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Standardisation of keystrokes for the web:
Setting and implementing standards for keyboard navigation on websites

By

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Preface

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Abstract

Keyboard shortcuts to navigate websites are an essential tool for blind users, and those unable to use a pointing device. So far shortcuts and keyboard aids built into web pages are inconsistent and unpredictable. Improving the keyboard shortcuts available will not only aid keyboard users but is also becoming increasingly important for expert users and those who use mobile technology.

The aim of this research is to find a solution to the existing problems with web keyboard shortcuts, and to determine a specification that could be used as a standard for the implementation of keyboard shortcuts on the World Wide Web.

In order to find the most effective keyboard navigational aids I surveyed 500 people, performed 20 user observations and facilitated 5 heuristic evaluations. The results of the testing revealed people's use, preferences and views of keyboard shortcuts. 55.2% of those surveyed believed that keystrokes are important. The results also demonstrated that keyboard aids on websites must be visible and intuitive.

My findings suggest that the browser should control the keys designated as shortcuts, as this will ensure standardisation and consistent use across the web. Separating the browser functions from the content also supports device independence.

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Chapter 1: Introduction

1.1 Problem description

Since its introduction in the 1980's the majority of people use a mouse to interact with their computer (WikiPedia n.d.a). Some people are however unable to use a mouse or pointing device[1] as a result of a visual impairment or a manual disability. The Disability Discrimination Act states it is unlawful for a provider of services to discriminate against a disabled person (DirectGov 1995). Computer interface designers need to ensure the systems they build are accessible to all users. Shortcuts are built into software to allow keyboard users quick access to menu items, e.g. Microsoft standard (Microsoft 2002). This research looks specifically at how keyboard aids can make websites more accessible for keyboard users.

There are a significant number of disabled users online, there are estimated to be 9.8 million (22%) disabled people in Britain today (Department for Work and Pensions 2003), and 13.1 million (55%) of households in Great Britain could access the Internet from their home in May 2005 (National Statistics Office 2005).

It is not only people with disabilities who benefit from keyboard shortcuts; there are also people who prefer to use the keyboard for some tasks. Expert users may find using the keyboard more efficient for certain tasks, or someone who suffers from repetitive strain injury (RSI) may find the keyboard more comfortable to use.

As more devices become connected to the internet, device independence needs to be considered when building webpages. In terms of interaction, users will need multiple ways of accessing information, e.g. using the pointing device on a laptop or PDA (personal digital assistant) can be awkward, and most mobile phones only have a numeric keypad.

Navigating websites with a keyboard is monotonous, navigational aids can be added to make the navigation more efficient for keyboard users. However, currently keyboard navigational aids are being added to websites inconsistently. The lack of standards has not only made them difficult to learn but also created conflicts with other software. This research aims to find a specification that could be used as a standard for the implementation of keyboard shortcuts on the web. The next section describes the objectives in detail.

[1] Pointing device, are input devices for direct manipulation, e.g. trackball, touchpad, pointing stick, lightpen, joystick, and head pointer.

1.2 Objectives

- Objective 1 **Review literature on keyboard shortcuts and related topics**

  In order to find the most appropriate specification for keystrokes on the web I needed to research the topic to ensure I have taken into account existing knowledge in this area. The research covered the following topics: keystrokes on the web, general keystrokes, statistics, user agents, usability testing, and standards.

- Objective 2 **Finding current implementations of keyboard shortcuts and accesskeys online**

  To find a specification for keystrokes on the web I first needed to understand what keyboard navigational aids were currently available. I had to find the current uses of accesskeys and other keyboard aids on websites. This meant I would not only be aware of the options and how they are built but I could also judge their popularity and success. Appendix A 'Sites including keyboard user aids' lists the sites found.

- Objective 3 **Evaluate current keystroke navigational implementations**

  In order to find the most effective specification for keystrokes on the web in terms of both usability and implementation I needed to evaluate the current implementations found during Objective 2. I evaluated them using a combination of usability evaluation methods, which included user observations, an online survey, and heuristic evaluations. The results of these tests could then be analysed using usability factors and implementation issues including time to complete task, ease of learning, number of keystrokes, user satisfaction, conflicts, extensibility, browser support, ease of programming and internationalisation.

- Objective 4 **Investigating standards for keystrokes**

  The overall project aim is to find a specification for keystrokes on the web, and this specification would need to become a standard to ensure consistent use. In order to understand how standards are set and adhered to on the web I investigated those currently in use on the web. This objective involved investigating the effectiveness of guidelines, standards and checkpoint documents of both private and public organisations. I also investigated the current legal requirements for accessible websites.

- Objective 5 **Specification for keystrokes on the web**

  The last objective involves collating all the information to produce a specification for keystrokes on the web. Using all the research from the literature review and my evaluations to determine the most effective and usable solution for implementing keyboard shortcuts on the web.

1.3 Chapter summaries

Chapter 2 Secondary data collection (Objectives 1 + 2 + 5)

Chapter 2 contains the information I found about keystroke use on the web and standards. This chapter investigates why and where keyboard navigational aids are used. Information was gathered from a variety of sources: accessibility/web development websites, books, web forums, public standards and academic papers from journals and conferences.

Chapter 3 Methods and research instruments (Objective 3)

Chapter 3 validates my choice of evaluation methods used to assess the keyboard navigational aids. The chapter explains the tests performed, questions asked, participants, and the artefacts tested. The chapter will also describe any shortcomings of my evaluation techniques.

Chapter 4 Primary data collection and preparation of results (Objective 3)

Chapter 4 includes all the data collected from the user observations, survey, and heuristic evaluations. The results are tabulated and graphically displayed to indicate the patterns found which may help find the most effective and usable solution to the research problem.

Chapter 5 Analysis and synthesis (Objectives 4+ 5)

Chapter 5 collates all the results against chosen performance measures to find which variant is the most suitable in both usability and technical terms. Some alternative solutions are proposed and preliminary analysis is done to assess their viability.

Chapter 6 Conclusion and evaluation (Objective 5)

Chapter 6 summarises my findings and gives recommendations for future keyboard navigational aids, and any future research that is needed.

1.4 Summary

In this chapter I have outlined my objectives and given a summary of each chapter. In Chapter 2 I will explore the problem domain further.

Chapter 2: Secondary data collection

2.1 Introduction

The first chapter outlined my objectives and summarised my chapters. This chapter contains information about keyboard use and the web. This chapter details the work done for Objective 1, 'Literature search on keyboard shortcuts and related topics', and Objective 2, 'Find all current implementations online'.

2.2 Accesskeys

Using a pointing device (e.g. mouse) is the most common way to navigate websites, however a web author must take into consideration those people who cannot or do not wish to use a pointing device. Designing web pages to support simple keyboard navigation is relatively easy. User agents[2] support tabbing, which enables the user to use the 'TAB' key to move focus[3] through links and form objects. Various aids can be added to web pages to allow the keyboard user quicker access to content. Some authors include additional invisible links to aid keyboard users, including 'skip to navigation' or 'skip to content'. Even with this added functionality, navigating web pages with only the keyboard is a laborious task.

HTML now gives web authors the opportunity to build keyboard shortcuts called accesskeys into websites (W3C 1999). Accesskeys are keyboard shortcuts that allow keyboard users to navigate websites more effectively using just a few keystrokes. Accesskeys give more power to keyboard users, allowing them to quickly navigate between content without being restricted by the predefined order of elements on the page. Users of mobile technology[4] also benefit from the use of accesskeys, browsing the web on a mobile phone involves 'tabbing' through long pages; shortcuts would be an invaluable alternative.

However, accesskeys are in their infancy and many developers are sceptical about their usefulness (Featherstone 2003; Foliot 2003; Shea 2005). There are ongoing problems with the implementation of accesskeys: firstly no standards for their use have been clearly defined or accepted, and secondly there are conflicts with keyboard shortcuts in other software.

[2] User agent is a client application used to view HTML documents (e.g. web browser)
[3] Focus is the point at which the mouse cursor is on screen.
[4] Mobile technology is portable computing, e.g. laptop, mobile phone, PDA

The accesskey attribute was introduced in HTML 4.0 (W3C 1999). The example below is the source code that would enable the user to use keystrokes to navigate to the home page of the website. Pressing the key combination 'ALT' and '1' will focus onto the link and then pressing 'ENTER' will activate the link.

```
<a accesskey="1" href="http://www.open.ac.uk/">……</a>
```

Mozilla[5] works slightly differently and does not require the 'ENTER' key.

Below is another example of the accesskey, this time the user can focus on a form field by typing 'ALT'+ 'F'

```
<a accesskey="1" href="http://www.open.ac.uk/">……</a>
<label for="formfield" accesskey="f">Field</label>
<input type="text" id="formfield">
```

XHTML2 has updated the accesskey attribute[6] to become an access element[7]. W3C have not yet released the final XHTML2 specification (W3C 2005). The example below 'ALT' + 'C' will take the user to the table of contents.

```
<access key="c" title="Table of contents" targetrole="toc">
```

A web author has to consider the following issues before building accesskeys into a website: Browser support for the attribute is variable, there are conflicts between other software packages and operating systems, and there are no standards or guidelines for implementing accesskeys. As well as being unpredictable, the keys are invisible to the user (excluding some text browsers[8]).

With no clear standards, website creators have been left to add in the feature as they see fit. There is a wide variety of implementations of the accesskey, which makes it difficult for users to know what to expect, as they have to relearn standards for each site they visit.

The consistent application of accesskeys would mean users would only need to learn the keystroke commands once. "Nothing could be better than relying on one set of keys to do the same thing across all sites you visit" (Shea 2003). However, as being consistent across all sites seems unattainable, all sites are different, have different concepts of the same thing, and a different view of what is important.

[5] Mozilla is a web browsers; the Mozilla Suite includes Firefox, Camino, Netscape 6, etc.
[6] Attribute is part of the HTML that modifies or further describes an element.
[7] Element is part of the HTML called a tag which is bound by a pair of opening and closing tags.
[8] Text browsers; display the content of a page as text, Lynx is a common text browser.

When it comes to assigning accesskeys, there are other issues that pose problems. Foreign language keyboards have separate keys for some accented characters. As it stands, browsers only understand US-ASCII[9] accesskeys, Internet Explorer and Mozilla ignore accented accesskeys (which are impossible to type anyway). An author can choose accesskeys from 26 unaccented letters, 10 numbers, and a few punctuation marks (Clark 2003 p.169).

Of the keys available to use, only a few will not conflict with other shortcuts. Each user, user agent, operating system and helper application has its own methods of dealing with shortcuts. John Foliot, a co-founder of WATS.ca found that the only three keys you can guarantee will not cause conflicts with other actions were '/' '\' and '[' (Foliot 2003).

Browser support is varied: some older browsers do not support the accesskey attribute. iCab[10] and other open source text web browsers such as Lynx and Links display the accesskey to the user, e.g. iCab uses a superscripted <accesskey> after the link.

One of the main reasons why accesskeys are not widely used is that users are not aware of them. Making the accesskey visible to the user is intended to increase its accessibility; some websites underline the character used. Is it up to the author or the user agent to promote and display the accesskey? Displaying the accesskey may not even be sufficient; tests done using mobile phones found 16 out of 20 users did not understand the relevance of accesskeys (Kaikkonen and Roto 2003).

The UK government has started using numbers to specify accesskeys; this is a common solution and possibly an emerging standard (GovTalk n.d.). The use of 'ALT+1' for home is intended to become as familiar and widespread as 'CTRL + P' (the keyboard shortcut for print).

Authors are given the responsibility to specify accesskeys for their pages; it is up to them to make consistent, intuitive, and non-conflicting choices. There are some recommendations available that promote the use of numbers, e.g. the UK government standards. The use of numbers is not only less likely to cause conflicts but will also work with other devices such as mobile technology.

[9] US-ASCII is a character set and a character encoding based on the Roman alphabet
[10] iCab is a highly-configurable web browser for the Macintosh

2.3 Shortcuts for website navigation

Objective 2 involved finding current implementations of keyboard shortcuts and accesskeys online; to ensure I conducted a thorough search, I used a variety of techniques. Some of the literature and websites found in the literature review referred to websites, I also checked accessibility websites and accessibility experts' web pages. I used search engines to directly search for the functions and help pages on websites for keyboard users. Current keyboard shortcuts fall into the following three categories:

Visible accesskeys: This category includes visible representations of the key on screen, which can be either in the form of an underlined character or a letter/number visible after the link. One example of this is the Ontario website, which underlines the character in the navigation (http://www.energy.gov.on.ca/index.cfm?fuseaction=english.main) (Ontario n.d.)

Invisible accesskeys: This category includes all sites that have keyboard aids that are not displayed on the page. The instructions may be hidden and only available to blind users, or may be on a help page, and these again will be either numbers or characters. One example of invisible accesskeys is on the UK government website. The government has been using numbers as a standard, and kept the keystroke assignment standard across all local authority sites (http://www.salford.gov.uk/online/howto/accesskeys.htm) (Salford City Council n.d.)

Hotkey: This category is for sites that use simple navigational features, e.g. one key or one dropdown. One example of this is the Ultimate Dropdown Menu (UDM4) accessible dropdown menu. UDM4 uses a function key to jump to the navigation (http://www.udm4.com/). (UDM4 n.d.)

2.4 Link relationships

Instead of using accesskeys WATS.ca suggests the use of link relationships (Featherstone 2003). Link relationships are a way of allowing the browser to read popular links such as index and sitemap, e.g. <link rel="home" title="Home" href="index.htm"/>. The browser then pick up the links and displays them in a site navigation bar below the adress bar. Currently site navigation is only available in Mozilla and Opera[11] (text browsers display the links on the page). In Opera and Mozilla it can only be used with a pointing device. The idea is that browsers would allow users to be able to assign their own keystrokes to each link. (Featherstone 2003)

Opera uses Home, Index, Contents, Search, Glossary, Help, First, Previous, Next, Last, Up, Copyright, Author, Newsfeed (See Figure 2.1).

Figure 2.1: Site navigation feature in Opera

Mozilla uses Top, Up, First, Previous, Next, Last, Document (Table of contents, Chapters, Sections, Subsections, Appendixes, Glossary, Index), More (Help, Search, author(s), Copyright, Bookmarks, other versions) (See Figure 2.2).

Figure 2.2: Site navigation feature in Mozilla

Unfortunately, Mozilla decided to remove this feature because of its small but measurable performance impact. However, the site navigation bar is available in an extension called 'Link tool bar' (Clavering and Neale 2004).

Interestingly, Mozilla Firefox[12] has another extension called 'Mouseless browsing'; this assigns an ID to every link on the page, and displays the number next to the links. To activate a link the user clicks 'CTRL + ID'.

[11] Opera is a web browser
[12] Mozilla Firefox, a web browser developed by the Mozilla Foundation and hundreds of volunteers.

2.5 User agents

When using keystrokes to navigate a web page by tabbing or using an accesskey the browser sends focus to the link. The focus is made visible by a dotted grey border around the area of the link. If a user tabs onto a page or clicks an accesskey, a faint grey dotted line will appear around the selected link area. Figure 2.3 shows the focus around the link to W3C activities. This however may not be clear enough for the user.

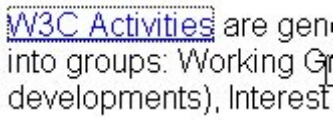


Figure 2.3: A standard HTML hyperlink

Figure 2.4: A CSS enhanced hyperlink

Figure 2.4 shows how JavaScript and Cascading Style Sheets (CSS) have been used on the W3C home page to enhance the locality of focus, with the following HTML.

```
<a href="#content" onfocus="this.style.background ='#fff'"
onblur="this.style. background='#fff'">
```

If the browser had made the focus more visible than the web designer wouldn't feel the need to define his or her own style rules. Web authors often duplicate web browser functions on web pages, e.g. the print icon (see Figure 2.5), a save icon, close window icons on pop-ups (see Figure 2.6) and more recently, text resize icons (see Figure 2.7). These are functions that are dealt with through the browser. The duplication of these functions would not be necessary if the browser dealt with them in a more usable way. For example, to increase the text size in Internet Explorer the user needs to open the view menu, up click text size and then click small, medium or large (Figure 2.8). Because this feature is hidden within a menu users often don't know it exists. Web authors have been putting this feature on the actual web pages when really the function belongs within the browser chrome[13].

Below are examples of the browser functions displayed on the actual web page.

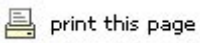


Figure 2.5: Browser facilities – Print icon

Figure 2.6: Browser facilities – Close window button

Figure 2.7: Browser facilities – Text resize icons

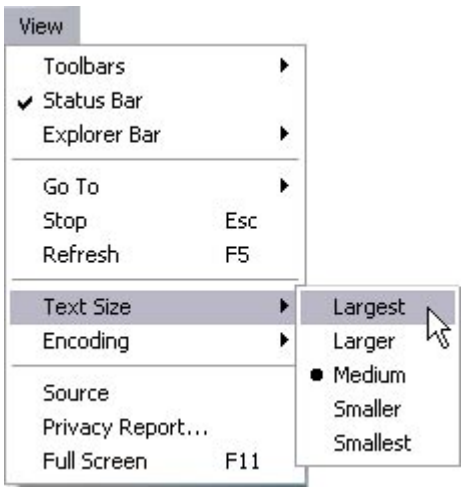


Figure 2.8: Browser facilities – Text resize menu Internet Explorer

[13] Browser chrome is the border of a web browser window, including the window frames, menus, toolbars and scroll bars.

2.6 Standards

User agents are required to meet Priority 1 of The World Wide Web Consortium (W3C)[14] User Agent Accessibility Guidelines (UAAG) (W3C 2002). Checkpoint 2.1 (Priority 1), states that accesskeys should function. Checkpoint 10.3 (Priority 2), states that the user agent should provide information to the user about the autho-specified keystrokes. User agents are evolving fast to meet W3C guidelines and adapt to new scripting capabilities. In some cases browser manufacturers have built in alternative shortcuts to avoid conflicts, e.g. Mozilla uses 'CTRL + L' to focus on the location bar. As with all fast-changing technologies, adaption is essential, but generally until something is a problem it doesn't get fixed. If authors make the decision not to add accesskeys, it is more likely that browser manufacturers will disregard any conflicts and problems.

Standards and techniques are emerging as the accesskey attribute evolves and user agents are adapting to accommodate it. At present the future of the accesskey is not certain. It is unclear whether the problems encountered with accesskeys are simple implementation problems or whether there it is something more fundamental.

Windows has a market share estimated to be around 95% for desktop personal computers (Wikipedia n.d.b). In Windows software a keyboard shortcut for a menu item is displayed by using an underlined character. The majority of people use the mouse to access the menus, however many people are likely to be familiar with this convention.

The Special Educational Needs and Disability Act 2001 (The Office of Public Sector Information 2001) is an act that makes it unlawful for educational websites to discriminate against people with learning disabilities. Further and higher education institutions need to reach at a minimum of level A (Priority 1) of the Web Content Accessibility Guidelines (WCAG) (W3C 2000). WCAG has 14 guidelines which have various checkpoints, and a developer has to meet certain criteria in every guideline to achieve Level A (Priority 1), Level AA (Priority 2), Level AAA (Priority 3). The guidelines cover all areas of accessibility and one of the priorities relates directly to keyboard use and accesskeys. Guideline 9, 'Design for device-independence', requires the use of features that enable activation of page elements via a variety of input devices. "9.5 Provide keyboard shortcuts to important links (including those in client-side image maps), form controls, and groups of form controls (Priority 3). For example, in HTML, specify shortcuts via the 'accesskey' attribute" (W3C 2000).

[14] W3C is a consortium that produces the software recommendations for the World Wide Web.

The United States government has a similar code of practice called Section 508. Section 508 requires that Federal agencies' electronic and information technology is accessible to people with disabilities (US General Services Administration 2001). The Centre for Information Technology Accommodation is in charge of educating federal employees. The section sets out standards for various technologies, one of which is web-based information and applications (1194.22). 1194.22 Part (o) is an aid for keyboard users called "A method shall be provided that permits users to skip repetitive navigation". Section 508 forces the developers to undertake tests using a mix of human and automated testing, to ensure their website complies (US General Services Administration 2001).

Private companies such as Microsoft use guidelines for accessibility standards and some specific guidelines for keyboard users, e.g. 'Guidelines for keyboard user interface'; this covers all tabs, windows, forms, key choice and display (Microsoft 2002). IBM software uses checkpoints for software being developed; one of the guidelines – 'Keyboard equivalent for actions' – is specifically for keyboard use (IBM 2005).

Issuing standards and making adherence compulsory is one way of making people adhere to them. This can only work in controlled environments, e.g. government organisations or within private organisations. When developers are not required to meet any guidelines, there are other ways to encourage and promote accessibility and standards. Methods include educating and encouraging the developers, raising awareness of the benefits of use, encouraging the use of validators, and offering accreditation for sites that meet a set of standards.

There are many public organisations promoting accessibility; the following are some of the larger ones. The Royal National Institute for the blind (RNIB 2005a) provides lots of resources and advice for web builders. TechDis is a leading educational advisory service working on accessibility and inclusion (TechDis n.d.). British Educational and Communications and Technology Agency (BECTA n.d.a) is the Government's key partner in the strategic development and delivery of its Information and Communications Technology (ICT) (BECTA n.d.b). These and many other respected organisations all play a part in setting standards and encouraging the use of standards in web production.

2.7 Summary

This chapter examined existing research into the problem domain of keystroke use on the web. The solution to standards and the best execution of accesskeys or any kind of keyboard navigation aid is unclear and advice and best practice within this area is diverse and becoming more negative towards accesskeys.

Objective 3 of my research is to evaluate keystroke use on the web. Finding the best way to implement keyboard navigational aids will involve finding out more about the following:

- The current use of keyboard shortcuts in software.
- The current use of keyboard shortcuts while navigating the web.
- The current use of browser shortcuts while navigating the web.
- Which website keyboard aid do users prefer?
- Should the functionality be dealt with on the web page or within the web browser?

To answer these questions various evaluation methods were employed; the next chapter explains in detail the methods chosen.

Chapter 3: Methods to evaluate current keystroke navigation

3.1 Introduction

Chapter 2 examined existing knowledge within the problem domain of keyboard use and the web. Objective 3 was to create and evaluate the keyboard navigational aids found. To evaluate this I produced some prototypes, and performed testing to assess their relative success. This chapter explains the evaluation methods, participants and artefacts, the evaluators used and the reasons behind my choices.

3.2 Usability

3.2.1 User-centred design

When producing potential solutions for keystroke navigation, a user-centred approach needs to be adopted. The benefits of a user-centred design process have been recognised by many.
Bevan (1995) believes usability is quality of use, and should be the major design objective for an interactive product. "The needs of the users should dominate the design of the interface" (Norman 1986, p. 397). Gulliksen and Göransson (2003) state that a user-centred attitude should always be established.

Usability practitioners describe how the focus needs to be on the human factors of a system and the process needs to start in the early stages of a project and throughout the project life cycle. Gulliksen and Göransson (2003, p. 1025) states "User-centred system design is a process focusing on usability throughout the entire development process and further throughout the system life cycle".
Preece *et al.* (1993) describes how task analysis, early testing, and designing iteratively will ensure user's issues are central to the design process. Gould and Lewis (1985) defines the following principles (i) designers must understand who the users will be (ii) a panel of users should work closely with developers (iii) early prototype testing (iv) iterative development. ISO 13407 provides similar guidelines for user centred design activities. (Usability Net n.d.)

The usability of the keystrokes chosen is extremely important; otherwise people will simply not use the feature. When developing the keystroke navigation prototypes I employed a user-centred design approach. I followed the principles and advice given to ensure I had focused on the users, their needs, tasks and context of use. To ensure I found a usable solution to keystroke navigation I involved users and experts throughout the development process.

3.2.2 Usability factors

After producing suitable prototypes, the usability of the potential keystroke navigational solutions needs to be assessed. Usability factors can be used to evaluate their success.

Any system designed for people to use should be easy to learn, useful, easy to use and pleasant (Gould and Lewis 1985). Preece *et al.* (1993, p.14) defines usability in terms of whether a user can carry out their task safely, effectively, efficiently, and enjoyably. One way of measuring the usability of a system is by user testing. Shakel (1990 p.47) uses the four factors for user testing: learnability, throughput, flexibility and attitude. Shakel uses different terminology, throughput meaning efficiency and attitude meaning satisfaction; he also includes flexibility, to ensure a diverse range of users can use the system (e.g. expert and novice).

The most commonly used usability factors to measure against during testing are efficiency, effectiveness, and satisfaction (User Focus n.d.). Efficiency measures the amount of time users take to perform a particular task, effectiveness is measured by the percentage of that task the users complete, and satisfaction measures are obtained from users' ratings.

The MUSiC (Metrics for Usability Standards in Computing) project provides a more complex way of measuring usability, measuring user performance and user satisfaction using goals achieved, time taken and time spent unproductively. The method is a very controlled test using software to retrieve times and the quality of tasks (Bevan 1995).

For the early prototypes under evaluation, I was unable to use such a controlled test. I used a combination of the factors described which could be assessed or measured in some way during the user observations: time to complete task (efficiency), ease of learning, user satisfaction, and content-specific (effectiveness).

3.2.3 Implementation issues

I have included some additional implementation issues to assess the technical aspects of each variant; the measures are universal browser support, conflicts with other shortcuts, ease of programming, extensibility and internationalisation. Firstly, universal browser support, the keystroke aid chosen will need to work on all browsers since the number of IE users has been dropping as users appear to be switching to other browsers: “Roughly 84% use IE-based browsers, down from a high of 94%” (Browser News 2005). I also need to ensure there are no conflicts with other shortcuts, as this can cause major problems by disabling shortcuts in users’ software. The solution chosen also needs to be simple to implement, if it is not easy to program then the majority of web authors will not build it into their web pages. The extensibility of the solution also needs to be assessed: scripting languages, software and hardware are changing fast, so the choice of keystroke needs to be a viable for future possibilities. Lastly the issue of internationalisation needs to be considered, as the keystroke aid chosen will need to be functional outside the UK, and overcome any language barriers.

3.2.4 Evaluation methods

Objective 2 involved undertaking a detailed search of all the implementations online. There were three distinct variations of implementing the keystroke aids, described in Section 2.2 (Invisible, Visible, Hotkey). I will be performing a comparative study to find out the merits of each variant. To assess the usability factors and implementation issues of the keystroke navigational aids I will use a variety of evaluation methods.

Nielsen (1994) lists 7 inspection methods that can be used: heuristic evaluation, cognitive walkthrough, formal usability inspection, pluralistic walkthrough, feature inspection, consistency inspection, and standards inspection. Hix and Hartson (1993) split the methods into two types: analytical and empirical. Analytical is based on analysis of the characteristics of the characteristics of a design; empirical inspection is based on the prototype/design in use.

Experts feel user observation is the most effective evaluation method: ”Analytic approaches should be used when they are applicable, but they cannot be seen as a substitute for empirical methods” (Gould and Lewis 1985, p. 304).

Studies by Jeffries *et al.* (1991) and Karat *et al.* (1992) have evaluated different user-evaluation methods. Jeffries *et al.* (1991) evaluated four techniques and found that the heuristic evaluation identified the most problems at the lowest cost, and user observation was the second-best method. Karat *et al.* (1992) has performed a similar comparison; however Karat identified that user observation found the largest number of problems.

Heuristic evaluation and user observation both involve finding errors, but they can produce different results. Nielsen views heuristics and user observation as quite different. User observation involves real users interacting with the system, whereas heuristic evaluation is a more analytical approach, where usability experts judge the user interface against established usability principles (Nielsen and Landauer 1993). Studies by Karat *et al.* (1992) show that user observation and heuristics should be used together for maximum benefit: "These methods are complementary and yield different results; they act as different types of sieves in identifying usability problems" (Karat *et al.* 1992, p. 403).

In order to find the most usability problems, I have chosen to conduct both user observation and heuristic evaluations (both empirical and analytical). In addition to these I will perform a survey enabling me to reach a wider range of potential users.

Table 3.1 details the methods used to measure the usability factors and implementation issues. The final column, judgment, marks the issues and factors that cannot be measured by a evaluation methods, and where my own judgement and any actual evidence can be used.

	Measurement	Observation	Heuristics	Survey	Judgement
Usability factors	Time to complete task	YES			
	Ease of learning	YES	YES		
	User satisfaction	YES	YES	YES	
	Content specific/ usefulness	YES	YES		YES
Implementation issues	Universal browser support		YES		YES
	Ease of programming and maintenance				YES
	Conflicts with other shortcuts		YES		YES
	Extensibility, future application		YES		YES
	Internationalisation		YES		YES

Table 3.1: Usability methods and measurements

The next sections will look closely at the techniques and methods used for each testing method: user observation, heuristic evaluation, and survey.

3.3 User observation

User observation is essential for any application development. “Wherever possible you should adopt user-observation in the first instance for evaluation” (M873 2001, Unit 6, p. 19). User observation is core to this research project. Participants were tested using various examples of keyboard navigational aids. The aim of the tests was to measure efficiency and effectiveness, by measuring time to complete task, ease of learning and user satisfaction.

To be most informative, user observation needs to be as close to real life as possible, using real users in their environment doing actual tasks. Recreating all these factors is, in most cases, not possible, but care must be taken to ensure a realistic simulation. The tests performed for this project were recorded and had an observer present so the environment was not the participants’ real environment, but care was taken to make the artefact (prototype), tasks and participants as real as possible.

3.3.1 Location and set up

The user observations took place at the Open University, Milton Keynes. The tests were a controlled study using two rooms, one for the facilitator and participant (see Figure 3.1) and the other room containing the video equipment and available for any observers (see Figure 3.2). The screens and participants’ comments were recorded onto video for each session.

The sessions were facilitated by myself and I enlisted the help of some colleagues to assist in greeting participants and recording the sessions. Being qualified in user interface evaluation, and also experience of facilitating in the past through my work, I had the experience required to perform the testing. Whitney Queensbury and Caroline Jarrett (usability consultants) helped with the script.

Figure 3.1: User observation – Test area

Figure 3.2: User observation – Observation room

3.3.2 Artefact

StudentHome was used as the artefact to be tested. StudentHome is a web portal used by all Open University students to access course information and assessment scores (The Open University 2005a.). The site is a suitable artefact for this project because of the following:

- The size of the site suits the needs of my tests and it has just the right level of complexity (two levels of navigation).
- The website is good for user observation because it offers various tasks for the participant to attempt.
- StudentHome is a crucial and frequently used resource for students, a site that would benefit from the addition of a navigation aid.
- The site already uses two accesskeys and skip to content; there is currently a need for the site to be developed in this area.

3.3.3 Script

To get the maximum information from the users they are asked a variety of questions and given a number of tasks to complete. Firstly, preliminary tasks and questions are posed to get an idea of current level of keyboard use and any non-standard or assistive technology used. The main part of the user observation involved a comparative study between the categories of keyboard navigational aids.

The following is an outline of what was tested:

Background

- Ask the participant:

  Do you use any assistive technology?

  Can you explain to me how it works and what difficulties it overcomes?
- Exercises to find out the current level of keyboard use. In Word asking them to perform various tasks, and HTML form fill (Figure 3.3). To understand how and why users use shortcuts. I will also investigate the use of keyboard shortcuts in software.

Comparative study

During the comparative study I will measure the following usability factors: time to complete task, ease of learning, and user satisfaction.

- Testing three variants of keystrokes for web navigation described in Section 2.2 (alternating the order):
  1. **Invisible** - Accesskeys as numbers, like the government standard (Figures 3.4 and 3.5)
  2. **Visible** - Accesskeys as letters and underlined, similar to the Microsoft standard (Figure 3.6)
  3. **Hotkey** - One customisable hotkey linking to the menu, and then the use of tab to move through the rest of the navigation. (Figures 3.7 and 3.8).

  I first asked the user to perform a task naturally, then I asked the user to use the keyboard, and finally I asked them to use the accesskey/hotkey.

I will also ask a few questions regarding site navigation to test familiarity and find out the participants' willingness to use such a feature. (Figure 3.9)

See Appendix B for the full user observation script.

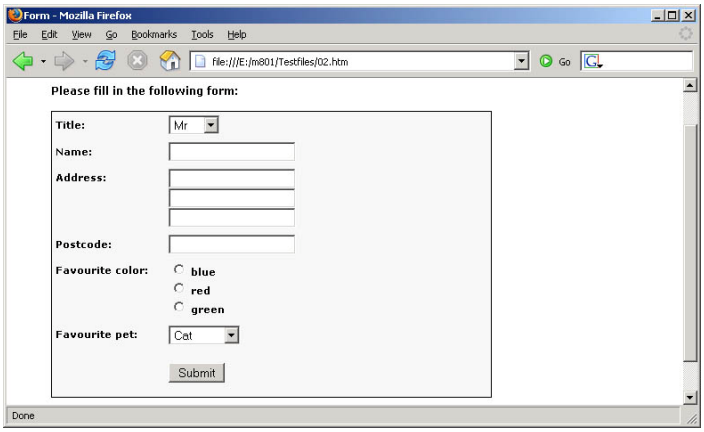


Figure 3.3: User observation – Form fill exercise

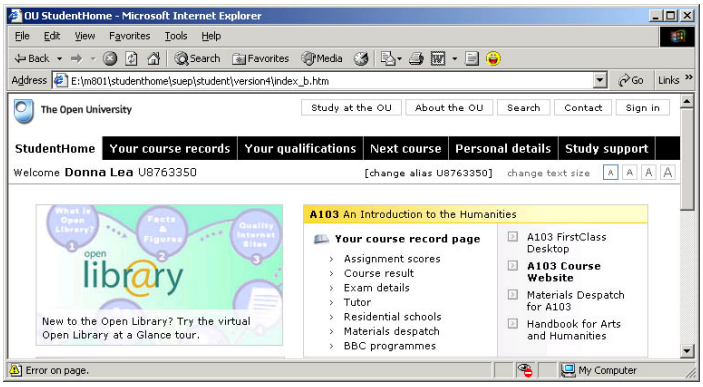


Figure 3.4: User observation – Invisible

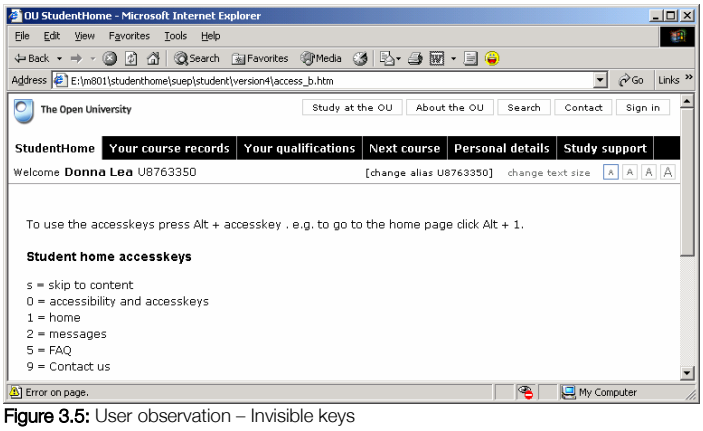


Figure 3.5: User observation – Invisible keys

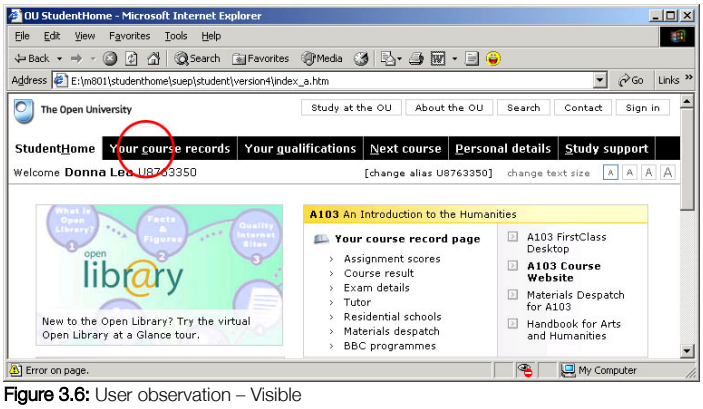


Figure 3.6: User observation – Visible

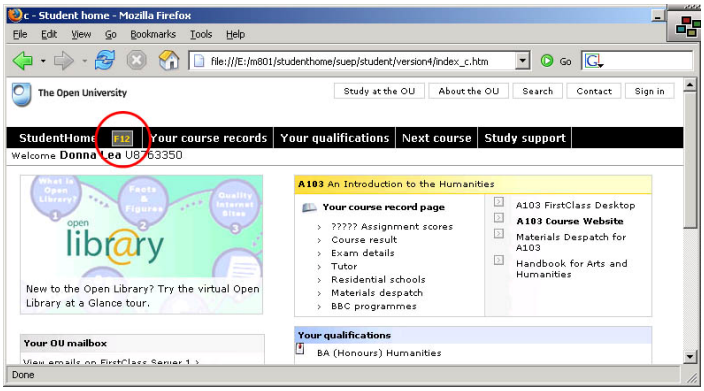


Figure 3.7: User observation – Hotkey

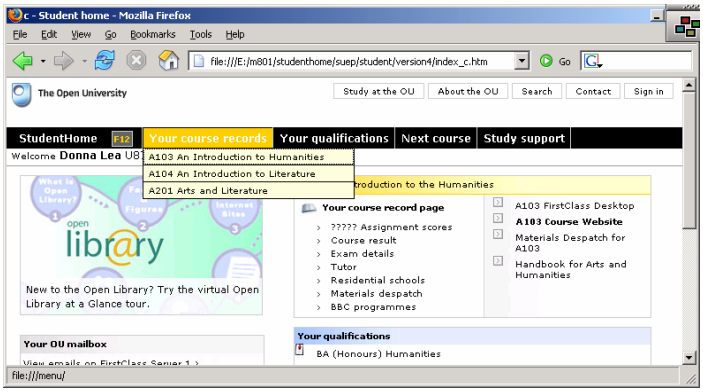


Figure 3.8: User observation – Hotkey with dropdown activated

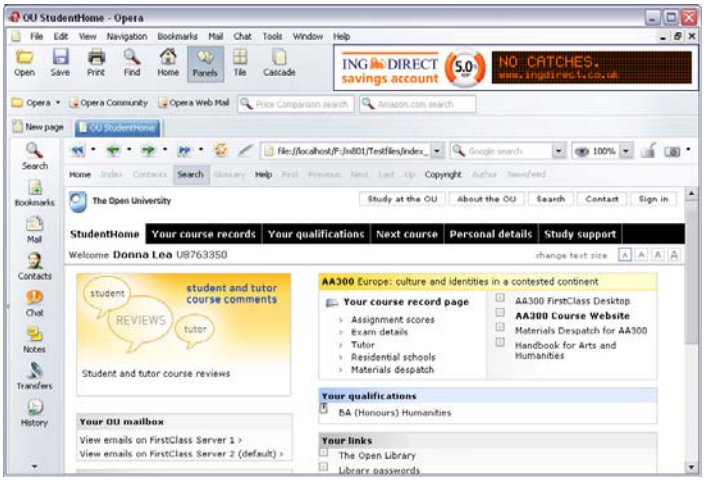


Figure 3.9: User observation – Opera displaying site navigation

Comparative studies need to be consistent for accuracy; the templates, environment and script being static throughout testing ensured consistency. However, for the comparative part of the script the variants were reordered for participants. Changing the order ensured that any biases as a result of learning were evened out.

3.3.4 Participants

The Open University currently has over 500,000 students, and for my participant search I was able to use the university's students as a representative body. There were 223,428 active Open University students between 2002 and 2003. 10,146 (4.5%) of those students registered disabilities with the university (The Open University 2005b). Over 75% of students are currently using StudentHome (The Open University 2004). "Ideally for user-observation your participant should be a potential user of the system" (M873 2001, Unit 6, p.36).

In terms of disability the amount of users is not a representative segment; I have chosen to test a large number of disabled users for two reasons. Firstly alternative forms of access such as a keyboard are important or, in some cases essential, to disabled users, e.g. blind users rely on keyboard access. Secondly disabled users' needs vary widely and all of these requirements need to be addressed.

W3C has created some online guidance, 'How People with disabilities use the web', which describes the wide range of people and needs using various scenarios because their circumstances differ so widely (Brewer 2004). The RNIB has also done some interesting research into the visually impaired and the use of computers. Interestingly the needs of people with poor sight can vary considerably, depending on how their eye condition affects their vision, e.g. some people prefer large text, while others can only read smaller text (RNIB 2005b).

The Open University uses nine categories to record students' disabilities (The Open University 2005b). Table 3.2 shows the percentages of students with specific disabilities and I have highlighted those disabilities that are relevant to keyboard use in yellow. The most relevant/interesting candidates to test are those who have registered disabilities of sight (1) and manual skills (4), because these users have difficulties using a pointing device. Users with fatigue/pain (9), mobility (3) may also have problems using a pointing device due to prolonged pain or dexterity.

	% *	Relevance
1) Sight	5.6	Yes
2) Hearing	4	N/A
3) Mobility	17	Maybe
4) Manual skills (difficulty handling items)	10.6	Yes
5) Speech	1.8	N/A
6) Dyslexia	9.1	N/A
7) Mental health	12.4	N/A
8) Personal care	4.1	N/A
9) Fatigue (extreme tiredness) or pain	23.3	Maybe

Table 3.2: The Open University categories of student disabilities

The number of participants needed for the observation is relatively small, it is widely known in usability world that only a small number of participants are necessary: "usability practitioners find that they learn so much from their first few sessions that about five participants are often enough" (M873 2001, Unit 6, p. 36).

In total 20 people volunteered; six of those participants had manual disabilities, and five had sight disabilities, and the other nine had no disabilities. Table 3.3 below shows the participants' disabilities.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1) Sight	X											X		X	X					X
2) Hearing								X												
3) Mobility				X							X									X
4) Manual skills			X	X			X	X	X		X									
5) Speech								X												
6) Dyslexia																				
7) Mental health																				X
8) Personal care																				
9) Fatigue or pain							X													

Table 3.3: User observation – The participant's disabilities

See appendix E for more information on the user observation participants.

3.3.5 Other comments

It must be noted that I could only get students in the surrounding area of Milton Keynes to attend because of the travel needed. I also acknowledge I have no participants under the age of 24.

The test was not controlled in all cases; I had to test two blind students at their workstations. I also performed two phone interviews with participants who could not easily travel.

Participants knew the purpose of the test and so this may have affected their use of the keyboard. There must have already been a certain level of positive interest in the subject. The face-to-face evaluations also mean participants may feel obliged to answer questions positively.

3.4 Survey

The user observation gave me an in-depth look at interaction with the keyboard, but number of people tested was too small a sample to give me representative totals on satisfaction and keyboard use, so a survey was conducted to test a larger segment of the population. See appendix C for the full online survey. The survey used the same structure as the user observation; this enabled me to make cross comparisons.

Background

- Some preliminary questions about assistive technology and competency level.
- Some questions to ascertain the current level of keyboard use. This would get some interesting totals on how many people use shortcuts in other software.

Comparative study

During the survey I was only able to test user satisfaction.

- Ask the participant to comment on, and explain their preferences from the following variants (including a screenshot and explanation of each variant):
  a. **Invisible** - Accesskeys as numbers, like the government standard.
  b. **Visible** - Accesskeys, as letters and underlined like windows application
  c. **Hotkey** - One customisable hotkey linking to the menu, and then the use of tab/arrow to use the rest of the navigation.
- Questions regarding site navigation to test familiarity and find out the participants' willingness to use such a feature.
- Ask the participant 'Are keyboard navigational aids important on websites?'

500 Open University students completed the survey. The survey gathered a wide range of participants and information about keyboard use and preferences.

The participants of the survey are all students of the university, so although there is a wide age-range there were few participants under the age of 20. All the participants are accessing StudentHome via the web and voluntarily filled in a HTML form, so there maybe a higher than average level of computer literacy. 93% of students own a computer, and 87% of students have nearby access to the Internet (The Open University 2004).

The survey was conducted online and unsupervised and didn't contain any tasks, it was simply a list questions asking for comments about screenshot examples. The survey concentrated on preferences and looked at keyboard use in general.

I tested the questionnaire thoroughly before release: I had to account for all types of user and ensure any technical terms were explained and that all the questions were easily understood. Some of the questions in the survey were open questions; which allowed the participants to explain their thoughts. This gave me a great insight into personal preferences and individual attitudes; however it meant it was not always amenable to numerical analysis.

3.5 Heuristic evaluation

For an expert review I facilitated five heuristic evaluations with domain/usability experts. “Usability specialists were much better than those without usability expertise at finding usability problems” (Nielsen 1992, p. 380). Ideally an inspector is an expert in HCI and the domain of the system (M873 2001), but these skills are rarely available in one person. Nielsen states that heuristic evaluation works best with three to five evaluators (Nielsen n.d.).

Outline of the evaluator’s backgrounds:

(1) Caroline Jarrett is a Chartered Engineer. She is a founder member of the UK Chapter of the Usability Professionals Association, a senior member of the Society for Technical Communication, a member of the Association for Project Management and an associate member of the Market Research Society.

(2) Whitney Quesenbery is the President of UPA (Usability Professionals' Association), the Past-Manager and Web Manager for the STC Usability SIG, and a member of the Executive Committee for UXNet, as well as an active participant in local usability groups. In 2005 she was given the STC President's Award.

(3) Chetz Colwell works for accessibility in educational media at the Open University, assisting staff in making course materials accessible to students with disabilities and conducting research into the accessibility of new technologies. Chetz has done research into web access for blind and visually impaired people, and has two publications in this area.

(4) Ian Roddis is the website co-ordinator at The Open University.

(5) Donna Lea is a full-time web designer and usability expert at The Open University, and the author of this thesis.

The evaluation uses Nielsen’s 10 heuristics as a basis for the evaluation. (Nielsen 1994) The evaluators were asked to look at the examples below and perform tasks.

1. Invisible – Numbers
2. Visible – Letters
3. Hotkey
4. Site navigation – Link-relationships

The evaluators were then asked to describe any problems found and indicate the level of severity using the following scale (Zero, Low, Medium, High, Severe). Nielsen recommends a five-point scale ranging from no usability problem to usability catastrophe (Nielsen 1995). See Appendix D for the full heuristic evaluation document.

Some of the responses to my heuristics evaluation were inconsistent; in future work it may be possible to simplify the questionnaire to reduce the possibility of misinterpretation.

3.5 Summary

This chapter explained and validated the chosen evaluation methods. The next chapter details the results of the evaluations.

Chapter 4: Evaluation data and initial analysis

4.1 Summary

The previous chapter validated my choice of evaluation methods. This chapter includes all the data collected from the evaluations and some analysis of the evidence found. This chapter relates to the second part of Objective 3, to evaluate keyboard navigational aids.

4.2 Survey data results

4.2.1 Background of participants

500 people completed the survey. Figure 4.1 shows the participants' ages were evenly distributed. Figure 4.2 shows that 12% of participants had disabilities, the proportion of disabled participants is less than the national total of 22% (Department for Work and Pensions 2003). Figure 4.3 shows the majority of participants' had intermediate web expertise.

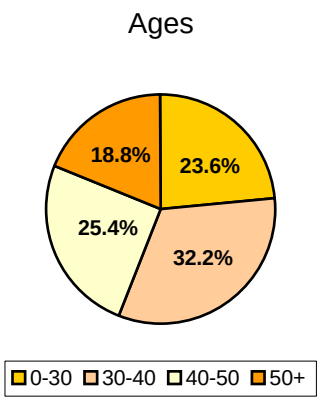


Figure 4.1: Survey data – Ages

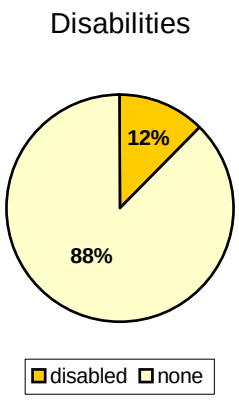


Figure 4.2: Survey data – Disabilities

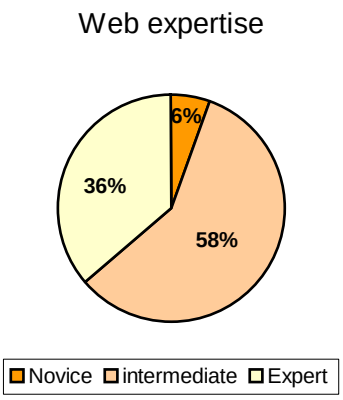


Figure 4.3: Survey data – Web user level

4.2.2 Keystroke use

Input devices and software mean there can be many different ways of performing the same task, e.g. an action such as copy and paste can be done in the following ways:

- The edit drop down menu
- Copy and paste icons on the toolbar
- Clicking the right mouse button
- Keyboard shortcut ('CTRL + C' and 'CTRL + V')
- A designated button on the keyboard (Logitech keyboard)

The reason a user selects a method of interaction may be physical, it may be what they have learned, or it may be based on perceived time and effort involved. In order to understand keyboard use further, I asked the people surveyed how they performed the following tasks (Copy, Print, Save). Figures 4.4 and 4.5 show users' keyboard use. Figure 4.4 below shows that 251 (50.2%) of people surveyed used the keyboard to copy and paste. I also asked the people surveyed how they were entering their details into the web form. 94 (18.8%) of the people surveyed used the 'TAB' key to move through form fields.

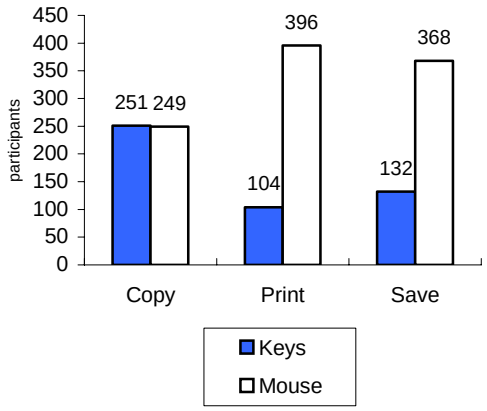


Figure 4.4: Survey data – Keyboard use

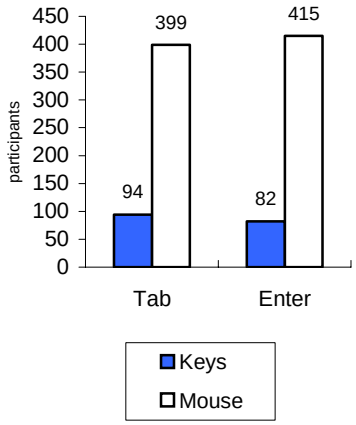


Figure 4.5: Survey data – Web keyboard use

Figure 4.6 below shows that a larger proportion of expert users used the keyboard shortcuts. Figure 4.7 above shows that a larger proportion of younger people use keystrokes. (Note: This correlates with the fact my survey found that a larger proportion of younger people saw themselves as expert users)

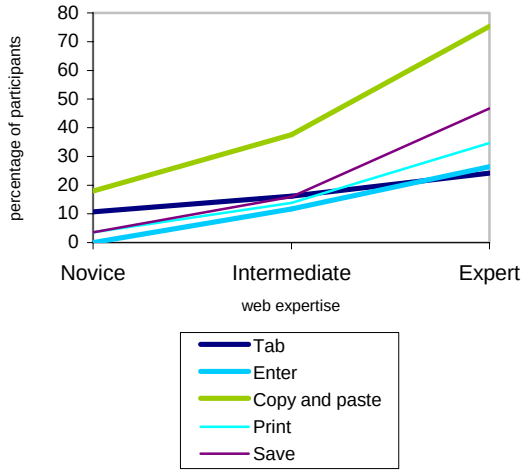


Figure 4.6: Survey data – Keyboard use plotted against web user level

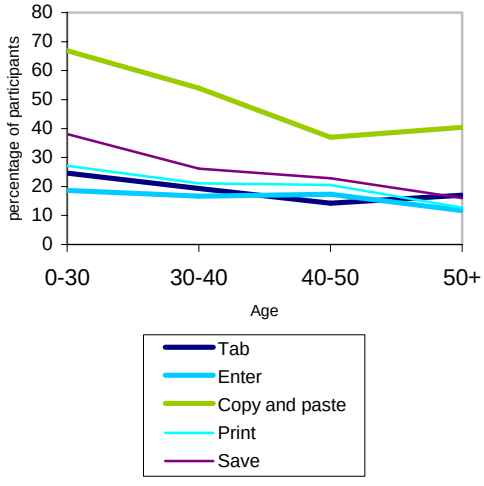


Figure 4.7: Survey data – Keyboard use plotted against age

Figure 4.8 below shows that a larger proportion of disabled people use the keyboard to navigate web forms. However, Figure 4.9 below shows that the same cannot be said for general Windows shortcuts. I separated the data into those with sight disabilities and those without, but the result was still the same. This was surprising, I expected the results would have clearly signified that disabled users would use their keyboard more frequently.

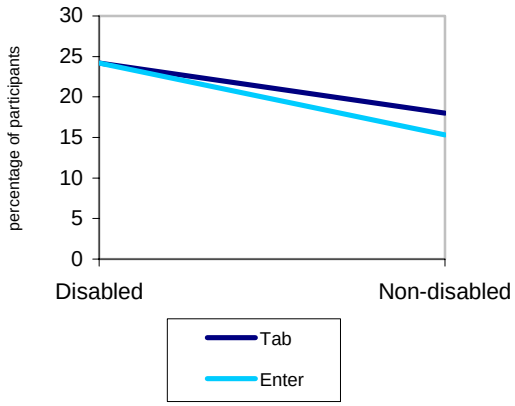


Figure 4.8: Survey data – Web keyboard use disabled users

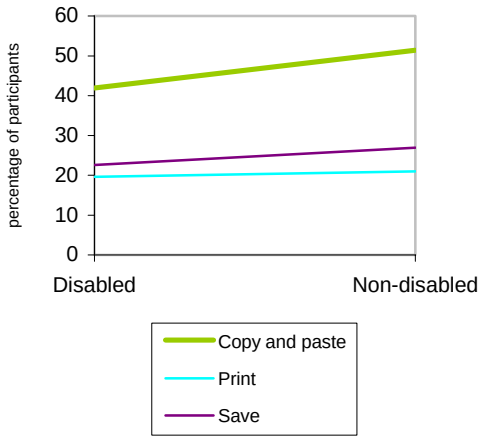


Figure 4.9: Survey data – General keyboard use disabled users

4.2.3 Importance of keystrokes

At the end of the survey I asked whether or not users felt keystrokes were important to navigate websites. I wanted to find out whether keyboard shortcuts on the web were a welcome feature.

- "Do you think allowing people to use keystrokes (i.e. accesskeys or hotkeys) to navigate websites is important?"
- "Are they important to you personally?"
- "When visiting a site in future would you be interested to find out if there are any accesskeys or keyboard navigation aids available?"

Figure 4.10 below shows 276 (55.2%) of people thought they were important, but only 17.8% thought they were important to them personally.

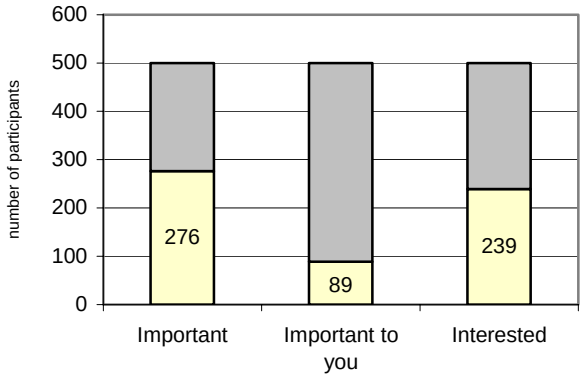


Figure 4.10: Survey data – Importance and ages

I asked people to add further comments; many people felt it was important to be given the choice of using a keyboard or mouse.

> **Importance of choice**
>
> *"I think it is important to give people a choice."*

Others thought the keystrokes were unnecessary and overcomplicated websites for novice users

> **Complications**
>
> *"if you can hit a key you could probably use a mouse- but hey- what do i know."*
>
> *"No - I don't think its something that is widely used."*
>
> *"Adding more options will confuse those individuals who are already intimidated by technology. We keep saying how simple computers are to use, then we devise 5 or 6 ways of doing the same thing!"*

A lot of people recognised that keystrokes were important for disabled users, and screen-reader users. People also felt experienced users would find the keystrokes useful for speed. It was also mentioned that people without the use of a mouse, or using a laptop would find the alternative keystrokes useful.

Important to others

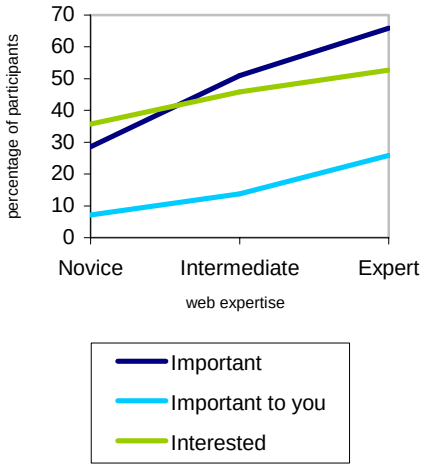
"Useful for mobile computing, speed work (without a mouse) or handicapped (unable to use mouse)"

"Yes - it can certainly help people with screen readers etc. I would imagine."

"Yes. They allow more experienced user to use shortcuts."

Expert users

Figure 4.11 below shows that a larger proportion of expert users think keystrokes are important, important to them and would look for such aids in the future.



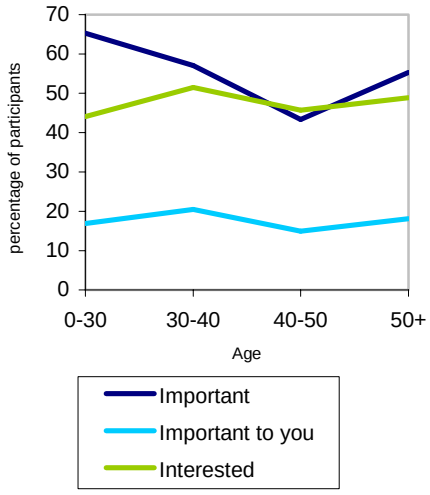
Expert users in comparison to all users:

- 10.7% more expert users thought keystrokes were important.
- 8% more expert users were important to them personally.
- 4.9% more expert users would be interested to look on sites for shortcuts.

Figure 4.11: Survey data – Importance and web user level

Younger users

Figure 4.12 below show that a larger proportion of young users think keystrokes are important. But a lesser proportion thought they were important for them and less would be interested in looking for such features in the future.



Younger users in comparison to all users:

- 10.1% more young users thought keystrokes were important
- 0.9% less young users thought they were more important to them personally
- 3.7% less young users would be interested in the future

Figure 4.12: Survey data – Importance and age

Disabled users

A larger proportion of disabled users think keystrokes are important, important to them and would look for shortcuts in the future.

(Disabled users in comparison to all users)

- 7.7% more disabled users thought keystrokes were important
- 8% more disabled users thought they were more important to them personally
- 15.1% more disabled users would be interested in the future.

Keystroke users (on websites –TAB)

A larger proportion of those that used 'TAB' on web pages think keystrokes are important, important to them and would look for shortcuts in the future.

(Keystroke users in comparison to all users)

- 14.8% more keystroke users thought keystrokes were important
- 20.5% more keystroke users thought they were more important to them personally
- 23.5% more keystroke users would be interested in the future

4.2.4 Preferences

I asked the people surveyed to look at the three variants and comment on whether they would use it and whether they understood it. Below are some common responses given for each variant.

Numbers (option 1)

When people were asked about the numbers option the most common comment was "I'm used to navigating with my mouse why would I need accesskeys?" Although some people were positive most couldn't see the benefit.

> *"I find it utterly unnecessary to mess about with accesskeys."*
>
> *"My eye would be taken off the screen which it isn't if using the mouse"*
>
> *"Last used Alt commands when I first learnt to use a pc 20 years ago."*
>
> *"Web pages are designed to be navigated using a mouse. Only form-filling is easier using keyboard shortcuts"*
>
> *"I don't think I would use it three clicks instead of one click"*

Many participants stated that using numbers was not intuitive and would take a long time to learn.

> *"I'd forget the keys required and it's not that intuitive"*

Letters (option 2)

The response to the letters was much more positive. Most people do not use the keyboard to activate dropdowns for underlines on the Microsoft interface, but they recognised and understood the feature. Users also pointed out the possibility of conflicts:

> *"It's clear because it's the Windows standard"*
>
> *"More in line with application standards on Windows, with which most people are familiar, and so very clear."*
>
> *"For me, it looks clear. Indeed, it is the same visual convention as for Microsoft products. However, I would be careful to make sure that the letters used do not conflict with the built-in browser alt + letter shortcuts"*

People also mentioned the number of keys and asked why 'ENTER' would need to be pressed. This is surprising because in the Windows dropdown you need to press 'ENTER'.

> *"I don't like the need to hit "enter" afterwards."*

Some think the underline should be visually more bold and that may need extra explanation as users didn't always know 'ALT' was needed

> *"I couldn't find the underline, sorry."*
>
> *"No I think it needs to say press ALT somewhere"*

People also had a preference for the links chosen and would prefer them to got to other sections.

> *"An option to go to my FirstClass email or to my course homepage""*

Hotkey (option 3)

Some people didn't understand the purpose of the hotkey, thinking it was just for the home page. Most people were familiar with the function key.

Some people thought it looked like an error on the page, or that it was an ugly design.

> *"If I were a keyboard user I might use it, but as an able bodied mouse user I think it goes one step too far in spoiling a great design to help a minority"*

Some people liked that it only uses one key

> *"I like this because it is quick and only one key required."*
>
> *"This is better than the other two options as at least it tells you which buttons to press!"*

Others wanted keys directly for the sections

> *"Using the letters allowed me to go into the main section this one still requires extra clicks"*

And others still couldn't understand why they would ever want to use the keyboard to surf:

> *"I still wouldn't use this feature and tend to surf exclusively with the mouse."*

Some people are cautious when using computers, and clicking the wrong key, so it needs to be very clear.

> *"I don't like pressing or clicking on things when I'm not 100% sure about them"*

To measure the user satisfaction usability factor, the people surveyed were asked which variant they preferred overall. The majority of people (45%) chose the Visible (letters) variant. Figure 4.13 below shows the number of users that preferred each variant.

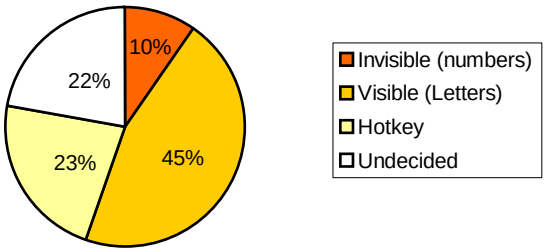


Figure 4.13: Survey data – Preference

Some users commented on their choice, choosing visible (letters) because the letters were intuitive. Others chose the hotkey because of its simplicity.

Letters (option 2)

"This option did not require me to memorise special keys, was easy to work out how to use the feature and less jarring to look at than having the function keys displayed."

"Letters has more meaning for me and would also be a mnemonic aid"

Hotkey (option 3)

"This is the only one that has a clear prompt on the screen"

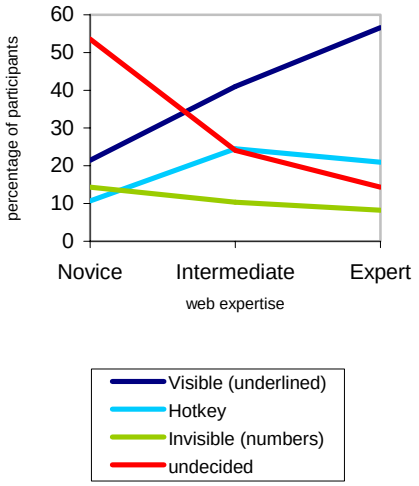
"The hotkey is the easiest and quickest to use. The other options where you have to press several keys are too complicated to learn when I can just click with the mouse."

None

"I'll keep using the mouse and the back or forward at the top of the screen"

Age and expertise

Figure 4.14 below shows that a larger proportion of expert users' preferred the visible (underlined) variant. Figure 4.15 below shows that a larger proportion of younger users' preferred the visible (underlined) variant.



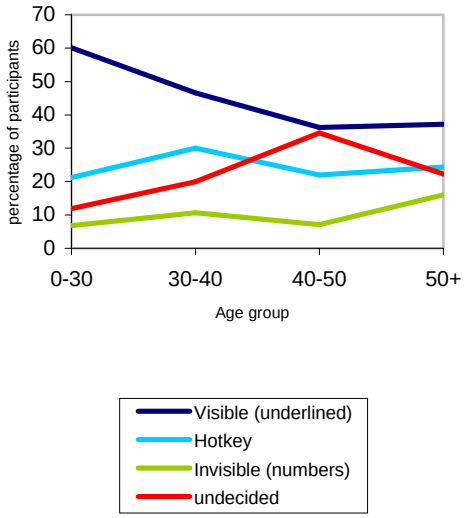
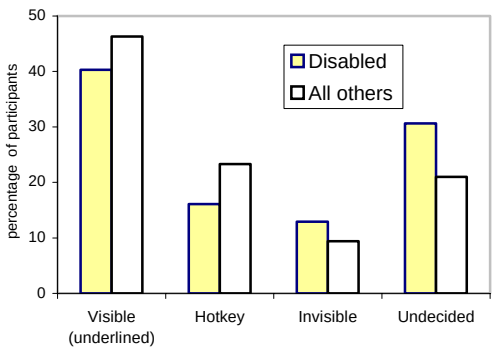


Figure 4.14: Survey data – Preference and expertise

Figure 4.15: Survey data – Preference and age

Figure 4.16 below shows that disabled users (yellow) were less decisive on their preferred option, and those that decided were more inclined to select the invisible government numbers standard. This is an existing standard, so it is possible that some disabled users may already be familiar with it.

Figure 4.17 below shows that (Web) keyboard users were more decisive on their preferred option then mouse users. The more decisive votes were given equally to both hotkey and visible. This suggests that the experienced keyboard users are more certain of which kind of keystroke aid they prefer, and want the shortcuts available to be displayed on screen.



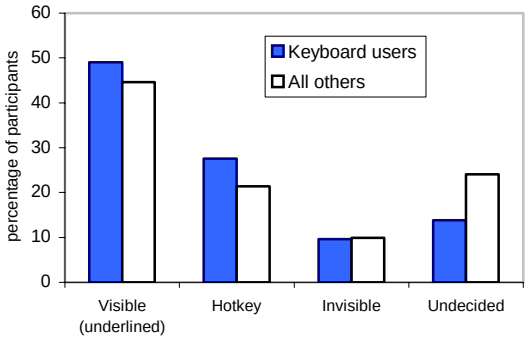


Figure 4.16: Survey data – Preference and disability

Figure 4.17: Survey data – Preference and keyboard users

4.2.5 Customisation

To find out more about users' willingness to customise applications, I asked the people surveyed if they would customise the hotkey. A few people seemed to be happy to spend the time customising the key for the following reasons: conflicts, ease of reach, or to aid memory. However, some people use shared computers and wouldn't want to change any settings

YES

"Would likely customise this as I use F12 for other things"

"The F12 key is very hard to reach so this is not at all convenient."

"Id probably customise to ctrl+f12 or something, just so I don't accidentally hit it."

NO

"I share this PC with husband and 3.5year old, therefore hotkeys could cause chaos."

4.2.6 Site navigation

42% of the people surveyed agreed that site navigation was a useful tool (see Figure 4.18). This is interesting because Mozilla did not include the feature in their most recent version of Firefox. 38% of the people surveyed also thought having keyboard shortcuts with the site navigation bar would be useful to them (see Figure 4.19).

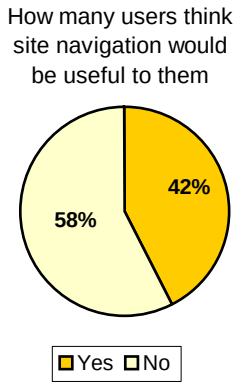


Figure 4.18: Survey data – Site navigation

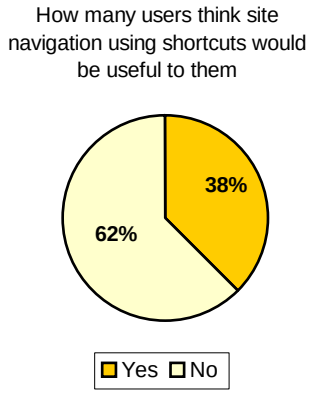


Figure 4.19: Survey data – Site navigation with shortcuts

However, some of the people surveyed said it used up valuable screen space, and thought it duplicated already available navigational elements. Others commented on how useful the feature would be to take them directly to the required content.

Site navigation bad

"No I disable it as I don't wish to loose the screen real-estate to duplicate functions."

"I generally know where I want to go, and normally like to know the difference between what the website offers and what the browser is adding; this feature seems to be blurring that line"

Site navigation good

"Yes, definitely there are always certain pages you use more than others and it would be good to be able to go straight to them."

"Yes. This is a good feature that isn't used widely enough."

4.2.7 Further comments

The people surveyed raised some additional interesting points.

> **Standardization**
>
> *"Keyboard navigation is more likely to be useful if the same keystrokes can be used for the same action on all sites. If each is different then the user is less likely to get into the habit of using them."*
>
> **Why can't screen reader of other software aid keyboard use if necessary?**
>
> *"Screenreader technology (and the like) should be intelligent enough to aid navigation for disabled users without all sites having to be configured specially."*
>
> **Change is good, new ideas**
>
> *"Just think new technology advancing all the time, keyboards still staying the same. Change is good and generates newer ideas."*

People often referred to their interaction style and the whether switching between mouse and keyboard is good or bad.

> *"I find that I either work entirely with the mouse (surfing the web) or entirely with the keyboard (editing in Word using the keyboard shortcuts) and never mix the two because it takes appreciable time to switch between the two, slowing me down."*
>
> *"I find it useful having the choice of switching between mouse and keyboard use. Sometimes I prefer one, sometimes the other."*

Other people felt that using keystrokes would be a backward step and was old fashioned.

> *"The whole trend in computing in the last twenty years has been to get people to stop using the keyboard and do everything by mouse, so I cant understand why we are now being told to go backwards."*
>
> *"I thought I wouldn't be able to use a mouse when they were first introduced. Now I cant imagine doing any day to day work on the computer without one."*

4.2.8 Shortcuts, mouse or extra keys

Some keyboards available today have extra keys on the keyboard for internet-related tasks; common keys include home, connect, email, and search. To find out how useful these keys are I asked the people surveyed if they had extra keys on their keyboards. Of the 500 people surveyed 50.6% had extra keys on their keyboard for internet functions, and 35% of those had used the keys at least once.

I wanted to find out details of when and why a user would use a certain input method. The chosen method can have a lot to do with how the user has been taught, their level of experience, preference, disability restrictions (although this seems a minor factor). The user may also adopt different methods dependant on how they are interacting with the computer. For example, someone who is tabbing through an HTML form and inputting text will use the return key to enter the results, but if the user were using his or her mouse to select a checkbox or widget then they would click the submit button, and not have to move their hand back to the keyboard.

Another interesting interaction is that of copy and paste: 50.2% of users use the keystrokes to copy and paste. It seems the reason behind this high number is the perception that using the mouse and keyboard simultaneously using the mouse to select the text while using the keyboard shortcuts – i.e. to copy and paste – saves time.

So it would seem that the choice of input method depends on the nature of the action being performed. It is all about saving time, whether it's keeping hands on an input device or using two devices to perform simultaneous actions.

4.3 User observation data

See Appendix F for all the user observation data.

4.3.1 Background of the participants

The user observation involved 20 participants. I have broken down the group into the same categories as the survey participants (see Figures 4.20, 4.12, and 4.22). Figure 4.21 shows the user observation tested a high proportion of users with disabilities than the survey.

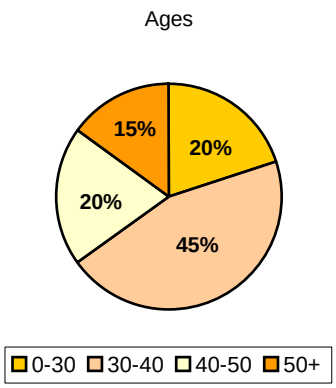


Figure 4.20: User observation data – Age

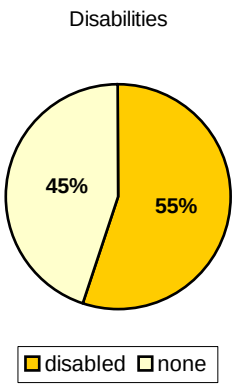


Figure 4.21: User observation data – Disabilities

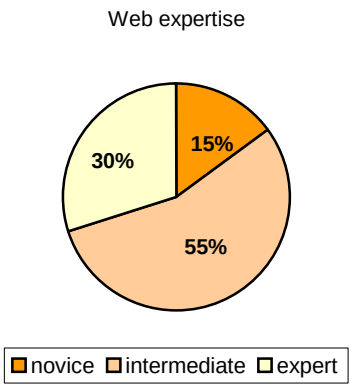


Figure 4.22: User observation data – Web expertise

4.3.2 Keystroke use

Users were observed completing certain computing tasks and it was recorded whether or not they used the keyboard or the mouse (see Figure 4.23 and 4.24).

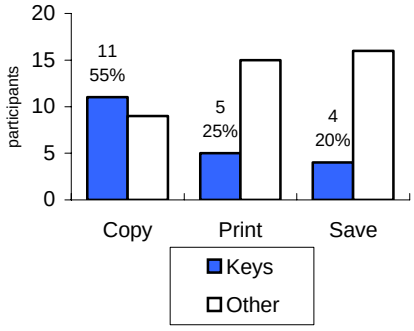


Figure 4.23: User observation data – Keyboard use

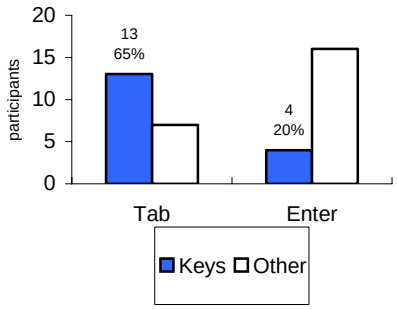


Figure 4.24: User observation data – Web keystroke use

The general tasks of using the keyboard align with the results from the survey results. However, 65% of people used the 'TAB' key to move around the form, which is 46.2% more people than in the survey. This could be because there was a higher number of disabled users, i.e. the two blind users use the keyboard for everything.

4.3.3 Importance

The user observation showed a higher level of deemed importance to keystrokes than the survey (see Figure 4.25). The positive response of the user observation could be because of the face-to-face nature of the testing. The response could also be because the participants were interested in keyboard use, they volunteered/attended the session. There was also a larger proportion of disabled users tested, e.g. blind users only use the keyboard.

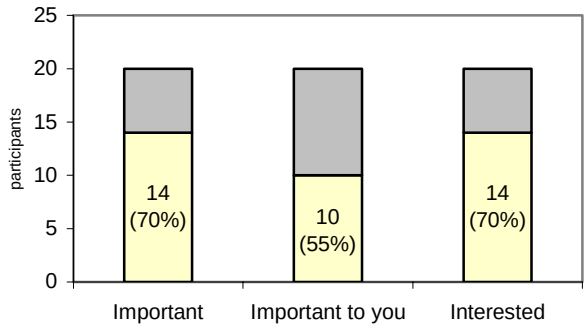


Figure 4.25: User observation data – Web user level

4.3.4 Preferred option

The preferred option of the user observation participants was evenly split between hotkey and visible (letters) variants (see Figure 4.26). This is significantly different to the survey, where visible (letters) received more than twice as many votes. This may suggest that the hotkey variant is better in practice.

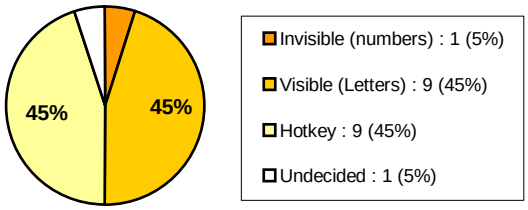


Figure 4.26: User observation data – Preferences

Below are some of the points users made when looking at the three variants:

Numbers (option 1)

An interesting point from one of the participants about where the standard should have originated:

> *"Are the government sites a significant source of reference ...if it was RNIB then that would be better."*

When asked which variant they preferred:

> *"To be honest I rarely use accesskeys, but I would use this"*

Letters (option 2)

The underline alone is not enough for the user to understand they need to click alt, however trial and error generally means the user will succeed

> *"I see there is an underlined letter so I'm assuming that is a function key, c doesn't work on its own so I'll try ctrl, and alt."*

When asked which variant they preferred:

> *"The menu was more explicit, and it goes to each menu item I want."*

Hotkey (option 3)

Like the survey, the F key is commonly confused and users wonder why there are no other keys.

> *"What are the other F keys?"*
>
> *"I like the fact there is only one key"*

When asked which variant they preferred:

> *"I'm used to using the numbers"*

4.3.5 Understanding/visibility

During the observation I asked users to try and complete the same task for each variant using the keyboard only. Figure 4.27 below shows the understanding and visibility of each variant. The table is split in half, with visibility on the left and understanding on the right. If the user used the keyboard aid supplied without any guidance I have shaded the “no hint” box, if however, I had to direct the participant to either use or notice the I have shaded the “hint” box; finally if the participant still doesn’t understand or see the feature I have shaded the “never” box.

For example, participant 1 needed a hint before they found the number accesskeys, they also needed a hint before they understood how they worked. (I have highlighted the number with red text)

The colour coding used in Figure 4.27 gives an overview of each variant, e.g. if you look at the top left-hand box it tell us that four participants found the numbers accesskeys with no direction from me.

	SEE												USE/UNDERSTAND											
	NO HINT				HINT				NEVER				NO HINT				HINT				NEVER			
Invisible (Numbers)	1	6	11	16	1	6	11	16	1	6	11	16	1	6	11	16	1	6	11	16	1	6	11	16
	2	7	12	17	2	7	12	17	2	7	12	17	2	7	12	17	2	7	12	17	2	7	12	17
	3	8	13	18	3	8	13	18	3	8	13	18	3	8	13	18	3	8	13	18	3	8	13	18
	4	9	14	19	4	9	14	19	4	9	14	19	4	9	14	19	4	9	14	19	4	9	14	19
	5	10	15	20	5	10	15	20	5	10	15	20	5	10	15	20	5	10	15	20	5	10	15	20
Visible (Letters)	1	6	11	16	1	6	11	16	1	6	11	16	1	6	11	16	1	6	11	16	1	6	11	16
	2	7	12	17	2	7	12	17	2	7	12	17	2	7	12	17	2	7	12	17	2	7	12	17
	3	8	13	18	3	8	13	18	3	8	13	18	3	8	13	18	3	8	13	18	3	8	13	18
	4	9	14	19	4	9	14	19	4	9	14	19	4	9	14	19	4	9	14	19	4	9	14	19
	5	10	15	20	5	10	15	20	5	10	15	20	5	10	15	20	5	10	15	20	5	10	15	20
Hotkey	1	6	11	16	1	6	11	16	1	6	11	16	1	6	11	16	1	6	11	16	1	6	11	16
	2	7	12	17	2	7	12	17	2	7	12	17	2	7	12	17	2	7	12	17	2	7	12	17
	3	8	13	18	3	8	13	18	3	8	13	18	3	8	13	18	3	8	13	18	3	8	13	18
	4	9	14	19	4	9	14	19	4	9	14	19	4	9	14	19	4	9	14	19	4	9	14	19
	5	10	15	20	5	10	15	20	5	10	15	20	5	10	15	20	5	10	15	20	5	10	15	20

Figure 4.27: User observation data – Visibility and clarity

4.3.6 Time to complete the task

To measure the usability factor, efficiency, I measured the time taken to complete the tasks during the user observation. The recordings give actual timings for how long it took the user to perform the task for each variant. However, due to the test environment and the order of the tasks, my results are not entirely accurate. It was difficult to measure as some participants were more vocal than others. I had to omit some of the measurements as they were corrupted by conversations.

Table 4.1 below shows the times each participant took for each of the variants. Some users used the feature straight away without exploration and so did not perform a second attempt.

	First attempt			Second attempt		
Participant	(Numbers) Invisible	(Letters) Visible	Hotkey	(Numbers) Invisible	(Letters) Visible	Hotkey
1	1:01 (61)	0:59 (59)	1:34 (94)	-	-	-
2	1:20 (80)	1:05 (65)	1:00 (60)	-	0:50 (50)	-
3	-	0:43 (43)	0:48 (48)	-	0:31 (31)	
4	1:21 (81)	1:30 (90)	0:55 (55)			
5	2:30 (150)	1:21 (81)	1:10 (70)		1:28 (88)	
6	0:56 (56)	0:59 (59)	2:27 (147)		0:34 (34)	0:34 (34)
7	-	1:38 (98)	-	-		0:58 (58)
8	1:01 (61)	2:16 (136)	4:08 (248)	-	0:32 (32)	1:26 (86)
9	0:26 (26)	1:44 (104)	2:35 (155)		2:09 (129)	0:39 (39)
10	0:26 (26)	0:45 (45)	0:36 (36)			0:27 (27)
11	0:20 (20)	0:57 (57)	0:32 (32)	-	0:20 (20)	0.14 (14)
12	1:21 (81)	2:57 (177)	1:21 (81)	-	-	-
13	0:38 (38)	0:28 (28)	0:17 (17)	-	0:33 (33)	0:13 (13)
14	-	-	-	-	-	-
15	3:29 (209)	2:23 (143)	1:28 (88)	-	-	
16	3:17 (197)	1:35 (95)	1:43 (103)	1:12	-	
17	0:36 (36)	1:03 (63)	0:26 (26)	-	20 (20)	-
18	1:07 (67)	0:24 (24)	0:38 (38)	-	-	
19	0:38 (38)	0:45 (45)	0:42 (42)	-	0:37 (37)	0:18 (18)
20	1:08 (68)	2:46 (166)	0:27 (27)	-	1:23 (83)	-
Mean	**1:16 (76)**	**1:23 (83)**	**1:12 (72)**		**0:51 (51)**	**0:36 (36)**

Table 4.1: Times to complete tasks

4.3.7 Further comments

Interesting points made during the observation mirrored those mentioned in the survey.

Consistency is the key

"Yes if it was consistent across all or most websites then yes I would be really useful.

Difficulty moving between keyboard and mouse

"When I'm surfing I don't use the key board I use the scroll on the mouse. It would be quite a switch to go back to the keyboard."

Site navigation option

"maybe This might be too complicated, with all the extra keys strokes, will it clash with other browser keys.

"This does not have everything I want"

"If there was a universal key on every site took me to the about page then that would be really useful."

4.4 Heuristic evaluation data

The heuristic evaluators were asked to look at each variant and to assess it against Nielsen's ten heuristics. Table 4.2 below details each heuristic and the level of problem. The table shading shows that the invisible (numbers) variant has the most severe usability problems.

		Invisible (Numbers)	Visible (Letters)	Hotkey	Site navigation
1. Visibility of system status	1	SEVERE	MEDIUM	N/A	MEDIUM
	2	HIGH	MEDIUM	ZERO	LOW
	3	LOW	ZERO	HIGH	LOW
	4	HIGH	HIGH	ZERO	ZERO
	5	HIGH	HIGH	ZERO	ZERO
2. Match between system and real world	1	SEVERE	MEDIUM	MEDIUM	MEDIUM
	2	LOW	N/A	ZERO	LOW
	3	MEDIUM	ZERO	HIGH	N/A
	4	HIGH	ZERO	LOW	LOW
	5	HIGH	LOW	LOW	LOW
3. User control and freedom	1	HIGH	MEDIUM	MEDIUM	MEDIUM
	2	MEDIUM	N/A	ZERO	LOW
	3	ZERO	N/A	ZERO	?
	4	MEDIUM	LOW	ZERO	ZERO
	5	MEDIUM	ZERO	ZERO	MEDIUM
4. Consistency and standards	1	MEDIUM	N/A	N/A	N/A
	2	N/A	LOW	ZERO	LOW
	3	?	ZERO	HIGH	ZERO
	4	HIGH	LOW	MEDIUM	HIGH
	5	HIGH	LOW	MEDIUM	ZERO
5. Error prevention	1	N/A	N/A	N/A	N/A
	2	MEDIUM	N/A	ZERO	ZERO
	3	MEDIUM	LOW	MEDIUM	LOW
	4	MEDIUM	LOW	LOW	ZERO
	5	MEDIUM	MEDIUM	MEDIUM	ZERO
6. Recognition rather than recall	1	SEVERE	N/A	MEDIUM	N/A
	2	MEDIUM	LOW	ZERO	ZERO
	3	LOW	LOW	LOW	LOW
	4	HIGH	LOW	ZERO	LOW
	5	HIGH	ZERO	ZERO	ZERO
7. Flexibility and efficiency of use	1	N/A	N/A	MEDIUM	MEDIUM
	2	MEDIUM	LOW	ZERO	LOW
	3	N/A	HIGH	LOW	LOW
	4	LOW	LOW	ZERO	MEDIUM
	5	MEDIUM	MEDIUM	ZERO	ZERO
8. Aesthetic and minimalist design	1	N/A	N/A	MEDIUM	N/A
	2	HIGH	ZERO	ZERO	ZERO
	3	N/A	MEDIUM	LOW	HIGH
	4	N/A	ZERO	LOW	LOW
	5	N/A	ZERO	LOW	MEDIUM
9. Help users recognise and diagnose errors	1	SEVERE	N/A	N/A	HIGH
	2	SEVERE	MEDIUM	ZERO	MEDIUM
	3	MEDIUM	HIGH	HIGH	?
	4	LOW	LOW	LOW	ZERO
	5	MEDIUM	MEDIUM	MEDIUM	ZERO
10. Help documentation	1	SEVERE	N/A	LOW	N/A
	2	HIGH	HIGH	LOW	LOW
	3	LOW	MEDIUM	MEDIUM	?
	4	HIGH	HIGH	ZERO	MEDIUM
	5	HIGH	HIGH	MEDIUM	ZERO

Table 4.2: Heuristic data – Colour coded problem severity

Figure 4.28 below shows the total number of problems for each variant and the severity ratings. It must be noted that although site navigation has the least problems, this partly due to the fact that some of the heuristics could not be answered because there was no physical interface to assess.

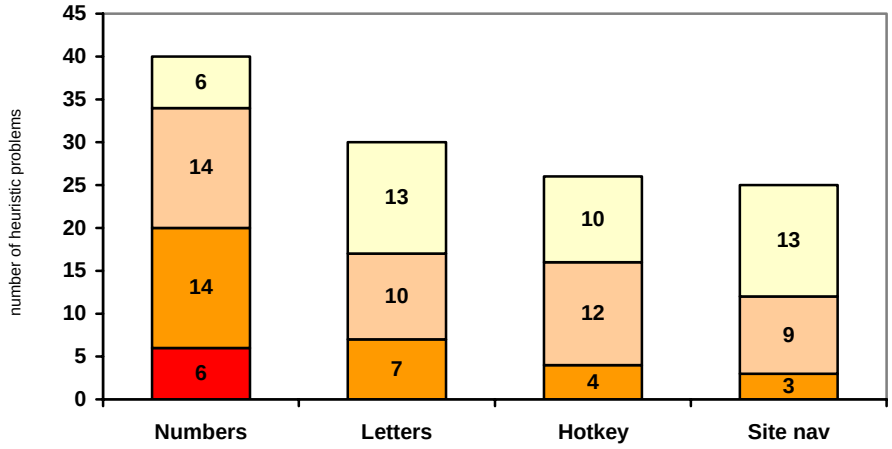


Figure 4.28: Heuristic data – Bar chart of problem severity

4.5 Measurements - Usability factors

4.5.1 Time to complete task

The usability tests give primary data on the time it took participants to complete each task.

Figure 4.29 below shows that, during user observation, the task was performed the quickest using the hotkey variant.

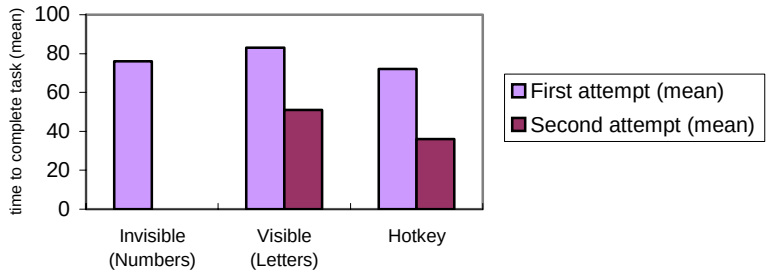


Figure 4.29: User observation data – Time to complete task

Number of keystrokes

The time taken can also be looked at the number of keystrokes needed. Below is the number of keystrokes needed to make the accesskey work.

Underlined = 3 keystrokes

Invisible = 3 keystrokes

Hotkey = 2 keystrokes + the number of tabs to get to desired menu item

It must be taken into account that for the invisible variant, three keystrokes assumes the user already knows what the accesskey is, and also that the accesskeys available to the user include the section they need. The latter is also true for the underlined variant, than if the user needs to go below the top-level navigation, it could take considerably more than three keystrokes. Using the hotkey may be the simplest to remember, and could take only two keystrokes, but it could take more keystrokes to get to a particular page.

4.5.2 Ease of learning

Ease of learning can be difficult to measure as the study has to be extremely controlled. From my face-to-face user observations I managed to get some interesting results about how users reacted to the new forms of navigation I put in front of them.

While testing I gave the users little direction, and allowed the participants to decide what the interface was telling them. Knowing that the user was under no influence from me meant I was able to note whether the participant had seen the keyboard aid and understood it. These brought some interesting results, shown previously in Figure 4.27 and collated in Figure 4.30 and 4.31 below. The hotkey is the most visible – most people were able to fully understand it without a hint – but at the same time many people didn't understand it after a full explanation. The letters are more visible than the numbers and more easily understood without a hint.

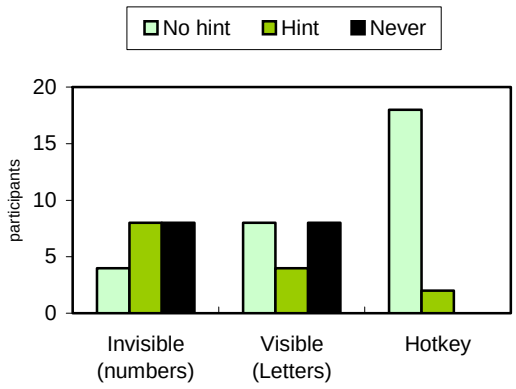


Figure 4.30: User observation data – Visibility bar chart

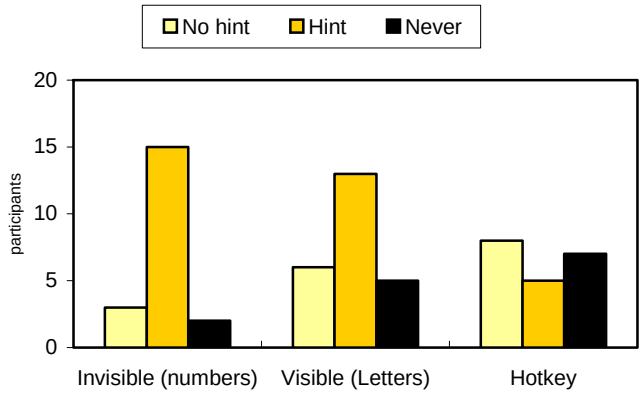


Figure 4.31: User observation data – Clarity bar chart

Preece *et al.* (1993) states that learning to use a computer requires active involvement: a user can learn through doing, by active thinking, goal and plan knowledge, through analogy, or from errors. This seemed very apparent during testing; users often learned by trial and error, and on subsequent tests users learned to look for accesskeys and then figured out how to use them.

4.5.3 User satisfaction

The user observation participants preferred both the letters and the hotkey. The survey participants preferred the visible (letters) variant. Figure 4.32 and Table 4.4 show the results from both the user observation and the survey.

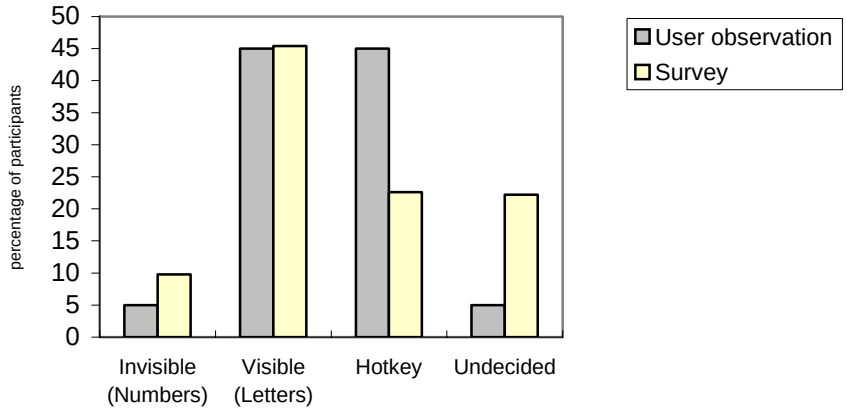


Figure 4.32: Survey and user observation – Preferred variant

	Invisble (Numbers)	Visible (Letters)	Hotkey	Undecided
User observation	1 **5%**	9 **45%**	9 **45%**	1 **5%**
Survey	49 **9.8%**	227 **45.4%**	113 **22.6%**	111 **22.2%**

Table 4.4: Survey and User observation – Preferred variant

Site navigation with shortcuts was liked by the majority (75%) of those asked during user observation – see Table 4.6. A large proportion of the people surveyed (37.6%) also felt this feature would be useful – see Table 4.5. The user observation was face-to-face, which may have encouraged a more positive response.

User observation	
How many users think site navigation is a good idea	(15) **75%**
How many users think site navigation **using shortcuts** is a good idea	(15) **75%**

Table 4.6: User observation – Site navigation

Survey	
How many users think site navigation is a good idea	(212) **42.4%**
How many users think site navigation **using shortcuts** is a good idea	(188) **37.6%**

Table 4.5: Survey data – Site navigation

4.5.4 Content specific (effectiveness)

How specific to a site's content (effective) is each variant?

Invisible (numbers): The government standard using numbers, and only has keys for sections that are generic to all sites, i.e. there could be no standard set up for a course record page of the StudentHome website.

Visible (letters): The visible (underlined) variant uses characters from the main section titles. This is very specific to the content and gives the user access to the main sections of the site.

Hotkey: The hotkey will link to the navigation bar but not to specific sections.

Site navigation: Site navigation offers links to generic pieces of information that can be found on most sites. Mozilla also allows the web author to add more non-standard links relationships, which can be more content specific.

4.6 Measurements - Implementation issues

To assess implementation issues I will compare browser support, conflicts, and extensibility of each of the three variants.

4.6.1 Browser support

The invisible and visible variants use accesskeys, which are part of HTML 4, supported by Internet Explorer 4 and above, and Netscape 6 and above (Wilson n.d.). Some browsers have inconsistent application of accesskeys, for example Mozilla doesn't require the 'ENTER' key to be pressed. ICab, a Mac browser, displays the accesskey visibly on the web page.

The hotkey variant uses JavaScript and is supported on browsers with JavaScript enabled.

Link relationships are supported by Opera, Mozilla, iCab, and some text browsers. The site navigation is only available in Opera and Mozilla. Site navigation do es not currently have keyboard shortcuts.

4.6.2 Conflicts

Both invisible and visible variants both use accesskeys, which cause potential conflicts with other software shortcuts, as described in a study by WATs.ca (Foliot 2003). The hotkey avoids conflicts because the user is able to customise the key.

Site navigation (if shortcuts are available) will also avoid conflicts because the user agent will be in control and can prevent any conflicts. In addition to this, if the features are embedded in the browser the user can customise them and the settings will be changed.

4.6.3 Extensibility

Assessing the future extensibility of the variants is based on my own judgement. There are various factors that can give some idea of future potential, such as how global the solution is whether the functionality can be transferred onto other , whether the variant supports other languages, and if it has potential for use with mobile technology.

The visible option is very effective for small sites but as a global solution it doesn't offer enough extensibility – particularly the variant examined, which uses underlined characters, meaning it relies on the letters existing in the link titles.

The invisible variant using the government standard has already proved partially successful within the UK government's suite of sites. However, I have found some internal government sites that adapted the standard to suit their structure. Changing a perceived consistency of a learned standard can cause more damage to the user's understanding.

The hotkey option is extensible, as the hotkey is consistent across any site visited, and will always jump to the navigation. The hotkey also allows the key to be customised to ensure it does not conflict with any other shortcut.

Site navigation is extensible; incorporating the keyboard shortcuts into the browser offers a consistent, easy to implement and non-conflicting solution.

Internationalisation is also an important issue that needs to be considered for extensibility. Numbers, hotkey and link relationships all have the potential to work on all international keyboards (Wikipedia n.d.c). It is only accesskeys that use letters from the section name that may course problem when translated into other languages.

Mobile technology is another issue that needs to be taken into account for extensibility. The use of numbers as shortcut keys means that they can be used on mobile phone numeric keypads.

4.7 Summary

This chapter includes all the data collected from the user observation, survey, and heuristic evaluation. I have looked in detail at each of the usability factors and implementation issues. The next chapter summarises these results to find out which variant is the most suitable in both usability and technical terms.

Chapter 5: Analysis and synthesis

5.1 Introduction

Chapter 4 collated the data from the evaluations. This chapter summarises the results in order to find out which keystroke navigational aid is the most effective. This chapter covers both Objective 5, to specify the most suitable implementation of keyboard shortcuts on the web, and Objective 4, investigating web standards in relation to the chosen solution.

5.2 Measuring usability and implementation aspects

This research aims to find a specification that could be used as a standard for the implementation of keyboard shortcuts on the World Wide Web. To assess the usability and implementation aspects of various keyboard aids I performed evaluations. Table 5.1 below details each keystroke variant against the usability and implementation issues. I have rated each factor using the following scale: Good, Satisfactory, and Poor.

		Visible (letters)	Hotkey	Invisible (numbers)	Site navigation
Usability factors	Time to complete task (see table 4.1)	Satisfactory During user observation the task took 83 seconds	Satisfactory During user observation the task took 72 seconds	Good During user observation the task took 76 seconds	-
	Ease of learning (See Figure 4.28 and 4.29)	Satisfactory Visibility medium Clarity medium	Satisfactory Visibility high Clarity low	Poor Visibility low Clarity medium	-
	User satisfaction	Good The user observation showed 45% of users preferred this variant	Good The user observation showed 45% of users preferred this variant	Poor The user observations showed that only 5% preferred this variant	-
	Specific to site content	Good Using visible cues on the screen next to chosen areas of content deemed important.	Poor The hotkey only jumps to the navigation bar, not to specific content	Good As with visible, the keys can be programmed to go to important sections.	Satisfactory The site navigation uses generic links and is not specific to individual sites
Implementation issues	Universal browser support	Good Recent browsers support the use of accesskeys	Good The hotkey will work in browsers with JavaScript enabled	Good Recent browsers support the use of accesskeys	Satisfactory At present this feature is only supported by Mozilla, Opera and Lynx
	Ease of programming	Good The accesskeys tags need to be added to every page	Satisfactory The hotkey uses complicated JavaScript to create the dropdowns and the hotkey configuration.	Good The accesskeys tags need to be added to every page	Good The link relationship tags need to be added to every page
	Conflicting	Poor Letters and numbers can potentially cause conflicts with other applications	Good The hotkey can be changed to avoid conflicts	Poor Letters and numbers can potentially cause conflicts with other applications	Good The browser is in control so no conflicts with the browser. (screen reader software may still cause problems)
	Extensibility	Poor The letters and numbers used for one site may need to be completely different to another.	Good The F12 hotkey can be used on all sites, all sites have a navigational menu with contents in.	Poor The letters and numbers used for one site may need to be completely different to another.	Good Being part of the user agent means the feature is more flexible and adaptable.

Table 5.1: Performance measures

From a usability perspective, visible (letters) and hotkey are the most user friendly. However, both of these options have serious implementation issues. The use of letters as shortcuts can cause conflicts and is not extensible. Hotkey is probably the best of the main three variants, but has the drawback that the JavaScript needed is quite complex.

Site navigation with shortcuts shows promise and giving control to the user agent (browser) could be the answer to some of the major problems with consistency, extensibility, and conflicts.

5.3 Solutions to consistency and standards

Without consistency accesskeys will need to be relearned on every site. Without consistency assistive technology software and user agents cannot hope to avoid conflicts. W3C set standards and guidelines for user agents and website builders, but there are far fewer user agents than web site builders. Therefore the user agent standards have a much greater chance of being adhered to consistently. I believe the solution to the problem of inconsistency is to allow the user agent to take control of the keystrokes. This not only means the keys are consistent but also ensures no conflict and that any international differences can be dealt with. It must be noted however that if the user agent controls the keystrokes available, the shortcuts available will be less specific to the site content.

5.3.1 Skip to navigation / skip to content

One possible solution is to just supply two shortcuts within the browser for:

1. Skip to navigation
2. Skip to content.

The user agent will manage these features and can check that the anchor points for ‘content’ and ‘navigation’ are specified on the page and display the links when appropriate. The two links can have shortcuts set by the browser; the example in Figure 5.1 below uses ‘ALT + N’ for skip to navigation, and ‘ALT + S’ for skip to content. The two links would be the first links tabbed to on any page.

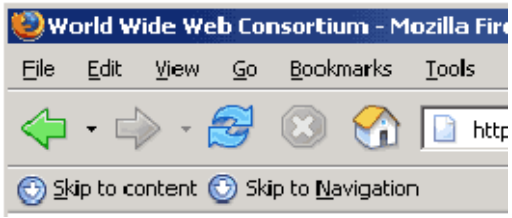


Figure 5.1: Skip to navigation, Skip to content

5.3.2 Site navigation with shortcuts

Another solution is to use the site navigation bar and incorporate the shortcuts. Below are three possible implementations of the site navigation bar with different shortcut keys. Figure 5.2 below uses letters, Figure 5.3 using function keys, and Figure 5.4 uses numbers.

Figure 5.2: Site navigation with underlined characters

Figure 5.3: Site navigation using F keys

Figure 5.4: Site navigation using numbers

Using F keys will conflict with other browser functions, since Jaws and other assistive software use the keys for lots of browsing actions. Using letters and underlines is the same convention as Microsoft interfaces. The browser can assign letters depending on those that may already have been used in the File menu bar, e.g. since 'F' has already been used for File, First will use the character 'I'.

When the item in the site navigation is selected the bar would highlight the link in the same way Microsoft menus work (See Figure 5.5 below).

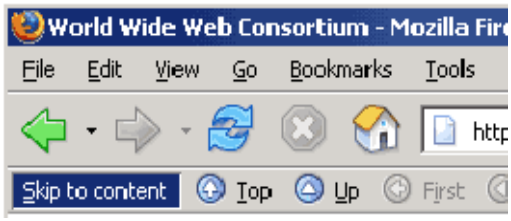


Figure 5.5: Site navigation with skip to content selected

Figure 5.6 below shows how the section dropdown would appear, after clicking 'ALT + D' for the document dropdown.

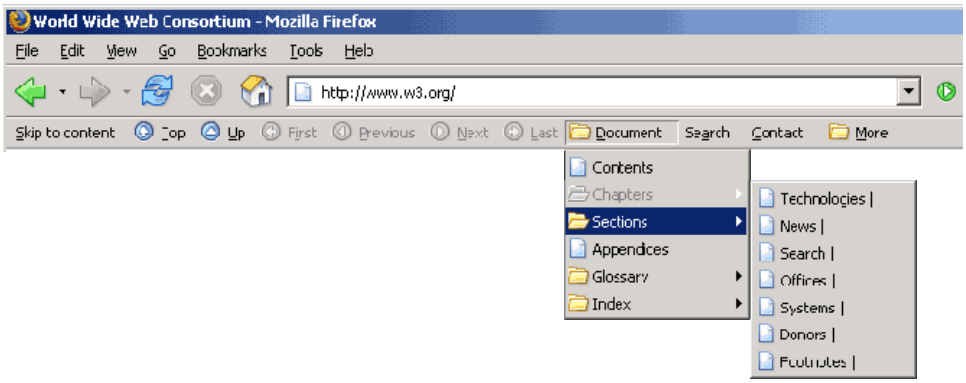


Figure 5.6: Site navigation using underlines with drop downs

A number of people tested did not expect to press 'ENTER' as well as the accesskeys (Mozilla currently does not require you to press 'ENTER' to activate accesskeys). My testing showed that very few people use 'ALT + F' to open the dropdown and they tend to use shortcuts such as 'CTRL + C'. Further testing would be needed to find out whether pressing 'ENTER' would be necessary.

In order to test out the ideas I have performed heuristic evaluations find the advantages and disadvantages of the following:

- Skip to content/navigation
- Site navigation (F keys)
- Site navigation (ALT + letter + ENTER)
- Site navigation (ALT + number + ENTER)
- Site navigation not requiring the user to press ENTER.

5.3.3 Advantages and disadvantages

The site navigation ideas proposed caused a few problems when assessed against Nielsen's ten heuristics, mainly with 'Control and freedom'. The user has less control because they will not be able to change the keystrokes. Another problem found is 'Aesthetics', as the site navigation bar uses screen space. On smaller monitors and average 800 X 600 monitors, complex websites and websites with long pages need as much screen space as possible. The heuristic 'Match between system and the real world' also causes problems, because users may be confused by the fact the web page navigation is in the browser window.

Table 5.2 below summarises the advantages and disadvantages of each the proposed site navigation solutions.

Solution	Advantages	Disadvantages
1. Skip to content/navigation	▪ Only two shortcuts to remember	▪ Will not go to specific pages
2. Site navigation (F keys)	▪ Can go directly to more content ▪ One key	▪ Too many commonly used user agent shortcuts use these keys. (e.g. F5 refresh, F6 go to address bar) ▪ Can't be used on mobile phone keypads
3. Site navigation (ALT + letter + ENTER)	▪ Can go directly to more content	▪ Three keys ▪ Can't be used on mobile phone keypads ▪ The user will not be able to change the keys used (This could be solved by allowing the user to change ALT to SHIFT or CTRL)
4. Site navigation (ALT and number and ENTER)	▪ Can go directly to more content ▪ Can be used on mobile phone keypads	▪ Three keys
5. Site navigation not requiring the user to press 'ENTER'	▪ Can go directly to more content ▪ Two keys	▪ May seem inconsistent with windows menus

Table 5.2: Advantages and disadvantages to site navigation solutions

The table suggests site navigation using letters or numbers are the best options. It also appears that something as simple as 'skip to content' and 'skip to navigation' could also be very effective. A second round of testing with user observation is necessary before any conclusions can be drawn.

5.4 Summary

This chapter summarises the results of the evaluations to find out which kind of keystroke navigational aid is the most effective. All of the variants tested had problems, and some further solutions were proposed. The ideas will need further testing to assess how usable they are, however this is beyond the scope of my project. The next chapter summarises all the work done in previous chapters and all the objectives covered.

Chapter 6: Conclusion and evaluation

6.1 Introduction

Chapter 5 summarised the data collected from the evaluations. This chapter summarises the entire study, explaining all the objectives covered. I conclude with my recommendations and further work needed regarding keystrokes on the web.

6.2 Objectives

This research project looked at keyboard navigation on the web, in particular accesskeys. Recent implementations of accesskeys are inconsistent; the lack of standards has not only made them difficult to learn but also created conflicts with other software. This research aims to find a specification that could be used as a standard for the implementation of keyboard shortcuts on the World Wide Web. In order to achieve this I worked through the following objectives:

Objective 1 Literature search on keyboard shortcuts and related topics

To complete Objective 1 I conducted a thorough literature search of academic, web/print publications, expert forums, and private/public standards. Chapter 2 details my findings; overall there is little research done into keyboard use in relation to the web. The most useful information gathered was found on websites and forums, and conference proceedings: these sources were more up to date but in some cases less reliable.

Objective 2 Find all current implementations online

There are various ways that accesskeys and other web navigable keyboard aids are implemented currently. I categorised the three main variants (Visible, Invisible, Hotkeys).

Objective 3 Evaluate current keystroke navigational implementations

In order to find the most effective implementation of keystroke navigation, I evaluated the current implementations. In Chapter 3 I explain my choice of methods. I surveyed 500 students, observed 20 users, and facilitated 5 heuristic evaluations. In Chapter 4, I present the findings from all the evaluations. During the research I discovered 55.2% of people think keystrokes are important to navigate websites for others. The results also demonstrated that larger number of young and expert users (an increasing group) see the importance of keystrokes. The survey revealed 68% of people surveyed felt the shortcuts available should be visible on screen. Both the user observation and

survey found that users' individual preferences are diverse; this means that allowing different modes of access to web pages is essential.

Objective 4 Investigating standards for keystrokes

Objective 4 involved investigating the subject of standards and the web. In Chapter 1, I discussed existing standards and practices. In Chapter 5, I concluded that relying on web authors to adhere to standards for shortcuts keys was unrealistic. The easiest way to ensure standards are followed is to give the responsibility to the user agents. All of the testing, comments and feedback reiterated that consistency is incredibly important. Consistency will not only improve implementation issues but also increase usability.

Objective 5 Specification for keystrokes on the web

All of the variants tested had problems with either the usability or implementation. Bearing in mind that extensibility and consistency are very important, the site navigation feature showed some promise. Accesskeys programmed by the web author that are incredibly difficult to control and standardise. If the browser takes responsibility for the keyboard shortcuts, standards are more likely to be adhered to, and key conflicts will be avoided. In Chapter 5, I suggested some possible solutions, using a site navigation bar with keyboard shortcuts. A heuristic evaluation found that letters and numbers were the most effective. However, actual user testing needs to be performed, as it may not make sense to have content related links in the user agent.

6.3 Recommendations

THE ACCESSKEY: My research has found two major problems with the accesskeys: firstly they can cause conflicts with other software, and secondly they are difficult to standardise. The working draft for XHTML2 (W3C 2005) changes the specification of the accesskey slightly, but the web author still needs to add the information about the character used as the accesskey. I believe the user agent should be in control of the keys specified. This is because a web page should manage the content and the presentation, and the user agent should interpret the content and determines how the user interacts with the page. This separation of content from function is especially important with the emergence of multiple methods of internet access via mobile devices. I do not think the accesskey should be removed from the specification, but I do however think that W3C should not encourage web authors to use it in order to gain Priority AAA in WCAG, explained in section 2.6 (W3C 2000).

VISIBILITY: In some cases web authors may need to leave accesskeys that are already being utilised. If web authors continue to use accesskeys I recommend they make them visible on screen. It is not only blind and visually impaired users who benefit from keyboard shortcuts; there are many sighted users who cannot use a pointing device, and sighted users who prefer to use the keyboard. In the working draft for XHTML2 (W3C 2005) there are recommendations that the user agent makes the key visible. However until this comes into effect, it is up to the web author to make the key visible. The majority of users wanted to see the keys, and 45% of people surveyed preferred the underlined characters.

USER AGENT FUNCTIONS: Another related issue is user agent functions and web page functions, discussed in section 2.5. I believe browsers need to expose existing browser functionality (e.g. text resize) more clearly in the browser chrome. However further investigation is needed to ensure users are not overloaded with features they will use rarely.

6.4 Overall approach (strengths and weaknesses)

The different evaluation methods employed during this study complimented one another. I was able to find some interesting data on general keyboard use and attitudes to keyboard shortcuts. The survey was particularly effective in reaching a large number of users. Despite being unable to find a complete solution, I have found some interesting results in a subject area that is relatively unexplored.

My evaluation methods were in-depth using open questions, this allowed for a lot of personal detailed data on people's opinions, but also meant more time was needed to analyse the data. If I had performed a more iterative approach in the early stages of the project it may have led me closer to implementation.

6.5 Future work

My research has tested various website navigational aids with users, and suggested some recommendations for the future use of keystrokes on the web. In Chapter 5 I propose some site navigational features that could be implemented, but it has not yet been irrefutably demonstrated which is the most effective. Further testing is required to ensure the chosen method is intuitive, easy to use and flexible. Any further testing should include a diverse set of users and specifically screen-reader users. The success of chosen feature is not only dependent on the usability and accessibility but more importantly needs to be agreed and disseminated by standards organisations such as the W3C, who will encourage user agents and websites meet any proposed guidelines.

Appendixes

Appendix A: Sites including keyboard user aids

Numbers
http://www.webnauts.net/access.html
http://www.patient.co.uk/access.asp
http://www.redbridge.gov.uk/toolkit/accesskeys.cfm
http://www.st-birinus.oxon.sch.uk/website.sbs [3]
http://www.rsc-ne-scotland.ac.uk/accessibility.php
http://www.gwynedd.gov.uk/gwy_doc.asp?cat=2759&doc=8110&Language=1
http://www.english-heritage.org.uk/elthampalace/access.html
http://www.ukwebstudio.com/

Numbers + S
The government have been using numbers as a standard http://www.salford.gov.uk/online/howto/accesskeys.htm
Nottingham county council http://www.nottinghamshire.gov.uk/home/help.htm
University of Bristol http://www.bris.ac.uk/university/web/accesskeys.html [2]
University of Cambridge faculty of law http://www.law.cam.ac.uk/accesskeys.php
Tagish http://www.tagish.co.uk/accessibility/accesskeys.htm
http://www.scope.org.uk/siteinfo/accesskeys.shtml
http://www.lloydspharmacy.co.uk/
http://www.blackburnbusiness.net/accesskeys.asp
http://www.ebusinessuk.biz/accesskeys.htm
http://www.iaa.gov.uk/638.htm
http://linktrim.com/It/accesskeys
http://www.mentalhealthleeds.info/access.php?option=accesskeys
http://www.rbwm.gov.uk/accesskeys.htm

Numbers + o
http://www.diveintomark.org/about/accessibility/

Numbers + S + C
http://www.hpa.org.uk/accesskeys.htm

Numbers + S + N
http://www.investni.com/index/about/ab-site-info/accesskeys.htm

Numbers + M
http://www.shef.ac.uk/accesskeys/

Numbers + S +Z http://www.trailventure.co.uk/index.php?func=accessibility//

Numbers and letters
wrexham.gov.uk information pages http://www.wrexham.gov.uk/top_navigation/accesskeys.htm
RCAHM - UK Government accesskeys system http://www.rcahmw.org.uk/accesskeys.shtml
Portsmouth city council http://www.portsmouth.gov.uk/HomePage/accesskeys.html
Dial UK http://www.dialuk.info/access/navigation.asp [underlined]
Scottish parliament http://www.scottish.parliament.uk/cnPages/accessKeys.htm [underlined]
http://www.testvalley.gov.uk/
http://www.frabjousday.com/akeys.htm

http://www.cieh.org/resources/accesskeys.htm
http://www.zelana.com/static/accesskeys.asp
http://www.pensionsappealtribunals.gov.uk/info/accesskey.htm
http://www.eastsussexcc.gov.uk/help/accessibility/accesskeys.htm
http://www.northernrecordercourse.org/access.html (first link on page is for accesskeys)
http://www.dartford.gov.uk/accesskeys/ (not government standard!)
http://www.compassion-in-business.co.uk/accesskeys.htm
http://www.tdas.org.uk/html/accesskeys.htm
http://www.xentica.com/accessibility.aspx
http://fit.arthritiscare.org.uk/accesskeys/

Numbers and letters and characters
Dial UK http://www.dialuk.info/access/navigation.asp

http://www.justice.govt.nz/accesskeys.html
http://www.surreyheath.gov.uk/surreyheath/isite3.nsf/accesskeys.html

F12
udm4 provide a fully-featured and accessible DHTML menu http://www.wbs.warwick.ac.uk/help/accessibility.cfm
http://www.udm4.com/

Letters
http://psyclick.34sp.com/accesskeys [underlined]
Brooklyn museum http://www.brooklynmuseum.org/ [underlined]
Ontario http://www.energy.gov.on.ca/index.cfm?fuseaction=english.main [underlined]
http://www.electoralcommission.org.uk/toolkit/accesskeys.cfm
http://www.amerasianworld.com/accesskeys.php
http://www.ncpad.org/organizations/index.php?accesskeyson=1#accesskey_info (top link on page, and displayed on all pages)
http://www.morimarketdynamics.com/accesskeys.php
http://www.carrolltech.org/site/accesskeys.php (accesibility specialist)

Linking to forms dropdowns, quicklinks
interesting a-z, link to a-z drop down then select letter http://www.waverley.gov.uk/a_z.asp?l=d

Appendix B: User observation script

Open Opera,
Open IE,
Open Word,
Delete cookie

Introduction: Welcome, and thank you very much for coming. The reason I've asked you here today is because I am conducting some research into keyboard use and the web and I would like to test out some examples with you.

> **Before we start, let me explain the set up:**
> This PC has a gadget attached to allow us to record the screens that you are looking at. The session is recorded on video. We only record the screens and your remarks, not you.
>
> Before we begin, I will need to ask your permission to make and use the recordings. The testing will take approximately half an hour. But if you wish to stop at any time, just let me know – you don't need to give a reason.
>
> Are you happy to go ahead?
>
> <start recording>

Declaration

For the record:

- do I have your permission to video the screens as you look at them?
- and do I have your permission to show anonymous, edited extracts of the recording to anyone directly concerned with this project?

Donna Lea (U8763350) donna1lea@yahoo.co.uk

16 North Thirteenth Street, Central Milton Keynes, Milton Keynes MK9 3BP.

Participant No:
Date/Time:

Pre-questionnaire

First of all I'm going to ask you a few questions, then I'll ask you to do a couple of quick exercises.

1. Do you use any assistive technology?
   Can you explain to me how it works and what difficulties it overcomes?
   <setup>

2. Are you currently studying?
   What are the courses?
   What do you do when you are not studying?

3. Do you use the web much?
   What sites do you visit frequently?
   Do you use email? From work…?

I am going to ask you to do a couple of exercises, to get a general idea of how you use your PC.

4. **Test:** Copy and paste
   Can you copy the text on the left into the box on the right

Users remarks	Observer comments

5. **Test:** Print

Users remarks	Observer comments

6. **Test:** Save

Users remarks	Observer comments

7. **Test:** Form fill

Users remarks	Observer comments

(Can we review what you just did?)

StudentHome

<show studenthome on screen>
Are you familiar with Studenthome?
How often do you use it? And what do you normally go there for?

Users remarks

Introduction: We are testing three variations of ideas to aid keyboard users. For these tests I am using Studenthome as an example, but we could use these techniques across any of the OU's websites. In this example I would like you to imagine you are a student working towards a degree in Humanities who is are currently studying AA300, and with previous courses are A103, A207 and U130.

Bring up any of the three examples

1. Could you show me how you would go about finding your assignment scores for one of your past courses A103?
   While you are doing the tasks where possible could you think aloud for me.

Users remarks	Observer comments

Invisible

1. Could you repeat the task but this time ONLY using the keyboard
   Could you think aloud again where possible, thank you

Users remarks	Observer comments

Do you know what accesskeys are?
Accesskeys are keystrokes built into a web page which allow you to link straight to a particular page, for example a web author may assign the key 1 to the home page, this means that you can type **alt+1** and return and you'll go to the home page.

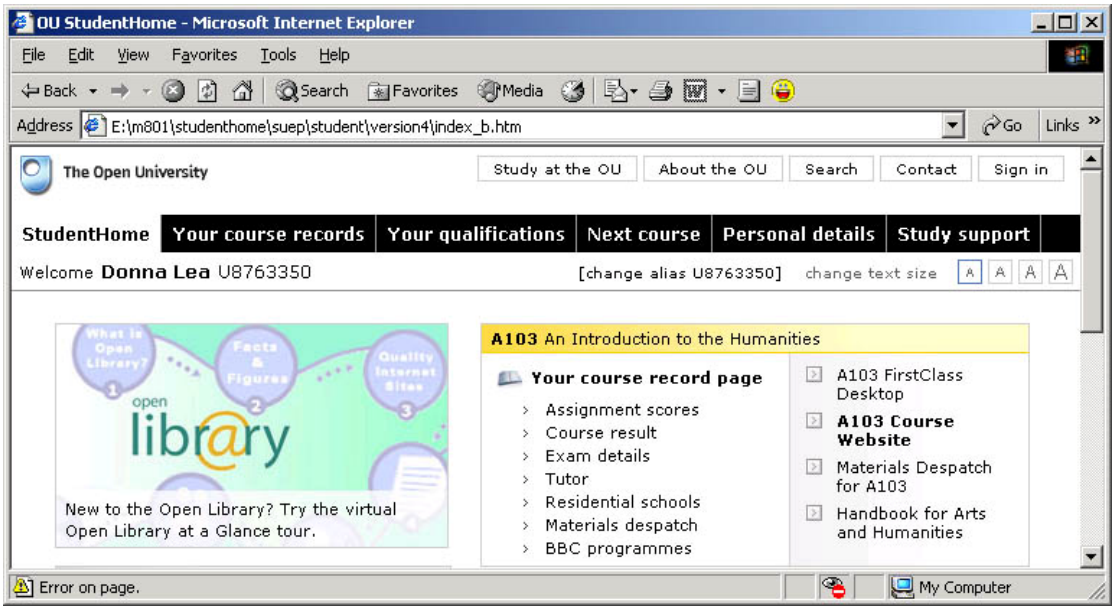
Users remarks	Observer comments

2. There are accesskeys on the page, could you find out what the accesskeys are on this page? (If not show them the page which lists them all)

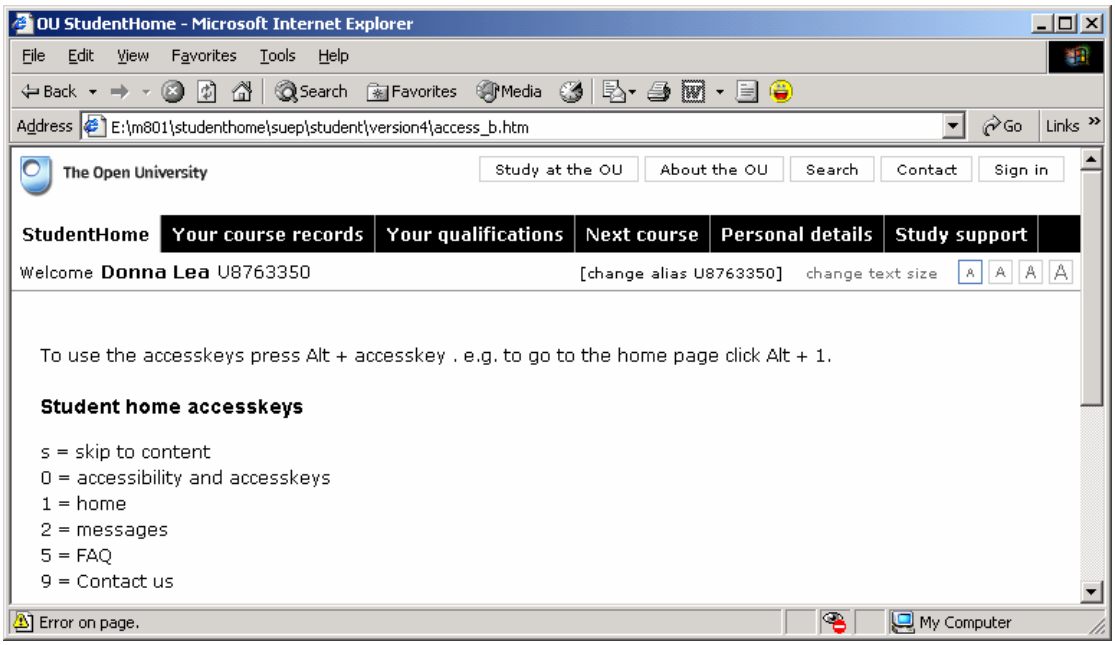
Users remarks	Observer comments

3. From this page could you show me how you would use the accesskeys to visit the home page

Users remarks	Observer comments



Invisible



Invisible – list

Underlined

1. This is alternative version of the same page. Could I ask you to repeat the task and show me how you would go about finding your assignment scores for A103? ONLY using the keyboard.
   Could you think aloud again where possible, thank you

Users remarks	Observer comments

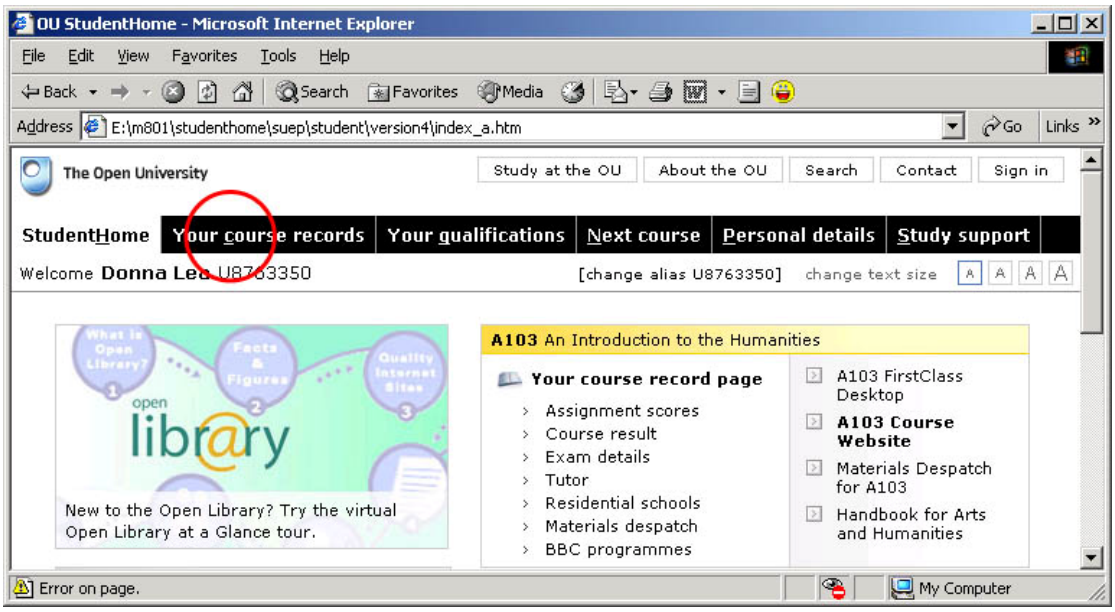
2. Did you notice anything different about this page? Do you know what the underlined character means?

Users remarks	Observer comments

The underlined character is the accesskeys, using Alt + the underlined letter and return will take them to that page.

3. Could you repeat the task of finding your assignment scores for A103 this time using the accesskey?

Users remarks	Observer comments



Underlined

Hotkey

1. This is the last variant of the page.
   Could you complete the same task of finding your assignment scores for A103?
   ONLY using the keyboard.
   Could you think aloud again where possible, thank you

Users remarks	Observer comments

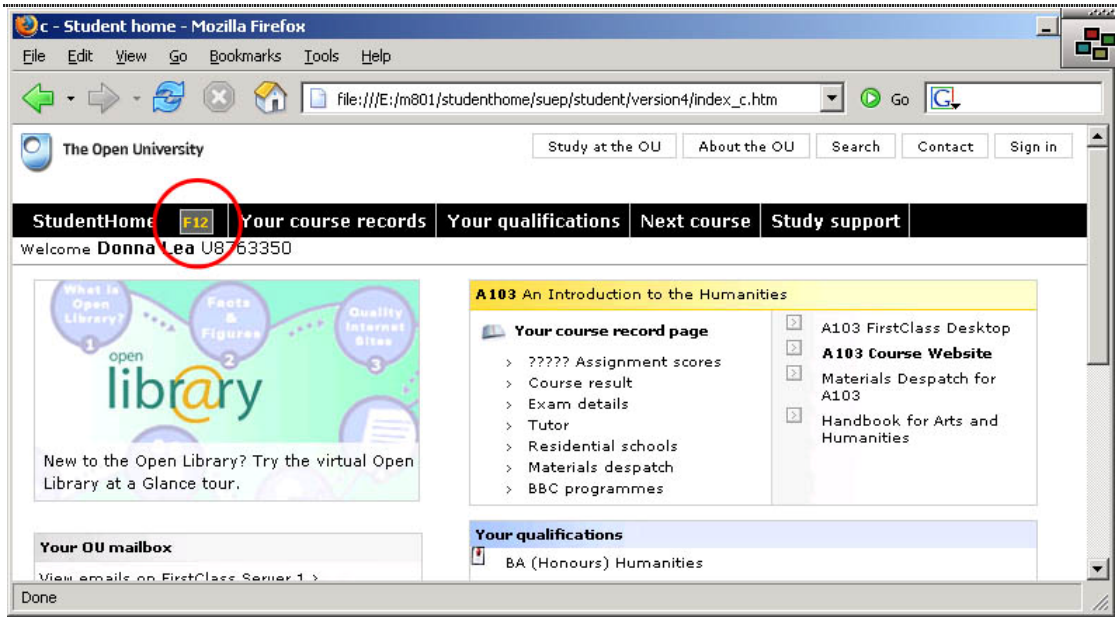
2. Did you notice anything different about the page?
   Do you know what the F12 icon means?

Users remarks	Observer comments

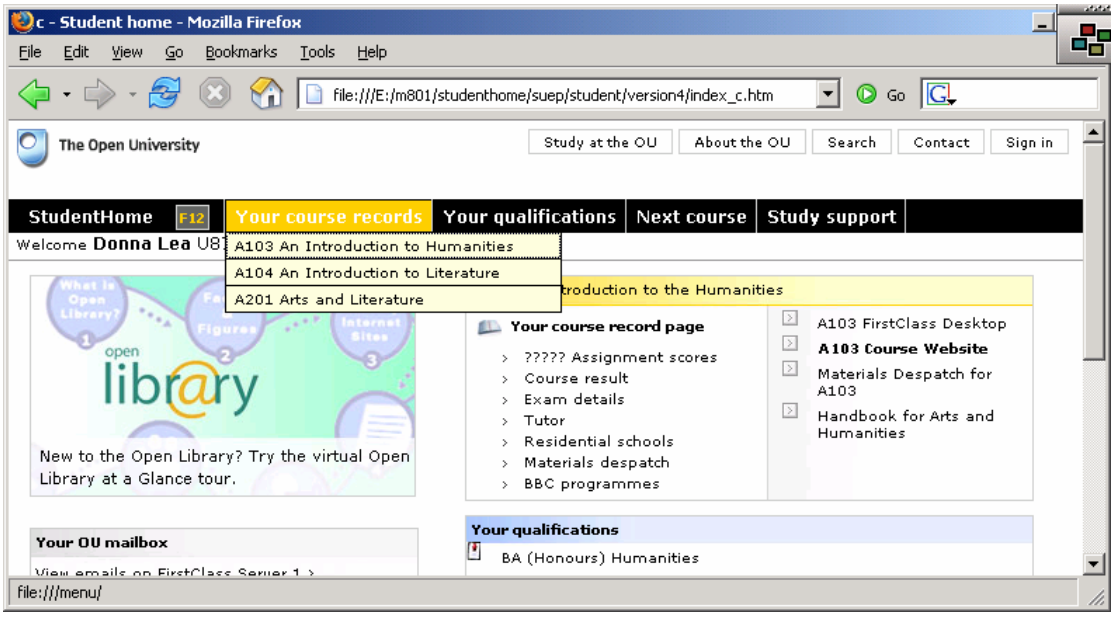
The F12 is a hotkey which means you can jump directly to the navigation.

3. Could you complete the same task of finding your assignment scores for A103 using the hotkey?

Users remarks	Observer comments



Hotkey



Hotkey

The hot key is customisable, for example if you need to change the key because it conflicts with another shortcut you use, or maybe you would just prefer to use another key.

1. From this page, how would you go about changing the specified key?

Users remarks	Observer comments

2. Here is the customise page.
Could you change the hotkey now for me please?

Users remarks	Observer comments

3. Do you think this is useful? Would you take the time to change the preferences?
Are there any browser shortcuts you already use? (e.g. F6 takes you to the address bar)

Users remarks	Observer comments

Hotkey - Customisable

1. So now we have looked at the three alternative variations, the numbers, the letters and the hotkey. Which one did you think was the best?
   Why?

Users remarks

2. Would you find it useful to have keyboard shortcuts on other websites that you visit?

Users remarks

Introduction: Now I want to look at something quite different, for this we will need to use the mouse again.

Link relationships

<open link relationship page>

4. Do you use Opera or Mozilla?
   Have you ever used site navigation feature?

Users remarks

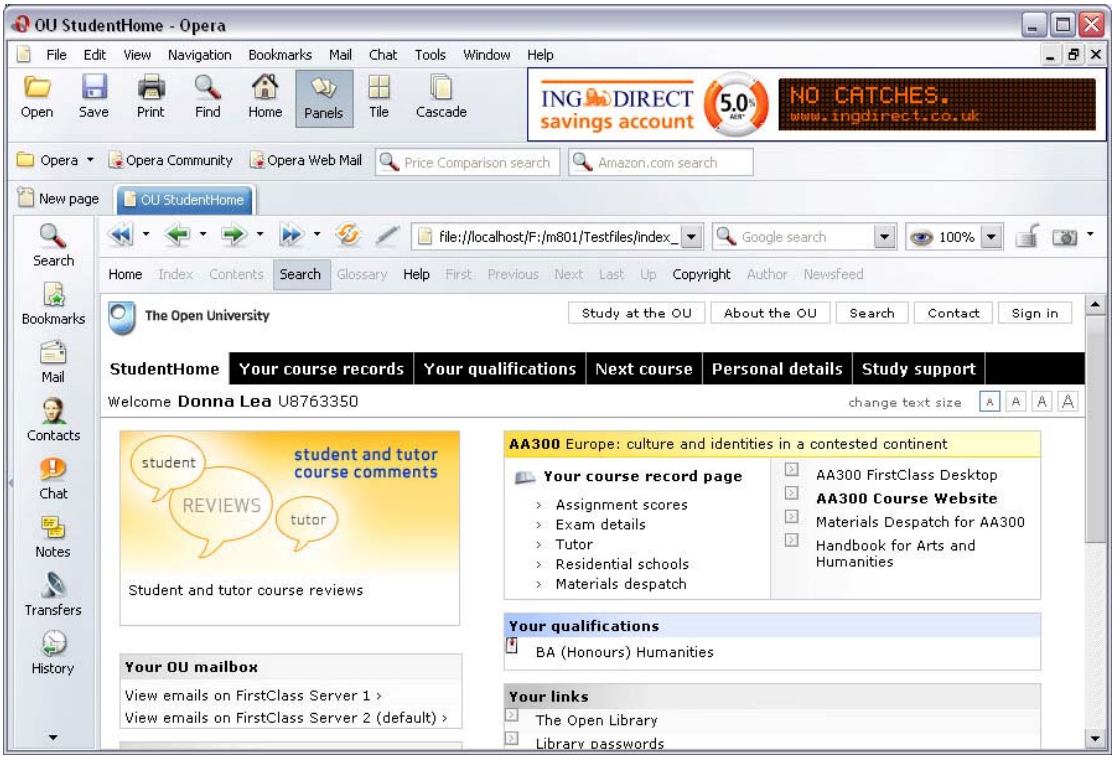
The site navigation bar allows the web page author to mark up popular links, e.g. Home page or site map. This means the browser will display the links and the user will not have to search through complex navigation to find the important information.

5. Can you use the site navigation on this example to visit search?

Users remarks	Observer comments

6. Do you think you would you find site navigation useful?

Users remarks



Link relationships

The idea is that in the future browser manufacturers will allow you the user to assign your own keystrokes to popular pages. This will mean that if you set ‘F12’ to take you to the search page this will transfer onto all the sites you use (in that browser and relying on the site owners implementing link relationships).

7. If this becomes reality and you can assign your own keystrokes to ‘major’ parts of a site, do you think this would be useful to you?

Users remarks

Post-questionnaire

All the testing is done now, thank you, but I would like to ask a couple of questions to round up.

1. Do you think keystrokes to navigate websites are important?

Users remarks

2. Would you use them if they were available?

Users remarks

3. When visiting a site in future would you be interested to find out what accesskeys if any they are using?

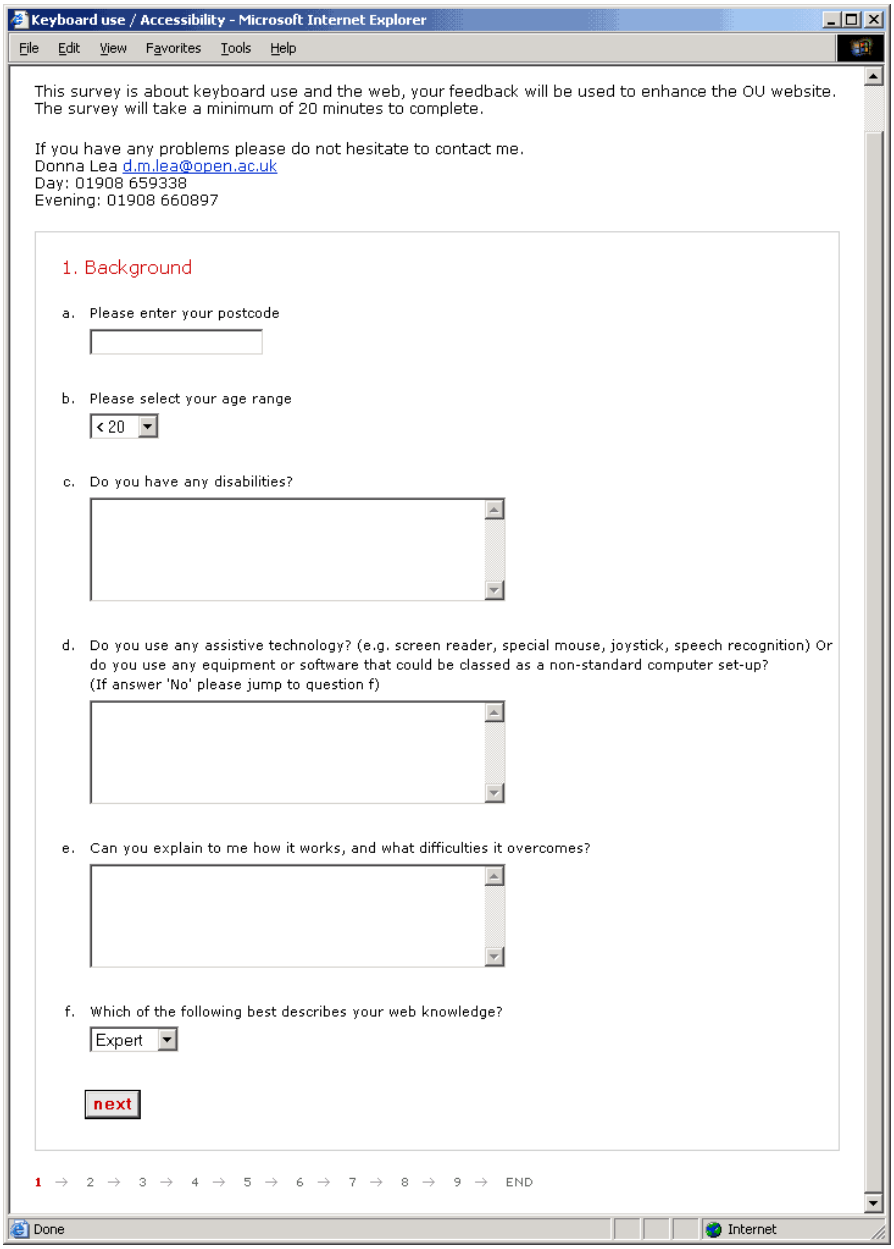
Users remarks

Your feedback has been really useful, thank you very much for coming in.

4. Any further comments?

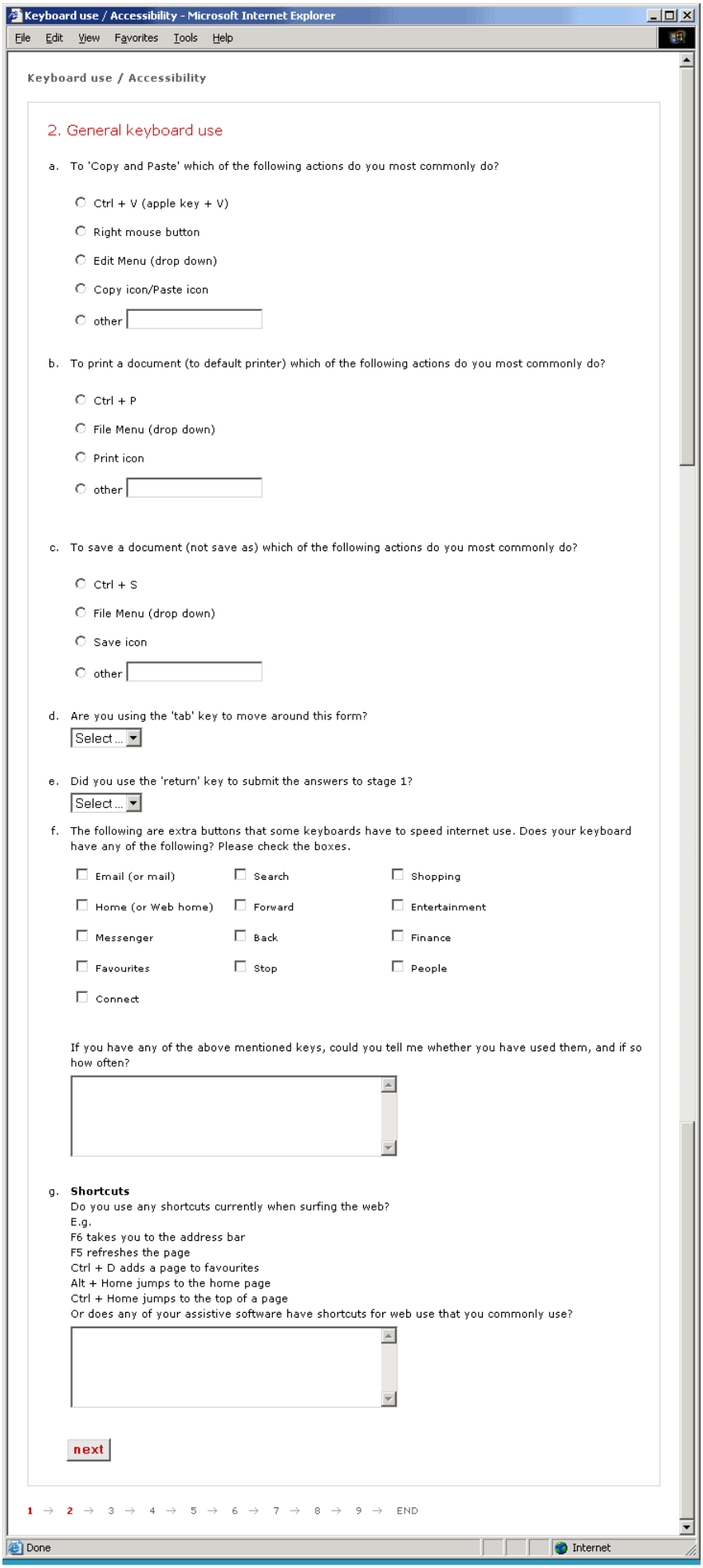
Users remarks

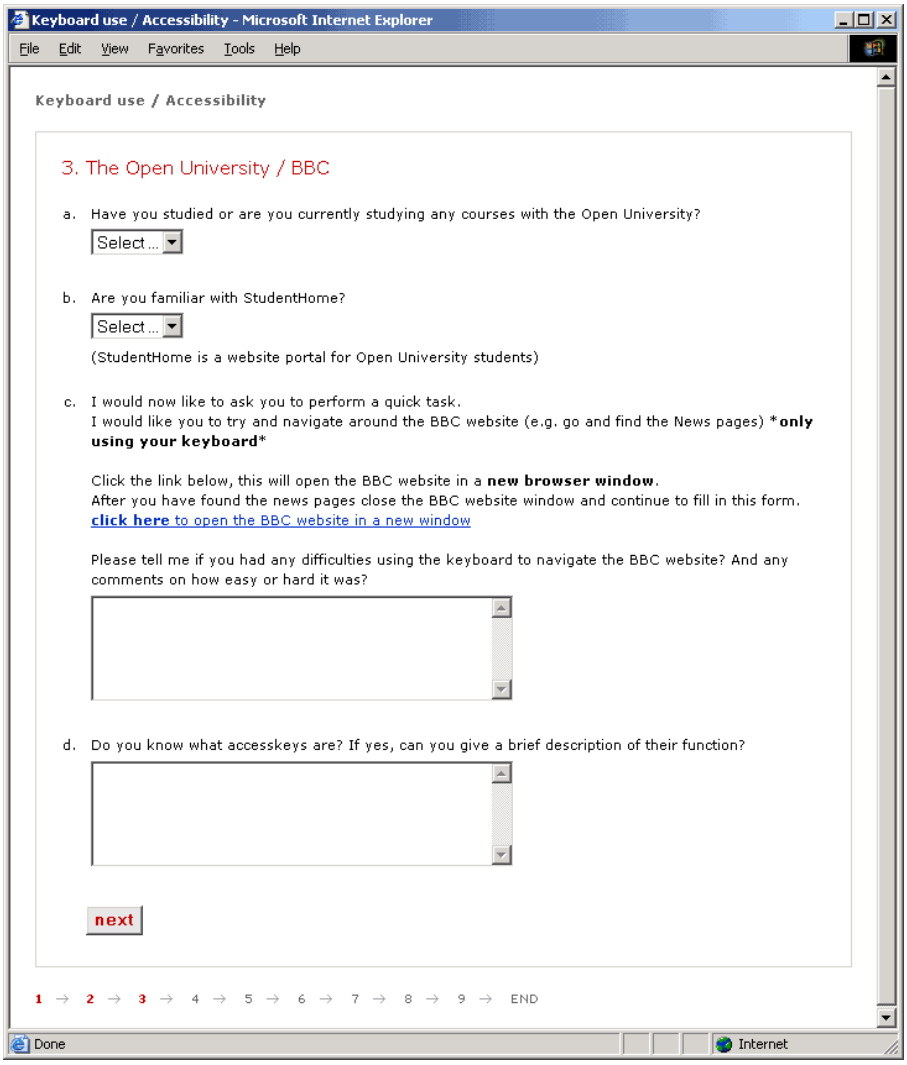
Appendix D: Online survey

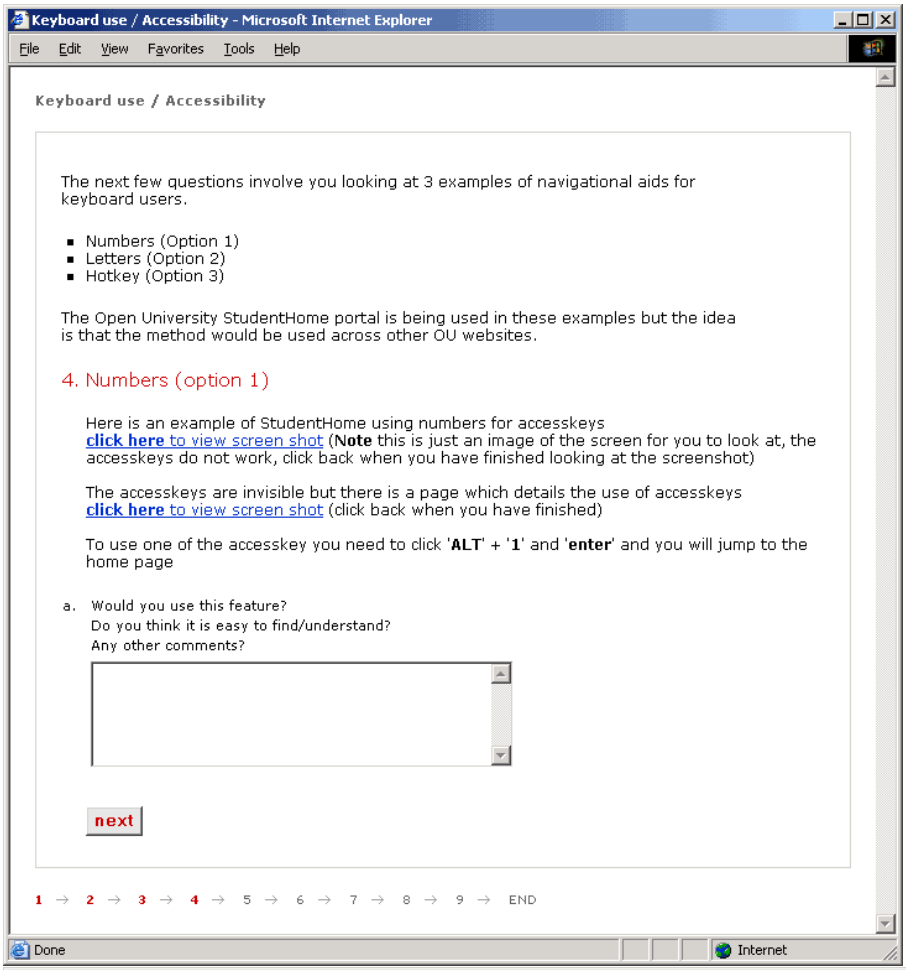


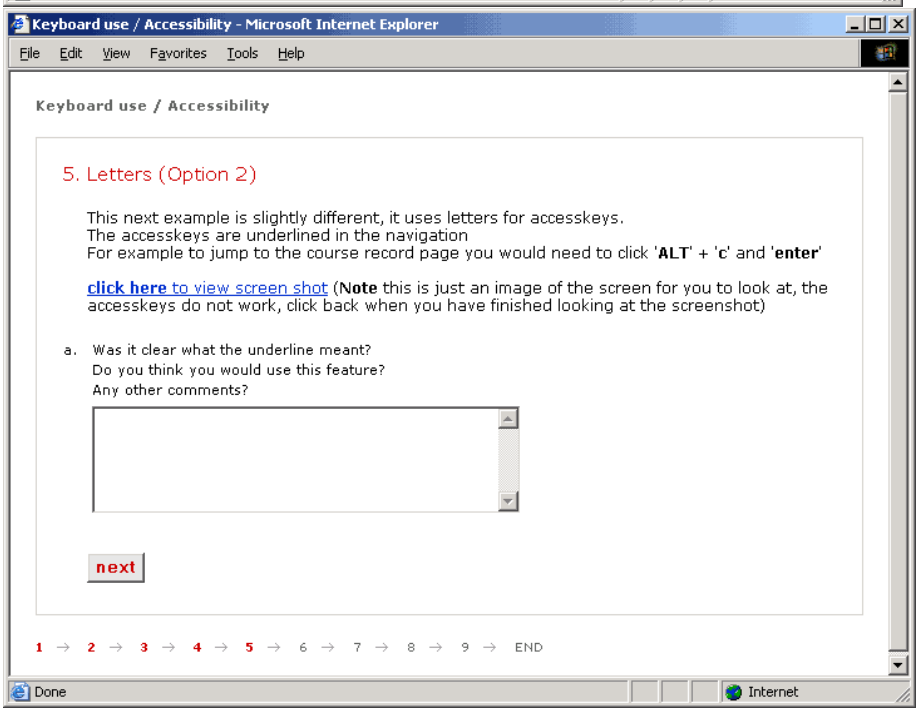
Donna Lea (U8763350) donna1lea@yahoo.co.uk

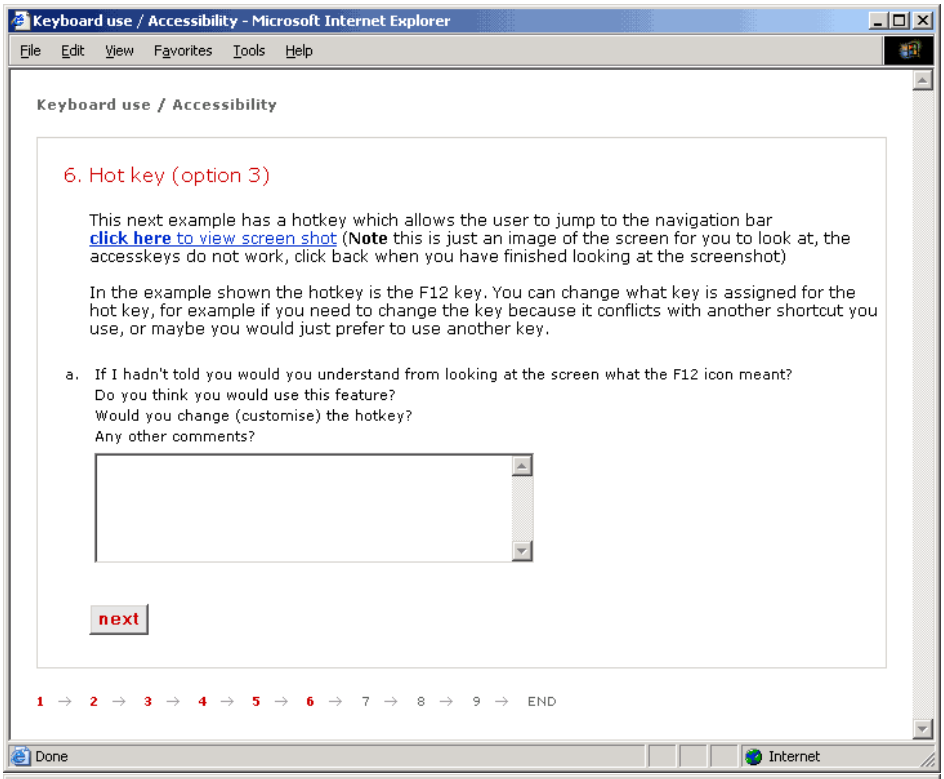
16 North Thirteenth Street, Central Milton Keynes, Milton Keynes MK9 3BP.

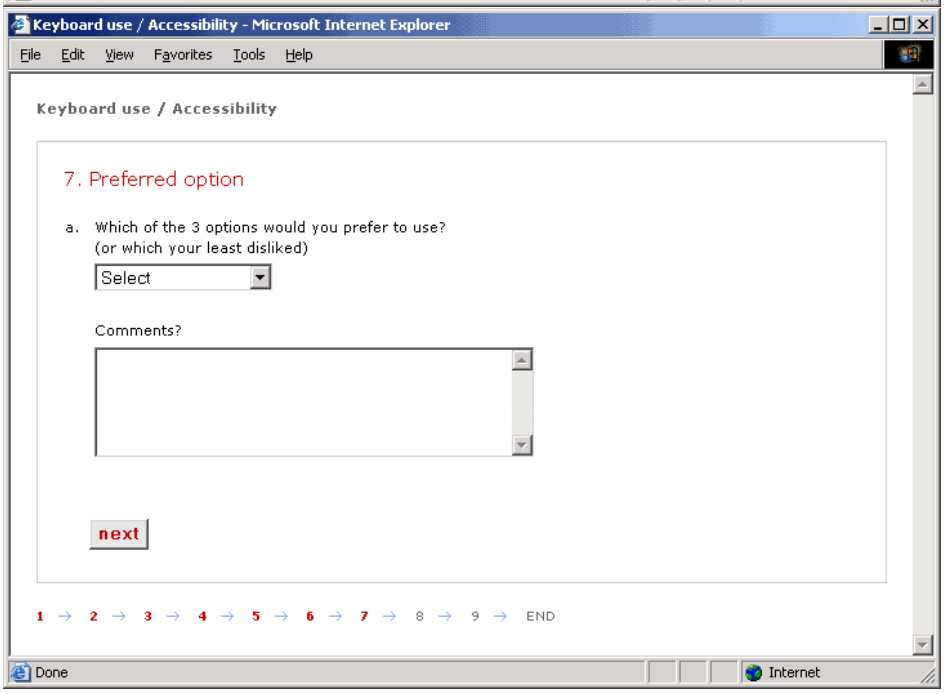



Keyboard use / Accessibility - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Keyboard use / Accessibility
3. The Open University / BBC
a. Have you studied or are you currently studying any courses with the Open University?
Select ...
b. Are you familiar with StudentHome?
Select ...
(StudentHome is a website portal for Open University students)
c. I would now like to ask you to perform a quick task.
I would like you to try and navigate around the BBC website (e.g. go and find the News pages) *only using your keyboard*
Click the link below, this will open the BBC website in a new browser window.
After you have found the news pages close the BBC website window and continue to fill in this form.
click here to open the BBC website in a new window
Please tell me if you had any difficulties using the keyboard to navigate the BBC website? And any comments on how easy or hard it was?
d. Do you know what accesskeys are? If yes, can you give a brief description of their function?
next
1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → END
Done
Internet


Keyboard use / Accessibility - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Keyboard use / Accessibility
The next few questions involve you looking at 3 examples of navigational aids for keyboard users.
Numbers (Option 1)
Letters (Option 2)
Hotkey (Option 3)
The Open University StudentHome portal is being used in these examples but the idea is that the method would be used across other OU websites.
4. Numbers (option 1)
Here is an example of StudentHome using numbers for accesskeys
click here to view screen shot (Note this is just an image of the screen for you to look at, the accesskeys do not work, click back when you have finished looking at the screenshot)
The accesskeys are invisible but there is a page which details the use of accesskeys
click here to view screen shot (click back when you have finished)
To use one of the accesskey you need to click 'ALT' + '1' and 'enter' and you will jump to the home page
a. Would you use this feature?
Do you think it is easy to find/understand?
Any other comments?
next
1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → END
Done
Internet


Keyboard use / Accessibility - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Keyboard use / Accessibility
5. Letters (Option 2)
This next example is slightly different, it uses letters for accesskeys.
The accesskeys are underlined in the navigation
For example to jump to the course record page you would need to click 'ALT' + 'c' and 'enter'
click here to view screen shot (Note this is just an image of the screen for you to look at, the accesskeys do not work, click back when you have finished looking at the screenshot)
a. Was it clear what the underline meant?
Do you think you would use this feature?
Any other comments?
next
1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → END
Done
Internet


Keyboard use / Accessibility - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Keyboard use / Accessibility
6. Hot key (option 3)
This next example has a hotkey which allows the user to jump to the navigation bar
click here to view screen shot (Note this is just an image of the screen for you to look at, the accesskeys do not work, click back when you have finished looking at the screenshot)
In the example shown the hotkey is the F12 key. You can change what key is assigned for the hot key, for example if you need to change the key because it conflicts with another shortcut you use, or maybe you would just prefer to use another key.
a. If I hadn't told you would you understand from looking at the screen what the F12 icon meant?
Do you think you would use this feature?
Would you change (customise) the hotkey?
Any other comments?
next
1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → END
Done
Internet


Keyboard use / Accessibility - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Keyboard use / Accessibility
7. Preferred option
a. Which of the 3 options would you prefer to use?
(or which your least disliked)
Select
Comments?
next
1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → END
Done
Internet

Keyboard use / Accessibility - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Keyboard use / Accessibility

8. Link Relationships

a. What browser do you use?

- Internet explorer (IE)
- Mozilla Firefox
- Netscape
- Opera
- other

b. Have you ever used site navigation? (Site navigation is a feature at present available in Opera and Mozilla)

Select ...

The site navigation bar allows the webpage author to mark up popular links, e.g. Home page or site map. This means the browser will display the links and the user will not have to search through complex navigation to find the important information.

c. The following screen shot has an example of Opera displaying the site navigation bar (see red circle)
click here to view screen shot (click back when you have finished)
Would you find this useful?

Link Relationships and shortcuts
The idea is that in the future browser manufacturers will allow you the user to assign your own keystrokes to popular pages. This will mean that if you set 'F12' to take you to the search page this will transfer onto all the sites you use (in that browser and relying on the site owners implementing link relationships).

d. If this becomes reality and you can assign your own keystrokes to 'major' parts of a site, do you think this would be useful to you?

e. **Link Relationships and designated keys**

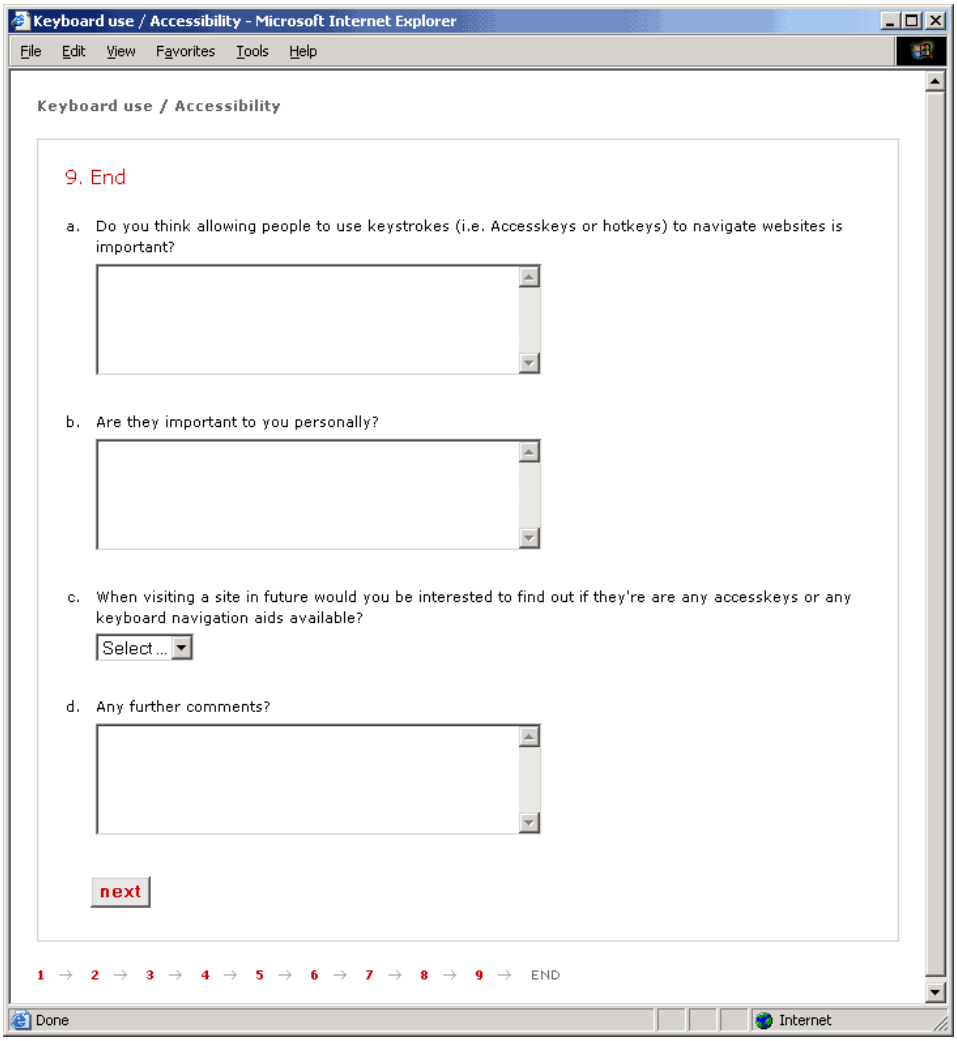
The diagram above gives an impression of what a keyboard would look like with extra keys specifically for site navigation. (i.e instead of typing Ctrl + H you would have a home button on your keyboard)

Do you think you would find it useful to have keys for this purpose?
Or is it uneccessary clutter?

next

1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → END

Done Internet


Keyboard use / Accessibility - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Keyboard use / Accessibility
9. End
a. Do you think allowing people to use keystrokes (i.e. Accesskeys or hotkeys) to navigate websites is important?
b. Are they important to you personally?
c. When visiting a site in future would you be interested to find out if they're are any accesskeys or any keyboard navigation aids available?
Select ...
d. Any further comments?
next
1 → 2 → 3 → 4 → 5 → 6 → 7 → 8 → 9 → END
Done
Internet

Appendix D: Heuristic evaluation document

Heuristic evaluation of Keyboard navigational aids

Firstly thank you for taking part in this evaluation.
I've asked you to do this evaluation as part of some research I am doing into keyboard use and the web. I would like you to assess three variations of ideas to aid keyboard users.

The example

The OU StudentHome website is being used as an example, but the techniques could be used across any website. For the evaluation you will be looking at an example record of a student who is working towards a degree in Humanities.

The evaluations
There are 4 parts to this evaluation. Firstly you will be evaluating 3 variants of StudentHome using different methods to aid keyboard use. You will be asked to perform the same task on each mock-up. The mock-ups are only designed to do the particular task, so you should not stray from the pages detailed

1. **Numbers**
2. **Letters**
3. **Hotkey**

To follow these 3 variants I will then ask you to evaluate **link-relationships**. Link relationships are mark-up which allows web page authors to highlight popular links in their web pages, e.g. Home page or search.

Entering your feedback

I have used Nielsen's 10 heuristics as a basis for the evaluation. After you have looked at all three examples, you will be asked to explain any problems found and indicate the level of severity using the following scale (Severe, High, Medium, Low, Zero, or N/A).

Please save this document, and when you have completed the forms, email it back to me.

Problems?

If you have any problems accessing the pages, or if you need any of the heuristics clarifying, or indeed if you have any questions please do not hesitate contact me:
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16 North Thirteenth Street, Central Milton Keynes, Milton Keynes MK9 3BP.

Option 1: numbers

Click this link http://www3.open.ac.uk/survey/testfiles/index_b.htm

Please perform the following task:
Find the assignment scores for your past course A103. **WITHOUT** using a mouse **AND** using the accesskeys if they are helpful (http://www3.open.ac.uk/survey/numbers2.jpg) available (Click '**Alt**' together with the '**accesskey**' and then click '**return**')

(**Note:** Only 's = skip to content, 0 = accessibility, and 1 = home' work.)

The mock up can be navigated pages available include
Course: List http://www3.open.ac.uk/survey/testfiles/courselist_b.htm

A103: http://www3.open.ac.uk/survey/testfiles/course2_b.htm

Accesskeys: http://www3.open.ac.uk/survey/testfiles/access_b.htm

Option 1: NUMBERS		
Visibility of system status Is it clear when the keystroke has worked?	**Problem** (select one) ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Match between system and real world Does the use of a keystroke resemble anything in the real world? Is the method intuitive?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
User control and freedom Does the user have control over the system when using the keystrokes	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Consistency and standards Does the choice of keys lend itself to an existing standard? Does it show potential for future extensibility?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Error prevention Does the method prevent a user from making errors?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments

Recognition rather than recall How easy are the keystrokes to learn? Remember?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Flexibility and efficiency of use Can the user change the keystrokes? How efficient/easy to use are they?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Aesthetic and minimalist design Visually are the designs (underline, hotkey, invisible) clear/minimal/aesthetically pleasing?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Help users recognise and diagnose errors Does the method make it clear why a keystroke doesn't work?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Help documentation Does the method provide suitable help information for the use of the keystroke use?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Overall verdict		

Option 2: letters

Click this link http://www3.open.ac.uk/survey/testfiles/index_a.htm

Please perform the following task:
Find the assignment scores for your past course A103. **WITHOUT** using a mouse **AND** using the accesskeys available if they are helpful ** Note: the accesskeys are the underlined characters in the navigation. ** (Click '**Alt**' together with the '**accesskey**' and then click '**return**')

(**Note:** only pages and accesskeys that are relevant to the task work)

The mock up can be navigated pages available include

Course: List http://www3.open.ac.uk/survey/testfiles/courselist_a.htm

A103: http://www3.open.ac.uk/survey/testfiles/course2_a.htm

Accesskeys: http://www3.open.ac.uk/survey/testfiles/access_a.htm

Option 2: LETTERS		
Visibility of system status Is it clear when the keystroke has worked?	**Problem** (select one) ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Match between system and real world Does the use of a keystroke resemble anything in the real world? Is the method intuitive?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
User control and freedom Does the user have control over the system when using the keystrokes	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Consistency and standards Does the choice of keys lend itself to an existing standard? Does it show potential for future extensibility?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Error prevention Does the method prevent a user from making errors?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Recognition rather than recall How easy are the keystrokes to learn? Remember?	**Problem** ☐ Severe ☒ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Flexibility and efficiency of use Can the user change the keystrokes? How efficient/easy to use are they?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Aesthetic and minimalist design Visually are the designs (underline, hotkey, invisible) clear/minimal/aesthetically pleasing?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments

Help users recognise and diagnose errors Does the method make it clear why a keystroke doesn't work?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Help documentation Does the method provide sui help information for the use of the keystroke use?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Overall verdict		

Option 3: hotkey

(please view in IE) **Click this link** http://www3.open.ac.uk/survey/testfiles/index_c.htm

Please perform the following task:
Find the assignment scores for your past course A103. **WITHOUT** using a mouse **AND** using the hotkey.

The mock up can be navigated pages available include
Course List http://www3.open.ac.uk/survey/testfiles/courselist_c.htm

A103 http://www3.open.ac.uk/survey/testfiles/course2_c.htm

Hotkey http://www3.open.ac.uk/survey/testfiles/hotkey_c.htm

Option 3: HOTKEY		
Visibility of system status Is it clear when the keystroke has worked?	**Problem** (select one) ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Match between system and real world Does the use of a keystroke resemble anything in the real world? Is the method intuitive?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments

User control and freedom Does the user have control over the system when using the keystrokes	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Consistency and standards Does the choice of keys lend itself to an existing standard? Does it show potential for future extensibility?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Error prevention Does the method prevent a user from making errors?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Recognition rather than recall How easy are the keystrokes to learn? Remember?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Flexibility and efficiency of use Can the user change the keystrokes? How efficient/easy to use are they?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Aesthetic and minimalist design Visually are the designs (underline, hotkey, invisible) clear/minimal/aesthetically pleasing?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Help users recognise and diagnose errors Does the method make it clear why a keystroke doesn't work?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Help documentation Does the method provide suitable help information for the use of the keystroke use?	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments

Overall verdict	

After reviewing the heuristics of option 1, 2, 3, if you have any conclusions please enter your comments below. (Which do you feel is the most usable?)

Link relationships

If you have the browser OPERA on your machine:

1. Click this link http://www3.open.ac.uk/survey/testfiles/index_d.htm
2. In the menu bar select: View > toolbars > Navigation bar

If you do not have OPERA:

3. Click here to view screen shot

The site navigation bar is the bar underneath the address bar; it allows the web page author to mark up popular links, e.g. Home page or search. The browser will display the important links for the user, and can make it easier for the user to reach important pages.

The idea is that future browser manufacturers will set default shortcuts to these items and will also allow the user to assign their own keystrokes to popular pages. For example setting 'F12' to take go to the search page will work on all websites the user visits (providing the site owners implementing link relationships).

I am going to ask you to fill in the form below which has the same set of heuristics as the previous inspections. However, because there are no actual mock-ups to demonstrate the USE of browser embedded shortcut keys this form may be less straightforward to fill in. I would like you to comment on the ideas and imagine them being implemented and give details of any comments and problems where possible.

Visibility of system status	**Problem** (select one) ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments

Match between system and real world	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
User control and freedom	**Problem** ☐ Severe ☐ High ☐ Medium ☒ Low ☐ Zero ☐ N/A	Comments
Consistency and standards	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Error prevention	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Recognition rather than recall	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Flexibility and efficiency of use	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Aesthetic and minimalist design	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Help users recognise and diagnose errors	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments

Help documentation	**Problem** ☐ Severe ☐ High ☐ Medium ☐ Low ☐ Zero ☐ N/A	Comments
Overall verdict		

Final comments?

Thank you!

Appendix E: User observation participants

	Age	Sex	Disability	Assistive technology
1	35-40	M	Colour-blind	Uses anti glare screen, and sets the background of screen to off-white
2	30-35	F	None	-
3	25-30	M	Repetitive strain injury	Joystick, graphics pen, alternates
4	35-40	M	Spinal injury – wheelchair, partial paralysis of hands	Windows sticky keys, infra-red mouse, easier to be more precise
5	45-50	M	None	None
6	55-60	F	None	None
7	45-50	F	Fibromylagia and arthritis	Marble mouse, Dragon 7, wrist rests
8	50-55	D	Partially deaf, arthritis	Ergonomic keyboard, joystick, genie FM
9	60-65	M	Parkinson's, stage 2	None
10	20-25	F	None	None
11	35-40	M	Physically disabled, spinal	JAWS, large keyboard
12	40-45	M	Blind	JAWS, Braille display
13	35-40	M	None	None
14	45-50	M	Blind	JAWS, Braille display
15	35-40	F	ME, fatigue	Dragon
16	30-35	M	None	None
17	25-30	M	None	None
18	30-35	M	None	None
19	30-35	M	None	None
20	20-25	M	Physically disabled, visually impaired	Text resize, Dragon

Appendix F: User observation data

ID	Age	Disabilities	assistive technologies	user level	studied recentl	copy	print	save	tab	enter	order
1	30-40 / 38	colour blind	anti-glare background colour	Expert	No	keys	menu	keys	keys	mouse	123
2	30-40 / 33	-	-	Intermediate	No	menu	menu	menu	keys	mouse	123
3	0-30 / 26	rsi	joystick, graphics pad	Expert	Yes	mouse	menu	menu	keys	enter	213
4	30-40 / 36	spinal injury left hand, right hand. I can't do	sticky keys, infra-red mouse.	Intermediate	Yes	menu	icon	menu	keys	mouse	123
5	40-50 / 42	-	rolling mouse	Intermediate	Yes	mouse	icon	icon	mouse	mouse	123
6	50+ / 52	-	marble mouse	Intermediate	Yes	keys	icon	icon	keys	mouse	123
7	40-50 / 48	arthritus	Genie, joystick, ergonomic keyboard, l	Intermediate	No	keys	keys	keys	keys	mouse	312
8	50+ / 52	deaf, right hand	enlarge the text size windows setting	Novice	Yes	menu	menu	menu	mouse	mouse	123
9	50+ / 60	parkinsons, manual	-	Intermediate	Yes	mouse	icon	icon	keys	mouse	213
10	0-30 / 24	-	-	Intermediate	No	mouse	keys	menu	mouse	mouse	231
11	30-40 / 36	mobility	screen reader, large keyboard	Expert	Yes	keys	keys	icon	keys	enter	321
12	40-50 / 47	Blind	JAWS screen reader, Braille display ...I have	Expert	No	keys	keys	keys	keys	enter	312
13	30-40 / 36	-	-	Expert	Yes	keys	menu	menu	keys	mouse	231
14	40-50 / 49	Blind	JAWS screen reader, Braille display	Intermediate	No	keys	keys	keys	keys	enter	321
15	30-40 / 37	ME, fatigue, vision	dragon	Intermediate	Yes	mouse	icon	icon	mouse	mouse	213
16	30-40 / 33	-	-	Intermediate	No	keys	menu	menu	keys	mouse	312
17	0-30 / 28	-	-	Intermediate	No	keys	keys	menu	keys	mouse	213
18	30-40 / 32	-	-	Novice	No	keys	menu	keys	keys	mouse	132
19	30-40 / 30	-	-	Expert	No	keys	menu	menu	keys	mouse	231
20	0-30 / 23	mobility, sight	text enlarged, dragon	Novice	No	mouse	keys	keys	mouse	mouse	321

ID	Studenthome famililiartity	accesskey aware	accesskey information	ability without mouse
1	Yes	I have an idea, are they like keyboard shortcuts for a website	view source, only need to see them once	good, used skip to content, once I'd found the ski
2	Yes	No	it did come up didn't it, be nice if it was visible.	bad, did realise to use the tab key, then was fine. Used down arrow key frequently.
3	Yes	yes	"again I'd look in the accessibility statement at the top of the page somewhere" I might look under 'about the OU' "Ah help and advice, maybe there would be something in there"	good, always tabbed didn't use down arrow
4	Yes	"yes, but alot of them are like shift and alt and that's where I have difficulty and I have to use sticky keys." "I'm starting to use shortcuts more on the mac for video editing	"I'd look under help" The user open up the help menu on the browser looking for the information.	The user knew to tab, but did not know how to activate the link, uses mac so not sure "I would have thought it was the down arrow"
5	Yes	no	I'll tell you where I don't want them, I don't want them obscuring my view." "depends what they look like" "Somewhere in the browser or on th edge." "I can't remember keys becuase I'm getting old"	Bad, using the page down key. I had to tell the user to use the tab key. Even after knowing the tab key was still trying to scroll down the page.
6	Yes	yes where you do a combinations of keys to get to a page.	down at the bottom for clues, in a help section.	okay, she knew to tab
7	No	I have, I haven'tused them	somewhere near the top, the user pointed to the header of the web page.	not good, didn't know to tab immediatley but then picked it up
8	Yes	no, in an application, or hotkeys? User went into start control panel and showed me the accessibilty windows	The OU home page, accessibility information at the top you can see straight away.	bad, trying to use the arrow keys and enter. "i'm lost without a mouse"
9	Yes	no, ... Now keyboards have the buttons on the key board to open mail and	? Next to the links, first letter. The user wanted the infomation next to the links.	bad, did not know to use tab, trying to use the arrow keys. Figured it out.
10	No	no	at the top with all the other standard stuff	Okay, no hesitation
11	Yes	yes, alt+p to get personal details		v good
12	No	yes	with links??	excellent
13	Yes	yes, is that just general windows? I've never used them but I know of them		good
14	No			good,
15	Yes	not the word 'accesskey' but I knew alternative keys	? I understood the underlines as hotkeys.	okay, using tab but got a little lost
16	No	?		Okay, not great, closed window clicked
17	No	"they're hotkeys aren't they?"	The user would like to see the accesskey information under the black navigation bar	okay, tabbed into the content of the page, had to tell the user to tab backwards, and knew to click return. And tabbed quickly all the way to the course. Used the space bar to scroll the page.
18	No	yes, not on websites. I use them in applications. Progress	underlined characters	bad
19	No	yes, I disable the keys in windows, because I dont' want to activate anything. I didn't realise there was a website version of it.		okay
20	No	No	not sure	Okay had to instruct

ID	Invisible (Numbers)	Underlined (Letters)	Hotkey
1	alt+1 and enter, ok	"Underscore c" Alt + c and enter onto the course record page. Tabbed to the course link, hit enter, tabbed to the on this page. "Similar to windows" in windows normally ctrl.	"I'm looking F12 next to studenthome, but I need to get to course record but there is no F keys assigned to course record." User didn't understand and clicked to reload home. Then started using the tab and down arrow and got directly to the course page. "I found it diconserting that there was only one Fkey assigned to the menu, I didn't work out that it would just take me to the menu." Once I'd done it more than once, I would get used to it" TERM hotkey "Yes I understand it" When you tab through with this design you go through every item, but it also makes it more difficult to move faster" "I'm sure when I got used to skip to nav it would be ok"
2	pressed alt and key but not return. Took a minute.	Tabbed through and skipped to content (not needed) stopped. Tabbed to course page (not using accesskeys) used down arrow to get down the page. NOTICE ANYTHING not really, are they shortcut keys? They could be the accesskeys? REPEAT TASK alt+c "Microsoft convention" user was fine!	tabbed through to hotkey page, clicked through to customise page and back. Got help menu pop up, "useful to have a pop-up" "pop-ups are good" user got directly "that's much better, much easier, much more intuitive"
3	2: couldn't find information, instructed user to tab through first few links "There we go, cool" "Yeah it tells me what they are, Yeah" "Ok Alt+1 and enter" Had not problem.	1: NOTICE didn't notice at first (but first task) They are probably the underlined letters, if I wasn't sure I'd look for an assessibility statement or a help page" "To me the underline seems to indicate they are" accesskeys" REPEAT TASK was fine when repeating the task	3: Tabbed passed hotkey information and into the menu. "Oh wow, then I would do that, the dropdown popped down which meant I could go directly to the page" Used down arrow to scroll the page WHAT DOES F12 DO? "It's a link home like the accesskey was" I had to explain "cool, fair enough" "So it takes me to the navigation bar, so I can move through it, which is good"
4	had not problem understanding how it worked but struggled to reach the keys due to disabilities, used Alt GR	I see there is an underlined letter so I'm assuming that is a function key, c doesn't work on its own dso I'll try ctrl, and alt. Keys are close together which makes it more difficult "For that I would put sticky keys"	There's a nice F12 key on studenthome but none elsewhere. Then clicked F12 got pop-up and scrolled through the menus. Although the user managed to use the key well
5	"just click 1" I haven't read the instructions. My intructions where not complete. Had to go back to have another look at help page "I can't remember them"	tabs through, paused at "accessibility" link but carried on tabbing. I can't see accesskeys. Very hesitant when using the keyboard. Didn't see underlines. After being told "Ah yes" User manegd to use them well after being told where they where. There is no easy way to get down to A103 on the course record page.	"I've noticed there's an F12 key but ther must be some more for something else" clicked hotkey link and is on help page and was confused to where they where. "I'm not sure how the hotkey is doing" I like drop downs, but the problem I have is you're not sure they're there. I have a problem with help pop-ups.
6	understood to do alt+1 to get back the home page....paused to click enter.	clicked accesibility link (live site) User didn't notice the underlines and continued to tab. NOTICE ANYTHING No. AFTER TELLING I'd guess that they were shortcuts. User used Alt+c to get to the course record page successfully. "You've still got to tab from there"	I notice on here you've got a function key. Having gone through the task I think course records must have a key, user went into explorer help to try and find information? User click hotkey configuration. I don't mind using F12. Its a shortcut to go to the navigation, some help telling me which ones are which. User didn't use F12! And tabbed all the way. Still didn't understand. I had to explain.
7	After being directed to the accesskey link .... User understood that alt+1 took her to the home page	tabbed all the way to the course page then user tabbed to the accesskey hidden page and read. "I didn't want to do that did I?" I didn 't give me what I was looking for? I was looking how to get to the assignment scores	tried to click on the F12 icon, didn't use the keyboard. User clicked the Function key and found the help and then understood. User used F12 when using the keyboard. Used the down arrow key. The user could get down the page, did not know to use tab
8	when asked to use the accesskey the user tabbed instead ..... ?? Took his time, his left hand in slightly paralysed	tabbed didn't see underlines, tabbs all the way to the assignment scores. (user got confused and had to go back to the home page) NOTICE ANYTHING? No, TOLD maybe they're hotkeys? USE THEM TASK paused ....at least a minute ...had to be told exactly waht to do?!!	User noticed F12 key and wanted to know what the other F keys were. Paused on hotkey configuration link. ignored pop-up on F12, tabbed through to next drop down. Went back ...?? And went into hotkey configuration page ...then eventually user just used the tab key.
9	user tabbed quickly through the pages .... USING KEYS fine, used right hand to do alt and left to do 1.	tabbed all the way through did not see underlines ...ANY CLUES maybe the boxes at the top right, they should have	tabbed to skip to content... Clicked ...?? Paused ...started again then clicked hotkey configuration ... Not there. User

		accesskeys. TOLD ctrl + q ... Or even alt+q REPEAT tried to type Alt+A103? Didn't understand to go to course records page ...then figured it out. From my point of view becuase of my left hand it's alot easier to use the mouse.	trying to use mouse and hovers over F12 icon. .... Now tabbing and went straight to A103 with arrow keys.
10	user tabbed through as did on the first example.	Didn't notice first of all CLUES? Scrolled, paused, not that I can see TOLD I see understood that alt and letter would work...used the key get to the course page ... Oh so now I have to tab	tabbed through to the menu and ignored the pop upo went straight to A103 in drop down. Tabbed to get to on this page. NOTICE? No underlines, PROMPTED USER F12 icon is probably related to the F12 key and probably takes you somewhere.
11	"tabbing through all the links …. Course records ….. A103 …… page down …got it" "I saw an invisible line that said accesskeys" "4 search" any sites I build. I use them on all not not when I'm surfing but I build. I'm not sure whether they work in my browser.	I'm tabbing through all the links, there are no drop down menu so I've pressed enter, I have to tabbed all the way through to get to A103, I'm pressing enter, now, and page down. NOTICE ANYTHING? It's missing the invisible link to the hotkey and there is no drop down menus, other than that it looks pretty similar. HAD TO TELL UNDERLINES "I wouldn't have notices" alt+q and enter…. Not working okay alt+c works, and skipped to contenet, tabs through A103 link and then page down.	I'm tabbing and it's highlight my browser address and no the invisible links. I went down arrow key to move through the menu drop down and the Page down to scroll the page to the assignment scores. (F12) I'm wondering if it highlights the bar. "That makes sense" REPEAT TASK The navigation is highlighted and then the arrows.
12	User confused took ages to find A103. Yes its telling me about an accesskey. ASKED one accesskey was clear it was alt + 1 but the others were hidden, another is alt+0 after looking again, and alt+ s. The skip should be first. Very difficult to know why the numbers are 123 and 9 ?? If it bcame a standardisation, that alt9 would mean something to people. Are the government sites a significant source of reference ...if it was RNIB then that would be better.	User quickened JAWS up, it doesn't make any sense, but gives an overall idea of the page. Yes like scan reading. So Terry heard that h q c was the acceskeys ... Really quickly picked out the infomation that he wanted. So what did I remember, your course records, Terry used links dialogue to get to the A103 course page... Depends how much time I have, depends whther you've been there before, whether you want the info quickly whether it's an introductory visit. I use bookmarks in pages if I want to go directly to a page. (Terry started going on about software PARITY) Congnitvely intuitive	User used links list dialogue. You probably want course records, but Terry clicked the link in the dropdown becuas ethat was a link. (It depends whether I need to read the content or need to move to anothe page) If that is what I am using the ... Localise information ... You use the link to get to the chapter. And then you are usig it like a document, looking for paragraphs or headings. The strategies will be dependant on the user and how intuitive, some people like links, JAWS gives you quick ways of doing things. Most things will take me a fair amount of time to do to do so it is up to me to try and adopted a streamlined strategy. ASKED TERRY TO NOT USE DIALOGUE Terry tabbed through the page and JAWS read all links,he then found the link in the dropdown and went straight to the course page TELL ABOUT F12 Yes I noticed that, if I was using something less powerful I may use it, but Jaws gives me enough functions. USER TESTS KEY
13	tabbed alot! Used skip to content "it didn't do anything? Oh yes it did" It is back to how studenthome is at the moment as far as i can see. (showed the user where the help page was) tested it and it worked fine and understood. I guess it's fine if you go there alot and remember the keys.	tabs, I saw skip to content and tab on the course record page and the arrow keys to scroll down. (The user didn't spot the underlines first attempt) Well in keeping with the windows standards the main sections items have underlined keys. I wasn't sure it selected, in windows you normally see something happen like the file menu drop down appearing.	I tabbed to course records and the menu appeared and I was able to go straight there. Notice anything, I noticed on studenthome there's and F12 that'll take me to the home page but thats the only page that has a shortcut. It's selected it, ?? Confused (had to explain) "It's like a skip to the menu" Once told had no problem
14	How will I know what the accesskeys are? Had a look at the accesskeys, I'm just looking in the page to fins out the acceskeys. User quickens up JAWS and then slows it down when in the content. Alt+1 to go to the home page, and enter has worked and took the user to the home page.	I'm trying to what the link was called, there we are using a links list. Using arrow keys to move through the page, I like to have a look around, so I can work out the quickest way to get there. As screen readers users you find the quickest where to get somewhere. Familiarity having a good idea of the strucutre is a good idea. I'm trying to think about enhancements to put in for visually impairred users. You've always got that standard stuff at the top of a page. Oh you have an accessibility link. That's all general stuff, I quite often skip over the navigation, or alt+s is a useful command. When I first used the internet the stuff at the top confused me. I see they've all got alt text, what is the letters I can use. I did alt+c enter. 40:40 Enter was moving the focaus around the page but it wasn't activated it. Derek uses left arrow. Oh what's going on there. Wierdly the accesskey didn't activate?? Had to tab back?? (HTML challenge) JAWS is so complicated you could go on a training course for every version, but I've got by. It	Clicks F12, F12 and tab, had to explain how to get to the A103. Yes I do use skip to content, I use Alt+s. Once you geet to know a site you can jump around quite quite quickly. I used H to go down the headings (completed, current) . To get to the configuration link the user did a links list.

		serves me well.	
15	There doesn't appear to be any clues, so I guess I would just use tab, oh a link has just come up that says accesskeys, I've clicked the link. User reads the page. I don't really know from that which one I want, so I have click alt+1 to go to the home. "and skip to content was alt+s" now in the content of the home page. "I don't want to go to the content, do I? I would click the right arrow key, it did nothing. ??TAB has taken me there, I'll try the down arrow which doesn't work. I used skip to content. And tabbed to A103. Why are the links on a white background? I would tab through to skip to content, "I could have used the accesskey again, couldn't I?	I don't often use the key board but I seem to remember you use alt+c for hotkeys (not working?) confused. Took a minute but realise that to click alt+c I still can't work out where I am. I tabbed through course records to A103, then I guess I'd have to tab down the page to get to the onthis page. Took a lot of tabbing I wouldn't have done that normally	I've found a little icon that says F12 which will take me to studenthome if I get lost. User clicks F12 and reads the pop. So I now need to got to tabbing again and then the right arrow key and then the down arrow key and then enter. And then I click skip to content but I don't know where it is so tabbing.
16	There is no F12, I am tabbing through, Is on the content of the page of A103, i want to go back to the beginning. Now the user has found accesskey page and reads the information and uses alt+1 to go to the home page. But this is not what I want I want to go to the next one. (told user how to tab backwards) took along time. this time use arrow key to scroll. It's nto the one I prefer in fact.	F1, is normally help? User tabs to accesskey link and the user is reading , okay I have it. The underline letters are the keys. User types alt+c and enter and then course record page. I'm not sure it'll be the same so I think I will use the tab key to get to A103. Down arrow.	Where is my, F12, and then moved with the arrow key. And when on the course page tabs through all the navigation to get to the assignment scores ...alt+tab ?
17	User quickly tabs through pages theres no indication of the acceskeys, so the user doesn't attempt to find them. Showed the user the page "That's a bit complicated actually" user used alt+0 took	"no there's no clue on this page" After being asked to look in the navigation "If I was using my brain I'd say alt+s alt+c alt+q." User was able to select the link but needed prompt to click enter.	User immediatley click F12 and read the pop-up and understood the function key
18	I'm looking for some accesskeys, but I'm unable to find them. So tabs through the links and gets to the page by purely tabbing	'Alt+c' and got to the course record page, and then knew to tab and get to the course page. I understood how they would work. "Really don't expect to have to press enter"	user clicked F12 "what is it?" the key was to go to the home page. But used the arrows to get into the menu bar and found the course extremely quickly.
19	The user tabs throught to the course record page. And tabs to A103 and uses the 'page down'. There are no alt F12 and there are no underlined letters. "There's a problem becuase you can use the letters for the windows application" told user to use shift tab to go backwards. There's the invisible link to the accesskey page. Tells me how to skip to content, whatever that is. It tells you about Alt+0 "So if you knew about these you would click alt+0 to find the keys for that website" alt+1 because the user didn't press return becuase they couldn't see the active link.	I'm using the tab key, the arrow keys don't do anything, I pressed enter on your course records.There's quite a few things to tab through. Clicked A103, and tabbed to on this page. AFTER TELLING ABOUT ACCESSKEY: I can click alt+c and enter I have got to the course record page, but now i can't do anything.	There are no accesskeys, but there is an F12. User ignores key and tabs to navigation and sees pop-up then uses arrow keys. "it says it focuses into the navigation bar and I can use the arrow keys" REPEAT THE TASK: "i'm learning by experience" scrolldown the page.
20	User tabbed through and went passed the link. Shift tab. EXPLAINED KEYS tried the number pad, just click the letter. Then after this didn't work used alt+1 and had to be told to activte the link but knew to use the return key.	There is no F12, but the user tried the key and nothing happened. Trying the arrow keys. Using the tab now to move around the page. Using tab on the course record page and zoomed past the footer. NOTICE "don't know" NAV "not sure" WHEN TOLD just clicking 'c' (the user had to be instructed)	I'd like to get to course records, but it doesn't have a function key, so I'll press F12 and arrow key along.

ID	Customize	Shortcuts used	Preferred
1	WHERE "Maybe there's a link in the top bar" (user found the customise page) changed it to ctrl F1 "yeah thats good" CUSTOMISE I'm more of a mouse person myself so I tend not to use shortcuts		underlined > it was more familiar to me , personally I didn't think there was anything I had to learn apart from changing ctrl to alt USEFUL ON OTHER WEBSITES Yes if it was consitent across all or most websites then yes I would be really useful. "If each website had a different set of keys to learn, as s a mouse user it wouldn't tempt me away"
2	WHERE found it fine CUSTOMISE	no	hotkey, "easy to use" "throughput" USEFUL ON OTHER WEBSITES
3	WHERE "maybe the hotkey link I saw earlier" I might change it to alt and M, Oh no it's got to be a finction key. CUSTOMISE probably not	yes, Alt + directional keys, uses alt to navigate the menu. "yeah I use alot of shortcuts" "I rarely use F keys"	hotkey, "I liked the function key one because I could easily navigate throught the navigation" "Although I'm not sure how obvious it is to me, once you explained it it's pretty neat. To be honest I rarely use accesskeys, but I would use this"
4	WHERE Again the user was looking through the browser menus for the information, I'd like to see the information in help. Clicking F12 would still like to see help and how to customise. CUSTOMISE yes maybe, I like the fact there is just one key. The user selected F11 and it enlarged the browser window (conflict)	A few, on the mac they're slightly different, some of the Alt function keys jump around places, I use the first 4 but after that my hands are crossed over so I may as well use the mouse. I find the mac environment so much better than windows.	Underlined, straight up.yes I would use it on sites I visit. "I'd prefer it to be a single command, but it's not something I worry about to much I get around." "but I'm quite happy to use a alt key I only get worried when they are close together."
5	WHERE CUSTOMISE possible, it depends if it's a site I regularly visit	no	Underlined were better then numbers, but this one is my preferred, but I still think the F12 not intuitive, I suspect because I'm old.
6	WHERE CUSTOMISE ?no, I might use the key on my laptop, if it was there and it was obvious I would probably use it.	no	Underlined, i think once you got used to it it would be easier to use the underlined keys.
7	WHERE at the top somwhere, the user found the hidden link CUSTOMISE I would if it was something I was going to use alot	not web browsing	hotkey I think, I found it a bit easy to follow. I think for the acceskey numbers, you would need to print out the screen. USEFUL erm yes accesskeys is a new concept for me, you need to be aware of whats available.
8	WHERE ? CUSTOMISE ?	no	Underlined, but need all information on one page, more explaination, but the others might take getting used to.
9	yes, I might change it for 2 reasons, if it conflicts with another key I use and also becuas of the limited use of my hands.	uses all the top ten prgrammed keys, logitech keyboard.	hotkey, becuase you can change it. Yes use it onm website I visit
10	WHERE ? CUSTOMISE no	no	hotkey, I wasn't keen on the underlined one it was too subtle.
11	WHERE I can't see anywhere, ah I remember when I tabbed through it was there CUSTOMISE I'm not sure how useful it is, and I would almost certainly not change the link.	If I'm ill and running my laptop in bed I need to use F12 to switch . I use it so I can use F4 to check my emails my F12 switch machine. I use	Numbers. I couldn't see the underlines, I'm used to using the numbers. The F12 was good it worked. If I'd noticed the first letter was underlined I'd probably use that one.
12	WHERE CUSTOMISE I'd be very careful, if F12 is fine, I wouldn't want to configure it without making sure it didn't conflict with any of the keystrokes for the JAWS	yes lots	? undecided I haven't got any preferences, I can't see any disadvantages with one or the other. Letters might be easier to remember. That is the logic that goes through the building of most microsoft products, and they're all to a greater of lesser extent intuitive, in a very literal way intuitive. There are people who don't like using combo boxes, there are some people who love combo boxes, people who like the combo boxes are the ones who like games machines, click and go. Combo boxes used badly on websites are a menace.

13	WHERE possible in the header, invisble help. If I just pressed F12 then I would have missed the customise link CUSTOMISE If I was using shortcuts yes.	no	underlined, because they're more obvious and you don't have to remember anything. USEFUL yes if I was using the keyboard. Yes when I 'm using my laptop I use the keyboard more. Good point
14	WHERE Should put a note for screen reader users. CUSTOMISE yes anything like this is useful. Obviously you have various levels of user level so you have to make it obvious.	Yes, a lot of the windows ones use ctrl, and JAWS typically uses ins. user pointed to the num pad which does most of the JAWS operations. Ins+v, if I want to bring up, alter the velocity level. Every task you do is different so I don't set it permently. W	Hotkey, I think I liked that verison useful, only having to rememer one key. The frustrating thing is having to do so much navgaiting around before getting to the content your looking for. Anything that gets you from point A to point B easily. Don't want to be fighting through this rubbish, well it isn't rubbish its just a nuisance. Jaws does have the ability now to put a page marker in a page so that it remembers.
15	WHERE not off hand no CUSTOMISE Yeah I would customise, but I would make it ctrl+N or something.	I don't use function keys, I use CtrlT and CtrlG in a desktop publishing program. No web browser shortcuts	Underlined, It's usual, I understand, I mean I don't use it a lot, but it's something I'm familiar with. I might use it on other website. If its an interactive thing and I'm using the keyboard I'l want to use the keyboard.
16	WHERE maybe it should be at the top with the menu. CUSTOMISE No I don't need to modify them	no	Underlined. The 'F' key was obvious so it was easy to find. But the menu was more explicit, and it goes to each menu litem I want. I prefer the letters if is better explained. USE IT? On a aeroplane?? Eurostar? on a laptop I have a wireless mouse.
17	WHERE CUSTOMISE yes if I used it alot I would set it to F1		hotkey becuase it was visible and I didn't have to look for it, everytime you see an F key you know what to do,. "would you find it useful? "If I didn't have a mouse.
18	WHERE CUSTOMISE yes it's useful	No, we usually we have …access... for things like that. No I don't user a browser much	hotkey, you can directly go to all the menu items. Rarely use a laptop. maybe it is beneficial if I didn't have a mouse
19	WHERE "it's gone now I've lost it, maybe I can find it." Told the user where it was. CUSTOMISE No, not useful. Sounds like it's a good idea to have it but it's just a distraction for me.	I used different browsers and linux, so I just use the mouse for most things	Underlined, I prefer underlined letters, becuase I know what's going on, but I understand that there are clashes. It possibly might be useful on websites I visit. When I'm surfing I don't use the key board I use the scroll on the mouse. It would be quite a switch to go back to the keyboard.
20	WHERE CUSTOMISE no	I used some function keys, F4, F12 to saves as	hotkey, yeah I'll find the function keys useful for other tasks.

ID	Site navigation	Site nav with keystrokes	important	important to you	interested
1	yes User used mozilla, and travelled directly to the course record page. USEFUL no, I think the navigation on the web page works better then the site navigation"	yes It certainly would be more useful if there was consitency, but I still think in terms of the navigation, for me it would be limited, I couldn't .... probably in reality there are only a few pages that are common to every website"	yes	no certain tasks I may use shortcuts for but on the whole I use a mouse	yes, its heightened my awareness, probably won't use them
2	Yes not aware, clicked directly to search USEFUL "yeah, I should imagine it would be very useful if there is alot of contnet onthe page" Obviously if you can see everything you want it's not necessary"	"yes, sometimes it's not obvious on sites whether you'll find the content you need"	maybe, only a little bit	maybe I might do, they could be useful, if I was on a laptop, that sort of thing they would be useful	might
3	Yes "yes I have used that, I use it on sites that have it. But to be honest alot of sites have there own navigation anyway. It's more like you put your standard stuff in, it's a bit like doubling up, I'm not overly bothered by it"	yes yeah, is it everysite that I went to? If there was a universal key on everysite took me to the about page then that would be really useful. I wouldn't assign them self	yes, very	yes	yes, I tend to look already
4	Yes I would	yes "that would definitely be useful, consistency is the key" Pop-up help	yes definitely "I do, I think there used to be alot more encouragemen t to use them, but you know it's a good way to let you know what the shortcuts are"	yes "yeah, when links a re too close it's nice to have an alternative where of selecting links"	yes
5	yes, absolutely, I find that's one of the best changes that you can make. I like to learn stuff on the hoof, but it may not be obvious where they are	maybe I can't remember them, a label would be helpful.	maybe (no?) I suspect the answer to that is yes. I find using a mouse much easier	no	maybe
6	maybe It would depend on the site. Probably for the OU site, becuase it's big. I would like it to be global links, that would be nice.	maybe You only tend to use the ones that are appropriate to you. If the icon is there I'll use it, e.g. When I save I use the icon in the header, rather then the accesskey	yes they are	maybe if mouse fails or using laptop	maybe
7	yes	yes, I probably would customise them becuase I use certain function keys already (F11)	yes	yes certainly for me	yes
8	yes	yes	yes, anything that is designed to make a students experience easier and faster is good.	yes	yes
9	yes brilliant, All the time on the information so any shortcuts are good.	yes good idea, yes I'd customise	yes	yes, my mother in law 79, still works. For older people if it's easier to use. Used macrod in dos to program keystrokes. Start menu, looks up MACROS	yes
10	no, I'm happy using the naivagtion	yes definitely, if you used the keyboard something that shortens the amount of time navigating is good	yes	no	no in same way I don't go into a restaurant and look in a disabled toilet
11	Yes The user uses the site navigation and finds them useful. On occasions, the	yes I would… the issue is, as will always be the case people are not ready to put these on their	yes	maybe important sometimes , but I mange with a	YES already do

	things is it's nonuniversal, not many sites use it	sites, not all websites will use the technique. I don't know how many people will use it.		mouse, but I forget about people who can't	
12	?	maybe If you're using browsers with JAWS you would need to know the home page reader. It's easy to put features in that aare not really wanted, it's easy to be imaginative... Could be very helpful but you need to be sure about why you are using particular keys, but you gotta have a good idea of why they would want to do it. Again you're looking for parity.	yes	yes	yes
13	yes it does seem quite useful, yes having the site navigation in one place would make it quicker to get around.	yes very good idea, I'd probably stay with the default, I don't tend to customise things. Keep it as it is	yes definitely. I'd use them occasionally, maybe as a secondary. If I had my hands on the keyboard already.	maybe	yes on a site I use alot
14	? JAWS can't get to this	yes Yeah you need to make sure that JAWS could get to it, and you need someone more technical then me. Erm if anything to help the navigation is good.	yes, yes becuase you haven't got a mouse you need to have a way of nvigating and getting to where you want to be. I have a tendenecy to have to look them up, I can't carry them in my head, the more intuitive they are, h for header, t for title, it helps	yes	yes
15	yes I would yes , it seems similar to the google toolbar.	yes It does sound useful, it's not somehting I'd thought about before, but yeah it would be good.	maybe erm maybe yes, I think they've got there place, their not important for me they're individual	no probably not, I tend to use my cordless mouse	yes
16	maybe ? I'm not so sure. Okay yes you don't have to go back?? Okay yeah	yes user suggested having an 'underscore' It will be useful	yes	yes, filling in my details for an aerolplane ticket I don't want to use the mouse to move about the screen, when I'm typing both hands are on the keyboard. USE IT? Yes in some circumstances. I don't web surf much	no
17	yes I suppose so, but it already looks quite complicate, you don't need all this author copyright stuff.	maybe possibly yeah	maybe If you can't use a mouse yeah, or if you have a disability.	no	yes I might do, I feel like I've been educated
18	yes it is useful	yes okay, yes it would be useful.	no, not really	yes I go for the mouse but I might use them more in software	yes
19	yes no not heard of it, "it's a good idea, becuase sometimes you might just want to know how to contact someone, and search is	maybe This might be too complicated, with all the extra keys strokes, will it clash with other browser keys. This does not have everything I want	maybe possible for certain people, if you find it difficult to use	no	maybe It's grabbed my attention, you've educated me.

	useful" "It might not have the options I want, I'd like somthing that would tell me how to contact of the company"		the mouse. If the mouse broke		
20	yes yeah	yes yeah I might	yes	yes	yes

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