

ESTUDAR A USABILIDADE DA WEB COM PESSOAS COM DIFICULDADES DE APRENDIZAGEM: O QUE A LITERATURA NOS DIZ

EL ESTUDIO DE LA USABILIDAD WEB CON LAS PERSONAS CON DISCAPACIDADES DE APRENDIZAJE: LO QUE LA LITERATURA NOS DICE

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RESUMO

Introdução: A internet é identificada como um veículo apropriado para fornecer informações a todos, inclusive para pessoas com dificuldades de aprendizagem. Um corpo pequeno, mas crescente número de pesquisas que tem estudado a usabilidade da Internet para esse fim, e esta revisão examina a literatura relativa a este assunto.

Objetivos: O objetivo do trabalho está em analisar as atuais pesquisas sobre as reflexões da questão do *web design* para as pessoas com dificuldades de aprendizagem, incluindo uma exploração tanto dos métodos utilizados e as principais conclusões.

Métodos: Foi realizada uma revisão da literatura do assunto, englobando as áreas da educação, ciência da computação e saúde. A literatura da pesquisa decorre de várias bases de dados bibliográficas adequadas. Ao examinar a literatura, uma proforma analítica foi utilizada para extrair informações, avaliar e comparar estudos.

Resultados: A partir de uma grande quantidade de métodos pelos quais a usabilidade tem sido apurada, incluindo o uso de um *site* convencional; ou comparando um *site* que foi especialmente adaptado por uma versão equivalente para essa dificuldade. Nesse sentido, a corrente principal da pesquisa foi comparar a acessibilidade de vários projetos de *websites*. Da mesma forma, os estudos incluídos comparam o desempenho de pessoas com dificuldades de aprendizagem com uma corrente geral e por conta própria. Sendo assim, a apreciação global sugere que os '*sites* acessíveis' são mais fáceis de usar por pessoas com dificuldades de aprendizagem. Estas dificuldades são encontradas na leitura, na busca de conteúdo a partir de uma

grande quantidade de texto e rolagem. Como também, o trabalho examinou a eficácia das imagens ou ícones, obtendo resultados contraditórios, de ter pouco ou nenhum benefício em termos de acesso à informação, para ajudar significativamente a compreensão do texto.

Conclusões: Os resultados contraditórios ou inconclusivos sugerem que tanto a necessidade de mais investigações, quanto para uma maior participação das pessoas com dificuldades de aprendizagem próprias em estudar a usabilidade de *sites* e outros aplicativos de TI.

Palavras-chave: World Wide Web. Internet. Usabilidade. Acessibilidade. Dificuldades de Aprendizagem.

1 INTRODUCTION

There is a small but growing body of research that has studied the usability of the Internet to provide information for people with Learning Disabilities. Just like everyone else, this cohort information needs - they may well want to know, for example, where the local football team is playing next, what's showing at the cinema and what they need to wear at work. However, again, as other people, they are only able to understand information if it is presented in an appropriate manner according to their abilities and vocabulary (HORTON; QUESENBERRY, 2013). Many individuals with Learning Disabilities have difficulties in accessing and processing information because of the way in which it is presented (BANES; WALTER, 2002; BOHMAN, 2004; ROWLAND, 2004). Even that written especially for this constituency may not be accessible because of difficulties in navigation and retrieval in an electronic environment. This review examines the literature relating to the usability of the World Wide

Empirical evidence around website design is sadly lacking. Armando Rotondi and colleagues undertook an extensive literature search and review of guidelines addressing 'cognitive deficits' (ROTONDI et al., 2007, p. 205) and found that 'design recommendations for persons with cognitive deficits were based on the authors' knowledge and experience with persons who had physical and sensory disabilities'

(i.e. rather than intellectual or Learning Disabilities). Also, “there has been no usability research on the types of designs that are effective for [...] persons [with cognitive deficits] [...] Virtually all published website usability studies have focused on people with standard information-processing abilities.” (ROTONDI et al., 2007, p. 204). Not surprisingly, calls have been made for increased study in this area (BOHMAN; ANDERSON, 2005; FRIEDMAN, 1996; SHNEIDERMAN, 2000).

This review examines work that has been done specifically with (or concerning) people with Learning Disabilities and their use of the World Wide Web, with particular emphasis on measuring the usability of web sites and pages. Where little research has been undertaken (with regard to the efficacy of images as aids to the understanding of text content, for example) research using other media is outlined. Clearly, this is not a perfect solution, but may nevertheless suggest issues that may pertain to an electronic medium. As this cohort, by definition, have a low level of literacy, guidelines tend to emphasise the use of images (BOHMAN, 2004) the issue is clearly worth exploring.

2 METHOD

A comprehensive literature review was undertaken encompassing material from the fields of education, computer science and health. Literature was elicited from appropriate bibliographic databases including the Web of Science, ERIC (Education Resources Information Center), EBSCO¹, Scopus, Medline and the British Humanities Index. Search terms included “learning disabilities” and related terms (intellectual, cognitive ... etc.) usability, accessibility, “website design” along with “information provision/retrieval” etc. The databases used all have functions for truncating and combining search terms and it was also

¹ EBSCO is short for ‘Elton B. Stephens Company’ although it never uses its full title.

possible to search authors' most recent works that cited relevant articles. Citations to previous works by the same or other authors were noted and sought – either through citation records (e.g. the Web of Science Index) or by referring to references at the end of journal articles and tracking back.

In examining the literature, an analytical proforma was used to elicit information, evaluate and compare studies. This included headings, where appropriate, on:

- Paper type: E.g. primary research, literature review, commentary etc.
- Aims and objectives
- Methods: E.g. brief notes, e.g. survey, interviews, case study, secondary data, multi-method, opinion piece, theoretical contribution
- Sample): E.g. number and characteristics (degree of literacy; condition [Asperger's etc.]); demographics
- Key findings: E.g. bullet points summarising the main findings relevant to the project.
- Comparative information or insights into earlier studies: E.g. including any pre-digital research.

3 FINDINGS

As mentioned in the introduction to this paper, empirical evidence around website usability and subsequent optimal design for people with Learning Disabilities is somewhat limited. Despite this, however, many different approaches are evident in the literature. These include undertaking usability tests or otherwise observing users using:

An especially adapted or accessible websites and equivalent 'mainstream' versions (KARREMAN; VAN DER GEEST; BUURSINK, 2007; SEVILLA et al., 2007).

Various different 'accessible' websites or pages (ROTONDI et al., 2007; WILLIAMS; HENNIG, 2015a, 2015b).

One website only (LEPISTO; OVASKA, 2004; WILLIAMS; HANSON-BALDAUF, 2010).

Studies generally consider websites globally – that is, the whole user experience is considered, comprising most if not all of factors such as understanding, navigation, aesthetics and user satisfaction (KARREMAN; VAN DER GEEST; BUURSINK, 2007).

Similarly, studies include those comparing the performance of people with Learning Disabilities with a ‘mainstream’ cohort (KARREMAN; VAN DER GEEST; BUURSINK, 2007) and on their own (WILLIAMS; HANSON-BALDAUF, 2010).

3.1 Studies Examining Websites ‘Globally’

3.1.1 Comparing mainstream and accessible or adapted sites

One approach to the issue has been to test the usability of two versions of a website - a ‘conventional’ site and one adapted on the basis of ‘easy-to-read’ guidelines. Karreman, Van Der Geest e Buursink (2007) undertook such a study, with two groups of 20 participants. One group had intellectual disabilities but could read, and the other group did not. The investigators tested whether the easy-to-read website was more accessible and usable for the participants with intellectual disabilities. All 40 participants were ‘frequent’ Internet users (using it at least once a week).

Two versions of a website for a welfare and care organization were developed describing its main services and activities, both in standard and also in “‘accessible’ text based on easy-to-read guidelines.” (KARREMAN, VAN DER GEEST E BUURSINK, 2007, p. 511). Both versions were used by a group of test participants with ‘intellectual disabilities’ and by a control group (those without intellectual disabilities) and tested for;

- Efficiency (searching and reading time);
- Effectiveness (comprehension);
- Satisfaction.

Participants undertook five search tasks on one of the two websites. They then had to answer 14 questions about content. Seven of these could be answered with text-based information, while the others had to be deduced from information in the site (inference questions). As the researchers note, (KINTSCH, 1988) studies of reading processes have shown that making inferences requires a deeper form of processing and comprehension than just recognition of information. The aim of using two types of questions was to see whether the adapted text increased comprehension of verbal content both at the recognition and the inference level. Satisfaction with the website was measured with an adapted version of the Chen and Wells (1999) instrument for measuring, as it is titled 'Attitude Towards the Site', consisting of statements about the site, scored on a five-point rating scale, from definitely disagree (1) to definitely agree (5).

Results showed, as noted above, that people with intellectual disabilities "need more time to read the text than a control group of people without identified intellectual disabilities, even when that text is easy-to-read". They also "need more help to find the pages in a site, again also when the verbal content is adapted to their needs." (KARREMAN; VAN DER GEEST; BUURSINK, 2007, p. 514). In fact, in these terms, there were positive effects in writing the information in an accessible way – there were almost no differences observed between the two versions of the site. In terms of site comprehension, the accessible (easy read) site was significantly better than the other site, in that it helped increase comprehension, both for the participants with intellectual disabilities and for the 'mainstream' participants.

Regarding site satisfaction, "participants with intellectual disabilities preferred the adapted website while [others] preferred the non-adapted website. In other words: each group liked the website best that was geared to [their needs]" (KARREMAN; VAN DER GEEST; BUURSINK, 2007, p. 517). Thus, there could be a "carefully attuned mix of adapted and non-adapted verbal content' and that 'information which

is visible at high-level pages could be made easy-to-read, with links to more specific, non-adapted information for those who want to know and read more.” (KARREMAN; VAN DER GEEST; BUURSINK, 2007, p. 518).

Importantly, the authors conclude by saying that “[content] writers can assure that they [use] clearest and simplest language only by involving test participants with intellectual or language disabilities.” (KARREMAN; VAN DER GEEST; BUURSINK, 2007, p. 518).

Sevilla et al. (2007) created a ‘simplified’ web browsing system and two types of pages: those that allowed the user to choose among several options, and those that allowed the user to browse the selected options. This was then compared to a ‘conventional’ site in terms of ease of use/browsing.

The simplified browser consisted of:

- ‘Back’ and a ‘Home’ buttons only on the toolbar ;
- No scrollbar (e.g. there is no content below screen level on a standard browser).

The constituent pages consisted of:

- Captioned images (using large text);
- A maximum of five content items;
- Highlighted images on ‘mouse-over’ and descriptive text;
- A ‘selection’ pictogram (a pointing hand image) indicating both the action to be done (choice) and the kind of page currently viewed.

This is shown more clearly in Figure , below.

Figure 1 - Simplified web browser and contents page



Fonte: Sevilla et al. (2007).

The authors examined contents item choice and browsing by a group of 20 participants, each having a degree of ‘mental retardation’ ranging from mild to severe (age range 24 to 46). The study was intended to demonstrate that:

- The web design was usable for people with cognitive disabilities;
- The philosophy and underlying architecture of this design is appropriate for giving steps towards a testable protocol on cognitive accessibility;
- For the end-user group targeted, the level of usability of the accessible design is higher than the level of a typical website.

Participants were presented with the accessible and a ‘conventional’ web page, the former being an adaptation of the latter (apparently set-up specifically for the experiment, rather than being pre-existing). Unusually, they were not given any tasks, but simply observed as they browsed the sites under three conditions:

- Teacher-directed navigation;
- Free navigation with teacher support when requested;
- Free navigation without teacher support.

Success was measured in terms of specific events observed, such as simple actions (use of the back button) or less well-defined behaviours (showing understanding of the site). Three measures were taken: efficacy, efficiency and satisfaction. Efficacy and efficiency were calculated in terms of measures of understanding of the website (based on interaction with the observers), number of 'visits' (including intended and unintended); use of navigational buttons etc. Neither term was defined, and measures of each overlapped considerably. Indeed, in the few measures where they did not – the use of navigational buttons counted only towards a measure of efficiency and not efficacy – it was difficult to determine the reasoning. Satisfaction was measured by noting cues such as the number of gestures of complaint or of lack of interest; number of positive and negative comments etc.

Findings indicate that participant search performance improved significantly ($p < .05$) in areas of both efficiency and efficacy when the accessible site was used – although this is perhaps unsurprising when considering the screen-shot provided of the 'conventional' site used, which appears to be very text-heavy, albeit with images – and 'cluttered'. The aim 'to demonstrate' that the adapted was 'usable for people with cognitive disabilities' and that 'the level of usability of the accessible design is higher than the level of a typical website' (SEVILHA *et al.*, 2007, p12) suggests this was a finding that the researchers were seeking, although the paper *is* based on empirical evidence.

Interestingly, unlike findings of usage with conventional web browsers, participant performance did not correlate with level of cognitive ability. No reason for this is offered, but it may be that as the site was accessible for all ability levels, other variables came into play.

3.1.1 Comparing only 'accessible' sites

Some research (ROTONDI *et al.*, 2007; WILLIAMS; HENNIG, 2015a) have tested different versions of an accessible site, eschewing the use of a 'mainstream' site altogether. Williams and Hennig (2015a)

tested 'accessible' web sites of different design layouts which used various combinations of menu position (vertical or horizontal), text size and the absence or presence of images. The aim was to determine how information can be optimally presented for people with Learning Disabilities. The designs were tested with people with low levels of literacy (104, ranging from 17 to 63 years of age) to determine which attributes of a site have the greatest performance impact, using simple information tasks. Inference questions were avoided, as site design and layout were the focus, rather than measures of comprehension. Instead, participants were required simply to look for particular text strings. For example, in a page on bowling included, in a short passage of 50 words, the phrase, 'to go bowling you need to wear bowling shoes'. One of the set tasks (delivered orally by the researcher) asked 'What do you need to wear to go bowling'? Task-time was used to determine the efficacy of the different page designs. Interface One (horizontal menu, no images and small- text) was the design facilitating the fastest information access, and Interfaces Six (vertical, no images and large text) and Eight (vertical, with images and large text) were the slowest.

Results suggested that menu position was the most significant factor, followed by text size. Surprisingly, small-text was imbibed more quickly than large (for this non-visually impaired cohort). Images did not appear to aid understanding or facilitate quicker access to information, and thus have only limited value - contrary to assumptions made in standard guidelines (W3C, 2008).

The major finding of the study, however, was that when formally seeking information, people with Learning Disabilities appear to imbibe content in an exaggerated linear form coined by the author as 'serial access'. This means that all of the information is taken in sequentially, until the required content is reached. Serial access is not the same as linear access, although it may be considered as an exaggerated form of it. The latter includes skimming inconsequential or trivial words so they are not imbibed, whereas the former consists of the processing of

information not only sequentially, but word by word, regardless of importance and without the predictive aspect of text consumption enjoyed by mainstream readers.

Thus, images were ignored until reached 'serially' via accompanying text being methodically negotiated; and that information took longer to be accessed from vertical menus, possibly because of distracting text at their side which drew the attention of the participants who felt compelled to read it. The small-text content was consumed quicker than the large-text, as the latter took up more lines – another indication of serial access in action. The added lines necessitated by the large-text condition took more time to negotiate, as when accessing information serially, it requires more eye movements to retrieve information from a body of text where more lines are used. Finally, task-time was not affected by task order - also suggesting 'serial access' behaviour. Significant decreases in task-time with task familiarity would have suggested that the imbibing of the information had become more sophisticated by speed-reading and skipping trivial words, in search of specific key words or phrases (or, indeed, of images or other non-text elements). By reading 'serially', task-time differences are minimised.

Study participants were also asked for their preferences via a 'smiley-face' rating scale and simple interviews. 'Acquiescence bias' was minimised by avoiding polar ('yes/no') questions, achieved by asking participants to compare layouts (such as horizontal versus vertical menu), with reasons coaxed from those able to articulate them. Preferred designs were for large text and images. This was the reverse of those facilitating fastest information-access times, a discrepancy due to preferences being judged on aesthetic considerations. Design recommendations that reconcile preference and performance findings are offered in the paper. These include using a horizontal menu, juxtaposing images and text, and reducing text from sentences to phrases, thus facilitating preferred large text without increasing task times.

Armando Rotondi and colleagues (ROTONDI et al., 2007) also compared various different ‘accessible’ website layouts. The aim was to “develop an understanding of the design elements that influence the ability of persons with severe mental illness (SMI) and cognitive deficits to use a website, and to use this knowledge to design a web-based telehealth (sic) application” (ROTONDI et al., 2007, p. 202). Ninety eight people, all with ‘a severe mental illness’ took part in the research.

The study was carried out in three stages. First, an examination was undertaken of the design elements of websites that influence the cohort studied to use the Internet. These included, in particular, various aspects of language and vocabulary. Second, insights gained from this first activity informed the design a of a web-based health information service. Three interfaces were constructed and tested for comprehension and usability. Finally, a fourth – and definitive - interface design was created following from the feedback from the usability tests.

Considering each of these stages in more detail, for the first stage, a series of tasks was devised, as follows, with brief findings given for each:

- *Task A: Link Meaning and Predictability:* Participants were presented with a series of website labels (e.g., link labels, titles of resources) to read and declare any difficulty in understanding any words. Results showed that compound labels (“I need to know what causes X”) were hard to understand, suggesting that a simpler form (“What causes X?”) would be preferable;
- *Task B: Link Meaning, Predictability, and Differentiation.* This tested the relationship between label and content. ‘Each participant was given:
 - several [labelled] cards ... to be used to “organise” information on the website (e.g., a link from the homepage, a table of contents heading); and
 - a list of cards with titles of website resources. Participants assigned each of the titles to one of the labels provided and explained the(ir) reasons’ (ROTONDI et al., 2007, p. 208).

Participants took a very personalised and idiosyncratic view of the labels. For example, one title, “Getting help paying bills” was assigned to

the label “information for families” instead of “Help paying bills” because the family was their first port of call when they needed money;

- *Task C: Card Sorting.* Participants were asked to put the title cards from Task B into groups meaningful to them. This task proved too difficult and was not completed;
- *Task D: Vocabulary.* To identify words that participants misunderstood and/or preferred, they were given a list of words which might appear on the web pages, and asked to define them. “Any terms participants preferred [...] were noted and incorporated in to the website” (ROTONDI et al., 2007, p. 211);
- *Task E: Article Comprehension.* Participants read documents written for the website and to identify any words or concepts not understood.

Ninety eight people completed the first four tasks, eliciting link labels and vocabulary to be used to develop various website interface designs. Initially seven were developed, but these were reduced to three following ‘initial testing’. Each design ‘represented a different theoretical approach to organising and presenting the same resources and information’ (ROTONDI et al., 2007, p. 208).

The designs were:

- One: ‘Strict modular abstract’: two navigational dimensions - unchanging menu items across the top; context-specific items vertically (i.e. the items changed according to the page in which the menu appears); deep hierarchy of content.
- Two: one navigation dimension. This was a table with high level entries on the left and lower levels on the right, the latter being more descriptive/explicit. This model did not use a ‘variable navigational tool bar’ so presumably each of the pages had either the same table or only the high level menu entries displayed.
- Three: ‘flat explicit weak-modular’: lower-level topic or labels (and therefore a higher number of modules or pages), achieved by using drop-down menus. The authors note that ‘of the three [designs], this design [...] presented the shallowest structure and simplest hierarchy, making it the most difficult in which to get lost’. The link labels were ‘the longest and most explicit [...] requiring the least amount of interpretation’ (ROTONDI et al., 2007, p. 213).

Interestingly, icons and graphics were not used in any of the designs. This was not due to any fieldwork undertaken or from findings of prior literature, however, but rather because of the assumed 'potential vulnerability to overstimulation' (ROTONDI et al., 2007, p. 118).

Twenty six participants undertook the usability element of the study. For two randomly assigned versions of each of the three website homepages, 'participants were asked to choose the link where they expected to find information on a specified topic or resource (e.g., "Where would you find information on treatments for schizophrenia")' (ROTONDI et al., 2007, p. 208).

'A higher proportion' of participants completed the usability tasks with Model Three (Flat, explicit) than with the other two designs ($p = 0.03$). Additionally, 57.3% of participants were correct on their first choice of answer with Model Three, with 54.3% with Model Two (Hybrid) and only 36.0% with Model One (modular) although the level of significance of this finding is not given.

Based on these findings and further feedback from participants, the third stage of the study was undertaken. This was to design a website that incorporated the most effective features of the other models and modified them according to results from stage two.

The resulting website (Model Four) contained the following features:

- Long labels for links 'thus reducing or eliminating a user's need to think abstractly' (ROTONDI et al., 2007, p. 216). This is because participants 'made highly concrete, personal and idiosyncratic associations between the resources they were asked to find and the labels from which they had to choose' (ROTONDI et al., 2007, p. 219);
- All site contents on one page (presumably this refers to all the links, rather than actual content, as there would be no need for links if the latter was the case) that 'reduced the amount of navigation required to access contents' (ROTONDI et al., 2007, p. 216);
- Pop-up menus activated on 'mouse-over' (replacing arrowheads in the dropdown menus, which had proved

troublesome) making it possible to navigate from the homepage to any destination with only one mouse click;

- A constant navigational bar at the top of each page (added from the previous version). The homepage used a frame which kept the tool bar at the top of the display even if users scrolled down to facilitate easy navigation.

The paper concludes (without testing the forth model) that people with 'cognitive deficits' have 'problems in accurately interpreting or understanding the organization and conceptual categorization of a design and, subsequently, in locating the information they are seeking'. However, as the paper goes on to say, 'none of these are so great an obstacle that it is unfeasible to design a website that can be utilized by these populations'.

Harrysson, Svensk e Johansson (2004) observed a small sample of users (seven) as they navigated between different web pages and sites using a standard web browser. The sites were

[...] specially selected pages with a clear-cut design and with a maximum of seven to ten informational units on each display screen (were) used. The amount of text on the pages was minimal, consisting mostly of common, single Swedish words and short phrases in combination with illustrations and pictures (HARRYSSON; SVENSK; JOHANSSON, 2004, p. 39-40).

Subjects, who ranged in age from 15 to 44 years, were set a series of web navigation tasks, on a selection of chosen (albeit 'mainstream' or non-adapted) websites. Results suggested that the group were adept at navigation. They used the forward/back buttons and hyperlinks without difficulty. However, where text-input was required, the users had difficulty - in writing a URL or a search term, for example. The researchers concluded that the 'the processing of text can impede accessibility to the Internet for people with cognitive disabilities' (HARRYSSON, SVENSK E JOHANSSON, 2004, p. 141), and suggest that screen-readers, and text-scanning technology would support this user group.

Davies, Stock e Wehmeyer (2001) examined a prototype accessible web browser, called 'Web Trek', which incorporated various 'accessible' features including:

- *Audio prompts*: 'where a message was played describing the use of a button when the cursor arrow was placed over it (without clicking)' and 'error minimization' cueing, in which a message was played following [an action], to guide the user to the next - most-likely step in a task.
- *Reduced screen clutter*. Only basic features being tested, plus a few others such as a print or exit button, were provided on the Web Trek interface. ..
- *Personalisation and customisation*: The capacity [...] to display the user's name on the Start button and Start Page appeared to be helpful;
- *Use of graphics*: [including an (unexplained)] picture-based search feature;
- *Error minimization methodologies [...] includ[ing] [...] concepts* such as consistent placement of familiar buttons from screen-to-screen, automating steps when possible' (DAVIES, STOCK E WEHMEYER, 2001, p.110).

Twelve adults with 'mental retardation' (intelligence scores ranging from 50 to 72) and no previous Internet experience, performed several typical Internet tasks with an accessible and also a standard (Microsoft Internet Explorer) web browser. Three tasks were undertaken, which involved searching for Websites, saving Websites to a favourites list, and retrieving saved sites from such a list. Measures of success included frequency counts for the number of prompts required to complete the tasks for each browser, number of errors made with each browser, and number of task completions.

In addition to these measures, informal assessments were made of participants' level of engagement and enjoyment. In this respect, the authors note that "all participants reported that it was a pleasurable experience for them to use the Internet and demonstrated their enjoyment by asking to do so again" (DAVIES, STOCK E WEHMEYER, 2001, p. 110). The main findings of the paper were that "the prototype web browser required significantly fewer prompts for people to use

independently” (DAVIES, STOCK E WEHMEYER, 2001, p. 111). The picture based search feature (in which website contents were depicted by images) was ‘very helpful to users’ (DAVIES, STOCK E WEHMEYER, 2001, p. 111), although the exploitation of this feature and information retrieval success were not explicated. Other limitations in the study are outlined by the authors. These include the use of a minimal number of research subjects and the use of only one of the browsers by each group. Despite these limitations, the researchers suggest that ‘overall, results of this project provide preliminary evidence that the Web Trek browser provided better access to the Internet for individuals with mental retardation than did a widely available web browser (Internet Explorer)’ (DAVIES, STOCK E WEHMEYER, 2001, p. 112).

3.1.3 Examining one site only

Lepisto and Ovaska (2004) undertook a similar study to that of Davies, Stock e Wehmeyer (2001), described above, although they tested users on only one site. This was an ‘Internet-based learning environment that was originally designed for users with no special needs’ (LEPISTO; OVASKA, 2004, p. 304) – a non-adapted or mainstream site, in other words, albeit one that was (presumably) designed for educational use. The authors set out to understand how the usability of a web interface could be improved to better suit people with Learning Disabilities, although the article confines itself to an outline of the (multi) methods used and why it is necessary to approach the issue of usability in a triangulated fashion.

Ten students with (unspecified levels of) ‘cognitive disabilities’ were observed using the resource in the classroom as part of the normal course of their studies. “Informal walkthroughs were conducted where students showed researchers what they do on computers.” (NIELSEN, 1994, p. 306). An observation sheet – again, not detailed in the article - was used to assess the performance of the participants. ‘Experts’ also

evaluated the interface. For the latter 'the application was evaluated against the heuristics proposed by [Jacob] Nielsen (1994, p. 306) and was done by the researcher and her research assistant independently of each other'.

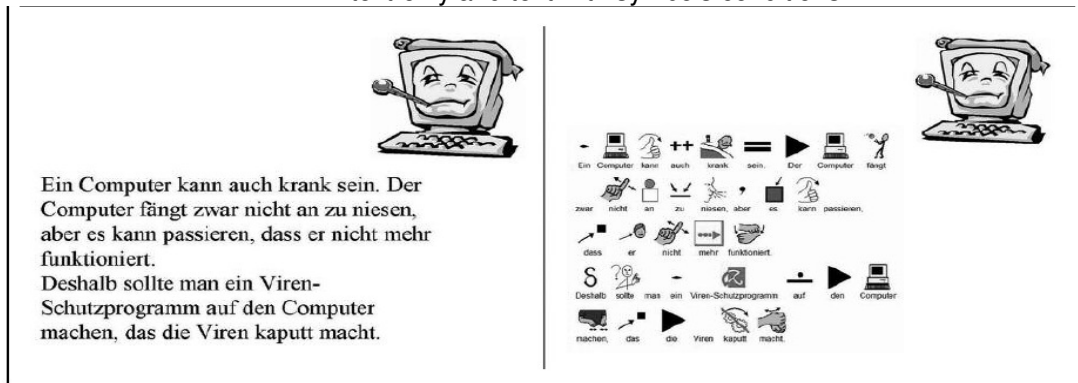
Results showed that 'The expert evaluation revealed usability defects different from those found by observing users. The experts found usability defects that were not marked as usability problems in the observation of real use situations. On the other hand, the experts missed some problems revealed in the observational study. This, and the variety of data accrued from each method, led the researchers to emphasise the "need to collect data with several complementary methods, and to adjust the methods to suit the characteristics of the participants." (NIELSEN, 1994, p. 305)

Peter Zentel, Opfermann and Krewinkel (2007) investigated a site with different attributes, but for content recall and understanding rather than usability. The research investigated which representational formats may be beneficial to foster recognition and understanding of information, by users with Learning Disabilities. The authors argue that the more 'redundant' (in this case, repeated) information is presented, the bigger the chance that disabled users can process it according to their skills. People with reading disabilities, for example, will use spoken text or pictures to help process writing.

To investigate this issue, the authors constructed a 'learning environment' which consisted of five pages that described basic aspects of computers and the Internet. Twenty students (ages from 14 to 22 years) participated in a comprehension and recall test of the materials, from two schools for Special Educational Needs students in Germany. During the presentation, participants were asked to tell in their own words what they had just read/seen/listened to on the page. The researcher varied the modality (visual, visual plus auditory) and codality (text, text plus pictures) attributes of the pages.

Examples of the page layouts for both text, and text with symbols, can be seen in Fonte:.

Figure 2 - Web pages (detail) used by Zentel, Opfermann e Krewinkel (2007) showing text-only and text with symbols conditions



Fonte: Zentel, Opfermann e Krewinkel (2007).

The relative effectiveness of various different conditions was measured by recall and understanding, rated by the researcher after viewing videotapes of the sessions, wherein participants were asked to describe what they had 'just' read, heard or seen (the time difference between exposure and recall/understanding task is not given in the paper).

Results suggested that 'the fourth condition which enriches written text with symbols and audio showed the highest scores for understanding and recognition, followed by the text with audio condition. The conditions which did not contain spoken text showed the lowest understanding and recognition scores'. An 'especially beneficial value seems to be due to the inclusion [with text and symbols] of audio'. The authors are quick to point out that 'it is now possible to add automatic speech support [...] for most common web browsers, a first step to make the Internet more accessible for users with Learning Disabilities could be achieved without major effort' (ZENTEL; OPFERMANN; KREWINKEL, 2007, p. 31). The authors add a note of caution, however - none of the differences reached statistical significance.

Finally, Williams and Hanson-Baldauf (2010) tested a web site for usability that had been designed specifically for individuals with Learning

Disabilities and, indeed, produced by them, which contained information around the transition from school to supported adult life. Seven individuals aged 14–16 years and identified with mild Learning Disabilities participated in the study. Assessment of findings includes evidence of participant self-directed interest and initiated use of web technologies, recognition and competent utilisation of basic navigation tools, and simple task completion within the web portal itself.

The study showed that people with mild Learning Disabilities can be adept with web technology and are able to navigate with little support in an environment of interlinked web sites. In free exploration, participants also showed capable search skills in accessing, for example, YouTube clips - although it was only necessary, in many cases, to enter the name of a particular pop artist or sports person, there was often then the need to scroll down and select a particular clip, a task that was undertaken with ease. However, participants accessed a great number of pages but appeared to imbibe very little meaningful information. In undertaking set-tasks, a more considered approach was taken, although much information was still missed through haste. Interestingly, under these conditions, scrolling proved much more difficult for some than in the free exploration phase (although none had physical disabilities) and others did not appear to realise that pages continued below screen level. A propensity to favour browser buttons to navigate (rather than use the 'back' button on the page itself) may be a manifestation of the tendency among people with Learning Disabilities to be more comfortable with a routine or standard method of doing something. Clearly, the 'Back' button on a browser looks the same and has the same function regardless of the web site being navigated.

3.2 Testing Specific Attributes of Web Sites

Rather than attempt to test a website in a holistic manner, some researchers have looked at particular discrete aspects only – such as

menu position or the efficacy of various menu entry formats, and the use of images in various ways. Although there is a certain overlap (ROCHA et al., 2012, for example, looked at image and no-image conditions in their examination of access to menu entries although audio was used in both), studies have been included in this section where there was an emphasis on one element.

3.2.1 Hyperlink representation / positioning

Tânia Rocha *et al.* (2012) investigated whether hyperlinks in menu lists are more perceptible with text or with images for people with 'intellectual disabilities'. The study was based on direct observation, video recording, interview and an eye-tracking device. Ten participants took part in this study. They were divided into two groups and asked to find links to two specific pages on websites designed for the study. The websites presented an image navigation menu or a text navigation menu, although in each case an audio rendition of the link label was used.

Results showed that participants found the correct links quicker when presented as images (with audio) rather than as text (again, however, with audio). As participants underwent two tasks it was possible to compare times for each to note if there was any improvement, in terms of speed of access and which condition better facilitated this. Results suggested a greater improvement in performance with the images condition.

Williams and Hennig (2015b) tested whether a horizontal or vertical menu/contents arrangement facilitates faster access to content for people with Learning Disabilities. Participants were timed as they looked for and then clicked on one word "dummy" menu entries appearing in along a horizontal or a vertical grid. The words corresponded to images shown at random in a "word-search" type

activity (i.e. a picture of a girl required participants to find the 'girl' entry on the menu list – whether being presented horizontally or vertically).

Figure 3 - Testing the efficacy of various menu entry positions.



Fonte: Williams and Hennig (2015b).

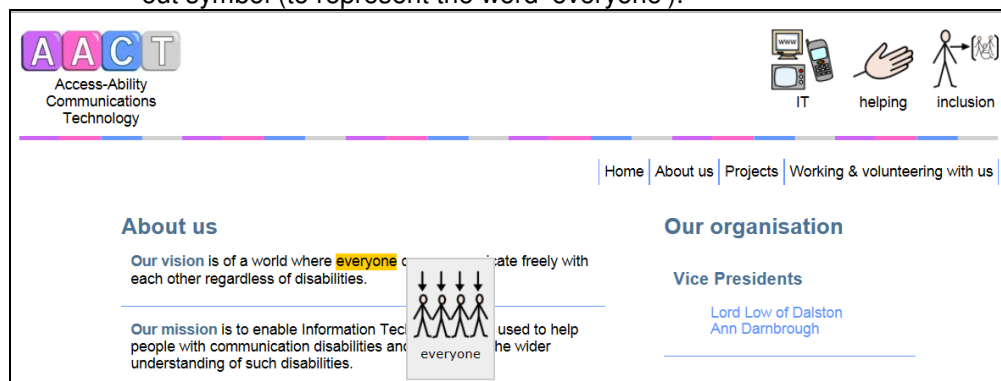
Results showed that mean search times increased as the position shifted from left to right and from top to the bottom. Thus, participants undertook the test as if it were a reading exercise, despite the images appearing in the centre of the page and the words appearing at random positions. The research also suggests that a horizontal menu may be more effective than a vertical one, with the most important links placed on the left.

3.2.2 Use of images

The use of images, symbols and other pictorial representation in websites is both common practice and urged in the literature on web design (BOHMAN, 2004; JIWNANI, 2001; HORTON; QUESENBERRY, 2013; SINGH; DOMONKOS; RHO, 1998). A more recent development has been to adorn sites for people with Learning Disabilities with symbols that appear when the cursor hovers over a piece of text. An example of this is the website for the accessibility charity Access-Ability

Communications Technology². Figure shows a symbol that appears when the cursor hovers over the word 'everyone'.

Figure 4 - Access-Ability Communications Technology website (detail), showing a pop-out symbol (to represent the word 'everyone').



Fonte: Access-Ability Communications Technology.

Images, in the form of photos, icons or other pictorial representation also accompany hyperlinks, most notably in contents or menu lists. Figure shows examples of the use of photos and icons that illustrate menu links, the former from the Trafford Borough Council Adult Social Care web page³, and the latter from Common Knowledge UK⁴, a charity providing accessible and interactive information and online learning 'that can be understood by everyone' (CKUK, 2011). Other sites include the health information website Easy Health⁵ (photos) and the transition information website Movingonup (icons). There are a great many other examples.

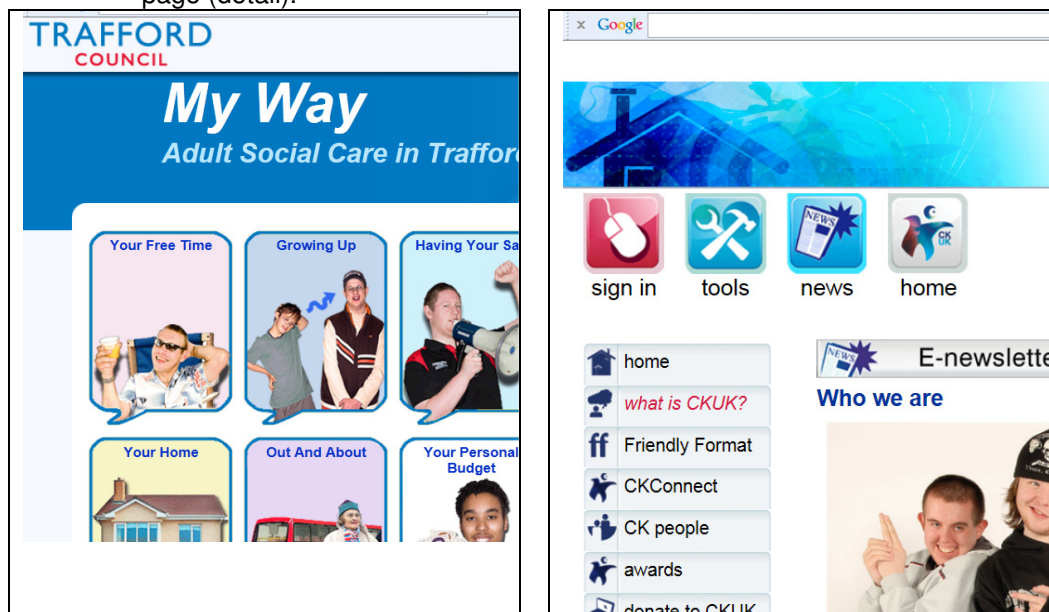
² <http://www.aact.org.uk/>

³ <http://myway.trafford.gov.uk/>

⁴ <http://www.ckuk.org.uk/index.html?pid=175>

⁵ <http://www.easyhealth.co.uk>

Figure 5 - Two means of illustrating menu items. Left, Trafford Council Adult Social Care web page (detail), showing photos, and right, Common Knowledge UK web page (detail).



Fonte: <http://myway.trafford.gov.uk/> (left) and <http://www.ckuk.org.uk/index.html?pid=175> (right)

Jones, Long e Finlay (2007, p. 546) note that 'the idea that [adding] symbols to text can improve its comprehensibility finds support from a theory called "stimulus equivalence"', and cite Sidman (1990) and Carr and Felce (2000) in this regard. They continue: 'stimuli, including words and symbols, can be substituted for each other in a particular context without meaning being substantially altered' (JONES, LONG; FINLAY, 2007, p. 546). They give the example of the concept 'fruit' being represented orally, in writing and by a drawing, with the representations being mutually substitutable.

Poncelas and Murphy (2007, p. 466) note that 'there is almost no published research investigating whether the use of symbols does increase the understanding of written material' (PONCELAS; MURPHY, 2007, p. 467). This is particularly true with regard to electronically-mediated information. Williams and Hennig (2015a) suggest that adding images to text or to hypertext menu entries does not aid the speed of access to information for people with low levels of literacy. In other words, an appropriate image by the side of some text related to it. For

example, a photo of a pair of bowling shoes next to text reading 'you need to wear bowling shoes when you go bowling' did not facilitate a more rapid answer to the question 'what do you need to wear to go bowling?' than the text without the image. The burden of reading, line by line and word for word, prevented participants from looking 'globally' at a page and spotting the image and potential clue as to the answer.

A rare example of a study examining a web site specifically in terms of the efficacy of images is that by Choi and Bakken (2010). The researchers created a multimedia educational Website for 'low-literate adults' attending a Neonatal Intensive Care Unit (NICU) in the United States. This included pictographs and photographs, and audio rendition of simplified text. The reading level of the content was 5th grade [10-11 year olds - although a screenshot of a page shows words such as 'ductus arteriosus', 'defect', 'premature' and 'vessel' included, which people who find reading difficult are unlikely to be able to read with ease.

Ten NICU parents were exposed given a number of information retrieval tasks using the resource, with performance being measured by the task-time and number of errors. A usability questionnaire was administered following the sessions, and field notes were taken of the cognitive walkthroughs participants were asked to perform.

Results showed that pictographs clearly represented the recommended healthcare actions (e.g., how to take a baby's temperature) and were well accepted by the participants. They perceived pictographs as illustrating action steps more understandable than text alone. However, photographs 'gave more realistic images' (CHOI AND BAKKEN, 2010, p. 572). However, the authors note that photographs 'are loaded with irrelevant details that are likely to attract the attention of low-literate users rather than key concepts', although as no evidence (except references to other work) is provided, this appears to be predominantly the views of the authors. Based more on the evidence was the other problem noted by Choi and Bakken (2010, p. 572) - photographs 'are not neutral in gender and culture'. The authors found

that ‘many participants perceived people in photographs as “not like me.”’ However, this area is perhaps beyond the remit of the current paper, and is mentioned here simply as an example of the complexities of providing information pictorially.

Research not based on web-mediated information includes that by Poncelas and Murphy (2007), who were concerned with written passages of text and whether the addition of adjacent symbols or icons was an aid to understanding. To address this, they tested whether a symbol-based passage of text, in the form of a simplified political manifesto increased the understanding of this material for people with intellectual disabilities. ‘Two versions of [the] manifesto were produced: one text-based and the other symbol-based (with text)’ (PONCELAS; MURPHY, 2007, p. 466). Participants were randomly assigned to two groups, each receiving one of the versions, and asked a series of questions about the material, both immediately after exposure, and then again and a short time afterwards.

Neither version was well understood by the participants. The group whose text was accompanied by symbols showed no better understanding than the group with text only. This was true whatever the level of understanding. For example, those with better language comprehension scores and those with better reading skills tended to show a higher understanding – but this was true of both conditions. The conclusion of the study overall was that ‘the addition of symbols to simple texts does not necessarily improve people’s understanding of it’ (PONCELAS; MURPHY, 2007, p. 466). Similar results were obtained by Hannus and Hyona (1999), who found that comprehension scores *were* improved by the presence of illustrations in textbooks, but not for low-ability children.

Much research, however, shows that in various circumstances, pictures or symbols can aid comprehension. Jones, Long e Finlay (2007) worked with 19 adults with ‘mild or borderline’ Learning Disabilities, whom they asked to read four short passages of text from the Neale

Analysis of Reading Ability (NARA) test (NEALE; CHRISTOPHERS; WHETTON, 1989) two of which had Widge symbols added to them. They were asked four comprehension questions (pre-constructed from NARA) to test their understanding of the text. Participants scored significantly better on the symbolised text condition than on the plain text one ($p < 0.05$). This was particularly true for those with lower reading ages, suggesting the symbols helped them more.

The stark contrast in these results, compared with the similar study by Poncelas and Murphy (2007), outlined above, might be due to the choice of materials used. Jones, Long e Finlay (2007) used a graded reading test, compared to a simplified political party manifesto by Poncelas and Murphy (2007). Although the political party manifesto 'was rewritten in clear, simple language', the actual topic may have been more challenging (although, of course, one could argue that this was the same for both the with-symbols and text-only conditions). Second, it is not clear which text was rendered into symbols. Jones, Long e Finlay (2007, p. 547) symbolized only 'words with a high degree of visual imagery (e.g. bird, cat) [...] while the other words (e.g. to, for, my) remained without them'. Poncelas and Murphy (2007) said only that they symbolized 'keywords'. Given the topic of the materials, these may have included attempts to symbolise abstract concepts.

3.3 Studies Factoring in Help Offered by Supporters

A number of studies outlined above have included measures or consideration of the input and impact of supporters or researchers themselves. It has been pointed out extensively (e.g. BOZIC; MURDOCH, 1996; FRIEND, 2005; EVANS, 1993), that the presence (and, indeed, quality) of support is an important factor in a special needs context. The influential Russian educationalist Lev Vygotsky goes so far as to say that undertaking an activity in a social context, with appropriate support, is a *necessary* (not simply 'preferable') step (i.e. even for people

who do not have Learning Disabilities) towards being able to learn independently (VYGOTSKY 1978).

Given the support needs of many research participants and the vital role generally that supporters are required to play in the Learning Disability field, how supporters work with their charges on negotiating ICT applications is an interesting area of observation. Several studies have included details of supporter involvement in people with Learning Disabilities using ICT.

In the study by Karreman, Van Der Geest e Buursink (2007) described above, the support consisted of the interventions of the experimenter, who:

[...] offered assistance [...] after the participants expressed their inability to find the information more than two times. Her assistance consisted [first] of [...] asking the participants what they tried to achieve. [...] in some cases [this] was enough to overcome the problems. When this was not the case, the experimenter directed participants to the page they had to visit' (KARREMAN, VAN DER GEEST E BUURSINK, 2007, p. 513).

Results showed that 15 (out of 20) participants with intellectual disabilities needed assistance, varying from one to seven times. Ten (also out of 20) participants 'without identified intellectual disabilities' needed assistance, on one or two occasions.

Interaction with the teacher was also observed and measured by Sevilla et al. (2007) in the study outlined above. This was in terms of the number of support actions carried out by the teacher and those requested by the participant. Table 1, below, completes the observational schedule shown **Erro! Fonte de referência não encontrada.** in **Erro! Fonte de referência não encontrada.**

Table 1 - Observation schedule (part of) used for calculating the measures of usability.

INTERACTION WITH THE TEACHER	
Support and requests	Number of support actions carried out by the teacher Number of support requests made by the

		participant
--	--	-------------

Fonte: Sevilla *et al.* (2007).

Results of these observations were factored into efficacy and efficiency measures of an accessible and a 'standard' web browser.

4 SUMMARY AND CONCLUSIONS

Summarising the research detailed in this article, it is clear that, despite the paucity of literature in the field, a large number of methods have been employed to test the usability of websites with people with Learning Disabilities. Methods by which usability has been studied with people with Learning Disabilities include:

- Comparing an especially adapted website against an equivalent "mainstream" version (KARREMAN; VAN DER GEEST; BUURSINK, 2007; SEVILLA *et al.*, 2007);
- Comparing various website designs, each of which was created for a Learning Disabled user group (ROTONDI *et al.*, 2007; WILLIAMS; HENNIG, 2015a);
- Examining one site only (HARRYSSON; SVENSK; JOHANSSON, 2004; LEPISTO; OVASKA, 2004)
- Researching one attribute of a website (ROCHA *et al.*, 2012).

With regard to populations and samples, these have generally been people with Learning Disabilities only (i.e. without a control or comparative group), albeit variously described, in addition to that term, as having:

- Severe mental illness and cognitive deficits (ROTONDI *et al.*, 2007)
- Intellectual disabilities (but could read) (KARREMAN; VAN DER GEEST; BUURSINK, 2007)
- Cognitive disabilities' (SEVILLA *et al.*, (2007)
- Mental retardation (DAVIES; STOCK; WEHMEYER, 2001)

One study was found which comparing the performance of people with Learning Disabilities with a 'mainstream' cohort (KARREMAN; VAN DER GEEST; BUURSINK, 2007).

Data gathering has included:

- Search and reading time (KARREMAN; VAN DER GEEST; BUURSINK, 2007);
- Task-time (CHOI; BAKKEN, 2010; ROCHA et al., 2012);
- Content comprehension (KARREMAN; VAN DER GEEST; BUURSINK, 2007);
- Error frequency (KARREMAN; VAN DER GEEST; BUURSINK, 2007; DAVIES; STOCK; WEHMEYER, 2001);
- Help sought or offered (SEVILLA et al., 2007);
- Surveys (KARREMAN; VAN DER GEEST; BUURSINK, 2007)
- Smiles and gestures (SEVILLA et al., 2007)
- Rating scales (KARREMAN; VAN DER GEEST; BUURSINK, 2007)

Findings overall suggest that ‘accessible sites’ – such as those with fewer menu entries and buttons (SEVILLA et al., 2007); audio rendition of content (DAVIES; STOCK; WEHMEYER, 2001); ‘easy read’ text (KARREMAN; VAN DER GEEST; BUURSINK, 2007) do facilitate information access for people with Learning Disabilities. One study (SEVILLA et al., 2007) found a correlation between level of disability (as manifested in IQ scores) and performance, in terms of understanding and navigation.

Difficulties elicited from the literature include finding content from ‘a large quantity of text’ (HARRYSSON; SVENSK; JOHANSSON, 2004, p. 141), managing ‘pop-ups’ (CHOI; BAKKEN, 2010), scrolling (WILLIAMS; HANSON-BALDAUF, 2010), negotiating a vertical menu layout (WILLIAMS; HENNIG, 2015a, 2015b).

Work examining the efficacy of images or icons has had contradictory findings. Williams and Hennig (2015a), in a rare examination of web-based text and images, found no benefit in terms of access to information. Poncelas and Murphy (2007) found no improvement in understanding when text was accompanied by symbols or icons, and nor did Hannus and Hyona (1999), when considering ‘low-ability’ children. However, Choi and Bakken found that in a health information website, pictographs represented information clearly, and were well accepted by participants. Similarly, Jones, Long e Finlay

(2007), and Mansoor and Dowse (2003) however, found that symbols significantly aided the understanding of text – as much health information/education research has also shown.

Finally – but perhaps most importantly – some recommendations can be elicited from the literature. In terms of content, Karreman, Van Der Geest e Buursink (2007) suggest ‘high-level’ pages be made ‘easy to read’ with more specific content available through links; and Williams and Hennig (2015a, 2015b) that the most important text be situated at the top of a page with no distracting side menu bar. Not surprisingly, screen-readers – usually associated with web use by visually-impaired people - have been recommended (HARRYSSON; SVENSK; JOHANSSON, 2004) as have ‘screen-prompts’ (DAVIES; STOCK; WEHMEYER, 2001). In general, information repeated in different forms (e.g. text, audio or picture) appears to aid understanding although, for readers, reliance on audio or pictures (i.e. removing text) may not be effective (ZENTEL; OPFERMANN; KREWINKEL, 2007). Rocha (et al., 2012), however, found that an audio with images condition aided comprehension more than text with audio – illustrating the difficulties in making recommendations based on a somewhat limited corpus of research.

Regarding navigation, Sevilla *et al.* (2007) found that a simplified toolbar was beneficial. These researchers also recommend a page which does not require a scroll bar, although the alternative of using ‘paging’ (splitting content into smaller chunks on separate pages) does not appear to have been tested in the literature, despite other evidence (e.g. WILLIAMS; HANSON-BALDAUF, 2010; SMALL *et al.*⁶, 2005) noting problems with scrolling. Conversely, Rotondi *et al.* (2007) recommend a large amount of content per page to reduce the need for navigation. In

⁶ The sample in this study was of people with cerebral palsy or obsessive-compulsive disorder, the first of which may not necessarily result in Learning Disabilities (FENNELL; DIKEL, 2001), whilst the latter is not related to IQ (PETERSON *et al.*, 2001) and therefore not to Learning Disabilities either. Hence the study not being detailed in this paper

terms of labelling, 'long' labels may be recommended, to avoid users having to imply or think abstractly about meaning.

Perhaps the best recommendation, and a suitable one with which to end this review, is to actually include the potential users – the people with Learning Disabilities themselves – in the design, testing and evaluation of web sites. Sadly, this is far from common. Rotondi *et al.* (2007) note that design recommendations for this cohort are often based on researchers' own knowledge and experience (ROTONDI *et al.*, 2007). Bohman (2007) could only find seven journal articles that dealt with web usability design by directly observing people with cognitive disabilities, and Williams (2013) found this situation had hardly improved in recent years. Apart from the ethical imperative to include the cohort in research (e.g. CAMERON; MURPHY, 2007), Lepisto and Ovaska (2004) note that 'expert' evaluation may not reveal problems encountered by actual, Learning Disabled, users. Only by exploring with this constituency themselves can optimum design and content be discovered that may better facilitate both information acquisition, and thus self-advocacy and empowerment.

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Title

Studying web usability with people with Learning Disabilities: what the literature tells us

Abstract

Introduction: It is well-recognised that the Internet may be an appropriate vehicle to provide information for people with Learning Disabilities. A small but

growing body of research has studied the usability of the Internet for this purpose. This review examines the literature relating to this issue

Objectives: The objective of the paper is to examine current research and thinking around the issue of web design for people with Learning Disabilities, including an exploration both of methods used and key findings.

Methods: A comprehensive literature review was undertaken encompassing material from the fields of education, computer science and health. Literature was elicited from various appropriate bibliographic databases. In examining the literature, an analytical proforma was used to elicit information, evaluate and compare studies.

Results: A large number of methods by which usability has been studied with this cohort were elicited, including using a mainstream website; comparing an especially adapted website against an equivalent 'mainstream' version and comparing various 'accessible' website designs. Similarly, studies included those comparing the performance of people with Learning Disabilities with a 'mainstream' cohort and on their own. Findings overall suggest that 'accessible sites' are easier to use for people with Learning Disabilities. Difficulties encountered include in reading, finding content from a large quantity of text and scrolling. Work examining the efficacy of images or icons has had contradictory findings, from having little or no benefit in terms of access to information, to significantly aiding the understanding of text.

Conclusions: Contradictory or inconclusive findings suggest both a need for further research and for greater participation by people with Learning Disabilities themselves in studying the usability of web sites and other IT applications.

Keywords: World Wide Web. Internet. Usability. Aecessibility. Learning Disabilities.

Titulo

El estudio de la usabilidad web con las personas con discapacidades de aprendizaje: lo que la literatura nos dice

Resumen

Introducción: Es bien reconocido que la Internet puede ser un medio apropiado para proporcionar información a las personas con discapacidades de aprendizaje. Un pequeño pero creciente cuerpo de investigación ha estudiado la capacidad de uso de la Internet para este fin. Esta revisión examina la literatura relacionada con este tema.

Objetivos: El objetivo de este trabajo es examinar la investigación actual y el pensamiento en torno a la cuestión del diseño de páginas web para personas con problemas de aprendizaje, incluyendo una exploración tanto de los métodos utilizados y los resultados clave.

Métodos: Una revisión exhaustiva de la literatura se realizó abarca material de los campos de la educación, ciencias de la computación y la salud. La literatura se obtuvo de diversas bases de datos bibliográficas apropiadas. Al examinar la

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literatura, se utilizó un proforma de análisis para obtener información, evaluar y comparar los estudios.

Resultados: se suscitó un gran número de métodos por los cuales la usabilidad se ha estudiado con esta cohorte, incluyendo el uso de un sitio web convencional; comparar una página web especialmente adaptada en contra de una "corriente principal" versión equivalente 'y comparando varios' accesibles 'diseños de sitios web. Del mismo modo, los estudios incluidos los que comparan el rendimiento de las personas con discapacidades de aprendizaje con una "corriente principal" de cohorte y por su cuenta. Los hallazgos sugieren que en general 'sitios accesibles' son más fáciles de usar para las personas con discapacidades de aprendizaje. Las dificultades encontradas incluyen en la lectura, la búsqueda de contenido a partir de una gran cantidad de texto y de desplazamiento. El trabajo examina la eficacia de imágenes o iconos ha tenido resultados contradictorios, de tener poco o ningún beneficio en términos de acceso a la información, para ayudar de manera significativa la comprensión del texto.

Conclusiones: los hallazgos contradictorios o no concluyentes sugieren tanto una necesidad de más investigación y una mayor participación de las personas con discapacidades de aprendizaje propios en el estudio de la usabilidad de los sitios web y otras aplicaciones de TI.

Palabras clave: World Wide Web. Internet. Usabilidad. ACESSIBILIDAD.
Discapacidades de aprendizaje.

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