Contextual Inquiry Method for User-Centred Clinical IT System Design

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Abstract. Little can be found in the literature about the applicability of field study methods, particularly contextual inquiry, in the health informatics field. This paper aims to inform and promote the use of contextual inquiry for user-oriented design of clinical information technology (IT) systems. The paper describes how the method was applied in two empirical studies to gather data about end-users' needs, as well as the use and usability of dictation solutions and electronic nursing documentation systems from the viewpoint of their end-users' in real working surroundings. Experience indicates that, compared to typical usability evaluation methods, contextual inquiry may provide valuable support for user-centred design activities: the method is suitable for increasing researchers' understanding of clinical practices, contexts of work, and end-users' interaction with numerous IT systems. However, in clinical settings there are special challenges related to recording and privacy issues, a wide variety of clinical practices and contexts of technology usage, as well as the hectic nature of clinical work.

Keywords. Contextual inquiry, user-centred design, clinical IT system

1. Introduction

Field study methods have not been widely adopted in the health informatics field, although the need for a participatory and user-centred design approach in technology development has been strongly acknowledged. Research literature on user involvement in healthcare technology development typically deals with a usability evaluation approach and studies that are conducted in the later phases of system development. Recently, researchers have suggested that, compared to the evaluation approach, field studies of clinical work are more suited for informing conceptual problems and developing an understanding of the wider context in which the clinical information and communication media are used [1,2]. Experiences from field studies have indicated that ethnographic methods (such as interviews, observations, and artefact analysis) have helped to efficiently explain relevant work practices (e.g. [3,4]). Furthermore, methods used to derive the requirements for healthcare systems are criticised as being inadequate (e.g. [5,6]). Among others, Malhotra et al. [5] and Croll and Croll [6], have stated that the biggest risk faced in developing IT systems for a healthcare setting is to understand the complex environments in which these systems are used.

Little can be found in the literature about the applicability of field study methods, particularly contextual inquiry, in healthcare technology development. A few researchers have reported contextual inquiry studies. Gennari and Reddy [7] applied the participatory design approach and used contextual inquiry to design and build a protocol screening tool of clinical trial protocol management. Gil-Rodríguez et al. [8]

applied the method to collect information about cognitive, symbolic, and practical characteristics of information technology (IT) systems use on daily tasks in clinical settings, with the aim of supporting the design of graphical user interfaces for telecardiology applications. Furthermore, some researchers have aimed at encouraging user-oriented methods for assessing clinicians' needs, and user requirements, for system design purposes. Already in the year 1995 Colbe et al. [9] argued that the contextual inquiry method has several advantages in obtaining a more comprehensive analysis of the true needs of users. In their review-based articles, Chan [10] and Martin et al. [11] introduced the contextual inquiry method with reference to its developers Holtzblatt and Beyer [12], and explained the principles of the method.

This paper aims to promote the adoption of the contextual inquiry method among practitioners and researchers in the health informatics field and provide information about the specific characteristics of healthcare contexts that are essential to be considered when applying the method. The described experiences and lessons learned are based on two empirical studies: a dictation study and an evaluation of nursing documentation systems.

2. What is the Contextual Inquiry Method?

Contextual inquiry is a field data gathering technique that forms the core of contextual design. The method enables researchers to create an understanding of who the users really are and how they work on a day-to-day basis. This understanding becomes the basis for developing a system model that will support users' work. From the user's viewpoint, the method helps people crystallise and articulate their work experience. Throughout the design process, contextual inquiry can be used to challenge the developers' current understanding and system design for users [13].

Contextual inquiry does not provide a set of steps to follow for collecting and interpreting user information; rather it describes concepts that guide the design and implementation of information collection and analysis sessions [12]. Inquiry studies typically involve four to eight users. In practice, the procedure of the inquiry is simple: while observing the user at work, the researcher asks about the user's actions in order to understand their motivation and strategy. The four principles of the method are [12]:

- *Context*: Inquiry takes place in the actual work environment, with emphasis on gathering concrete data and ongoing experience.
- *Partnership*: The overall aim is to create a partnership which fosters the creation of a shared understanding and discovery of work and practices. In the inquiry, the user is the expert on the work, whereas the researcher is an apprentice who is willing to learn about and understand the user's work.
- *Interpretation*: Interpretation means determining what the user's words and actions mean together. It is a chain of reasoning that turns a fact into an action relevant to the designer's intent. Design is built upon interpretation of facts. Researchers share these interpretations during inquiries with users.
- *Focus*: Focus defines the point of view a researcher takes while studying work. The focus steers the conversation and gives the interviewer a way to keep the discussion on topics that are useful without taking control back from the user.

3. Overview of the Dictation and Nursing Documentation System Studies

The contextual inquiry method was applied in two empirical studies to gather data about end-user needs as well as the use and usability of a range of technology applications in clinical settings. In both studies, the overall aim was to create a comprehensive understanding of the use situations, and thereby gather data to support the further development and redesign of the currently used clinical IT systems.

The first study, *Dictation Study with Physicians*, had its focus on investigating the procedures of dictation utilising a variety of techniques. The study was carried out in spring 2008 in a large hospital in Finland and involved seven physicians from three hospital units. Of these physicians, two used cassette dictation as their primary method for dictation, whereas three used digital and two voice-recognition techniques [14].

The second study, *Evaluation of Nursing Documentation Systems*, focused on documentation tasks in nursing work and incorporated four system implementations in electronic health record (EHR) systems [15], which were all based on the Finnish national nursing model [16]. The study was conducted in spring 2010 with 18 Finnish nurses who were representatives of seven healthcare organisations.

All of the contextual inquires with physicians and nurses were conducted in real working environments and followed the principles of the contextual inquiry method [12]. In general, the inquiries followed the same structure. The structure and themes for inquiries are presented in Table 1. Each inquiry lasted about one hour and was guided by an experienced usability practitioner. A recorder and a digital camera were used to record interviews for later analysis.

Table 1. The predetermined structure and themes for inquires in two empirical studies.

Phases of inquiry.	Themes in dictation study	Themes in nursing documentation system evaluation
Phase 1: Background Discussion about users' backgrounds and their previous experiences with the clinical IT systems and tool.	- Education and current job description - Information technology skills and enthusiasm - Dictation methods and experiences	- Education and current job description - Information technology skills and enthusiasm - Working history and experiences with nursing documentation techniques - Descriptions of daily work and situations in which documentation is conducted, as well as patient information retrieved
Phase 2: Practical exercise The user is asked to conduct a dictation or documentation entry as they would normally do and, while working, explain and give reasoning for their action.	Description of the situation and surroundings in which documentation is typically conducted. A dictation walkthrough in practice from the beginning till the end using a real patient case: - the beginning of the dictation - dictating, the use of the dictation solution and related IT systems and applications - end of the dictation - approval of transcribed dictation (cassette and digital dictation) - discussion of performed activities	A documentation entry exercise using prewritten patient case scenarios, which included the following: - background of the patient (e.g., age, the reason for coming to the hospital) - what the patient has told the nurse about her condition - description of the conducted nursing activities, including medication given and interaction with related parties - how has the situation evolved during the shift/outcome of the appointment. After the exercise, discussion on performed activities
Phase 3: Summary and futuristic views	Evaluating and discussing mobile phone dictation concepts (prepared concepts illustrated using storyboards)	Discussions on collaborative use of documented data, fluency of documentation, availability and accessibility of the information, and ideas for improvements

4. Experiences with the Contextual Inquiry Method: Advantages and Challenges

Experiences from the described empirical studies showed that the contextual inquiry method has several advantages and challenges when employed in clinical contexts. The experiences and lessons learned are summarised in the following table (Table 2).

Table 2. Summary of methodology findings: Advantages and challenges of applying contextual inquiry.

Advantages
Enables the researchers to make insightful observations, enquire about the clinicians' actions, and identify general and context-specific needs when the studies include numerous healthcare units and organisations.
Addresses the issues of clinical IT system usage from the task and end-user oriented perspectives (versus system-centred evaluation of the usability characteristics of a single clinical IT system). Thereby, the study can include a number of techniques (e.g., for dictation) and diverse systems (e.g., different implementations of nursing documentation systems), which are used to perform similar tasks in various clinical environments.
Makes it possible to analyse clinicians' actions with interactive systems in environments in which numerous systems are used simultaneously and some of those are integrated together.
Provides the researchers with an opportunity to increase their understanding of healthcare technology, as well as medical terminology and working practices.
Can reveal needs and problems in system usage that the clinicians cannot articulate.
Enables the gathering of a large amount of qualitative data. The gathered data can be used for several purposes, e.g., to analyse the success of interaction and user interface design; to describe the contextual issues around healthcare ICT use; to addressed issues of usability from a wide perspective; to determine users' needs and wishes concerning improvements; to support the design of new applications.
Provides concrete data about IT systems' usage in clinical settings: interaction between the user and the systems, effectiveness of use, and communication and information sharing aspects.

Challenges
Requires an access to real healthcare settings and permission to record audio or voice data.
Might be time-consuming to conduct due to its highly qualitative nature.
Requires clinicians' participation. While working in hectic and critical environments, clinicians tend to be busy with customary clinical tasks and unexpected emergencies.
Issues of recording of medical and patient data, as well as patient privacy and health data security aspects, are essential to be considered.
All of the pictures and other recorded data need to be carefully anonymised, at the latest, in the analysis phase.
It is easy to question the representativeness of the data, since the interview studies typically involve a rather small number of users per user group. When the total number of involved users is rather small, how are we to take into account the wide variety of clinical practices and contexts of technology usage?

5. Conclusion

The relatively small number of usability studies conducted in the health informatics domain may derive from the identified challenges in applying user-oriented methods in the health informatics domain. Different from typically applied evaluation methods, contextual inquiry approaches the study issues from the perspective of performing clinical tasks in real environments. Thereby, contextual inquiry may provide valuable support for user-centred design activities. The method enables researchers to approach usability from a broader perspective and reveals results that go beyond what can be

found by a traditional stationary user-interface evaluation. Contextual inquiry is suitable for increasing researchers' understanding of clinical practices, the characteristics and various contexts of clinical work, as well as end-users' interaction with numerous IT systems. Additionally, inquiries conducted in real clinical contexts provide rich qualitative data for the purposes of developing new concepts and visions of future ICT systems. What is more, findings from inquiries indicate direct clinical response and have high descriptive value. Nevertheless, special challenges in clinical settings are related to recording and privacy issues, the wide variety of clinical practices and contexts of technology usage, diversity of clinical applications, heterogeneity of studied user groups, as well as the hectic nature of clinical work.

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