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An investigation into culturally-relevant GUI components within marginalised South African communities

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Abstract. Traditional Graphical User Interfaces (GUI) were designed primarily within the context of western communities and for the task of office automation. Metaphors that are typically used in these GUIs stem from this office environment: files and folders as the primary unit of storage, recycling/rubbish bins for unwanted files, and tabs for indicating a group of related tools. This metaphor was chosen as it was intuitive for the majority of the intended users of desktop computers. However, computers (along with their traditional GUI components) are becoming more prolific and are being introduced into new communities, and used within different contexts. In some cases these new communities do not have an understanding of an office environment, so the office metaphor serves to confuse new users rather than to provide an intuitive metaphor for interacting in the digital environment. This paper presents the results of a study to investigate the use of culturally-relevant GUI components within peri-urban and rural areas of South Africa. After undertaking a Wizard-of-Oz study to determine the way users would intuitively interact with a system, it was discovered that the primary problem users faced was using a tabbed interface. A culturally relevant tabbed interface was then created and a user study was performed to investigate the intuitiveness of the new interface compared to the traditional tabbed interface. This study collected both quantitative and qualitative data from the participants. It found that participants could interact with the culturally relevant tabbed interface faster and more accurately than the traditional counterpart. More importantly, participants stated that they intuitively understood the culturally relevant interface, whereas they did not know understand the traditional tab metaphor.

Keywords: Cross-cultural and social issues, ethno-computing, graphical user interface, Wizard of Oz study, user study.

1 Introduction

The digital divide is a term often used to describe differences between rich and poor communities. This term however is more encompassing than that, as it relates to the divide between those who have access to information and communication technologies (ICTs) and those who don't. The Graphical User Interface (GUI) became commercially available in the early 80's and provided a more intuitive alternative to its predecessor, the text-based interface. Despite being a step in the right direction, the heavy use of text in GUI interface components on everything from menus to document content, poses an accessibility barrier to those who are unable to read. GUIs were designed primarily within the context of western communities and for the task of office automation. Metaphors that are typically used in these GUIs stem from this office environment: files and folders as the primary unit of storage, recycling/rubbish bins for unwanted files, and tabs for indicating a group of related tools. This metaphor was chosen as it was intuitive for the majority of the intended users of desktop computers. However, computers (along with their traditional GUI components) are becoming more prolific and are being introduced into new communities, and used within different contexts. In some cases these new communities do not have an understanding of an office environment, so the office metaphor serves to confuse new users rather than to provide an intuitive metaphor for interacting in the digital environment.

This paper presents the results of a study to investigate the use of culturally-relevant GUI components within peri-urban and rural areas of South Africa. It begins by describing a preliminary Wizard of Oz study that was undertaken to investigate how community members within these areas intuitively would understand how to interact with computers. This study found that participants struggled with a number of traditional desktop metaphors, but in particular the tabbed interface. It then describes a further study that was undertaken comparing participant's use of a culturally-relevant tabbed interface with the traditional tabbed interface.

2 Related Work

In 2002, Sun categorized usability studies into two approaches: a narrow, engineering approach; and a broad, humanist approach. Sun argued that Nielsen's classic definition of usability came from a narrow perspective, a view that "favors the system and defines usability as attributes measured by quantitative methods" . Nielsen's perspective is shared by many other researchers , with his peers including claims such as "usability is an attribute of every product" , depicting the notion that the usability of a product is the same for all participants as it is an attribute of an artefact, rather than of the use of an artefact. Sun notes that a limitation of this engineering approach is that it views participants from a mechanical perspective, as only their low level actions are observed. Researchers from the humanist approach suggest that a broader perspective on usability should be used, to include more than just the measurable qualities of a product. In particular, these researchers state that the research should include the context and the culture of the user .

At the same time, other researchers have also recognized the real world aspects of software engineering . Ethnography aims to view activities as social actions embedded within a social domain, and accomplished through the day to day activities of participants . Ethnocomputing is a comparatively new discipline that builds on social informatics and extends ethnography to the computer science domain, by emphasizing the importance of integrating cultural aspects into software development . It finds that the theory of computing takes on different forms in different cultures, and that the traditional view of computing is also culturally bound . Ethnocomputing refers to "a cultural perspective in the problem solving methods, conceptual categories, structures, and models used to represent data or other computational practices" . It points to technological determinism, where technology is separated from the outside world, as a flawed view of the role of ICT in society. Stated simply, ethnocomputing finds that, "the technology that is best from one point of view is not necessarily best from another" . Tedre, Kommers and Sutinen state that each community (where a community is defined as a group of people who form a distinct segment of society) can have its own culturally bound theory of computing, that includes the language and culture of the community . These theories of computing can in some circumstances overlap with one another, but all extend from a universal theory of computing.

To construct a culturally bound theory of computing, there must be an understanding of the language and culture of each community. The following section describes the communities targeted as part of this research.

3 South African Marginalised Communities

South Africa is in a very interesting position for research, combining typical features of a developed and a developing country . It has urban centres equipped with excellent infrastructure within a short distance of truly marginalized areas. Due to the racial segregation that occurred under apartheid, black and white people were not allowed to live within the same communities. Ten economically unproductive areas of South Africa were denoted as self-governing homelands, each of which was supposed to develop as a separate nation-state for different ethnic groups. Many black South Africans were forcibly removed from cities to these under-developed homelands, and were forced to become citizens of the new homeland (and to renounce their South African citizenship). Homeland citizens were granted a pass to travel to a particular magisterial district for approved work. White urban centres, were surrounded by underdeveloped peri-urban black townships, where the workforce could live close to their place of employment.

Although the apartheid system is now a thing of the past, the former inequalities still have lingering effects, with the predominately black townships and peri-urban areas remaining less developed from an infrastructural, educational, and health perspective. The former homelands bear the scar of the past inequalities, with vast differences in the quality of services that they are provided with.

Fig 1. Location of Dwesa and Rhini in Eastern Cape, South Africa. Courtesy of Google Maps

To ground this research in practice, one rural area and one peri-urban area were identified as target sites: Dwesa and Rhini respectively. These communities are representative of the peri-urban and rural realities of South Africa, where a large part of the South African population live. Figure 1 presents a map of South Africa, highlighting the location of both Dwesa and Rhini. The remainder of this section provides an overview of the two communities.

3.1 Dwesa

Dwesa, in the former Transkei Homeland, is traditionally a subsistence farming community, and as such depend on their land for their livelihood. The region features a coastal nature reserve and it was the site of the first restitution projects in post-apartheid South Africa. Unfortunately, like many rural areas, Dwesa is characterised by lack of infrastructure in terms of roads, water and electricity, sub-standard education facilities, widespread poverty, lack of services and isolation. Isolation is probably the main reason for young people leaving Dwesa for the cities, a typical phenomenon in rural areas. This deprives the community of fresh energies and of the primary force for change and innovation.

The Siyakhula Living Lab (SLL) is an ongoing project hosted by the Telkom Centres of Excellence at University of Fort Hare, a previously black university, and Rhodes University, a former white university. The project aims to facilitate user-driven innovation in the Information and Communication Technologies for Development (ICTD) domain to empower rural communities and integrate the innovative potential in rural marginalised areas with the general nation system of innovation. The SLL undertook a baseline study was undertaken between March 2008 and April 2009 to assess the current statues of the community . The study found a demographic imbalance with the majority of residents over 65 and under 15. It showed a local unemployment rate of nearly 90% with the middle generation moving to work in cities and leaving their children with their grandparents in Dwesa. More than half of the locals (59%) depended on pensions and government grants, and around a quarter of residents (24%) received some sort of support from children and other close relatives. The monthly income in households in Dwesa is very low, with few households earning more than R375 a month.

Within Dwesa only 6% of households had access to electricity, with 4% of houses using solar power, 1% using a generator, and 1% having mainline electricity installed. At the time of writing this paper, electricity was being rolled out, although the price to connect households to the electricity grid was beyond the means of most households (R600). Within Dwesa, 26% had completed some secondary education, and only 5% had completed secondary school.

3.2 Rhini

Rhini is a peri-urban area on the outskirts of Grahamstown, an education hub within the Eastern Cape province of South Africa. Although no figures are available for unemployment in Rhini, other studies have found unemployment rates of between 35 and 77% in peri-urban areas in South Africa.

Like most peri-urban areas in South Africa, infrastructure is of a higher quality than in rural areas, but it does not match those available in urban centres. In Rhini most houses have access to electricity, although a substantial portion of the community does not have running water in their houses (and therefore flushing toilets). Schools are typically better resourced, as teachers prefer to work in peri-urban areas to rural schools.

In 2007 the Institute of Social and Economic Research undertook a household study in Rhini where they interviewed 1020 households across each of the 23 neighbourhoods. Of the respondents, the average age was 38 years, with a significantly higher proportion of women (60%) than men (40%). A small portion of respondents (8%) had no formal schooling, 40% had completed some secondary education, and 18% had completed secondary school. Only 7% of respondents had received post-secondary school education or training.

The study found that approximately 38% of households reported that a member had full time employment, and 35% reported that a household member had either part time or a casual job . Similarly to the situation in Dwesa, a large portion of households receive a social grant such as a child support grant (44%), old age pension (30%) or a disability grant (19%) . The average monthly income in Rhini is R1,100 per month.

Within Rhini, 83% of households had access to electricity, with 25% reporting that they receive free basic electricity. A large proportion of households have a radio (70%), a television set (69%), and a telephone or cellular phone (65%). Less than 3% of households have a personal computer.

3.3 Comparison of Rural and Peri-urban Communities

Across both Dwesa and Rhini, the following similarities were found in communities.

- Widespread illiteracy. Community members from Dwesa and Rhini, typically speak isiXhosa as their first language. As this is primarily a spoken language, there was evidence of high levels of illiteracy. In Dwesa in particular, most older community members did not speak English at all. The younger community members had learnt English in school and could at least speak (if not write) in English. Although community members were illiterate, they were numerate, being able to recognise numbers due to their use in everyday life.
- Widespread computer illiteracy. Although there was a high computer illiteracy, most community members were familiar with a mobile phone. In the baseline study undertaken as part of SLL, it was found that even in rural areas each household had access to a mobile phone . Within the younger generations in particular, there was great interest in learning how to use a computer.
- High unemployment rates.

4 Wizard of Oz study

Initially, this project aimed to investigate how community members would intuitively interact with computers, given that they had no prior experience with them. In order to investigate their perceptions of intuitive interaction, a preliminary Wizard of Oz (WOz) study was undertaken. In a WOz study, participants interact with what they think is an autonomous computer system, when in reality an unseen observer interprets all input from the participants, and provides output on behalf of the system. In doing so, it seems to the participants that the computer system naturally understands the input that they have provided.

Foley, Wallace and Chan developed a model of interaction, denoting six building blocks that all tasks performed on interactive systems can be broken down into: path, location, text, value, object orientation, and position. Foley *et al.*'s model was used in identifying tasks for the participants to undertake to ensure that a complete range of interactions were performed.

Sixteen participants took part in the WOz study, and were grouped into four groups of four. After consent was given to participate in the study, a basic literacy test was undertaken, which resulted in 14 participants being identified as illiterate, and 2 as semi-literate. Throughout the study, an interpreter was available in case participants required further information and were uncomfortable to express themselves in English. A pre-test interview was then performed to identify participants' prior experience with technology. After the interview, participants were introduced to the computer and a brief demonstration was provided (via a pre-recorded video) of some of the possible ways of interacting with the computer. After the introductory video had been played, participants were asked to perform four tasks on a system. These tasks included:

1. Find a particular piece of jewellery on an e-commerce system
2. Find the latest reports on an e-government system
3. Determine the cost of an item that had been ordered on an e-commerce system
4. Apply for a birth certificate on an e-government system

Throughout the duration of the study, one observer sat in the room with the participant and guided the study. This observer was fluent in both isiXhosa and English in case the participants required further explanation or assistance. An unseen observer (or wizard) sat in a neighbouring room and interpreted the input from the participant. This was achieved through the use of four cameras placed around the participant to capture their interaction, an audio feed from a microphone and a real-time screen capture so the wizard could see if the participant used either the mouse or the keyboard. The wizard provided feedback using the following output: by updating the screen contents (for example by following a link that had been requested); moving the on-screen cursor; reading out any information that is selected, or where the cursor is over any words (where the participant would hear a digitally altered version of the wizard's voice that made it sound like it had been electronically generated).

There were two general classifications of findings from the WOz study: interaction style and GUI. Within the interaction style category, the primary finding was that participants preferred the use of speech and gesture in interacting with a computer. This is unsurprising, especially when considering the literacy levels of the participants. They tended to shy away from the keyboard, feeling intimidated by the reliance on letters. These findings are similar to other findings by researchers who investigated interfaces for semi-literate and illiterate users .

Perhaps more interesting findings were in the category of GUI findings. Firstly, all participants struggled with the tab metaphor that is used throughout most desktop interfaces. They did not realise that tabs would link to extra pages, or in fact that they could be pressed at all. Secondly, they did not understand that pages could scroll. When available, the scrollbars on the sides of the screen were not dragged, as their intention was not clear to the users.

The tabbed-interface finding in particular reinforced the notion put forward by Tedre, Kommers and Sutinen that communities may require their own culturally-bound model of computing. In particular metaphors that underpin GUIs may need to be contextualised so they are intuitive to users from each culture.

Based on these findings, a prototype of a new, culturally-relevant GUI was designed and developed. The interface combined this new metaphor with text to speech when the user hovered their mouse over textual items. The next section describes a user study undertaken to compare users' performance with the traditional interface, with the new interface.

5 User Study

This section describes an investigation carried out to compare users performance on two tabbed interfaces. The first interface, the traditional tabbed metaphor interface (TTMI) employs the traditional tabbed metaphor seen across most desktop applications. The second interface, the localised tabbed metaphor interface (LTMI) uses a new metaphor that was localised for the peri-urban and rural areas described in Section 3 of this paper. Instead of using the tabbed-file metaphor that was developed to mimic an office filing cabinet, this metaphor uses a group of baskets that are traditionally used to store items in rural areas. This section describes the user study setup, followed by the results and analysis of the user study findings.

5.1 Participants

Thirty two community members volunteered to be part of the user study. Of the volunteers, 20 participants were chosen from across Dwesa and Rhini. A stratified sampling was used to ensure equal numbers of Dwesa / Rhini and illiterate / semi-literate volunteers participated. Of the 20 participants, 10 were semi-literate and 10 were illiterate. None of the participants had been part of the WOz study described in the previous section, and none of them had any previous experience with computers. Participants varied in age from 18 to 50 years old.

5.2 Performance metrics

Four performance metrics have been proposed by Palmer and Bowman and Hodges : task completion time(time taken to complete a task), task success, errors, and user satisfaction. These performance metrics were used to compare the TTMI with the LTMI in this study and will be defined below.

Task completion time is the time taken by the user to complete a task. This is measured from the time the user starts to interact with the system to the time they complete the task given, in other words the time spent actively engaged with the system .

Task success measures the ability and effectiveness of the user to complete the task given to them. Task success was scored in a binary task success form where 1 represented task completed and 0 represented failure to complete a task. The participant acknowledged completion of task and this judgment was verified by the observer, who checked the content of the final web page visited by the participant. In cases where the participant declared success but the final page did not contain the required information, the task success score was adjusted by the experimenter to 0. In this study, the overall result was either a success(1) or a failure(0).

Festinger developed a theory of cognitive dissonance for describing user errors. In Festinger's model, a human error is always an expression of certain habits that cannot automatically be used in specific situations and thus result in an error during the operation. Errors in this study were counted as the number of mistakes made by the user while performing a certain task.

User satisfaction is normally measured by providing questionnaires after carrying out a user testing . In this study, written questionnaires were not feasible since the study was carried out on semi-literate and illiterate users who could not read and understand the written form. Questions were asked by an observer and user's response was recorded. Questions that were asked included the following:

1. Were the systems easy to use, and what did you like about them?
2. Which system did you think was easiest to use?
3. What did you not like about the other systems?
4. What do you think could be improved on either system?
5. Do you have anything else you want to say?

5.3 Procedure

On volunteering to be part of the study, participants were first given a basic literacy test to allow a classification of users as either semi-literate or illiterate. Once quotas of illiterate/semi-literate and rural/peri-urban community members were filled, the remaining volunteers were thanked for their time and dismissed. Participants took part in the study individually. On agreeing to take part in the study, a consent form was completed (with details of the study explained audibly so that participants would understand exactly what they were agreeing to undertake). Permission was also sought to record the participants actions for analysis after the study had been completed. Each participant was introduced to the computer system using a video explanation. The video was used to ensure each participant received consistent information on the interface. The video described how to use the mouse, keyboard, and other inputs (gesture, and voice) that were available to the participants. To be certain that participants understood the instructions that they were given, they were asked to perform certain tasks with the new input devices.

Participants were grouped into four groups, with each group being presented with the tasks and metaphors in a different order. This was undertaken to ensure that the effects of learning did not change the results of the study. The participants were randomly grouped into the four groups, each consisting of five participants. The time taken to complete each task was recorded by the system. The recorded video was used to quantify the participant’s performance for the metrics listed above. After completing the four tasks with both the TTMI and LTMI interfaces, participants were given a post-test interview consisting of the questions outlined in Section 5.2. Finally, participants were thanked for their participation in the user study.

5.4 Results

This section will describe the results of the user study for semi-literate and illiterate users separately.

5.4.1 Semi-literate users

The first measure recorded for this user study was task success. All semi-literate users were able to complete all of the tasks. As such, there was no statistically significant difference between performance using the TTMI and LTMI interfaces.

The second measure was the time taken to complete a task using the TTMI and LTMI interfaces. Table 1 shows the results of all tasks carried out by semi-literate users. The table shows the mean and standard deviation for time-on task across both interfaces. As can be seen in the table, there was a large deviation in participant's performance, particularly for task 2. A paired- t-test with assumed equal variance was performed to test for a statistically significant difference between time taken to complete each of the four task using TTMI and LTMI. The results found that there was a statistically significant difference across each of the tasks ($t=1.86$, $\rho<0.05$; $t=2.98$, $\rho<0.05$; $t=2.35$, $\rho<0.05$; $t=7.69$, $\rho<0.05$ respectively).

Table 1. Mean (and standard deviation) for semi-literate users for time on task in seconds.

Task	TTMI time	LTMI time
1	118.6 (41.75)	84.9 (53.7)
2	276.6 (236.6)	142.9 (98)
3	341 (31.32)	264 (17)
4	563.7 (37)	410 (11)
Average	324.98 (85.67)	225.45(44.93)

The third measure of interest in this study was the number of errors that were committed. Table 2 illustrates the number of errors across each task and interface. Numbers in brackets illustrate the standard deviation for each measure. The user study found that on average, more errors were made using TTMI than LTMI. A paired t-test with assumed equal variance was performed to test for a statistically significant difference in the number of errors committed. The results showed that there was no statistically significant difference in performance across Tasks 1 and 2 ($\rho>0.05$), but the difference was significant with Tasks 3 and 4($t=2.31$, $\rho<0.05$; $t=1.17$, $\rho<0.05$).

Table 2. Mean (and standard deviation) for semi-literate users for number of errors.

Task	TTMI errors	LTMI errors
1	4.4 (2.63)	3.3 (3.05)
2	8.6 (3.92)	5.1 (2.9)
3	9.3 (2.5)	6.5 (3.03)
4	18 (4.67)	10.5 (3.47)
Average	10.1 (3.43)	6.35 (3.18)

The final measure that was used in this study was subject satisfaction. Six out of ten semi-literate users preferred the LTMI system. They mentioned that it was easier to use. Five of the six users mentioned that the use of a localized metaphor was easy to understand as they were familiar with the metaphor and understood its' use. They also mentioned that the preview of the next page was of much help as they could visually see what was on the page they were about to open. One of the participants said "when I saw a basket, I was curious to see what was inside it, that's why I hovered my mouse over the basket, after seeing that one of the baskets opened and produced something, I then started opening the other baskets".

The other four were comfortable with using the TTMI system as they mentioned that they enjoyed reading the labels used and could understand them. When they were asked on what needed improvement, most of them thought that combining the two systems would be of great help. One of the participant said "I prefer using the TTMI but I also like some of the features that are provided on the LTMI such as previewing the next page".

This section has presented the results of a user study comparing performance with TTMI and LTMI interfaces by semi-literate users. The next section will explore the results for illiterate users.

5.4.2 Illiterate Users

The first measure, task success, produced some interesting results for illiterate users. As shown in Table 3, most users (9 out of 10) were able to complete Task 1 using TTMI, while all users completed successfully with LTMI. Tasks 2 and 4 were more telling, with only one user able to complete using TTMI compared to 9 with LTMI; and no users able to complete with TTMI and 7 using LTMI respectively. A paired t-test with assumed equal variance was undertaken to compare results for Tasks 1 and 3. Both tasks showed no significant difference ($\rho>0.05$) between performance with TTMI and LTMI interfaces.

Table 3. Mean task success (and standard deviation) for illiterate users

Tasks	TTMI Task Success	LTMI Task Success
1	0.9 (0.316)	1 (0)
2	0.1 (0.316)	0.9 (0.316)
3	0.7 (0.48)	0.9(0.316)
4	0	0.7 (0.48)
Average	0.57 (0.37)	0.88 (0.28)

The second measure was the time taken to complete each task using the TTMI and LTMI interfaces. Table 4 illustrates the results for this measure, with average time taken and standard deviation for each task. Users performed faster with LTMI than with TTMI across all tasks apart for Task 2. As was described earlier, this task was only completed by one user with TTMI, so the performance comparison is not truly representative of the sample population. Due to the low success rates, a statistical comparison cannot be made for Tasks 2 and 4. A paired t-test with assumed equal variance was performed to test for a statistically significant difference between the time taken for Tasks 1 and 3. This test showed that there was no statistically significant difference between performance using TTMI and LTMI for Task 1($\rho>0.05$). Task 3 however showed a significant difference between the performance ($t=3.48$, $\rho<0.05$).

Table 4. Mean (and standard deviation) for illiterate users for time on task in seconds

Tasks	TTMI time	LTMI time
1	176 (64.65)	138.5 (62.66)
2	186.04 (0)	258.78 (145.12)
3	420.86 (23.09)	363 (19.59)
4	-	430.3 (19.63)

Average	261.1 (43.87)	297.65 (61.75)

Table 5 provides the results for the number of errors made by illiterate users with the TTMI and LTMI interfaces. As can be seen from this table, on average more errors were made with TTMI than LTMI. As mentioned when detailing the results for the previous measure, due to the low success rate for Tasks 2 and 4, a comparison for these tasks would not be representative of the sample population. A paired t-test with assumed equal variance was performed to test for a significant difference in performance across Tasks 1 and 3. This test found that there was no statistically significant difference in performance across Task 1 ($\rho>0.05$), but the difference was significant in Task 3 ($t=3.01$, $\rho<0.05$).

Table 5. Mean (and standard deviation) for illiterate users for number of errors

Tasks	TTMI Errors	LTMI Errors
1	4.38 (1.85)	3.2 (2.74)
2	6 (0)	4.67 (4.18)
3	12.3 (3.4)	5.9 (4.7)
4	-	11.43 (2.88)
Average	7.56	6.3 (3.63)

The final measure used in this study was subject satisfaction. All illiterate users were comfortable interacting with the LTMI. Eight out of ten users mentioned that they could not understand the TTMI and preferred the LTMI. When asked how easy it was to use the system, they mentioned that it was self explanatory. They preferred the use of localized metaphors and the fact that baskets which they use for storing at their homes were used. One thing that was mentioned quite often was the positioning of the metaphor, at home when baskets are used for storing, they are normally placed on top of kitchen-units and other furniture so finding them on top of the page made them realize there might be something stored in them. The use of baskets caught their attention as they were familiar with baskets.

When they were asked on what they thought needed improvement, some of them mentioned that the page that was coming out of the basket was too big as compared to the size of the basket. When they were asked if they will be able to see what will be on the page if the page size was decreased, they all opted for a bigger page. Some of the users wanted all the baskets to automatically open when a page is opened so that they could see what would be in each basket and then choose what they wanted.

6 Discussion

This section discusses the results of the user study. Performance across each task will first be discussed, followed by an overview across all tasks. Across the discussion, reference will be made to Table 6, which shows a summary of the findings from Section 5. It indicates the tasks and measures for which there was a statistically significant difference between user performance with TTMI and LTMI interfaces.

The first task was to locate a black beaded anklet that appeared on the home page of both the LTMI and TTMI e-commerce interfaces. Both illiterate and semi-literate users were comfortable with this task, and nearly all were able to locate the anklet on the interface (except for one illiterate user). Table 6 indicates that with both illiterate and semi-literate users, there was a statistically significant difference in the amount of time it took to complete tasks with LTMI compared to TTMI.

The second task required users to navigate through an e-government system to locate a particular report. This task required users to navigate between a number of web pages, and to recognise names and dates of reports. Obviously, the latter part of the task required users to read small portions of text which was problematic for illiterate users. Users struggled with the TTMI interface as they did not understand the traditional tabs, or realise that they could click on tabs to navigate to different pages. Only one illiterate users was able to complete this task with TTMI, whereas nine illiterate users completed the task with LTMI. The larger success rate was because users could see a preview of the next page when baskets "opened" and they could get an audio description of the page. Semi-literate users performed far better than their illiterate counterparts, with a statistically significant difference existing between the amount of time taken for them to complete the task using TTMI and LTMI interfaces.

The third task produced the most statistically significant differences in performances using TTMI and LTMI interfaces. With this task, users were required to determine the cost of an item on an e-commerce system. This task was carried out successfully by all users as it required the user to find images and symbols that were easily recognisable. Semi-literate users performed statistically better using the LTMI interface than using the TTMI interface across the time and error measures. For illiterate users, this was the only task where there was a statistically significant difference between performance on TTMI and LTMI interfaces. For this task, users performed faster and with fewer errors using LTMI than with TTMI.

The final task was to apply for a birth certificate on an e-government system using a form. Users were required to navigate from the home page to the download page, complete a form and submit it. All semi-literate users managed to complete the task using both TTMI and LTMI interfaces. None of the illiterate users could complete the task on the TTMI system. Seven of the ten participants managed to complete the task using the LTMI interface, making use of the text to speech functionality that it provides.

Table 6. Statistical significance of performance across all measures using TTMI and LTMI

Statistical Significance of Semi-literate User Performance

	Success	Time	Errors
1		✔	
2		✔	
3		✔	✔
4		✔	✔

Statistical Significance of Illiterate User Performance

	Success	Time	Errors
1			
2			
3		✔	✔
4			

7 Conclusion

This paper has described an investigation into the use of culturally relevant GUI components for illiterate and semi-literate users. It has illustrated the use of a wizard of oz study to first identify how participants would intuitively interact with a computer interface, and used this information to pinpoint key areas where they struggled. One particular GUI component that they struggled with was the tabbed interface which is used across most contemporary applications to group related information together. A culturally relevant interface was developed and prototyped and the results of a user study comparing this new interface to the traditional tabbed metaphor were presented. Not surprisingly, illiterate users still struggled to complete tasks that required them to read / write text. Users performed faster and more accurately using the LTMI interface than the TTMI interface primarily due to the text to speech functionality that it includes. With semi-literate users, users performed significantly faster using the LTMI over TTMI interfaces, and showed a preference for LTMI over TTMI interfaces.

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