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THE CHALLENGES OF TAKING A USER-CENTRIC APPROACH WITHIN DEVELOPING COUNTRIES: A CASE STUDY OF DESIGNING MEDICAL SOLUTIONS FOR ZAMBIA.

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ABSTRACT

In an attempt to meet the needs of the world's poor, user-centric methodologies have been applied to the development of appropriate product solutions, with growing popularity. However, despite the popularity of these approaches there have been criticisms surrounding their development within industrialised nations and calls for an analysis of their contextual suitability for developing regions. In response to these calls this paper presents findings from a study applying Human-Centred Design's (HCD) process of rapid-prototyping and user testing in the context of the UK and Zambia. The findings of the study present an overview of the benefits that can be gained through HCD's application in the UK and Zambia context, whilst also identifying contextual elements that placed restrictions on their use and which resulted in compromises needing to be made. These elements included: varied comprehension of the product development process and language and literacy barriers. In conclusion the paper presents a number of recommendations for future studies.

Keywords: developing countries, user-centric, design, ideation, user testing.

1 BACKGROUND

When tackling the issue of designing appropriate solutions for developing countries, user-centric approaches such as User-Centred Design (Norman 1986), Human-Centred Design (HCD) (ISO 9241-210:2010), Design Thinking (DT) (Brown, 2009), and Participatory Design (PD) (Crabtree, 1998) have been applied with growing popularity. However despite the popularity of these approaches, their application in the context of developing countries has come under some criticism as a result of their development within Western settings. One criticism is that they often fail to account for the cultural and environmental challenges in non-western environments (Donaldson, 2006; Puri, 2004; Winschiers, 2006; Mauder, 2007; Putman, 2009). To overcome these problems there have been calls for further research to be conducted on the use of user-centric methodologies within developing countries, and the development of methodologies designed specifically for use in developing environments (Hussain, 2012).

In light of the criticisms surrounding the application of western methodologies to the developing world context, IDEO was funded by the International Development Enterprise in 2008 to design a methodology capable of enabling the development of solutions that meet the needs of the world's poor. In response, IDEO produced the 'Human-Centred Design Toolkit'; that guides users through a process similar to Brown's (2009) method of DT.

Brown (2009) argues that as a means to meet the global challenges of health, poverty and education we should apply a process of DT. A process of three overlapping non-linear spaces: inspiration, ideation and implementation, applied

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by an inter-disciplinary team. The inspiration stage involves using ethnographic research methods to listen to and understand the needs, desires and dreams of the people you wish to affect. This information is then synthesised into insights that can lead to solutions and opportunities, within the ideation phase. Ideas are then turned into prototypes, tested and implemented in society.

When discussing DT Bjögvinsson et al. (2012) argue that it portrays many similarities to the pre-established process of PD. A methodology, which since its introduction in Scandinavia during the 1970's, has been applied to Social Development and Social Innovation projects with growing popularity (Byrne & Sahay, 2007). PD based methodologies such as Participatory Rural Appraisal (Mascarenhas, et al., 1991; Chambers, 1994) and Rapid Rural Appraisal (Longhurt 1981; Chambers, 1992) have been implemented in international development programs by agencies such as The World Bank, UNICEF and the United Nations (Williams, 2004). However despite the acceptance of PD based methodologies by international agencies, they have faced some criticism in the academic field, with questions being raised about the suitability of applying a western methodology (PD) to a developing country context (Puri, 2004).

2 INTRODUCTION

This paper describes the application of a human-centred approach to medical product design, in the context of the United Kingdom (UK) and context of Zambia. With the aim of providing insights into the impact cultural differences and varying environments can have on the application of design methodologies. It primarily focuses on HCD's process of iterative prototyping and user testing with target users.

3 PROJECT DESIGN AND METHODOLOGY

This study was carried out by an interdisciplinary team with a mixture of medical, technical, design and commercial backgrounds and was broken down into four key stages:

1. An initial 10-day field study in Lusaka Province Zambia to conduct rapid ethnography.

Two researchers from the interdisciplinary team joined a group from the medical education charity, Mothers of Africa and spent time in three locations with varying degrees of healthcare services, social amenities and cultural differences: Lusaka, Zambia's capital city, Chongwe Township, and Shiyala Village.

2. The field trip findings were synthesised to enable the identification of the three competing constraints: desirability, feasibility, and viability (IDEO, 2009). These insights were used to formulate a brief for a new design.

3. The findings from Stages 1-2 were used to facilitate ideation. The team followed an iterative design process, primarily driven by prototype-facilitated user feedback from typical users in both the UK and Zambia.

4. The most appropriate solutions derived from Stage three were developed, trialled in Zambia and analysed for their effectiveness.

This paper primarily focuses on Stage 3 of the study. It describes the interactions of typical users and the prototyping and user testing processes in

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the UK and Zambia. Stage 3 itself represents a development of developmental solutions produced during Stage 2. *'The development of a First Responder pack composed of sustainable, locally sourced materials, which can be used by people with limited knowledge, understanding and education, to stabilize victims of Road Traffic Accidents (RTAs).'*

Stage 3 of the study was initiated with the expansion of the interdisciplinary team to include a 'typical UK user' (Gulliksen, 2003) - a UK first responder and trauma specialist. His inclusion was used to aid in synthesis of the finding from the ethnographic field study and to facilitate ideation. Following ideation to expedite the development process, rapid, iterative, low fidelity prototyping (Blacker, 2009) was employed to enable functional testing to be conducted.

Once the UK trauma specialist classified the prototypes as being functionally sound and capable of performing effectively, user testing was conducted and feedback gathered (Nielsen, 1994) with a range of British and Zambian target users. Methods used to conduct testing and gather feedback included: discussions; questionnaires (Abrams et al., 2004); scenario-based user testing (Maguire, 2001; Carroll, 1999) and Think Aloud protocols (Nielsen, 1993). To ensure that all the main target users in Zambia were represented during the user testing (Rubin, 1994) and in response to Zambia's cultural diversity, participants were sourced from three locations: Lusaka; Chongwe Township; and Shiyala Village. The three locations represented varying environments and included users with a range of educational backgrounds, vocations and native languages. Prior to testing, participants were presented with an overview of the insights gathered during the ethnographic research, the project brief and the aim of the project. Users were also informed that the solutions were in a stage of development and feedback was only required on the material choices and functionality of the solutions. Each stage of user feedback was followed by further iterations until the solutions were warmly received and efficiently used.

4 PROCESS

4.1 PROTOTYPING

Step 1: Feedback was received from the UK trauma specialist as well as from medical members within the interdisciplinary team.

The received feedback was invaluable, providing insights on the suitability of the form; success of the function; suitability of solutions to perform the required task; and the identification of specific areas requiring further refinement. These insights were used to facilitate an iterative cycle of refinement.

Step 2: The solutions were presented to a medical specialist from Zambia.

During this time, the solutions were still in a state of development and little effort had been put into developing their aesthetic appeal. In response to the findings from the ethnographic research and developed brief, the medical specialist from Zambia showed great enthusiasm for the project and willingness to be involved. However contrary to the targeted insights gained from the UK expert, the medical specialist from Zambia showed minimal interest in the prototypes' functional capabilities focussing instead on their aesthetic qualities. Subsequent discussion revealed an inability or unwillingness to 'filter out' aesthetic issues in favour of the functionality of the prototyped solutions.

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Whereas the UK trauma specialist had been enthusiastic about the prospect of taking everyday low cost, locally sourced objects and turning them into functioning medical products, the medical specialist from Zambia argued that *'the use of such materials prevents the solutions from being recognised as important medical products, (sic)'* and was therefore pessimistic about their use. He argued that the solutions were unappealing and that if he was to try gain support for such solutions in Zambia he would *'be dismissed on grounds of their present lack of desirability (sic)'*. This could be attributed to the trend of using media coverage of improvements in medical provisions, as a method of gaining political favour – people are often sold on aesthetics.

The team consequently developed a new series of refined prototypes that, while still low fidelity, had a higher finish quality. These were used in a series of user trails in the next step:

Step 3: Scenario-based user testing and questionnaires, with eight UK paramedics.

The UK paramedics were presented with an acting patient, the solutions and a scenario: *'You have come across a victim of a road traffic accident; you have access to this selection of medical equipment. The patient has hurt their spine, has a possible broken arm and leg, and a large wound to their right leg.'*

During testing the 'think aloud' protocol was enacted and each participant verbalised their thoughts and actions, explaining specific choices during application. The findings reflected many similarities to the feedback received from the UK trauma specialist and medics included within the interdisciplinary team. All eight paramedics demonstrated an appreciation for the use of low-cost easily accessible materials and 6/8 of the users argued in favour of the low cost solutions, over the UK's use of expensive products.

During testing the UK paramedics willingly presented ideas for improving the solutions to increase functionality and ensure comfort for the user and presented a willingness to see the developed solutions in the future.



Fig. 1-4. User Testing with Paramedics.

Step 4: The same selection of solutions was taken to Zambia and testing was conducted with 40 Zambian users: 20 medics (10 in Lusaka, 7 in Chongwe and 3 in Shiyala) and 20 non-medics (12 in Chongwe and 8 in Shiyala). The non-medical participants were identified as target users due to their status as being most likely to be first on the scene of an accident and included fire fighters, police officers, ambulance drivers, drivers and rural dwellers.

Testing was conducted in the same format as the testing with the UK paramedics. During testing differences were identified between both the

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reactions of UK and Zambian participants and within the Zambian participant group.

Testing with users from medical backgrounds in Lusaka was conducted in group settings (discussed in 4.3, below) and presented many similarities to the tests carried out with the UK paramedics. This time the prototypes were well received with all participants being excited to see highly functional products built from locally available materials, and argued in favour of the benefits this increased accessibility could provide.



Fig. 5. User Testing, Lusaka; Fig. 6. User testing, Chongwe; Fig. 7. User testing, Shiyala.

Testing with non-medics in Shiyala and the Chongwe was conducted with two participants at a time and, as happened at Step 2, communication issues surfaced. During testing it became clear that the participants had failed to comprehend that the prototypes were under a process of development and that the aim of the task was to assess the prototypes' suitability to certain scenarios. Participants responded to the task as if it were a learning exercise, or a test, which they would pass or fail. Translators and senior members of the community were employed to explain the study more clearly but to no avail, and the misunderstanding persisted throughout the testing process. As a result, participants failed to provide any additional feedback on their experience of using the solutions or insights into how they might change the solutions.

Further misunderstandings occurred during the testing with medical participants from Shiyala and Chongwe. Despite the participants acknowledging an understanding for the aims of the project, similar issues occurred to those found during testing with the medical specialist from Zambia (Step 2). As before, there was a difficulty in comprehending the prototype's status, and participants presented a lack of appreciation for the material and aesthetic choices. All the Shiyala participants and around 70% of those in Chongwe laughed at the prototypes. Typical statements included: *'this does not look like anything important, I could make this myself (sic)'* and *'this does not look like a normal medical product (sic).'* This resulted in a need to encourage participation and explain the product development process and the process of conducting usability testing before aesthetic refinement. An effort that did result in participation, but failed to encourage users to provide valuable oral feedback.

Step 5: On return to the UK, findings from the Zambian user testing were presented to the interdisciplinary team, on reflection the next range of prototypes were developed to a 'finished' state in terms of aesthetics, form, colours and graphics. On completion, the prototypes were presented to four typical UK users with experience of working in low-resource environments, including: an orthopaedic surgeon, a nurse and 2 anaesthetists. Feedback was gathered through the use of informal discussions while the participants used the prototypes. The feedback received was highly insightful, identifying a possible incorrect choice of colours; changes that needed to be made to increase clarity

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of the instructions; alterations to the sizing of the final solutions; and possible additional elements that could be included into the kit.

Step 6: The refined solutions were taken to Zambia for a further round of user testing, with 40 new participants from Chongwe, Shiyala and Lusaka.

Testing followed the same procedure as Step 4. During testing the [team encountered](#) changes in the reactions to the higher fidelity prototypes, with all of the participants failing to comprehend that despite the solutions high quality feel, they were still under development.

Unlike Step 5 where participants highlighted aspects that they didn't understand or like about the solutions, feedback on the high-fidelity solutions was limited to compliments and appraisals - even the participants who failed to recognise the solution or the correct method of use. It became clear that participants were unwilling to cause offence to the team by giving negative feedback about the high-fidelity prototypes that had obviously taken time to create.

4.2 QUESTIONNAIRES

During the user testing stage of the study questionnaires were employed as a method for sourcing further feedback from participants. During both the UK and Zambian user testing, users were offered the option to either complete the questionnaire on their own, or to use the questionnaire as a method of leading a conversation. The use of questionnaires with the UK paramedics (Step 3), proved highly insightful. All of the users chose to complete the questionnaire whilst talking through their answers to the questions, providing insights that had failed to be gathered during the user testing itself.

While the questionnaires had worked well in the UK, their use in Zambia presented some difficulties, resulting in a failure to gather the same level of insight. It became clear that there was no ideal method of identifying literate users without causing offence, and a lack of familiarity with the questionnaire's use resulted in participants looking at the paper for a period of time and failing to answer any of the questions.

Due to the difficulties faced when trying to use the questionnaires amongst the educated participants in Lusaka and Chongwe, and the high illiteracy levels in Shiyala, questionnaires were not employed there.

On the second trip to Zambia to conduct user testing, in an effort to increase ease of use, the questionnaire was revised. Prior to testing, the user's job title was recorded and a judgement was made on their literacy capabilities in response. Jobs that required good literacy capabilities were presented with the re-formatted questionnaire after the usability testing was complete. Notwithstanding this careful selection of participants the results of the study showed that participants still faced great difficulty, with most either copying each other's answers, answering only half the questions or simply writing the same answer for each question.

4.3 RECRUITMENT AND ORGANISATION

Organisation of testing with the UK paramedics was conducted via email with the locality manager of a local ambulance station. The initial email presented the project, the reason for it being conducted and requested feedback on initial

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design solutions. The response was immediate and encouraging, with the department showing great enthusiasm and agreeing to provide assistance with the project. An offer was made for the first author to visit the ambulance station with the solutions, where a room was made available for the user testing with participants. On arrival at the station the first author presented the project to paramedics and received a positive response towards participation in the study.

The Zambian elements of the study took place alongside charity expeditions providing medical teaching within hospitals in Lusaka Province. Prior to the trip, arrangements were made and permission gathered via email. On arrival at the different locations in Zambia, further meetings had to be held with the person(s) in charge in each location to acquire permission for the study. During the meetings arrangements were also made for the provision of a room where the study could be conducted. The recruitment of participants in the different locations took varying formats. In some instances recruitment took place alongside the educational courses being held by medical members of the charity team. Others required the first author to move around the different locations and source participants - this method was frequently challenging.

Contrary to the ease of organisation and recruitment in the UK, gaining support for the project in Zambia was a challenge as other elements of the charity expedition were seen as presenting greater importance, resulting in a failure to gather sufficient support. When attempting to recruit participants for the study in Chongwe and Shiyala the team encountered reluctance due to a lack of understanding of what the project involved. Difficulties included a lack of familiarity with product design, user involvement and user testing participation levels, and an inability to communicate due to language barriers.

In response, the team made efforts to get to know the villagers and incorporated stakeholders into the team as translators, who could explain the study. This approach increased the amount of available participants, however reluctance remained and had to be overcome through conducting testing as the participants desired i.e. in group settings, pairs or individuals.

5 DISCUSSION

The findings presented in this paper are only a précis of the full study, however they identify compromises that were made and elements that should be accounted for when applying the HCD methodology in Zambia in comparison with the UK. For example, the findings demonstrated the impact that varying levels of comprehension for the product development process and prototypes can have. Despite UK participants demonstrating an understanding of the use of prototyping as a tool for gathering feedback on a solution's functional capabilities during the product development process. Zambian participants presented varying levels of understanding of the development process and frequently failed to comprehend that the prototypes presented were under a stage of development, not the end solutions. As a consequence, feedback varied from insightful and encouraging to dismissive and limited. In addition, misinterpretation of the project aim sometimes resulted in the Zambian studies failing to gather the same level of insight as the UK studies.

The findings present noticeable differences between questionnaire use, recruitment and organisation in the UK and Zambia, with the UK benefitting from easy recruitment and organisation, and an ability to gather extensive

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insights from the completion of questionnaires. In Zambia, the use of questionnaires caused difficulties as a result of varying language use, low literacy levels and a lack of familiarity with questionnaires, resulting in them failing to provide useful insights. The organisation and recruitment of the Zambian study was laborious due to a lack of appreciation for the eventual benefits the project could provide.

Despite the identified difficulties, the findings also identify benefits of the HCD approach in both the UK and Zambia, with invaluable insights having been gained into the solutions' functionality, suitability and acceptance within the different environments. The use of prototypes in the UK enabled a process of development that ensured solutions functioned as required and the patient received the necessary level of care. The use of prototypes in the Zambian context allowed for usability testing to be conducted and to ensure that the solutions overcame the culture barriers to product use. User testing in Zambia also highlighted the importance given to the solutions' aesthetic quality over accessibility, cost and functionality, allowing for the necessary refinements to be made. Despite low-fidelity prototypes being dismissed as unattractive, their use encouraged participants to provide honest feedback and acknowledge areas that they least desired, an aspect not present when using high-fidelity solutions.

6 STUDY LIMITATIONS

The study faced time restrictions as a result of it taking place alongside charity expeditions. Due to PhD requirements and financial limitations the design phases took place within the UK. Travel within Zambia was also limited as a result of poor road safety.

7 CONCLUSION

In exploring the suitability of applying a HCD methodology to the context of the developing world, this paper conducts an analysis of the differences between the use of prototype-driven user testing with target users in the UK and Zambia. In conclusion, the findings identify variations in the ease of applying the HCD methodology as a result of language and literacy barriers, a lack of familiarity with the product development process and the use of prototypes. While organisation, recruitment and the conducting of user testing with prototypes within the UK proved to be quite straightforward, the Zambian study was met with some resistance and sometimes failed to gain sufficient support. This might have been due to a perceived lower status of the study compared with other elements of the charity expeditions. Perhaps this was due to a lack of immediate reward or maybe a limited understanding of what the project hoped to achieve. These same elements also impacted upon the recruitment of participants resulting in changes having to be made to the method of conducting user testing, be it with groups, pairs or with individuals. The use of questionnaires failed to provide useful insights and verbal feedback from the majority of participants was limited on account of a failed understanding of the aims of the project and the status of the prototypes.

However, despite the identified difficulties, the paper also identifies benefits of using a HCD methodology in Zambia. Extensive insights were achieved through observing and analysing participants' interaction with the solutions and through their open disregard or acceptance of the different solutions. In response, one of the outputs from the research, beyond the actual medical solutions developed

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themselves, is the development of a set of recommendations for future medical design projects run in Zambia:

1. Initiate the study with a contextual review, and use findings to drive the design process.
2. Ensure the choice of typical users reflects the wider community, Rubin (1994). Feedback from different spectrums of the community may vary.
3. Don't assume willing participation, make efforts to socialise, develop friendship and gain trust, and then gradually introduce the project.
4. Don't rely purely on oral communication of feedback, or questionnaires. Focus on analysing users physical responses to solutions.
5. In an effort to ensure the highest level of functionality, combine feedback from users with comprehensive knowledge of the subject area (in this study the UK participants), with usability testing with the intended end users.

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