The use of ethnography in computer science research: a systematic literature review

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The use of ethnography in computer science research: a systematic literature review

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ABSTRACT

Ethnography is a qualitative research method frequently used in social science. We performed a Systematic Literature Review to know better its use in Computer Science research. We selected 273 papers published at ACM Digital Library in 2015 and 2016, and extracted information about their research goals, characteristics of the samples, investigation period, data collection and data analysis procedures. The main contribution of this work is to provide researchers with a pragmatic understanding of the method, presenting references for specific situations such as small samples, studies that applied specific types of ethnography or used research instruments different from observation and interview.

KEYWORDS: Ethnography. Systematic Literature Review. Qualitative research method.

INTRODUCTION

Computer science is an exact science, and as so, research in this area is usually associated with quantitative methods. In its turn, ethnography is a qualitative research method, used mainly by social, human and health sciences. Although some authors state that ethnography is not widely used in the area of computer science, the search for the term ethnograph* (that is, ethnography and other related terms such as ethnographic or ethnographer) in the most important digital libraries in the field of computer science returned, in September 2016, about 1,700 articles published from 2015.

This result indicates that computer science researchers are recognizing the contributions of research methods from humanities and the possibilities of applying them in many computer science studies. Ethnography is particularly important for a research that aims contextual analysis to better understand the relationship of people with technology, as occurs in many computer science fields such as human-computer interaction, games and computers in education. However, how is this method used in the computer science context? To answer this question, a Systematic Literature Review (SLR) was performed, searching for the term ethnograp*.

The initial search returned 1063 articles. After applying the defined search filters and exclusion and inclusion criteria, the number of articles was reduced to 273. From the analysis of these articles, it was possible to extract information about: the research goals, characteristics of the samples, the investigation period, the activities developed, the procedures applied for data collection and data analysis, and the areas of computer science where the method was applied.

Thus, the main objective of this article is to present the results of a SLR, which can help computer science researchers understand some methodological decisions taken in previous ethnographical studies.

This article is organized as follows. Section 2 covers an overview of the ethnographic research method. Section 3 presents details about the systematic literature review conducted. Section 4 presents a summary of the search results and highlights some answers to the research questions. Section 5 discusses the obtained results, and, finally, Section 6 brings the main conclusions about the results obtained.

Ethnography

The traditional conception of an ethnographic study came from anthropology (CRESWELL, 2002), and it was developed under the tide comparison with another important anthropological concept, which is the ethnology. For one hand, ethnology was the scaffolding of anthropology research, based on the results of report from expeditions and missions to discover new lands. Lately the pure ethnology practice has expands itself, because it was not possible a full description of the conquered lands without establishing a correlation between the territorial field with the local agents. Then, ethnography became a theoretical methodological approach where the empirical investigation meets the comparative analysis with a level of balance to increase the reliability of qualitative research as reported by (HAMMERSLEY; ATKINSON, 2007).

An ethnographic study is concerned about a qualitative project where the researchers tried to define the similarities and/or the differences in a community or a large group of individuals (HAMMERSLEY; ATKINSON, 2007). Following this perspective, in an ethnographic study the researchers will be focusing in to get a deeply understanding about the values, beliefs, behaviors and the language shared by an entire community or a group of people. Such detailed level of understanding regarding the cultural domain depends on field research based in intensive and extended data collection activities.

In order to provide researchers with the conditions to get information, traditional ethnographic studies are developed by using qualitative research tools, such as: narratives, diaries, interviews, surveys and observation notes. Then, observation is only one among many others instruments to support data collection, which will provide researchers with information to develop a description of a community or group. It is also very common that researchers conduct interviews with many community's members or use surveys or diaries as a way to increase the information to seek for behavior, cognitive or cultural pattern clues that will be used to explain the individual aspects as well as the community dynamic.

Nowadays, ethnography has been used in many different research domains beyond the anthropology, which includes technology, psychology, education, medicine, marketing, engineering and design. In fact, ethnography will always fit in studies where people plays a key role in the expected outcomes. Indeed, research where people can not be considered as an inseparable element of the research context or the artifact developed.

Because of the relevance of the human factors issues as well as the impacts of software and hardware inside organizations and into different user communities, it became clear the significance of applying ethnography beyond the traditional human and social research domains (e.g., arts, languages, religion, sociology). Thus, the use of traditional ethnography has become a relevant inspiration for many kinds of projects regarding public interventions and interactions projects. It is interesting to observe how traditional ethnographic approaches have been used to inspire new research domains such as the Urban Computing.

METHOD

We conducted a systematic literature review in order to identify how computer science research is using ethnography. The activities followed the guidelines proposed by (KITCHENHAM, 2007). Considering that data collection and analysis are two important steps in conducting an ethnography (CRESWELL, 2002), we defined one main research question and six secondary questions. The fourth secondary question has one specific question, as follows:

RQ 1 How is ethnography used in computer science research?

RQ 1.1 What were the objectives of these studies?

RQ 1.2 What were the characteristics of the selected samples?

RQ 1.3 How long did the data collection last?

RQ 1.4 Which were the data collection procedures?

SQ 1.4.1 Which were the data collection instruments adopted?

RQ 1.5 Which were the data analysis procedures?

RQ 1.6 Which areas of computer science already used ethnography?

The major search term was ethnography and related words to the topic, such as ethnographer and ethnographic. Initially, we were planning to search this term in the title, abstract and keywords of articles published in three important bases in the field of Computer Science: the digital library of the Association for Computing Machinery (ACM), the digital library of the Institute of Electrical and Electronics Engineers (IEEE) and Science Direct. After an extraction pilot session, we detected a problem with this strategy – we found out that the search did not return all known primary studies, because not all the articles used the term ethnography in the fields that we had chosen. Thus, we decided to look for the search term in full texts. However, the number of articles returned was unworkable: in a period of five years, we got 2686 articles from ACM, 196 from IEEE and 517 from Science Direct. Therefore, we decided to narrow the search to the digital library of ACM, because it is the world's largest scientific computing society. Besides, we considered only two years – 2015 and 2016 – which resulted in 1063 articles to be analyzed. Considering the query syntax of ACM, the search term was ethnograp* and it was searched in all text. It is important to point out that the search was restricted to primary studies, that is, we did not consider the references of the selected articles to search for additional articles about the subject.

The inclusion criteria were: the article must be written in English, ethnography is explicitly mentioned as a research method adopted, and the article presents details of the research methodological planning.

The exclusion criteria were: duplicate article (when similar articles were published in more than one source, it was considered the most recent or most complete) and articles not related to computer science. After narrowing our searches to ACM Digital Library, we disregarded the second exclusion criteria, since all articles from that library are related to computer science.

Each article was reviewed by one of the seven researchers, who are also the authors of this paper. Doubts were solved by discussions involving all research group during face-to-face or virtual meetings. One of the researchers randomly checked some of the articles included and excluded. A list of excluded articles was retained for future retrieval, if necessary.

All selected articles are peer-reviewed, because they belong to the ACM digital library. So, the only quality criterion that we included was that the article should answer to at least four of the six research questions.

Data were extracted from the following sections of the articles: abstract, introduction and the sections that addressed the research method.

RESULTS

The SLR planning began in August 2016. In September 2016, we retrieved articles published in 2015 and 2016, in ACM Digital Library. In January 2017, we sought for articles published by ACM from September 2016 to December 2016. In total, 1063 articles were extracted. As we retrieved them solely from ACM Digital Libraries, there were no duplicates to be removed.

After reading the title of these 1063 articles, 985 were selected. From these, considering the inclusion and exclusion criteria, 629 were discarded because they did not clearly claim the use of ethnography, 2 because they were written in French and 81 because they did not answer at least four of the research question. Finally, 273 papers were selected for analysis in order to answer the questions raised in this study.

There is no general answer to the main research question. Its answer is the result of gathering all the answers to the secondary questions. In the following subsections, we present the answers to our research questions.

WHAT WERE THE OBJECTIVES OF THE SELECTED STUDIES?

72 articles (26%) had the objective of understanding something. For instance, Aranda, Ali-Hasan and Baig (2016) used ethnography to "understand how people experience smartphone notifications", and Snow and Vyas (2015) sought to understand "the context of use and elicit some requirements for design".

The second most frequent verb was "explore" (43 articles), as in a "case study exploring the social scene created on a newly developed online service for increasing the study motivation of 16-18 year-old students in vocational education in Finland" (MARTINVIITA; KUURE; LUOMA, 2015).

"Investigate", "describe" and "discuss" are also verbs frequently used in the objectives. For example, Knobelsdorf and Frede (2016) investigated "how undergraduate CS majors solved assignments from a Theory of Computation (ToC) course in individually-formed study groups", Clarke (2015) aimed to "describe the local practices used to build up and deploy segments of users as a feature of a digital workplace while orienting to customer issue". It is worth highlighting the study of Mancini et al. (2016), as the authors "discuss the importance of interaction design principles to achieve good usability and user experience", from a canine perspective.

WHAT WERE THE CHARACTERISTICS OF THE SELECTED SAMPLES?

Regarding the precision of the data information, 12% of the selected studies did not provide clear information about the samples reported in the research, and in 3% of these, sample data was considered not accurate, since the authors stated that groups of individuals participated in the study, however they did not specify, for example, the number of individuals in each group, as in (RAPTIS; KJELDSKOV; SKOV, 2016).

Regarding the samples sizes, it was identified that only 2% of the samples were related with only one individual, which was the lead researcher involved in an auto-ethnographic study, such as in (MUELLER; PELL, 2016). Most of the studies (64%) were related with samples up to 50 individuals. The percent of samples between 50 and 150 individuals were around 13%, which is considered a high number of participants to an ethnographic study. Even so, it was observed 5% of samples with more than 150 individuals and from these, 2% of samples with more than 1000 individuals such as in (MORRISON et al., 2016).

Concerning the sampling by type of subjects, most studies (84%) reported as sample, individuals or groups composed of a highly variety of participants, such as students and professionals from many different domains. We also observed many studies which had data collected from interactions logs, records of interaction involving animals, objects, buildings, scenarios and electronically devices (6%), such as in (ASPLING; JUHLIN; CHIODO, 2015). Other samples were composed by many types of document sources, including historical letters, encyclopedias, architectural plans, posts (in blogs, social networks and web pages), logs from online platforms and from software modules, such as in (BALESTRINI et al., 2016).

These results are a relevant demonstration of ethnography flexibility, confirming its reliable fits for research beyond humanities and social research domains.

HOW LONG DID THE DATA COLLECTION LAST?

Different periods were dedicated to the ethnographic study in the reviewed articles, ranging from less than a day, as in (KAZIUNAS et al., 2015), to more than 3 years, as in (BENNETT; HINDER; CATER, 2016). Table 1 summarizes these results.

Table 1 - Data collection period

Period	Number of articles
Less than 1 day	10
From one day and up to a week	16
From 8 days up to a month	25
More than one and less than 6 months	43
From six to 12 months	28
More than one year	45

Source: Authors

As can be seen, there are 51 articles in which the ethnographic studies took no more than one month, whereas in 116 articles the period ranged from one month to more than three years. This shows that ethnographic studies usually take long periods of research, including the preparation and definition of the activity, the accomplishment of these activities and subsequent analysis of the results obtained.

It is worth to mention that in 78 articles the ethnographic studies used different data collection methodologies, from different activities types, which are described in the form of many and different time periods, such as days or weeks,

without clearly delimiting the duration of each period. In other cases, these periods present overlapped dates between different activities, with different duration. Thus, it was not possible to clearly calculate the total period of time in which the data collection were carried out in these articles, such as in (BOULUS-RØDJE; BJORN, 2015).

WHICH WERE THE DATA COLLECTION PROCEDURES?

As expected, the most used research instruments were interview and observation.

Considering the selected articles, the most used interview protocol was the semi-structured. Some authors opted to conduct two types of interviews – semi-structured and unstructured, for example (THERIAS; BIRD; MARSHALL, 2015). Unstructured interviews were the only choice of (REDAELLI; CARASSA, 2015).

One study that used structured interview is (WOLTERS et al., 2015) which, according to the authors, "had been designed to be easy to follow for people with and without cognitive impairment". However, they inform that "participants with dementia were additionally debriefed during an informal interview".

Ethnography is directly related to field research, and, as so, one of the most important research tools is observation. For better analysis of the collected data, the observation period is recorded in field notes and also in films, photographs and voice recording. Field notes can consider diverse aspects, besides the speech, such as facial expression, gestures, movements of the body, as well as the moment in which each one of these aspects occurred, for better synchronization between the annotations and the recordings (SADIK, 2015).

Using digital resources, the observations need not be on-site. Data on participants' behavior and actions can also be obtained from log files (trace ethnography), diaries (BOGERS et al., 2016), social networks and virtual community posts (WAYCOTT et al., 2016). As all participants of the research conducted by (FEDOSOV et al., 2015) "owned a smartphone and routinely used it on a daily basis", they could record sessions for later analysis. Lee, Lim and Lee (2016) provided participants with wearable cameras. In cases such as these, there was a concern with the participants' privacy who were allowed to stop the recording whenever wanted.

Data can also be captured by sensors. For example, Giaccardi et al. (2016) equipped some objects "with small logging cameras called Autographers", which "provided detailed information about the use patterns of particular objects and their trajectories throughout space and time, as well as data on parallel activities and objects".

Sometimes, the observation period of each participant is short, for example, 60 to 90 minutes (ICHINO et al., 2016) or 2-4 hours (TANG et al., 2015). Others, a little longer. (JOHRI, 2016) stated having spent 5-8 hours at the research site on all week days and on some weekends.

Ciolfi and Petrelli (2015) adopted the approach of field walks, which "consist of conversations while moving along a path, documented as connected instances of conduct". In that approach, "the researcher documents practices as they occur

in-situ, thus noting the relationship between certain themes of the conversation and elements of the space and of the walk itself".

Besides, the activities of an ethnographic research need not be limited to those formally planned. For example, participants can interact regularly with the researcher and share everyday messages (JONES; PAL, 2015), by email, applications or by phone (WAYCOTT et al., 2016).

A key part of an ethnographic study is to develop "vulgar competence": "in order to understand the practices of participants/members, one must first become a member" (MCGRATH; CHAMBERLAIN; BENFORD, 2016). For this, Pritchard; Vines and Olivier (2015) "spent many hours riding bus routes". They also stated that they "spent time around bus garages and depots talking to this occupational group on an informal and serendipitous basis". In the study of (AHMED et al., 2016), one of the researchers "spent time learning to repair mobile phones at a training center operated by a senior repairer". As claimed by the authors, "this allowed him to be deeply engaged with the community and learn the norms and values associated with mobile device repairing". Asad and Dantec (2015) participated in organization meetings and protest events, attended major actions, such as marches, court auctions, and press events.

Some authors explained how they conducted the process of building rapport, which is about establishing a relationship of trust and mutual respect. In the work of (THERIAS; BIRD; MARSHALL, 2015), "the researcher was presented to the teachers and students as a classroom assistant, there to observe and assist if needed". In (SOBEL; O'LEARY; KIENTZ, 2015), "the lead researcher volunteered as a teachers' assistant, helping in the classroom for approximately 70 hours over eight months". Crabtree et al. (2015) mentioned trust building based on numerous meetings or regular visits to the target audience. Sun et al. (2015) established rapport "by engaging with the members" of several online forums and "subsequently being invited to a series of offline gatherings and events".

Ethnography can also be combined with other activities, such as user tests (ROCHA; BESSA; CABRAL, 2016), Action Research (LUDWIG; REUTER; PIPEK, 2015), and participatory design (GILES, E.; van der LINDEN, 2015).

In addition, other adopted approaches were: visual ethnography, autoethnography, online ethnography, rapid ethnography, critical ethnography.

Visual ethnography can "address multimedia digital objects in the web browser" (LUPFER et al., 2016).

Autoethnography is derived from the active participation of the researcher. Rapp (2016) claims that in autoethnography, "the ethnographer's point of view is considered valuable on its own, being continuously reported in the ethnographic recounting".

Martinviita, Kuure and Luoma (2015) used the term online ethnography for their method, because all the data collected was obtained from a community page. Online ethnography is also known as digital or virtual ethnography.

Raptis, Kjeldskov and Skov (2016) chose digital ethnography, because "the Internet is widely used by people to voice their opinions on technology and/or ask for help", and as so, they "decided that an online study of web posts,

discussion forum posts, and blog posts would be a suitable methodological approach".

Rapid ethnography "is characterised by the use of multiple methods to gather a rich set of data in a short period" (THERIAS; BIRD; MARSHALL, 2015). For example, Balestrini et al. (2016) adopted rapid ethnography approach, over a two-week period, conducting "18 hours of direct observation at six of the most salient places in the city".

In (TOOMBS; BARDZELL; BARDZELL, 2015), "the ethnography was conducted through the critical ethnographic approach", "which includes a specialized set of empirically validated tools that enable the researcher to reconstruct qualitative data to explore meaning within illocutionary spaces".

Gheitasy, Abdelnour-Nocera, and Bonnie Nardi (2015) proposed a new combined methodological framework that they called predictive ethnography. "In this framework, online ethnography complements predictive evaluation with the aid of heuristics that serve as metrics to investigate the issues" in a community. "These heuristics identified in previous research as success factors for online communities include sociability, usability, and user experience items".

WHICH WERE THE DATA ANALYSIS PROCEDURES?

Concerning the methods used in the analysis of the data collected, the grounded theory was the most used, being cited in 43 articles, such as in (CORNEJO et al., 2016).

The thematic analysis approach was the second most used method, applied in the data analysis of 33 articles, such as in (MAO et al., 2016).

Some articles used more than one method for analyzing different types of data. Avni (2015) used the Philipsen's Speech Code to analyze visual communication codes, while Carey´s Ritual Communication Theory was used for non-verbal communications. Barbarin, Veinot and Klasnja (2015) used grounded theory for analysis of interview transcripts and visual analysis for photographs. Lee, Lim and Lee (2016) used the grounded theory and another method referred to as Delphi Method. In (RAPTIS; KJELDSKOV; SKOV, 2016), the grounded theory was used in combination with "Affinity Diagramming".

It is worth to mention that in 92 articles, the main steps of the data analysis was described, but no specific method was explicitly stated. Besides, in 11 articles the authors merely stated that their study used ethnographic methods for data analysis, but did not detail the methods or the way they were used.

WHICH AREAS OF COMPUTER SCIENCE ALREADY USED ETHNOGRAPHY?

The ACM category Information Interfaces and Presentation appear respectively in 114 articles selected in the SLR process.

The selected articles were published in 78 different conferences and in eight different journals. The five most frequent conferences are stand out in Table 2.

Among the conferences that cover more open or different topics from human-computer interaction are: Decennial Aarhus Conference on Critical

Alternatives, International Symposium on Software and Systems Traceability, International Conference on Computer Systems and Technologies, Workshop on Information Sharing and Collaborative Security, and Annual Meeting: Creating Knowledge, Enhancing Lives Through Information & Technology.

Table 2 - Most frequent conferences

Conference	Number of articles
Human Factors in Computing Systems	70
Computer-Supported Cooperative Work & Social Computing	44
Information and Communication Technologies and Development	14
Human Computer Interaction	10
Designing Interactive Systems	9

Source: Authors

The eight journals that have published one or more of the selected articles are: ACM Transactions on Computer-Human Interaction, ACM Transactions on Interactive Intelligent Systems, Communication Design Quarterly Review, Computers in Entertainment, Interactions, Journal of Usability Studies, Personal and Ubiquitous Computing, ACM SIGCAS Computers and Society. As can be seen, most of them are in the field of human-computer interaction.

DISCUSSION

Most of the selected articles had emphasis in human-computer interactions. From the objectives of the articles, it was found that ethnographic research is used in several areas that use computers to improve human quality of life, such education, health and entertainment. However, the concentration of more than 50% of the articles in four conferences suggests the need to broaden the use of Ethnography to more different computer science fields.

In terms of participants in samples, it was possible to observe a highly variety of personal characteristics (such as ages, genre, education level, cultural heritage, social streams and health conditions) as well as professional backgrounds (e.g., academic, industrial, commerce, technology, political). This confirms the need of studying the applications of computers for different publics. The most interesting aspect to highlight regarding the sampling was the possibility to deal with samples composed by not only human individuals, but also animals, objects, electronic devices, buildings, as well as to settled samples based in posts in online social networks, forums, blogs, platforms and interactions logs of module software.

Also concerning the participants of a study, it is not considered a flaw calling only acquaintances of the researchers. On the contrary, it is a common practice, due to the need of rapport.

Different periods were dedicated to the ethnographic study in the selected articles, ranging from less than a day to more than 3 years. In many studies the data collection period was longer than 12 months. This confirms that many ethnographic studies demand long periods of research, including the preparation

and definition of the activity, the accomplishment of these activities and subsequent analysis of the obtained results. Alternatively, some authors applied a rapid ethnography, to justify a short period of time for data collection.

Regarding data collection, as expected, the most used research instruments were observation and interviews. However other tools and data sources were also used, including diaries, focus group, questionnaires, workshops, videos and posts. With respect to the methods used to analyze the data collected, grounded theory and the thematic analysis approach stand out as the most used by the authors.

CONCLUSIONS

This article provides a detailed survey of the studies which used an ethnographic approach and were published by ACM in 2015 and 2016. 273 articles were selected and analyzed to provide a set of information to other researchers who want to become acquainted to the use of Ethnography in Computer Science research. The SLR results show the use of ethnography mainly in studies that aim at understanding and exploring aspects mainly related to human interaction with computing. One problem of our method is that we only considered studies that explicitly stated having used Ethnography. So, there were some discarded studies that have many characteristics of an ethnographic study. The other problem is that as we restricted our search to the ACM digital library, we narrowed our answers to ACM fields of interests.

A positive contribution of this article is that it shows that despite of what some authors state, there is not a minimum period or sample size to conduct an ethnographic study. The most important is to have a rigorous methodological plan. We have been careful to cite some references in the text so that the reader knows where to look for specific cases. For example, which study used small sample, which was based on rapid ethnography, which publications have accepted computer articles about studies that have used ethnography.

We also highlight the opportunity for the computer science community to have more contact with a research method well-known to other scientific communities. It is interesting to observe the use of ethnography with different participants, such as animals, or in different contexts, such as the Urban Computing.

Using Ethnography, we can produce relevant multidisciplinary research including social aspects related with the use of technology.

For future work, we suggest to do the search in other sources in order to find more possibilities to apply Ethnography in other computer science areas.

O uso da etnografia na pesquisa em ciência da computação: uma revisão sistemática da literatura

ABSTRACT

A etnografia é um método de pesquisa qualitativa freqüentemente usado em ciências sociais. Realizamos uma Revisão Sistemática da Literatura para conhecer melhor seu uso na pesquisa em Ciência da Computação. Foram selecionados 273 artigos publicados na Biblioteca Digital ACM em 2015 e 2016, e extraídos informações sobre seus objetivos de pesquisa, características das amostras, período de investigação, coleta de dados e procedimentos de análise de dados. A principal contribuição deste trabalho é fornecer aos pesquisadores uma compreensão pragmática do método, apresentando referências para situações específicas, como amostras pequenas, estudos que aplicaram tipos específicos de etnografia ou utilizaram instrumentos de pesquisa diferentes de observação e entrevista.

KEYWORDS: Etnografia. Revisão Sistemática da Literatura. Método de pesquisa qualitativa.

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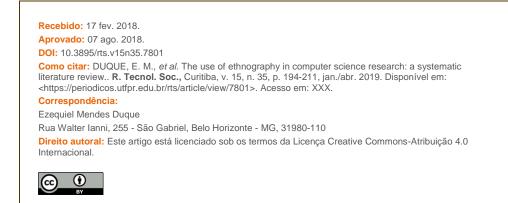
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