A Quality Inspection Method to Evaluate E-Government Sites

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Abstract. Electronic government allows a broad range of citizens to access governamental information and services, as well as to participate in the government decision-making process. On the other hand, it imposes a higher challenge on a web designer to avoid digital exclusion. Before proposing guidelines to design e-gov sites, it is important to have objective methods to evaluate their quality. Traditional inspection methods do not cover the specificities of e-gov sites. This work proposes an extension of Nielsen's heuristic evaluating method, applied to the information, services and citizens' participation categories. Broad accessibility, interoperability, security and privacy, information truth and precision, service agility, and transparency are added. The g-Quality method was instrumental as an objective evaluation form. It was applied to 127 Brazilian e-gov sites. The extended method found more problems, resulting in more negative ratings than the Nielsen's original method. The Brazilian public sites quality level was determined by using the g-Quality method, producing positive results.

1 Introduction

The use of Information and Communication Technologies (ICTs) have been pointed out as being some of the fundamental paths towards improving democracy and increasing people's participation in the decision-making process. Countries are investing more and more in technological improvement for guaranteing universal ICTs accessibility [1]. However, having a computer and an Internet connection are necessary, but far from being enough to achieve an electronic government (e-Gov), name given to the on-line exchange and transactions between governamental institutions and the population. E-gov means citizens having access to governmental information, getting on-line services and also participating in the government decision-making process. The three items must be made accessible in any e-Gov portal [2]. However, by implementing the so-called e-governance, a greater participation of the population in the decision-making process is sought, as well as greater control of the State's actions. That way, through the Internet, one could access the budget and investment plans of a determined city, not to mention sending and receiving complaints and suggestions for the application of public resources. Consequently, besides working for the digital inclusion, governments around the world must invest in designing webportals that offer information efficiently and services to their citizens, which also allows people's participation [3].

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Like all new ideas, the electronic government concept is still designing its tools and measures. During the research that resulted in this article, it was verified that neither specific design guidelines nor evaluation criteria has been designed to address the specificities of e-gov sites such as interoperability, accessibility, transparency and information accuracy. The lack of such design and evaluation guidelines may be the cause for e-gov excluding more than including people in the digital society.

It was proposed an inspection method of evaluating the e-gov sites, the g-Quality. The method is an extension of the heuristic evaluation proposed by Nielsen [4]. The criteria and respective components, which are defined in this research, were formatted into a questionnaire, to guide the evaluators' analysis process. The method was applied to evaluate 127 e-Gov Web sites, including the federal web site (representing the country), all Brazilian capitals (representing the states) and all of Rio de Janeiro's state cities (municipal level). The case study has shown that the method is sound to evaluate e-gov sites. Interesting results include security and privacy, accessibility, and information truth and precision.

2 Electronic Government

Electronic government, most commonly called e-gov, means the use of Information and Communication Technology (ICT) to attempt the governamental directives and obligations defined by each country rights principles and development of democracy levels. Tambouris et al. [2] analize electronic government different websites through three constitutive caracteristics. Satisfying meeting the citizens' needs, regarding information acquisition is the first webportal constitutive caracteristic. It enables the access of government directive and decision information. A Pew Internet and American Life Project have indicated that "65% of Americans expect to find government information online". This same research shows Internet as the first place that most users will go to for any kind of information.

The second e-gov constitutive characteristic is rendering services, which allow online transactions of government products and services. Through an on-line governmental portal, it is possible to have 24-hour access to public services from home, from work or any other place connected to the Internet. An e-gov webportal high-positioned in maturity and quality of usage evaluation as the Singapore G2C portal, offers over 500 online services, from buying a home, finding a job, to dealing with death and taxes. Other countries, such as the UK central government, are fixing goals for delivering electronically – or digitally – all governmental services to citizens.

The third e-gov constitutive caracteristic is promoting citizen participation in government decision making-process. In this perspective, webportals offer population the possibility of consulting government statistical data and giving suggestions in webforums about the government policy or the electronic service delivery quality. They can also vote via Internet in the most attractive governmental decisions. In a country best-developed speaking in e-government initiatives as Canada, people can access public costs and budget, and choose who will represent their interests. Two out of three Canadian Internet users say they would vote on federal, provincial and municipal elections over the Net if the options were available to them, says a NFO CFgroup study.

The challenge in designing these governmental portals is not to restrict people's participation to only the service consumer character of getting governamental services and information. For completing the direct democratic process, citizens should be able to receive a feedback about their suggestions or opinions for measuring their influence in the decision process.

Each e-Gov sites presents a configuration related to these three constitutive characteristics: information migration percentage, service offer, and citizen's participation capacity. An e-Gov site, for example, can be totally informative if it is 100% informative, 0% service and 0% participatory. Depending on the site's features, a particular evaluation heuristic might have a more or less relevant role in its evaluation. It means that while doing an e-gov website heuristic evaluation, it is of primary importance to take in to account what category is more relevant and what are the website objectives. An e-government site that is focused on on-line governmental services, the e-procurement, doesn't have the objective of offering the design tools for people's participation, voting or giving opinions in an electronic forum. So, if through people participation usability inferences in e-procurement websites are used. Otherwise, in the site specialized in increasing people's participation in the governamental decision making process, it is not recommendable to use e-procurement usability criteria.Another important factor that should be taken into account involves the percentages regarding information, services, and participatory government processes to be migrated into the Web. This will indicate the government's strategy and migration maturity.

In the government's pursuit to let citizens to access government services from the Web, several obstacles should be examined to maintain existing relationships which are clear in the traditional venue when a citizen seeks information, requires a service or wishes to participate in government decisions.

In order to obtain government information through traditional means, such as finding out about a particular real estate tax, the citizen must first approach the pertaining government sector. After checking that the desired information is available, since it is official, the citizen has total assurance regarding its usage, validity (expiration date), and non repudiation (official guarantee of acceptance).

In a non electronic reality, if a government service is needed, such as handing in the yearly income tax form, the citizen must approach a Brazilian IRS office. Upon its delivery, a receipt guarantees that the document has been duly processed, and one can rely on its security and on the privacy of the information rendered.

Citizens who wish to participate in government decisions, for instance, in the participatory budgeting assembly, may attend its meetings to present motions, verify and/or record demands quite easily and, on some occasions, participate in the decisions by voting.

When the government tries to migrate the provision of services to the Web environment – be it to display information, to render services, or to establish participation channels – it must take into account the peculiarities of the traditional means. It must guarantee access and information accuracy, non-repudiation of data, security and privacy. Such peculiarities may trigger problems that are not detected by the Heuristic Evaluation method proposed by Nielsen.

Hence, to embrace these peculiarities, which are not covered by the traditional evaluation method, the broadening of the heuristic evaluation criteria for the e-Gov domain is proposed.

3 Evaluation Criteria for E-Gov

A multidimensional Web-based e-government evaluation is discussed in [13]: usability testing; user feedback; usage data; and Web and Internet performance data. It stands out that specific methods are appropriate for obtaining different types of information at various stages of the Web site's life cycle. Among them, Nielsen's usability heuristic evaluation method [6] is broadly used, particularly in the initial phases of the project. The method consists of a set of rules that a usability expert should be looking at when evaluating an interface. The set of heuristics were upgraded to fit web site interaction requirements. Nielsen's heuristic rules were complemented with others rules to evaluate all possible e-gov sites.

Many evaluators have found that Nielsen's list does not always meet their specific needs and they frequently require alternative guidelines or some re-interpretation of Nielsen's original descriptions in order for each item to make sense. The difficulty of creating a single set of heuristics that can accommodate every system, achieve thorough results, and be interpreted reliably by multiple evaluators [6].

To access the electronic government domain on the Web, bearing in mind that the citizen should be the main focus, it was realized that the heuristics could be grouped under five evaluation criteria, namely:

- *Cognitive Effort:* Use of individual attention to understand and learn a task. By minimizing the cognitive effort, users will perform tasks more intuitively, thus reaching their objectives more effectively;
- *Tolerance:* Citizen's motivation and patience in awaiting, understanding and performing tasks according to site responses;
- *Reach:* Possibility of reaching a greater number of citizens, whatever the technical features of the user's equipment or their special physical or cognitive needs;
- *Physical Effort:* Easiness to use the site, as a result of data reuse;
- *Trust:* Demonstrating reliability and credibility, guaranteeing security in the information exchange and in the site navigation.

Nielsen's usability heuristics, we suppressed any further explanation [7], [8]. The last five are the extension required to evaluate e-gov sites, as follows:

- *Visibility of system status:* the system should always keep users informed about what is going on, through appropriate feedback within reasonable time.
- *Match between system and the real world:* the system should speak the user's language. Follow real-world conventions, making information appear in a natural and logical order.
- *User control and freedom:* users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue.

- *Consistency and standards:* users should not have to wonder whether different words, situations, or actions mean the same thing.
- *Error prevention:* even better than good error messages is a careful design which prevents a problem from occurring in the first place.
- *Recognition rather than recall:* make objects, actions and options visible. The user should not have to remember information from one part of the dialogue to another.
- *Flexibility and efficiency of use:* Accelerators may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users.
- *Aesthetics and minimalist design:* dialogues should not contain information which is irrelevant or rarely needed.
- *Help users recognize, diagnose, and recover from errors:* error messages should be expressed in plain language, precisely indicate the problem, and constructively suggest a solution.
- *Help and documentation:* even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation.
- *Accessibility* – e-gov site should include all citizens. Consequently, the site should attend people with special needs.
- *Interoperability* – e-gov site should be able to exchange information and services as in actual government bureau. In order to achieve interoperability, at least communication protocols should be defined, but it is recommended standards.
- *Security and privacy* – Government site should be protected against hackers because people will rely on the information. Additionally, citizens' information should be protected when sent to e-gov sites.
- *Information truth and precision* – Information must be true and precise since it will influence citizens' life. It is the government responsibility to maintain its sites updates and corrected.
- *Service Agility* – Time response to citizens' requests is fundamental to create trust; i.e. communication is a two-way road.
- *Transparency* – The governments must make available to the public all pertinent information, such as, public expenditures, so as to allow a clear view of governmental operations. The publication of government budgeting and spending permits people to accompany better what is planned and what has been executed in the governmental administrations (Fiscal Responsability Law) [10].

The five criteria are mapped to the sixteen heuristics as illustrated in Figure 1. Heuristics can be mapped to more than one criterion with similar or different weight, in the range 0-3, from the least to the most important. No relevance receives weight 0; low relevance receives 1; average relevance receives 2 and high relevance receives 3.

When satisfying such criteria, citizens on the Web will get better navigation. The usability propriety embraces all quality criteria, however not with the same intensity, as the legends for Figure 1. Some properties such as Security and Privacy satisfy only the trust criterion. Another such as the property "Service Agility" reflects only in Tolerance and Trust criteria for the citizen.

To implement the g-Quality method, the heuristics were charted on an evaluation table, a checklist, presented in the addendum. The *checklist* also quantifies the

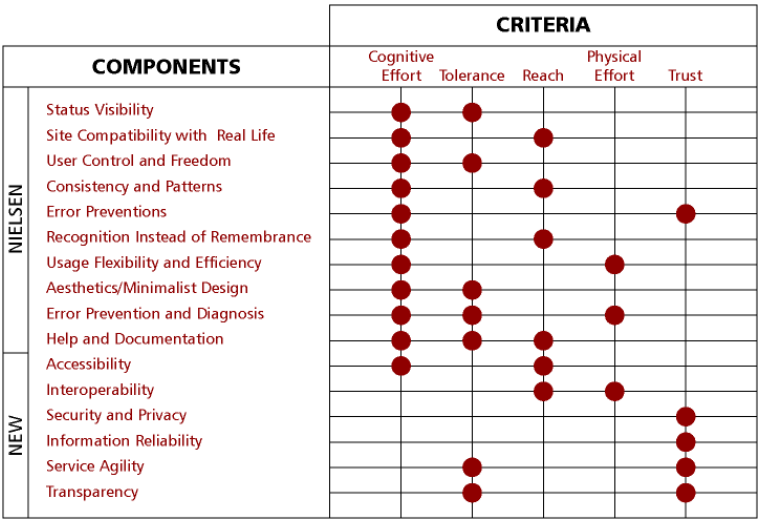

Fig. 1. e-gov evaluation criteria and heuristic rules mapping

migration scope, to the Web environment, of the government procedures in the various categories – information, services, and participation.

4 Case Study

In this section, to test the efficiency of the g-Quality Method for the e-Gov domain, a case study was presented, including scenario, method implementation and data analysis. The efficiency of the method is thus tested.

4.1 Scenario

The proposed method was implemented to analyze the quality of Brazilian e-Gov sites, with the following breakdown: 9 federal sites, 91 municipal sites (all of them in Rio de Janeiro state) and 27 municipal sites (from Brazilian state capitals). The sites were picked through a search service, covering the gov.br domain. If the sight being searched could not be found in the gov.br domain, the one found (.com or .org) would be taken into consideration, later checking if it was the official one.

To analyze the collected data, two government site classifications were taken into account: 1) according to the government jurisdiction (municipal, state and federal); and 2) according to the number of inhabitants in the municipality. This was based on a classification made by IBGE (Brazilian Institute of Geography and Statistics) Agencies, whereby a small municipality has less than 25,000 inhabitants, a medium-sized one has between 25,000 (inclusive) and 50,000 and a big one has more than 50,000 (inclusive).

4.2 Subject (E-Gov Sites)

We divided e-gov sites in three types:

- Informative sites: the government uses the web site channel to display information that is useful to its citizens as well as to make transparent its decisions.
- Services: the government uses the web site channel to allow a broader access to its products and services, such as citizen's income tax electronic submission and follow up.
- Participative: the government uses the web site channel to allow citizens to talk and get an answer from the government. Services such as participative budget and a talk to us e-mail service are good examples.

4.3 Implementation of the G-Quality Method E-Gov

The g-Quality method was implemented by seven specialists in the Post-Graduate Program of Computer Sciences of the Universidade Federal Fluminense, between September and November 2004. The evaluators took a course, to discuss usability inspection methods and the evaluation criteria to be used for the e-Gov domain, as well as the checklist.

The first step involved the checklist piloting, which enabled detection of possible inconsistencies. Four external specialists used the checklist to evaluate a government site, as well as the course students. These results were compared in order to assess the checklist's objectivity and pertaining adjustments were made.

It was concluded that the digital migration would be measured based on the existence, or not, of a specific information, service or participation resource.

Considering that each heuristic can be mapped into various sub-items and that each sub-item can have a positive or negative influence, we weighted each sub-item using an interval of less than four to three. In this way, we highlighted the positive and negative points of each sub-item and used these weights to obtain their weighted average.

To fill out the checklist, we used the following concepts: 2 – for "always"; 1 – for "sometimes'" and 0 – for "never/option not applicable". For locations in which no government sites were found, a 0 value was attributed. Finally, each value was multiplied by the attributed weight to calculate the weighted average, and the result for each heuristic was normalized.

The quantitative data were presented in tables and graphs, so as to facilitate their quantitative analyses. Some graphs are shown in the following item, along with the respective analyses of the collected data.

4.4 Data Analysis

It was analyzed 127 e-gov sites using g-Quality method. There are many cities that have no official site. Only seven e-gov sites were considered good according to our evaluation method from the following cities Aracaju (SE), Belo Horizonte (MG), Brasília (DF), Curitiba (PR), Natal (RN), Recife (PE), Rio de Janeiro (RJ) e São Paulo (SP).

Most e-gov sites only handle information delivery. In average, only 10% of the government services are available through e-gov sites, considering the capital cities.

Table 1. Percentage Criteria

Criteria	Evaluation Grade (0-100%)
Cognitive Effort	37.14
Tolerance	39.12
Reach	36.14
Physical Effort	26.94
Trust	24.74

Table 2. RJ e-gov sites heuristic evaluation

Components	Evaluation Grade (0-100%)
Visibility of system status	24.4
Match between system and the real world	52.1
User control and freedom	48.0
Consistency and standards	67.1
Error prevention	36.1
Recognition rather than recall	57.0
Flexibility and efficiency of use	1.5
Aesthetics and minimalist design	48.6
Help users recognize, diagnose, and recover from errors	56.1
Help and documentation	7.7
Accessibility	9.61
Interoperability	23.1
Security and privacy	0.4
Information truth and precision	16.6
Service Agility	30.43
Transpareny	25.0

This number is even lower to interior cities. It was observed that the government digital service migration has been slow, with the exception of the Porto Alegre (RS) e-gov site. Citizens' participation, in general, is constrained to e-mail. There are some voting services [9], but restricted to a selected group.

Comparing the three focused governmental spheres, it could be concluded that, according to the not only evaluation criteria but also to the realized heuristics, the Federal e-Gov Websites have the best percentiles. In cause of the analysis homogeneity, only Rio de Janeiro e-gov websites data were discussed argued in this data analysis.

Due to as illustrated in Table 1, current RJ e-gov sites have serious problems related to information trust. Sites are not well designed. Surprisingly, the problem is not to make sense of what to do, but the effort required to accomplish the task. Unfortunately, Brazilian e-gov sites lack reliance, putting in danger their feasibility to represent the government (who wants to get information from a site that cannot be reliable).

Table 2 illustrates, in more detail, the evaluation of RJ e-gov sites. One of the most striking observations was the lack of any design standard, even within sites from the same city.

During the evaluation process, it was perceived that there was a preoccupation with the e-gov websites design in terms of functionality patronization, together with an agreeable aesthetic. However, the navigation structure organization, the user action feedback and error prevention are aspects, wich can be checked by the Nielsen heuristics had poor evaluation results in the evaluated websites. "Flexibility and efficiency of use" also presented a much lower value than the desired (1.5%). This shows that the websites are not worried about service customization and personalized user attendance, indispensable factors when taking into account citizen web users necessities. It is possible to notice the lack of preoccupation with offering usage help and documentation as relevant faults as observed in the website evaluation.

Using the heuristics proposed in this work, "Service Agility" (45.7%) had the highest value. However, analyzing the e-mail contacts, the majority of the messages weren't answered. Homepages updating, "Information truth and precision" checked-in component need a lot of improvement (16.6%). Facilitating citizen usage of e-gov websites means "Interoperability" and to "Accessibility", along with other low evaluated heuristics.

In the "Security and privacy" heuristic, evaluation results were much closer to 0 (zero), this being a noteworthy problem for this kind of domain. Personal information that requires privacy should be securely transferred on the net so that the user feels at ease to interact with the system without the risk of frauds.

As for "Transparency" it could be noticed that the government administrations have not used the Internet as a channel for rendering public accounts to citizen. Only 32.6% of the sites have this data available on the Web.

According to Nielsen's heuristics, Brazilian e-gov sites have average usability. Although it is common knowledge that Brazilian e-gov sites are still not appropriate to be properly used as an information medium for most citizens.

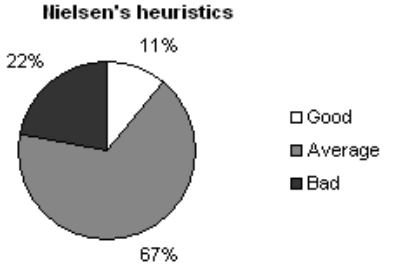

Fig. 2. Brazilian e-gov sites – Nielsen's evaluation

The heuristics that have been included, such as accessibility, security and privacy, information truth and precision, have shown to be fundamental to highlight the problems in e-Gov Web sites. As illustrated in Figure 3, Brazilian e-gov Web sites have been evaluated as mostly bad to average quality.

In general, the number of sites classified as good are the ones which attend poorly the citizens's needs. However, when considered all heuristics of the g-Quality Method, the percentage of good sites even decreases (7%).

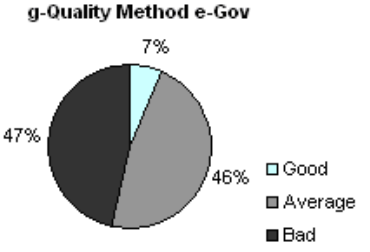

Fig. 3. Brazilian e-gov sites – g-Quality Method evaluation

5 Conclusion

The paper suggests an extension to the Nielsen's heuristic evaluation method. It can be observed that the inclusion of specific heuristics (accessibility, interoperability, security and privacy, information truth and precision, service agility, and transparency) enable a more thorough and in-depth inspection. These heuristics were charted according to previously defined evaluation criteria (cognitive effort, tolerance, reach, physical effort and reliability). A quality evaluation of 127 Brazilian e-gov sites is reported, comparing the result when the new method is used versus the Nielsen's original method. The g-Quality method found more problems, resulting in more negative ratings than the Nielsen's original method.

It was noticed that without the extra heuristics, Brazilian e-gov sites would be evaluated as average, which is not at all an accurate assessment. The g-Quality method could refine this evaluation and show not only that Brazilian e-gov sites are not yet adequate, but also to highlight what are the main problems such as security and information veracity.

All the pages for each site were totally evaluated. Besides usability problems, such as the lack of padronization and bad design, the sites reflected the lack of government responsibility for the digital inclusion. It is not enough to make infrastructure available for the citizen. It is necessary to guarantee an efficient interaction in the government Web applications. If the government is democratic and "for all", these characteristics be provided on the Web, as allowing citizen's an unrestricted participation, including those with special needs.

Brazilian government is spending money and effort to make e-gov reality. Citizens are willing to participate and cooperate. This joint effort should not be wasted. There is hope to make it right, but guidelines emphasizing security and information truth are required.

When issues are raised, which are relevant to both the citizen and the government, a set of measures must be established to evaluate e-Gov sites, so as to provide better quality. It is hoped that this research contributes to the process by raising new indicators to improve electronic government systems.

Developing e-Gov sites evaluation methods, as the one presented here, are the first steps to understanding the problems. Next, and more importantly, guidelines are been developed to build efficient e-Gov sites.

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Addendum: Examples of Checklist items

Options: (2) - Always, (1) - Sometimes, (0) - Never/Option not applicable.

Components	Sub-items	Indicate option
Visibility of system status	Provides *feedback* information on user location.	
	Keeps user informed regarding processing progress.	
Match between system and the real world	Uses metaphors common to citizen's real world.	
	Other: _____	
User control and freedom	Guides users to non-existing links.	
	Requests user confirmation of relevant actions before executing these...	
Consistency and standards	Uses an information hierarchy pattern, creating specific pages for each specific navigation level.	
	Standardizes scheme for colors, font, ..., links, including e-gov sites.	
Error prevention	Informs which fields are mandatory and how each field should be filled out.	
	Calls the user's attention when field completion is incorrect.	
Recognition rather than recall	Relevant or commonly sought information is highlighted in the site.	
Flexibility and efficiency od use	Offers shortcuts so those more experienced users can access information with fewer clicks.	
	Personalizes pages to suit different citizen profiles.	
Aesthetics and minimalist design	Information is provided in progressive detail levels.	
	Avoids scrolling.	
Help users recognize, diagnose, and recover from errors.	When filling out forms, the site informs the user what is causing the error and instructs on how to correct it.	
	In case of failure, previously input items can be rescued.	
Help and documentation	Offers help tool.	
	Offers personal help resources online and in real time.	
Accessibility	Allows visual perception through text markers.	
	Site compliance with W3C recommendations.	
Interoperability	Offers document under patterns xml, swx, rtf, pdf , txt, htm or html.	
	Foresees gradual substitution of "login/password" for access (preferentially for intelligent cards).	
Security and privacy	Uses digital certification.	
	Uses virtual keyboard for password input.	
Information truth and precision	When necessary, informs last update of each page.	
	When necessary, informs date of each displayed content.	
Service Agility	Offers other contact means besides Internet.	
	User requests are complied with in due time.	
Transparency	It monitors the budgetary execution.	
	Renders public account to citizens.	