A Mixed-Method Approach for In-Depth Contextual User Research

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Abstract. Successful design requires an in-depth understanding of user behavior. The paper will describe how we applied a mixed-method research approach, which combines a traditional contextual inquiry with a modified diary study, in three different studies. The proposed methodology permits the inclusion of more participants in a larger geographical area, maximizing research resources, and the collection of longitudinal data. A summary of lessons learned from the new hybrid method will be presented.

Keywords: contextual inquiry, diary study, design research, HCI.

1   Introduction

Successful interface design relies upon a multifaceted understanding of users – their behaviors, thoughts, interests, feelings and emotions. The HCI field has proposed several techniques to gather this kind of complex information about users, including contextual inquiry and diary studies. The design of a product intended for a major market can require in-depth research studies with numerous participants and unique use cases across multiple locations and with repeated tasks and interactions. In order to accomplish such studies, we are proposing a mixed approach, which combines a traditional contextual inquiry with a modified diary study.

1.1   Contextual Inquiry

Contextual inquiry is a research methodology that involves researchers observing and interviewing participants in their natural environment. While derived from traditional ethnography, in contextual inquiry the researcher does not seek to integrate seamlessly into the participant culture but instead adopt a collaborative relationship with research participants as Master (participant) and Apprentice (researcher) [1]. Creating this relationship is important for a few reasons: it provides researchers a framework for behavior rather than asking them to follow particular rules for

communication with participants, and it creates a model that naturally draws out relevant information from the participant while enabling learning for the researcher [2]. While a master may not be a natural teacher, by teaching in the context of his or her work, describing actions as they occur, the apprentice learns. The apprentice-master model thus allows participants to talk about their work as it happens, explaining it, rather than the researcher trying to draw out that information from user as in a traditional interview scenario.

As defined by Beyer and Holtzblatt [2], contextual inquiry is based on four principles: context, partnership, interpretation, and focus. Context is critical to the method as it allows the researcher to understand and collect information on the ongoing experience, that is, what is happening now versus what the user may remember or think is important to recount. In a traditional interview, the participant may summarize the experience for the researcher, leaving out critical details and lumping like scenarios together into one abstraction. Contextual inquiry methodology focuses on collecting concrete data, the specific and not general experience. Partnership refers to both to the apprentice-master model and how that relationship between researcher and participant fosters the ability to share and analyze design possibilities in the moment. This interpretation is a key benefit of using contextual inquiry, as it allows the researcher to test assumptions in the exact moment the user is completing a task. The user should then be able to modify the idea as he or she can compare it directly to the current state. Finally, the principle of focus, while important for all research activities, is critical for contextual inquiry because of the undefined nature of user's environment. The interviewer needs to know and be cognizant of the goals of the session and be able to guide the conversation in a productive direction. As such, the interviewer should prepare a moderator guide with a list of questions that can prompt the participant and structure the interview [14].

Contextual inquiry is best used for understanding how specific environmental factors influence or impact user behavior [6]. While a qualitative method, contextual inquiry mitigates some of the problems inherent in user interviews because it gives researchers a fuller picture of the user experience and grounds insights in reality – what users actually do and not simply what they say they do. One downside of the methodology is that it only accounts for one slice in time of the user experience. Researchers may miss critical activities, challenges, or behaviors if they are not present during a specific time. Additionally, contextual inquiry may be seen as lacking rigor as it takes place in an uncontrolled environment and relies heavily on the subjective interpretation of the researcher of anecdotal data [15].

1.2   Diary Study

Diary study is a research method in which participants self-log their activities over a discrete period of time [20, 9]. Participants are asked to describe their activities, user needs, context information and thoughts on a daily basis, either at the end of the day or as soon as the activity of interest has occurred. Since the diary entries portray relatively recent events, participants usually provide a rich summary of their thoughts, feelings and reflections on the logged activities [7, 18]. Diary studies that monitor

data collection allow researchers to both encourage participants to complete their required log as well as expand or clarify on their entries. The diary method is particularly useful because it requires minimal research resources while at the same time capturing contextual and user-submitted data. This method is commonly used for understanding behavior, predicting behavior or guiding product design [4, 3, 15].

A key advantage of a diary study is that participants' entries are recorded directly after an activity is performed, minimizing demands on memory usually present in regular interviews or surveys [19]. Having participants record information immediately reduces common effects of recall such as saliency and recency. Diary methods also help diminish aggregation errors. Aggregation errors are observed in survey and interview responses, when participants are asked to estimate the frequency in which they perform a particular activity. The logging of such activities over a period of time allows for a direct frequency count rather than asking for a frequency estimate. This decrease in response bias increases the ecological validity of the study [18].

The main drawback of diary studies is that they rely on participant cooperation, which can diminish over time as logging data can be tedious or time-consuming [7]. The importance of engaging participants throughout the process makes a proper study design even more critical. Diary designs can vary from simple entries with free format and a date stamp to involved questionnaires with branching logic [19]. A good balance is needed between collecting a lot of data and not overwhelming participants in order to reduce attrition rates.

1.3   Mixed Method Approach

Traditionally, a contextual inquiry and diary study are considered two separate methodologies. The authors propose and have tested a technique wherein the two methods are combined into one comprehensive study. The benefits of such an approach are obvious: the limitations of each method are complemented by the strength in the other. For example, contextual inquiry lacks a longitudinal focus that can be compensated for by a diary study. A diary study also helps sharpens the qualitative data collected in a contextual inquiry by providing information directly submitted by users, without being filtered through the lens of a researcher. On the other hand, contextual inquiry balances out the raw, unfiltered view of user-submitted data and allows researchers to begin to understand a user's actual world instead of a simple description of it.

Other researchers have utilized a mixed-method approach to understanding the holistic user experience with a type of product or life event. Müller, Gove, and Webb used a combination of written and video diaries, in-home interviews, and contextual inquiry to understand the primary and secondary activities users perform on tablet devices, as well as common locations and times of day tablets are used [11]. The range of data collected- both longitudinal, user-generated, and researcher-observed- gave the team a fuller view on the role tablets play in users lives and allowed them to provide guidance on key areas of focus for website and app developers when designing for the tablet experience.

Leedy and Downes-Le Guin [10] used a similar approach when studying one very specific experience: how men select engagement rings and think about the betrothal process. The research team asked participants to complete pre- and post-visit surveys and conducted a contextual inquiry. In this case the surveys acted as a type of diary study, without the longitudinal component, as they provided user-submitted data and allowed users to document their own reflections on the experience.

2   Study

2.1   Method

Following is a description of the mixed method approach employed in three studies on telework technologies, audio listening behavior and HR resources and tools. The telework technologies study investigated how workers use telepresence technology – what works and what doesn't – as well as formulating a strategy based on user needs for new solutions for the future. The listening behavior study examined different population segments and their behaviors around collecting, listening to and sharing audio content. The HR resources and tools study researched the environment in which HR personnel perform their jobs and what tools and resources they use and need. The approach did not vary and will be summarized once. The description is followed by the methodological results from all studies and will detail result characteristics that can be obtained when applying this mixed method approach.

2.2   Participants

Each study had unique requirements for participation based on the goals of the study. In general, participants needed to be willing and able to let researchers observe them in a variety of scenarios and environments. This can be an issue in contextual inquiry especially when potential participants deal with sensitive information in their work or have concern about allowing a research team to visit them in their office environment. Participants also needed to be tech-savvy enough to use the remote diary study tools, including online surveys and a mobile app, and take digital photos. In the case where participants did not have a smartphone, an online option was always provided as an alternative.

The first study – telework technologies study – involved (24) professionals from four major US cities who either conducted work remotely (in their homes or other locations) or who communicated with remote coworkers (or a combination thereof). In order to observe and document a range of experiences, participants were selected who used technologies including but not limited to phone calls, including conference call systems, videoconference tools like Skype or GoToMeeting, screen-sharing applications like JoinMe, and in-office based telepresence systems.

For the audio listening behavior study (40) participants from three major US cities were recruited based on specific criteria related to the needs to the study, including frequency of audio listening and devices and technology used. In order to screen participants more thoroughly, the client created a battery of questions included as part

of recruitment that segmented the participants per pre-defined market research categories.

The HR resources and tools study involved (24) participants, all of whom work for a central organization at unique sites, in four geographic locations around the US. Each participant had the same role in their organization, managing benefits and HR tasks, but had slightly different duties depending on the needs of their specific organization.

2.3   Procedure

Contextual Inquiry. The contextual inquiry complements the longitudinal diary study component of the study by providing an in-depth snapshot into the daily activities of a participant. The goal of the in-person method is to understand specific user behavior as it relates to his or her environment.

Researchers visited participants on-site (at a location that made sense for particular study objectives). Sample locations included: a participant's home, a coffee shop, and an office. While just one participant was recruited for the in-person interview, in some instances related individuals were interviewed "on the spot" in context to the study subject (e.g. a colleague or roommate).

The research sessions, as defined by the contextual inquiry methodology, included elements of observation of user behavior and directly interviewing participants, either prompting them to teach or "show and tell" a particular environment or task or through pre-defined questions brought into shape the interview.

During observation, researchers focused on documenting the following types of activities:

- User tasks performed - specifically noticing any "workarounds" or challenges
- Tools used and materials, artifacts, or other individuals referenced or consulted
- Interactions, both impromptu and scheduled, between participants and other individuals
- Environment, including physical model and space set-up and technology/devices

A team of two researchers attended each session; one led the session and guided the interview, while the second researcher took notes, ran the video camera, and took relevant photos.

Diary Study. The diary study is a longitudinal journal that helps capture a day in the life of participants, track their routine tasks and situations and identify resources used, both on a regular or less frequent basis.

The diary study began with a remote briefing session using web video technology to ensure participants fully understand the type of information desired and when to input an entry, as well as a walkthrough of the different technologies that will be used for the study. This instructional briefing was given 1-to-3 days before data collection began. In addition, participants were emailed a detailed manual with instructions related to the study and the technologies they would be using.

The actual data collection was both signal contingent, meaning a signaling device was used to prompt the participants to make an entry in their journal, and event contingent, where participants were asked to record a journal entry each time a specific event occurred. The signal contingent tools included calendar reminders, text messages, and emails to prompt participants to record data. Event contingent tools included note-sharing applications with image capability [12], web-based surveys [16, 17], and a mobile app documentation tool [8].

The data entry portion used a semi-structured design, which included both closed- and open-ended questions. Closed-ended questions were included to ensure consistency in response and increase validity and reliability. Open-ended questions were included to elicit personal thoughts and experiences. Entries were designed to be as simple and concise as possible to encourage voluntary logging. Participants reported on their day-to-day activities including:

- Resources that they use as part of the monitored activity
- Image captures of their workspace, documents, screen shots of websites or application, tools (hardware, artifacts) used
- Thoughts, feelings, emotions and issues encountered

All participants were constantly monitored. Ad hoc surveys were sent to ask specific questions about participant's entries and any issues they raised regarding user behavior, problems, and needs. Participants responded with more detail. At the end of the longitudinal portion, the researcher interviewed a group of participants individually for an in-depth debrief.

Mixed Method. The data collection concluded with a final remote video-based debriefing session with participants from both the contextual inquiries and diary studies. This "focus group style" session encouraged participants to interact with one another and allowed researchers to direct the conversation toward global themes and solutions. Examples of items discussed are:

- Typical and atypical situations that occurred for participants
- Resources and tools that participants use and how they use them
- Group brainstorm of ideas for solving challenges common to the group

2.4   Methodological Results

Many of the types of results expected to be found from contextual inquiry also occur in the mixed-methods approach, including work models, physical models, and artifact models. These models are a way to explain the user behavior in one, visual representation. A work model depicts the structure of the participant's activity. The physical model illustrates the physical environment related to the activity. The artifact model shows both physical and electronic objects that are used or created by the user [5]. For all three studies, different models were created to express different pieces of the environment or system that impact user behavior.

The additional longitudinal data gathered in the diary study methodology also allows researchers to create in-depth personas describing user characteristics as well as supporting storyboards that reflect how a particular persona behaves over the course of a set period of time. A persona is a description of a typical user based on the composite of several users with similar behaviors, interests and user needs. Each persona, given a fictional name and demographic information, describes the needs and tasks this user has in relation to the research area and to their physical, social and technological environment [13].

The combination of overall system/environmental understanding, created by the models, combined with the in-depth insight into specific user behavior as defined by the personas provides a holistic view of challenges and gaps. This knowledge can lead to concepts addressing both existing problems as well as the development of new products or services.

3   Discussion

In general, the studies to which the mixed methodological approach was applied had successful outcomes, as the research objectives were achieved. As with any study that involves a large number of participants in multiple locations, as well as both in-person and remote activities, coordination and management is challenging. However, the benefits of combining the diary study component with the contextual inquiry outweigh the additional time and resources needed. Understanding the user perspective through their direct entries not only provides more information about participants, but also allows for another touch point between the research team and user, making it easier for researchers to ask follow-up questions or receive clarity about an experience. Additionally, having more information about participant behavior over time accounted for behaviors that were not seen during the contextual inquiry session. For example, how a specific piece of technology malfunctioning impacted a participant workflow or how the experience of going to a concert with a friend affected future music listening choices. The debrief sessions at the end of the study were critical for linking the in-person research experience with the diary study entries, giving researchers the opportunity to co-design with not just a single participant, but with a group. This group dynamic was important for allowing participants to build off one another's idea and compare and share experiences.

The authors hope that this approach can be improved upon and refined in future studies. Opportunities exist to add in more efficiency to the study protocols and for ensuring more consistency between types of participant responses to allow for more direct comparison.

3.1   Lessons Learned

Experience with using this mixed-method approach in three different studies taught us several lessons.

Contextual Inquiry. First, proper recruitment of participants is vital for the contextual inquiry portion. The carrying out of the contextual inquiry process involves many man-hours (scheduling, traveling, meeting). Due to this investment, it is of critical importance to ensure participants fit the correct behavioral and demographic profile for the study. Our second study – the audio listening behavior study – required a very specific segmentation of the target population. On a couple of occasions we had to eliminate participants because they did not fit the intended segment.

Second, semi-structured interviews should be the norm with some allowance of new ideas to be brought up. A moderator guide with standard questions will ensure that at least some common questions are addressed to the group of participants as a whole. Permitting the flow of new ideas allowed the researchers to learn of new perspectives that were not initially considered. These new ideas were integrated in later interviews and the diary study to confirm their relevance.

Third, visual recordings of the participant's environment are extremely helpful. Even if participants are requested to take photos as part of the diary exercise, taking additional photos and creating sketches of the environment during the contextual inquiry can be very useful. In many instances, the participants took more detailed focused photographs of the artifacts, while the researcher took more comprehensive photographs of the user's environment.

Diary Study. First, make several types of logging artifacts available. Our first study – the telework technologies study – required the use of a specific note-sharing application. The target population for this study was extremely tech-savvy and didn't have problems learning to use the application. In fact, some already were already expert users. This wasn't the case for the other two studies. The audio listening behavior study had a target population that was mobile and required a logging artifact that allowed data entry on the go. For this study we initially decided to use a smart phone app that would capture images and text. We soon discovered that not all participants had access to a smart phone. Thus, we provided an online option that could be accessed via a 'non-smart' phone or computer. The third study – the HR resources and tools study – had a target population with varying degrees of technological sophistication. In this case, we utilized an online survey that was both user-friendly and accessible from any device.

Second, an initial briefing is paramount before data collection starts. This purpose for this briefing is twofold. First, it helps participants understand the areas of interest that they should log. Entry examples are provided to illustrate this point. Second, it helps participant become comfortable with the logging technology to use. A walkthrough is performed and simple instructional manual is given.

A third lesson is the importance of personal interactions. Researchers would send out friendly reminders for participants to log their entries. In addition, diary entries were closely monitored. If the participant hadn't entered data by the end of the day, the researcher would nudge him/her to do so. The close monitoring also prompted researchers to dive deeper or ask clarification about a particular point or entry. The researcher then reached out the participant via email or a short ad hoc survey.

A fourth lesson is to start participants in waves. Different start days allow enough time to schedule initial briefings and to monitor data. Not all participants should start on the same day. It takes a participant at least a day to get comfortable with entering data and clarification requests are most common at the beginning.

A fifth lesson is flexibility. The researcher must be willing and able to interact with participants at their convenience.

A final lesson refers to data interpretation and coding. This is a resource intensive process. Every entry needs to be read and analyzed. In the case of multiple researchers, an agreement should be reached beforehand on how to approach this analysis to maintain a high inter-rater reliability.

Mixed Method. First, select a representative sample of participants for the focus-group debrief. Including – and specifically scheduling – all participants will be impossible. Since the debrief will be using remote technologies a smaller size than a regular focus group is recommended, approximately 6 to 8 participants.

Second, use a structured interview that will guide discussion to pinpoint areas of interest. Participants in remote sessions tend to lose interest more quickly than in-person sessions. If a participant starts dominating the discussion or taking it in a different direction, others will get easily distracted and not participate. Incorporating activities as part of the debrief, such as asking participants to note in a viewable shared document all the tools they use for their job, is helpful in soliciting and maintaining participant attention.

3.2   Limitations

As with any qualitative study, this mixed- method approach is subjective in nature and cannot be used to derive certainties. Additionally, the combination of contextual inquiry with a diary study is more time and resource intensive and requires additional collaboration between research team members to ensure data is being collected and interpreted in a standardized fashion.

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