

Adapting Ethnography for Design Research: Lessons Learnt from Design of Mobile Systems for Rural Health Care in Ethiopia

Short Paper

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Abstract

This paper attempts to address how ethnography can be adapted and customized to design research for software development in resource constrained social settings. Based on the experience from the Technology Enabled Maternal and Child Health Care (TEMACC-Ethiopia) research project, the work reported demonstrates the suitability of a modified ethnography in a design research particularly in mediating the communication between users and programmers, facilitating reflection and communication among users, programmers and stakeholders, transforming field study insights into design artefacts, testing and deploying software tools as well as supporting users in their work places. The practical guidelines that emerged in the course of the research work are presented as lessons learnt. Extending the ethnography to support usability assessment and change management beyond those conducted in this study are also identified for further research.

Keywords: ethnography, design research, mobile apps for health care, maternal care

Introduction

Nowadays, technology-enabled health information systems are increasingly seen as critical factors to enhance performance in the delivery of healthcare services (Watterson, 2015; Hall, 2014; Hamel, 2010). The situation in most developing countries, however, indicates that such systems are often poorly designed and hence unsuccessful in terms of sustainability and scalability (Dodson et al, 2013; Maaíl, 2011; Heeks, 2010). The failures are attributed to a number of reasons such as misfits of software

development methodologies, lack of participation of users leading to poorly adapted technologies, users' lack of awareness on relevance of technology, etc. (Maail, 2011; Tongia and Subrahmanian, 2006). Primary level healthcare service delivery in developing countries usually takes place in complex social settings. Understanding these social settings and turning the insights gained into artefacts for the design of software tools are challenging tasks for developers (Bekele et al, 2019; Maier and Thalmann, 2012). The situation becomes more complicated when considering both established and such emerging technologies as mobile devices, which demand careful consideration of the social and organizational context of use.

Exploring the potential of mobile devices generally presents designers with a unique opportunity and challenge that sometimes render traditional systems design methods inadequate (Paay, 2008). System development attempts that focus on technical issues only are reported to have difficulty when it comes to successful deployment and sustainable use. This is partly because they do not sufficiently take into account the human and organizational dimensions, or the social contexts (Al-Karaghoul et al. 2005). It is argued that interpretive research approaches are better capable in terms of providing deep insights into human thought and action in social and organizational contexts. These approaches would offer a distinct advantage, particularly where the insights can be transformed into the design of IT artefacts (Maier and Thalmann, 2012; Hevner et al., 2004). To this end, there is now a trend towards applying interpretive research methods to design science activities. To mention a few, user centered design (Bekele et al., 2019; Teka et al., 2017), participatory design (Mutenda et al., 2011) and, ethnographic action research (Paay, 2008; Tacchi, 2003). Within this line of work, ethnography would appear to be the most explored method. Yet, full adaptation of ethnography has not been given adequate research attention for utilization in environments characterized by poor and unreliable technical infrastructure (energy/power, network etc.), lack of experienced ICT experts, and low education level of user groups. There are also concerns that such qualitative methods are time-consuming and costly, and transforming qualitative research results into artefacts for design activities are challenging (Maier and Thalmann, 2012).

The research work reported in this paper demonstrates the suitability of a modified ethnography in a design research aimed at software development. In particular, we attempt to address the question of how ethnography can be adapted and customized to design research for software development in resource constrained social settings. The paper's distinct contribution is the adaptation and application of ethnography for design research in fitting software development methods to their use context. We also demonstrate how ethnographic methods added value for design science research. Another contribution of this research work is the exhibition of the critical role of user study teams in the development work, particularly in facilitating reflection and communication among users, programmers and stakeholders, transforming field study insights into design artefacts, testing and deploying software tools as well as supporting users in their work places.

The paper is organized as follows. This first section introduced the existing research gap and the focus of the paper. The next section presents a review of related literature followed by the research methodology. Subsequently, results from applying the methodology adapted to the case area are discussed under various categories. Concluding remarks and areas for future research are provided at the end of the paper.

Literature Review

Case Description

According to the Ethiopian Demographic and Health Survey of 2016 (CSA and ICF, 2016), maternal deaths represent 25% of all deaths among women aged 15–49. Maternal mortality is 273-551 per 100,000. The infant mortality rate is 48 deaths per 1,000 live births. The child mortality rate is 20 deaths per 1,000 children surviving to the age of 12 months. Lack of awareness of maternal and infant health issues that need immediate care from a skilled provider, time delays in accessing health care facilities, overworked and unequipped healthcare workers, all make the delivery of effective maternal healthcare practices in rural and remote regions very challenging (Tura, 2009). To this end, timely provision of healthcare before, during, and after delivery is considered a critical factor in preventing the majority of maternal and neonatal deaths.

The report by the Federal Ministry of Health (Federal Ministry of Health, 2015), shows that the Ethiopian health care system is organized into four levels: a primary health care unit (PHCU), a hospital, a zonal hospital and a specialized hospital. A typical PHCU comprises one health center (HC) and five satellite health posts (HPs) working under HC. HCs are designed to provide comprehensive primary health care which includes curative and rehabilitative services. An HP is designed to serve communities within the lowest government administrative unit, typically comprising 1000 households or 5000 people. Each HP is staffed with two female health extension workers (HEWs). HEWs are trained to provide care services covering mainly reproductive health, maternal and newborn care, child health, as well as disease prevention and control.

Despite the existence of the PHCU, the EDHS 2016 report indicates that the services introduced to improve the healthcare situation in Ethiopia are extremely basic and have a limited reach (CSA and ICF, 2016). Mothers have limited or no awareness on safe maternal care practices, child health, family planning, and hygiene. They also have limited information on such important issues as preventing deaths attributable to common illnesses caused by poor nutrition. Although the HEWs seem to have had a substantial contribution in several aspects of the utilization of maternal health services, more efforts are needed to improve their effectiveness and efficiency.

It is against such circumstances that the Technology Enabled Maternal and Child Health Care (TEMACC-Ethiopia) research project was initiated.

Design Research

Both action research and design research belong to the realm of problem-solving oriented research methods, with significant similarity in their use. (Collatto et al., 2018; Dresch et al., 2015; Hevner, 2007). These methods emanate from different traditions: action research from social science and design research from engineering science. The inquiry and generation of knowledge is usually conducted through a close collaboration between researchers and practitioners. The research interests are framed by existing problems in practice with the goal of improvement. Both methods have found their way into the information systems discipline; and by comparison, while action research is more established, design research is becoming more of a trend now-a-days. The process steps followed in both cases are mostly similar: a situational inquiry (a diagnosis of practice problems, objectives and needs), followed by the build process (proposing, demonstration and construction), and then evaluation, in iterative cycles.

From the practitioner viewpoint, a distinct trait of action research is its consideration of the organizational adaptation of change resulting from the implementation of artefacts developed (Collatto et al., 2018). Action research goes to the extent of conducting work practice rearrangement as part of the embedment of change. Without any consideration of organizational implementation, action research is design research. We use the term design research in this sense.

Ethnography

Effective implementation of IT-enabled healthcare services requires addressing a variety of inter-related issues including the socio-economic situation, culture, low literacy and numeracy levels as well as the complexity of healthcare services (Njihia and Merali, 2013). In the case of mobile apps for instance, Paay (2008) articulates that mobile software development and its usability are often highly contextual. Predicting what will work best for users requires a deep understanding of their needs in context. What is more, traditional participatory research methods like focus groups and surveys have obvious face validity but may not provide the insights that design teams need (Biru, 2008). On the other hand, it has been reported that use of alternative methods to examine what people do rather than what they say they do, may provide a better alternative to gather the underlying user needs (Paay, 2008). To this end, design researchers have appropriated methods from ethnography and applied them to user requirements identification.

Ethnography is a research approach that has traditionally been used to understand customs of individuals and cultures through participant observation in real-world settings (Maier and Thalmann, 2012). Although this research tool has its origins in 18th century anthropology, its scope and application is now broadening into such fields as organizational studies at corporate levels (Maier and Thalmann, 2012) and system design and development projects (Hughes et al., 1995; Suchman, 1983). Ethnographic approaches in system development are considered relevant in terms of facilitating richer understandings of the domain of the application, providing a holistic understanding of the users' perspective of the world, their work, and their context.

On the other hand, there are limited research efforts to address the challenges and limitations of ethnography with respect to time and cost consumption as well as transforming research results into artefacts for design (Maier and Thalmann, 2012). What is more, design research for software development in resource limited settings provide additional challenges given that the problems to be addressed, the local practices, and the social processes to be looked into are different in some ways. In our work, we attempted to adapt ethnography for design research with a view to address the methodological challenges and limitations.

Methodology

The research process in this study is built based on a design research and included the following main steps: a situational inquiry (a diagnosis of practice problems, objectives and needs), followed by the build process (proposing, demonstration and construction of artefacts), and then evaluation through reflection and testing (with the view to introduce improvement), in iterative cycles. In this process, we use ethnography in order to guide the research process. For this purpose, some characteristics of traditional ethnography have been modified to support the design research in context. For instance, increasing more field visits but spending less time on the field as compared to traditional ethnography (3-5 days rather than months), narrowing down the study focus on certain aspects to be studied, introducing a team of collaborating researchers, as well as performing analysis and discussion both on and off the field through collaborative reflection as suggested in Biru (2008). Part of the field study is inquiry, in the form of interviewing users about their jobs and the ways they use the prototypes, etc. Another part of the field work is observation, which involved watching people use the prototypes in the way they normally would in the course of their day-to-day work life.

Discussion of Results

Situational Inquiry

During the situational inquiry, there were 14 health extension workers, 8 health officers and 20 mothers involved. The research team first familiarized themselves with the day to day activities of HEWs by making observations as they visit mothers from house to house as well as conducting interviews and focus group discussions. The discussions focused on socio cultural conditions, infrastructure, and challenges encountered in the daily work. Selected topics on maternal and child health education, the major knowledge gap on health issues in the community, as well as the level of ICT utilization were also discussed.

In subsequent activities, discussions were made with mothers with the objective of understanding the existing level of awareness in relation to antenatal care, neonatal care, postnatal care, nutrition, treatment of a sick child and hygiene. Instead of formal structured interviews, attempts were made to achieve closeness particularly with the mothers so as to create a friendly atmosphere (warm cultural greetings, trying to learn the local language, asking if coffee is ready, playing with the kids, helping in the household chores, etc.). Discussions always started when the team felt the mothers were free and at ease for a friendly conversation. As such, free conversational styles were used with the view of revealing much more detailed information. In each interview session the team worked in pairs (one member from public health and one from technology, paying particular attention to the gender - at least one member of the team is female). The arrangement was that one moderates the interview and the other takes notes. Field

notes were taken by each team member on a daily basis to reflect on what was achieved and what was yet to be achieved.

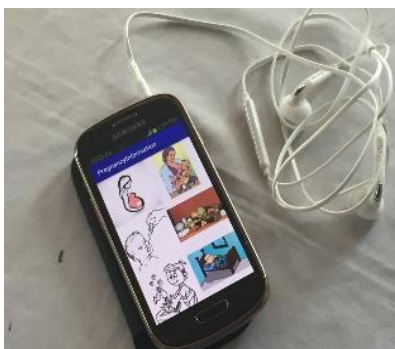
All the interviews and focus group discussions were conducted in local language and audio recordings were used with the consent of the mothers and health workers. They were then transcribed by members of the study team and later translated into English. For easy reference and identification, coded numbers were used to systematically tag list items and contents. The verbatim were then given codes line by line using the Open Code¹ software. At the end of the coding, similar codes were kept under the same category and the category was used to identify, interpret and present themes. Selected user stories were critically examined, paying special attention to relevancy, reliability and timeliness. The interviews and discussions helped to get preliminary identification of problems and constraints regarding access to health information.

The successive design considerations and system development were guided by the major socio economic challenges identified during the first phase of the requirement gathering process. The requirements gathered, as well as the social and economic challenges observed led to the design and development of (i) mobile apps for mothers to receive healthcare related information, reminders and promotional messages and (ii) antenatal care follow up system which helps HEWs to support routine antenatal, delivery and postnatal care tracking. Among the major technology platforms explored for use are mobile phones, web-based systems. Appropriate contents were selected, translated to local languages and presented in various formats including video, audio, text and images.

Demonstration of Artefacts

The issues identified during the situational inquiry were prioritized and used for developing health content, designing paper mockups, as well as the development of mobile application prototypes. All attempts were used as additional instruments to gather more user requirements. The contents on antenatal care, postnatal care, vaccination, nutrition, hygiene and the basic treatment of a sick baby were developed by public health professionals with reference to the national maternal and child health related guidelines. Around 109 digitized content slides and corresponding audio formats were prepared for use in the mobile prototype application. A total of 10 mothers aged 15-49 and 10 health workers, all with no exposure whatsoever to technology, tested and gave feedback on the prototypes and paper mockups.

An Android prototype app (Figure 1) was developed with images, text and voice, taking into consideration the information provided during the situational inquiry. The app by design was an attempt to address the issue of limited connectivity with no cost of interaction. As such, all contents, images and voices were stored in the mobile. Extra reminders and promotional messages were also included to be activated on periodical basis depending on the pregnancy status of the mother.



¹<https://opencode.software.informer.com/4.0/>

Figure 1: Prototype Mobile application

Paper prototypes (mockups) were also used for testing the user interface further. These were human moderated so as to observe what actions the mothers perform as they come across different screens. The paper mockups helped to closely observe as well as to address and record questions or hesitations during the sessions. The aim was not to test the effectiveness of the prototype but more to test the extent of satisfaction and understanding of the elements of the prototype. Various images were also presented to mothers to obtain their opinion on cultural appropriateness.

This phase also helped to get feedbacks on mothers' interests of making use of such an application. According to the observations made, most were eager to actively try the prototypes and provide feedback. It was also surprising to learn that even those women, who claimed to be illiterate, had no difficulty to identify the numbers 1 up to 10. As compared to paper prototyping, the mobile prototype application served as a better option for the design and user interface testing. This also shows the tendency to favor and incline towards new ways rather than the usual manual paper they see in their everyday life. This said, however, some of the women involved did not understand very well the use of the app as they were often observed to simply click on the numbers without first listening to the content. It is noted that the voice that describes the menu options was too long to remember what it represented. We also found out that some images were not culturally appropriate to be used in the mobile apps.

During the field visits, discussions were also made with health workers on the respective application modules designed for use. The use of paper layouts was very useful for enlightened discussions and active involvement of the user community. However, the female health extension workers needed a lot of encouragement to talk, as compared to the male health officers. The research team later made group discussions with female participants only to give the design process an added advantage of getting more female oriented reflection.

Evaluation

Based on the requirements understanding process, the redesigned mobile apps contain basic maternal and child health care information in the local language supported by audio and pictures. As mentioned earlier, the applications have stored reminders and personalized messages based on the pregnancy stage of the mother. From the feedbacks and practical hands-on sessions, the interfaces on mobile phones were designed with appropriate pictures rather than numbering. Each picture has a corresponding text and audio in the local language as shown in Figure 2.



Figure 2: Redesigned sequential menus in the mobile app.

To work with the mobile apps, a light weight web based antenatal care system was also developed. Among others, the antenatal care system allows the HEW to capture essential data on pregnant women for the purpose of antenatal care follow-up, makes automatic calculation of expected date of delivery and provides reminders on appointments and follow-up dates.

During the implementation of each subset of the requirements, users were made to use a prototype system to take advantage of their feedback and assess whether the software is usable, simple enough to understand and implement. As such, the analysis of the iteration and redesign was based upon user feedback on reliability, efficiency, learnability & achievement of goals.

In order to assess the effects and improvements resulting from this research work, the developed system was put into use by mothers, HEWs and health professionals. Experience so far indicates that the IT tools deployed seem to be well-received by the rural women and health extension workers, although the usability rating and its effect on improving the health conditions of the women and children in rural areas has yet to be established by the intervention study underway.

Collaborative Ethnography

In the TEMACC project, the system development team is composed of programmers and user study experts (drawn from information systems and public health professionals). The main task of the programmers was to develop an application which meets the requirements specification jointly developed with the user study team. As such, the user study team worked very closely with both users and programmers in user interface design, technical writing, deploying, usability testing, user training and support. The team was also instrumental in facilitating continuous informal engagement between experts from the north and their southern counterparts. The team also ensured that sufficient, inclusive and transparent consultation takes place for better understanding of requirements, work relationships and roles, project plans and deliverables. For this purpose, members of the team have developed an understanding and a special relationship with the users. Compared with traditional ethnographic studies performed by a single researcher, the use of a user study team as ethnographers provided added value in terms of bringing different perspectives that increased quality in transferring field study results to design.

Practical Guidelines

In the course of the lessons learnt from the field work, the following set of practical guidelines emerged in respect of planning and conducting field studies, analysis, and use of the data collected to inform the design work.

- Make preparation: define the objective/purpose as well as scope of the field work; prepare questions, discussion materials and artefacts; make arrangements in terms of schedule and logistics.
- Conduct the field study: meet, establish rapport with and motivate participants; present materials and artefacts; observe the work they perform and physical objects in the work environment (information on the walls, instruction sheets, the state of documentation, paper files, etc.); maintain records through note taking, photography, audio/video recordings; discuss matters arising on related issues.
- Organize and analyze data collected: focus on repetitive tasks, duplications, common errors, information gaps, communication problems, etc.; summarize, share, and discuss the results of the analysis/findings.
- Reflect collaboratively on findings: use support infrastructure for continuous learning and communication (the sort proposed in Biru (2008)); reflect at a team level on the development process (which techniques worked, which ones didn't), project progress (which activities were on, behind or ahead of schedule), product (which artefacts were easy or difficult to use) and context (the effect of power relations, morals and ethics in the process), with a view to improve action in the next field visit; use reflective workshops and journals as supplements to conventional methods of workshops and meetings (Biru, 2008).
- Organize data/documents and findings: transcribe where necessary; prepare metadata records and indexes for referencing and filing documents; identify and categorize common themes in relation to the study objectives; summarize comments and reflections on methodological issues; capture successes and problems encountered; summarize key results/findings, and interpretations.

Conclusion and Future Work

In the course of this work, we have used the methodology adapted in the development of prototypes for the purpose of getting feedback from users and to inform the design work. The prototypes were in direct response to needs identified from the field studies. By applying the methodology adapted, we have worked continuously with the users to refine the prototypes.

Summing up, using a customized ethnographic method has facilitated our design process in several ways. It has increased our trustworthiness and credibility with the user community and our ability to understand the complexities of PLHC firsthand. This is a further confirmation to the effect of trust and credibility on technology based development projects (Walton, 2012). Paying repeated visits to the work places of HEW and living areas of mothers helped us to develop working relationships. Most importantly the users have become increasingly active participants in the deployment and use of the software tools.

In our research, we have also found field observation, hands-on experience workshops, and focused collaborative reflection sessions to be very useful techniques for understanding requirements and making design decisions. Having a tighter collaboration among the user study team, the programmers and end users have contributed to the quality of the tools developed. The user study team members have also become effective collaborative ethnographers. The field study practical guidelines that emerged were useful to designers in their efforts of transforming the data collected to inform design.

The availability and use of mobile applications for healthcare in rural settings confirmed the already recognized potential to improve healthcare services in remote and resource-constrained settings. The TEMACC research project reported in here is an ongoing project. We are currently undertaking intervention studies to assess the effect and improvements in rural health care as a result of using technology. In addition to finalizing this assessment, extending the ethnography to support usability evaluation and change management is worth further research. What is more, addressing the integration of mobile based systems with other clinical software services is an additional area of further research to realize the full potential of the technology.

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References

- Al-Karaghoul, W., Alshawi, S., and Fitzgerald, G. 2005. "Promoting Requirement Identification Quality Enhancing the Human Interaction Dimension," *Journal of Enterprise Information Management* (18:2), pp. 256-267.
- Bekele, R., Groher, I., Sametinger, J., Biru, T., Floyd, C., Pomberger, G. and Oppelt, P. 2019. "User-centered Design in Developing Countries – A Case Study of a Sustainable Intercultural Healthcare Platform in Ethiopia," *Symposium on Software Engineering in Africa (SEiA 2019)*, co-located with ICSE 2019, Montréal, Québec, Canada, May 25 - June 1, 2019.
- Biru, T. 2008. *Reflective Steps: A Collaborative Learning Oriented Approach to Software Development and Process Improvement*, PhD dissertation, University of Hamburg, Hamburg, Germany.
- Cathy, M. C. 2012. "Understanding Participatory Action Research: A Qualitative Research Methodology Option," *Canadian Journal of Action Research* (13), pp. 34-50.
- Central Statistical Agency (CSA) and ICF International. 2016. *Ethiopian Demographic and Health Survey*, Addis Ababa, Ethiopia.
- Collatto, D.C., Dresch, A., and Lacerda, D.P. 2018 "Is Action Design Research Indeed Necessary? Analysis and Synergies Between Action Research and Design Science Research" *Systemic Practice and Action Research*, (31:3). pp. 239-267.

- Dodson, L., Sterling, S. R., and Bennett, J. K. 2013 “Considering failure: Eight years of ITID research.” *Information Technologies & International Development* (9), pp. 2-19.
- Dresch, A., Lacerda, DP., and Cauchick, M.P.A. 2015. “A Distinctive Analysis of Case Study, Action Research and Design Science Research”. *RBGN-Revista Brasileira De Gestao De Negocios* (17), pp. 1116–1133. doi: 10.7819/rbgn.v17i56.2069.
- Federal Ministry of Health 2015. *Health Sector Development Programme (HSDP) 2015*. Addis Ababa, Ethiopia.
- Hall, C., Fottrell, E., Wilkinson S., and Byass P. 2014. “Assessing the impact of mHealth interventions in low and middle income countries what has been shown to work?,” *Global Health Action*, (7:1), DOI: 10.3402/gha.v7.25606.
- Hamel, J. 2010. “ICT4D and the Human Development and Capabilities Approach: The Potentials of Information and Communication Technology,” *Published in: Human Development Research Paper Series (HDRP)*, (37), pp. 1-77.
- Hartswood, M., Procter, R., Slack, R., Soutter, J., Vob, A., and Rouncefield, M. 2002. “The Benefits of a Long Engagement: From Contextual Design to The Co-realization of Work Affording Artefacts” *Scandinavian Journal of Information Systems* (14:2), pp. 9-30.
- Heeks, R. 2010. “Do Information and Communication Technologies Contribute To Development?,” *Journal of International Development* (22:5), pp. 625–640.
- Hevner, A. 2007. “A Three Cycle View of Design Science Research.” *Scandinavian Journal of Information Systems* (19), pp. 87-92.
- Hughes, J., Brien, J., Rodden, T. and Rouncefield, M.1995. “Ethnography, Communication and Support for Design,” *In Workplace Studies*. Heath C and Luff P (eds.), Cambridge University Press, Cambridge, pp. 187–214.
- Maaill, A. 2011. User Participation and the Success of Development of ICT4D project: A Critical Review,” *In Proceedings of the 4th Annual Workshop, ICT in Global Development. Pre-ICIS Meeting*, Shanghai, China, December 3, 2011.
- “User Participation and the Success of Development of ICT4D project: A Critical Review,”
- Maier, R., and Thalmann, S. 2012. “Collaborative Ethnography for Information Systems Research: Studying Knowledge Work Practices and Designing Supportive Information Systems,” *Australasian Journal of Information Systems* (17:2), pp. 137-160.
- Molapo, M., and Marsden, G. 2013 “Content Prototyping – An Approach for Engaging Non-Technical Users in Participatory Design,” *In Human-Computer Interaction – INTERACT 2013. Lecture Notes in Computer Science*, P. Kotzé, G. Marsden, G. Lindgaard, J. Wesson, and M. Winckler (eds.), Springer, Berlin, Heidelberg, (8117), pp. 788–795.
- Mutenda, T., Mpazanje, F., and Chigona, W. 2011. “Community Participation in ICT4D Projects: Where Are We Getting It Wrong?,” *Proceedings of ReSNES’ 2011*, pp. 1–13.
- Njihia, M., and Merali, Y. 2013. “The Broader Context for ICT4D Projects: A Morphogenetic Analysis,” *MIS Quarterly* (37), pp. 881-905.
- Paay, J. 2008. “Chapter I From Ethnography to Interface Design,”. *Handbook of Research on User Interface Design and Evaluation for Mobile Technology*. J. Lumsden (ed.), pp.1-15.
- Suchman, L. 1983. “Office procedures as practical action: Models of work and system design,” *ACM Transactions on Office Information Systems* (1), pp. 320-328.
- Tacchi, Jo., Slater, D., and Hearn, G. 2003. *Ethnographic Action Research*, UNESCO: New Delhi.
- Teka, D., Dittrich, Y., Kifle, M., Ardito, C. and Lanzilotti, R. 2017. “User Involvement and Usability Evaluation in Ethiopian Software Organizations,” *The Electronic Journal of Information Systems in Developing Countries* (83), pp. 1-19.
- Tongia, R. and Subrahmanian, E. 2006. Information and Communications Technology for Development – A Design Challenge?. *Published in IEEE/ACM International Conference on Information and Communication Technologies and Development, ICTD2006*. Berkeley, California, May 25-26, 2006.
- Tura, G. 2009. “Antenatal Care Service Utilization and Associated Factors in Metekel Zone, Northwest Ethiopia,” *Ethiopian Journal of Health Sciences* (19:2), pp. 111-118.
- Walton, Rebecca. 2012. “How Trust and Credibility Affect Technology-Based Development Projects,” *Technical Communication Quarterly* (22:1), pp. 85-102.
- Watterson, J., Walsh, J., and Madeka, I. 2015. “Using mHealth to Improve Usage of Antenatal Care, Postnatal Care, and Immunization: A Systematic Review of the Literature,” *Biomed Res Int*,doi:10.1155/2015/153402.