Accessibility Research in a Vocational Context

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Abstract. Current experience shows that vocational context has a vital role to play in research on inclusive information society technology, for at least four reasons. First, the occurrence of disabilities has a major impact on employability and employment. However, the potentially significant contribution of accessible and usable information society technology (IST) in employment has yet to make more than little difference in practice. Context of use is still often ignored. In other words, to ensure that applications can achieve as broad a customer base as possible, they are often designed for generic, rather than specific, cases. While this enables those applications to support a wide variety of use-case scenarios, the corollary is that not as much specific support is afforded to individual use-case scenarios as when designed for a more focused sets of tasks. Second, despite the impressive increases in computing power, innovations in interactive design, such as 3-D user interfaces (UIs), are rarely incorporated into mainstream IST products. One of the fundamental principles taught to most software UI designers is that of 'consistency', i.e. that similar functions should look the same and behave in similar ways across a variety of applications. The benefit of this approach is that once a user is familiar with the interaction metaphors being used, it will take minimal time to learn to use a new and unfamiliar application. The flip-side of this principle, though, is that it can stifle the development of new and innovative UI techniques, because they will not be 'consistent' with existing applications and UI designs. Greater emphasis upon the context of use in general and the vocational, educational and lifestyle context in particular could lead to better user uptake, as the resultant UI would be better suited to the individual needs and wants of each particular user. This better uptake, in turn, gives better feedback to mainstream system designers. Third, without context, the identification of user and system characteristics is an unbounded problem. There are simply too many possible different design options to manage easily. The consideration of vocational or recreational context significantly reduces the scale of the problem and renders it more manageable. Fourth, accessibility research in a vocational context ensures that the participants not only gain indirectly from it but benefit directly too, often gaining an improved vocational standing. If so, emerging design methods like unified user interface design (UUID) methods should place much more concentration on the vocational context of use.

1 Introduction

There are several urgent reasons why research on accessibility and assistive technology should include research within a vocational or educational context. For example, there is substantial evidence that acquired or inherited disabilities have a substantial impact upon the educational and vocational prospects of the individual and that the adaptation and deployment of personalised technology to support accessibility can improve vocational standing significantly (Adams and Langdon 2003; Adams, Langdon and Clarkson, 2002). Put simply, if a person is given the right tools to do a job, then it increases the chances of that person getting gainful employment.

Also, as Beaudouin (2004) points out, the capabilities of modern information society systems have increased many times over, but mainstream interface design has improved only modestly over the same time span. Accessibility considerations have often failed to transfer from assistive technology or design innovations to mass produced systems. The effective use of context has substantial implications for accessibility and usability of information society systems for all, including people with disabilities and the older adult. Mainstream interface design for all could be achieved by greater emphasis upon the context of use in general and the vocational, educational and lifestyle context in particular (Stary, 2002).. This could lead to better user uptake, in turn giving better feedback to mainstream system designers.

2 Impact on Employability

There has been considerable work on user modelling and monitoring that has identified a number of dimensions that could or should be assessed when attempting to establish the requirements of an individual or group of people for information society technologies for work or personal use (Adams and Langdon, 2003; Adams and Langdon, 2004; Adams, Langdon and Clarkson, 2002 etc). Such work has effective user modelling. However, whilst useful characteristics of the intended users of a system can be identified, it is not clear just how many of those characteristics are relevant at any one time. There is some evidence that human cognitive features may be necessary but not necessarily sufficient. For example Adams (2004) has identified that levels of insight and performance awareness can be important, as can aspects of personality.

3 Participant Benefits of Research

Scientific research in the human-related disciplines often requires the involvement of human participants, as, for example, in medicine, psychology or HCI. There is rarely any indication of a direct benefit for those participants, not even when potentially relevant prototype systems are being explored. In many cases, the potential benefits are purely indirect through a generic contribution to knowledge. However, when participants are involved in a vocationally relevant way, they can potentially benefit directly from the acquisition of new insights about themselves and from expert vocational advice.

4 The Impact on Employability

First, there is substantial evidence for an impact of disability on employability. On the Wage website (<http://www.wage.eu.com/articles/dda/stats.html>), the following statistics are given from UK government sources.

- 42% of disabled people of working age are in employment contrasting to 81% of non disabled people in the same age range.
- Disabled people are over 5 times as likely to be out of work and claiming benefits.
- Disabled people in full time employment earn about 20% less than non disabled people considering all types of jobs

Broadly similar estimates are given by Harrison and Phipps (2006). When considering the link between employability and disability for disabled students in the UK. Harrison and Phipps (2006) point out that any consideration of the employability should remember that in the UK only 50% of people with disability and of working age are in employment as compared with 87% of nondisabled people of working age. There are both practical and legal reasons why it is important to increase this 50% figure. In practical terms, it may profit the individual in many cases in many ways to be employed and receiving a realistic salary and benefits, but it would also benefit the economy that is experiencing skills shortages. Initiatives like the Employers' Forum on Disability provide a voice for employers on disability as it impacts business in the UK. This is a not-for-profit membership organisation, funded and led by almost 400 private and public sector members, which between them employ circa 20% of the UK workforce.

5 Legal Mandates

From a legal perspective, in the UK the Special Educational Needs and Disability Act (SENDA) specifies that institutions should treat all students favourably and make all reasonable adjustments so that students with disabilities do not face substantial disadvantages. The student experience should enable those with disabilities to develop the skills and knowledge required for them to pursue their chosen vocations.

If so, students with disabilities should be given equal opportunities to demonstrate employability and to receive vocational advice that is relevant to them. Croucher, Evans and Leacy (2004) have provided a major AGCAS (Association of Graduate Careers Advisory Services) evaluation of the first destinations of UK graduates (2003) with disabilities. This is an important report, since it is issued only one year after the date of graduation. They considered 11,651 first degree graduates with a disability out of a total of 182,319 graduates. Croucher et al (2004) explored what happened to them, their success in getting a job and the types of jobs and further education they obtained. They also considered the vocational experiences of students with different types of disabilities e.g. dyslexia, blind/partially sighted, deaf/hearing impairment, wheelchair user/mobility difficulties, personal care support, mental health difficulties, an unseen disability, multiple disabilities and other disabilities.

Their findings include: 48.4% of disabled graduates were in full-time paid work compared with 54.6% of non-disabled graduates, 8.4% of disabled graduates were in part-time paid work compared with 7.6% of non-disabled graduates. 8.2% of disabled graduates were engaged in work and further study relative to 8.0% of non-disabled graduates. 16.6% of disabled graduates were engaged in further study compared with 15.9% of non-disabled graduates. 9.6% of disabled graduates were assumed to be unemployed compared with 6.9% of non-disabled graduates. Observed differences between different industries were often absent or marginal.

They also examined differences between the different disability groups. As a baseline, they reported that overall 48.4% of disabled graduates and 54.6% of non-disabled graduates were in full time employment. The figures for entering full time work were: 52.5% of graduates with an unseen disability, 50.3% of graduates with dyslexia, 43.7% of blind / partially sighted graduates, 44.3% of deaf/hearing impaired graduates, 30.3% of graduates who are wheelchair users/have mobility difficulties and 29.5% of graduates with mental health difficulties.

These results, and others like them, demonstrate the complex nature of the relationship between student employability and disabilities. Overall, the results are encouraging, with overall high levels of employment. However, there are many unanswered questions, including the role of the specific disabilities in influencing employability. Within the overall figures, it is clear that individuals with mobility or mental health vectors present significantly lower levels of employment. The potential application of accessible and usable information society technology (IST) in higher education and initial employment is little understood, but it is suggested that much could be done to apply IST for the facilitation of people with different disabilities in different ways so that they may achieve the potentially best levels of employability. Recent examples of this type of work are now emerging, with an increasing emphasis upon inclusive design (Keates and Clarkson, 2003), cognitive user profiling (Adams, 2004) and policy development (Stephanidis et al, 2001).

6 Lack of Innovation

Pure research studies of the human computer interface in general and studies of usability and accessibility in particular seem to lead to little if any take up by major manufacturers and developers of system interfaces. Beaudouin (2004) has argued that whilst PCs have been increased in power over a thousand times in the last ten years, user interfaces have basically stayed the same. Comparatively few of the radically new concepts and techniques for user interfaces proposed and developed in research labs have found their way into new products and services. He argues that this problem can only be overcome by switching from a focus upon the design of user interfaces to the design of interactions themselves and to a "broader view of interaction in the context of use".

7 Context of Use

The notion of context of use is well recognised in studies of universal access (Keates and Clarkson, 2003; Shneiderman and Plaisance, 2004; Stary, 2002; Stephanidis,

2001). Often the context of use is depicted as a specific model or set of models. For example, Stary (2002) considers model based development schemes and the types of models that can be used to develop a design for a user accessible interface. Such models include the development of task models (both existing and envisaged), user models, data models and interaction models that can be used to capture the essential requirements of a new interactive system design. However, present research, a much wider perspective of the context of use is envisaged and that wider view provides benefits for the end-users, the researchers and for practitioners.

8 Approaches to HCI

There are at least three approaches that can be taken to the issues of human computer interaction. First, the HCI expert can be seen as an evaluation specialist who is brought in at a later stage to evaluate a prototype or a system and give advice on the final design of the interface. In this case, the HCI expert may work as part of a large team working on mainstream applications for larger vendors. For example, see the discussion of different methods reviewed by Shneiderman and Plaisance, (2004). A second approach is the production of an accessible and usable prototype directed by an HCI practitioner and supported by technical staff who program the software to instantiate identified users and to revise that software in line with feedback. Such projects tend to be more modest in size until they are adopted by mainstream vendors. The third type of HCI research involves working with individual users in a vocational and assistive technology setting, identifying user requirements, building user models and adopting / adapting information society technology and assistive technology to meet the needs of individual users. In this approach, a substantial level of success can be delivered in terms of the present users, but mainstream applications and systems designs would not be altered or informed by it unless there is an active process of feedback to mainstream programmers and designers. It can be readily seen that the three approaches are all significantly different from each other in terms of focus and scale, though they all require feedback to mainstream developers if the latter are to be significantly informed by the outcomes of this work. The present purpose is not to compare and evaluate these three approaches, since there are others for which there is not space to mention here. The aim is to describe, present and advocate the third type of research which is much more akin to work with rehabilitation and assistive technology. However, it should be noted that the present focus is on research rather than practice.

9 Working with Individual Users

Typically, in this approach, an individual would consult with one or more experts with expertise in vocational psychology and assistive / adaptable technology. They would work with an expert on a one-to-one basis to work out how best to develop their education, career or lifestyle or some combination of these themes. This work would include a consideration of the ways in which IST can be adapted to meet their needs directly and / or through the use of assistive technology. Such an evaluation

could take up to three days of contact time but, in the main, as the participants could perceive a benefit in participation, they were happy to do so.

10 Assessment Methods and User Models

The first problem to be overcome was the lack of a systematic selection of appropriate and relevant assessment methods. Whilst a wide range of cognitive, occupational and psychometric methods could draw upon, this seemed to be in danger of a lack of systematicity. This issue was addressed by Adams, Langdon and Clarkson (2002) in which the need for a systematic basis for cognitive assessment methods for assistive technologies were tackled. A review of the cognitive psychology literature led the authors of that paper to adopt and adapt Broadbent's Maltese cross (Broadbent, 1984) as a roadmap of the relevant psychological processes to be considered in user requirement evaluation and user modelling.

Fig. 1. The Maltese cross

This provided a simplistic model of human functioning i.e. powerful enough to take in pertinent research results but simple enough to be used to guide good practice. It also has the advantage of being based upon a considerable volume of high quality research. The model provided five components of user functioning, including input processes, output processes, working memory, long term memory and executive functions. These components constitute the first level of the model that can be unpacked to a second level in the model to consider IST activities e.g. select a menu etc. Whilst Broadbent's Maltese cross is intended as a theory of human memory, our own development of it is intended to provide a basis for user modelling and for user requirements assessment. It is a theory of cognition and in addition each module in the model has both memory and processing capacity, giving the model the power of a von Neumann machine. This model, a direct descendant of the Maltese cross is called Simplex One, used as a simplistic model in HCI in combination with concepts like the Inclusive Design Cube (Keates, Langdon, Clarkson and Robinson, 2001). Further

work, reported by Langdon, Adams and Clarkson (2003) demonstrated that the new battery of tests could differentiate the needs of three different individuals with different types of head injury.

Whilst they did not expect to change the architecture of Simplex One, merely to refine the details, discussions with designers and meta-analyses of the literature (Adams, *in press*) convinced them of the need to add a further four components i.e. feedback, mental models, complex output and emotions, as presented by Adams and Langdon (2003) to produce Simplex Two. In addition, they were able to show that Simplex Two could be used to generate universal access heuristics for blind and visually impaired people using IST (Adams, Whitney and Langdon, 2003). In this study, the model was used to generate accessibility design heuristics to evaluate three systems for people with impaired vision.

11 Results

The work on user sensitive design methods for IST users with special needs led to the observation that the specific assessment techniques depended critically upon the insight and awareness of the users (Adams and Langdon, 2004). Considering different psychological assessment methods e.g. tests, questionnaires, structured interviews etc, it is typical to consider that these different options have different levels of accuracy, strengths and weaknesses, but otherwise confirm each other. It is now known that is not the case (Dix, Finlay, Abowd and Beale, 2004). In an evaluation of nine case studies, Adams and Langdon (2004) investigated the insight (defined as the long term knowledge of strengths and weaknesses) and awareness (showing short term appreciation of current performance), in individuals with muscular-skeletal and brain injuries. Of the nine case studies, eight showed some lack of insight into their problems and four also showed a lack of awareness when they had performed badly on a task. Clearly, the relationship between insight and awareness is more complex than anticipated and that methods that rely on either should be viewed more critically in future. This conclusion is supported by work reported by Adams (2004) in which self report, observed task performance and personality inventories were all used to evaluate user requirements in four case studies. However, the three methods showed diverse results, again showing that user modelling cannot rely on a limited range of methods.

12 Conclusion

Overall, working in a vocational context has a number of tangible benefits for all the stakeholders i.e. users, researchers and practitioners. Users were comfortable about participation as they saw it as a positive process. The process was designed to produce significant output in terms of educational, vocational, life style and technological developments.

In this paper three approaches to HCI research were identified. Whatever your chosen approach, it is clear that feedback must be provided for mainstream system / application design. If HCI is to influence mainstream IST product design, then it is

argued that the wider context must be involved to a much greater extent and specific mechanisms for feeding the results of such research into mainstream design. If so, this will require a radical change in traditional HCI methods.

13 Suggestions for Future Work

It is clear from the above account of work in universal access that users' requirements and optimal system designs should take the context more strongly into account. It is already clear that the context-of-use is an important consideration for accessible system design and meeting the needs of specific users or groups of users. However, it is concluded here that the wider vocational (or lifestyle context) should be allowed, where appropriate, to have a major influence. Consider the following diagram.

Fig. 2. Understanding context

As yet, there is not a clear understanding of the intervening variables that mediate the influence the wider environment like vocational context or lifestyle on the overall model constituency of the user (user profile, context of use / task context and the technology models). Perhaps concepts like social intelligence could cast some light here and that will be one line of future work. However, the long-term memory and cognitive modelling skills of the individual are, *inter alia*, of potential relevance here (Adams 2004). Whatever the outcomes of such work, it is clear that a systematic consideration of the vocational and lifestyle context of the users will, almost certainly, contribute substantially to their effective inclusion in the Information Society.

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