A revolution in ICT, the last hope for African Rural Communities' technology appropriation

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ABSTRACT

In this paper we present a methodological perspective on the challenge of designing products suited to rural practices and conceptualizations in Southern Africa. To create a framework compatible with rural customs of information transfer and supportive of rural priorities, we are sensitive to the way power relations between the rural and urban practises affect development and design methods. This paper argues within a theoretical perspective of Development Informatics on designing for the oral and performed knowledge that people routinely share, informally, and face-to-face. Such knowledge inherently differs from those knowledge forms that Information communication Technology (ICT) explicates and codifies and is ill-served by knowledge representation and retrieval mechanisms (e.g. hierarchical structures, text-based search, technical ontologies). Uncovering the incompatibility of existing technologies with the representation of African Indigenous Knowledge systems reveals our own conceptual limitations in finding new answers without falling back on familiar ICT patterns, be they technological or methodological. Adopting a dialogical and participatory action research approach to ICT design and development is core not only to preserving culture and identity locally but nourishing local invention of ICT more generally. Thus, our discussion explores how the processes and methods, through which we understand users and their activities, can shape design and development concepts and paradigms.

Author Keywords

African Indigenous Knowledge systems

1. Introduction

Information and Communications Technology (ICT) innovation and applications developed in technologically-urban and dense settings scarcely encounter the challenges of African rural environments. Mismatches between ICT paradigms, local practices and world-views present difficulties beyond hardware related issues (such as electricity and network constraints, dust and heat, cost and maintenance). The literature is strewn with failures or short-term successes in adapting existing technologies to rural settings and littered with examples of low acceptance, usability and usage of technology to the benefit of the communities. Despite the runaway success of certain appropriations, especially mobile phones, there are only few examples of digital technologies that have widely contributed to rural social or economic development. Even fewer reports can be found on locally owned development processes.

Based on studies across three continents, Oyugi, Dunckley, & Smith (2008) note that, "local people have their own concepts of knowledge and their own forms of information communication so that it is essential that they should be able to shape their use of ICT without the risk of losing their culture and identity". We reflect on our experience of working with communities in Southern Africa to develop an indigenous knowledge management system that enables communities to collect, organize and retrieve knowledge according to their own ways of doing, saying and being. The system aims to preserve local wisdom, empower rural people in ICT for development and redress disturbances in the traditional processes of knowledge transfer incurred by increased rural-to-urban-migration.

We adopt a dialogical approach to design and frame our process within critical action research. This acknowledges first, that our understandings of users and their activities, for the purpose of design, lives in sets of relationships between ourselves, others and context; and, second, that in the absence of a common problem and solution definitions, iterations of actions, in forms of joint design interactions, followed by critical reflections will lead to introducing appropriate technology. We describe the way we draw on

techniques from ethnography, participatory design, and prototyping to prompt further design ideas from the communities.

2. ICT in Rural Settings

Developing ICT applications, for socio-economic development in rural areas is extremely challenging both in developing (Chambers, 1994) and so-called developed regions (Bidwell & Browning, 2009). Over decades people in rural communities in Namibia, as elsewhere in Africa, have used resources in the environment for survival and applied their own special ways to communicate and share their knowledge and ideas. It has always been a face-to-face process from generation to generation. The knowledge transfer has been selective and regulated by traditions and culture.

Introducing ICT into such areas to help preserve indigenous local knowledge requires considering the rural communities' thought and communication patterns. Moreover to prevent alien conceptualizations from being carried forward into the implementation, the design and evaluation process needs to be fully appropriated by the user community (Winschiers-Theophilus, 2009)

Furthermore we assume that inherent in the social, cultural, economic, political and technological challenges which undermine sustainability of ICT projects in rural areas are power relations between rural and urban and epistemological differences between technology design and rural knowledge systems (Bidwell & Browning, 2009; Brynjarsdóttir & Sengers, 2009; Patel, Bataveljic, Lisboa, Hawkins, & Rajan, 2006). The locale of technology production, sited in research labs and design studios in cities and industrialized regions entrenches power relations in creating and controlling technology. For instance, a 3D representation of Indigenous Australian land is mediated and maintained by city-based design teams not the land's traditional owners (Truna aka Turner, & Bidwell, 2007). Moreover the urban locale of technology production is a conduit for particular emphases, such as aiming to make urban services available rurally. For instance, in rural India people can visit 3D worlds to shop (Schmitz, & Quraischy, 2009), access information and services Patel et al. (2006), or gain a formal education (Moraveji, Ge, Inkpen, & Mulcahy, 2008) .While rural people should not be excluded from such services, we must appreciate that these contribute selective interpretations of knowledge and its relations to rural life. As Chambers (1994) remarks we need an awareness of whose reality ICT projects reflect, and account for local knowledge systems. Brown (2008) argues that approaches that fail to recognize a range of knowledge types rarely yield sustainable solutions. She addresses the need to synthesize many different types of knowledge for local problem solving in practice. Brown identifies: the personal felt and tacit knowledge of individuals; shared local knowledge about culture, stories, history and symbols in specific contexts; expert knowledge which may be formalized and represented in texts; organizational knowledge about the alliances, networks and agendas of groups and individuals; and holistic knowledge about overall purposes and goals. Thus a more thorough understanding of the African Indigenous Knowledge System is required for the modeling of an appropriate ICT.
In Southern Africa, a widespread perception that computers only suit the formally educated is fostered by a scarcity of media content and mismatches between interactions with technology, daily practice and local knowledge systems (Thinyane, Dalvit, Slay, Mapi, Terzoli, & Clayton, 2007). Design decisions are guided by literacy rather than orality, thus the gap between the ones using and those shaping technology is widening.

The systems we commonly use to organize knowledge in computers, such as chronologies, taxonomies, cartographies and authorship protocols, are produced in particular socio-cultural discourses. This affects usability (Winschiers, & Fendler, 2007) and can displace other knowledge traditions (Green, 2007). Indeed, as Moraveji, et al. (2008) notes, mechanisms developed precisely to preserve local cultural heritage can ignore the aspects most critical to local people. Consider an Indigenous Australian Elder's disappointment with a GPS-based system which was designed to assist preserving his clan's traditional knowledge on fire but did not support the nuances of transfer in "walking country" (Bidwell et al. 2008). Consider also how, by separating geographical locations from temporality, 3D visualizations inadequately depict the experiential memory of Arawakan people in their stories about journeys in Amapá, Brazil (Green, 2007). Rural people's conceptualization abilities developed by recognizing and interpreting natural signs, interact with design's spatial logics. For example, in using a mobile system to gather conservation data, African trackers' remembered the entire interface, the exact position of an icon and retrieved icons based on position in a list (Blake, Steventon, Edge, & Foster, 2001).

We believe that in designing for an 'illiteracy' of some sort, be that reading and writing text, a mapping convention or a classification, we privilege information transfer associated with knowledge systems already emphasized in technology and de-centre those logics in which we are ourselves illiterate. For instance, commentary on what oral users of technology do not do, cognitively (Sherwani, Ali, Penstein Rose, & Rosenfeld, 2009) de-centres what users who emphasize verbal transfer accomplish. Consider the preference of many rural communities in India (Seshagiri, Sagar, & Joshi, 2007) and Africa (Bidwell & Browning, 2009) for face-to-face over technology-mediated communications, despite transport constraints.

Making design decisions in line with local knowledge systems is at the core of bridging the gap between technology and rural ways of doing and saying. However a challenge remains the methodological approach to ensure that the voice of the users is not overwritten by the developers. Even an evaluator situated in the users' culture cannot compensate for methods that are inappropriate to the context (Oyugi, et al. 2008). Following a participatory action research paradigm, even though developers implement based on their background and skills, the community has an influence on design strategies. The design iterations of intervention and reflections allow a user group to learn about ICT's, their possibilities and malleability, while the developers learn about the socio-cultural usage context (Blake, 2010).

3. Namibia's Rural-Urban Contrasts

In Namibia, more than half of the population lives in rural areas which are very different from the urban areas in many respects. In our study most participants are pastoral dwellers in the Omaheke region. The pilot sites are near the Botswana border, accessed from the highway by a gravel road and sand tracks which can take five hours to traverse by car. We are linked to the villages via one of our researchers who resides in the capital, Windhoek. He lived in the village until twelve years old when he moved to the capital with his family. Like many Herero rural-to-urban migrants the researcher returns regularly to the village to participate in everyday tasks.

3.1 Oral and Informal Education

The community members transfer information orally in their mother tongue by sitting around a fire or when they are performing their day to day individual chores.

Most of the community members have little or no formal education as well as little or no reading and writing abilities. Very few members are able to converse in English.

3.2 Technology Usage

None of the permanent residents in the village has ever been introduced to computers or even cameras. In general, the villagers use few electronic technologies in their everyday life. Some listen to the radio but no one locally accesses TV or grid electricity. While some own a cell phone, the cell-phone coverage is limited to a distant village. Thus members from the pilot site travel to the villages where coverage allows them to communicate. Even fewer households do have landlines. One of the most frequent requests from the community members was the extension of network coverage to communicate with family members in town.

3.3 Rural-Urban Migration

Most of the youth reside in the urban areas where they are attending schools or look for work. This has broken the chain of inter-generational knowledge transfer. When the urban migrants return to the village, there is an obvious knowledge gap between them and the ones who have gained knowledge from the wise elders in the village. People coming from the urban areas have gained technological skills, which are however of limited use in the rural environment with limited electricity and network access. Every day tasks of cooking, husbandry, food production and preservation have evolved and successfully been executed in the absence of alien technologies. The matured knowledge thereof only resides in the wise elders, lacking the opportunity to pass it on to the next generation, due to the rural-urban migration.

4. Technology Opportunity: Bridge the Gap!

Our project aims at developing an indigenous knowledge management system, which maps communication patterns and thoughts of rural Herero people, to enable them to transfer their wisdom and skills to urban migrants and thereby preserve their knowledge needed in the rural area. To create a system compatible with rural customs of transfer and supportive of rural priorities we are sensitive to the way power relations between the rural and urban affect development and design methods and ideas.

To ensure participants determine potential uses we undertook ethnography, engaged in community discussions, contextual interviews, informants questioning, introduced media adaptively in situ, conducted technology experiments and tested prototypes. We followed a participatory action research approach which allowed for phases of joint interventions followed by community discussions and developers' reflections. In this way we merged design and usage context.

We investigated the living style of the community and their everyday communication practices to determine how the people communicate with each other and how they share their knowledge. This influenced our methods as well as design decisions taken.

4.1 Phase 1: Users Experiment with Technology

The first phase of the project consisted of collecting data on indigenous knowledge. We chose video as our first

medium; capturing data using camcorders, flip video cameras and sophisticated mobile phones. Besides the research team having taken videos of different narrations, demonstrations, contextual interviews, community discussions and prototype evaluations, community members were asked to take videos of their choice. We selected young people from the village who used the flip cameras and sophisticated cell phones to record scenes in and around the village. They kept the device for half a day. At some time in the afternoon the device was collected and the recorded video was played back from the device.

This yielded a collection of clips in which participants tell, demonstrate and discuss rural knowledge in the yards and bush around their homesteads including: 9 hours that was recorded; 1 hour recorded by participants while we concurrently observed; and 40 minutes independently recorded by participants.

Even though they had not gathered their stories with photography or video before, participants found the collection process rather easy. Before the experiments, they had no idea on what a camera was for and what the outcome would look like after using the camera.

The videos were then uploaded on a laptop and played back to the wider community. For most it was the first time seeing themselves on a screen. A lively and unexpected discussion erupted around knowledge transfer and the new possibilities of preserving and broadcasting to a selected community or an even wider public. A critical discussion point was about the importance of the knowledge conveyor, as not every community member is regarded as being equally knowledgeable. It was emphasised that only selected community members qualify to be narrators of certain content.

4.2 Researchers' Reflections

The context analysis, technology user experience observations and community discussions brought about numerous design ideas and methodological insides. A major design decision was uncovered: namely the strong distinction between the narrator and the listener role. This has been identified to be a peculiar feature of African rural communication. It has been followed through in a number of prototype implementations. In terms of methodology, community discussions prompted by technological artefacts and interventions has lead to a number of crucial design directions.

5. Community-Centred Design Prompting

Determining the appropriate conceptual model of the knowledge architecture has presented us with an ongoing challenge. We are conscious that technology based knowledge representations are mostly incompatible with the indigenous knowledge system and that we as western-trained developers are having our own bias towards ICT solutions (Winschiers-Theophilus, Bidwell, Blake, Kapuire, & Rehm, 2010). Thus the design must be community driven for it to be adequate. However, once more we are only equipped with a finite set of methods and techniques to prompt users' design ideas. In this project, we have explored a number of different design interventions with different outcomes. All technology used in the implementation process was new to the community members. This added an additional challenge to all experiments conducted. The community's members were positive towards the technology and always eager to try out what they were presented with. The learning curve within the experiments was remarkable. However no direct relation to their everyday life was yet established. Ideas were tested in order for the data model to reflect the thought processes of our users. To inform the system architecture experiments conducted showed the way in which the community members organized their videos. It gave some ideas on how they link related videos together. It also yielded in some vague organizational and retrieval requirements. But most and for all it set the scene for an entire different design paradigm, focusing on the oral and performed knowledge transfer.

5.1 Technology experiences

After having collected a number of different video clips, an application displaying thumbnails in a list was introduced to the community. They then scrolled to the left and to the right each time trying to identify the video of choice to view. During that experiment, it showed that scrolling from left to right and vice versa is a long process if more videos are uploaded. However asked for display suggestions, the users requested it to remain a list as is. A number of other experiments were conducted using different features of i-movie. Yet the results were not conclusive.

5.2 Thumbnail Sorting

To determine how the videos should be organized so that they are retrieved in a community appropriate manner, a paper thumbnail sorting exercise was introduced. The idea was to obtain a knowledge architecture for organizing and retrieving videos, as well as to determine the different linkages that exist between the videos.

Cards of thumbnails (images) were made for some of the videos collected. The videos were from different times, different places, different stories and recorded by different people from the community. The users were asked to identify the cards, place them on a board and sort them

according to perceived belonging. Users placed them in their preferred order and then linked the cards with a line between. Finally they selected which video should be played back first for the set of videos that they linked together. For example they selected all thumbnails where a goat was displayed and ordered them in accordance with daily routine order; e.g. goats in the kraal then goats out in the field.

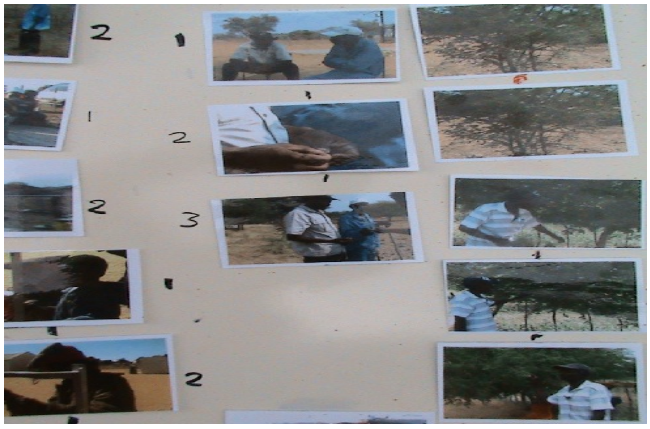

Figure 1. Thumbnail sorting

6. First prototype: How wrong can you go?

Based on the previous design interventions a first prototype was developed. Following the principle of narrator roles and listener roles, selected community members were assigned the roles prior to the testing. The emphasis was on a contextual retrieval, meaning a user (listener) being of a certain age, gender and engaged in specific activity would obtain the appropriate video, as it would be in the natural set up. The one uploading the video (narrator) therefore had to specify a video and a target audience description. The user interface language was English while the pre-loaded content/meta data were in the local language.

6.1 Usability evaluation set up

The user group had to perform two computer-based tasks, representing a natural flow of the narrator uploading a video specifying a target audience succeeded by a listener retrieving a video. The aim was to observe the users' conceptualisation, trial and error behaviour, hesitations, and difficulties with the system. As it was the first time for the participants using an application of such kind, the usability tester guided them through a typical sample process, indicating what to type where. Once the users gained some experience they were left alone to try out the system by themselves. All actions were monitored by the usability testers and recorded with a usability software and video camera.

The following two tasks were given to the user group:

Task 1 (narrator role): The narrator logs onto the system, enters keywords on the search criteria to play a video, uploads a video clip from the desktop into the application, enters the respective meta data, saves it and plays back the newly uploaded video.

Task 2 (listener role): The listener logs onto the system, enters information about themselves and keywords of their choice. The system then displays the videos retrieved based on the data entered. The users then view all the videos displayed.

At first the users only looked at the prototype with surprise. After some explanation and guidance, they started experimenting on the system. They formed a group, trying to experiment all possible actions on the system based on their normal approach of exploring, as pictured in figure 2.

Figure 2. Prototype test by community members

The users were hesitant with using the system as it was their first time. They were explained how to log onto the system, but the concept of a user name and a password remained alien to them. Once logged on, a basic explanation was given to the users about the features on the user interface. The users asked one another to start entering keywords to search for a video. During the prototype testing, it took more than 5 minutes for the users to type in the search keyword for the choice of the video, even though they could use their mother tongue. Some of the search keywords were not matched due to typing errors, so it failed in the retrieval task.

In fact all actions on the prototype took a great deal of time. Entering meta data was an even more lengthy process as it was based on entering a number of data.

The users did not know how to browse for videos on the prototype: they had no idea of what search criteria to put in order to find a video. Everything performed needed an explanation first, before they attempted it.

6.2 Researchers' reflections

The evaluation of the system showed a big gap between the conceptualisation of community members and the realisation in the prototype. Firstly, the prevalence of text-based input was a major stumbling block. Every activity required typing, consisting of a combination of unnatural tasks such as using a keyboard, looking at letters appearing on the screen, being conscious of spelling of a language which does not have wide spread writings. Then to express meaning in single words rather than using entire spoken sentences was another challenge. The conceptualisation of logging in, dragging files between applications, entering meta data, and search keywords remained alien throughout. The inadequate mapping of communication and thought patterns became apparent. Developers' technology habits were implicitly coded into the system, believing in the obvious of used features. Retrospectively looking at the text cluttered user interface for uploading meta data in Figure 3 and picturing an oral and performed narration of a situation, clearly shows the discrepancy.

Figure 3. Textual versus oral

7. Second prototype: Change of paradigm

The design of the second prototype considered the lessons learned from the first prototype evaluation. Thus all text was replaced with speech output and visual displays. User interactions were reduced to touch pad actions such as selecting, clicking and dragging visual objects. Figure 4 depicts the new login screen, where the user gets prompted with a voice output in Otjiherero, asking the user to select their own picture.

Figure 4. Login screen

The new meta data upload interface was modified to select the main narrator and the one who took the video from a list of pictures similar to the login screen. To identify the video, the users can now choose their own thumbnail being a frame out of the entire video clip and not necessary the first one. This allows the users to choose a scene in the video which they associate with the content.

As previous design interventions have not yet lead to a conclusive knowledge architecture we have shifted the emphasis of the prototype towards a narrator video sharing platform rather then a listener retrieval interface. As depicted in figure 5, the narrators choose from their list of videos who of the community members should watch which video, by dragging the video clip into the "basket" of the listeners. Once the listeners logs in they will find the video clip to view. We are thereby simulating the real set up of the elder choosing who to tell what based on their own judgements of contextual suitability. We hope that by logging the sharing actions we discover generalised patterns, which we can then use as underlying retrieval algorithms.

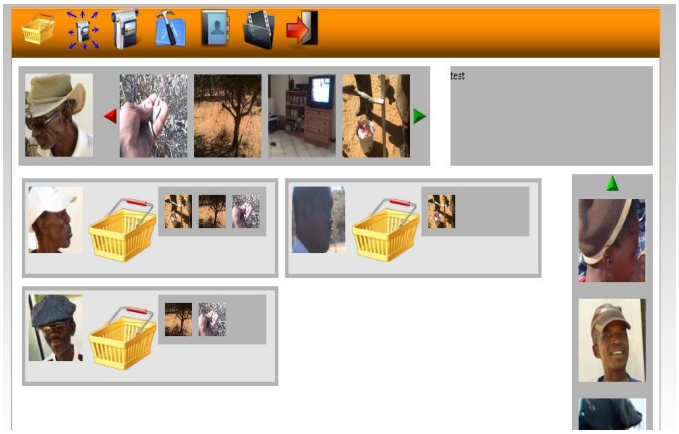

Figure 5. Video sharing mode

7.1 Usability test set up

We tested the prototype to confirm that our perceived communication behaviours do conform with the community members' reality. All activities were recorded with a usability software, and observations and comments noted by the testers. Once more we drew up two task sets in a logical flow of the narrator uploading and sharing videos, followed by a listener finding the video for display.

Task 1(Narrator): Users were asked to log onto the system, upload a video, and then play the uploaded video back. In the sharing mode, the narrator was asked to share videos with community members of choice.

Task 2 (Listener): The listener had to test the scenario of sharing videos in order to see if the video placed by the narrator was in the listener basket and could be viewed. A listeners had to log on first, verify what is in their basket.

7.2 User experience

The people appreciated the prototype evaluation session. Much less hesitation than in the first session could be observed. The users enjoyed the dragging of videos in the basket even though they had problems moving the mouse and making use of the touch pad.

7.3 Researchers' reflections

The obvious changes required were much more at a detail level then from the first prototype, such as the voice of the instructions not being clear enough, and the voice should be repeatable. A number of other features have been planned for the next prototype thereby progressing slowly towards an appropriate solution.

In terms of design intervention logistics, the lack of power supply for the laptop, cameras and microphones has influenced the recording and testing. Also do the community members usually have social gatherings in the evenings around the fire while in the day pursuing their duties, making scheduling of sessions a challenge.

8. Conclusion

The objective of the project described is to build a system to preserve traditional knowledge and map contextually dependent rural practices onto the system. The project involves researchers and the community over a long time period. Both parties have learnt from each other to design a local ICT solution which reflects the living style of the community. Facilitating early and continuous interactions between community members and researchers ensured mutual learning. On the one hand the developers get to understand conceptual challenges never encountered in technology dense zones. On the other hand community members get sufficient knowledge about how technology can be adapted and what opportunities it opens up.

One outcome of the community driven design decisions was that much more emphasis should be put on the oral aspects of information flow in future design of ICT for rural settings. In the interface text should be replaced with audio files and icons carefully chosen by the community members themselves. As communities recognize technological opportunities, design decisions can be taken with less urban biased influence and more locally appropriate solutions deployed.

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