Knowledge sharing platforms in ICT4D: towards validated content requirements

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Abstract—Open knowledge repositories (OKR’s) provide an open platform where collaboration can be supported by sharing ideas, resources and opportunities within a community. The usefulness and actual use depend on the usability as well as the relevance of the content for the target audience. There are guidelines for Information and Communication for Development (ICT4D) knowledge repositories but theorization on the evaluation of OKR’s are lacking. In this study we report on the content evaluation of an OKR developed for South African ICT4D researchers. The aim is to investigate what the user’s content requirements are when using an ICT4D OKR. We used a mixed-methods approach, whereby we conducted pre-test interviews on users’ expectation. We then presented them with an OKR which was developed according to user requirements from literature. Usability testing with eye tracking was used to evaluate the OKR, the evaluation also included a post-test questionnaire and interviews. The approach allows triangulation between the data from the interviews and the usability testing. The contribution lies in the updated content requirements and the use of a mixed-methods approach in validating OKR requirements.

Keywords—ICT4D; knowledge sharing platforms; collaboration;

I. INTRODUCTION

Open knowledge repositories (KR) aim to provide an open platform where collaboration can be supported by sharing ideas, resources and opportunities [1]. The success of an OKR as measured by acceptance and actual use depends on the usability and the relevance of the content for the target audience [2]. Guidelines on user requirements for knowledge repositories and maturity models for guiding content development have been published [3;4;5] but empirical evidence on the evaluation of OKR’s are lacking. In this study we report on the empirical evaluation of an OKR developed for South African ICT4D researchers. This study is guided by the question: What are the user’s content requirements when using an ICT4D OKR? Using a mixed-methods approach, we conducted interviews, usability testing and eye tracking in evaluating the OKR. The findings from the pre-test interviews are triangulated with the findings from the usability testing with eye tracking (which includes a post-test survey) to inform the findings on the content evaluation of the OKR. The focus is on validating the content provided by the OKR but also evaluating the usability of the website added useful insights. Iterative design has long been part of the software design cycle and having users focus on evaluating the site while observing and capturing their interaction added richness to the requirements capturing effort. However, a comparative analysis of usability methods for capturing user requirements is beyond the scope of this paper. The paper is organised as follows: Section II briefly reviews the literature on knowledge repositories in ICT4D and usability evaluation respectively. Section III explains the research design of this study; Section IV provides the results while Section V concludes.

II. KNOWLEDGE SHARING PLATFORMS

A. Knowledge sharing platforms in ICT4D

Considering the ICT4D research researchers as a community, the OKR is proposed as a platform to help support research collaboration. According to De Moor (2017) that entails that community members ”jointly find out what their collaboration is about, what relationships and interactions their community and its context consist of, what collaboration resources are available, and what concrete opportunities exist for better working communities” [6] P37. Understanding potential users’ needs with respect to a technology is essential to good design [7]. The extant literature covers users’ needs and requirements [8]; and examples of how OKR’s have been implemented [9] but content specific, empirical evaluation is lacking as is empirical participatory evaluation examples. The use of participatory evaluation has been recommended as a best practice for improving community involvement [10].

B. Usability evaluation

Usability focuses on user performances during the execution of tasks and the interaction with technology. It emphasises task efficiency and how effective the task could be done since the perceived efficiency and effectiveness will influence the user satisfaction [11]. Usability testing is aimed at evaluating a system according to specific usability criteria which relies on the interaction experiences of typical users in the controlled environment of a usability laboratory [11]. In this study usability data was captured by requesting users to perform prescribed tasks while observing their performance and recording the data on predetermined metrics. Eye tracking was done in addition to usability testing. The human eye reads a line of text in discrete chunks through a series of fixations and fast
eye movements to take in the next section [12]. The data analysis distinguishes between fixations (times when the eye is essentially stationary) and saccades (rapid re-orienting eye movements) [12]. The usefulness of eye tracking is based on the fact that a record of a person’s eye movements while doing a task provides information about the nature, sequence and timing of the cognitive operations that took place [13].

III. RESEARCH DESIGN

This research is directed by the question, What are the user’s content requirements when using an ICT4D OKR? Ethical clearance for this research and data capturing including video and audio recordings were obtained from the Ethics and Research Committee at the University of South Africa. The mixed-methods design comprised three phases:

● Firstly, we interviewed users on their requirements for an ICT4D OKR. (See Appendix A, Pre-test Interview).

● Secondly, we evaluated an ICT4D OKR (see https://www.ict4dsa.com/), the latter was developed according to literature based content requirements [8; 2]. Evaluating the website was a secondary goal but the interaction with the tangible artifact stimulated the participants thinking about specifying content requirements (the primary goal). We selected representative tasks, observed the participants while performing those tasks and capture the effectiveness and efficiency metrics besides eye tracking the task completion. Our tasks were based on the ICT4D OKR requirements from literature [5]; see section D for more detailed task descriptions.

● Thirdly, we interviewed users on the ICT4D OKR. (See Appendix A, Pre-test Interview).

C. Participants profile

The study involved nine participants. Usability evaluation with eye tracking is time consuming and that limits the number of participants. The accepted number of participants is between 5 and 8 [14] and therefore this study where two participants were involved in the pilot study and nine in the actual study is even better than the acceptable limit. The participants’ home languages included Sepedi, South Sotho, English, Afrikaans, Luganda and isiZulu and the ages ranged between 30 and 55 years. The participants all had at least an honours qualification in Information Systems or a related field to ensure a minimum level of computer literacy.

D. Conducting the test

The usability laboratory is equipped with a 17” TFT monitor with resolution of 1280x1024 and a Tobii 1750 eye tracker, allowing the eye movement of participants on the screen to be recorded. A 5-point eye tracking calibration was used at all times. One participant was tested at a time. On arrival, the purpose and procedure were explained. The participant was required to complete the form of consent, which was followed by the pre-test interview. The eye tracker equipment and details of the material to be recorded were explained before the calibration was done. The participants completed five tasks available from an onscreen task list (tasks provided in the next section). Following the tasks, the participants were requested to complete the System Usability Scale (SUS) post-test questionnaire and that was followed by a post-test interview. Finally, the participant was thanked for the time and participation in the project.

E. Questionnaires used

SUS consists of ten questions, each question is a statement and a rating on a five-point scale of “Strongly Disagree” to “Strongly Agree” [15]. In an evaluation comparing five usability questionnaires, SUS reached 75% accuracy at a sample size of 8, while the others stay down in the 40-55% range [15] and that motivated the selection of SUS for this study with 9 participants.

F. Tasks

The tasks focused on the following requirements prioritized for ICT4D OKR’s [5].

● Understanding the purpose of the OKR

● Connection: Access to other researchers in the ICT4D field in SA with some indication of their research areas

● Information and awareness:
  o Sub-fields in ICT4D and the researchers involved
  o Information about the events in the field of ICT4D

● Resources, specifically references to South African papers and links to software resources and policy documents.

Initially there were seven tasks but during the pilot test we realised that the usability test was too long so we revisited the evaluation criteria and combined tasks to reduce the number to the following five tasks.

T1: What is the purpose of the website?

T2: Login:

If you are a new user, login using the following login = anonymized and password = anonymized.

If you are a registered user: Login and update your login details to include ‘HCI’ as a Research Field

T3: Search for the person with surname “Chigona” and find out where the person(s) is affiliated as well as their Research Interests.

T4: What events are planned in South Africa in 2018?

T5: Can you find the title of the South African, 2016 paper by Herselman, M and Botha, A.

G. Limitations

This research focused on the OKR’s content based usability and user reported requirements while the infrastructural, social and cultural factors can also influence the perceived usability.

IV. RESULTS AND DISCUSSION

The results presented include the interview results and the usability evaluation results.
H. Interview results on OKR requirements

Open, thematic coding was used to analyze the data from the interviews and identify new content categories. Table 1 depicts the results from the interviews. Comparing the user requirements from literature (column 1) with the requirements captured in the pre-test interview (column 3) and the post-test interview (column 4). We had to decide between prompting users on the relevance of specific features and functionalities and an open question. We decided on the latter as not to limit the data and user aspirations on what could be useful. The disadvantage of this approach is that we cannot tell if a specific feature or function is relevant – it could be that the user did not think about mentioning it at the time although they find it relevant. Consequently, the relevance of a requirement was confirmed if at least one of the participants voluntarily mentioned that during the pre-test or post-test. Considering the results depicted in Table 1, it can be observed that the importance of the current content and functionality have been confirmed for all categories (column 3) with suggestions for extensions added (column 4).

The participants mentioned the following requirements that were not specified in the literature but has already been met: security - the site is secure as indicated in the URL (see https://www.ict4dsa.com/) versus http as used for less secure sites. Another participant mentioned “Top and most important publications in the field”, which is provided under seminal papers. One participant complained that the tasks were not comprehensive enough to cover the entire repository and therefore it was difficult to comment on what should be added. The tasks were reduced from seven to five after the pilot testing since there was an overlap between what the tasks were testing.

However, allowing users more time to browse and familiarize themselves with the site will be considered in future testing.

The following insights on requirements were gained that should be considered in future evaluations of user requirements of ICT4D OKR content: There should be provision for non-academic information about community events, and community projects; ability to post projects on the website and to get feedback from others, indicating supervision topics and capacity for postgraduate students.

Notably, researchers’ publications were not provided in this OKR due to conference and journal restrictions on disseminating publications. Originally, the researchers’ websites were included but since only a few researchers had personal websites that was later removed.

Toyama [7] advocated moving beyond needs to aspirations when considering information technology for development. We considered that from inception and found that useful in broadening the scope, formulating our questions and guiding our interview responses but more research is required to overcome the entrenched narrow focus on needs. That includes formulating questionnaire items to capture the difference between needs and aspirations and ensuring that all participants have a working definition and constant awareness of the distinction. In this paper the terms expectations and requirements were used interchangeably since some participants had never used an ICT4D OKR and they related better to the term expectations.

### TABLE I. INTERVIEW RESULTS

<table>
<thead>
<tr>
<th>Requirement [2]</th>
<th>SADIIP Evidence</th>
<th>Interviews Pre-test/Post-test Comments on extending and improving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose of the site</td>
<td>Yes</td>
<td>Confirmed</td>
</tr>
<tr>
<td>Connection (Member Management)</td>
<td>Login and roles</td>
<td>Confirmed</td>
</tr>
<tr>
<td>Knowledge Sharing</td>
<td>Publications, policies and links</td>
<td>Confirmed</td>
</tr>
<tr>
<td>Social Networking</td>
<td>Forum</td>
<td>Confirmed</td>
</tr>
<tr>
<td>Thematic areas</td>
<td>Presented and linked to researchers</td>
<td>Confirmed</td>
</tr>
<tr>
<td>Events</td>
<td>National and international</td>
<td>Confirmed</td>
</tr>
</tbody>
</table>

I. Usability evaluation

Table 2 depicts the usability evaluation results. The participants are listed in column 1 and that is followed by the effectiveness, which is measured in terms of the ability to complete the task and the number of times that assistance was required in column 2. Column 3 depicts the efficiency (total time) that the participant took to complete all the tasks. Notably participant 2 took a long time but completed without assistance so the metrics of effectiveness and efficiency need to be considered together. The user satisfaction as measured by the System Usability Scale ® is presented in column 4. The sum of the 10 ratings in the SUS questionnaire leads to a general measure of perceived usability. Notably, the values ranged between 60 and 100- with an average of 78 therefore it is concluded that the user satisfaction was usually perceived as positive. Notably one participant found the website ‘not sticky’ and mentioned that it could be more ‘funky’ although he found it fit for task. The observations and comments in column 5 provide some qualitative explanations for the results.
### TABLE II. USABILITY EVALUATION RESULTS

<table>
<thead>
<tr>
<th>Participant number</th>
<th>USABILITY METRICS</th>
<th>Observations and comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Effectiveness</td>
<td>Efficiency (total time)</td>
</tr>
<tr>
<td>1</td>
<td>Completed with assistance (T3)</td>
<td>9:15</td>
</tr>
<tr>
<td>2</td>
<td>Completed without assistance</td>
<td>12:04</td>
</tr>
<tr>
<td>3</td>
<td>Completed with assistance (T5)</td>
<td>7:36</td>
</tr>
<tr>
<td>4</td>
<td>Completed without assistance</td>
<td>5:52</td>
</tr>
<tr>
<td>5</td>
<td>Completed with assistance (T5)</td>
<td>4:52</td>
</tr>
<tr>
<td>6</td>
<td>Completed without assistance</td>
<td>4:52</td>
</tr>
<tr>
<td>7</td>
<td>Completed with assistance (T5)</td>
<td>6:14</td>
</tr>
<tr>
<td>8</td>
<td>Completed with assistance (T5)</td>
<td>7:21</td>
</tr>
<tr>
<td>9</td>
<td>Completed with assistance (T5)</td>
<td>4:59</td>
</tr>
</tbody>
</table>

Considering the data gathered from the usability testing and eye tracking in terms of effectiveness it can be observed that only two of the tasks (Task 3 and Task 5) caused participants to ask assistance. The overall completion times ranged from a minimum of 4 minutes and 52 seconds (04:52) to a maximum of 12 minutes and 4 seconds (12:04). Notably the participant with the longest completion time did not ask for assistance so the participant’s attitude to asking assistance could have influenced the completion time. Time per task was not reported or discussed due to space limitations.

Task 1: Participants were expected to deduct the purpose for the vision but many kept searching for the exact term (purpose) and could not find it. This may be due to the testing situations where people were focused on completing a task rather than understanding the purpose of the site. However, changing the term from vision to purpose should be considered.

Task 2: No problems experienced with the login.

Task 3: One participant required assistance to clarify the meaning of ‘research interest’. Figure 1 shows a scan path of the eye movements prior to the request for assistance. Assuming that eye movements correlate to comprehension of the text [16] the many saccades and fixations is interpreted as confusion, the participant’s actively searching but not making sense of what he is seeing, when trying to find the research interests. The heat map of the same segment (see Figure 2) is useful in confirming where the participant looked and what held his/her attention, it also uses colour to distinguish the most searched areas (yellow and red).

![Fig. 1. Example of a gaze plot showing evidence of confusion during execution of task 3](image)

The results indicate usability issues relating to the understandability and clarity of the term 'research interest' and highlighted the need for context dependent assistance, e.g. mouse over help.

Using a keyword search (surname) returned more than one results in some cases. However, given the context that is considered preferable to using more complex search terms.
Task 4: Which required participants to identify the events to be held in South Africa in 2018 was completed without raising any usability issues. Note that the term events refer to conferences, workshops or meetings open to the community.

Task 5: In this task 5 of the 9 participants requested assistance. This indicates a serious usability issue and led to the realization that the design does not align with user’s mental model of searching. In this case users were expected to select the appropriate tab and then search locally while they were used to typing in a word and searching globally. Providing direct access to researcher’s publications is essential (from the requirements perspective) but participants expected to find the publications using a global search so the use of a reference list was not satisfactory. To do that within the rules governing copyright and access a link to the researchers’ websites will be added (rather than uploading the papers on the knowledge repository).

J. Summary of results

Our evaluation captured the user requirements during pre-test and post-test interviews and triangulated with the findings from the usability testing. The post-test results were useful in confirming the validity of the content categories. The interview results confirmed the need for the following content categories: Purpose of the site; Connection (Member Management); Knowledge Sharing; Social Networking; Thematic areas and Events. Based on the findings the following content categories need to be added: Community events and projects, Supervision opportunities (indicating topics and capacity) and open Research Projects.

The usability evaluation allowed the users to engage with the OKR, evaluated the OKR and then they had the opportunity to confirm or update their initial requirements. The usability was found to be acceptable but the search function was not intuitive. The participants felt that the website met their content requirements in general but some expected a more interesting user experience. Future research is planned to evaluate the user experience - once the OKR has been updated according to the findings from this study.

CONCLUSION

This paper reports on validating users’ content requirements for an ICT4D OKR. In response to the research question, the user’s requirements from literature on using an ICT4D OKR have been confirmed and extended to propose a updated list of validated requirements. When evaluating an OKR, the fitness for tasks will depend on the usefulness of the content and functionality, i.e. whether that meets the user requirements and the usability. Traditionally, user requirements on content and functionality would be finalized before usability testing starts but the novel practice of repeating user requirements interviews before usability testing has been found useful in sensitizing the users, uncovering new requirements and providing continuous feedback during participatory user evaluation.

ACKNOWLEDGMENT

This work is based on the research supported by the South African Research Chairs Initiative of the Department of Science and Technology and National Research Foundation of South Africa (Grant No. 98564).

REFERENCES


Appendix A (Interview questions)

Pre-test Interview

Good day
Thank you for your assistance in helping to evaluate the South African Development Informatics and Information, Communication and Technology for Development Platform.

Please answer the following questions verbally for the interviewer to record.

1. Have you visited the [http://www.ict4dsa.com/] website previously?
2. Are you a registered member of the SADIIP?
3. What is your age?
   - Younger than 30
   - 31 - 40
   - 41 - 50
   - 51 - 60
   - 61 - 65
   - 66+
4. What is your first language (mother tongue)?
5. What is your highest qualification?

Website information

1. What would you like to see on a platform for sharing data, information, and knowledge relevant to the Southern African Development Informatics research and practitioners community?
2. What content would you find useful on such a website?
3. What functionality would you find useful on such a website?

Post-test Interview

1. Did the website meet you expectations as a platform for sharing data, information, and knowledge relevant to the Southern African Development Informatics research and practitioners community?
2. Content to add (or remove)?
3. Functionality to add (or remove)?
4. Any other comments?