International Journal of Mobile and Blended Learning

April-June 2012, Vol. 4, No. 2

Table of Contents

Special Issue on Mobile Learning in Africa

Guest Editorial Preface

Using a Participatory Action Research Approach to Design a Lecture Podcasting System

Raymond Mugwanya, University of Cape Town, South Africa

Gary Marsden, University of Cape Town, South Africa

Dick Ng'ambi, University of Cape Town, South Africa

John Traxler, University of Wolverhampton, UK

ABSTRACT

Although podcasting is popular in higher education, there is limited research on podcasting in developing institutions or resource constrained environments. There are fragmented implementations of podcasting projects by enthusiastic faculty but the tools used are often proprietary, imported from the West by administrators without any consultation with the lecturers who eventually use them. Similarly, many of these tools are used on a trial basis. The authors hypothesize that involving academics through user centered approaches to the design of educational applications will encourage them to use the tools. This paper reflects on a Participatory Action Research approach adopted in the design of a podcasting system. The research study incorporated a cyclical action model with four distinctive stages designed to guide the constituencies involved in the study to design, test, and possibly enhance the tool. The findings reveal some of the contextual phenomena that create both challenges and opportunities for a podcasting model.

Keywords: *Higher Education Institutions (HEIs), Information and Communication Technologies (ICT), Mobile Learning Content Authoring Tool, Participatory Action Research Approach, Podcast, Podcasting System*

1. INTRODUCTION

Despite use of podcasting becoming increasingly popular in higher education, there is inadequate research published to explore podcasting in developing Higher Education Institutions (HEIs) let alone the design of tools to support these tasks. Podcasting is defined as the authoring of, distribution over the internet and the subscription thereof to audio, video and other media files via feeds with clients such as iTunes (Malan, 2006; Lonn & Teasley, 2009). This definition depicts how podcasting is done in the developed world where internet connections are reliable and students have access to high-end mobile devices, i.e., iPods, iPhones and other smart phones. In this paper, we use a looser definition of Podcasting, i.e., a form of

DOI: 10.4018/jmbl.2012040105

mobile learning in which audio/video content is authored and made available on the internet, using some server or shared storage space for downloading onto a computer and or transferred to mobile devices (possibly via data cables) for "consumption".

This view provides a way of appropriating the affordances of podcasting to harness the use of Information and Communication Technologies (ICT) for development.

Research undertaken in the developing world involving the application of ICT within the fields of socioeconomic development, international development and human rights is referred to as ICT4D. ICT4D research generally covers domain areas such as agriculture, health, economics and education. In particular, educational applications for the developing world have been an active ICT4D research area over the last decade.

However, the majority of these applications have either been developed for the underserved populations, rural children and particularly for informal education scenarios (Kumar et al., 2010; Kam et al., 2008). Therefore, podcasting in developing HEIs presents an interesting study area because educators are slowly beginning to realize its benefits. Currently, there exist some fragmented implementations of podcasting by enthusiastic faculty but the tools used are imported from the West and are usually not adopted in the long term due to mismatches in needs and requirements. Communities are complex structures influenced by local customs, practices and various other constraints, such as digital divides, that designers must understand if they wish to build relevant contextual technologies (Kam et al., 2005). Moreover, literature from computer supported collaborative work (CSCW) (Maguire, 2001; Grundin & Pruitt, 2003), Information Systems (IS) (Heeks, 2002) and Human Computer Interaction (HCI) (Zimmerman et al., 2007) identifies that a common reason why systems fail is because the people who are expected to use them do not necessarily get to contribute to the design. Additionally, where possible, the opportunity to iterate or modify the technology, as uses and requirements emerge, is desirable.

The implementation of mobile education systems has not paid adequate attention to understanding the organizational contexts and environments in which they will be implemented (Mugwanya & Marsden, 2010). Therefore, too little attention is ultimately given to the design, implementation and evaluation of mobile education systems, despite advances in technology and a clear compelling case to support their utilization. There is a need within mobile-education research to invest in matching requirements more closely with design, while applying human centered design approaches (Mugwanya & Marsden, 2011). This paper explores how adopting a Participatory Action Research (PAR) approach gave rise to our first software prototype, and presents the challenges faced as well as future plans. We postulate that actively engaging with the end users throughout the stages of the project lifecycle improves the chances of the podcasting systems being successful. The rest of this paper is organized as follows: Section 2 presents some related work; Section 3 the first Participatory Action Research cycle; Section 4 the second participatory action research cycle; Section 5 the findings and reflections; Section 6 the lessons learnt while Section 7 presents the conclusions and future work.

2. RELATED WORK

Mugwanya and Marsden (2010) reveal that much mobile learning activity has involved the use of the following categories of tools namely: *"hypertext and multimedia applications for content creation, video recording tools, artificial intelligence tools and natural language processing tools"* (p. 24). However, lecturers (or end users of these systems) generally have little or no opportunity to contribute to their design. In addition, these tools are normally costly and are general purpose commercial tools not developed within developing (ICT4D) contexts. As a result, the systems do not necessarily adequately address users' needs and are often complex and difficult to use. Therefore, a closer match between the needs of the lecturers and the technology is required. Moreover, literature on mobile learning in the ICT4D context, particularly podcasting, is mostly practice based and anecdotal. The majority covers "how to" create podcasts, and technical requirements, while the rest describes use and perceptions thereof.

For instance, Kim (2009) discusses an action research study focused on developing a mobile learning model of literacy development for marginalized migrant indigenous children in Latin America who have no consistent access to a formal education system. The study is part of a larger project established to develop entrepreneurial strategies that help the underserved with educational capacity building (i.e., initially through literacy development), ultimately leading to increased economic and social mobility.

In another study by Ramachandran et al. (2007), they describe findings from two field studies in India and Uganda where they explore technological solutions in the domains of communication, microfinance and education. Of particular interest is the one involving universal primary education for school children from the rural schools and urban slums of Uttar Pradesh (UP), India. They observed and interviewed teachers and rural school children in UP and used semi-functional prototypes (as probes) to gain deeper insights about how computer and mobile technologies could be used to best meet the educational needs. They go on to present a synthesis of the three experiences that draw some practical lessons for ICT designers to elicit meaningful feedback and participation from local stakeholders in developing regions communities.

Kumar et al. (2010) argue that cell phones are a perfect vehicle for making educational opportunities accessible to rural children in places and times that are more convenient than formal schooling. Using participant observations, they report on how rural children use cell phones that were loaned to them in their everyday lives. The cell phones were pre-loaded with applications that target English as a Second Language (ESL) – an important "gateway" to economic advancement in India.

These studies mainly focus on the underserved populace, literacy, English as a second language (ESL) and used the rural poor (as the target user group) with low income and education levels, and design mobile phone applications based on their needs. However, urbanization in the developing world is on the rise leading to an increasing number of the urban poor in the cities. Consequently, the urban poor are emerging as an essential target group for the design of technology interventions given the emergence of free primary and secondary education students in much of the developing world (i.e., in Africa and Asia) who will eventually enroll for courses at HEIs. To the best of our knowledge, despite the reported successes for many of the tools presented above, there is a gap in the literature on designing podcasting systems for developing HEIs.

Mugwanya and Marsden (2010) further reveal that the majority of tools published for authoring mobile educational content report on their use in developed HEIs. These tools may not be easily adapted to developing HEIs due to the varying social, economic and cultural environments hence the need to adopt participatory user centered design approaches in designing contextually relevant technology interventions. This is evident from the low adoption of some e-learning tools such as Blackboard and WebCT in various African HEIs. In addition, podcasting is not yet widespread in African HEIs therefore; we explore its use and seek to answer the following question

How can we design podcasting tools, with the assistance of lecturers and students in developing HEIs, that are suited to their needs?

Therefore, we first describe the use of podcasting systems that failed to achieve the goal of local appropriation by users. We begin by describing some preliminary results from document ethnographies and usage. Our findings highlight several challenges with the adoption of "Western" technologies and as a result, we opted for a user-centric strategy that is grounded in HCI best practice. Next, we describe the execution of the design strategy in detail while drawing specific attention to the operation of PAR, which resulted in the generation of the MLCAT solution. An Action Research approach was employed to investigate the possible effects of various affordances for the MLCAT (Mobile Learning Content Authoring Tool) podcasting model. Chetty et al. (2004) advocate that Participatory Design (PD) (Muller & Grudin, 1991), Action Research (AR) (Kim, 2008) and iterative participatory cyclical approaches have been reported to provide an ideal framework for introducing ICTs and bridging the technology gap. These approaches have also been recommended by Chetty et al. (2006) for the design of locally relevant technologies.

2.1. Participatory Action Research

According to Baskerville (1999), AR manages better than conventional methods to remain relevant to the real world. However, some AR can lack discipline and lead to context bound solutions. These problems are overcome by ensuring that AR interventions have good theoretical foundations, that all phases are well documented and the outcomes have restricted generalization. Thus AR and particularly its most typical variant, i.e., PAR, is a well-suited methodology for the project being undertaken. PAR's philosophical context is couched in strongly post-positivist assumptions such as idiographic and interpretive research ideals. The designers opted for a design approach that utilized Participatory Design (PD) in combination with AR and the rationale behind the decision was related to the role of each method in the overall design process.

PD ensures that the users are actively involved in the design process and that their insights and feedback are captured to help shape and refine the final solution. The AR approach on the other hand operates at a higher level and it encourages designers to engage with the target community (while including them as participants). The process of participation requires that activities be used only in identifying locally relevant problems without placing any emphasis on technology aspects (Maunder et al., 2007; Bidwell et al., 2010). The difference between a typical AR approach and one that emphasizes participation is that AR requires the designer to collaborate with the target community whereas the participatory variant requires both the designer and the community to be in agreement as to:

a. What the problems are (Analysis, fact finding and conceptualization)
b. Which problems will be addressed (action planning)
c. How they will be addressed (Action implementation)
d. What the criteria for success might be (Evaluation)

The PAR cycle has four phases as highlighted and they operate within the client-system infrastructure, which is the context and environment within which the research is conducted. These cycles are repeated until there is no new knowledge being discovered, normally exiting the loop at the end of the third PAR cycle.

3. PROCEDURE

3.1. Background

The research topic emerged from one of the authors' work as a lecturer at a developing HEI. The researcher completed his first degree in 2001 and during this time all lectures were delivered through faculty writing down material on a Chalkboard (for the highly mathematical/practical content), through dictation of notes for the more theoretical content and a combination of the two approaches where appropriate. In very few instances, faculty typed out notes and made a single hard copy available to students in A4 print. The class notes were normally housed at a commercial photocopy area (just outside the department building) where students would make copies at a fee.

In 2005, while the author was at the University of Liverpool, faculty delivered content such as lectures, assignments in digital form (mostly as PowerPoint slides). Moreover, a Learning Management system called LearnWise was used for content delivery with mostly undergraduate students, and in rare instances graduate students, to collaborate on assignments through forums. In 2006, the author then returned to Makerere University as an assistant lecturer in the department of Information Technology. All lectures in the department were presented and delivered in digital form using PowerPoint and e-mailed to students through the various mailing lists.

No use of LMSs was noted although the University had procured BlackBoard and was currently in the process of trialing open source LMSs including KEWL and Moodle. During this time, there were still very few computers compared to the growth in student numbers, Internet access was very intermittent and load shedding (random power cuts) was very prevalent despite a majority of the students owning a mobile device.

In 2008, while at the University of Cape Town (UCT), the author found that, despite it being more developed than Uganda, similar problems persisted in South Africa, i.e., a limited number of computers, relatively slow Internet access and divides amongst students in terms of access to ICTs. One thing they had in common was the high prevalence of mobile devices, particularly mobile phones, among students, the use of Power Point to deliver content and a more widespread use of LMSs (i.e., Vula – a Sakai based LMS) for delivery and access to content. Since 2008, we have witnessed some erratic implementations of lecture recordings/podcasting at UCT (Ng'ambi, 2008a; 2008b) normally undertaken by enthusiastic academics albeit with a number of challenges. Therefore, in order to understand the organizational context, environment, define the problem domain and select a design direction for the rest of the process, we undertake an AR – PD approach as detailed in the subsections that follow.

3.2. Analysis, Fact-finding and Conceptualization

The overall aim of the baseline study was to understand the current working environment of the lecturers prior to any new technology being introduced. This phase of the AR cycle is analogous to the contextual analysis in user centered design (UCD) (Beyer & Holtzblatt, 1997). The primary data collection tools were interviews with the eight participants who were lead users (Von Hippel, 1986) of podcasting (conducted individually with each taking about 45 - 60 minutes). They consisted of lecturers, curriculum developers and a technician. This was followed by a survey with 225 students. In parallel, we did thorough document ethnography of written materials (research articles, system manuals, etc.). Interviews were administered to assess lecturers' approach to technology and their work environment; a survey was undertaken to identify students' experiences with digital content and informal observations were conducted in the classrooms in which technologies were used. The critical document ethnography provided an objective snapshot of the systems and gave context to the other data collection initiatives.

In 2009, one of the lecturers in the department of Computer Science at UCT introduced OpenEyA (Enhance your Audio), a system that facilitated archiving (in Flash format) and sharing (via web, zip) of traditional scientific lectures carried out using chalkboards in classrooms and/or modern presentations (PPT, PDF, animations, etc.) (http://www.openeya.org/). OpenEyA is developed for Linux (Ubuntu) and can run on a low-cost Netbook with just one click in order to synchronize:

1. Video in Flash format (to see whatever happens in front of a classroom),
2. High resolution digital photos or VGA screen captures (to zoom specific areas of the Classroom podium, blackboard and projector screen, if any) and
3. Classroom audio (without the need to wear a microphone).

One of the lecturers proposed the use of OpenEyA to record lunch time presentations done by students and visiting academics. The idea was immediately discarded because the workshops coordinator thought it would intrude on the privacy of the presenters. Therefore, the researcher decided to trial the system through conducting informal presentations; reading system documentation and research papers on OpenEyA in order to gain an in-depth understanding of the tool. During the same period, the department of Information Systems at UCT was in the process of trialing Apple's Podcast Producer server in the second semester of 2009. Just as with the OpenEyA system, despite its sophistication, the resulting recordings are only accessible on iPhones which are not very common with students in developing HEIs; the implementation and costs were prohibitive, in addition to the setup and administration being complex. In order to gain an in-depth understanding of the workings of Podcast Producer server, the researcher attended one day training with Project3, a company that re-distributes Apple products in South Africa.

Project3 provided the researcher with a copy of Podcast Producer server software so that they could deploy a stand-alone implementation of the system at Makerere University. During December of 2009, the researcher presented the software to the then Faculty of Computing and Information Technology at Makerere University. However, the setup and configuration of the system proved complex even for an advanced user and the system administrators were not familiar with the administration, setup and configuration as they mainly use Windows and Linux systems for server-side computing. With almost no Apple distributors to provide support, coupled with limited training, this initiative was immediately discarded.

Consequently, the designers settled on the design path that tackled the problem of a labor-intensive podcasting process. Typically, our analysis revealed that the lecturers were not using any standard architecture or model for authoring lecture podcasts as some had their own piecemeal improvisations. The lecturers and designers were in agreement that the process of authoring digital lecture content was a time consuming one. Implementation cost was an issue, likewise inadequate funding and skills required to set up and configure the systems. Access to podcasts in QuickTime, Flash or as a Zip file may not be ideal. Despite the fact that these file formats seem fairly easily understandable, the resultant videos should be in formats that do not require downloading additional software, and are suited to an environment where students have Personal Computers or laptops to access content, but there already exists divides amongst students in terms of access to ICTs. Students encountered a number of challenges during off-campus access (since students either have no or different access devices, connection speeds, etc.); incompatible formats, lecture podcast upload delays and a limited ownership of personal computers by students. It is normally very difficult to access university resources off-campus as some student's primarily access PC internet on campus. The size of the resultant recordings was an issue as well, for instance a one hour video ranges from 230 – 350 MB which may take a long time to download at a developing HEI where the bandwidth and cost of internet access is still prohibitive.

In addition, during this time, the University of Cape Town undergraduate students had a monthly 300MB internet cap. There was also a need to have an automated way of transforming and processing the content into formats that are easily consumable without the need for client software. Further, many of the students are not aware of the availability of podcasts therefore there was a need for a mechanism to notify students that recordings are available.

The designers believe that by addressing the challenges presented above, they would improve the quality of the podcast production process. To accomplish this, the researchers proposed a desktop system that utilized PowerPoint as the host application to facilitate the production and distribution of podcasts.

3.3. Action Planning: The MLCAT (Mobile Learning Content Authoring Tool) Requirements

The implementations described earlier were problematic and ultimately failed. In most cases, technicians undertook all podcast production activities such as equipment setup (as the lecture theatres do not have integrated infrastructure), the post production process (i.e., compressing and breaking down of video into smaller chunks), uploading to the LMS, server or shared volume and lastly access by students. The design team chose this problem because the lecturers had trialed with podcasting systems and developing a contextual solution would have a positive impact on its users. Moreover, utilizing tools such as mobile devices already in the possession of students in HEIs and relieving the pressure on HEI infrastructure through the use of a simple, easy to use desktop application would save HEIs and academics alike valuable time, effort and resources. The designers then began to address the problems by initiating an AR – PD design process based on an evaluation of the existing ICT systems. As a result we scheduled PD workshops at UCT and MUK (Makerere University Kampala) with a purpose of refining requirements for our proposed tool.

3.4. Action Implementation–The Participatory Design

The designers facilitated a Participatory Design process in order to develop a new version of a mobile educational content authoring tool. The goal was to empower lecturers to take charge of the entire podcasting process. Three Participatory Design workshops were conducted on different days at UCT and MUK. Seven participants were selected from Computer Science and Information Systems departments at these universities. Typically, industrial environments use from seven participants and more during PD sessions (Boehner, 2007). Participants were divided into three groups (one with three participants and the others with two each) in which the researcher acted as the facilitator. Two participants who had initially volunteered to take part did not turn up hence the two groups with two members each. Figure 1 shows examples from our PD workshops. During these workshops, participants were briefed about the overall objectives of the sessions; goals to be accomplished; then introduced to the paper prototyping technique (Bailey et al., 2008; Snyder, 2003).

3.5. Evaluation–The Paper Prototype

Some design solutions were generated from the paper prototyping workshops in the form of low-fidelity prototypes. This study was never intended to follow PD in the strictest sense (as that would require longer multiple sessions to work towards a final agreed design) but rather to keep participants informed and facilitate opening up of the design space so as to uncover crucial requirements. At this stage, our goal was not to come up with a complete tool design as each participant only afforded us two to three incomplete screens, though the ideas were well received. As a result, several issues were identified during the paper prototyping process, such as: incomplete interfaces and missing links, failure to generate tasks and the reluctance from some of the participants to sketch solutions. Figure 2 shows examples of the low fidelity prototype screen elements.

At this point, the participants had begun to draw inspiration from already familiar tools such as PowerPoint to provide this functionality. Thus, the low – high fidelity prototype design was born (Figure 3) and the resultant formative evaluation results presented. MLCAT requires that it is installed on Microsoft Windows XP operating system or higher, running PowerPoint 2007 and .NET framework 3.5 or higher. Once PowerPoint is launched, it creates an add-ins tab which houses the application interface. The interface ribbon has five functions as shown in Figure 3 namely: *create video* – which provides the recording controls, *take screenshot* – which takes a snap shot of a page, *preview video* – which allows users to preview

Figure 1. PD workshops with lecturers

Figure 2. Sample paper prototype screen elements

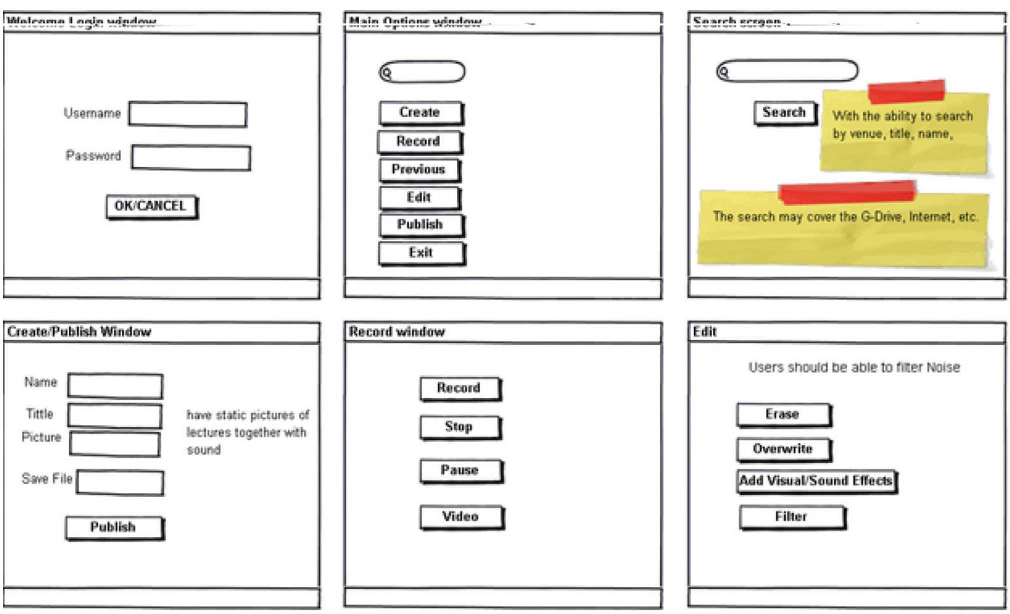
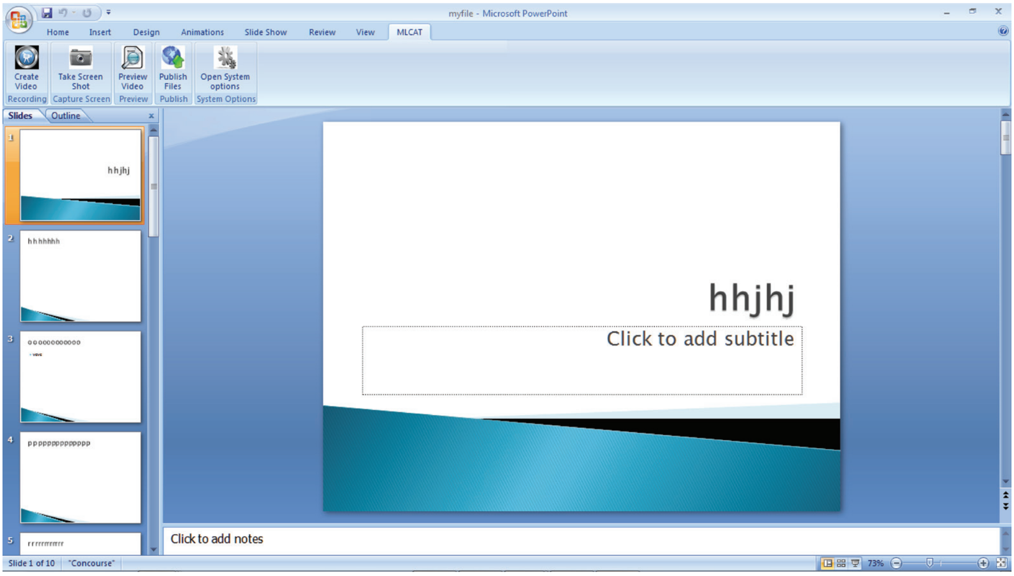


Figure 3. Sample paper low – high fidelity MLCAT prototype



recordings, publish files to a Learning Management System or server and lastly *open system options* in order to adjust tool settings.

Evaluation results indicated that the prototype was successful in revealing usability issues. The primary goal of formative evaluation was to collect information about the perceptions on learning effectiveness, users' satisfaction and identify any usability issues early in design (Boehner, 2007; Mäkelä, 2001). In order to achieve this, we used five of the participants who took part in the PD sessions individually to act as users. The reason for individual sessions was because we could not get them to take part in a group formative evaluation due to their busy schedules. The participants were given an introductory briefing about the high-fidelity prototype, user goals and requirements derived from the PD sessions. In terms of users' perceived learning gain, the majority of participants reported that the tool is easy to learn and in terms of users' satisfaction, users were enthusiastic to use the tool. The positive results of the formative evaluation confirm that the user-centered design process allows for designing and implementing usable software. However, a number of issues were pointed out as described.

Layout

- The prototype had two preview buttons which was confusing. The preview after recording and preview to edit. We therefore eliminated both and ended up with "preview" functionality.
-

Functionality

- One user suggested a reduction in the number of steps required to produce the end product.
- The users insisted on the need for the tool to offer support for fault tolerance.
- Participants also expressed the need for the tool to be as non-intrusive as possible and more intuitive.

Navigation

- Two of the users suggested that the navigation needed to be improved and that the tool should provide meaningful alerts and prompts.

Terminology

- Some terminology had to be re-thought, for instance some users did not understand what "publish" or "upload" meant. Just as in the first design session, the participants needed clarification on some of the terms for example *"publish"* – they preferred to use *"distribute"*.

The screen designs produced during the design activity revealed a trend towards simplicity. There was a need to strike a balance between functionality and the number of steps to accomplish a lecture podcasting task. They also verified the assumptions about what users minimally expected on a podcasting tool, i.e., record, encode, preview and upload. The result was that the ideas captured in the prototype sessions were perpetuated into the second action research cycle where a high fidelity prototype was to be generated.

4. THE SECOND AR CYCLE

4.1. Analysis, Fact Finding and Conceptualization

In this cycle the designers analyzed the users and their context from a technical standpoint based on the findings from the previous cycle. For example, the need for more automation (reduction in the steps required to create a podcast/vodcast); integration of podcasting activities with already existing systems and the design of a tool that is intuitive (requires limited training). In addition at MUK there are frequent power outages. The results were then used to generate a detailed requirements specification and produce a high fidelity prototype.

4.2. Action Planning–System Requirements

The designers decided that a tool with the ability to offer the following advantages was needed:

- Reduce lecturer involvement through automation to a high degree.
- Reduce the pressure on the university infrastructure.
- An all in one tool that would utilize already familiar applications as opposed to the use of various tools (i.e., iMovie, Windows Movie Maker and Audacity) to achieve the end product as is done currently.
- Integration with other existing tools, i.e., Vula – a learning management system (LMS) used at UCT; and Moodle – another open source LMS used at Tsiba – a not for profit HEI that offers business degrees; and the snap and grab system.

4.3. Action Planning–The User Requirements

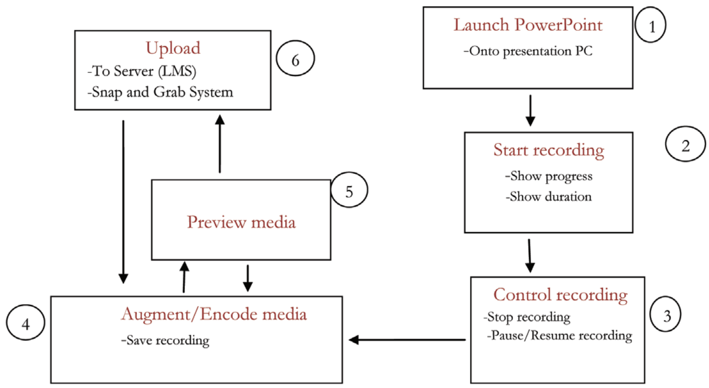
The MLCAT design listed the following as the features to successfully accomplish a podcasting task, i.e., "Launch PowerPoint," "start recording," "control recording," "encode media," "preview," and "upload" (Figure 4).

4.4. Action Implementation–The MLCAT Design

The MLCAT design consisted of a Windows-based application that offers the ability to record PowerPoint lecture presentations, with the presenters' audio, and encode the content into a mobile compatible video format. Ultimately, this led us to using the .NET environment as it offers the ability to develop extensions or add-ins for Microsoft Office applications. In particular, we designed our tool functionality into the PowerPoint ribbon interface.

We then developed click events to offer the varying functionality provided by the MLCAT tool such as recording, previewing, encoding and saving. The system allows the lecturer to capture their PowerPoint slides, presentation audio and convert this into a video recording that can be played back on cell phones. Once the user is satisfied with their recording, they can upload it to a Learning Management System or the Snap and Grab system (Maunder & Marsden, 2008), an application used for sharing files using Bluetooth or uploading to a shared volume. Figures 5, 6, 7, 8, and 9 give an

Figure 4. MLCAT tool features



overview of the prototype screen elements, the system architecture and mobile content samples.

5. FINDINGS AND REFLECTIONS/DISCUSSIONS

Based on our experiences during the process of designing MLCAT, we believe that the approach utilized has been successful in accessing our stakeholders and developing a tool that will cater for their needs and benefits. We have also been able to reflect on a number of obstacles that must be carefully navigated when working with lecturers and students in this way, as well as the relative success of individual methods used at different stages within the process.

In this section, we discuss our findings and outline recommendations for any project utilizing a similar approach.

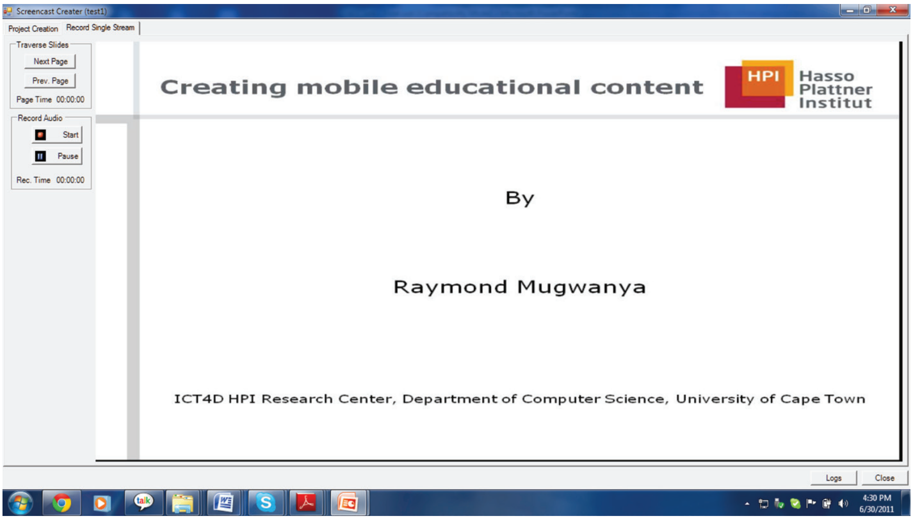
5.1. Key Strengths

The main strength of the Participatory AR approach lies in the longitudinal deployment of prototype systems in the real world, where actual usage can be observed over an extended period of time, while providing participants with concrete examples of a novel technology being used in their environment. We are currently in the process of deploying our system at Tsiba (http://www.tsiba.org.za/). In our deployment meetings, users seem certain of the role the tool might play in their institution and as a result, how they intend to use it in their environment. As the participants begin to learn about the technology and its implications, we will continue to learn about our participants and build relationships with them through usage logs, interviews and participatory workshop meetings.

5.2. Finding Participation

As our approach relies heavily on participation of lecturers and students; their feedback and usage of the prototype system, one of the first tasks is acquiring willing participants. During our baseline studies, we used participants at UCT and MUK in order to understand their work environments and later on build relevant prototypes. By the time our first working prototype was developed, some of our initial participants had since moved on to using other technology to record lectures. In addition, UCT is in the process of introducing another system called Opencast (http://www.opencastproject.org/content/berkeleys_next_generation_web-castpodcast_system/). As a result, the initial baseline study participants are confused by the number of tools that have been introduced thus far in such a short space of time, making the researchers re-think their deployment strategy. Moreover, our deployments came at a time when end of semester one exams were almost underway. Typically, lecturers and students were so

Figure 5. MLCAT main screen



busy and there was normally no active teaching going on during the time in order to conduct trials. Therefore, the researchers contacted the Extra Mural Studies department, the distance learning division at UCT, but they were only due to undertake courses in August 2011. They however linked us to one of the directors at Tsiba who was very enthusiastic about mobile learning. We then had initial contact and identified three lecturers and a librarian who are going to take part in the deployment trials at the start of semester in 2011. The influence of the Director at Tsiba – a technology champion (Heeks, 1998) - aided finding participation for

Figure 6. Compile and save video interface

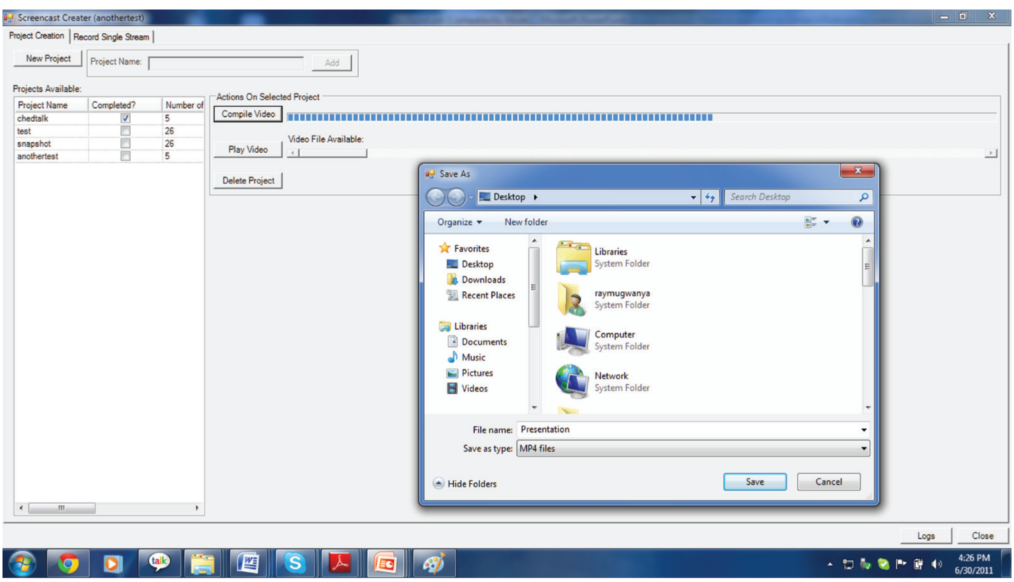
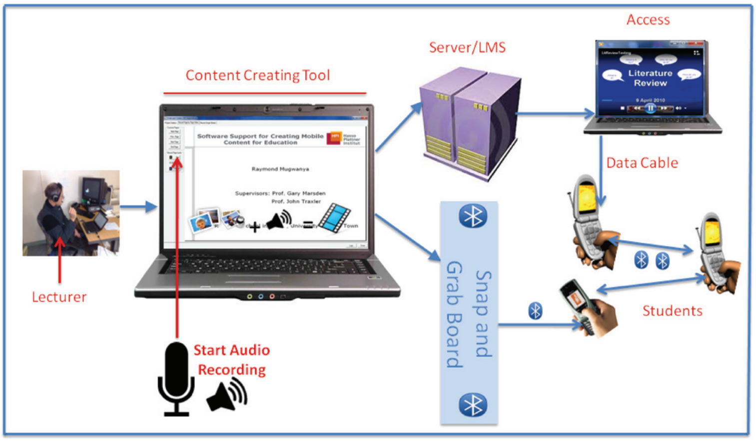


Figure 7. MLCAT architecture



our trials considerably. Further deployments at Makerere University in Uganda with willing participants are ongoing.

5.3. Selection of Methods

As noted previously, the selection of techniques used in making observations, gathering feedback and designing with participants remained flexible. Naturally, suitable techniques varied between settings and participants, and thus the choice of techniques was a matter of past experience, expert knowledge and a certain amount of trial and error made possible by the iterative nature of the approach. For instance, academics had heavy workloads and tight schedules therefore conducting design sessions with busy professionals demanded preparation, improvisation, and clarity of purpose. We needed techniques to gather and engage them within a short time frame. As a result paper prototyping during the Participatory Design sessions, quick and dirty ethnography and qualitative and quantitative studies were used. There was a strong consensus that these methods formed an essential part of eliciting requirements and

Figure 8. Video lecture on Nokia N95

Figure 9. Video lecture on Nokia 6120

evaluating design ideas for interactive systems. It was often the most simple of approaches that yielded the most success, including largely unstructured discussions to gather on-the-spot feedback from casual conversation rather than structured investigation, where respondents seemed less comfortable and vocal.

5.4. Expecting the Unexpected

Throughout the project, flexibility had been a necessity; rarely had an arranged meeting proceeded in the way we had planned. At various meetings, we found that the purpose of the session may have been mis-communicated, participants may have had more pressing issues to discuss, or may simply have been uncomfortable with the material we had prepared. In each of these cases, rather than enforcing our original plans, we chose instead to adapt them and focus on the participants' concerns, while gently guiding them towards any particular questions that we had hoped to address during the session. Although occasionally frustrating, each of these sessions proved fruitful despite the change in plans. Indeed, participants seemed most vocal when sessions had been steered in a direction they felt was interesting or important, whereas they often fell silent when presented with a task with which they were not comfortable. For instance the unsuccessful attempt at user interface sketching, prioritizing scenarios and surprisingly having no idea what sort of design was required despite providing useful key features that they hoped the tool would have. We therefore decided to consolidate the ideas from the workshops to create low – high fidelity prototypes which the participants evaluated formatively.

5.5. Influence of the Technology Champion

We cannot overstate the importance of the role our technology champion played in the project. Her help was vital in communicating with the lecturers, initiating contact with key personnel and securing participants as well as offering advisory support. Without her input, it was unlikely that we could have maintained our productive relationship with the lecturers.

That said, we often felt that her strong views in relation to technology and assertive personality had the potential to distort feedback from the lecturers and direct the flow of discussion groups in directions that were not always helpful. Often, she seemed to pressure the participants to use the technology, although it was clear that some participants might not have been interested. This may be a trade-off that must be accepted and negotiated in exchange for the benefits brought by the champion; as it were these very same characteristics that made her an ideal contact and spread the word of the project around the community.

5.6. Influence of Researchers

Our champion was certainly not alone in attempting to influence the direction of the deployment. As researchers, it was difficult, particularly when involved deeply in a project for a long period of time, to remain free of preconceived ideas and wishes for the development of the system. Certainly, it was expected that researchers bring their own expertise to the process and guide participation, but they must be aware of this influence and willing to embrace alternate ideas in response to feedback received from participants. Early in our project, based on earlier feedback, we thought that participants would want to record entire live lectures during class but it became apparent that they only wished to record different aspects of their courses. For instance, one participant expressed the need to record video of only the models that are covered in their strategic management course as opposed to the theoretical aspects.

5.7. Reliability

From a more technical perspective, it was important to ensure that prototypes remained reliable, despite being developed and deployed rapidly. The use of off-the-shelf components to build prototypes rather than a bespoke solution helped to ensure the reliability of the hardware, whereas the relative simplicity of the system limited software problems. Interestingly, we eliminated the need for students to download content directly onto their cell phones using the mobile internet because of the cost involved. Therefore once the recordings were uploaded, they could be downloaded from Moodle using PC Internet at Tsiba and transferred to cell phones by data cables or directly from the snap and grab system via Bluetooth.

5.8. Generalization

Finally, we must consider the ability to generalize any research conducted using this approach. Since we positioned our work as a means of learning about a community and its use of novel technologies, generalization was certainly a concern. Baskerville and Wood-Harper (1996) recognized this same issue in their analysis of action research, but also noted that it applied to much of social science research generally. The longitudinal nature of our approach meant that, at the very least, results reflected a far broader sample of usage than could be achieved in lab-based trials of prototypes, taking into account long-term rhythms of community life, but there remained an issue of determining to what extent the deployment site was representative of the target environment in general. We treated our work as an exploratory venture of HEIs, which could be validated by subsequent studies in different settings utilizing the same approach. On a practical level, our approach would also lend itself well to parallel deployments, as deployments did not require constant attention and it was entirely feasible to timeshare between different study sites.

5.9. Ethical Dilemmas

While the collaboration and close contact between researchers and lecturers (or other research subjects) yielded many benefits, this contact may often lead to some challenges. For instance some lectures had concerns about re-distributing copyrighted material to students in digital form. However, the authors cleared this with the lecturers and management by assuring them that as long as they do not re-distribute the content at a fee, they will not in breach of any laws.

6. SOME LESSONS LEARNED

Below are some of the lessons we have learnt thus far:

- **Lesson #1**: **Users may not be in position to visualize how they would like their ideal systems to appear**

Lecturers had heavy workload and tight schedules therefore paper prototyping was a suitable approach to soliciting crucial requirements, as low fidelity prototypes were fast and easy to create. The first step normally involved an introduction of paper prototyping and participatory design to participants while presenting examples in order to give a clear overview and the type of artifacts designers hope to achieve at the end of the process. However, in our experience, we felt that showing examples may have biased participants because they all tended to draw similar screen elements to the ones we had shown them. Similarly, a number of steps in the paper prototyping process such as encouraging users to present a set of goals, risks and concerns that they agree upon and translating user goals and questions into tasks did not yield much. During these sessions, we identified the key functionality that was minimally required to create a podcast. We printed each item on a single A4 sheet of paper and engaged the participants in arranging the functions in the order they would follow to create a lecture podcast. The participants found this activity interesting and it stimulated discussions on terminology as well.

- **Lesson #2: Use technology probes**

During the early requirements phases, it was clear that users needed a tool that would automate recording to a high degree but also record entire lectures as they happen in class. During our initial deployment meetings, we found out that participants wanted to record certain aspects of their courses. For instance one of the lecturers just wanted to record short clips of the sections that he thought students find difficult (to avoid providing answers to the same question repeatedly to different students by referring them to the recording). Others only wanted to make recordings of models and not the theoretical aspects of the course. These are interesting usage scenarios which we would never have anticipated.

- **Lesson #3: Do not underestimate the power of a technology champion**

We reiterate that it was essential for researchers in developing regions to identify and use the help of technology champions. The environment in which technology interventions were used could help researchers uncover valuable socio-cultural information through observations of users situated within the context of the greater community. The mere fact that we brought along new technology was enough to draw attention within the community. The technology champion introduced the researcher to their campus, provided a guided tour and introduced them to a number of lecturers who showed very keen interest and took part in trials. Unlike traditional snowball sampling wherein respondents recommend who the researcher should interview next, the champion made community members excited enough that they undertook the responsibility of recruiting subjects voluntarily on behalf of the researchers.

- **Lesson #4: Use artifacts to assess the technology baseline**

The technology baseline of users in developing HEIs particularly in the mobile education space could often be a surprise. Luckily, our participants in some cases had trailed some podcasting tools. These technology artifacts aided our interviews in such a way that they provoked discussion about previous exposure. Also, given the level of education of our stakeholders, even in instances where they had not directly used a tool, they provided an opinion of how they envisaged the resultant future design. Therefore, artifacts were useful tools in provoking stakeholders to share thoughts about issues concerning the design and use of technology.

7. CONCLUSIONS AND FUTURE WORK

This paper has explored how an Action Research approach was able to influence the success in the design of a podcasting system. Owing to the commitment to understanding work practice and the high level of interaction with lecturers and students at three developing HEIs through the baseline study, we were able to identify the risk that a number of tools developed in contexts different from users (e.g., the Western World) could not necessarily be effectively customized and used to achieve podcasting purposes. We were also able to identify different ways in which participants decided to use the tool which were different from what the designers had initially anticipated. For example, we thought that participants would record their entire lectures in order to make them available to students. However, lecturers expressed the need to break down their courses into very small chunks and record those, as well as recordings aspects that students normally find difficult to understand. The use of the proposed tool will hopefully directly contribute to its success, particularly if this continues beyond the initial deployment trials. We were also able to better deal with unanticipated events such as the launch of Opencast at UCT, a new open source podcasting tool, which could have potentially ended the project.

Through this case study we have reflected on how the Action Research methodology contributed to designing and implementing a podcasting system for a developing HEI environment that was useful and useable. In addition to providing this experience for participants, researchers themselves were able to gain an understanding of the community both from their own interactions with participants and from data that were collected by the prototype. Initial discussions with faculty at Tsiba highlighted various considerations that should be taken into account when utilizing this approach, many of which may equally apply more generally to iterative, participatory approaches. Our findings have included reflections on possible conflicts of interests between researchers, technology champion, other participants and the need for reliable prototypes. Most importantly, we have witnessed repeatedly that agility and flexibility, both in terms of prototype systems deployed and our interactions with participants are key to maintaining their interest and enthusiasm and being able to adapt rapidly to feedback. These were valuable lessons, which could be incorporated into our future work (i.e., our third Participatory AR cycle) for this study and other environments.

REFERENCES

Bailey, B. P., Biehl, J. T., Cook, D. J., & Metcalf, H. E. (2008). Adapting paper prototyping for designing user interfaces for multiple display environments. *Personal and Ubiquitous Computing*, *12*(3), 269–277. doi:10.1007/s00779-007-0147-2

Baskerville, R. (1999). Investigating information systems with action research. *Communications of the AIS, 2*(19).

Baskerville, R. L., & Wood-Harper, A. T. (1996). A critical perspective on Action Research as a method for information systems research. *Journal of Information Technology*, *11*(3), 235–246. doi:10.1080/026839696345289

Beyer, H., & Holtzblatt, K. (1997). *Contextual design*. San Francisco, CA: Morgan Kauffmann.

Bidwell, N. J., Reitmaier, T., Marsden, G., & Hansen, S. (2010). Designing with mobile digital storytelling in rural Africa. In *Proceedings of the 28th International Conference on Human Factors in Computing Systems*. Retrieved from http://portal.acm.org/citation.cfm?doid=1753326.1753564

Blake, E., & Tucker, W. (2006). Socially aware software engineering for the developing world. In *Proceedings of the IST-Africa Conference*.

Boehner, K., Vertesi, J., Sengers, P., & Dourish, P. (2007). How HCI interprets the probes. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1077-1086). New York, NY: ACM.

Chetty, M., Tucker, W., & Blake, E. (2004). Developing locally relevant software applications for rural areas: a South African example. In *Proceedings of the Annual Research Conference of the South African Institute of Computer Scientists and Information Technologists on IT Research in Developing Countries*, Stellenbosch, South Africa (pp. 239-243). New York, NY: ACM.

Evans, C. (2008). The effectiveness of m-learning in the form of podcast revision lectures in higher education. *Computers & Education*, *50*(2), 491–498. doi:10.1016/j.compedu.2007.09.016

Grudin, J., & Pruitt, J. (2003). Personas, participatory design and product development: An infrastructure for engagement. In *Proceedings of the Conference on Designing for User Experiences* (pp. 1-15). New York, NY: ACM.

Heeks, R. (1998). *Information system for public sector management (Paper No. 4)*. Manchester, UK: Institute of Development Policy and Management, University of Manchester.

Heeks, R. (2004). Information systems and developing countries: Failure, success, and local improvisations. *The Information Society*, *18*(2), 101–112. Retrieved from http://www.informaworld.com/openurl?genre=article&doi=10.1080/01972240290075039&magic=crossref||D404A21C5BB053405B1A640AFFD44AE3 doi:10.1080/01972240290075039

Kam, M., Agarwal, A., Kumar, A., Kumar, A., Lal, S., Mathur, A., et al. (2008). Designing e-learning games for rural children in India: A format for balancing learning with fun. In *Proceedings of the 7th ACM Conference on Designing Interactive Systems* (pp. 58-67). New York, NY: ACM.

Kam, M., Ramachandran, D., Sahni, U., & Canny, J. (2005). Designing educational technology for developing regions: some preliminary hypotheses. In *Proceedings of the Fifth IEEE International Conference on Advanced Learning Technologies* (pp. 968-972). Washington, DC: IEEE Computer Society. Retrieved from http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=1508873

Kim, P. (2009). Action research approach on mobile learning design for the underserved. *Educational Technology Research and Development*, *57*(3), 415–435. doi:10.1007/s11423-008-9109-2

Kim, P. H. (2008). Action research approach on mobile learning design for the underserved. *Educational Technology Research and Development*, *57*, 415–435. Retrieved from http://www.springerlink.com/content/l2418241405w3h42/ doi:10.1007/s11423-008-9109-2

Kumar, A., Tewari, A., Shroff, G., Chittamuru, D., Kam, M., & Canny, J. (2010). An exploratory study of unsupervised mobile learning in rural India. In *Proceedings of the 28th International Conference on Human Factors in Computing Systems* (pp. 743-752). Retrieved from http://portal.acm.org/citation.cfm?doid=1753326.1753435

Lonn, S., & Teasley, S. (2009). Podcasting in higher education: What are the implications for teaching and learning? *The Internet and Higher Education*, *12*(1), 88–92. doi:10.1016/j.iheduc.2009.06.002

Maguire, M. (2001). Methods to support human-centred design. *International Journal of Human-Computer Studies*, *55*(4), 587–634. Retrieved from http://linkinghub.elsevier.com/retrieve/pii/S1071581901905038 doi:10.1006/ijhc.2001.0503

Mäkelä, K., Salonen, E.-P., Turunen, M., Hakulinen, J., & Raisamo, R. (2001). Conducting a Wizard of Oz experiment on a ubiquitous computing system doorman. In *Proceedings of the International Workshop on Information Presentation and Natural Multimodal Dialogue*, Verona, Italy (pp. 115-119).

Malan, D. J. (2007). Podcasting computer science e-1. In *Proceedings of the 38th ACM Technical Symposium on Computer Science Education*, Covington, KY (pp. 389-393). New York, NY: ACM.

Maunder, A. J., & Marsden, G. (2008). SnapAndGrab – Accessing and sharing contextual multi-media content using Bluetooth enabled camera- phones and large situated displays. In *Proceedings of the Extended Abstracts on Human Factors in Computing Systems* (pp. 2319-2323). New York, NY: ACM.

Maunder, A. J., Marsden, G., Gruijters, D., & Blake, E. (2007). Designing interactive systems for the developing world - reflections on user-centred design. In *Proceedings of the International Conference on Information and Communication Technologies and Development* (pp. 1-8). Washington, DC: IEEE Computer Society. Retrieved from http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=4937419

Mugwanya, R., & Marsden, G. (2010). Mobile learning content authoring tools: A systematic review. In *Proceedings of the 1st Conference on E-Infrastructures and E-Services on Developing Countries* (pp. 20-31).

Mugwanya, R., Marsden, G., & Boateng, R. (2011). A preliminary study of podcasting in developing higher education institutions: A South African case. *Journal of Systems and Information Technology*, *13*(3), 268–285. doi:10.1108/13287261111164853

Muller, M. J. (1991). PICTIVE -An exploration in participatory design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: Reaching through Technology* (pp. 225-231). New York, NY: ACM.

Ng'ambi, D. (2008a). Podcasting for reflective learning. In Salmon, G., & Edirisingha, P. (Eds.), *Podcasting for learning in universities* (pp. 132–145). Milton Keynes, UK: Open University Press.

Ng'ambi, D. (2008b). Podcasts for expansive learning: a case of reflective student stories. *South African Computer Journal*, *42*, 9–13.

Ramachandran, D., Kam, M., Chiu, J., Canny, J., & Frankel, J. F. (2007). Social dynamics of early stage co-design in developing regions. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 1087-1096). New York, NY: ACM. Retrieved from http://portal.acm.org/citation.cfm?doid=1240624.1240790

Simonsen, J., & Kensing, F. (1997). Using ethnography in contextual design. *Communications of the ACM*, *40*(7), 82–88. doi:10.1145/256175.256190

Snyder, C. (2003). *Paper prototyping: the fast and easy way to design and refine user interfaces*. San Francisco, CA: Morgan Kauffman.

Von Hippel, E. (1986). Lead users: a source of novel product concepts. *Management Science*, *32*(7), 791–806. doi:10.1287/mnsc.32.7.791

Zimmerman, J., Forlizzi, J., & Evenson, S. (2007). Research through design as a method for interaction design research in HCI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 493-502). Retrieved from http://portal.acm.org/citation.cfm?doid=1240624.1240704

Raymond Mugwanya is a PhD candidate of Computer Science at the HPI Research Center in ICT4D, University of Cape Town, South Africa. He is also a member of staff from Makerere University in Kampala, Uganda. His research interests are HCI, Usability Evaluation, User Centered Design, Participatory Design, Ethnographical methodologies, Learning technologies, multimedia development, web technologies. Raymond has published parts of his PhD research in a number of international conferences and Journals.

Gary Marsden, PhD is a professor of Computer Science at the University of Cape Town, South Africa. He is also the Director of the Hasso Plattner Institute Research Center in ICT4D at UCT. Gary's research interests are in the broad area of Mobile Interaction Design and ICT for Development. Prof. Marsden has published widely in a number of international conferences and journals

Dick Ng'ambi, PhD is an associate professor of information systems at the University of Cape Town, South Africa. He works for the Center for Educational Technology (CET) which has an institutional mandate to enable, develop, investigate and evaluate pedagogically effective, innovative and transformative uses of information and communication technology for teaching and learning. His research interests are in informal learning, collaborative learning, intelligent tutoring systems, mobile learning, reflective learning, and social networking. Dr. Ng'ambi has published widely in a number of international management information systems and computer science academic journals, conference publications, and books.

John Traxler is Professor of Mobile Learning and Director of the Learning Lab at the University of Wolverhampton. He is a Founding Director of the International Association for Mobile Learning, Associate Editor of the International Journal of Mobile and Blended Learning *and of* Interactive Learning Environments. *He is on the Research Board of the Association for Learning Technology, the Editorial Board of Research in Learning Technology and of IT in International Development. He was Conference Chair of mLearn2008, the world's biggest and oldest mobile learning research conference. He has guest edited three special editions of peer-reviewed journals devoted to mobile learning including Distance Education. John has co-written a guide to mobile learning in developing countries and is co-editor of the definitive book,* Mobile Learning: A Handbook for Educators and Trainers*, with Professor Agnes Kukulska-Hulme. They are working a second book on contextual mobile learning. He is an Academic Reviewer for the ESRC Peer Review College and is on the Steering Group for the USAID mEducation Alliance.*