ICT Services for Every Citizen: The Challenge of Gaps in User Knowledge

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Abstract. Many services in our society are digitalized. Being able to access and use information and communication products and services (ICTs) has become a prerequisite for independent living and to fully be able to take part in society. Therefore, ICTs should be designed in such a way that they are usable and accessible to all citizens. Experiences and results from four case studies involving diverse user groups are discussed in this paper. The focuses of the studies were usability and accessibility of ICTs intended to be used by "anyone." When looking across user interaction observations of these mainstream ICTs, the challenge of gaps in user knowledge were striking. The challenge of defining a basic level of usable and accessible ICT features is also discussed.

Keywords: universal usability, e-Inclusion, universal design, gaps in user knowledge, accessibility, user diversity, elderly, visually impaired.

1 Introduction

In today's society, we encounter information and communication-based services (ICT services) everywhere. Services in important areas such as government, education, health, culture, travel, commerce and others are increasingly digitalized. Being able to access and use ICT services has become a precondition for independent living and to be able to take part fully in society. Therefore, ICT services should be designed in such a way that they are usable and accessible to all citizens.

In order to reach the goal of producing products and services that are accessible and usable for all, it is necessary to focus on the variety of users and usage contexts. Detailed knowledge about how the wide diversity of users with diverse needs affects the use of ICTs is needed.

Four case studies involving diverse user groups will be presented and discussed in this paper. The focuses of the studies were usability and accessibility of mainstream ICTs. When looking across user interaction observations of these mainstream ICTs, the gaps in user skills and knowledge were striking. This leads to a discussion of how to deal with this, and whether it is possible to define a basic level of usable and accessible ICT features that developers of mainstream ICT services can build upon.

2 Related Work

Several design approaches that encompass the goal of designing products and services that are accessible and usable for all have emerged within the ICT-communities since

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the mid-1980s; see [1-4]. The overall goal of these approaches is to enable the widest possible range of users to benefit from ICTs.

In an article entitled Universal Usability, Shneiderman outlines a research agenda for making ICT services available to every citizen [3]. Three main challenges in attaining universal usability are highlighted: technology variety, user diversity and gaps in user knowledge. This paper will focus on the last two challenges, i.e., the challenge of user diversity and gaps in user knowledge. User diversity is about accommodating users with different age, gender, disability, skills, literacy and culture. Common ways to deal with this challenge are to let the user customize elements of the interface, such as font sizes, contrasts, mouse click speed and key combinations, language and so on, and to follow accessibility guidelines and standards such as W3C/WAI [5] and ISO/TS 16071:2003[6].

Another challenge is that even if accessibility guidelines are applied, great variations in the applications are often observed. Thus, users who move from one ICT service to another face the need to learn new ways and conventions even for functions they have mastered well in one service. The challenge of gaps in user knowledge is somewhat related and is about how to bridge the gap between what users know and what they need to know. Common ways of dealing with this challenge is different types of user training and teaching, the use of standard terminology, metaphors and different types of online help. Layered interfaces and scaffolding are also proposed to meet the challenge of gaps in user knowledge [7, 8].

There is much ongoing work to define the ICT skills needed for doing basic ICT tasks in the information society. Several different certification programs exist, such as e-skills passport [9] and e-citizen computer skills certification [10]. A myriad of ICT skills assessment tools and teaching programs also exist [11].

3 Four Case Studies

The four case studies are based on four projects. In each project, users have been studied while performing tasks with mainstream ICT. For convenience, the projects are numbered from P1 to P4 in this article.

P1: ICT for an inclusive working life (15 participants): The main goal of this project was to identify possible ICT barriers for workers in practical occupations when they were required to make use of a new ICT product. Employees were studied while performing tasks with a software tool for control and management of invoicing and an e-learning course for in-house security training [12]. Participants were recruited through the human resources department of two large enterprises using the software tools to be studied. The participants had low education and little previous ICT experience. Participants were from 30–61 years old.

P2: DIADEM (22 participants): Elderly and people with cognitive difficulties were studied while using two different electronic forms: a travel reimbursement form and an application form for a safety alarm. Participants were recruited among patients with cognitive impairments after brain injuries at a rehabilitation hospital (33–47 years old), from the organization seniornett.no, promoting ICT use by the elderly

(65–75 years old), and among two groups of relatively low educated workers (cleaners and workers serving food to hospital patients) at a hospital (57–65 years old).

P3: UNIMOD (four participants): Users at an employment training program were studied while filling out an electronic job application form. Some of the participants had low ICT competence and some of the participants had cognitive challenges (participants were in their twenties).

P4: ICT barriers for the visually impaired (28 participants): Visually impaired users were observed while using different ICT products and services, among them also the safety alarm form used in P2 and the job application form in P3. The intention was to give a broad overview of the situation for visually impaired and the participants varied widely with regard to age, sex, education, ICT-experience and job experience. The participants were from 17–60 years old [13].

Table 1. Overview of the four case studies

Project no	Project name (project period).	Case ICT: task	Target groups	No of participants
P1	IKT-arbeidsliv (2005). Eng: "ICT for an inclusive working life".	- Software related to purchasing and invoicing. - E-learning security course.	People with - low education - low ICT skills	15
P2	DIADEM (2006-2009). Delivering Inclusive Access for Disabled or Elderly members of the community.	- Electronic forms: travel reimbursement and safety alarm.	People with - cognitive difficulties - elderly (65+)	22
P3	UNIMOD (2007-2009). Universal design in multimodal interfaces.	- Electronic form: job application.	People with - low education - cognitive difficulties	5
P4	Synshemmedes IKT-barrierer (2007). Eng: "ICT barriers for visually impaired".	- Electronic forms: safety alarm and job application.	- Visually impaired (17 – 60 years)	28

3.1 Similarities and Differences of the Tasks Across the Studies

The following tasks were studied:

- Controlling an invoice by looking at scanned orders and documentation (P1).
- Going through a security course by using a web-based e-learning application (P1).
- Filling out an electronic form for travel reimbursement based on provided travel scenario and dummy information (travel plan and receipts) (P2).

– Filling out and submitting a job application form based on provided dummy information (P3 and P4).
– Filling out and submitting an application for a safety alarm to the local authorities. Dummy information was provided (P2 and P4).

The first task was based on a stand-alone software application; the other tasks were web based. Two of the forms, the safety alarm application and the job application had very similar layout as they were designed by the same provider. These two forms also followed user interface guidelines for Norwegian governmental forms on the Internet [14]. Forms following these guidelines were used in three of the projects (P2, P3 and P4). This provided a good basis for making comparisons on the performance across different user groups: the elderly, people with cognitive difficulties and the visually impaired.

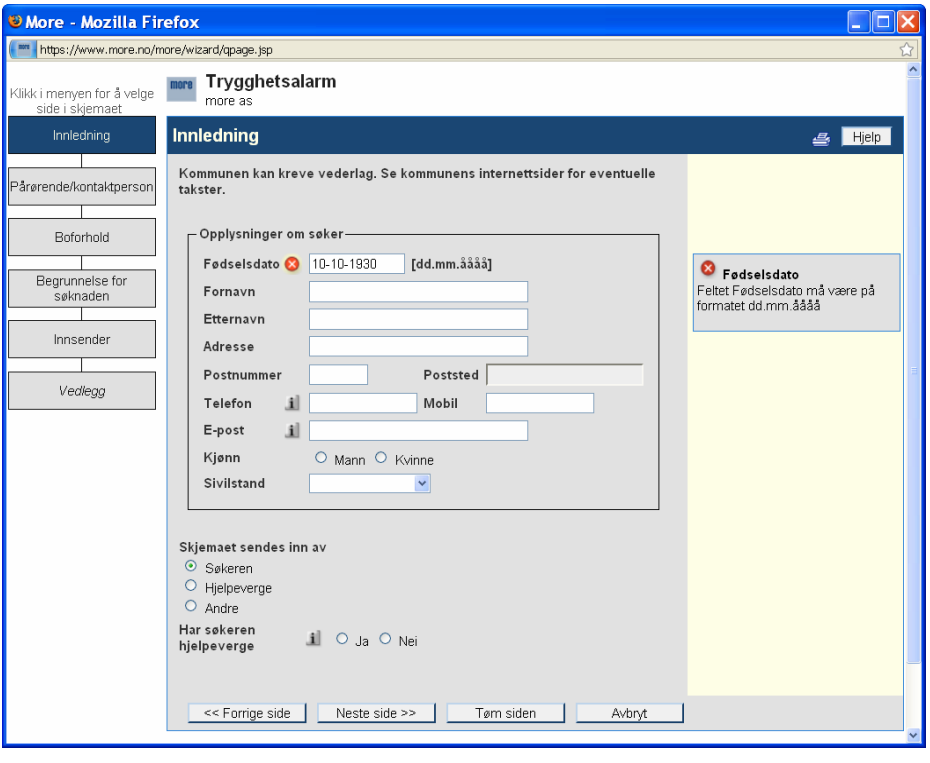

Fig. 1. A screenshot of the first page of the safety alarm form

3.2 User Diversity in the Four Studies

All the studies were qualitative and the users were recruited through different channels as indicated in the project descriptions above. Although there were several young participants in P4, most of the participants were middle aged and elderly. The ICT

skills varied widely. It was a prerequisite in all the four projects that all participants should have some previous experience using a PC. In general, the participants had little formal ICT training. The actual ICT skills varied greatly within each project and across the projects. Most participants had no problems in opening web pages and sending e-messages. Also, there were some participants with very high ICT skills, especially in P4. Other background variables also varied across the projects. Some participants were in education (P4), had low education level (P1, P2, P3 and P4), had high education level (P2 and P4), were young (17–25 years) (P3 and P4), were elderly (65+) (P2 and P4), had cognitive challenges related to concentration, orientation, memory or reading/writing (P2 and P3), were visually impaired (P4), were in an employment training program (P3), were employed (P1, P2 and P4) and were retired or unemployed (P2, P3 and P4).

3.3 Research Design and Data Collection

A qualitative approach was used in all four projects, and the overall procedure was fairly similar across the projects: notes on background variables, a short, semi-structured interview on the participant's experience and attitudes on use of ICTs and then solving a practical ICT task. In each project an interview guide and concrete ICT tasks were developed. The ICT tasks were mainly web based, with the exception of a task in a software program for document management, purchasing and invoicing (P1).

Some background information such as age, occupation, experience and training was noted in each project. The semi-structured interviews on experiences and attitudes on ICTs varied in length and detail across the projects.

The participants were asked to think aloud during the subsequent task-solving activity. For the electronic form tasks, dummy information was provided.

The whole session, including the interview and task-solving session were voice recorded. During the task-solving phase, the researcher took notes on all types of difficulties, obstacles and misinterpretations. Sometimes the participants would get stuck. If they seemed not to be able to continue on their own, they would get tips from the researcher on how to continue. This was also noted.

Notes and recordings were used when transcribing and summarizing each user session. A fairly detailed set of minutes from each session were written, although not all parts of each session were transcribed in detail.

The author of this paper has been heavily involved in all the projects. In order to refresh and be familiarized with the material and to compare observations across the studies, the minutes from the sessions from each project were re-read. Notes on special problems and issues that seemed important were taken. From these problems and issues, themes were formed and the notes were coded (with color) according to the different themes.

4 Data Analysis

Many of the participants in all projects encountered problems while solving their task. While going through the material, the difficulties that seemed to be related to the same type of ICT-feature or functionality were grouped. We tried to see whether there

were special patterns, similarities or differences between the problems experienced by the elderly, people with cognitive challenges and the visually impaired. It turned out that many participants across these three groups had problems with many of the same features. Especially, many participants across the groups had problems with navigation and overview. The reason for the problems seemed to vary. Several of the visually impaired had more e-skills than participants from the other groups, and their problems were to a much greater extent related to inaccessible design. Many of the difficulties of the other groups seemed to be correlated to lack of ICT experience. The participants with the least ICT experience appeared to feel that the task was overwhelming. Here are some examples of common features or functionality that caused difficulties in the studies:

Need for scrolling up and down the pages: Several of the participants did not know how to, or did not think of the possibility of, scrolling down the page. This led to problems with progressing both for the e-learning application and the forms, because the "next" button often was placed "below" the screen, requiring the user to scroll down in order to find it.

Navigation: Both in the e-learning course and in the electronic forms, many users had problems in understanding how to navigate from page to page. In both cases, a list of page headers was presented to the left of the screen (see Fig. 1.) It was possible to navigate between the pages by clicking on the page headers. The users that had problems with this feature and the scrolling feature would have serious problems in knowing how to proceed.

Precise use of mouse: All participants had used a PC before and they knew basic operation of the mouse. The electronic forms could be operated without a mouse, so in general this did not cause trouble for the visually impaired. For the other groups, especially the elderly, it was a common problem that the clickable area of selectable items on the screen was too small. An example was difficulties when trying to tick off a radio button. When clicking and nothing happened because they didn't hit the right area, they became doubtful about how to handle the item. This could lead to the conclusion that they were not supposed to click on the item anyway.

Formatting and special characters: Many difficulties were related to a combination of strict formatting requirements, incomprehensible information about the required format and the need for entering special characters. For example, a time field required the user to separate hours and minutes with a colon (e.g., 12:30). First, many of the users didn't understand the need for entering a correct separating character. Second, entering a colon required pressing both the *shift key* and the *period key* at the same time. Several participants did not know how to do this. Similar problems occurred when entering dates. This caused problems for very many participants across the studies. An example of a typical error when entering date of birth (Fødselsdato) is shown in Fig. 1.

Switch between windows and close windows: Sometimes new windows were opened, typically with help information. Some participants did not know how to get rid of the help information, i.e., close the help window, and in some cases, when the new help window covered the whole screen the user got lost.

Upload a file: Two of the forms, the safety alarm and the job application, suggested that the user should upload documents as attachments to the form. The concept of uploading a file was not known to the majority of the participants and caused confusion. There were instructions on how to do this, but in general they were not able to understand the instructions and most participants failed in this part of the task.

Open and close file catalogs: Many of the participants were not familiar with the concept of a file catalog and the way to open and collapse such catalogs by pressing the plus or minus buttons. This caused problems when uploading a file. It also caused problems in navigating through the content in the e-learning course, because the content was presented in a file catalog structure, with main headers and sub headers.

Use of drop-down lists: Several of the participants had problems in operating drop-down lists. Some participants had problems in hitting the right choice because their hand movements were not precise enough. Some participants had problems with opening the drop-down lists as well. They did not react to the little arrow indicating a list. They became confused because they thought they should enter information into the field.

Find and make use of help facilities: In general, the users did not use any of the existing help resources. In all three of the forms, there was a help button at the top of the screen, to the right. This was hardly ever used. In addition, there were small icons marked with an "i" indicating more information placed in connection to many of the fields in the forms. Even when stuck or confused the participants hardly ever made use of this information button. After the session, they were asked whether they had considered this opportunity. Most participants said that they did not think of it or notice it. The visually impaired users had large problems in localizing the help features. For the participants using a magnifier, the problem was that the help information tended to fall outside the screen and too far from where the problem occurred on the screen. The design of the help features turned out to be inaccessible for the blind participants using a screen reader or text-to-speech software. There was no meaningful text connected to the information icon, and there were no direct links to the error information showing up to the right when an error occurred.

To summarize, many of the participants were not familiar with one or more of the features or functionalities listed above. In general, the participants had little formal training, and their knowledge seemed to be quite arbitrary. This affected their task-solving performance and many got stuck and could not complete the task on their own. Even when stuck or in trouble, many users did not try to find or use the help facilities. An overall impression is that lack of basic ICT skills seems to be a more severe obstacle to task completion than having an impairment, except when the feature were totally inaccessible. This was the case both for the visually impaired and also for people with cognitive impairments. Participants with solid previous ICT-experience and a cognitive impairment due to brain injury (P2) or other cognitive difficulties (P3) performed considerably better than the workers with little ICT experience (P2). It seemed to be the case that those users that needed help the most were least inclined to use the help facilities. Other studies also show that users often do not use help functions very effectively or even ignore them totally [15, 16].

5 Discussion

The question is how we may overcome the problems of users that are not able to use such features and functionalities as listed above. Many would think of these features as quite basic ICT features. A combination of several strategies is probably needed and here are some main possibilities:

1. Make the features more accessible and easier to use, in other words strive for universal design.
2. Change the help resources so that more users utilize them.
3. Change the design in order to avoid "difficult" or complicated features.
4. Personalize and adapt the user interface to each particular user.
5. Define a basic set of universally designed ICT features and train citizens to use them.

Even though there is an increased focus on usability and accessibility, there seems to be a huge potential in improving the usability and accessibility of many applications. For example, many of the problems caused by strict formatting requirements could probably be avoided by better design and possibly by more robust and intelligent field content validation. Better designs of drop-down lists are also suggested, for example to provide a default text such as "Nothing selected" rather than blank.

As stated above, users seem to be reluctant to utilize help functionality. A second strategy might be to improve online help features to be more attractive, usable and accessible. Examples of recent advice and approaches are to provide more examples [16, 17], live help systems [18], embedded user assistance [19], animated talking assistants [20] and just in time learning through short instructional videos [21]. The UNIMOD project (P3) has developed prototype instructional videos or so-called screen casts and is investigating accessibility issues related to this.

Another possibility would be to avoid some of the features causing problems, such as the need for entering special characters and the need for scrolling. However, the user's ability to solve the ICT tasks will be dependent on many factors, such as (dis)ability, previous experience, training and culture. It is not obvious that it is possible, for each "difficult" feature, to come up with alternative designs that would be usable and accessible to all. Layered interfaces and scaffolding are suggested to meet the challenge of gaps in user knowledge [7, 8, 22]. But it is pointed out that these approaches need to be extended with frameworks and methods to define the basic layer [8] and to prioritize functionality for scaffolds [7].

A related strategy to avoid difficult features would be to personalize and adapt the user interface to the particular user. This is the goal of the ongoing DIADEM project (P2). The DIADEM technology monitors the ability of the user to interact with electronic forms and dynamically offers assistance and personalization of the interface. The target groups are the elderly and people with cognitive challenges. One interesting feature of the DIADEM system is that it can transform electronic forms from different providers to one common look and feel, thus reducing the user's need to learn new ways and conventions all the time. In order for this approach to succeed, it is vital that the adapted design is easy to use for the particular user, and that the support features are able to analyze the situation accurately and give meaningful and helpful advice.

One of the seven principles of universal design, as defined by the Center for Universal Design [1] is that the design is easy to understand, regardless of the user's experience, knowledge, language skills or current concentration level. Many seem to interpret this to mean that the design should be usable without previous ICT experience and training. The question is whether this is achievable in reality. What seems to be lacking is a set of basic ICT-features that developers of mainstream services can build upon, a set of features that are usable and accessible and that they can assume that the users would be able to understand or handle. Especially it seems to be important to put people in a position so that they can make use of help and learning facilities, so that they can more easily solve problems and extend their skills. The above-mentioned approaches, such as help systems, layered interfaces, etc., could build upon such basic features.

The studies have highlighted the importance of having some basic ICT-skills in order to use mainstream ICT services. For many people, the most effective way of achieving the required level of skills would probably be to go through some kind of systematic ICT training program. The various initiatives on developing e-skills and e-literacy frameworks are trying to define what skills are needed to take part in the information society. It would probably be beneficial for developers and the HCI community to look to this work and vice versa. A closer co-operation will possibly result in an increasing overlap and alignment between what training the citizen gets and what type of skills and competencies are needed to use common mainstream ICT services.

6 Conclusion

This paper has reported four field studies of diverse users using mainstream ICTs. In each study, there were mismatches between the ICT skills required to be able to use the case application and the participants' ICT skills and knowledge. This lack of what we may call basic ICT skills would hinder task completion for many of the participants.

The studies shed light on the variances of user skill and knowledge. All the case applications made use of ICT features that some of the participants did not understand and manage to use. Examples are navigation, entering dates, using drop-down lists and make use of help features. The case applications made use of different subsets of features, and the participants knew yet other subsets of features.

Different strategies to close the gap between what users know and what users need to know in order to fully take part in the information society have been discussed. These strategies are universal design, improved help facilities, avoiding difficult features, personalization and adaptation. Finally the emergence of a common basic set of universally designed ICT features, that application developers can build upon and citizens can be trained to use, are called for. Advancements in all these areas are required in order to lower the threshold to the information society.

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References

1. Center for Universal Design, http://www.design.ncsu.edu/cud/
2. Design for All (DfA), http://ec.europa.eu/information_society/policy/accessibility/deploy/dfa/index_en.htm
3. Shneiderman, B.: Universal usability. Commun. ACM 43, 84–91 (2000)
4. Stephanidis, C., Savidis, A.: Universal Access in the Information Society: Methods, Tools, and Interaction Technologies. Universal Access in the Information Society 1, 40–55 (2001)
5. Web Accessibility Initiative (WAI), http://www.w3.org/WAI/
6. ISO/TS 16071: Ergonomics of human-system interaction – Guidance on accessibility for human-computer interfaces. Technical specification. International Organisation for Standardisation. ISO, Switzerland (2003)
7. Lee, A.: Scaffolding visually cluttered web pages to facilitate accessibility. In: Proceedings of the working conference on advanced visual interfaces. ACM, Gallipoli (2004)
8. Shneiderman, B.: Promoting universal usability with multi-layer interface design. In: CUU 2003. ACM, Vancouver (2003)
9. e-skills Passport, http://www.e-skills.com/e-skills-UK-in-work/e-skillspassport/1863
10. e-citizen, http://www.ecdl.ie/homepage.aspx
11. ICT Digital Literacy Skills Assessment, http://www.ictliteracy.info/ICT-Assessment.htm
12. Fuglerud, K.S.: IKT for et inkluderende arbeidsliv (Eng: ICT for an inclusive working life). Report number: 1009. Norwegian Computing Center, Oslo, 28 (2005)
13. Fuglerud, K.S., Solheim, I.: Synshemmedes IKT-barrierer (Eng: ICT-barriers for the visually impaired). Report number: 1016. Norwegian Computing Center, Oslo, 91 (2008)
14. ELMER, Simplification of public forms, http://www.elmer.no/english/
15. Aleven, V., Stahl, E., Schworm, S., Fischer, F., Wallace, R.: Help Seeking and Help Design in Interactive Learning Environments. Review of Educational Research 73, 277–320 (2003)
16. Novick, D.G., Ward, K.: Why don't people read the manual? In: SIGDOC 2006. ACM, Myrtle Beach (2006)
17. Moallem, A.: Usability of Software Online Documentation: A User Study. In: HCI International 2003, vol. 1, pp. 549–553 (2003)
18. Aberg, J., Shahmehri, N., Maciuszek, D.: User modelling for live help systems: initial results. In: EC 2001. ACM, Tampa (2001)
19. Matthew, E.: Embedded user assistance: the future for software help? Interactions 14, 30–31 (2007)
20. Foglia, P., Giuntoli, F., Prete, C.A., Zanda, M.: Assisting e-government users with animated talking faces. Interactions 14, 24–26 (2007)
21. Baecker, R.: Showing instead of telling. In: SIGDOC 2002. ACM, Toronto (2002)
22. Baecker, R., Booth, K., Jovicic, S., McGrenere, J., Moore, G.: Reducing the gap between what users know and what they need to know. In: CUU 2000. ACM, Arlington (2000)