

TOOLS OF IMPROVING THE QUALITY OF INFORMATION ON WEBSITES

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Purpose: Identification of methods and tools of improving the quality of information on websites. The investigated instruments, techniques and mechanisms are described with regard to solving problems of the information quality from the user's perspective.

Design/methodology/approach: Literature studies along with analysis of tools of improving the quality of information on websites. The analysis of tools for improving the quality of information was conducted within four areas: information integration, information validation, providing context of information, as well as adjusting information to be used. The presented examples concern, among others, information websites, government sites, online auctions and search engines, and are of cross-cutting nature.

Findings: The presented tools aggregate information, enable verification of its correctness, provide both context and adjusting information to be used, which significantly affects the possibility of solving problems with information quality. For information should be: current, error-free, written objectively, having recourse to its origin, and easy to apply. Operationalization of the presented tools may be realized by means of summaries, tables of content, highlights in the content, infographics (information integration), or tag clouds, site maps, filters (information categorization). Verification of the reliability of information sources is enabled by methods of assessing information quality, whereas feedback and opinions provided by the users verify the quality of products along with the credibility of sellers. The important group of tools are so-called contextualizes of information which concern the kind of available piece of information, when it was used, its origin, when it was created/published/updated, or the author's references/qualification. Adding meta-information improves significantly the particular piece of information's context of use. More advanced flexible information presentation methods enable to improve the relevance of information retrieval results, the suggestion and completion mechanism accelerates the information retrieval process, whereas the automatic notifications call the user to action based on his/her interests and needs.

Research limitations/implications: The cross-sectoral nature of the presented examples is the limitation of the conducted research. Further, practical, research will enable identification of new methods and tools in order to improve the information quality in websites.

Practical implications: Knowing the tools mentioned in this article is crucial, especially for information users, for it improves the quality of acquired information. Poor information quality may lead to wrong decisions which may cause multiple negative consequences.

Originality/value: Identification and examples of tools for improving the quality of information on websites from the user's perspective. This paper is addressed to all those interested in theoretical and practical research on information quality, i.e., producers, providers and information suppliers, administrators and those responsible for taking care of websites, but, most of all, their users.

Keywords: information quality, information on the Internet, improving information.

Category of the paper: research paper, case study.

1. Introduction

In the literature, the authors propose different definitions of the concept of information quality. Quality of information means:

- “The degree to which information has content, form, and time characteristics which give it value to specific end users” (Brien, 1991).
- “[...] the characteristic of information to meet the functional, technical, cognitive, and aesthetic requirements of information producers, administrators, consumers, and experts” (Eppler, 2000).
- Consistent following the user's expectations through information and information services allowing them to work efficiently (English, 1996).

Other authors define information quality as its property, according to which:

- Information is of great value for users (Wang, 1998).
- Information is *fit for use* for its consumer (Huang, Lee, Wang, 1999).
- Information satisfies or exceeds user's requirements (Kahn, Strong, Wang, 2002).
- “[...] the sum of information characteristics and dimensions to meet or exceed information consumer – knowledge worker – expectations and requirements, expressed or unasked needs” (Ruževičius, Gedminaitė, 2007).

Most of the presented definitions are derived from the user's perspective and it is widely accepted by subsequent researchers. In this article, the author takes an approach to information quality from the user's perspective. The perspective of the information producer shows a different approach in defining the quality of information. From the point of view of responsibility for the quality of information and its improvement, there are three groups of people: administrators (e.g. owners of websites, managers), information creators (e.g. authors of publications, Website content writers, Webmasters), IT workers (e.g. Web Server Administrators, Database Administrators, Web developers, Webmasters). People from the three above-mentioned groups are responsible for solving the problems. The information producer perspective is not discussed in this article.

According to M.J. Eppler, problems with information quality concern three areas (Eppler, 2006, pp. 41-46): their origins, areas of responsibility for their creation, as well as consequences of using wrong piece of information. From the website's user's perspective these issues regard finding information (e.g., incomplete or irrelevant), reliance on identified piece of information (e.g., incoherent, imprecise), wrong interpretation of the retrieved and unreliable piece of information (e.g., vague, anonymous), and using particular piece of information (which is e.g., obsolete, not possible to be used) (Krzyszak, 2019, pp. 323-337). Among the possible solutions to information quality problems such activities as integration of information, verification of its correctness, providing its context and adjusting information to be used can be found. Methods of information integration include aggregation, categorization, customization and personalization. In the event that information cannot be trusted, the reliability of source of information or the mechanisms providing safe access to data should be verified. Whereas, the tools providing context of information by adding meta-information will allow the user to understand it. Flexible forms of presenting information, providing examples or ready-made schemes of problem solution, along with using the 'push' mechanism will all let adjust the information to be used (Krzyszak, 2019).

Introducing particular tools within websites is the guarantee of appropriate quality of information. This article aimed to identify the exemplary tools of information quality improvement within websites. There is a research gap in the area of information quality on websites. The mentioned instruments, techniques and mechanisms are described in the context of solving problems with information quality from the user's perspective. There exist various ways of operationalization of the indicated remedies, starting with relatively simple ones ending with advanced ones. The presented tools were divided into four groups: integration, validation, information contextualization and adjusting information to be used.

2. Information integration tools

Information overload reduces the possibility of finding relevant information. Poor access to information or too detailed descriptions have negative impact on the process of finding necessary information by a user. One of the methods which eliminates this problem includes integrating information from various sources. Integrative mechanisms on a website concern mainly increasing the availability of information. This aim may be accomplished using the following methods:

- Verbal (e.g., abstracts, summaries, tables of content).
- Visual (e.g., diagrams, tables, highlights, infographics).
- Integrative sources of information within one place (e.g., filtering, website's map, hashtag/ tag clouds).

Information integration may concern a website or some part of it (information on a subpage within a particular domain), or a group of websites connected by a common theme. Abstracts or summaries of e.g., messages, articles and documents which contain less content than the original information are relatively simple methods of content aggregation. They include aggregated key content excluding unnecessary details. They may occur in a descriptive form relating to the content structure or in informational form focusing on the most important ideas of the content. Abstracts containing the main results of the research included in the original article presented using particular number of words are an example of scientific content. However, there has occurred a new trend also in case of Internet articles in which an abstract with the most important information is placed at the beginning of the description. Examples of this form of content aggregation are presented in Figure 1.

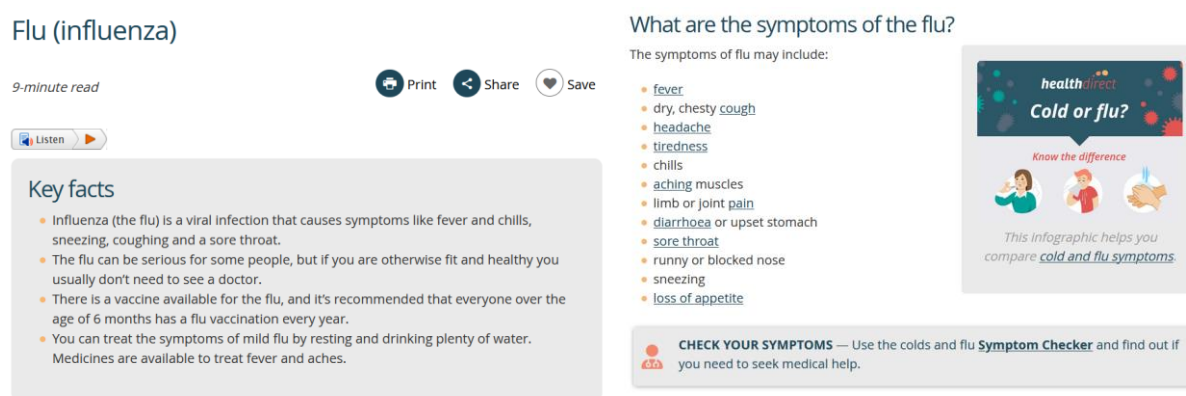


Figure 1. Examples of content aggregation using abstracts or summaries.

Source: <https://www.healthdirect.gov.au/flu>, 23.10.2022.

Assigning labels is another representation of information integration. Labelling information objects serves mainly as an indicator, but it also defines the meaning and kind of an information object, as well as the possibility of fast access to a particular text excerpt using a hyperlink. Labels may become links in an article's table of content or a defined phrase (names of chapters, subchapters). They significantly minimize the investment in time necessary to analyse the content, meaning of which may be substantial from the prospective information user's perspective and his/her needs, e.g., of an entry defined on an Internet encyclopedia (Figure 2).

Influenza

From Wikipedia, the free encyclopedia

For other uses, see [Influenza \(disambiguation\)](#), [Flu \(disambiguation\)](#), and [Grippe \(disambiguation\)](#).

"Flus" redirects here. For the diagnostic class of thyroid nodules, see [FLUS](#).

Not to be confused with [Flue](#).

Contents [hide]	
1	Signs and symptoms
2	Virology
2.1	Types of virus
2.2	Genome and structure
2.3	Life cycle
2.4	Antigenic drift and shift
3	Mechanism
3.1	Transmission
3.2	Pathophysiology
3.3	Immunology
4	Prevention
4.1	Vaccination
4.2	Antiviral chemoprophylaxis
4.3	Infection control
5	Diagnosis
6	Treatment
6.1	Antivirals
7	Prognosis
8	Epidemiology
9	History
9.1	Etymology
10	Research
11	In animals
11.1	Birds
11.2	Pigs
11.3	Other animals
12	References

Figure 2. The use of table of contents to integrate information based on definition in Wikipedia.

Source: <https://en.wikipedia.org/wiki/Influenza>, 23.10.2022.

Another visual integrative activity is the use of highlights. The most important elements in the text can be emphasized with the use of bold in the body of the text, bigger font, underline or colours. Such activities enable the user to reach key information in the text due to focusing attention on the highlighted elements. Using headings in the text (e.g., first- and second-level headings), as well as their unique content enable the increase of content conciseness. When designing content on a website, clear hierarchy of concepts should be used. Implementing such structure will make it possible for the users to reach the most important information. Websites containing headings are ‘clearer’ for Internet browsers as they define the main content described on the website.

Increased availability to information may be realised by categorization of information with the use of tables, graphs and diagrams. The use of tables enables organizing pieces of information into groups based on few dimensions or information aggregation based on particular category. Tables can be classified by the content, format, and their use. Regardless of this division, tables contain data placed in columns and lines. The first line and/or the first column of a table, depending on the type of a table, constitutes its heading. According to M.J. Eppler, there are six types of tables applicable in case of management. The aims of applying tables are as follows: matching, listing, comparing/contrasting, examining pros/cons, strengths/ weaknesses, rating and combined purposes (Eppler, 2006, p. 111). The mentioned types of objects tend to be frequently used information integrators within websites. However,

diagrams (schemes, graphics, graphs) enable greater opportunities of information integration than tables. They are the representation of particular ideas, dependencies or structures used for visual representation of information, whereas the information transfer presented in a form of colourful images is easier to understand for the recipients. An interesting example of graphic visualisation of information, data and knowledge is infographic. Its role is to draw the recipient's attention, while the transparency of communication lets him/her acquaint with the content fast. The infographic's user is able to notice particular shapes, colours and size of the objects, therefore, s/he can interpret them initially as a whole. Integrating the text with graphic objects enables memorising larger part of its content than in case of the text itself (McDaniel, Bugg, 2008, pp. 237-255). Figure 3 presents an infographic which integrates both the text and graphics.

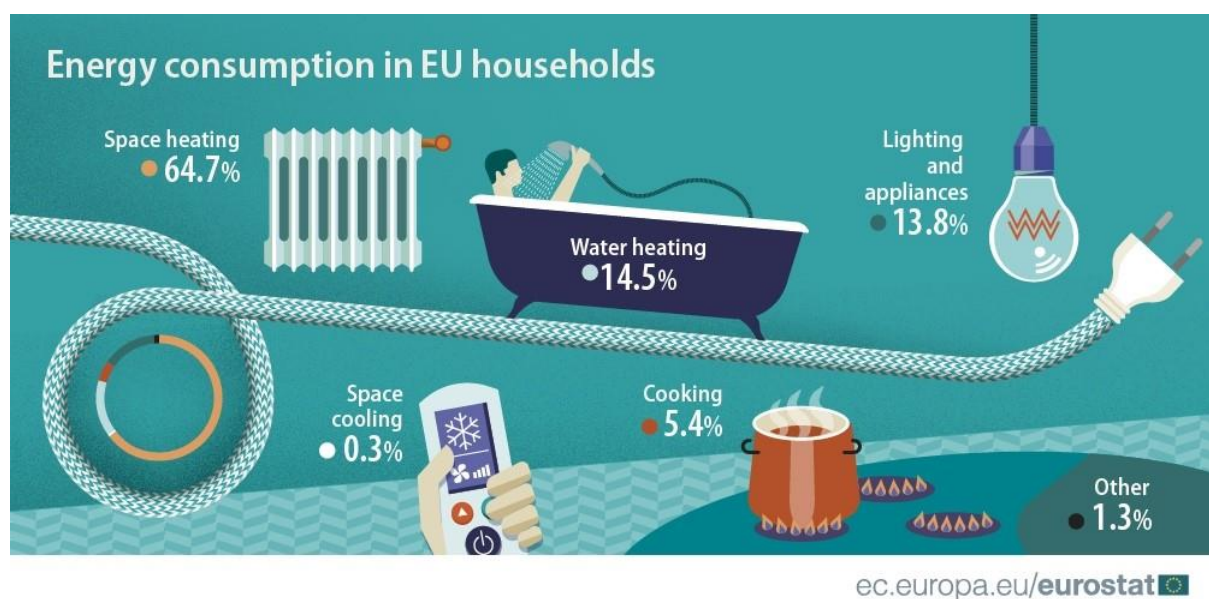


Figure 3. An example of an infographic.

Source: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Energy_infographic.jpg, 23.05.2022.

The mechanism which may be also used to integrate various sources of information in one place is a site map. Site maps contain a list of subpages, which are part of a particular website, that are often organised alphabetically or create particular hierarchy, e.g., of the importance of key issues. Users can familiarize with the index of subpages containing direct links to a given website. Such mechanism of information integration enables users to locate necessary content, as well as convenient navigation within a website (Figure 4).


 Markets Economy Companies Tech Autos India Video International ▼			
<h2>Sitemap</h2>			
News	Markets	Personal Finance	Video
All Latest Financial Stories Companies Economy International News The Buzz Financial News Video	Premarket Trading After-hours Trading World Markets U.S. Markets Market Movers Dow 30 Bonds Currencies Commodities Mutual Funds ETFs The Buzz Markets Video Your Profile/Alerts	Real Estate News Retirement Jobs Autos Taxes Smart Spending College Personal Finance Video Loan Center Insurance Money Essentials Calculators/Tools Your Money Money Moves	Business News Investing Luxury Media Tech Personal Finance Small Business CNNMoney Original Shows Ask the Expert Best Jobs The Buzz CNNMoney NOW CNNMoney Reports Corner Office Strategy Session Help Desk How We Got Started Innovation Nation Small Biz Tips The Stream
Technology			
Innovation Nation Tech Video			
Investing			
The Buzz Fear & Greed Dow 30 ETFs Mutual Funds			
Economy	Small Business	Services & Other	
Federal Reserve Jobs International Economy 100 Top MBA Employers Best Jobs in America	How We Got Started Best Places to Launch Small Business Tips Owner Tested Innovation Nation The Turnaround Small Business Video	Mobile News Email Newsletters RSS Feeds Advertise with Us Contact Us CNN.com Terms of Service Privacy Policy	

Figure 4. Money.cnn.com sitemap example.

Source: <https://money.cnn.com/services/sitemap/>, 23.10.2022.

One of the popular methods of systematisation and categorization of information on the Internet is tagging, which means applying key words to one's classification of objects in a form of photos, tabs, products or posts on blogs (Unold, 2015, p. 205). Creating tags facilitates the searching process and the process of categorising information objects. Within the decentralized network, tagging is the created by users process of ordering information and presenting its context in the categories. Evolutionary, constant and dynamic creation of content does not allow to define or hierarchize information sooner, as it is possible in formal methods of classification. Tagging does not limit the choice of words describing a particular object (e.g., a photo in social media), as it is visible in structured systems. Users classify information themselves according to their needs and preferences. Tag cloud presents the content of a website in a form of a graphic representation of tags. Tags, in form of links, direct users to the particular part of a website. Their varied appearance expressed by colour, size or bold font reflects the popularity of a particular tag (Figure 5). From the user's perspective tag cloud is one of the ways of exploring

- Multimedia search engines (e.g., google.pl).
- Search engines dedicated to information (e.g., news.google.pl).
- Address search engines (e.g., Pkt.pl, Panoramafirm.pl).

Results provided by search engines are possible to be connected into easily searchable categories. By the use of cluster analysis method, such as grouping results or clustering, alignment and simplifying access to the categorized searched information is possible, whereas appropriate presentation of the obtained results improves the overall quality of information.

Clustering search engines use the grouping results methods. One of the examples of such search engine is Carrot2. Clustering search engines present results assigned to separated groups described by a common theme. Apart from results directly related with the searched job they also present keywords related to this topic. The results of searching for the phrase information quality are presented in Figure 6.



Figure 6. Results of the search for the phrase information quality by Carrot2 search engine.

Source: <https://search.carrot2.org/#/search/web/information%20quality/pie-chart>, 28.06.2022.

Another example of information integration tools is filtering information which is used in many services of various content (e.g., internet stores, websites with databases). The aim of filtering is despatching irrelevant information which leads to obtaining information more

suitable for the users' needs. An exemplary set of filters applied in Internet stores may include: price (range), technical and functional parameters, availability, status (e.g., special offer, new). The values of particular criteria provided by the user are automatically included in the search results on the principle of conjunction.

3. Information validation tools

Verifying the correctness of information by a user is possible with the use of methods enabling to assess the quality of information resources found on the web. In order to assess information quality, methods relating to the general assessment of website quality and to assessment of its particular areas, such as content, utility or specific information resources, can be applied. In selected methods of information quality assessment website resources (e.g., content of databases, industry-specific special papers) are not subject to evaluation. For instance, methods of assessing medical information quality addressed to the website users include evaluation criteria regarding: the website's author's competence, revealing information about the website's owner and sources of financing the site, the website's relevance, providing information sources or literature reference. Consequently, users do not evaluate the website's content due to frequent lack of proper qualification in this matter, however, they assess the presence of information or the quality of meta-information (e.g., competence of an author responsible for the quality of shared information). In other methods, apart from the content on the website, elements allowing to reach some resources (e.g., built-in search engines) or presenting how to use them (e.g., manuals, tutorials) are subject to assessment (Czerwiński, Krzesaj, 2018, p. 79).

In practice, the following methods relating to the information quality evaluation are applied (Czerwiński, Krzesaj, 2018, pp. 80-88):

1. Methods of automatic procedures (technical).
2. Statistical methods.
3. Quality – heuristic methods (expert).
4. Methods of evaluating information resources on the Internet.
5. Methods of creating theme quality-controlled services (gateways).
6. Methods of evaluating medical information quality.

In case of finding information by a user, it should be possible to verify it. M.J. Eppler suggests an information validation procedure consisting of the sequence of five steps (Eppler, 2006, p. 139):

1. Verifying the goal of the posted information (e.g., if there was a clearly defined goal).
2. Verifying the author's reference (e.g., the author's credibility, his/her qualification and affiliation).

3. Verifying the source of information (e.g., information about the website's owner, mechanisms of posted information control, connection safety).
4. Examining information itself (e.g., its validity, inconsistency or reoccurring errors, content objectivity, sources of the posted information, language, structure, layout).
5. Comparing the analysed content with information from other sources (e.g., by comparison).

The presented procedure of information validation is holistic and requires significant involvement of the information user. However, application of this procedure when analysing any piece of information increases the probability of using it in the future.

The mechanism, which especially on the Internet may be automatised, is the resource use measurement. Even though it does not guarantee the quality of the measured resources, it may be a precious indication regarding highly evaluated content elements by other users. Based on the gathered information rankings concerning the most popular articles, the most frequently downloaded files, or users' ratings are created. Some of the popular examples of ratings given by users on the Internet are those regarding opinions about a product or a seller. As an example, opinions provided by the users on Amazon are presented (Figure 7). Customer Reviews, including Product Star Ratings help customers to learn more about the product and decide whether it is the right product for them.

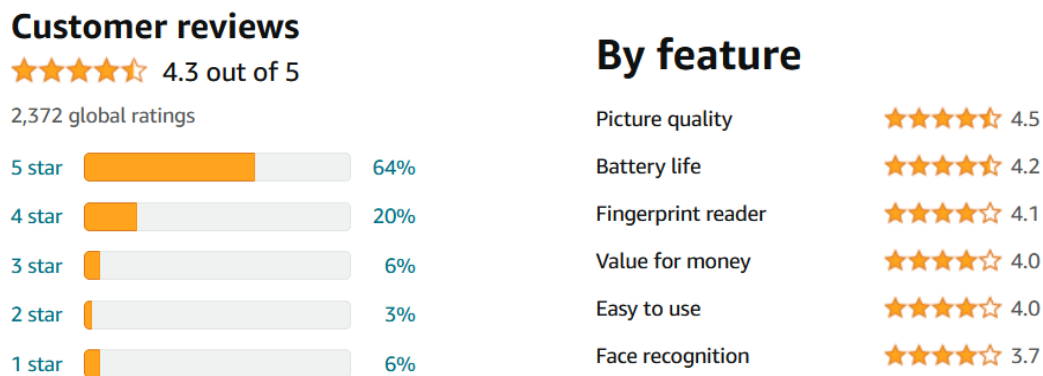


Figure 7. Consumer reviews: example of cell phone on Amazon.

Source: <https://www.amazon.com>, 28.10.2022.

Another example refers to the possibility of verifying information about the seller of a particular product. Figure 8 presents an overview of feedback about the seller based on the opinions provided by the current customers. This indicator is expressed as a percentage in the last 12 months (96%), as well as a number in the period of time: 30 days (5/100%), 90 days (11/100%), 12 months (47/96%) and lifetime (357/94%).

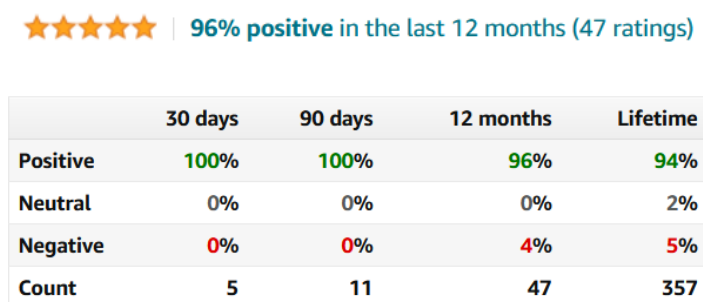


Figure 8. Feedback example about the seller on Amazon.

Source: <https://www.amazon.com>, 28.10.2022.

4. Tools of information contextualization

The received information can be misunderstood by the user. Repeated several times, false, vague or anonymous information influences significantly the way of interpreting it. Such issues can be limited by mechanisms creating information context. When the context is provided, it increases the clarity of information, perceived accuracy when used, identifiability, i.e., the possibility of tracing its sources, as well as the possibility of updating it. There are various mechanisms in the Internet environment within the indicated areas. The mentioned mechanisms of improving information quality are called the information contextualizes (Eppler, 2006, p. 145).

Adding meta-information improves significantly the context of using particular piece of information. Attaching information regarding the kind of available information (e.g., text, graphics, sound, film), file format (e.g., doc, pdf), the situation of its use (e.g., official business), source of information (e.g., institution or reference) influences the decision of the recipient to use particular piece of information. Providing information regarding time as the moment of creating information, as well as the moment when it was published, is of similar importance. Typical meta-information describing documents in a form of keywords, references or abstracts reveal their context.

For instance, legal articles published in the Internet System of Legal Acts provide metadata describing their status, dates of announcing, issuing and entering into force of a particular Act, along with information concerning the authority issuing a particular document (legal act). The content of legal acts is released in the pdf file format with additional information connected with the document: amended acts, acts deemed to be repealed (Figure 9).

[Journal of Laws](#) / [2022](#) / item 1265

Act of June 9, 2022 amending the act on personal income tax and certain other acts

Text of the act:	D20221265L.pdf
Text announced:	D20221265.pdf
Consolidated text:	D20221265Lj.pdf
Legal act status:	obligatory
Date of announcement:	2022-06-15
Release date:	2022-06-09
Effective Date:	2022-07-01
Remarks:	1) art. 1 point 5 and art. 2 shall enter into force on June 16, 2022; 2) art. 8, art. 11 and art. 31-35 enter into force on June 30, 2022; More... point 3, point 7 lit. b, points 11, 12, point 13 lit. b and c, points
Issuing authority:	SEJM

- The course of the legislative process
- Amended acts (13)
- Acts deemed repealed (2)
- Amending acts (2)

Figure 9. Meta-information describing a document in the Internet System of Legal Acts.

Source: <https://isap.sejm.gov.pl/isap.nsf/DocDetails.xsp?id=WDU20220001265>, 23.05.2022.

Unambiguity of information source origins and the date of publishing the content presented on the service website influence the recipient's decision whether or not to use such information. Information quality is significantly improved when the entitlement of people or organisations to publish particular piece of information on the website is provided (e.g., references/qualifications of the information's author) along with the date of publishing it. Additionally, transparency of information about the owner of a website (surname/name, address, e-mail address of a person or organisation responsible for the service) together with unambiguity of stating the goal of the website service and clearly defined content recipient, enable the increase of reliability of information sources origins.

Placing the date and hour of publishing the content is a frequent mechanism of improving information quality. Regular updating information through providing date and time of the update in a visible place enables systematic content control. Users are able to compare the dates of publishing and updating it. The author's responsibility for publishing content can be also reviewed by users. Their opinions about the provided information increases the author's responsibility for publishing any content. Unfortunately, the mechanism of giving users' opinions is frequently deactivated. Comments in a form of a reply to frequently asked questions (FAQ) are another example of adding context to information. Placing information like *It will take 10 minutes* to read this text lets users know how much time they need to spend on reading

a particular text, which is a useful mechanism. There also appear contents with the information regarding sources used in them.

The presented examples regard cases of adding informative context directly to the information itself. There are mechanism allowing to set the context which does not concern the information, but, e.g., the website's owner. Lack of information transparency about the website's owner in a form of incomplete data regarding organization responsible for the website is possible to be verified. Information about the names of registered domains, such as .pl are available in the WHOIS database (<https://www.dns.pl/whois>), which is held by NAKS (Scientific and Academic Computer Network). It is possible to find the following data in the register of domen.pl: status of timeliness of registration of the domain's name, date of creating or modifying the domain's name, name and type of the domain's subscriber, as well as organization which registered the domain.

5. Tools of adjusting information to be used (by a user)

The mechanisms which increase the possibility of using information improve significantly its quality. Information which is inappropriate to be used does not provide the possibility of taking action by a user on its basis. Therefore, information to be used should be adjusted so as to be comprehensible and used easily. The exemplary remedies are following: flexible forms of presenting information, providing examples, ready-to-use schemes of solving problems, push mechanisms. Presentation of the ways of using information is called their demonstration, e.g., in a form of video films, tutorials or manuals for the users. This type of tools may regard, e.g., the way of measuring the ordered produce, or the stages of realising particular tasks, such as procedures of executing official affairs. The possibility of printing the website's content without any prior preparation is the easiest form of adjusting information to be used, e.g., in a form of files in pdf format. However, lack of necessity of transforming or converting information is crucial, e.g., lesson plans/ information, instructions, tutorials for students are ready to be printed without the necessity of copying, formatting or adjusting them to be used. Other ways include frequently asked questions (FAQ), interactive forms of presenting information with the use of communicators and programme agents (assistants), as well as the mechanisms supporting the process of searching information.

In the process of searching information, the obtained answers frequently do not meet the users' expectations. As a result of the query, search engine presents several hundred thousand of answers, and their relevance is not completely aligned with the users' expectations. The result means lack of information relevance which is one of the most important features of its quality. W. Abramowicz describes relevance as the importance and suitability (Abramowicz, 2008, p. 317). When assessing relevance, it is important to assign the significance of information by

its user. Validity indicates the relation with the person, for whom someone or something is supposed to be important. In practice, search engines presenting relevance as a logical value (e.g., graphic symbols) or numeric value (e.g., percentage - the indicator of search relevance) to its users can be seen only incidentally. In the BazEkon service the indicator of search relevance is presented next to the bibliographic specification of a searched document in a form of a numeric value presented in percentage and in a graphic form - pole with the height of direct proportion to this value (<http://bazeikon.icm.edu.pl>).

The frequently used method of justifying the relevance of search results to a given query is highlighting keywords used in the query (Figure 10). It happens that the search results contain all or some part of keywords from the query, however, they are irrelevant in the user's perspective, as they do not meet his/her need for information. The obtained search results which do not contain relevant information cause lack of possibility of using it. Subjective character of the query of no precision in forming it can lead to discrepancies between the obtained results and expectations.

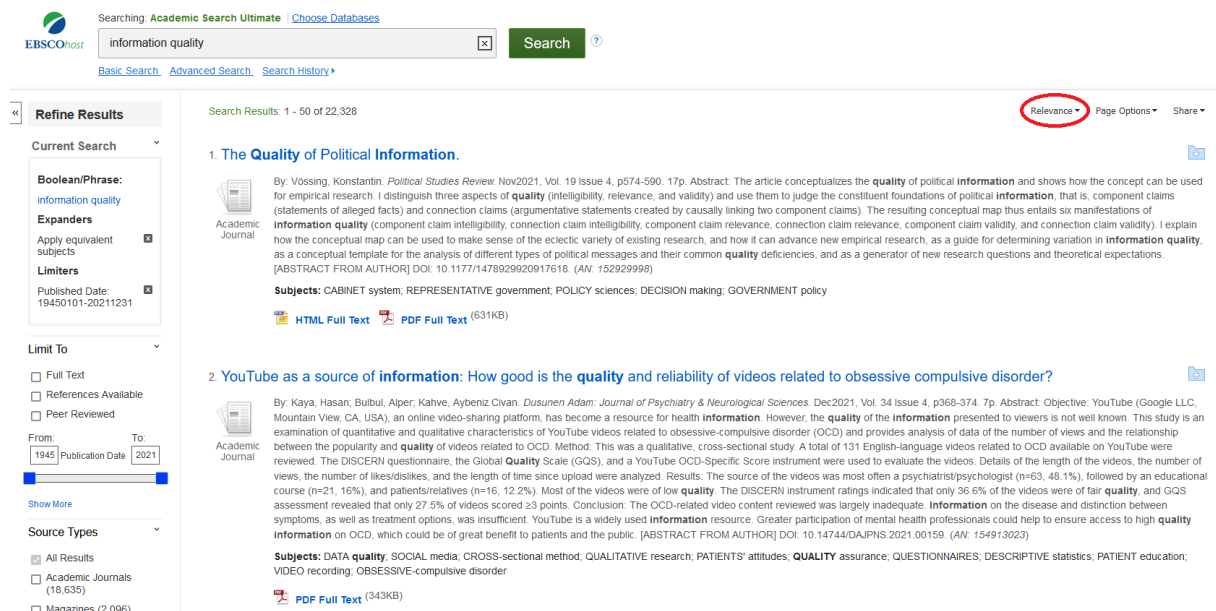


Figure 10. Example of a search engine in the Ebsco database with the indication of relevance option in the search results.

Source: <http://web.a.ebscohost.com>, 23.06.2022.

In case of search engines, W. Abramowicz identifies three reasons of calculating relevance inconsistency with the users' experience (Abramowicz, 2008, pp. 317-320):

- Query represents incorrectly the user's informative needs.
- Index represents the document differently than the user understands it.
- Calculation of relevance between the query and index does not correspond to the interpretation of this relation by the user.

It is quite uncomplicated to improve the relevance in the first case – only through changing the query. In other two cases the user has no influence on the calculation of relevance, as the way of indexing resources by search engines is its producer's secret. An Internet user defines a query, based on which s/he expects relevant responses. Formulating complex queries influences significantly the search results, e.g., by narrowing and limiting them. It should be emphasised, that the level of informative competence of users has a major impact on the process of searching information. A user is able to optimise the information search process with the use of advanced options of a search engine based on the Boole's algebra. It is a little-known and underestimated option, despite the fact that majority of search engines offer such functionality. Proper selection of keywords, creating phrases, using the syntax mechanisms, all improve significantly the relevance of the obtained results. When creating complex queries in search engines, the following options are used (<https://www.google.pl/...>):

- Operators, such as: and, or, "+", "-", "*", "[#]..[#]".
- Advanced operators, e.g., "cache", "link", "related", "info", "filetype".
- Query modifiers, e.g., "site", "allintitle", "intitle", "allinurl", "inurl".

Quite important example improving the quality and relevance of search results is using hints of entered keywords and autocompletion. The latter accelerates and facilitates the search of information based on the search engine's hints. Search engine, on the basis of the users' queries, proposes potential hints to the entry. By choosing the hint, the user formulates the query in the search engine. According to Google, hints in this search engine come from various sources (<https://support.google.com...>):

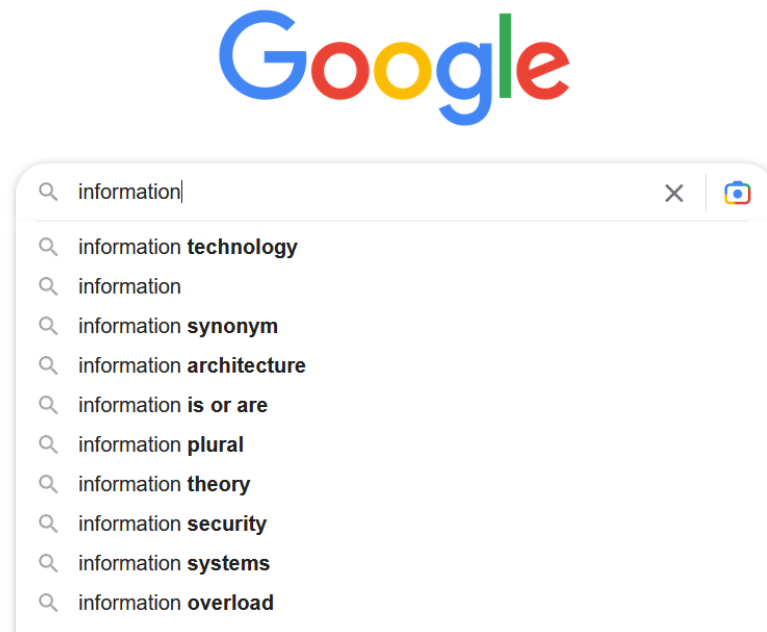
- Query entered by a particular user.
- Queries searched by other users, including those obtained based on their popularity.
- In case of users logged on Google, using active option of activity on the Internet and in applications, accurate results of searches in the past are used.

The giant stipulates that the hints to the user's queries in the search engine are not the results of search or opinions of other users. Hints in the search engine are not created by a human, yet they are generated automatically by an algorithm. Lack of hints may occur in case of unpopular or too modern words. Figure 11 presents the result of the activity of the autocompletion mechanism in Google and Bing search engines for the keyword information. The results differ in informative scope and the order of appearance.

In the Internet services push mechanisms involving providing information in which the user is automatically informed, e.g., about the news or price products, are also used. Such solution is used in Google News service for logged users. Google News is an Internet aggregate of news from information services (<https://news.google.com>). At the same time, it is an interesting example of an instrument integrating information from various sources into themed information categories. Based on the observed sources and topics of articles, users see materials of similar

subject matter. In the For You section they can see news connected with their interests. Additionally, they can see local news from the places of their interest.

a)



b)

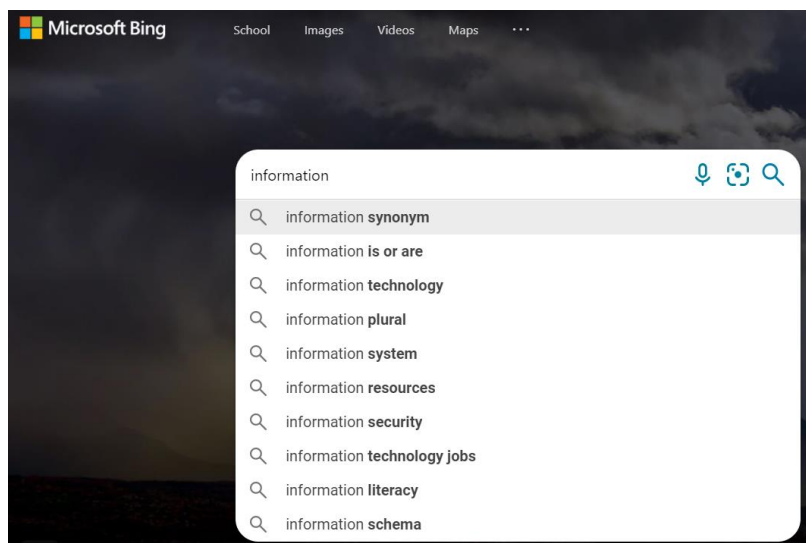


Figure 11. Autocompletion mechanism in a) Google search engine and in b) Bing search engine for the keyword *information*.

Source: a) <http://www.google.com>; b) <http://www.bing.com>, 27.06.2022.

The notification mechanism is widely used in case of mobile devices. Notification is a short message displayed outside the application. Such information indicates the occurrence of an interesting, from the user's point of view, event in a form of an alarm or a new message. The user can activate the notification which will open a particular application or execute an activity from the level of notification. Therefore, the user is called to action based on his/her interests and needs. The issue of notifications in mobile devices is another field of research and may be the subject of interest in another publication.

6. Conclusions and further research

In this article exemplary tools of improving information quality on websites are presented. Tools, techniques and mechanisms are described in the context of solving problems with information quality from the user's perspective. The result of an analysis of given examples is the conclusion that multiple tools of improving information quality are used. Information aggregation (e.g., abstracts, tables of content, highlights, infographics), as well as information categorization (e.g., hashtag/tag clouds, site maps, search engines) are the most frequent examples. The mechanism of information validation consists mainly of verifying the validity of information sources (methods of information quality assessment) or opinions given by the users (feedback and opinions about a product or seller). Adding contextualizes of information regarding the kind of available information, its use, source of origin, time of creating/publishing/updating it, or the author's reference/qualifications, influences the recipient's decision about the use of information. The presented examples of adjusting information to be used regard flexible forms of presenting information (e.g., tutorials), providing examples (e.g., the autocompletion mechanism) and using the push mechanism (e.g., notifications).

Knowing the tools mentioned in this article is crucial for the information users, but also for the producers, providers and suppliers of information, as it improves the information quality on websites. The limitations of the research include the cross-cutting nature of the presented examples. In further research an attempt to specify the analyzed examples in given areas will be made. One of the possible directions is researching tools assuring the context of information within Polish and foreign news portals. Another interesting area of research is the use of hashtags as one of the methods of information categorization in social media: Twitter, Instagram, Facebook, YouTube and TikTok.

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