Web accessibility and usability: limits and perspectives

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Abstract

Considering that to this day there are still a lot of barriers to access ICT (Information and Communications Technology), this work aims to clarify the distinction between "usability" and "accessibility". On one hand, the national regulatory framework provides the guidelines that make "accessible" and "usable" the Public Administration sites; on the other hand, the international legislation ones, with particular regard to the W3C (World Wide Web Consortium, an international non-governmental association), define the technical references for the World Wide Web to the right of universal accessibility. The W3C has issued precise and detailed guidelines (WCAG) to ensure web usability, as an approach to make websites easy to use, even and especially by users with visual, hearing, motor, cognitive, etc. difficulties. Subsequently, we will illustrate the role of usability of online learning paths, to determine whether the tools, content, interfaces of e-learning systems, support students in various learning contexts. Specifically, we will examine the experience of Moodle, used in academia for distance learning.

Keywords [1]

Web Accessibility, Usability, Education, ICT, E-learning

Digital Italy and accessibility standards

Tim Berners-Lee, co-inventor of the World Wide Web and director of the W3C (World Wide Web Consurtium), defines accessibility as that characteristic of the web by which its services are "available to all individuals, regardless of their hardware and software requirements, network infrastructure, language of birth, culture, geographic location, and physical and mental attitude" [1]. Accessibility, therefore, contributes to guarantee the universality of the right of access to information and new technologies, in implementation of the principle of equality referred to in Article 3 of the Constitution of the Italian Republic, for which, we recall, "All citizens have equal social dignity and are equal before the law, without distinction of sex, race, language, religion, political opinions, personal and social conditions. It is the duty of the Republic to remove those obstacles of an economic and social nature which, by limiting the freedom and equality of citizens, prevent the full development of the human person and the effective participation of all workers in the political, economic and social organization of the country". Even today, in fact, there are still many barriers (mostly related to geographical area of origin, social class, level of education) to access to ICT (Information and Communications Technology).

Accessibility, therefore, does not depend on the knowledge of the subjective condition of the final users of the resource, which, for this very reason, must be usable also and above all by users with visual, hearing, motor, cognitive difficulties, etc. [2]. [2]; likewise, a site will be "accessible" only if it can be reached and visualized with a text-only browser, a voice browser or an obsolete version of the same,

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with a different operating system, with a slow connection, with an older hardware and, therefore, less powerful.

In Italy, the reference regulatory framework is represented by Law no. 4 of January 9, 2004, known as Stanca, regarding "Provisions to facilitate access to IT tools for the disabled", the aim of which is to eliminate digital barriers that limit or prevent access to ICT tools to the disabled, by Implementation Regulation no. 75 of March 1, 2005, by the Ministerial Decree of July 8, 2005 ("Technical requirements and different levels of accessibility to IT tools") and by the Digital Administration Code (CAD), established by Legislative Decree no. 75 of March 7, 2005, established by Legislative Decree no. 25 of July 8, 2005. M. of July 8, 2005 ("Technical requirements and the different levels for accessibility to IT tools") and the Digital Administration Code (CAD), established by Legislative Decree No. 82 of March 7, 2005, subsequently amended and supplemented first by Legislative Decree No. 179 of August 22, 2016 and then by Legislative Decree No. 217 of December 13, 2017.

The above-mentioned normative interventions define the requirements that a website must meet in order to be considered "accessible", providing for Public Administrations to obtain certification for sites recognized as "accessible" by DigitPA (previously CNIPA, National Centre for Information Technology in Public Administration). In addition, in compliance with Implementation Regulation no. 75 of March 1, 2005, Public Administrations may carry out an independent assessment of the accessibility of their own sites. The Ministerial Decree of July 8, 2005, finally, dwells on the technical requirements of accessibility and the relative control points for the verification of conformity, defined on the basis of the "Principles", "Guidelines" and "Criteria for success" already identified by the World Wide Web Consortium (W3C) [3].

Usability: definitions and principles

The ISO (International Standardization Organization) 9241 standard introduces the concept of "usability", which can be defined as "the degree to which a product can be used by particular users to achieve certain goals with effectiveness, efficiency and satisfaction, in a specific context of use" (ISO 9241-11) [4]. The definition introduces some very significant concepts:

1. Effectiveness: a site is effective when users achieve specific goals completely and accurately.
2. Efficiency: a site is efficient if the expenditure of resources by users to achieve specific goals is minimal.
3. Satisfaction: a site is satisfactory if users achieve their goal without inconvenience and receive a positive impression of it.
4. Context of use: the context consists of the characteristics of the users, their goals, and the environment in which they are located.

The definition accepted by the International Standardizing Organization is not, however, the only one. Usability, in fact, has been variously defined. Jacob Nielsen, one of the leading scholars of web usability, defines usability "as the measure of the quality of the user's experience in interacting with something, whether it is a website or a customary software application or any other tool with which the user can operate" [5]. Therefore, according to Nielsen, a site will be usable if it is efficient, easy to memorize and learn, has few interaction errors, and is pleasant to use.

To this end, Jacob Nielsen [5] identifies five key factors that circumscribe usability and allow one to assess whether and to what extent a site is truly usable:

1. ease and simplicity: the user can navigate immediately on the site, learn the basic functions and perform the tasks;
2. efficiency and effectiveness: in a short time the user can use the site more quickly and perform more tasks;
3. memory: over time the user is able to remember well the functions of the site;
4. serious and frequent errors: the user in the use of the site has made only a few mistakes and not so serious as to compromise the success of the tests, you have never made the same mistake twice;
5. satisfaction: the final feeling of the user is of pleasant satisfaction.

Ben Shneiderman [6], American scholar and computer scientist, distinguishes four different main dimensions of usability:

1. efficiency (efficiency)
2. ease of learning (learnability)
3. ease of remembering the main commands (memorability)
4. satisfaction with use (satisfaction)

Other authors, again, refer to usability as the four main components of a work situation: user, task, system and environment. An effective design, which aims to ensure usability, must aim at the harmonization of these factors.

From what has been said, it emerges how the usability must rise to an intrinsic quality of a web site as a whole, to a parameter of measurement of the simplicity of navigation, of the homogeneity, of the comprehensibility of the same. For this reason, usability must concern all the different stages of design and technical planning, implementation, management and evaluation of a website, without neglecting an accurate assessment of the user to whom it is addressed.

The designer, in fact, cannot refrain from considering the different types of potential users: a particular product, made for a novice user, may not be good for an advanced user. A product designed for a novice user may not be suitable for an advanced user. Usability is certainly greater in those products that boast analogies with cultural models and/or objects in common use: for example, icons depicting an “eraser” and “scissors” to recall, respectively, the “erase” and “cut” commands.

Even in the absence of dedicated legislation, the Public Administration is called to conform sites and services offered to usability criteria: the Digital Administration Code (CAD), in fact, establishes the obligation for Public Administrations to create institutional websites respecting the “principles of accessibility, as well as high usability and findability, even by people with disabilities, completeness of information, clarity of language, reliability, ease of consultation, quality, homogeneity and interoperability” [7]. The so-called Stanca Law and the Guidelines for Public Administration websites, drawn up pursuant to Directive no. 8 of 2009 on the reduction of institutional websites and the improvement of the quality of online services and information to citizens [8], offer valuable indications on the usability of Public Administration websites.

A public website must be designed with the needs of all potential users in mind, regardless of each individual's digital skills and physical abilities. The guidelines for Public Administration websites define some fundamental usability principles [9]:

1. Perception: the information and commands needed to perform the task must be available and perceptible at all times.
2. Understandability: the information and commands needed to perform the task must be easy to understand and use.
3. Operability: information and commands must allow an immediate choice of actions necessary to achieve the desired objective.
4. Consistency: symbols, messages and actions should have the same meaning throughout the site.
5. Protection of health: the site must have suitable characteristics to safeguard the psychophysical well-being of the user.
6. Security: the site must have suitable characteristics to provide reliable transactions and data, managed with adequate levels of security.
7. Transparency: the site must communicate to the user the status, the effects of actions taken and the information necessary for the proper evaluation of the changes made on the site itself.
8. Ease of Learning: The site must have user-friendly features that are easy and quick to learn.
9. Help and documentation: Help features, such as online help, and documentation on the operation of the site must be easy to find and linked to the actions taken by the user.
10. Fault-tolerance: The site should be configured to prevent errors; however, if errors do occur, they should be clearly marked and actions should be taken to correct them.
11. User-friendliness: The site should have features that encourage and maintain user interest.
12. Flexibility: The site should take into account individual preferences and contexts.

World Wide Web Consortium: WAI e WCAG

In October 1994, Tim Berners-Lee founded an international non-governmental association called the World Wide Web Consortium, also known as the W3C, whose main objective is to facilitate navigation on the web, ensuring the effectiveness and universality of the right to accessibility. To this end, the World Wide Web Consortium has defined the technical references for the World Wide Web, in relation to markup languages (e.g. HTML) and communication protocols (e.g. HTTP). The W3C, in essence, monitors the correctness and validity of data processing and transmission and contributes to the definition of web standards.

Whatever the purpose of a site, it is essential that the guiding principles of usability are respected; only in this way, in fact, it will be possible to design effective, efficient and satisfactory web sites for the user.

In October 1997, the W3C launched the WAI (Web Accessibility Initiative) which, with a transversal scope of operation compared to the initiatives of the W3C, aims to promote and study web design in order to ensure that web content is accessible to everyone, especially the disabled, whose approach to the network is mediated by the use of specific tools and applications (so-called "assistive technologies"). The areas of intervention of the WAI are essentially five [10]:

1. The study of recommended technologies
2. The drafting of precise and detailed guidelines
3. Assessing accessibility
4. Training
5. Scientific research

The WAI is now the most authoritative and accredited source referred to by the European Union to ensure the accessibility of website content.

The WAI has issued precise and detailed guidelines to enable web designers to design accessible websites. WCAG 1.0 (Web Content Accessibility Guidelines), published on May 5, 1999 as a W3C Recommendation, defines de facto standards for defining accessibility criteria. The document contains 14 guidelines or principles for accessible design [11]:

1. Provide equivalent alternatives for visual and audio content
2. Do not rely solely on color
3. Use markup and style sheets, and do so appropriately
4. Make natural language use clear through markup
5. Create tables that transform elegantly
6. Ensure that pages, using the latest technology, transform elegantly.
7. Ensure that the user has control over time-dependent content changes.
8. Ensure direct accessibility of embedded user interfaces.
9. Design for Device Independence
10. Use temporary solutions
11. Use W3C technologies and guidelines
12. Provide context and guidance information
13. Provide clear navigation mechanisms
14. Ensure that documents are clear and simple

On December 11, 2008, WCAG 2.0 [12] was published, an evolution of the previous WCAG 1.0: the principles are the same, although they are structured differently. The main difference is that the guidelines contained in WCAG 2.0 are independent from the technologies used, whereas WCAG 1.0 was strongly linked to CSS and HTML; consequently, they guarantee greater flexibility, as well as being simpler to understand and apply. They focus primarily on barriers that may impede access to the Web for people with visual, hearing, physical, cognitive and neurological disabilities, and elderly users. They provide for four guidelines:

1. Perception: content must be presented in a way that can be perceived by any user, except for those components that cannot be expressed in text.
2. Operability: interface elements must be operable by any user.
3. Understandability: It should be as easy as possible to understand the content and controls.

4. Robustness: Web technologies must be used in a way that maximizes the ability to operate with current and future technologies, and with user agents.

On June 5, 2018, WCAG 2.1 was published: it is an integration, and not a radical replacement, of the previous WCAG 2.0, with the provision of 17 new criteria designed primarily to help people with low vision, cognitive disabilities and learning disabilities. "The Web Content Accessibility Guidelines (WCAG) 2.1 define technical specifications for making Web content more accessible to people with disabilities. Accessibility addresses a wide variety of disabilities, including visual, hearing, physical, speech, cognitive, language, learning, and neurological disabilities. Although these guidelines consider many issues, they do not address the needs of people with all types, degrees, and combinations of disabilities. These guidelines also make Web content more usable for older people with aging-related skill changes and often improve usability overall for all users" [13].

The main difference is that many of the criteria contained in WCAG 2.0 could be checked by automated software, whereas most of those introduced by WCAG 2.1 require manual testing.

According to the W3C (World Wide Web Consortium), "In order to meet the needs of different groups and situations, three levels of conformance have been defined: Level A (lowest), Level AA, and Level AAA (highest)."

As an example, the new Level A and AA criteria are shown below:

1. Orientation (AA)
2. Identify the purpose of the inputs (AA)
3. Recalculating the flow (AA)
4. Contrast in non-textual content (AA)
5. Text spacing (AA)
6. Content with Hover or Focus (AA)
7. Hotkeys (A)
8. Pointer movements (A)
9. Clearing pointer actions (A)
10. Name label (A)
11. Action from movement (A)
12. Status messages (AA)

Usability and LMS platforms: the case of Moodle

Usability also plays a key role in the design of online learning paths [14]. It is necessary to avoid, or at least contain, the risk that students take time away from the learning process, using it to understand the working mechanisms of the software: if the e-learning platform does not respect certain standards of usability, the learning process will be, even partially, compromised [15]. An online learning path must be designed on the basis of tools inspired by established pedagogical models. The issues related to usability take on a particular value in educational environments; it is customary to speak, in fact, of pedagogical usability, or rather pedagogical usability, to indicate whether the tools, content, interfaces of e-learning systems support students in various learning contexts and according to the pedagogical objectives set [16]. Obviously, pedagogical design evaluation should not replace but complement usability evaluation [17].

In order to measure the level of usability of e-learning systems one can make use of Nielsen's ten heuristics [5] of measuring the usability of interfaces. The decalogue includes:

1. System status visibility: the system must always keep the user informed of what it is doing, providing adequate feedback in a reasonable time.
2. Correspondence between the system and the real world: the system must speak the user's language, with words, phrases and concepts familiar to the user.
3. Control and freedom: the user must have control of the information content and move freely between topics.
4. Consistency and standards: the user should expect the conventions of the system to be valid throughout the interface.

5. Error prevention: avoid placing the user in ambiguous, critical situations that may lead to error.
6. Recognition rather than recall: instructions for using the system should be clearly visible and easily retrievable.
7. Flexibility of use: offer the user the possibility of differential use - depending on his experience - of the interface.
8. Minimalist design and aesthetics: give more importance to content than to aesthetics.
9. User help: help the user recognize, diagnose and recover from error.
10. Documentation: although the system should be usable without documentation, it is preferable that it be available.

Among the most widely used open source learning environments at the academic level, there is Moodle (Modular Object-Oriented Dynamic Learning Environment), a dynamic, modular and object-oriented learning environment, adaptable to different teaching and learning styles, in order to implement e-learning. It is, in essence, an LMS (Learning Management System), i.e. a system for organizing and managing online courses, an open source software package, based on pedagogical principles. Its basic functionality can be exponentially extended through the implementation of thousands of plugins.

In Italy, it has been adopted by many universities, including the University of Foggia.

Since its release, Moodle has aroused the curiosity and interest of the scientific community which, for various reasons, has conducted investigations into the accessibility of the new environment and its impact on distance learning for people with disabilities [18].

In a first, older case [19], the investigation focused on accessibility for visually impaired users, with the help of an expert in accordance with WCAG 2.0 guidelines. Several critical issues were found: excessive use of tables for the construction of page layouts, lack of tools to ensure accessible control of navigation, difficulty in navigating using the keyboard, lack of an editor with features to support content accessibility, lack of dedicated tools for searching text within the generated content.

In a second, more recent case [20], a group of university students without disabilities were asked to access Moodle from mobile devices, using the official app. At the end of the experience, they were given an accessibility assessment questionnaire. Again, accessibility problems were found to be mostly related to the presence of excessively long lists, the use of icons as a vehicle for relevant information and toggle menus.

In a third case [21], much more recent, the investigation concerned the accessibility of content containing mathematical formulas and notations by users with visual impairments. In this case, the authors point out that, while the most recent releases of Moodle are characterized by a better general accessibility, there are still some problems related to the management of mathematical content, mainly due to the use of a language such as LaTeX, which is not well suited to the needs of accessibility. Other problems, however, appear to be related to the units of measurement used in CSS to define the size of the text and the use of headings.

Conclusions

It is undeniable that many of the criticalities detected, and detectable, are intimately linked to the structure of the platform and the use of PHP language (Hypertext Preprocessor), while offering many advantages, imposes a “tabular” setting of the pages and the adoption of specific TAGs for alternative information.

The solution, therefore, should be sought in the modification of the code: an open source platform can be modified and adapted to specific needs, even after the event, usability and accessibility, unlike proprietary platforms, whose “accessible” versions must necessarily be released by the manufacturer, that will provide only if the release appears economically convenient.

The “manipulation” of the code can be onerous, in terms of time and commitment, but it is certainly a viable way.

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