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Ergonomic adjustments on a website from the usability of functions: Can deficits impair functionalities?

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ABSTRACT. Current study assesses whether deficits and usability of ergonomics impair the functionality of a university website. The concepts of functionality, usability and ergonomics were foregrounded by contextualizing them within a university profile. Later, a satisfaction survey was proposed to users to measure the satisfaction in the use of the website and to map the problems in usability. In addition, an ergonomic inspection was performed on the site by applying Bastien and Scapin´s ergonomic criteria. After analyzing results by descriptive statistics and content analysis, the ergonomic and usability problems were detected, or rather, feedback deficits, minimum action (navigation), flexibility and experience impaired the excellence of website´s functionality, causing dissatisfaction or abandonment of the website by the users. After the analysis of the results, ergonomic adjustments were suggested for the website. They may be a help in new website projects or adjust products in which usability has not been incorporated to the development process.

Keywords: ergonomics, software quality, website evaluation.

Adequações ergonômicas em website a partir da usabilidade das funções: podem os déficits prejudicar as funcionalidades?

RESUMO. Esta pesquisa visa a avaliar se os déficits de ergonomia e de usabilidade podem se sobrepor às funcionalidades, em website de universidade. Buscou-se, inicialmente, fundamentar os conceitos de funcionalidade, de usabilidade e de ergonomia, contextualizando esses conceitos em relação ao perfil de uma Universidade. Posteriormente, realizou-se uma pesquisa de satisfação (*survey*) junto aos usuários, com o objetivo de mensurar a satisfação de uso do website, bem como mapear os problemas de usabilidade percebidos. Em complemento, realizou-se uma inspeção ergonômica do site, através da aplicação dos critérios ergonômicos de Bastien e Scapin. Após a análise dos resultados por meio de estatística descritiva e análise de conteúdo, observaram-se problemas de ergonomia e de usabilidade, em que déficits de *feedback*, ações mínimas (navegação), flexibilidade e experiência prejudicaram a excelência das funcionalidades do portal, gerando insatisfação ou descarte pelos usuários. Sugeriu-se, após a análise dos resultados, adequações ergonômicas ao website, que podem orientar o projeto de novos websites ou adequar os produtos em que a usabilidade não tenha sido incorporada ao processo de desenvolvimento.

Palavras-chave: ergonomia, qualidade de software, avaliação de website.

Introduction

Among other purposes, one of the goals of Production Engineering is the improvement of productive processes for more productivity and cost-effectiveness (Marques, Tavares, Souza, Magalhães, & Léllis, 2010). Within this scenario, ergonomics may contribute by rethinking processes while considering human biomechanics and cognitive conditions. With the rise and consolidation of information technologies in several fields, these objectives must be extended to the process of software development, where intellectual capital is transformed into a digital product and, once a product, it has to satisfy the customer's needs. The quality of software goes beyond the application's ability to 'function' since the usability of the system and the ergonomics of interfaces, among other aspects, are valorized.

There are three production paradigms: after the Industrial Revolution, mass production (1st) emerged, followed by customized mass production (2nd) which led to the current paradigm of customization (3rd) (Hu, 2013). In this scenario, clients prioritize products or services that satisfy their expectations with efficiency, effectiveness and interaction readiness. This new paradigm confirms

the relevance of the product's usability and ergonomics, which are features that may impair the product's functionality when absent.

Software quality

Although it may seem intuitive, the quality of software is a complex concept since it takes into account the difference between what is specified and what is observed in the software, or rather, the stakeholders' emotions (those involved in the project), and the ability to resolve organizational problems (Koscianski & Soares, 2007). So that the quality of softwares may be evaluated, the International Organization for Standardization developed a Quality Model: ISO/IEC 9126 standard was used until 2012 when it was replaced by ISO/IEC 25010 standard. This model proposes eight quality attributes among other guidelines, namely, functionality, reliability, usability, performance and efficiency, maintainability, portability, compatibility and security. The latter two attributes were added by the new ISO. Current paper focuses on aspects of functionality and usability associated with ergonomics.

ISO/IEC 25010 standard defines functionality as the product's ability to provide previously specified functions that satisfy the explicit and implicit needs of the software's user, which could be measured by the quality of the utilization that was experienced by the user (International Organization for Standardization [ISO], 2011). Functionality is composed of three characteristics (Table 1).

Table 1. Characteristics of the software's functionality (ISO, 2011).

Characteristic	Ability
Functional completeness	Introduces appropriate functions for the user's tasks and objectives
Functional correctness	Introduces precise results in a satisfactory manner
Functional Adequacy	Facilitates the execution of specific tasks and objectives

In the case of a university website, some of the main functions are 'listing of courses', 'consultation of notices', 'access to external links', 'finding extensions' and 'reading news'. To provide an example of the function 'listing courses', the first characteristic refers to its adequacy (functional completeness) in relationship to users´ tasks and objectives. In order to determine the user's objectives, it is important to know, in advance, the profile of the user being analyzed. For a new user, with the profile 'future students', the function of listing courses must show, objectively and succinctly (functional correctness), all the courses offered by the institution, regardless of the educational level (high school, undergraduate, graduate, extension) or place (city, campus). When accessing a certain course, its details must be presented, while useful links should redirect the user to specific information (e.g. location). On the other hand, the aims are different for a user with a different profile.

Non-functional requirements describe the quality and readiness expected from the system. They do not represent functionality but they determine how these routines take place. A system's utility is determined by both its functionality and its non-functional characteristics (Chung & Prado Leite, 2009). The relevance of non-functional requirements to the quality of information systems is also evident, especially those used by the organization's clients (Ferreira & Leite, 2003). They may be classified into two distinct groups. Table 2 reveals a considerable similarity with Bastien and Scapin´s ergonomic criteria.

Table 2. Non-functional requirements by evaluation aspect (Pressman, 2010).

Information display	Data entry
Consistency	Support mechanisms
Feedback	Error prevention
Levels of human skill and behavior	Error treatment.
Human perception	
Metaphors	
Minimization of memory load	
Functional classification of commands	
Project independent of the monitor's resolution	

Due to the similarity between aspects, the authors have opted to evaluate the website by Bastien and Scapin's ergonomic criteria, in which the evaluation aspects of non-functional requirements are already included. In current study, usability (Item 2.3) will be treated as a non-functional requirement, although many authors detect a powerful relationship between the properties of functionality and usability (Luna, Panach, Grigera, Rossi, & Pastor, 2010). This relationship corroborates current investigation, since difficulties in the use of a function may be detrimental (distress that causes dissatisfaction) or invalidating (user dismisses the use of the feature, appropriating other external alternatives to the website to perform the same function).

Usability

The term usability has been defined by "[...] the ability of the software product to be understood, learned and operated by a user, and its attractiveness, when used under specified conditions" (Associação

Brasileira de Normas Técnicas [ABNT], 2003, p. 9). It was later redefined as "[...] degree to which a product or system can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO, 2011, p. 8).

This interaction between user and web content may estimate the system's performance, once it interferes in the productivity during navigation (Peña-Ortiz, Gil, Sahuquillo, & Pont, 2015). Although perceived as an obvious concept, the concern with usability is not frequent in information system projects (Ferreira & Leite, 2003), even though the success of web applications is limited by the lack of usability (Luna et al., 2010). The model of a software product with satisfactory usability must be intelligible (it allows the user to understand how it can be used), learnable (it allows the user to learn its application), operational (the user may operate and control); it must have error protection, user interface aesthetics (according to standards, conventions, styles) and, finally, accessibility (ISO, 2011). The user interface design, often referred to as usability design (Pressman, 2010), comprises the aesthetics in the project (layout, colors, graphics, interaction mechanisms, ergonomics (information disposal and layout, metaphors, navigation) and technologies (interface standards, reusable elements).

However, usability also depends on the user's aims and the environment of usage during the execution of tasks, allowing its improvement, based on six principles: evidence (clear meaning in the interface's goals, reducing learning time, facilitating memorization and reducing errors); consistency (standard for similar operations, e.g. menus); ability (respect of user's ability, avoiding information density by aids such as hearing); compatibility, satisfaction of the user's expectations (colors, movements and actions); prevention and correction of errors (avoid and correct errors) and feedback (feedback to users) (Jordan apud Iida, 2005). When comparing usability principles with ergonomic criteria (item 3.1), it becomes evident that the principles are contained within the criteria, confirming the choice of the tool to evaluate the website.

Software ergonomics

According to the definition of the Brazilian Ergonomics Association (Abergo), ergonomics is a scientific discipline related to the interaction between human beings and other elements or systems. In products, including software, its purpose is to guide the physical, cognitive and organizational aspects to increase productivity. It also contributes towards the design and evaluation of tasks, jobs, products, environments and systems to ensure compatibility with the characteristics of individuals (Theberge & Neumann, 2010). Guidelines on design and style, principles, heuristics, standards and guidance may be found to support the development of ergonomic projects, which may vary according to the design strategy adopted while its features may be related to cognition (logic, mental models, memory, language and skill acquisition) (Bastien, Scapin, & Leulier, 1999). The recommendations on software ergonomics included in the standard, if applied, allow the facilitation and reduction of the time needed to access information, avoiding user's dissatisfaction and disinterest in the utilization of the software (Longaray & Silveira, 2013). The ergonomic evaluation techniques for the interface may be categorized as analytical (software project), heuristics (judgment of the ergonomic qualities by specialists) or through the use of checklists (Cybis, Betiol, & Faust, 2010).

The Eight Ergonomic Criteria of Bastien and Scapin are used in the form of a checklist to evaluate the ergonomics of the software. These criteria (Table 3) facilitate interaction between the user and the interface, reducing the workload without impacting adaptation and comprehension, reflecting the actual environment of the users (Bastien & Scapin, 1993).

University website

A university website is a virtual environment to disseminate information to students (alumni, current and future students), servers and the external community. Since it is an educational institution, its main product is education, or rather, the offer of courses that range from high school to graduate programs, as well as extension courses for the community. It also counts on infrastructure for research and the development of technological projects, uniting the pillars of teaching, research and extension. A university website provides information on institutions, news, programs, regulations, links to external systems (webmail, library, Moodle virtual environment, student's portal), internships, information on student applications, research and contacts. A brief visual inspection of the website reveals high information density available in its structure. The layout is confusing, complicating navigation and access to information.

Table 3. Ergonomic Criteria. Source: based on Bastien and Scapin (1993).

(Continues)			
Criteria		Subcriteria	
Guidance	Guidance to beginners, facilitating interaction with layout.	Prompting	Influence users in their actions, ensuring the lack of doubts.
		Grouping/distinction	Fast intuitiveness for users. Item subdivided into Group/Dist by Location and Format.
		Feedback	Immediate response to the users' actions, with instant feedback.
		Legibility	Show legible information, focusing on the accessibility to a specific group of users.
(Conclusion)			
Workload	Reduction of repeated activities, redundant interpretations.	Brevity	Limit activities that compel users to take decisions that require higher cognitive and motor skills. This item is subdivided into Concision and Minimum Actions.
		Information density	Supply relevant data only, compatible with the real routine of users.
Explicit Control	Right of user to control the dialogue.	Explicit Actions	The system's processing must be a result of users' actions, and they cannot be unsure about the actions to be performed.
		User Control	Users must predict the next actions of the software, allowing cancel/return/continue.
Adaptability	Search for balance and alternatives for the adaptability of the layout to every type of user.	Flexibility	Offer several ways to perform the same task.
		User experience	Differentiate the level of experience of the user.
Error Management	Structure to avoid/reduce errors, favoring prompt corrections.	Protection against errors	Identify and prevent the entry of data that may cause an error.
		Quality of error messages	When the error is identified, the user must be informed not only on the inconsistency, but on the solution as well.
		Error correction	Offer comfortable and speedy correction alternatives.
Consistency	Standardization of objects, facilitating the use of the site.		
Code significance & denominations	Respect of users' reality.		
Compatibility	Layout that respects the psychological characteristics of users, with organization, according to their expectations or habits.		

An opinion survey was conducted to evaluate usability and a checklist of ergonomic criteria was applied to map problems related to ergonomics, usability and functions which will contribute towards the proposal of ergonomic improvements or adjustments (Table 6).

Material and methods

Current research is a cross-sectional explanatory survey to identify the situation, causes and theories related to a phenomenon as it occurs at a single moment (Freitas, Oliveira, Saccol, & Moscarola, 2000). It also represents a case study, defined as the analysis of one or more objects with the use of different collection instruments (observation, questionnaire, checklist), and the interaction of the researcher with the object evaluated (Berto & Nakano, 2000). Collection is undertaken with a digital structured questionnaire with ordinal qualitative scales, developed to identify the ergonomic and usability problems within the website.

The questionnaire should take into account objective, research hypothesis, target audience, and methods that will be used to analyze the data (Ghünter, 2003). Following these recommendations, research goal may be defined as the mapping of the website's problems of usability and ergonomics and, as the hypothesis, the idea that the usability and ergonomic problems affects the system´s functionality. As for the satisfaction survey, a prospective analysis technique was applied (Cybis et al., 2010) through an online questionnaire to servers and students, respectively comprising 419 and 3,500 participants.

Once the parameters and the minimum size of the samples were defined, 10 multiple-choice questions were prepared, or rather, three were related to the identification of the respondent; two were general satisfaction questions; five were based on Bastien and Scapin´s ergonomic criteria. The questionnaire was developed after a pilot test was applied among the authors and random users to validate the tool. After validation, the questionnaire was applied through the university e-mails and social networks, whose response rate was monitored until it reached the minimum rates for the previously mentioned samples. Responses were tabulated according to the Likert Scale (adapted), one of the most popular and reliable scales to measure behavior by response options that vary from one extreme to the other (Ghünter, 2003). The instructions in the survey were also included in the development of the questionnaire (Survey monkey website de serviços de questionário, 2015), as well as the use of clear response options, unipolarity (extremely brave and not brave at all, instead of extremely cowardly), the use of an odd number of options (in order to have a midpoint), maintaining the continuity of responses, covering all possibilities of alternatives, and the use of questions instead of statements.

Results and discussion

An ergonomic problem is established when an interface is not consistent with the characteristics of users and their manner of performing tasks. This inconsistency may be described as an inadequate aspect of the interface, disregard for an ergonomic recommendation, usability problems and the operational context where the problem occurs. Based on the same logic, a usability problem may be described by its context, by the possible ergonomic problem that caused it and the potential effects to users and their task. Therefore, usability is measured according to the difficulties users have in performing tasks, while ergonomics may only be inspected by ergonomic criteria (Cybis et al., 2010). In current study, the website's levels of usability were measured with an opinion survey applied to users and the results were compared against an ergonomic inspection of the interface, contextualized by users´ opinion and author's considerations based on the theory. The analysis resulted in recommendations for website interfaces that may be replicated in different scenarios, and also used as 'good practices.'

Survey

With a confidence level of 95% and a sampling error below 10%, the rate of respondents reached 104 servers, 178 students and 7 individuals from the external community (outsourced workers, alumni, interns and former employees), totaling 289 participants (Question 1). The confidence level is the probability that the effective sampling error is lower than the sampling error admitted in the research. In other words, it is the level of certainty that the sample represents the population with precision. On the other hand, sampling error is the difference between the rate estimated by the research and the true rate (Santos, 2015), also understood as the certainty that responses reflect the opinions of the population. When asked about the frequency in which they use the university website (Question 2), the participants were distributed evenly with regard to frequency of access. A summary of the responses given to questions 3 to 9 of the survey is presented and commented in Figure 1 to 7.

Further, the questionnaire included an open question to collect richer data without the influence of pre-determined responses. Thirty-three percent of employees made suggestions, which were read, and their most common expressions were identified and tabulated (Table 4), resulting in an index of recommendations (Table 6). The recommendations indicate actions, such as the insertion of shortcuts or fast access menus, the improvement of the search engine and a redesign of the system, which may significantly improve user's satisfaction.

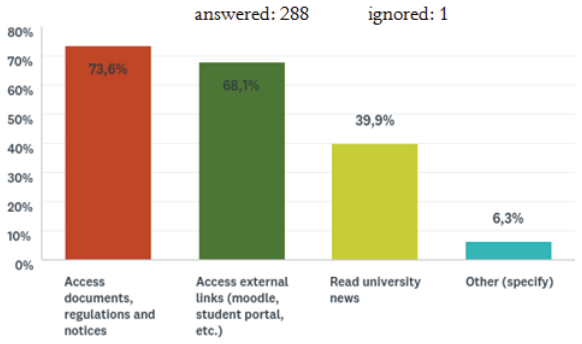

Figure 1. Answers for question: 'What was your objective for accessing the University's website?'. Most participants access the university website to read documents and access external links, with more than 60% of the layout of the home page being used for the news. Even within the alternative 'others', many users report the access of external links (library, corporate systems and webmail). Developed by the author.

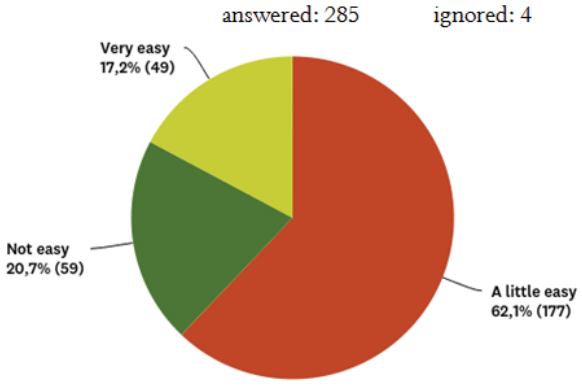

Figure 2. Answers for question: 'Was it easy to find the desired information?'. More than 62% of the users find it is 'not so easy' to find information on the website. The extremes were balanced, and their variation may be associated with the level of experience and/or connection of the user with the environment and information technologies. Developed by the author.

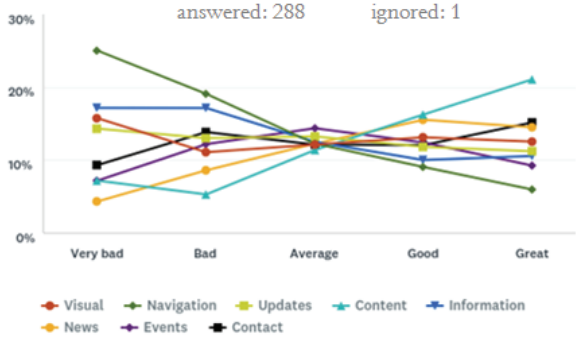

Figure 3. Answers for question: 'How do you evaluate the site in relation to:'. Emphasis on the satisfaction of the user with the website's content, negatively exceeded by the navigation problems. Developed by the author.

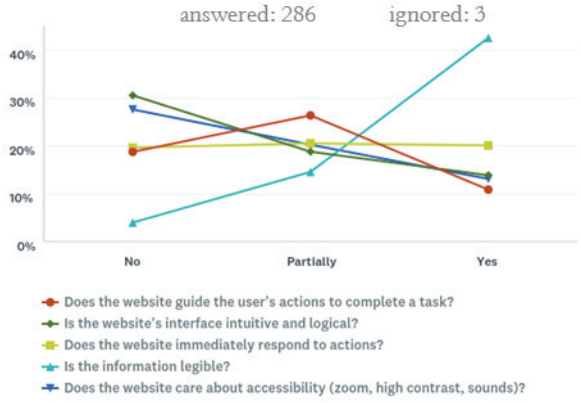

Figure 4. Answers for question: 'In relation to the ease of interaction with the layout, evaluate:'. The best aspect was the legibility of information. The aspects with high dissatisfaction levels were the website's lack of logic and intuitiveness and the lack of assistive technology resources (accessibility). Developed by the author.

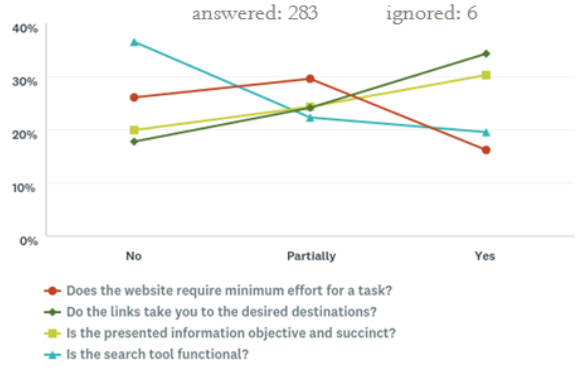

Figure 5. Answers for question: 'In relation to the reduction of repetitive activities, evaluate:'. The opinion of respondents points to problems in the search engine because, despite returning values, it does not seem functional to users. The lowest level of agreement is associated with the criterion 'minimum effort', indicating that it is difficult to navigate on the website. Developed by the author.

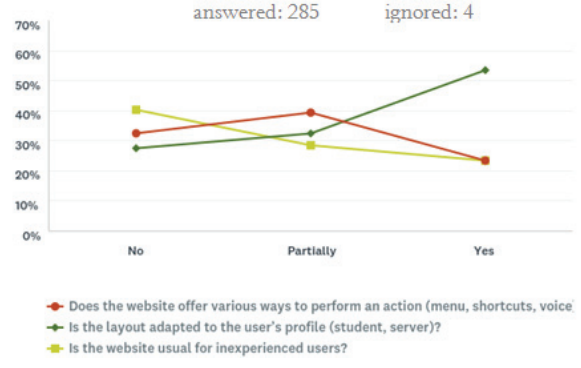

Figure 6. Answers for question: 'In relation to the user's profile, evaluate:'. Regarding to user's profile, the website shows few manners to perform an action and difficult usability for the less experienced audience. Most users considered the layout to be adapted to the profiles. Developed by the author.

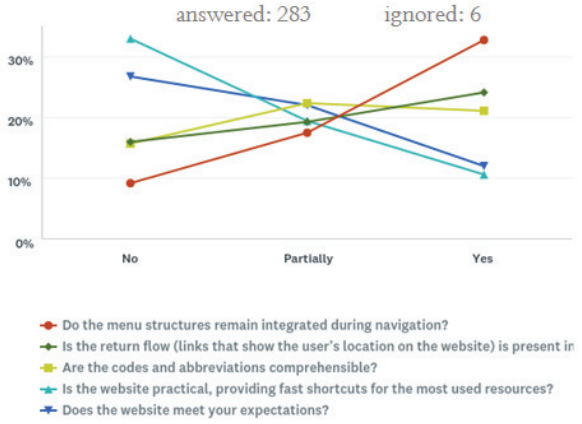

Figure 7. Answers for question: 'In relation to the layout in general, evaluate:'. There was partial satisfaction with the layout, with a higher deficit in practicality (shortcuts and focus on the main resources) and the fulfillment of users´ expectations. The menus, return flow and codes were better tolerated by the participants. Developed by the author.

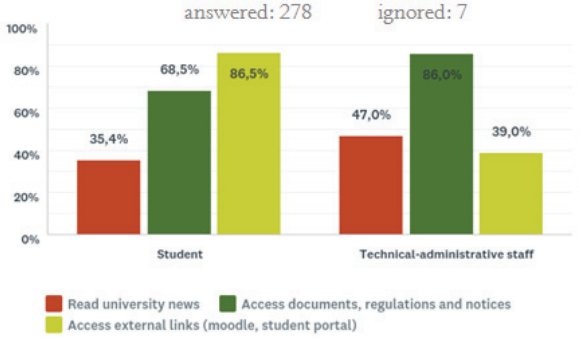

Figure 8. There was a pattern in the remaining responses when compared to groups of users, except in the item 'objective.' While students went to the website to access external links and documents, servers visited the website to access university documents and news. Developed by author.

Table 4. Index of users' recommendations (open question) based on the expressions extracted from the descriptive responses, to improve the website's usability. Source: Developed by the author.

Expressions of Users	Qty
Facilitate access to links/frequent documents	32
Improve search	23
Improve design	23
Consider users' profiles	12
Improve layout	11
Update information	10
Organize content	10
Research within the context	10
Improve navigation	9
Improve the quality of information	9
Re-evaluate website Project	9
Organize menus	7
Highlight the most read/most important news	5
Facilitate contacts	4
Standardize the screens	4
Describe acronyms	3
Make other languages available	1
Facilitate content publication	1
Integrate social media	1

Checklist of ergonomic criteria

The highest rates of conformity were found in the criteria 'Legibility', 'Concision', 'Information density', 'Explicit actions' and 'Compatibility', while the most significant problems identified indicated deficits in the criteria 'Feedback', 'Minimum actions', 'Flexibility', 'User experience' and 'Protection against error' (Table 5). The criteria 'User control', 'Error message' and 'Error correction' are not applicable because the data entry takes place exclusively within the search mechanism, which performs the search without errors, even in the absence of the parameter.

Table 5. Results of the application of Bastien and Scapin´s ergonomic criteria of the website evaluated. Source: Developed by the author.

Criterion	Yes	Partial	No
Promptness	40%	30%	30%
Grouping by location	38%	25%	38%
Grouping by format	55%	27%	18%
Feedback	50%	0%	50%
Legibility	71%	24%	5%
Concision	75%	25%	0%
Minimum actions	0%	50%	50%
Information density	75%	0%	25%
Explicit actions	100%	0%	0%
User control		Not applicable	
Flexibility	0%	0%	100%
User experience	0%	17%	83%
Protection against error	0%	100%	0%
Error message		Not applicable	
Error correction		Not applicable	
Consistency	57%	29%	14%
Meanings	42%	42%	17%
Compatibility	71%	14%	14%

Comparing similar websites

When accessing websites of other universities, several ergonomic attitudes that might help solve usability problems in current website were identified. Table 6 lists the ergonomic and usability adjustments that are considered good practices in this study, based on results (survey and checklist), and on the observation of ergonomic websites.

Since results obtained from the survey were similar to results in the checklist, they indicated that the survey is aligned to Bastien and Scapin´s ergonomic criteria. It therefore proves to be adequate for the ergonomic inspections of the interface in the search for relationships between ergonomics and usability. At its early stage, the purpose of current research was to verify whether the functionalities of a system may be suppressed by ergonomic and usability deficits. After analysis of the results, the perception was that it was 'not so easy' to find information on the website in which the functions of search, course listing, document access, external link access and site navigation, among others, were partially suppressed by the deficits of ergonomics and usability. This difficulty has been associated with 'find the task/information', and not with 'performing the task.' Figure 3 and 4 confirm this aspect, or rather, the user seemed satisfied with content and legibility but dissatisfied with navigation. The function 'research in the context' was mentioned 10 times (Table 4) and, in this case, might be suppressing the function 'improve search' (23 occurrences; Table 4), whose evaluation indicated that it did not return the results expected by the user (Figure 5).

According to the open answers to the questionnaire, many users claimed to replace the function 'search the site' by an external search engine due to the difficulty in searching the context (campus). The design has also been the cause of dissatisfaction of participants. When the checklist is applied, the minimum actions (Figure 5) may be applicable through the insertion of fast access panels similar to the 'metro' panels on Microsoft Windows 8/10, with access buttons for the most frequent functions. Although the survey's results indicated that users perceive the website layout to be adapted to different profiles (Figure 6), the checklist of ergonomic criteria indicated the need to optimize flexibility and take the users´ experience into consideration, according to recommendations listed in Table 6. Another aspect observed refers to the absence of an accessibility bar. Despite the use of keyboard controls that increase or decrease the size of the font, less experienced users are not familiar with these resources. The accessibility bar, when available, shows high contrast for visually impaired users. Therefore, Table 6 brings a summary of the ergonomic adjustments resulting from this study, which may be employed to adapt websites already designed, as well as guide the project of new websites, although the usability may be incorporated into the development process (Jacko & Stephanidis, 2003). In the case of the website evaluated, it is possible to make it ergonomically adequate. Since many interventions are needed, the limitations of the technology employed and the organization's interests have to be considered to guide the decision between adjustment and reconstruction. Further studies should assess the quality of the website's information since it requires exclusive attention due to its relevance and complexity, or make in-depth studies on the ergonomics and functional requirements of usability.

Table 6. Ergonomic recommendations for the establishment or adjustment of university websites. Source: Developed by the author.

(Continues)

Ergonomic Criterion	Usability deficit	Ergonomic adjustments
Promptness	User does not know where to find information, absence of help, confusing menu structure	Take the user´s profile into consideration when creating the interface (cases of user´s profile use), insert fast access panels (shortcuts) and rethink the structure of the website (complex chart).
Grouping by location	Lists of complex selections, menus with no logical organization or grouping, excessive focus on news on the homepage typesetting.	Replace the name of sectors for names that are more expressive to users, group menus per subject (use color code), change the typesetting of the homepage: 40% access to documents and notices, 20% fast access links to systems (right upper corner), 20% news (dynamic banner) and 20% menus and other items.
Grouping by format	Website colors show low contrast and are not being used as visual code. On pages with a lot of information, there are no formatting resources used.	Use colors that highlight the menu groups, making the access more intuitive. On pages with high information density, use flashing visual resources to highlight data and information.
Feedback	The cursor does not display help messages to the user, the search box has no automatic focus	Implement help messages according to the context, displayed when the cursor is positioned over an element of the page. Attribute automatic focus to the search box (highlight the field).
Legibility	There are free areas that are being used inappropriately, the side menu has no separation margin, and the horizontal menu bars are too close to one another.	Occupy the free spaces with fast shortcut panel for the most frequently accessed options. Create menu groups by subject, and add a separator (soft line) between each item. Create spaces between the horizontal menu bars.
Concision	Menu options are not concise.	It is recommendable to re-evaluate the website structure. It is currently organized according to the chart. Foregrounded on the ergonomics and usability perspective, it should be built according to the needs of users and their tasks.
Minimum actions	The website does not highlight the search box when loading the homepage. Navigation through the TAB key is impossible. The menu structure is not conceived to decrease the steps necessary for selection (slow and confusing navigation).	Attribute automatic focus to the search box, highlighting it. Correct the order of the TAB key and create a visual highlight to the object selected (current highlight is almost indistinguishable). When positioning the cursor on the menu, the submenus should be displayed, decreasing steps and waiting time. Another suggestion is the insertion of fast access icons in the upper right corner that direct the user to the external systems (Moodle, e-mail, student's portal, library, etc.) and documents (Figure 8).
Information density	There is too much information on the screen, distracting users from what they to do to perform the intended task.	After implementing the grouping, the minimum actions and color codes, the recommendation is to evaluate the quality of the information presented (suggestion for future studies).
Flexibility	Users cannot modify or eliminate irrelevant items from the windows, or alter values defined by 'default'.	The suggestion is to solicit the user´s profile before loading the homepage: student, server, future student, external community. By doing so, it is possible to offer a standard customization guided by the profile. Another solution would be to implement a login mechanism, allowing users to customize their area. However, as there is a profile standard, the first solution is adequate.
Users´ experience	The system does not provide different ways of presenting the same information to different types of users. There is no step-by-step for beginners, or areas specifically for experts. There is no support for keyboard shortcuts.	This may be managed together with flexibility. The system may invite/direct the less experienced user towards the right actions, through specific areas, and allow leaner layouts for experts. The addition of keyboard shortcuts to activate menus is suggested.
Protection against error	The system does not separate appropriately the selectable areas of the menu to minimize accidental activations.	Reorganize layout / design, separating menus and using free spaces to minimize accidental activations.
Consistency	The identification of the windows is not unique. The menus do not remain consistent during navigation.	This refers to the contextualization issue. The suggestion is for the page titles to show the name of the associated campus. In the case of the menus, the pre-display of submenus is suggested.
Meanings	Naming used in menus is not familiar to users. Abbreviations are not significant and are often similar.	Users need to memorize the click paths of the website. The naming will be clearer when implementing flexibility taking into consideration the profile and the tasks performed by the user. Abbreviations are determined by the university's structure.
Compatibility	The website does not provide any help.	Implement a presentation video of the website on the homepage, with audio, subtitles and sign language. Provide a map of the website.

Conclusion

Current study has shown that ergonomic and usability deficits may impair the functionalities of a website, causing dissatisfaction or abandonment by users. The diagnosis of many deficits indicates that ergonomics and usability have not been incorporated into the software development process, whose current structure is oriented to the functionalities, and the organized content. Thus, current format requires the adaptation of the worker to the environment, contrary to the assumptions of ergonomics and their criteria.

The adjustments generated represent a construct that may be followed to adapt websites already built to users´ needs or to guide new projects. In fact, usability is as important as functionality since the former may impair or invalidate the latter.

Future comparative research that evaluates usability from a heuristic perspective may refine the ergonomic recommendations, and in addition, map the similarities already perceived between ergonomic criteria, principles of usability and functional and non-functional requirements.

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