*Kierowcy i pojazdy*”) or “*Work and Business*” (pl. „*Praca i biznes*”). Additionally, heading labels include explanatory text, which provides a high degree of contextualization and ultimately enhances their semantic interpretability. Examples of links, along with an analysis of their syntax and visual hierarchy, are presented in Table 3.

Table 3.
Syntactic Analysis of Contextual Links

Example Link (Website)	Syntactic Form	Visual Hierarchy
“Report child’s birth” (pl. „Zgłoś urodzenie dziecka”, gov.pl)	Verb + noun	Underlined, blue, embedded in bulleted lists
“How to handle an official matter?” (pl. „Jak załatwić sprawę urzędową?”, gov.pl)	Interrogative form	Smaller font, link within an informational text block
“Add to cart” (pl. „Dodaj do koszyka”, allegro.pl)	Imperative form	Large button, orange color, central placement
“Buy and pay” (pl. „Kup i zapłać”, allegro.pl)	Imperative form	Large button, orange color, central placement
“Registration form” (pl. „Formularz rejestracyjny”, uni.opole.pl)	Noun phrase	Underlined, standard font, in sidebar
“Check class schedule” (pl. „Sprawdź plan zajęć”, uni.opole.pl)	Imperative form	Highlighted button/darker text, featured on homepage

Source: own elaboration.

Based on the presented examples of links, their syntactic forms, and visual hierarchy, it is possible to identify key information quality characteristics such as comprehensibility, unambiguity, accessibility, transparency, functionality, usability, timeliness, and consistency. Clear, imperative, or task-oriented syntactic forms (e.g., “Report child’s birth” (pl. „Zgłoś urodzenie dziecka”), “Add to cart” (pl. „Dodaj do koszyka”), “Buy and pay” (pl. „Kup i zapłać”), “Check class schedule” (pl. „Sprawdź plan zajęć”)), combined with distinct visual emphasis (large button, contrasting color, central placement, underlining), significantly enhance the readability and accessibility of information, making it easier for the user to quickly understand and perform the intended action. The interrogative form (“How to handle an official matter?” (pl. „Jak załatwić sprawę urzędową?”)) or the noun phrase (“Registration form” (pl. „Formularz rejestracyjny”)), presented in a less visually prominent manner (smaller font, standard column), serve informational or navigational functions, supporting the completeness and consistency of information, though they do not always attract immediate attention. Visual hierarchy – through contrast, scale, color, and placement – assigns priority to the most important elements, guiding the user’s gaze and organizing content by significance, which increases the transparency and functionality of the site. As a result, users can more easily find the information they need, and the overall message becomes more intuitive and user-friendly, which is crucial for high information quality on websites. The provided examples, which include the syntactic features of contextual links and visual hierarchy, function complementarily. A clear linguistic form enables the user to understand the meaning and function of the link, while appropriate visual emphasis attracts attention and highlights the importance of the information.

It should be emphasized that significant problems with the quality of contextual links include: excessive quantity on the page, lack of updates, and semantic inconsistency – all of which directly lower the level of the most important information quality characteristics on the site. An excess of links leads to information overload and a loss of transparency, making it difficult for users to quickly find key content. In turn, failing to verify the currency of links

results in users being redirected to incorrect or non-existent pages, which undermines timeliness and credibility. Links leading to a general page instead of using a precise URL (e.g., a “Download instructions” (pl. „Pobierz instrukcję”) link) cause semantic inconsistency – reducing the unambiguity and consistency of the message. Proper design of the syntactic form of links and their visual hierarchy therefore not only improves the readability and functionality of the site but also minimizes the aforementioned quality issues, thereby supporting the comprehensibility, accessibility, timeliness, and consistency of information. Analysis of examples from public services, e-commerce, and education indicates that the effectiveness of contextual links is closely connected to their alignment with the user’s mental model and the principles of user-centered design.

4. Informational Labels as Headings

Informational labels in the form of headings serve an important descriptive and structural function. Their primary purpose is to characterize the segment of information that follows them, enabling users to quickly identify the content of a given section. Moreover, headings reflect the hierarchy of content within a document, creating a multi-level organizational structure that facilitates navigation and understanding of relationships between individual informational elements. The structural function of labels used as headings relies heavily on visual elements such as text color, font size, numbering, indentation, or heading gradation. The aim of using these features is to distinguish heading labels from the main body text or to create a hierarchy among the headings themselves. For example, a heading label typically features a larger font size than the main text. Differentiating font sizes when using headings establishes a hierarchical organization of content. Thus, the use of informational labels as headings creates a multi-level categorization system, in which main (higher-level) headings define thematic areas, while subordinate headings specify detailed issues within a given area.

Table 4 presents the semantic and syntactic characteristics of headings on websites in three domains: public services (gov.pl), e-commerce (allegro.pl), and education (uni.opole.pl). The conducted analysis allows for the identification of both universal and domain-specific features of headings, as well as their potential impact on information quality.

Table 4.
Syntactic Analysis of Contextual Links

Domain (Website)	Semantic Characteristics	Syntactic Characteristics
Public Services (gov.pl)	- Precise reflection of the scope of services (e.g., “Documents and Personal Data” (pl. „Dokumenty i dane osobowe”), “Taxes” (pl. „Podatki”)) - Use of language understandable to various citizen groups, e.g., for entrepreneurs, a phrase such as “Starting a Business” (pl. „Zakładanie firmy”) - H1-H3 headings group thematic content into a logical whole, referencing user processes and tasks, e.g., the structure of the tax process	- Heading hierarchy H1-H3 (e.g., H1: “Taxes” (pl. „Podatki”), H2: “Annual Settlement” (pl. „Rozliczenie roczne”), H3: “PIT-37 Form” (pl. „Formularz PIT-37”)) - Distinct formatting: font size, bold, color, numbering. Gradual decrease in font size from H1 to H6 (e.g., H1: 24 pixels, H2: 20 pixels) - Uniform structure of sections and subsections across the entire website
E-commerce (allegro.pl)	- Clear product categories (e.g., “Home and Garden” (pl. „Dom i ogród”), “Health” (pl. „Zdrowie”), “Automotive” (pl. „Motoryzacja”)) - Contextual content, dynamically adjusted to trends and seasonality, e.g., “Weekly Promotions” (pl. „Promocje tygodnia”) - Use of commercial terminology understandable to users, e.g., “Buy Now” (pl. „Kup teraz”)	- Hierarchy H1-H3 (e.g., H1: “Electronics” (pl. „Elektronika”), H2: “Computers” (pl. „Komputery”), H3: “Computer Components” (pl. „Podzespoły komputerowe”)) - Category headings highlighted in color #0066CC and 20-pixel font - Stylistic consistency within each category
Education (uni.opole.pl)	- Unambiguous definition of academic processes (e.g., “Session Schedule” (pl. „Harmonogram sesji”), “Academic Staff” (pl. „Pracownicy naukowci”)) - Content adapted to the target group (e.g., candidate, student, staff) - Timeliness of content related to a given cycle, e.g., “Admissions 2025” (pl. „Rekrutacja 2025”) - Linguistic relevance facilitating interpretation, e.g., “Assessment Rules” (pl. „Zasady zaliczeń”)	- Hierarchy H1-H3 (e.g., H1: “Computer Science Major” (pl. „Kierunek Informatyka”), H2: “Study Program” (pl. „Program studiów”), H3: “Summer Semester 2025” (pl. „Semestr letni 2025”)) - Bold, icons, contrast compliant with WCAG - Consistent style in logically grouped thematic sections

Source: own elaboration.

The presented examples of headings used on websites in the three domains illustrate their diversity both semantically and structurally.

The semantic characteristics of headings – such as precision of meaning, contextualization, and linguistic relevance – determine the clarity of communication and the alignment of content with user expectations and needs. The semantics of headings relate to the meaning and communicative function of the text, which serves as a label. For example, unambiguity, visible in headings such as “Taxes” (pl. „Podatki”, gov.pl) or “Session Schedule” (pl. „Harmonogram sesji”, uni.opole.pl), eliminates ambiguous interpretations by precisely defining the content scope and reducing the risk of misunderstanding. Contextualization, which involves integration between headings and content, reflects relationships between elements; for instance, “Weekly Promotions” (pl. „Promocje tygodnia”, allegro.pl) adapts language to a specific audience or situation, increasing the accessibility and intuitiveness of the message. The use of terms tailored to the target group strengthens linguistic relevance, as in phrases like “Buy Now” (pl. „Kup

teraz”, allegro.pl) or “Admissions 2025” (pl. „Rekrutacja 2025”, uni.opole.pl), ensuring the timeliness and practical usefulness of information, which in turn enhances the credibility and usability of the content.

Structural characteristics include the hierarchy of headings, visual formatting, and stylistic consistency. These elements provide logical organization of content, recognizability, and support navigation. A structure based on HTML tags (e.g., H1: main categories, H2: subcategories, H3: sub-subcategories) demonstrates the logic of content organization, reducing the time required to find information by creating a structural hierarchy. Visual formatting, such as varying font sizes, text color, and spacing between headings, ensures the clarity of the navigation path. Consistently applying a uniform page layout, for example by using standardized section numbering such as “1. Documents” (pl. „Dokumenty”), “1.1. Identity Card” (pl. „Dowód osobisty”), allows users to quickly access specific information or services.

Headings, as informational labels, have a multidimensional impact on specific information quality characteristics on websites:

- **Accessibility:** A hierarchical and logical structure of headings facilitates the quick discovery and understanding of information, which is crucial for effective user navigation.
- **Consistency:** Uniform terminology and style in headings build predictability, increase trust in the website, and make it easier to orient oneself within the content.
- **Comprehensibility:** Precise and relevant headings group content into logical blocks, enhancing the clarity of communication and minimizing the risk of user confusion.
- **Completeness:** Headings organize content into complete, self-contained thematic sections, making it easier for users to gain a comprehensive understanding.
- **Timeliness:** Dynamic headings reflect changes in content, enabling rapid adaptation of the presented information to current needs.

5. Informational Labels in Navigation Systems

Navigation labels are intended to indicate the direction of navigation for the user within a website, enabling quick access to specific resources and allowing users to move between pages or sections of the site (Garrett, 2010, pp. 65-66). Typical examples of their use include the main menu, navigation bars, and buttons. These elements perform key tasks derived from the principles of information architecture and information quality management. The main menu is responsible for the logical segmentation of content and users, providing rapid access to the most important areas of the site and tailoring the navigation path to the recipient’s needs. A well-designed menu increases the relevance, accessibility, and clarity of information,

reducing search time and minimizing the risk of user confusion. Navigation bars (breadcrumbs) display the user's current location within the site structure and make it possible to quickly return to higher levels of the hierarchy. As a result, they improve orientation within the site, shorten the path to information, and support clarity and predictability in navigation. Buttons, in turn, serve task-oriented functions by initiating specific user actions (e.g., starting a process, submitting a form, proceeding to the next step). They are often based on graphic elements or icons that, instead of text, represent functions or page content. These operate similarly to text, though with certain limitations and specific applications. Icons constitute an alternative form of information representation in navigation systems, especially in mobile applications where screen space is limited.

The navigation system of a website typically contains a limited number of options, which means that these labels must be used with particular consistency. The importance of consistency in navigation systems is emphasized by Rosenfeld et al. (Rosenfeld et al., 2017, pp. 130-132). This feature builds a sense of security and confidence when navigating the site, as the user becomes familiar with its structure. Inconsistent navigation options are highly noticeable and result in a negative evaluation from the user. Using different labels to define the same function in various sections of the site is an example of poor practice. Users base their interactions with the system on the assumption of rationality and predictability of navigation elements throughout the entire website, and such inconsistency negatively affects the semantic and functional consistency of navigation labels. Problems with navigation label naming, such as word ambiguity (polysemy) – for example, “Services” – or excessive specialization due to technical terms incomprehensible to laypersons, require the use of additional explanatory elements. The implementation of contextual hints, activated by hovering the cursor over a label, allows for the display of additional information explaining the semantic scope of a given navigation element. This technique makes it possible to keep labels concise while ensuring the precision of their interpretation. A good practice example is the navigation system of the gov.pl portal, which provides a comprehensive example of the use of textual labels to organize access to public services. These labels are characterized by a high degree of standardization and semantic consistency, which is crucial for providing a predictable user experience. Informational labels in the main categories of the navigation system are highly abstract, yet they unambiguously communicate the thematic scope of the information they contain, such as “Education” (pl. „Edukacja”), “Work and Business” (pl. „Praca i biznes”), or “Travel” (pl. „Podróże”). Labels in navigation subsystems contain more detailed names that specify particular administrative services. Examples of labels in the “Agriculture” (pl. „Rolnictwo”) category include: “Direct Payment” (pl. „Płatność bezpośrednia”), “Assessment of Crop Losses” (pl. „Oszacowanie strat w uprawach rolnych”), “Excise Tax on Agricultural Fuel” (pl. „Podatek akcyzowy za paliwo rolnicze”), and “Phytosanitary Certificate” (pl. „Świadectwo fitosanitarne”).

In practice, the naming of informational labels may vary depending on the industry or their area of application within navigation systems. Among the most popular informational labels in the navigation systems of e-commerce websites are: *Bestsellers* (pl. „Bestsellery”), *New Arrivals* (pl. „Nowości”), and *Promotions* (pl. „Promocje”). On the websites of higher education institutions in Poland, frequently used labels include: *About the University* (pl. „O uczelni”), *Students* (pl. „Studenci”), *For Candidates* (pl. „Dla kandydatów”), and *Science and Research* (pl. „Nauka i badania”). Nevertheless, informational labels (navigation system labels) on many websites feature popular names familiar to most internet users. These include labels such as: *Home Page* (pl. „Strona główna”), *News* (pl. „Aktualności”), *About Us* (pl. „O nas”), *Find* (pl. „Znajdź”), *Contact* (pl. „Kontakt”), and *Help* (pl. „Pomoc”). Table 5 provides examples of informational labels in navigation systems (main menu, buttons, navigation bars) for three areas: public services, e-commerce, and education.

Table 5.

Examples of informational labels in navigation systems: main menu, buttons, navigation bars

Element Type	Public Services (gov.pl)	E-commerce (allegro.pl)	Education (uni.opole.pl)
Main Menu	- <i>Services for Citizens</i> (pl. „Usługi dla obywatela”) - <i>Services for Entrepreneurs</i> (pl. „Usługi dla przedsiębiorcy”) - <i>Services for Officials</i> (pl. „Usługi dla urzędnika”) - <i>Services for Farmers</i> (pl. „Usługi dla rolnika”) - <i>Chancellery of the Prime Minister</i> (pl. „Kancelaria Premiera”) - <i>Council of Ministers</i> (pl. „Rada Ministrów”) - <i>Ministries</i> (pl. „Ministerstwa”)	- <i>Categories</i> (pl. „Kategorie”) - <i>My Allegro</i> (pl. „Moje Allegro”) - <i>Smart!</i> (pl. „Smart!”) - <i>Home and Garden</i> (pl. „Dom i ogród”) - <i>Fashion</i> (pl. „Moda”) - <i>Weekly Promotions</i> (pl. „Promocje tygodnia”) - <i>Bestsellers</i> (pl. „Bestsellery”)	- <i>University</i> (pl. „Uczelnia”) - <i>For Student</i> (pl. „Dla studenta”) - <i>For Employee</i> (pl. „Dla pracownika”) - <i>Admissions</i> (pl. „Rekrutacja”) - <i>Science</i> (pl. „Nauka”) - <i>Cooperation</i> (pl. „Współpraca”) - <i>HRS4R</i> (pl. „HRS4R”)
Buttons	- <i>Log in to ePUAP</i> (pl. „Zaloguj się do ePUAP”) - <i>Log out</i> (pl. „Wyloguj”) - <i>Check Application Status</i> (pl. „Sprawdź status wniosku”) - <i>Submit Application Online</i> (pl. „Złóż wniosek online”)	- <i>Buy Now</i> (pl. „Kup teraz”) - <i>Add to Cart</i> (pl. „Dodaj do koszyka”) - <i>Watched</i> (pl. „Obserwowane”) - <i>Cart</i> (pl. „Koszyk”)	- <i>Sign Up</i> (pl. „Zapisz się”) - <i>See Schedule</i> (pl. „Zobacz harmonogram”) - <i>Download Syllabus</i> (pl. „Pobierz sylabus”) - <i>Book an Appointment</i> (pl. „Zarezerwuj termin”)
Navigation Bar	- <i>Services for Citizens > Documents and Personal Data > Identity Card</i> (pl. „Usługi dla obywatela” > „Dokumenty i dane osobowe” > „Dowód osobisty”) - <i>Services for Entrepreneurs > Starting a Business > I Want to Set Up a Joint Stock Company</i> (pl. „Usługi dla przedsiębiorcy” > „Zakładanie firmy” > „Chcę założyć spółkę akcyjną”)	- <i>Electronics > Phones and Accessories > GSM Accessories</i> (pl. „Elektronika” > „Telefony i akcesoria” > „Akcesoria GSM”) - <i>Child > Toys > Blocks > Lego</i> (pl. „Dziecko” > „Zabawki” > „Klocki” > „Lego”)	- <i>For Student > Usos</i> (pl. „Dla studenta” > „Usos”) - <i>Admissions > Studies 2025/2026 > Admission Dates</i> (pl. „Rekrutacja” > „Studia 2025/2026” > „Terminy rekrutacji”)

Source: own elaboration.

Based on the analysis of informational labels in navigation systems (menus, bars, buttons), a set of semantic and syntactic characteristics was identified. The general semantic characteristics of informational labels in navigation systems on websites include:

- Unambiguity: the label presents clear and understandable categories (e.g., “Taxes” (pl. „Podatki”), “Electronics” (pl. „Elektronika”), “For Candidate” (pl. „Dla kandydata”).
- Relevance – alignment with user needs and task context (e.g., “Admissions 2025” (pl. „Rekrutacja 2025”).
- Contextualization: placing the label in the appropriate area of the site’s structure; considering the place and situation of use.
- Semantic consistency: consistent use of terminology throughout the entire navigation system (e.g., stylistic consistency).
- Functional transparency: clearly indicating the outcome of an action (e.g., “Log out – you will lose access to services” (pl. „Wyloguj – utracisz dostęp do usług”).
- Personalization/segmentation: tailoring labels to the user’s profile or segment (e.g., “My Cases” (pl. „Moje sprawy”), “For Entrepreneur” (pl. „Dla przedsiębiorcy”).
- Directness of communication: clearly specifying the result of clicking or selecting (e.g., “Add to cart” (pl. „Dodaj do koszyka”), “Sign up” (pl. „Zapisz się”).
- Timeliness: signaling new, changed, or time-limited functions (e.g., “New” (pl. „Nowość”), “Weekly Promotions” (pl. „Promocje tygodnia”).

Among the syntactic characteristics of labels in navigation systems, the following can be distinguished:

- Hierarchy: logical ordering of labels (e.g., main menu > submenu > options), supporting user orientation.
- Formatting: highlighting (e.g., font, color, bold, icon) that facilitates quick recognition and scanning.
- Layout and number of options: limiting the number and length of visible labels, logical grouping to facilitate quick decision-making by the user.
- Responsiveness: adapting the layout and label visibility to different devices (e.g., smartphone, laptop) and screen resolutions.
- Visual hierarchy: differentiating label importance through size, color, placement, presence of icons or buttons.
- Integration with other mechanisms: linking labels with search, navigation bars, filters, notification systems.
- Dynamic state: labels/buttons changing depending on context, status, or user action (e.g., “Added to cart” (pl. „Dodano do koszyka”).
- Digital accessibility: compliance with WCAG, readability for screen readers, appropriate contrast and size.

Some of the presented semantic and syntactic characteristics of informational labels in navigation systems go beyond the classic aspects of headings and contextual links discussed in this publication. They are crucial for building modern, effective, and inclusive interfaces. These features not only allow for better adaptation to user needs and context but also ensure high information quality. Characteristics such as personalization, functional transparency, and segmentation of the offering enhance the level of user experience individualization, increase credibility and predictability of interactions, and support verifiability and information security. Meanwhile, multichannel integration, adaptability, responsiveness, dynamic state, and digital accessibility increase the usability of the navigation system, ensure access for different user groups (including people with disabilities), and enable effective information management in a multiplatform environment. Dynamic changes in labels (e.g., “Added to cart” (pl. „Dodano do koszyka”)) increase interactivity and operational efficiency, while contextual layout and minimalism in the number of options reduce cognitive overload and improve navigation clarity.

All three navigation system elements – through appropriately designed labels – significantly enhance the quality of information on the website, impacting its accessibility, relevance, comprehensibility, and usability for the user. A main menu based on audience segmentation, such as: “Services for Citizens” (pl. „Usługi dla obywatela”), “Services for Entrepreneurs” (pl. „Usługi dla przedsiębiorcy”) (gov.pl), increases the relevance and accessibility of information by quickly tailoring the navigation path to user needs. Buttons support navigation efficiency and minimize the risk of errors (e.g., “Submit Application Online” (pl. „Złóż wniosek online”), “Buy Now” (pl. „Kup teraz”), “Sign Up” (pl. „Zapisz się”). Navigation bars reflect process logic in public administration services (gov.pl), filtering on e-commerce platforms (allegro.pl), or the academic cycle on university websites (uni.opole.pl), thereby improving site orientation and shortening the path to information. Contextual links are embedded in appropriate sections and precisely describe their function, increasing the relevance and comprehensibility of the message.

6. Informational Labels as Index Terms

Index terms used in the indexing process are a key element of information architecture, enabling the integration of information on websites. Index terms such as keywords, tags, phrases, or controlled vocabularies and thesauri describe the subject matter of content (content organization function for the user), enable precise searching (content filtering), and support content classification processes on websites. For example, tags are often used to group content by topic, which supports the indexing process by search engines (tag hierarchy). According to Rosenfeld et al (2017, pp. 132-134), index terms improve browsing of site content, subpages,

and content fragments, creating an alternative to the basic content organization system. By presenting the meaning of a content fragment as an index term, more precise searching is possible compared to full-text search. Index terms are linked to search engines and filters, allowing users to quickly and accurately find the needed content without having to browse the entire site. For example, an advanced public service search engine (gov.pl) enables filtering by category; on an auction portal, products can be filtered by tags, manufacturers, or features (allegro.pl); and on a university website (uni.opole.pl), the scientific publication search engine uses a keyword index. Informational labels represented by index terms are also crucial for indexing pages by search engines. Properly selected metadata increase the likelihood of a website being found by users using search engines. Content organization through indexing enables grouping and classification of content according to specific criteria, such as subject, time, or location. M.J. Eppler points out that hierarchical indexing structures allow for efficient management of large data sets by logically organizing them (2006, p. 65). Integration of information by linking dispersed data into coherent structures, creating connections between elements (e.g., through metadata), allows users to interpret data more easily in relation to their application (Eppler, 2006, p. 146). Thus, indexing is a mechanism for contextualizing information, assigning meaning by embedding it in a network of relationships. Indexing also optimizes the content search process through the use of, for example, tags or keywords, enabling precise information filtering. M.J. Eppler emphasizes the importance of automatic indexing in content management systems, which increases search efficiency and reduces the time needed to find information (2006, p. 183).

Index terms often interact with one of the three basic types of text labels in information architecture on websites – contextual links (pl. *linki kontekstowe*), headings (pl. *nagłówki*), and navigation labels (pl. *etykiety nawigacyjne*). In practice, the boundaries between these types of labels are fluid and frequently overlap, serving complementary functions within the information organization system. Index terms may appear as anchor text in contextual links, guiding users to thematically related resources and thereby simultaneously facilitating navigation and increasing the relevance and accessibility of information (e.g., “PIT-37 Form” (pl. „Formularz PIT-37”) as a link in the tax section). They may also serve as headings for sections or subpages, acting as thematic descriptors that organize content into logical blocks and establish hierarchy, which makes browsing and searching for information easier – for example, “Taxes” (pl. „Podatki”) as both a heading and an index term in the public services catalog (gov.pl). Additionally, in navigation systems, index terms are used as labels for navigation options such as categories, tags, or thematic sections (“Education” (pl. „Edukacja”), “Health” (pl. „Zdrowie”), “Electronics” (pl. „Elektronika”)), which enables quick filtering and classification of content and makes them an integral part of the navigation interface. Such overlapping of roles allows for consistent and multidimensional indexing of content, minimizing search time and increasing user satisfaction. On the other hand, excessive overlap of these functions without maintaining semantic and syntactic consistency can lead to user

confusion, duplication of information, or navigational inconsistency. Therefore, it is crucial to consistently apply labelling principles, hierarchy, and unambiguous naming.

Index terms, contextual links, headings, and navigation system elements share a set of common structural and semantic features, as discussed in the descriptions of each informational label. The key shared structural features include, above all, content hierarchy, stylistic consistency, and integration with the information architecture – labels are an integral part of organization, labelling, and navigation systems. In terms of semantic features, all text labels share unambiguity and precision, relevance, and contextualization resulting from their placement within the site structure.

Against this background of shared features, index terms stand out with specific structural and semantic characteristics that distinguish them from other types of labels on websites. Among the specific structural features of index terms is, above all, thematic indexing, which involves creating logical, often hierarchical structures of connections, such as tag lists or topic directories. An example of this feature is the structure on the government portal (gov.pl), where the term “Services for Citizens” (pl. „Usługi dla obywatela”) leads to further subcategories, such as “Documents and Personal Data” (pl. „Dokumenty i dane osobowe”), and then to more detailed topics, e.g., “Identity Card” (pl. „Dowód osobisty”), which enables quick access to the relevant category regardless of one’s location in the site structure. Another important feature is cross-referencing – index terms enable the linking of related content and the building of a network of connections, allowing users to smoothly transition between different but thematically related resources. For example, the tag “Taxes” (pl. „Podatki”) connects articles on various tax aspects. Another example is the tag “GSM Accessories” (pl. „Akcesoria GSM”, allegro.pl), which is linked both to the “Electronics” (pl. „Elektronika”) category and to products such as “Chargers” (pl. „Ładowarki”) or “Cases” (pl. „Etui”), enabling users to move fluidly between different but related resources. Modularity and scalability are also important – the index term system can be easily expanded with new concepts without the need to reorganize the entire structure. This is especially important for dynamically developing websites. For example, on a university website (uni.opole.pl), it is easy to add new terms such as “Online Courses” (pl. „Kursy online”) or “Psychological Support” (pl. „Wsparcie psychologiczne”) to the existing structure, while maintaining consistency and clarity.

On the semantic level, index terms are distinguished by precise terminology based on specialized and unambiguous concepts, often in accordance with controlled industry or institutional vocabularies, e.g., official names such as “PIT-37 Form” (pl. „Formularz PIT-37”) or “Identity Card” (pl. „Dowód osobisty”, gov.pl). This eliminates ambiguity and polysemy, resulting in higher information quality. Multidimensional categorization allows a single term to be assigned to multiple contexts or categories, increasing the flexibility of the content organization system; for example, the term “Scholarships” (pl. „Stypendia”) appears in both the “For Students” (pl. „Dla studentów”), “For Doctoral Students” (pl. „Dla doktorantów”), and “Financial Support” (pl. „Wsparcie finansowe”) sections. Additionally, index terms serve

as metadata for describing and classifying content, supporting advanced search and filtering according to various criteria. Examples include tags such as “Smartphones” (pl. „Smartfony”), “New Arrivals” (pl. „Nowości”), or “Weekly Promotions” (pl. „Promocje tygodnia”, allegro.pl), which enable quick filtering and product discovery, increasing the relevance of search results.

The impact of these features on information quality is multidimensional. Above all, they increase accessibility and search speed, as logical indexing and cross-references shorten the time needed to access required data. Narrowing search results to the most relevant resources reduces search time and increases user satisfaction. As a result, information becomes more accessible and relevant, and users can make decisions more quickly based on current and complete data. Precise terminology and multidimensional categorization improve consistency and unambiguity, eliminating the risk of misinterpretation. The metadata function enhances the relevance and usefulness of information, enabling personalized results and efficient filtering even in very extensive websites. The modularity and scalability of the index term system allow for dynamic content development without losing the clarity and consistency of the information structure. Ultimately, the specific features of index terms translate into higher information quality, supporting both users in quickly and accurately finding content and administrators in efficiently managing information resources.

7. Conclusions

Informational labels constitute a key element of information architecture, and their proper implementation ensures appropriate information quality. The characterization of four categories of labels presented in this publication has made it possible to demonstrate their impact on a range of information quality characteristics. The analysis was conducted based on a study of informational labels on websites in three key areas: public services (gov.pl), e-commerce (allegro.pl), and education (uni.opole.pl). These diverse areas allow for a comprehensive approach to the issue of labelling, taking into account the specifics of each sector.

Table 6 presents the semantic and syntactic characteristics as well as their possible impact on information quality in the online environment.

Table 6.

Overview of the semantic and syntactic characteristics of informational labels and their impact on information quality

Label Type	Semantic Characteristic	Syntactic Characteristic	Information Quality Characteristic (Impact on Information Quality)
Contextual Links	Name precision (unambiguous indication of content)	Content conciseness (1-4 words) using verbs or nouns	Unambiguity (elimination of ambiguous content interpretations)
	Contextual fit to content	Placement in text consistent with narrative (e.g., embedded in a paragraph)	Relevance (increasing the accuracy of information relative to user needs)
	Clear statement of link purpose	Contain hyperlinks within page content	Accessibility (faster finding of needed information)
	Links to authoritative sources – credible sources	SSL certificate	Credibility (building trust in the presented content)
	Dynamic labels adapted to current trends	Responsiveness (adaptation to mobile devices)	Timeliness (ensuring consistency with reality)
	Personalization (adaptation to the recipient)	Grammatical correctness	Comprehensibility (facilitating content interpretation)
	Thematic relevance	Visual hierarchy (highlighting, color, position)	Usability (readiness for use – effective searching and use of content)
Headings	Unambiguous definition of headings	Structural hierarchy of headings (H1-H6) and color contrast	Accessibility (easier finding and understanding of information)
	Uniform naming of headings throughout the site	Fixed arrangement of headings in various sections, numbering (logical segmentation)	Consistency (uniform structure)
	Linguistic relevance (terminology adapted to the target group), content contextualization	Stylistic formatting consistency (size, font, color, indentation)	Comprehensibility (clarity of message, minimizing confusion)
	Communication of the full content scope, precise reflection of content range	Logical division of content into closed sections, integration with navigation system	Completeness (full information)
	Dynamic headings (updating presented information)	Formatting changes (color/font) to highlight new items, responsive design (e.g., adaptation to mobile devices)	Timeliness (reflecting content changes)
Navigation System Labels	Unambiguity (clear categories)	Menu hierarchy (e.g., main categories > subcategories), dynamic adaptation of labels to context	Accessibility (quick access to key site areas)
	Relevance (adaptation to user needs)	Formatting (visual highlighting)	Transparency (facilitating site orientation)
	Contextualization (placement within structure)	Layout and number of options (limiting quantity)	Predictability (consistent structure)
	Semantic consistency (consistent terminology)	Responsiveness (adaptation of label layout to devices)	Usability (navigation efficiency)
	Functional transparency (clear indication of action outcome)	Visual hierarchy (prioritization)	Relevance (path adaptation to needs)
	Personalization/segmentation (adaptation to user profile)	Integration with other mechanisms (e.g., filters, search engines, breadcrumbs)	Verifiability (certainty of function)

Cont. table 6.

	Timeliness (signaling changes)	Dynamic state (labels changing depending on context)	Timeliness (ensuring consistency with reality)
	Terminological consistency (stylistic consistency)	Fixed menu layout	Consistency (uniform structure)
Index Terms	Terminology standardization (semantic consistency)	Structural consistency	Consistency (uniform layout on all subpages)
	Precise terminology (unambiguous concepts)	Modularity and scalability (ease of expansion)	Accessibility (shortening time to information)
	Unambiguous terminology	Thematic indexing (logical structures)	Unambiguity (precise content indication)
	Multidimensional categorization (flexible classification)	Cross-references (network of connections)	Relevance (personalization of search results)
	Thematic connections	Hierarchical structures	Completeness (full access to information)
	Metadata function (search support)	Integration with search and filters	Search and filtering speed

Source: own elaboration.

Table 6 reveals significant relationships between the semantic and syntactic properties of informational labels and the quality outcomes they generate in the context of websites. It should be emphasized that this is not a closed set of features and their effects. Various configurations of the characteristics identified in the study and their impact on information quality are possible.

The conducted study revealed differences in label characteristics between the public services, e-commerce, and education sectors, reflecting the specific needs of users and the operational context of each website. The analysis of informational labels allowed for the identification of semantic and syntactic characteristics influencing seven primary information quality criteria. The most frequently occurring semantic characteristics were unambiguity, relevance, and contextualization, while personalization and segmentation were the least represented. Dominant syntactic characteristics included visual hierarchy, formatting, and stylistic consistency, whereas responsiveness and integration with search mechanisms were observed less frequently.

Seven dominant attributes determining information quality were identified: accessibility, consistency, timeliness, relevance, completeness, unambiguity, and usability. These attributes occur with the highest frequency across the structure of different label types. Semantic characteristics, which focus on the meaning and communicative function of labels, directly translate into quality aspects such as unambiguity, relevance, and message credibility. On the other hand, syntactic characteristics, encompassing the structural organization and presentation of labels, primarily influence accessibility, clarity, and the efficiency of information retrieval.

The interaction between semantic and syntactic characteristics is also critical. The highest information quality is achieved through the synergistic combination of precise semantics with an appropriate presentation structure. Regardless of the label type, its embedding in the appropriate context – both semantic and structural – is a key condition for high information

quality. Contextualization enhances the relevance, comprehensibility, and usability of the conveyed content.

The introduced analytical approach, combining semantic and syntactic perspectives in information quality research, contributes to the theory of information architecture and information quality management. The identified information quality characteristics of informational labels show significant alignment with universal information quality models (Kahn, Strong, Wang; English; Eppler; Stvilia et al.). Common characteristics include unambiguity (clarity), relevance, accessibility, consistency, and timeliness. The obtained results confirm their applicability in designing information quality-oriented user interfaces. Effective labelling of information on websites requires a balanced approach to semantic and syntactic characteristics. Practical implications also include the need for systematic auditing and optimization of labelling systems as part of a holistic information quality management strategy for websites. Continued research will enable the development of labelling standards for different types of online services.

Proper label design requires an understanding of both semantic (meaning, terminology) and syntactic (structure, formatting) aspects. Based on the conducted study, practical recommendations for website designers can be proposed in these two areas:

1. Designing semantic labels:

- Use unambiguous terminology tailored to the target audience.
- Ensure contextualization of labels in relation to surrounding content.
- Implement mechanisms to verify label relevance.

2. Optimizing syntactic characteristics:

- Apply visual hierarchy consistently across the entire system.
- Ensure label responsiveness across devices.
- Integrate labels with navigation and search systems.

A limitation of the conducted study is the analysis based on individual Polish-language websites from three sectors (public services, e-commerce, education), which may not reflect the full diversity of labelling practices within the industry. The cross-sectional nature of the study prevents observation of changes in labelling practices or their long-term impact on information quality. Cultural and linguistic differences pose significant limitations that may influence label interpretation and user experience:

- Cultural mental models of users affect how informational labels are interpreted (e.g., cultural context of international websites).
- Linguistic contexts characterized by distinct grammatical structures and communication conventions.
- Regulatory frameworks for digital accessibility and information standards, which may vary significantly between countries.

Future studies should expand the analysis to additional industries and service types (e.g., healthcare, finance, media) and incorporate dynamic aspects of labels (e.g., algorithmically generated labels, personalization).

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