

Accessibility for People with Cerebral Palsy: The Use of Blogs as an Agent of Social Inclusion

Ariane Oliveira
Ferreira¹

Simone Bacellar
Leal Ferreira¹

Denis Silva da
Silveira²

Aurélio Fernando
Ferreira²

¹{ariane.ferreira, simone}@uniriotec.br

Universidade Federal do Estado do Rio de Janeiro (UNIRIO) - Departamento de Informática Aplicada
Av. Pasteur, 436, Urca – Rio de Janeiro – RJ – Brasil

²{dsilveira, aurelio.fernando}@ufpe.br

Universidade Federal de Pernambuco (UFPE) - Departamento de Ciência da Informação
Av. da Arquitetura s/n, Campus Universitário – Recife – PE – Brasil

ABSTRACT

Cerebral palsy is a brain injury, which depending on the affected site, may be responsible for affecting a person's movements. In extreme cases, the consequences brought about by physical disability may influence the social exclusion of the individual. The situation may be aggravated by problems with speech and vision. In addition, low purchasing power, which is commonplace, can hinder the citizen's adaptation to the routines of everyday life and keep him/her from accessing software and hardware. These resources, if well designed, tend to contribute to the social inclusion of computer users, and in particular using the web as a communication tool. Among the systems found on the web, blogging, due to its interactive features, was selected as a research subject. For these reasons, this paper addresses the identification and analysis of problems of accessibility and usability in web access to public blogs by users with cerebral palsy, proposing a list of recommendations for developers of blog publishing systems. It is noteworthy that the article is a contribution in the computing challenges of the Twenty-First century proposed by the Brazilian Computer Society as the fourth challenge, universal and interactive access of the Brazilian citizen to sources of knowledge.

Keywords

Cerebral Palsy, Web Accessibility, Social Inclusion.

INTRODUCTION

Cerebral palsy is a retardation in neuro-psychomotor development, with sequels in an individual's motor control and posture. The problems caused by paralysis can manifest themselves in different ways, as they depend on which part

of the brain is impaired. There are no two identical cases. Some cerebral palsy victims show small, almost imperceptible alterations in the way they gesticulate, for example. Others may show more serious damage, such as not being able to move and speak, being almost totally dependent of others in their daily tasks [23].

The variability of problems for users with cerebral palsy is a challenge in the development of computer resources, with economic consequences in the development of hardware and software, which must be almost totally crafted in a manual way. This complexity makes hardware and software development much more expensive, a complicating factor in the socialization of these users, since the acquisition of these resources can substantially help this process [12][10].

Due to these characteristics it is believed that blogs can be used by users with cerebral palsy. Besides bringing about a more autonomous way of communicating, blogs can help to cover the deficiency of computational resources, especially more affordable blogs designed for cerebral palsy victims [26]. The blog can also be used as a support tool to educational methods in Collaborative Apprenticeship [21], as a system that allows interaction among users and stimulates reading and writing. Blogs can be used to post messages, images and videos among other available services. Therefore, the use and publishing of blogs can involve and enable a user in a virtual environment, thereby socially including this user. However, it behooves to analyze whether this system is accessible to persons with cerebral palsy [25].

This study aims to analyze the web accessibility and usability of blog publishing systems. The analysis includes reporting the experience of participating users with cerebral palsy suffering from motor dysfunctions in their upper limbs.

Based on the study of automatic evaluators and on the study of users, the study also aimed to create a list with

recommendations of accessibility and usability directed to the developers of blog publishing systems. This list can contribute to guidelines for the improvement of access to users with cerebral palsy and, more specifically with motor deficiency in their upper limbs.

This study is justified by the theme's scarcity in literature, and by the almost total absence of case studies of accessibility and usability guidelines for these users, thereby contributing to this research field.

Another aspect of the universal and interactive access to the web in reducing social exclusion of the Brazilian citizen is to view it as a tool in awakening and developing the individual's citizenship values. For this reason this study was included as a contribution to the fourth computing challenge of the Brazilian Computing Society [8].

ACCESSIBILITY AND USABILITY

Accessibility consists in offering autonomy to individuals, when physical, mental, cultural or social conditions are not favorable. Therefore the objective is to make sure that access to places, services, transportation, means of communication and technologies in general is available to all, without distinction. In narrowing the concept, we arrive at digital accessibility. This should assure that access to Information Technologies is available to all, even if a special interface is needed. However in order to make this possible, hardware and software must be integrated and appropriate to all users, deficient or not [20].

Web accessibility or e-accessibility means universal access to the World Wide Web component, or simply Web. However its flexibility and reach require a deeper study. To these concepts, we can add usability, which refers to the ease of use of web elements [20]. We are therefore underlining the importance of making Web-based systems more adequate or adaptable to users with cerebral palsy.

In trying to offer more means of access to this audience, many research studies of hardware and software were undertaken. Some of these studies cover the development of so-called assistive or adaptive technologies, whereby these tools and resources are intended to offer new facilities or to increase the capabilities of existing ones, such as the walking stick, the wheelchair, special keyboards and screen reader programs for example [17]. Due to cost, some of these resources are the privilege of a few, but substantial efforts are being expended to make them more affordable.

There are several proposals for web accessibility guidelines aimed at making web systems more available for most people, or less difficult to operate or simply to improve them. The following examples can be mentioned: Web Content Accessibility Guidelines (WCAG 1.0 and WCAG 2.0), WCAG Samurai, the Irish Accessibility Guidelines and the Brazilian Accessibility Model (e-MAG). This study included a survey of guidelines with an international range.

Therefore the WCAG was chosen, since it is used by the automatic validators selected for this research [3]. Considering that the WCAG 2.0 was not ready when this research was started [7], its first version was utilized [9]. These documents are W3C proposals (World Wide Web Consortium).

RESEARCH METHOD

The present research, of an exploratory character, presents three stages: i) face-to-face ethnography; ii) on-line ethnography; and, iii) study of multiple cases. The first two stages (face-to-face ethnography and on-line ethnography) were intended to make us aware of the difficulties and behavior of the users in the study, as well as to choose an adequate web system to contribute to their socialization. The third stage (study of multiple cases) was used to evaluate the selected web system based on web accessibility and usability aspects.

Both studies were performed from October 2008 to June 2009. No tasks were given to the participants to avoid bias in the research [24]. The studies of multiple cases were performed in October 2009 and December 2009, and this time the participating users had to execute some tasks. However both studies had an observational style.

The focus of face-to-face ethnography as well as on-line ethnography may throw light on important facts about the social inclusion of persons with cerebral palsy as they interact with the web environment, since they reveal their day-to-day challenges in trying to overcome their impairments which helped in the development of interfaces better suited to users with this profile. The visualization of the theme helps the understanding, as the issue of the relationship of humans and objects is analyzed. In this same scenario, case studies are an important tool in the observation of the users' interaction with blogs, as the characteristics of this interaction are analyzed.

Research Method Limitations

Not all existing blog publishing systems were analyzed, and perhaps some important ones were left out. Nor is it possible to take in account all types of cerebral palsy due to the variety of sequels. It was also not possible to evaluate users utilizing some type of assistive technology, whereby the majority was able to adapt to the available devices, such as the traditional keyboard and mouse.

Before starting the research we had to overcome the difficulty in location users with the profile of motor deficiency in their upper limbs who had no serious cognitive faults and who could read and write. Therefore a single locale for the research was not enough and several sites had to be searched, including virtual communities.

Regarding the use of virtual communities (on-line ethnography), there are ethical issues related to the consent of data collection; the need to set boundaries to the research;

avoiding the loss of focus whose maintenance is not trivial since this task depends on the bloggers' actions which is usually spontaneous. Another limitation of this strategy may be the truthfulness of facts and the bloggers' identity.

ETHNOGRAPHIC STUDIES

Ethnographic studies aim to collect data by studying the interaction of users with information systems, and through analysis of this interaction, to propose recommendations to help in the development of cognitive as well as economically accessible solutions in remedying problems in the use of blogs.

Study of Face-to-Face Ethnography

The study was applied in an *Association of Parents and Friends of Handicapped Persons* (APAE in the Portuguese acronym) [2] which is an organization whose objective is to help persons with special needs. Two users, both literate and wheel-chair users, who had some habit in web activities took part in this study. Since user confidentiality was guaranteed, the participants will be called *user-1*, *user-2*, etc.

The web activities reported by APAE teachers or by the users themselves refer to the use of e-mails, of the *Orkut* social network, of the *MSN Messenger* or of a chat environment. The users were observed as they attended IT lessons in the APAE's lab and all events were logged.

Monitored by a student in the APAE institution, *User-1's* shortcomings were to only be able to move two fingers of her left hand, speech impairments and problems in writing manually. Although her chronological and educational ages did not match, she could read and write. *User-2* was not considered a student, since she attended only the rehabilitation sections offered by the institution and her profile was quite similar to *User-1's*, however she made effective use of her feet for typing and for chores considered manual (drawings made with the use of rulers and coins; cutting and sewing; use of musical instruments). She had speech problems and an aggravating factor related to visual deficiency.

Data collection was done with the reading of reports posted in blogs, virtual communities and websites by selected users, starting in February 2009 with the Internet implementation and the participation of *User-2* in the research, when both users showed interest in accessing e-mails, *Orkut*, blogs and search sites, in posting images (photos) and watching videos; of course sometimes they needed help in performing these tasks. *User-1's* experience in Internet usage began in the APAE institution, while *User-2's* already had web experience before joining same. Sub-section Result Analysis of Case Studies describes more details. We can surmise that according to their reports, these users were not socially excluded, which proves that blog publishing systems can help in the social inclusion of such persons.

Study of Online Ethnography

One of the challenges posed during this stage was to locate persons who had the same profile at the two participants in face-to-face ethnography. The web was utilized for this task, as it broadened the search universe.

As already mentioned in sub-section Research Method Limitations, it was not easy to locate persons with the same profile of the users participating in face-to-face ethnography, reason enough to resort to another method of analysis. At this point we made a survey of the possibility and limitations of the application of on-line ethnography in the studies of blogs. These possibilities include: (a) exploration of communication through multimedia (text, audio and video), whereby these resources enrich traditional face-to-face ethnography; (b) ease in the search and collection of data; (c) scope in the collection and storage (both time and space); (d) quick application of the research.

We also consulted communities that handled cerebral palsy in a general way (Cerebral Palsy, Cerebral Palsy – Brazil and Sons (and Daughters) with Cerebral Palsy). Among several subjects identified in blogs, *MySpace* and websites, some dealt with assistive technologies or communications tools through the web, or all these subjects at the same time.

Even though the persons we found were socially included, some felt the need to better fit in this environment and depended on other factors such as more affordable assistive technologies. More details about the survey in sites and blogs can be found in the next sub-section.

Web-User-1 was a pedagogue, writer and public speaker. She was a 47-year old wheel chair user, using her tongue to type texts and a specially-adapted mouse and a virtual keyboard as shown in the published videos [14]. *Web-User-2* was a 38-year old graphic artist at the time the interview to a blog called "Special Education Blog" was held, and was able to control the movement of his left forefinger [5]. *Web-User-3* was an accessibility consultant for blogs, wheel chair user using her left thumb to type [Hyatt 2009]. *Web-User-4* was a 44-year old self-taught web designer using his feet to type [11].

Result Analysis of the Ethnographic Studies

The data collected in the face-to-face ethnographic study, revealed that the computer helped in the improvement of *User-1's* academic performance, since motor deficiency in the upper limbs can limit the development of hand writing. *User-2* needed systems allowing font resizing so that she would not have to resort so much to the use of a magnifying glass to read small letters, since she could not wear glasses due to lack of control in the use of her hands.

The lack of resources for resizing resulted in errors caused by the disposition of elements in the screen. In addition, we observed that web systems as well as blogs can encourage

writing, since they don't require speed when typing. The cognitive process in the composition of the subject to be posted in the blog, helped *User-1* and *User-2* to improve their language.

The reports collected in the second study (on-line ethnography) showed that the passion in typing text related to their histories and the publication of photos and videos are likewise a constant practice for the users in the research, according to their own depositions and according to the videos they published in the web.

Therefore, we could see that the blog empowers users and allows them to post texts, comments, images and videos. However one must analyze the blog publishing systems, to see if they are accessible to this audience. We also found out that the user may have trouble in adapting, but some users are able to use the tool even without assistive or adaptive technologies [16]. Maybe these technologies underestimate the individual's capacity to adapt.

From this analysis, we set up a list of the problems detected in our observation of users (Table 1).

Table 1. Problems Detected from the Ethnographic Study

User	Problems
1	<ul style="list-style-type: none"> • Low purchasing power. • Trouble handling shortcut keys, i.e., two keys at the same time. • Trouble with words. • Slow hand writing.
2	<ul style="list-style-type: none"> • Low purchasing power. • Trouble seeing font sizes in web pages. • Resorting to Microsoft Word to increase font size, or to the browser menu to increase zoom. • Use of a table to set the keyboard height to a more comfortable position.
web-1	<ul style="list-style-type: none"> • Problems with the limit of pictures in <i>Orkut</i>.
web-2	<ul style="list-style-type: none"> • Trouble in the use of a mouse, even if specially adapted. • Cost prevents a better technology.
web-3	<ul style="list-style-type: none"> • Need to think on web accessibility for blogs. • Popularity of blogs causing accessibility errors (problem detected by user)
web-4	<ul style="list-style-type: none"> • Low purchasing power. • Trouble in the use of the mouse and in using more than one key at the same time. This problem was partially resolved by a program included in <i>Windows</i> itself, which minimized the difficulties. • Need of help by third parties to develop the site.

The problems listed in Table 1, identified by the user-object interaction, showed that problems of a social nature such as system cost and dependency on help by third parties are

added to hardware and software accessibility problems. These factors complicate the social inclusion of participating users. To this end, developers need to find affordable solutions whose operation requires less dependency.

STUDY OF MULTIPLE CASES

Five users were selected for the study of multiple cases. This number was defined considering the recommendations of Jakob Nielsen who states that with any higher number, few relevant problems are detected by the additional users, whereby the problems start to repeat themselves [22]. To adjust the tests and to avoid errors, in addition to the five users, two more persons were added to the evaluations (*pre-test user* and *test-user*).

The *pre-test-user* had no motor deficiency and was a novice in blog publishing, so that her interaction with the system would avoid some problems detected only with users with motor deficiency.

In order to set up the study of multiple cases, it was initially necessary to identify which web accessibility problems in blog publishing systems could jeopardize their utilization by users with cerebral palsy. This stage had an exploratory character, and for its execution, tests with automatic validators in publishing systems and on-line user questionnaire were deployed.

The tests with the *Hera* and *DaSilva* validators [18][13] were applied on October 01 and 11 of 2009, re-applied and evaluated on October 25, 2009 in the home pages of the *Blogger* and *WordPress.com* publishing systems. These tests were applied before and during the pilot test's sub-stage.

The online questionnaire was drafted and applied to the seven users before the test. It was intended to find out the length of their experience in the Internet, to detect personal limitations and to define subjects of interest to be published. The *Google docs* system - an editing tool for *Google files* - was utilized to draft the file since it offered tools to publish forms and sending the questionnaire to the participants' personal e-mails.

In the selection of persons who would participate in the analysis, only the *pre-test-user* had no cerebral palsy, we opted for persons with cerebral palsy and motor deficiency in the upper limbs, who, due to this problem would need adaptations, as well as persons with serious cognitive impairment. It was important that they could read and write, had some knowledge in the use of the Internet and that they were interested in the access of and publishing in blogs. However, they should be novices in blog publishing. The users (1 and 2) analyzed in the first study (face-to-face ethnography) took part in the study of multiple cases as *user-test* and *user-1* respectively.

Besides these users, four users were selected: 2, 3, 4 and 5, with all of them having the profile set up for the research.

The persons analyzed in the second study (on-line ethnography) did not take part in the study of multiple cases. The participating users are described in Table 2.

Table 2. Characteristics of Users in the Case Studies

Characteristics of Users				
Users	Diagnosis	Sex/ Age	Schooling	Length of Experience with the Computer
<i>Pre-test</i>	No deficiency	F / 37	Postgraduate in Education	Longer than 5 years.
<i>Test</i>	Spastic quadriplegic (speech impairment)	F / 27	Literate	Longer than 1 and less than 5 years
1	Coreoatetoid Quadriplegic (speech and sight impairment)	F / 39	Incomplete Primary School	Longer than 1 and less than 5 years
2	Atetoid Quadriplegic (speech impairment)	M /15	Incomplete Primary	Longer than 1 and less than 5 years
3	Coreoatetoid Quadriplegic (speech impairment)	F / 15	Incomplete Middle School	Longer than 5 years.
4	Spastic hemiplegic (light disfunctions on the body's right side)	M /34	Incomplete High School	Longer than 5 years.
5	Spastic quadriplegic (sight impairment)	M /28	Complete Middle School	Longer than 5 years.

There are two types of systems for blog publishing: hosting software and blog publishing tools. Both are publishers, however in the latter case the user needs to find a dedicated hosting system and download this tool, thereby it is considered more complex as it requires more user expertise [19].

The systems chosen for this research were classified as software for blog hosting, offering hosting, i.e., the user does not need a dedicated hosting service [15]. The systems themselves allow publishing and already host the blogs.

Therefore, the blog publishing systems we selected were *Blogger* [6] and *WordPress.com* [27], as they are more user-friendly, not requiring web programming knowledge. However, other criteria were also considered, such as popularity, gratuity, language, the use of themes (templates or models), the feasibility of posting images and videos and an accessibility test performed by another research [4].

Observation with User Participation

The observation with user participation had three stages: pilot-pre-test, pilot test and test with users. During the pilot pre-test and the pilot test, we realized that it was better if the observations were done in a spot familiar to the users. We realized that it was possible to use a digital video camera recording on a memory card in .wmv format (for privacy reasons the images are confidential) and using the *Webinaria* (free) program to capture the screen and the users' actions in .flv format. We also used notes. With that, during the whole observation phase, we recorded the tests and the notes about the observations, both to be used at a later time.

The initial phases required the set up of tasks to be followed by users during the actual test performance with the purpose of confirming or not whether the automatic validators – *Hera* and *DaSilva* – detected the problems during the actual test performance in the same fashion, and to observe other problems not detected by the validators. This required the publication of blogs in the two blog publishing systems used in the research, so that we could set up a sequence of tasks for the publication tests. They were printed so they could be read by the users.

Although the *Blogger* and *WordPress.com* publishers featured different interfaces and resources, it was possible to set common tasks to both, as recommended by the W3C for the evaluation of web accessibility [1].

The following tasks were defined: typing the publisher's URL (whereby all URLs were supplied at execution time); setting up a login code and making an e-mail available to get access to the publisher; following the blog publisher assistant's steps; visualizing it after it is ready; editing the presentation text; altering the theme (template); posting texts, images and surveys; posting a page; visualizing the blog again; repeating the previous steps with the other publisher.

These tasks were set up so that the final results consisted of two blogs, published and ready to be accessed at any time.

The pilot pre-test with expanded tasks was performed with the two publishing systems, *WordPress.com* on the 12th and *Blogger* on the 25th of October, 2009. We analyzed the feasibility of utilizing software and photo or video cameras to record the evaluation for analysis at a later time. The sub-section with the Result Analysis of Case Studies provides more details.

Next, a pilot test of the actual tasks was performed on November 11, 2009 with the same objective of the pre-test; however it was more decisive, since it was performed with a user whose profile was similar to the other participants'. This sub-stage helped in the determination of the tasks' duration. Likewise, it also helped to find out if the evaluation should be performed in the user's own environment or in a lab

environment and if there was the need of assistive technology.

The proposal of the tests with users was to observe the behavior of the five users selected for the research and to verify the difficulties detected through video recordings, screen capture and notes, evaluating the time expended to effect the publication tasks in the *Blogger* and *WordPress.com*, if possible on the same day, and if any task was not performed by the five, due to the lack of accessibility resources to the publishers. The tests were performed in the period between November 19 and December 07, 2009.

Analysis of Results of the Case Studies

The automatic validator detected errors of priorities 1, 2 and 3 in the *Blogger* and *WordPress.com* initial pages. According to Table 3.

Table 2. Number of errors detected in the Publishers by the Validators

Level	Number of errors detected			
	Blogger		WordPress.com	
	Hera	DaSilva	Hera	DaSilva
Priority 1	*	01 (01)	0	01 (13)
Priority 2	*	04 (04)	04	02 (06)
Priority 3	*	02 (03)	04	01 (02)
Total of errors	*	07 (08)	08	04 (21)

The asterisk (*) represents the impossibility of evaluating by the *Hera* validator due to the occurrence of the following error: “*https protocol not supported*”. In the results of the *DaSilva* validator, the errors are represented by the number of occurrences, while *Hera* determines the number of verification points. For this reason, the number of occurrences is shown in brackets. For example: *Blogger* is represented by *DaSilva* in the following way: priority 1 – 01 (01), i.e. there is a verification point with error and this happened once during the evaluation. Priority 3 is represented as 02 (03), meaning that there are two different verification points with errors and in total there are three occurrences referring to the two points.

According to the results, we observed that *WordPress.com* did not show Priority 1 errors under the *Hera* validator. However in terms of the total number of errors, it found 4 (four) more errors than the *DaSilva* validator. To compensate, the *Blogger* publisher had the lowest number of error occurrences for the same verification point according to the *DaSilva* validator. Some of the errors found by automatic validators actually interfered in the access to these publishers by persons with motor deficiency, such as cerebral palsy victims. Table 4 highlights an error that is common to both automatic validators and users.

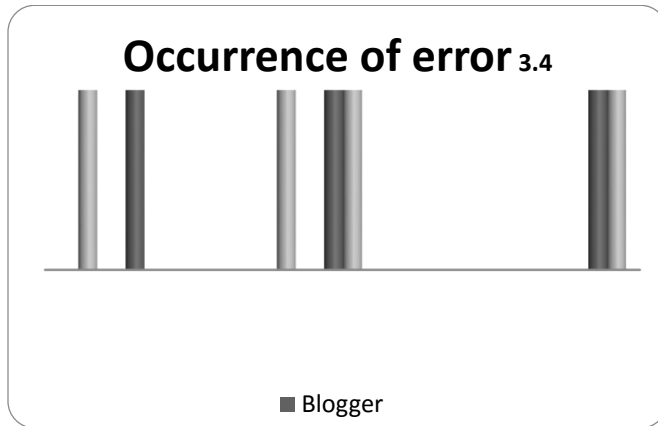
Table 3. Error 3.4. A – Agent; P – Publisher; Y – detected; N – not detected; NE – not evaluated.

Error	3.4. Use relative units instead of absolute		
Level	Priority 2		
Details	Absolute units in the CSS: absolute units were detected (in cm mm pt pc) or font sizes defined in px in the style sheet values. Problems with font sizes.		
A \ P	Blogger	WordPress.com	
Hera	NE	Y	
DaSilva	Y	N	
Pre-test User	N	N	
Test-user	N	Y	
User-1	Y	Y	
User-2	N	N	
User-3	N	N	
User-4	N	N	
User-5	Y	Y	

Among the problems found with the automatic validators and with users, font resizing was the outstanding one, since when it was necessary to increase the font size with the browser, some page elements such as the scroll bar would disappear or would be shown in other spots, such as links.

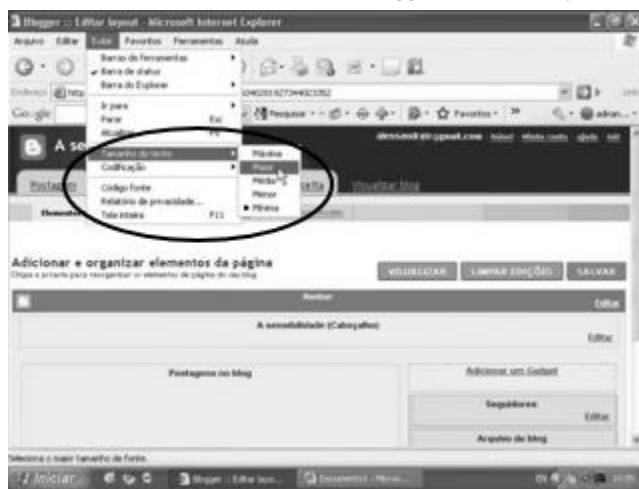
Also, empty spaces would appear, giving the impression of non-existence of text. This happened on *WordPress.com* with the *test-user*, *user-1* and *user-5*. With *Blogger* it happened to *user-1* and *user-5*, as illustrated in figure 1. This indicates that most accessibility problems are related to vision problems since users 1 and 5 were diagnosed with visual deficiency without blindness. However this was enough to trigger a problem that can be even more harmful to people with motor deficiency.

Figure 1. Occurrence of Error 3.4 (Use relative units instead of absolute) on WordPress.com and Blogger



Some images were captured by the Webnaria program during the tests, contributing to the conclusions. The e-mail names and addresses are fictitious, having been changed for ethical reasons. Below are some images of *user-1*'s experiences.

Figure 2. Font size increase in the Blogger's browser by *user-1*



As the font size was increased, the horizontal scroll bar disappeared (it was hidden due to the font size increase), preventing it from being utilized to change configurations in the blog. Consequently the performance of this task became impossible.

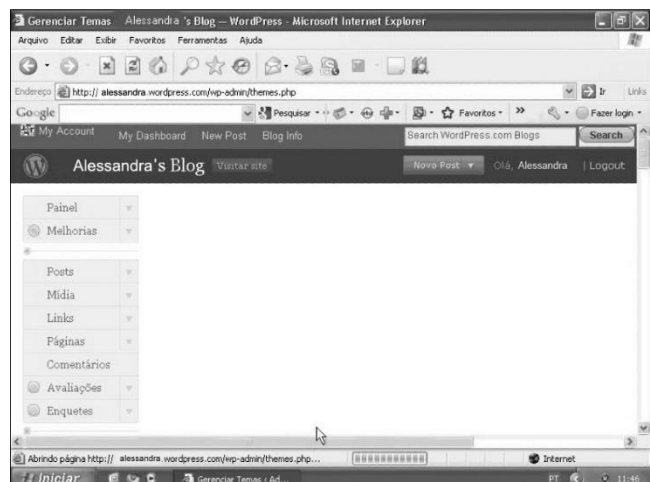
Figure 3. Link found in the Blogger by *user-1* with the use of the tab key



The user was forced to use the tab key, to which she was not accustomed in order to find the Personalize link which was hidden, as shown in Figure 3. The time expended in this task was 2 minutes and 49 seconds, taking in consideration that the researcher had to suggest using this key, since the user did not think about this alternative.

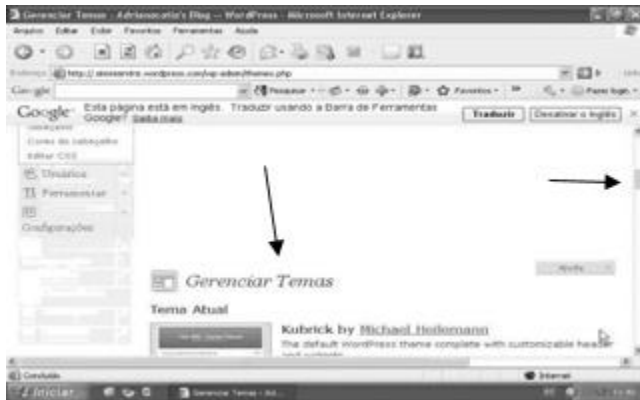
On another occasion, in WordPress.com, *user-1* accessed the themes (models or templates) and to the user's surprise there was no apparent content, as shown in Figure 4. This was probably also caused by the increase in font size, since *user-5* who was using the same resource, experienced the same problem.

Figure 4. Page apparently without content in WordPress.com, in a test by *user-1*.



Immediately afterwards, *user-1* noticed that the content was present, but it was far away, forcing the use of the vertical scroll bar in order to view it, according to Figure 5. Fourteen seconds were expended in performing this task, enough to understand what was happening.

Figure 5. Use of the vertical scroll bar to find the content in WordPress.com, user-1



Language errors were very common in *WordPress.com*, however this type of error did not bother people with cerebral palsy. We could see other problems which were not listed as web accessibility problems by the automatic validators, but were detected by users. They are: technical jargon (upload, screen name, gadget); difficult association of icons (image posting icons, videos); difficulty in identifying elements in the screen (links, buttons); problems with the tabulation sequence; need of orientation (activate blog through e-mail) and need to resort to another program to type the text (*Microsoft Word*).

Problems that occurred in both systems and that were observed more frequently in *WordPress.com* confirm that it is considered a more accessible system, but not necessarily easier to use. All the users managed to complete the tasks and liked to participate, but in some occasions, asked the researcher to help in typing or in understanding what was requested of them.

RECOMENDATIONS FOR DEVELOPERS OF BLOG PUBLISHING SYSTEMS

The evaluations with the automatic validators were important to point out errors, but evaluations involving users were essential to check whether the errors identified by the validators actually harmed the users participating in the research. Even though accessibility is not only directed to blind persons, when one compares the results of automatic evaluations with tests performed by the users, one can see that web accessibility guidelines are still very much geared towards vision problems (some type of blindness).

Among the errors detected by the automatic validators, many were identified as problems interfering in the navigation through the keyboard and in the use of assistive technologies of the screen reader type, which do not portray the condition of participating users since they navigate with the mouse and do not use such technologies.

An error that was detected by the automatic validators as well as by the users (3.4 Use relative instead of absolute units in the values of the notation language attributes and in

the values of style sheet properties), brought about a series of problems such as: disappearance of elements with visual disorganization in pages. This affected persons with visual deficiency (not blindness), added to motor deficiency in the upper limbs and confirmed that most web accessibility problems are a result of visual deficiency.

Tables 5, 6 and 7 presents recommendations for blog publishing directed to system developers, which may contribute to guidelines on improvements for the access of users with cerebral palsy and, more specifically, of those with motor deficiency in their upper limbs. The recommendations were classified according to the moment when problems were identified, ie, they were prepared based on the automatic validation and testes involving users.

Table 5 shows recommendations based on problems detected by automatic validators as well as by users and table 6 the recommendations based on problems identified solely by user evaluations. Table 7 presents some general recommendatios.

These recommendations cover items in conformity with the web accessibility guidelines, and sometimes are the same as usability guidelines. However the WCAG 1.0 guidelines use different priority levels, and depending on the level (priority 1, 2 or 3) those guidelines may be aligned with usability.

Table 4. Recommendations Based on Problems Detected by Automatic Validators as well as by Users for Developers

1. "Use style sheets to control the disposition of elements in the page and the way they are presented". This practice prevents elements of suddenly changing their location, confounding the user.
2. "Use relative instead of absolute values in the attributes of the notation language and in the values of style sheet properties". This prevents that problems in font resizing harm users who do not see well but are not blind, and in addition suffer from motor deficiencies. The non-utilization of this resource triggers other problems for people visualizing the page's graphic interface and causes problems with persons with motor deficiencies.
3. "Use explicit associations between the labels and the form controls, for all controls with implicitly associated labels". This helps using the tab key for navigation, since the user may have problems positioning in a field due to the non-control in label association. Another problem may be the lack of sequence in tabbing.
4. "Identify the document's main language and allow this language to be changed, for instance, from English to Portuguese or Spanish". This practice may help users who do not master a given language when publishing their blog.

Table 6. Recommendations Based on Problems Detected by Users for Developers

1. Use clear language, easy for the user to understand, especially novices. It terms should explain what they mean.

2. Create icons which are clearly associated with their functions. For fast web page navigation, it is important to use images that are easy to understand for people with good vision as well as those who have some sight impairment.
3. Provide better organization of window elements, i.e., dispose the objects so that the user does not have to search a distant link or button, or clicking on several elements until the desired function is found. This contributes to a better perception of elements.
4. Need to instruct users. Systems have publishing assistants, but it does not always happen that the user is instructed how to fill out the fields. A novice user sometimes does not know that sometimes capital letters, blanks or special characters should not be typed. Sometimes these instructions are not displayed or displayed in a way that a more distracted user does not notice them.
5. Detach user help instructions, or if they don't exist, add them to the system to prevent users from utilizing other software to satisfy a need, and as a result, taking longer to execute a simple task. Example: use of Microsoft Word (Text editor) as spell check or to resize the font.
6. Avoid long registration procedures, such as blog activation by e-mail, or filling out Identity fields such as CPF (Individual Taxpayer Registration Number) or RG (Identity Card Number). The difficulty set up to provide more safety may make system access unfeasible. This happens mainly when the instructions to activate the blog by e-mail is not in the user's language (usually English).

Table 7. General Recommendations for Developers

1. Everything should be done to better instruct the user. It should be taken in account that the user may be a novice in web publishing, or unfamiliar with web jargon, who needs the system to help in his/her social inclusion.
2. The system should be adapted to any kind of user, with visual, auditive, motor impairments, with multiple or no deficiencies.
3. Users should be able to navigate the systems, according to individual habits, i.e., without having to adapt to a specific navigation mode.
4. The tips of automatic validators could be clearer, contain more examples, helping developers in the search of information about web accessibility.

CONCLUSIONS AND FUTURE STUDIES

The present study covered three research strategies: ethnographic studies in an institution (APAE), ethnographic studies in sites and blogs, and the study of multiple cases to establish a comparison among web publishing systems with the participation of users with cerebral palsy.

Based on these two ethnographic studies, we discovered research subject characteristics, for instance, that they needed means for written communications and that they could interact with other users through blogs. Likewise, e-mail, chat systems and social relationship sites (*Orkut*) were

also considered for the study, but the blog system could encourage written communication, without requiring typing dexterity and having the same possibility of interaction as a relationship site.

With that it was decided to research blog publishing systems and not to evaluate blogs already published by other persons, because the users had no experience in publishing and the activity of publishing their own texts could be more stimulating.

In the third study (Multiple Case Studies), two blog publishing systems (*Blogger* and *WordPress.com*) were compared and evaluated in their web accessibility aspects, in two modalities: one with automatic validators and the other one utilizing seven users who had no experience in blog publishing.

Since users with motor deficiency have special needs and need instructions on how to deal with their specific problems, the study of multiple cases allowed us to set up a list of recommendations on web accessibility aspects for developers of blog publishing systems (Table 5, 6 and 7).

In the future we intend to make a study to help users to follow up on their publications and to verify whether these blogs contribute to social inclusion. We also intend to develop a framework for blog publishing systems, in compliance with accessibility and usability recommendations.

REFERENCES

1. Abou-Zahra, S., Arch, A., Bjarno, H., (Eds.) 2006. Evaluating Web Sites for Acessibility: Overview. Available in: <http://www.w3.org/WAI/eval/Overview.html> Access Jan 17, 2007.
2. APAE Três Rios. Available in: <http://www.tresrios.apaerj.org.br> Access Dec 04, 2008.
3. Bach, C. F., Leal Ferreira, S. B., Silveira, D. S. da, Nunes, R. R. 2009. "Diretrizes de Acessibilidade: Uma Abordagem Comparativa entre WCAG e E-MAG", Revista Eletrônica de Sistemas de Informação, ISSN 1677-3071, Vol. 8, No 1, Available in: <http://revistas.facecla.com.br/index.php/reinfo/article/view/271/233> .
4. Bez, M. R., Montardo, S. P, L. M. Passerino. 2009. "Digital Inclusion Challenge for People with Disabilities: analyzing Accessibility in Blogs", In: *Proceedings - Education and Technology for a Better World Monday*, v. 1. p. 239-251. (Germany: IFIP WCCE).
5. "BLOG DE EDUCAÇÃO ESPECIAL". 2006. Available in: http://todosiguais.zip.net/arch2006-10-29_2006-11-04.html. Access Jun 17, 2009.

6. Blogger. Available in: <https://www.blogger.com.start> Access Set 20, 2009.
7. Caldwell, B., Cooper, M., Reid, L.G., Vanderheiden, G., (Eds.) 2008. Web Content Accessibility Guidelines 2.0. World Wide Web Consortium. Available in: <http://www.w3.org/TR/2008/REC-WCAG20-20081211/> Access Set 30, 2009. Dec.
8. Carvalho, A. C. P. L. F., Brayner, A., Loureiro, A., (Eds.) 2006. Grandes Desafios da Pesquisa em Computação no Brasil. Available in: <http://www.sbc.org.br> Access Jul 28, 2011. May.
9. Chisholm, W., Vanderheiden, G., Jacobs, I., (Eds.) 1999. Web Content Accessibility Guidelines 1.0. *World Wide Web Consortium*. Available in: <http://www.w3.org/TR/WAI-WEBCONTENT> . Access May 06, 2010.
10. Conforto, D., Santarosa, L. M. C. 2002. “Acessibilidade à Web: Internet para Todos, *Revista de Informática na Educação: Teoria, Prática – PGIE/UFRGS*, V. 5, N° 2 pp.87-102. Nov.
11. Correia Junior, R. “Dedos dos Pés”. 1997. Available in: <http://www.dedosdospes.com.br/>. Access Oct 18, 2008.
12. Costa, M. H. P. da, Costa, M. A. B. T., Pereira, M. F. 2007. “Perfil clínico-epidemiológico de pacientes com Paralisia Cerebral assistidos em um centro de odontologia do Distrito Federal”, *Com. Ciência Saúde*, p. 129-139 Jan.
13. DaSilva. Available in: <http://www.dasilva.org.br/>. Access Oct 01, 2009.
14. Ferreira, A. C. 2007. “Sensibilidade e Acessibilidade”, Available in: <http://anclf.spaces.live.com/blog/>. Access Oct 20, 2008.
15. Gardner, S. 2005. “Time to check: Are you using the right blogging tool?”. Available in: <http://www.ojr.org/ojr/stories/050714gardner/>, Access Jul 20, 09.
16. Heidrich, R., Torok, D. L., Martins, M. B., Fleck, L. M. S., Muller, M. S., Silva, G. M. 2003. “Desenvolvimento de Hardware na Inclusão de Aluno com Paralisia Cerebral”, Projeto Nedeta, Novo Hamburgo, RS.
17. Heidrich, R. O., Santarosa, L. C. 2003. “Novas Tecnologias como apoio ao Processo de Inclusão Escolar”, V. 1, N° 1 Feb.
18. Hera. Available in: <http://www.sidar.org/hera>. Access Oct 01, 2009.
19. Hyatt, G. W. 2009. “Combining Two Passions to Build an Accessible Blogosphere”. Available in: <http://www.doitmyselfblog.com/2009/combining-two-passions-to-build-an-accessible-blogosphere>, Access Jun 17, 2009.
20. Leal Ferreira, S. B., Santos, R. C. dos, Silveira, D. S., 2007. “Panorama de Acessibilidade na Web Brasileira”. In: *XXXI Encontro da ANPAD -*

- ENANPAD, RCA. Revista de Controle e Administração*, v. 3, pp. 206-235 Sep.
21. Marques, A. de M., Pimentel, M., Siqueira, S. 2010. “Dinâmicas Educacionais com o Uso de Blogs: Requisitos a partir de Experiências”. Anais do XXX Congresso da SBC (WIE). Belo Horizonte, MG. pp. 1177-1186.
 22. Nielsen, J. 2000. Why You Only Need to Test With 5 Users. <http://www.useit.com/alertbox/20000319.html>. Access Jul 28, 08.
 23. Oliveira, A. I. A., Pinto, R. F., Ruffeil, E. 2004. “A Tecnologia e o Desenvolvimento Cognitivo da Criança com Paralisia Cerebral”. In: *anais do V Congresso Iberoamericano de Informática na Educação Especial – CIIIE*. Jul.
 24. Preece, J. Rogers, Y. Sharp, H. 2005. “Observando os Usuários”, Bookman, “Design de Interação. Além da Interação Homem- Computador”, Porto Alegre, p. 379-409.
 25. Ribeiro, A. E., Fonseca, G. M. de C., Santos, E. R. S. 2010. “O Site da Escola como Operador do Letramento Digital”. Anais do XXX Congresso da SBC (WIE). Belo Horizonte, MG. pp. 1314-1323.
 26. Tijiboy, A. V., Santarosa, L. M. C., Tarouco, L. M. R. 2002. “A Apropriação das Tecnologias de Informação e Comunicação por Pessoas com Paralisia Cerebral”, In: *Revista Informática na Educação: Teoria & Prática*, p.131-152. Porto Alegre RS, Nov.
 27. Wordpress.com. Available in: <http://pt-br.wordpress.com>. Access Sep 22, 2009.