USING PAPER PROTOTYPING AS A RAPID PARTICIPATORY DESIGN TECHNIQUE IN THE DESIGN OF MLCAT - A LECTURE PODCASTING TOOL

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ABSTRACT

Podcasting has permeated the developed world higher education environments. Despite this, there is inadequate research published to explore podcasting in developing Higher Education Institutions. In areas with limited electricity, never mind the internet, how can podcasting succeed? This paper describes Participatory Design activities with university lecturers in sub-Saharan Africa (University of Cape Town and Makerere University) to design a podcasting tool. We postulate that by involving them in the design, we can identify specific requirements and they will accept and use the tool. Academics have heavy workloads and tight schedules and conducting design sessions with busy professionals demands preparation, improvisation, and clarity of purpose. Therefore, this paper presents the use of paper prototyping technique during the two hour Participatory Design sessions with lecturers in the design of a horizontal MLCAT prototype. In addition, we present formative evaluations that reveal insightful results which will be used in the further implementation of the tool.

KEYWORDS

Podcasting, mobile education, PD, Paper Prototyping, Podcasting Tools, African HEIs

1. INTRODUCTION

Podcasting has permeated the developed world higher education environments. Despite this, there is inadequate research published to explore podcasting in developing regions, particularly African Higher Education Institutions. Within Africa, South Africa is regarded as an advantaged country. In terms of GDP, by 2006, it rated 29th (International Monetary Fund 2007) which was two-and-a-half times higher than the next African country on the list (Nigeria at 48th). With this position on the African continent, one expects SA to be far ahead of its African counterparts in terms of ICT infrastructure. Indeed, SA is well positioned and in as far as ICTs diffusion in higher education in Africa is concerned, it is one of the few African countries that have trialled with mobile learning initiatives such as the use of short messaging service to increase student participation and most recently are keen on Podcasting. - *"a form of mobile learning in which audio or video content, available on the internet or some server can be downloaded onto a computer then transferred to mobile devices for consumption"* [6].

However, according to [7], generally, Higher Education Institutions (HEIs) in developing regions are still lagging behind in terms of exploring the use of technology for learning, particularly Podcasting. The majority of existing published works report on tools and their usage in developed regions HEIs with little or no instances published for developing regions. Moreover, a number of key issues still impact on Sub Saharan African HEIs such as: the number of Internet users is higher than the availability of personal computers which indicates how critical community facilities and work environments are in providing access to ICTs, Internet costs constitute an important issue for academics and students alike and it is quite fair to say that SA are the most expensive country in Africa and one of the most expensive in the world; Limitations in bandwidth impact on the teaching in learning environment governing what is possible and what is easy to do; inadequate skilled human resources and we still need to be very conscious of divides amongst our students as access levels remain disparate between demographic groups [13].

In addition, much of SSA has relied on technologies from the developed world (Learning Management Systems (LMSs) such as WebCT, Blackboard and most recently open source LMSs like KEWL and Moodle) which in most cases are not transferable due to the various social, economic and cultural constraints.

Therefore, just as researchers in the Human Computer Interaction for Development (HCI4D) and Information and Communications Technology for Development (ICT4D) communities, we reiterate the need for contextual tools. We postulate that by involving academics in design, we can get a deep knowledge of their work context and needs, identify specific requirements and ensure that they accept and use the technology [2]. Participatory Design, according to [4], facilitates working directly with users to design social systems. However, academics are busy with their teaching schedules, hence the need for techniques to gather and engage them within a short time frame. We therefore use paper prototyping during the Participatory Design sessions. There is a strong consensus that paper prototyping forms an essential part of eliciting requirements and evaluating design ideas for interactive systems [5]. It facilitates rapid iteration on design and ultimately significant usability improvements with minimal investment in time and resources. In this paper, we report on our two hour participatory design sessions with academics from two African universities. Present insightful results from our formative evaluations which will be used in the further implementation of the tool and finally present conclusions and future work.

2. THE MLCAT TOOL DESIGN

In our previous works, we conducted a concurrent mixed study with faculty and students at the university of Cape Town (UCT) and only academics at Makerere University Kampala (MUK) (because there were no instances of Podcasting) in order to understand their contexts. We noted that UCT currently had a manual method of recording, processing and distribution of podcast lecturers. Moreover, the entire production process was left to the technicians. Although to some, this may seem ideal, our preliminary studies have shown that as a result, the academics distanced themselves from the entire lecture podcast production process, did not know what happened to the recordings after class, where they were stored and whether or not they were made available to students. In order to assist in automating the process and empowering academics to podcast lectures, we utilize the work of [2][4][5][9][11] and the call for open approaches in design and evaluation, instead of using hypothesis testing based methods to provoke inspirational responses. Consequently, we organized three participatory design workshops with users from UCT and MUK in which the researcher was the designer and facilitator. In particular, we use the work of [12] to develop low – to – high fidelity prototypes during the participatory design sessions.

3. METHODOLOGY

Paper prototyping is a widely used and validated technique for exploring, communicating, and evaluating early interface designs [8][12]. Prototypes are typically constructed using combinations of stock paper to represent main interface screens, overlays and sticky notes to represent results from user interaction, colored pens and pencils to sketch content, etc. Paper prototyping has many benefits during the design process. These benefits include allowing rapid externalization of design ideas with low investment and allowing numerous alternatives to be generated and tested early in the design cycle. The primary limitation of constructing paper prototypes is the lack of complete realism in the resulting interaction, but this is generally a worthwhile tradeoff for the ability to explore numerous alternatives early in the design cycle. Participatory Design (PD) enables end users to become part of a design team as well as test the usability of systems. Therefore, involving users in design facilitates the elicitation of requirements and early refinements. In this study, we used academics from the Information Systems Department because they were lead users [14] of the podcasting technology and those from Computer Science because they were trialing an open source tool called OpenEyA (*http://sourceforge.net/projects/openeya*). Typically, industrial environments use from seven participants and more during PD sessions [3].

However, published works such as that of [3] use from four participants and during PD sessions, the researcher(s) normally takes on multiple roles such as the developer, designer and facilitator. We therefore feel that the seven participants used in this study are sufficient. The academics were told that they were users and that they were going to be involved in designing a podcasting tool. Thus as users, they know their specific needs and their involvement in the design, would ensure use of the system.

4. PROCEDURE

Three participatory design sessions were conducted on different days at UCT and MUK. Seven participants were selected among Computer Science and Information Systems lecturers at these universities. They were divided into three groups (one with three participants and the others with two each) in which the researcher acted as the facilitator for each group. Two participants who had initially volunteered to take part did not turn up hence the two groups with two members each. Figure 1 below shows an example from our PD sessions.

Figure 1. A few examples from our PD sessions

During the PD workshops, participants were briefed about the overall objectives of the sessions and the goals to be accomplished. Then they were introduced to the paper prototyping technique in which the following aspects were highlighted as presented by [12]:

1) An introductory briefing on the history of paper prototyping, its relevance and use in the industry and how it relates to participatory design.

2) Participants were also informed that they were learning paper prototyping. They were further told that there is no right or wrong answer and were free to explore their creative side.

3) The three groups worked separately in developing the prototypes, which meant that at the end of the sessions, a number of requirements were elicited. All the members in each group collaboratively developed the prototypes.

4) The participants were briefed about the stationeries and materials used to develop paper prototypes. This was followed by showing the participants samples of paper prototypes in order to stimulate their design.

5) The benefits and the positive aspects of paper prototyping were highlighted throughout the briefing, to convince skeptics and to encourage the participants to give their full commitments.

In the first step, the concept of user goals was explained to the participants. They were also reminded that they were the users and that they were developing a podcasting tool. Thus, as users, they know their specific needs. They were asked to think about the things that they do frequently and the things that were important. Next, they were asked to list a set of questions regarding the functionality, navigation and terminologies to be used in the prototype. They were also asked to prioritize activities although they all validated the idea that that all activities were of equal importance.

We then presented the participants with story-boards showing activities (that simulate the production of a lecture podcast) in order to stimulate them to think about podcasting. They were required to re-arrange them starting with the first activity to the last. After each session, a walkthrough (which is a rehearsal in which any problems can be detected and corrections made) was done in order to identify any issues and for the participants to justify their choices. The groups then started developing the prototypes with the assistance of the facilitators. This is the moment where they could explore their creative side to design the tool. Because academics are busy and we only had 1.5 – 2 hours for each of the sessions, paper prototyping during the PD sessions helped in eliciting user goals and identifying requirements for our tool.

5. RESULTS

5.1 Design Sessions

At this stage our goal was not to come up with a complete tool as each participant only afforded us two to three incomplete screens. Therefore, this study does not undertake PD in the strictest sense (as that would require longer multiple sessions working towards a final agreed design) but facilitates opening up of the design space and uncovering a number of crucial requirements. As a result, several issues were identified with the prototypes, such as: incomplete interfaces and missing links; failure to generate tasks and the reluctance from one of the participants to sketch solutions. 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 verified the assumptions about what users minimally expected on a Podcasting tool: record, capture screen shot, preview, edit, publish and modify settings. Figure 2 below illustrates an example of the prototype elements that were created by our participants.

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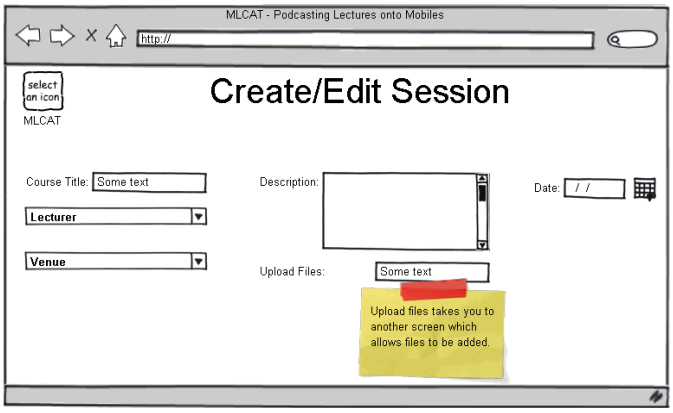

Figure 2. Sample paper prototype

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In this light, it was interesting that, all our participants were wary of using varying tools (i.e. iMovie, Windows Movie Maker and Audacity) to achieve the end product as is done currently. They expressed the need for an all in one tool that would fit in with their existing tools. During the design sessions, all participants' discussions revolved around the use of PowerPoint to deliver their lectures. In fact all of the participants expressed the view of using existing tools in such a way that it would not require further the use of separate tool to perform certain functions such as record, edit and encode recordings. Therefore, rather than think of our system as a stand-alone application, we started to integrate the ideas into a PowerPoint metaphor – to think of the system as an extension to an already familiar application.

The faculty who had experimented with Podcasting at two South African universities used an audio recorder and later on audacity software to edit recordings. This normally took a number of weeks before they were uploaded onto the server. We sought to capture both the lecturer presentation and audio therefore the overall design goal was to offer a "one stop shopping" for authoring Podcasts. 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 use VB.Net to design interface ribbons onto which we developed click events to offer the varying functionality provided for by the MLCAT tool such as recording, previewing and editing a recording, encoding and publishing. The system allows the lecturer to capture their presentation speech, convert the PowerPoint slides into images, augment them and create an MPEG video that can be played back on mobile phones. MLCAT also provides the means to perform minor edits such as delete or add slides and trim audio.

Once the user is satisfied with their recording, they can encode and publish it onto Vula – the LMS used at UCT, upload it to the Snap and Grab system (An application used for sharing files using Bluetooth) or upload to a shared volume. Having built a first high-fidelity prototype, we needed to further refine the design and therefore undertook formative evaluations, as detailed in the section that follows. This integrated prototype is shown in Figure 3 below.

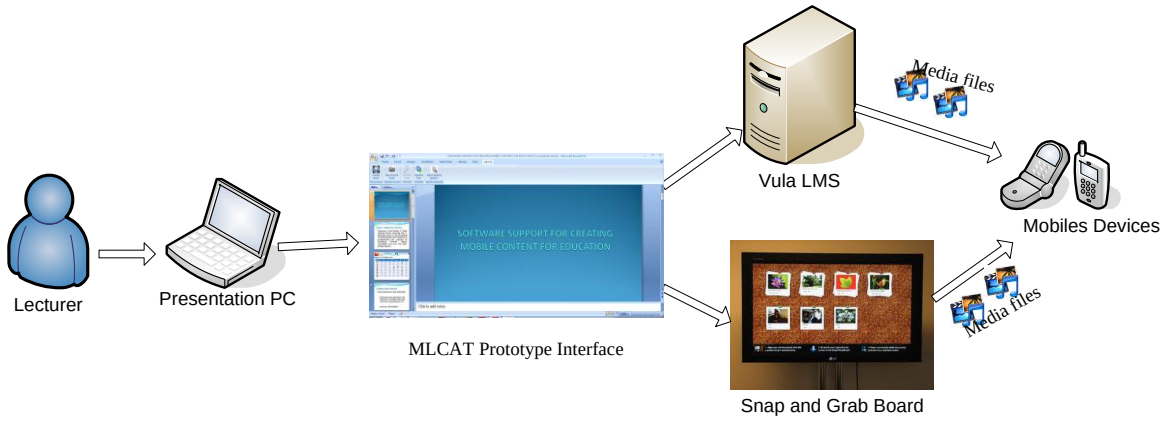

Figure 3. Sample MLCAT Prototype Interface

5.2 Formative Evaluation

The primary goal of formative evaluation is to collect information about the perceptions on learning effectiveness, users' satisfaction and identify any usability issues early in design [2][10]. In order to achieve this, we use five academics who individually act as users. The reason for individual sessions is the simple fact that 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. The evaluation was then driven by the following scenario and task: *Assume that you are Joe - a lecturer at university X. Joe has been lecturing for at least 3 years and uses Power Point to deliver lecture content to his students. He is now required to create lecture recordings for his course and later make them available for students to access. Please spend the next few minutes using MLCAT.*

During this Wizard of Oz scenario [10], the researcher used an audio recorder to capture the think-aloud, constructive interaction interface usage [1]. The participants were then given a debriefing questionnaire in order to capture their experiences with the interface. A number of issues were highlighted as revealed in our subsections that follow. Our participants were two females and three males from the departments of Computer Science and Information Systems at UCT. Each of them have been lecturing for at least three years, hold academic positions ranking from Lecturer to Associate Professor and are aged from twenty six years old and over.

In order to collect information about the perceptions on learning effectiveness, users' satisfaction and identify any usability issues early in design, we utilize Likert scale attitude statements as illustrated below:

5.2.1 Learning Effectiveness

The evaluation of perceived learning effectiveness of MLCAT gives satisfactory results. The first four questions posed sought to measure how easy it is to learn, ease of navigation, enjoy- ability and ease of use after training. The results in table 1 below confirm that users found the high fidelity prototype easy to learn, navigate, enjoyable and easy to learn after training.

SD – Strongly Disagree, **D** – Disagree, **A** – Agree and **SA** – Strongly Agree

Learning Effectiveness	**SD**	**D**	**A**	**SA**
1. MLCAT is not easy to learn.		60%	40%	
2. It is not easy to navigate MLCAT.	20%	40%	40%	
3. MLCAT is enjoyable to use.			100%	
4. MLCAT is easy to learn after training.			40%	40%

Table 1. Prototype learning effectiveness

5.2.2 Perceived Benefits

In order to evaluate the perceived benefit of our prototype, we asked the users whether they thought the tool may help make podcasting easier, whether the prototype functions facilitate ease of use and whether the prototype features are easy to understand. The majority of our participants revealed positive results for the three questions except one as shown in the table below.

Perceived Benefits	**SD**	**D**	**A**	**SA**
5. MLCAT may help make Podcasting easier.			80%	20%
6. The MLCAT functions facilitate the ease with which content can be created.		20%	80%	
7. It is easy to understand the features provided by MLCAT		20%	80%	

Table 2. Prototype learning effectiveness

5.2.3 User Satisfaction

In order to evaluate the perceived users' satisfaction of our prototype, they were asked four questions. More precisely, the users were asked to answer questions that focused on measuring aspects related to the their reaction to the interaction with the interface, the user's opinion about the navigation, how the functions are structured, the sequence of screens and whether the prototype could be explored using trial and error.

Results from table 3 reveal that 100% (5) of our respondents thought the interface was intuitive, only 20% (1) said it was confusing to navigate, 100% (5) said the functions were not structured suitably, 80% (4) said the sequence of screens were not confusing and that 80% (4) said you could explore the prototype features using trial and error.

Users' Satisfaction	**SD**	**D**	**A**	**SA**
8. MLCAT interface is intuitive (i.e. It can be used without thinking)			100%	
9. MLCAT is confusing to navigate.		60%	20%	
11. MLCAT functions are not structured suitably.		100%		
12. The Sequence of screens is confusing		80%		
13. You can explore MLCAT features using trial and error		20%	80%	

Table 3. Prototype learning effectiveness

The data analysis points out that the prototype has been fairly appreciated. The tables 1, 2 and 3 under section 5 show the representation of the different usability aspects measured. Lastly, there were various user comments on the user interface design and functionality as detailed in below:

Layout

• The prototype had two preview buttons which was confusing. The preview after recording and Preview to edit. We therefore eliminated the preview to edit and incorporated the edit functionality within one Preview.

Functionality

- One user suggested a reduction in the number of steps required to produce the end product and automate as much as possible

- The users insisted on the need for the tool to offer support for fault tolerance i.e. if a user provided the system with many instructions.

- The participants also expressed the need for further automation so that the tool is as less intrusive as possible and more intuitive.

Navigation

• Two of the users suggested that the navigation needed to be improved such that the tool provides 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"*

6. CONCLUSION AND FUTURE WORK

A participatory design approach has been brought to the design of Podcasting tools. Such an approach recognizes the articulation work done by the users in adapting and appropriating Podcasting technologies into their cultural practices and environments and seeks to engage them in design. Therefore, this paper describes design activities with academics, sufficient to lead to the design of a useful prototype, even though they could only offer limited time to the design endeavor. The design effort focused on creating and maintaining fruitful exploratory design discussions facilitated by development of a series of low to high fidelity prototypes that both explored and demonstrated technical choices and allowed contingent use of technology in context to be revealed. Interestingly, our studies resulted into MLCAT being incorporated into the PowerPoint metaphor. Therefore MLCAT – a podcasting tool is an example of what can be achieved using this process. We highlight issues of accountability and the extent to which this was participatory or user-centered design as a great deal of improvisation had to be done for instance where users failed to elicit user goals, prioritize activities and sketch solutions. These were derived from discussions during the design sessions. We then present formative evaluation of MLCAT. Results indicate that the prototype has been successful in revealing usability issues. In terms of users' perceived learning gain, the majority reported that the tool is easy to learn and in terms of users' satisfaction, the users were enthusiastic to use MLCAT. The positive results of the formative evaluation confirm that the user centered design process allows for designing and implementing usable software. In this work, particularly important has been the involvement in the designing phase of the domain experts, the university academics who are keen on making available podcast lectures to their students. As further works, MLCAT is being implemented in order to allow users to record and publish lecture content for use on students' mobile devices.

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