

Testing Usability in an ICT Solution for Care Cooperatives: A Case Study

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Abstract: This paper describes a usability test design in the development of an ICT management system in an EU project under the Ambient Assisted Living (AAL) programme. The population of Europe is aging, and the elderly population is increasing. This demographic change will create an increasing need for social and healthcare services. The purpose in developing the ICT management system is to meet this challenge by creating an effective ICT management system for elderly people in need of assistance. Results from the usability test give the developers insight into features to be changed to create a user-friendly software. The methods used in this study were standard usability tests and emotional wheel scores. Representative end users were given a number of tasks while conducting thinking aloud tests and emotional wheel scores followed by qualitative interviews. The test results were categorised in terms of effectiveness, efficiency and satisfaction. In general, the end users' response were positive. They suggested improvements and identified a number of challenges mainly related to effectiveness. Emotions ranged from happiness and joy, especially after successfully completing a task, to anger and frustration when obstacles occurred.

1 INTRODUCTION

The population of Europe is aging, and the elderly population is increasing compared to the rest of the population (Hametner and Adelman, 2012). In the near future, these demographic changes will cause serious challenges in social and healthcare systems because this group of people has a higher need for services. Therefore, new solutions must be developed to address the increasing population.

This article describes processes in an EU Ambient Assistant Living (AAL) project carrying the title iCareCoops. The purpose of the iCareCoops project was to accommodate the demographic challenges by developing an effective ICT management system for elderly people in need of assistance. The study intends to develop a model to organise elderly care in an efficient way and thereby support elderly care and services.

The project supports management of care cooperatives through a web based ICT management system that supports interaction and fosters prosperous collaboration among care providers, care receivers and managers of care cooperatives.

The requirements collection for the management system were that it could contain and handle all care

cooperatives in Europe. The system support the managers tasks when it comes to organising care and social services. The management system should coordinate services between care providers and care receivers. Care receivers should be able to order a service using the system. Care providers should be able to accept the job using the system and register when the service is done. The system must contain a billing module handling the payment of services.

Nine partners from eight European countries collaborated in the development of the ICT management system. They contributed to various areas of responsibility. SIVECO ROMANIA SA (Romania) and SYNYO GmbH (Austria) participated in the development of the technical parts of the web solution and iDeal Development (Denmark) developed the mobile app for Android. VIA University College (Denmark) developed a test design exploring participants' usability experiences. SYNYO GmbH (Austria), ZHAW - University of Applied Sciences Winterthur (Switzerland) and ZDUS - Zveza društev upokojencev Slovenije (Slovenia) conducted the tests. Senior Citizen Cooperative Riedlingen (Germany) participated in tests of the management system. Cooperatives Europe (Belgium) provided contact to cooperatives.

Usability testing is a form of quality assurance. In this article, it is associated with users' experiences when testing the iCareCoops product. Results from the usability tests provide developers insight into features to change to create a useful solution. It is essential to conduct usability tests to discover problems and make an ICT product as useful as possible (Gregersen and Wisler-Poulsen, 2013).

Eight attributes are associated with usability: efficiency, effectiveness, learnability, accessibility, satisfaction, navigability, content and interface design (Aziz et al., 2018). However, according to ISO 9241-110 former ISO 9241-11, three of these usability test categories are essentially: effectiveness, efficiency and satisfaction (Aziz et al., 2018; Aziz and Kamaludin, 2018). Therefore, these three test categories are used in this study. According to Gregersen and Wisler-Poulsen (2013) the definition of effectiveness and functionality is identical. Thus, these terms are used interchangeably in this paper.

When testing effectiveness, the aim is to identify if and to what extent the goals or tasks are attained. Also, collecting suggestions for improvements is important. Furthermore, it is important to identify conformity with expectations as a part of effectiveness. The aim when testing efficiency is to identify how easily users can navigate the solution and solve certain tasks.

The aim of this article is to contribute a method of usability testing and present the results of this method's use when testing the usability of iCareCoops products.

2 METHOD

This study's usability test design consists of expert tests and three other data collection methods with selected end users consisting of thinking aloud tests, systematic qualitative interviews and emotional wheel scores.

Expert tests are used to explore technical aspects and, for example, identify navigational dead ends and other bugs. The purpose of end user tests is to investigate how end users experience usability.

All tests were performed in the language of the countries in question except for those carried out by the ICT experts. These tests were in English.

Prior to developing the Prototype I a paper prototype test was conducted (Sefelin et al., 2003).

The only inclusion criteria for care providers was that they work at a cooperative taking care of care receivers.

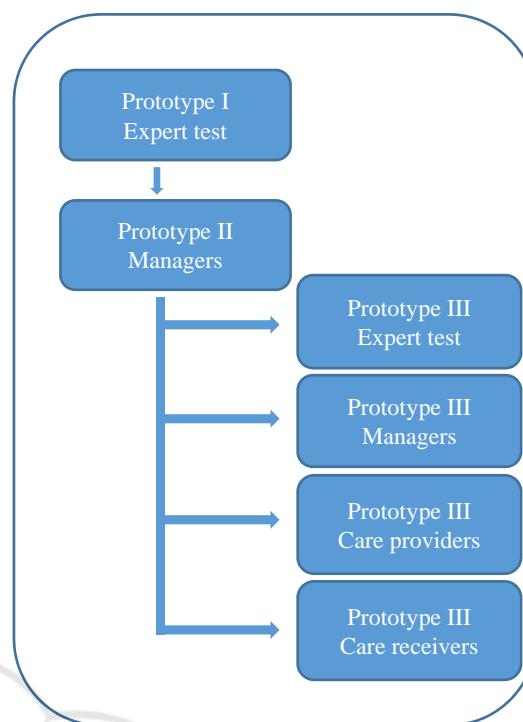


Figure 1: Plan of iCareCoops usability test design showing which user groups testing different prototypes.

Inclusion criteria for care receivers required that that they be more than 65 years old and in need of some kind of health care or service. The managers, care providers and care receivers solved tasks while thinking aloud. After the test, managers were interviewed to collect feedback and ideas to be incorporated into further prototypes.

It was expected that the interviews with managers would contribute sufficient information on usability issues because of their preconditions. Therefore, no interviews were conducted with care providers and care receivers, as four to five users will expose 80% of user interface (UI) flaws (Rubin and Chisnell, 2008). Each prototype test involves representative test individuals from the user cohorts (Nielsen and Landauer, 1993).

The three prototypes were tested in different setups (see Figure 1). Prototype I was tested using an expert test. Prototype II was tested using a thinking aloud test in combination with an emotional wheel score and a qualitative interview only with managers. Prototype III was tested using an expert test followed by a thinking aloud test and emotional wheel score with all three end user groups.

Experts participating in the expert tests consisted of a class of Danish ICT engineering students. All findings reported were incorporated when developing Prototype II.

Table 1: Examples of tasks for users.

<p><u>Manager</u> Login and registration Invite and remove members Set service provider role to edit Edit content in a cooperative profile Add a cooperative service</p> <p><u>Care provider</u> Register for iCareCoops Request joining a cooperative Add a new service to the list Place a request Answer a message.</p> <p><u>Care receiver</u> Register for iCareCoops Join a Cooperative. Reply to a message. Order a care service and schedule it</p>

The Prototype II usability test was carried out with ten cooperative managers from two countries, five from each country. In Prototype III, twelve managers tested the management system. Five non-professional care providers, two nurses, one occupational therapist and one physiotherapist evaluated the system as care providers. Twelve older adults in need of care evaluated the system as care receivers. They explored usability by performing relevant tasks in an artificial working environment see table 1.

Tests of managers consisted of thinking aloud tests and emotional wheel scores during task solving, followed by systematic qualitative interviews after performing tasks. The tasks were created to be realistic and were mainly administrative in nature.

Prior to testing, a brief introduction was given containing information about the purpose of the test, interviews and testing procedure. All participants signed informed consent forms.

2.1 Expert Test

The expert tests were conducted twice, first on Prototype I and again on Prototype III. For both tests, a class of 16 Danish ICT engineering students tested the web solution and reported all technical findings, such as navigational dead ends and errors.

2.2 Thinking Aloud Test

The thinking aloud test provides a list of identified

usability problems for performing basic tasks (Gregersen and Wisler-Poulsen, 2013). Thinking aloud tests are frequently used to test websites. In this study, it was used to test the usability of the iCareCoops management system. The test users performed realistic tasks while thinking aloud.

The thinking aloud test requires users to verbalize thoughts while working with the system to provide a better understanding of their interpretations or potential misconceptions of the interface (Nielsen, 1993). The thinking aloud test was recorded. This provided analysers the opportunity to use the recordings while analysing usability and emotions in connection with tasks.

The thinking aloud test was analysed in an inductive manner. Questions, such as ‘What obstacles prevent users from completing tasks?’, ‘Which interface elements are problematic or helpful?’ and ‘How easily do users solve the tasks?’ were answered to explore the three usability categories: efficiency, effectiveness and satisfaction.

The interviewer’s task was to ask questions if the test person stopped thinking aloud for example, by asking, ‘What are you thinking?’

If tasks could not be solved, the user was guided through the problems to be able to continue.

The findings from Prototype II testing were incorporated into Prototype III.

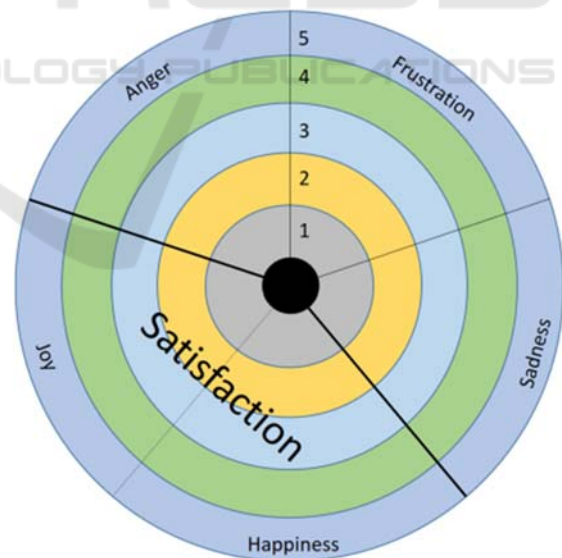


Figure 2: Modified Emotional Wheel Score.

The thinking aloud test was repeated for Prototype III with managers, care providers and care receivers.

Emotions evoked during the thinking aloud test were analysed by associating them with the task where they occurred (see Figure 2).

For all tests, a set of qualitative data was derived from the measured usability criteria during the session. Results from each iteration were used for further development of the iCareCoops solution.

2.3 Satisfaction and Other Emotions

The emotion scoring method was inspired by the emotional wheel (Fontaine et al., 2013). The emotional wheel was used during the task solving process to identify personal experiences in the satisfaction category (see Figure 2).

Satisfaction is defined as how it feels to use the solution (Gregersen and Wisler-Poulsen, 2013).

After solving each task, the type and the degree of evoked emotions were collected. Participants could choose between the following emotions: anger, frustration, sadness, happiness and joy. If emotions were evoked, they were scored on a scale from 1 (lowest degree) to 5 (highest degree). The emotional wheel provides the opportunity to investigate and analyse how emotions are affected when using the iCareCoops solution. If anger, frustration or sadness during a given task dominate the scores, then the design of this part of the iCareCoops solution should be reconsidered (Fontaine et al., 2013).

The emotions happiness and joy indicate satisfaction and that this part of the product has a high degree of usability.

2.4 Qualitative Interview

Managers tested Prototype II to explore further details about the usability of the iCareCoops solution. An individual motivational qualitative interview was performed immediately after the manager solved the tasks.

The interview was based on an interview guide. The questions in the interview guide seek to uncover usability criteria, such as effectiveness (including conformity with expectations), efficiency and satisfaction. The recorded interviews were analysed in ways inspired by the systematic text condensation method, a qualitative analysis strategy (Malterud, 2012). The procedure involved a transcription of the interview, a coding process to define meaningful categories and interpretation.

2.5 Cross Analysis

A Prototype III cross analysis between all participants from expert tests, thinking aloud tests and emotional wheel scores was performed and categorised for three subjects: functionality, efficiency and satisfaction.

3 RESULTS

The test design shows an iterative interactive process in which findings are incorporated continuously and involves a number of tests conducted over a period of time. Therefore, the results presented are mainly from tests associated with Prototype III.

3.1 Experts

The amount of technical errors and bugs in the expert test decreased considerably in the second test compared to the first. The number decreased from 64 bugs in the first test to 16 bugs in the second.

The experts mainly found browser related bugs in the second test. What worked using one browser did not necessarily work using another. Several bug reports described problems with functionality, such as change of language, lack of button functionality, problems with registration and lack of search field functionality.

3.2 Managers, Care Providers and Care Receivers

The outline of the findings presented below originates from managers, care providers and care receivers who completed thinking aloud tests and emotional wheel scores. Results are divided into three categories: functionality (including conformity with expectations), efficiency and satisfaction and other emotions.

3.2.1 Functionality or Effectiveness

Conformity with expectations is to answer the question 'How useful is the iCareCoops solution in the user's organisation?' In general, users were positive about the web solution. However, several managers expressed concerns and were taking precautions against how the solution could be integrated with other ICT solutions. Users stated that the app prototypes were practical because they can manage tasks on the go. They also suggested certain optimisations so that the solution matches their expectations (e.g., a billing functionality).

A number of requests regarding the conformity of the solution concerned consistency in colour usage and colour coding for different roles, especially the distinction between the menu buttons "My Cooperative" and "Cooperatives", and button placement. Members of all three user groups found it confusing that similar functions did not share a colour. Managers found it useful that members have

various roles, but they asked for colour coding for different roles. Some managers and care receivers also asked for a simplification of the menu and the elimination of unnecessary duplicates (i.e., services and service categories). Although managers asked for simplification in general, they also asked for additional features.

Users faced a number of challenges. Registration was a problem for some users. A manager and a care provider claimed that older adults in particular would not be able to register themselves. It was difficult to understand the difference between login and registration, especially for care receivers, but also for some care providers. This became obvious because all of them tried to register in the login section. All but one care provider did not find the register button on the first attempt and instead tried to register in the login section. Besides the problems with registration and requests to join a cooperative, care providers and care receivers reported problems with the chat format of the e-mails. They found it frustrating. Moreover, some care receivers were uncertain if a message had been sent because it was not shown on the website. Some of them also experienced trouble exiting the receiver dropdown menu. Thus, regarding the message functionality, some care receivers mentioned that they would prefer to write a conventional email instead. One person mentioned that she would prefer to join directly on the homepage of the chosen cooperative instead of the iCareCoops homepage. Care providers recommended that emails that had been replied to should be marked as such. In general, users claimed that the solution should be simpler and more straightforward, especially for care providers and care receivers, and that support in the form of a helpdesk would be useful.

3.2.2 Efficiency

The efficiency category aimed at investigating whether certain obstacles prevented users from completing the tasks. All users agreed that the main functionalities were covered by the solution. They also identified areas for improvement. Navigation was not easy for managers in general, and some of them experienced it as inconsistent, but once the principle was understood, the solution was easy to use. In particular, inconsistencies in translations and terminology proved to be an obstacle. It is worth mentioning that no obstacles occurred that prevented users from completing the tasks. However, care providers and care receivers mentioned that the solution was only understandable for users who were accustomed to ICT solutions.

Users were confused by the date format (mm/dd/yyyy). Moreover, there was no information about choosing a password – specifically, that at least seven letters were required to create a password. When the password was inadequate, every written letter or number disappeared when clicking the “REGISTER” button. This caused frustration for all users.

With reference to interface efficiency, care receivers had problems with navigating the system. The facilitator had to help them several times, and they were not able to complete several tasks independently.

Increasing the size of the letters appeared to be irritating because a smaller cut-out was displayed, causing them to lose overview.

Care providers and managers had no significant difficulties in navigating the interface.

3.2.3 Satisfaction and Other Emotions

Various emotional reactions occurred during the thinking aloud test. The emotions joy and happiness correspond to satisfaction. Emotions ranged from happiness and joy, especially after successfully completing a task or when functions were understood, to anger and frustration when obstacles occurred.

There was a lack of feedback when requests for a service were given. The results in relation to satisfaction by senior users revealed the need for more detailed and precise feedback, as requested by both care receivers and care providers.

Care providers expressed frustration when they did not successfully complete registration, and they wanted precise feedback on their actions. In general, they experienced difficulties getting an overview of the web solution. Overall, two tasks, registering for iCareCoops and service requests, must be taken into account. All other tasks scored mainly positive emotions, which correlates with a high degree of satisfaction and, therefore, in this category, a high degree of usability.

4 DISCUSSION

The expert test showed that technical errors and bugs decreased considerably in the second expert test compared to the first. This may be a result of the error corrections that were made when developing later prototypes.

In this study, the satisfaction category was mainly explored during use of emotional wheel scores. Other studies used post interviews or diaries to document

and explore satisfaction (Bastien, 2010). The purpose of scoring emotions during the thinking aloud tests and task solving process is that the users do not have to remember which emotions they experienced during the task and to what degree they experienced these emotions. They were instead encouraged to express them while they felt them (Fontaine et al., 2013).

A study on mobile applications showed that degree of satisfaction is directly associated with functionality, such as the amount of user errors and navigational errors (Saleh et al., 2017). Their finding conforms to this study, in which the number of navigational dead ends and other errors resulted in low functionality and satisfaction scores.

Other studies have explored usability aspects in a quantitative manner using various methods. Aziz et al. (2018) measured the role of satisfaction. They used a survey to quantify users' perceptions, feeling, opinions and thoughts. The emotional wheel method provided the opportunity to analyse and continuously identify subjective emotions while testing the ICT solution. Qualitative interviews primarily explore explanations for evoked emotions.

Regarding efficiency, it was found that the solution was easier to operate for users who were accustomed to ICT solutions. This result is in accordance with the result of Aiyegbusi et al. (2018), who found that users who were used to navigating the internet were much faster and made fewer errors when solving tasks than users who were not familiar with navigating the internet (Aiyegbusi et al., 2018).

5 CONCLUSION

The aim of this article is to contribute a method of testing usability and present the results when this method is used for testing usability of the iCareCoops products.

The methods used in this study were paper prototype testing, expert tests, thinking aloud tests and the collection of emotional reactions using emotional wheel scores. The test design was found useful when testing the iCareCoops web solution.

All in all, experts mainly found technical related errors and bugs. The other test results were categorised in terms of functionality, efficiency and satisfaction. The representative end users were positive in general but suggested improvements and identified a number of challenges, mainly in the functionality category. Emotions ranged from happiness and joy, especially after successfully completing a task, to anger and frustration when obstacles occurred.

Testing this kind of management systems it is useful to combine several methods in order to get insightful perspective of the users experience, needs and emotions.

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