Usability evaluation of frugal innovation: A case of mobile training for micro businesses in Tanzania

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Usability evaluation of frugal innovation: A case of mobile training for micro businesses in Tanzania

William Clifford Gomera 1,2,*, Jarkko Suhonen 2, Markku Tukiainen 2, George S. Oreku 2,3, Matti Tedre 2 and Solomon Sunday Oyelere 2

1 Accountancy Department, College of Business Education (CBE), Tanzania
2 Faculty of Science, School of Computing, University of Eastern Finland, Finland
3 Faculty of Science, Technology and Environmental Studies, (FSTES), The Open University of Tanzania (OUT), Tanzania

*Corresponding author. email: c.gomera@cbe.ac.tz, billcliff2002@yahoo.co.uk

This study evaluated a mobile training pilot prototype designed for micro business owners in Tanzania. The paper focused on the extent to which features of the pilot prototype developed under frugal innovation confirmed the defined user requirements of the mobile training and met usability perception of the potential end users in solving the practical problem. The practical problems addressed are time, low education level and geographical challenges facing the training service. The evaluation assessed whether the features of the mobile training pilot prototype met the previously identified user requirements and investigated users' perceptions of the pilot prototype's attractiveness and perspicuity and their enthusiasm for it. In this mixed-methods study, data were drawn from a questionnaire and focus group discussions. The study found positive views on the features of the pilot prototype based on the defined user requirements, as well as the usability elements of attractiveness, perspicuity, and enthusiasm. The participants thought that the pilot prototype’s navigation and interaction features needed further modifications to make use of the mobile training application easier. This study contributed that, the artefact developed through frugality innovation within DSR framework confirmed earlier identified user requirements and met usability criteria of attractiveness, perspicuity, and enthusiasm.

**Keywords:** usability, design science research, frugal innovation, mobile training application, micro business, micro finance institution

**Introduction**

Tanzania’s micro business (MB) sector is characterized by insufficient capital, informal operations, having owners with low education levels (Hamisi 2011; Mead and Liedholm 1998). MB owners often lack business skills, such as business management, financial management, marketing, and proper record-keeping management (Berger et al. 2012). However, there is increased awareness that the success of MBs in developing countries, particularly Tanzania, requires human capital as much as financial capital (Kessy and Temu 2010; Kjetil and Bertil 2010). Therefore, training is as an important service as microloans. Microfinance institutions (MFIs) seek to offer training to improve business management skills and strengthen businesses (Abebe, Tekle, and Mano 2018).

Currently, MFIs’ training for MB owners takes place through physical contact between trainers and trainees, which requires well-established premises and time dedicated to training (McKenzie and Woodruff 2017). This dominant training mode faces the following challenges: (1) variation in training, particularly in content and delivery mode across locations and organizations; (2) poor training environments and premises, which affect both trainers and trainees; and (3) unfriendly schedules for trainees, who often have difficulty of being away from their businesses (Gomera and Mikko 2015; Kessy and Temu 2010; McKenzie and Woodruff 2014, 2017). Our review did not find any application specifically developed to offer mobile training to MB owners despite the opportunity of using mobile technology to address problems related to time, space, and distance (Berge et al. 2012; Gomera, Suhonen, and Oreku 2020; LaFortune, Riutort, and Tessada 2018; Wyatt, Donovan, and Johnson 2018).

These challenges motivated us to start developing a Microbusiness-Microfinance (MBMF) mobile training application for smartphones (Gomera et al. 2017) to deliver training materials to MB owners anytime and anywhere (Gomera and Oreku 2016). The main aims of this MBMF mobile application are to eliminate the need for physical contact between trainers and trainees and to reduce the need of specific premises for training. In addition, the application is aimed at delivering training materials and saving time for MB owners to carry out their business operations without interruptions.

The design of the MBMF mobile training application is grounded on the design science research (DSR) framework introduced by Johannesson and Perjons (2014). During the design and development of the pilot prototype, the DSR framework was supplemented with frugal innovation (Brem and Wolfram 2014; Zeschky, Winterhaltere, and Gassmann 2014), design thinking (Brown and Wyatt 2010; Dolak, Uebernickel, and Brenner 2013). At this evaluation stage, usability evaluation was used (Brown and Wyatt 2010; Davis 1993; Dolak, Uebernickel, and Brenner 2013; Venkatesh and Davis 2000).

The usability evaluation was used to establish whether the use of frugal innovation resulted in an artefact with the required features that meet the usability criteria and lead to a viable and affordable solution for the development of sparse resource societies (Brem and Ivens 2013). The evaluation was accomplished through assessing users’ acceptance and gauges the features of pilot prototype to the identified user requirements. The assessment of
Training challenges and solutions for micro business owners

Despite the importance of MFI training among MB owners, the training has had low uptake and poor attendance among this target group, which significantly reduces the impact of the trainers’ efforts of building participants’ capital (Iacovone, Calderón, and MacGregor 2018; McKenzie and Woodruff 2017). Several challenges that directly affect training for MB owners have been identified (Kjetil and Bertil 2010). The first challenge is lack of continuity (Berge et al. 2012). Most of the MFIs provide training that lasts for two days to one week, which is not long enough to equip MB owners with the needed business skills (Iacovone, Calderón, and MacGregor 2018).

The second challenge is time; this is reported to have constrained MB owners’ knowledge acquisition. Most of the MB owners are managers and owners and must be on their business premises at all times, thus denying them time of attending training (Kessy and Temu 2010). The third is lack of appropriate premises; this is identified as constraining training. While some training takes place on MFIs’ premises, most do so in MB owners’ workplaces, whose environments are inappropriate for training endeavours to both trainers and trainees (Kjetil and Bertil 2010; McKenzie and Woodruff 2014).

Various solutions have been proposed to overcome these training challenges for MB owners. For example, outsourced of training programmes from business training professionals, such as entrepreneurship centres, has been proposed as one of the solutions. However, this solution is considered expensive for MFIs and is difficult to implement due to a large number of customers that are to be served by MFIs (Kjetil and Bertil 2010). Another proposed solution is to have longer and consecutive training or shorter training sessions presented over a long time.

In another proposed approach, a mentor identifies useful skills for a mentee and creates a plan for learning these skills (Wyatt, Donovan, and Johnson 2018). Many suggested solutions have proven to be ineffective and have not improved the attendance rate of MB owners (Berge et al. 2012).

Learning technologies and e-learning solutions offer possibilities of facilitating informal learning, for example, by increasing access to knowledge and enabling flexible ways of learning (Deen-Swarray, Moyo, and Stork 2013; García-Peñalvo, Colomo-Palaci, and Lytras 2012). E-learning has become a popular delivery method for informal learning because it has many advantages: there is no requirement for space, it has substantial cost savings due to the elimination of travel expenses, it has timely access to information and has greater flexibility in the workplace and ways of addressing trainees’ needs (Jantjies and Joy 2015; Sanga et al. 2016).

One solution for informal training is massive open online courses (MOOC), which are supported by technological infrastructure. This allows participants to use videos, links, and text materials (AlDahdouh and Antonio 2016). However, most of the MOOC platforms are focused on formal learning at the university level and offer courses in line with university courses (Airton, Nunes, and
Informal practitioners such as MB owners lack a platform for informal training (Esfer et al. 2017). However, mobile learning has been identified as a potential solution for the challenges facing MB training (Berge et al. 2012; Kjetil and Bertil 2010; McKenzie and Woodruff 2017), particularly in Tanzania and East Africa (Iacovone, Calderón, and MacGregor 2018; Wyatt, Donovan, and Johnson 2018) generally. This finding was the main motivation of designing the MBMF mobile training application with a view of delivering training materials to MB owners anytime and anywhere (Gomera et al. 2017).

**Design of mobile training application for micro business owners in Tanzania**

**Design science research framework supplemented by frugal innovation, design thinking, and usability evaluation**

*Design Science Research* (DSR) is a scientific approach of developing solutions to practical but complex problems that have significant impacts on people’s development (Hevner and Samir 2010; Johannesson and Perjons 2014). The problems tackled in DSR can involve either puzzling questions or identified needs of improving the situation of a class of users through human-centered and design thinking approaches (Hevner 2007; Hoadley 2004; Owen 2006; Venable 2006). The DSR process can be conceptualized as three interconnected cycles: the relevance, design, and rigor cycles (Figure 1; Hevner 2007).

In the relevance cycle, the problem, the specific requirements, and acceptance criteria for the solution are identified. The design cycle consists of the iterative design, development, and evaluation of the solution, while the rigor cycle connects the overall DSR process to the scientific knowledge base. The DRS process involves interactions among all these cycles, creating a strong and complete research approach of understanding better practical problems, and developing knowledge related to finding solutions to those problems (Hevner and Samir 2010; Venable 2006).

**Figure 1:** Design science research cycle (Hevner 2007).

**Figure 2.** Design Science Research framework (Johannesson and Perjons 2014).
We used Johannesson and Perjons’s (2014) DSR framework to concretize the design cycle of the general DSR process because this framework provides a well-organized, stage-by-stage view of the design and development of viable and affordable solutions (Brem and Ivens 2013). The iterative and interconnected stages in the framework are problem explication, requirement definition, and outline of possible solutions, design and development, demonstration, and evaluation (Figure 2).

In order to increase the applicability of the DSR framework for the environments with scarce resources, we integrated the concepts of frugal innovation (Brem and Wolfram 2014; Zeschky, Winterhaltere, and Gassmann 2014) into the framework. We also included design thinking (Brown and Wyatt 2010; Dolak, Uebernickel, and Brenner 2013), and usability evaluation (Brown and Wyatt 2010; Davis 1993; Dolak, Uebernickel, and Brenner 2013; Petrie and Bevan 2009; Ramiller 1993; Venkatesh and Davis 2000) into the framework (Figure 3).

The advantage of frugal innovation is that it enables economic efficiency amid scarce resources, but there is still a need to develop good-enough and affordable products that meet the requirements of resource-constrained end users such as MB owners (Agarwal and Brem 2012; Zeschky, Winterhaltere, and Gassmann 2014). The frugal innovation entails various activities in providing effective functional solutions to problems encountered by sparse resource societies. This concept is in contrast with the notion that innovations are too resource constrained, expensive, or are not available. The frugal innovation motivates researchers, designers, practitioners, and other stakeholders into working with what they have using affordable but effective tools, processes, and techniques to solve practical problems (Tran and Ravaud 2016). Moreover, with frugal innovations, constraints surrounding sparse resource societies are changed to opportunities that bring products, services, and systems to reach multitudes of users. The resource sparse settings may involve institutional and resource constraints – such as limited capital resources, lack of basic provisions, weak infrastructure, or poor policies on governance innovation (Knorringa et al. 2016).

Design thinking gains insights into human behaviour by creating interactive experiences for user involvement that can encourage technological acceptance of artefacts. Design thinking focuses on human centred design that can create and evaluate tangible artefacts through physical prototypes (Dolak, Uebenickel, and Brenner 2013). The use of pilot prototypes can uncover unforeseen attitudes and unintended consequences, increasing solutions’ reliability and usefulness (Brown and Wyatt 2010; Dolak, Uebernickel, and Brenner 2013). Design thinking focuses on creating human-centred solutions, the design process, tentative solutions, and perceptions on how well solutions fix problems (Brown and Wyatt 2010; Meinel, Lindberg, and Wagner 2010). Design thinking calls for full participatory involvement by end users in all stages of the design and development process (Kuhn and Muller 1993; Venkatesh and Davis 2000).

Finally, usability and user experience aspects were used because they are naturally connected to frugal innovation and design thinking. Usability and user experience focus on the human-centric experience of the working environment in both the product and design processes (Bargas-Avila and Hornbaek 2011; Brown and Wyatt 2010; Dolak, Uebernickel, and Brenner 2013; Schrepp 2015; Yogasara et al. 2011). For example, to ensure acceptance of an artefact developed through frugal innovation, various usability aspects, such as the system design features, perceived usefulness, and ease of use, and attitudes of prospective end users (Chau 1996; Davis 1993; Sanchez and Hueros 2010) should be considered. System design features measure the degree to which users perceive the system’s features as meeting the defined user requirements (Davis 1993; Venkatesh and Davis 2000). Perceived usefulness measures the
degree to which persons believe that using the system would enhance their job performance. Perceived ease of use measures the degree to which persons see that using the system is free of effort. Attitudes measure the degree to which users are interested in the system and have direct behavioural intentions to use it in the future (Sanchez and Hueros 2010; Sumadio and Ramlí 2010; Turner et al. 2010; Venkatesh et al. 2003).

Problem explication: microfinance institutions and microbusiness owners’ interactions

The problem explication stage of DSR identifies and defines the problem facing stakeholders in a given practice (Johannesson and Perjons 2014). The main aims in this stage are to explicate the problem clearly, formulate the practical problem in question, and explore the significance of solving the problem. To enable novel interactions with potential end users, researchers and designers need to consider users’ requirements, experiences, and working environments (Olsson et al. 2013; Suhonen, Mattila, and Mäkelä 2012).

The first steps in the design of the MBMF mobile training application were to identify and explore the interactions between MFIs and MB owners and the challenges related to these interactions. Training was identified as one of the main services MFIs provided to MB owners (Gomera and Mikko 2015). The problems facing MB owners related to MFI training services were investigated and analyzed through descriptive approach. The researchers, the designer, MFIs, and MB owners were involved to have common understanding that training service needs a special attention in the interaction between MFIs and MBs. During this stage, data were gathered through face-to-face interviews, focus group discussions, and researchers’ observations to gain insights into training practices, challenges to training, and potential solutions to those challenges. The user requirements indicated the need for the use of mobile technology in training and the following challenges facing the quality of training MB owners were identified: lack of continuity, lack of time for MB owners to attend training, and inappropriate delivery methods for training materials. Others include high costs of preparing hard copies, inappropriate training environments, especially at MB owners’ workplaces, and lack of physical contact between the trainer and the trainee. MB owners’ characteristics and training environments, and the application by potential users were also identified. The problem explication stage clarified the problem to be solved and guided the DSR process by providing evidence on the significance of developing a mobile application to enable the delivery of training materials to MB owners anywhere and anytime (Gomera, Suhonen, and Oreku 2020).

Requirement definition: outline of potential solutions for the MBMF mobile training application pilot prototype

The second stage in DSR concretizes the solution requirements and outlines potential solutions of addressing the identified problem (Johannesson and Perjons 2014). Several meetings following participatory design principles were conducted with the researchers, software engineers, MFI personnel, and MB owners to reach a consensus on problem explication, define the requirements of the proposed solution, and identify user expectations (Gomera and Oreku 2016). Among the identified user requirements, the learning materials uploaded in the application had to be available on video, audio, and text formats. Such learning materials had to be easily transferable, the user interface had to be minimal, and the application had to have a discussion forum. Moreover, the application had to use Kiswahili language and operate on mobile phones (Gomera, Suhonen, and Oreku 2020).

In this stage, the technical requirements that led to modifying the requirements for functions and features were presented to the MB owners and MFI representatives to ensure that the end users and researchers had a common understanding of the functionality and features of the pilot prototype. The meetings helped to confirm the identified challenges to MFI training for MB owners, which led to a consensus on the main challenges related to training services. The MB owners’ working environments and their characteristics were further elaborated and identified. Specific user requirements and the main functionalities were agreed upon based on the identified challenges. Potential solutions for the prototype were presented to the users to gather their comments and suggestions. Finally, the developers applied the knowledge learned during the requirement definition phase to the architectural design of the MBMF pilot prototype (Gomera et al. 2017).

Design and development: MBMF mobile training application pilot prototype

The development proceeded next with the implementation of a pilot prototype of MBMF mobile training application as frugal innovation (Gomera et al. 2017). The frugal innovation was supplemented in the DSR framework to enable pilot prototype of MBMF mobile training application reach MBs in sparse resource settings. The use of frugal innovation aimed at emphasizing resources minimization while maintaining user value and quality of the proposed product or service (Knorrina et al. 2016). With frugal innovations, the project team changed constraints surrounding MBs to opportunities that may bring effective training to their working environment.

We observed that institutional and resource constraints – such as limited capital resources, lack of basic provisions, weak infrastructure, or poor governance innovation policies, and financial resources were the main constraints on research and development in most informal sectors in developing countries. Frugal innovation, therefore, can be a useful technological solution to many challenges facing resource-limited environments (Gomera et al. 2017).

The pilot prototype used the Android studio to share learning materials prepared by the trainers (MFIs) with trainees (MB owners) through various delivery systems including Google Drive, Archive.org, and YouTube. Google Drive delivered slides of written documents (Figure 4), Archive.org learning materials in audio format, and YouTube video materials (Figure 5). The
main menu of the prototype had the option of choosing the preferred delivery medium for materials: video, audio, or slides. All these features were important to ensure easy access to and comprehensibility of materials shared with MB owners (Gomera et al. 2017). The prototype used Kiswahili to enable participation of the majority of MB owners in Tanzania.

**Demonstration and evaluation of the pilot prototype**

MFI representatives demonstrated the pilot prototype created during the design and development stage to a group of MB owners. This training workshop also showed the feasibility of the pilot prototype in MFIs representatives’ working environments. Figure 6 illustrates the demonstration meeting conducted in the MFIs premises (Gomera et al. 2017). However, part of the figure that showing demonstration’s participants is blurred purposefully to protect their identity.

In the evaluation stage, testing of a pilot prototype in a working environment and evaluation approaches can be
applied to establish the extent to which the implemented solution meets the potential users’ expectations (Johannesson and Perjons 2014). The present study was the first evaluation of the pilot prototype.

Methodology

Role of the pilot prototype and evaluated aspects

The MBMF pilot prototype was adopted as a platform of enhancing training for male and female MB owners in their working environments. The training materials covered the importance of entrepreneurship (ujasilmamali ni tegemeo in Kiswahili), business management (usimamizi wa biasarana), and microloans for entrepreneurs (mikopo kwa mjasilamali). The MB owners were asked to download the application on their mobile phones and view all the shared video, audio, and text materials before sharing their perceptions on the application.

The evaluation of the MBMF pilot prototype had two phases: ex-post evaluation and ex-ante evaluation. The ex-post evaluation focused on the prototype’s usability evaluation (Pries-Heje, Baskerville, and Venable 2008; Venable, Pries-Heje, and Baskerville 2012). The end users completed a questionnaire on perceived attractiveness, perspicuity, and enthusiasm (Bargas-Avila and Hornbæk 2011; Davis 1993; Schrepp 2015; Yogasara et al. 2011). These three usability aspects were selected because they could be used to measure persons’ perceptions and responses resulting from the use and anticipated use of a product, system, or service (International Standardization Organization [ISO] 9241–210 2010). Attractiveness referred to overall impressions of the product, or users’ subjective perceptions of its visual design (Chau 1996). Perceived perspicuity referred to beliefs about how easy it was to interact with the product (Bargas-Avila and Hornbæk 2011; Schrepp, Hinderks, and Thomaschewski 2017). Enthusiasm referred to users’ excitement and attitudes toward the product (Turner et al. 2010). The participants were also invited to join a focus group discussion to express their perceptions on the pilot prototype’s usability (Davis and Viswanath 2004). Through the questionnaire and focus group discussions, the participants rated and provided their perceptions on the expected use of the pilot prototype (Azom and Muying 2010).

The ex-ante evaluation focused on the product’s design and development (Prat, Comyn-Wattiau, and Akoka 2014; Venable, Pries-Heje, and Baskerville 2016) process. We evaluated the extent frugal innovation that was applied in the mobile training pilot prototype safeguarded the identified user requirements of the MBMF mobile training application. We also sought concrete ideas to improve the pilot prototype. We then consulted a number of MB owners whom we asked to download the prototype application on their mobile devices and run it individually before completing the questionnaire and participating in the focus group discussions. The participants were given a brief general introduction to the application and on how to download it on their mobile devices. The participants also received help using the prototype to ensure that they could understand it and relate it to their working environments. This assistance allowed the researchers to observe the initial reactions of the artefact’s potential users before gathering detailed reactions through questionnaires and focus groups (Heikkinen, Olsson, and Mattila 2009).

Questionnaire

Questionnaires are viewed as an efficient, inexpensive, and simple method of measuring user experience of interactive products (Laugwitz, Held, and Schrepp 2008; Mashapa and van Grevenen 2010; Schrepp, Hinderks, and Thomaschewski 2017). We used a subjective satisfaction questionnaire (Schrepp, Hinderks, and Thomaschewski 2014) to evaluate the pilot prototype’s attractiveness, perspicuity, and enthusiasm (see Table 1 for the questionnaire components). The questionnaire had a Likert scale (1: strongly agree, 2: agree, 3: neutral, 4: disagree, 5: strongly disagree).

Focus group discussions

The focus groups were used to obtain rich, qualitative information, and insightful feedback that the questionnaire could not capture. The focus group discussions focused on the three usability aspects of the pilot prototype evaluated (attraction, perspicuity, and enthusiasm). The focus groups provided a forum of discussing the initial user requirements of the MBMF mobile training application and the participants’ feelings about the application (Kontio, Lehtola, and Bragge 2004; Olsson et al. 2013). The participants could also recommend improvements to the pilot prototype.

The focus group discussions were held in three business locations in Dar es Salaam City popular with MBs: Kisutu Market, Ubungo Bus Terminal, and Tandika Market. The focus groups involved twenty-eight participants, including eleven from Kisutu Market, nine from the Ubungo Bus Terminal, and eight from Tandika Market. Each focus group discussion lasted for less than ninety minutes. The discussions were moderated by the first author.

Ethical considerations

During data collection, consent was sought and obtained from all the participants. The collected data were used only for academic and research purposes. It was agreed that the participants’ information and any other materials and pictures that could identify participants would not be disclosed. Participants were free to withdraw from the study and were not forced to talk during focus group discussions.

Participants and data collection methods

Fifty-three MB owners who received microcredit services from MFIs were recruited to participate in the usability study through purposive sampling. We opted for using purposive sampling to target only participants who met specific criteria: MB owners who had loans from MFIs, were willing to be involved in the discussion, and owned a smartphone. The first author obtained permission from the market authorities to test the MBMF pilot prototype.
Results

Ex-post evaluation of the pilot prototype

Table 1 summarizes the results of the evaluation of the usability aspects (attractiveness, perspicuity, and enthusiasm). In the analysis, lower means indicated stronger agreement by the participants, and vice versa.

<table>
<thead>
<tr>
<th>Usability aspect</th>
<th>Evaluated items</th>
<th>Mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attractiveness</td>
<td>I feel proud to use the application.</td>
<td>1.19</td>
<td>.39</td>
</tr>
<tr>
<td></td>
<td>The interaction is friendly.</td>
<td>2.13</td>
<td>1.08</td>
</tr>
<tr>
<td>Perspicuity</td>
<td>The artefact is easy to use.</td>
<td>2.17</td>
<td>1.09</td>
</tr>
<tr>
<td></td>
<td>The language is clear.</td>
<td>1.23</td>
<td>.42</td>
</tr>
<tr>
<td>Enthusiasm</td>
<td>I feel excited about the application.</td>
<td>1.38</td>
<td>.49</td>
</tr>
<tr>
<td></td>
<td>I find the application to be interesting.</td>
<td>1.23</td>
<td>.47</td>
</tr>
<tr>
<td></td>
<td>I find the application to be motivating.</td>
<td>1.30</td>
<td>.50</td>
</tr>
</tbody>
</table>

Regarding the attractiveness aspect of the pilot prototype, the participants indicated that the most positive aspect was the pleasure of using it (mean 1.19, standard deviation .39). The participants also strongly agreed that the prototype was attractive and operational (mean 1.32, standard deviation .46), and most of them enjoyed the multimedia design of the prototype (mean 1.25, standard deviation .47). However, the participants only mildly agreed that the interactions with the prototype were friendly (mean 2.13, standard deviation 1.08), and the high standard deviation indicated variation in the participants’ opinions on the friendliness of the interactions.

Regarding the perspicuity of the pilot prototype, the participants strongly agreed that the language used was clear, as indicated by the low standard deviations. Most participants strongly agreed that the navigation of the application was good (mean 2.13, standard deviation .43), and the prototype was easy to use (mean 1.36, standard deviation .56). However, navigation received lower scores for perspicuity (mean 2.17, standard deviation 1.09).

Regarding enthusiasm, the participants strongly agreed that they felt proud of the application (mean 1.28, standard deviation .46). They also indicated that they were excited by the prototype (mean 1.38, standard deviation .49), were strongly interested in using it (mean 1.23, standard deviation .47), and were strongly motivated to use it (mean 1.30, standard deviation .50).

Focus group discussions

Regarding attractiveness, the focus group participants regarded the application as attractive and appropriate for their working environments. The following statement is a representative of these opinions: ‘The mobile application layout/interface is very attractive and enjoyable. However, we would like to see photos of MB owners in the application.’ Another representative response was that ‘It is very entertaining to view the materials in all forms of multimedia. We wish that pictures depicting our working environment were used in the application, even when we are doing our businesses.’ Another participant commented that the prototype was relevant to their activities: ‘We are happy to find an application that specifically deals with our business and working environment.’ However, some participants considered the application unpleasant and unfriendly and did not enjoy the demonstration. The participants noted that the application took a long time to open, which wasted time. One participant commented, ‘It is true that the materials in the application are multimedia. However, it takes so long to open. It occurs even when one finds written text without sounds or video associated with the text in question.’

Regarding perspicuity, the majority of the participants indicated that the prototype was easy to learn and use and that the use of Kiswahili enhanced the intelligibility of the training materials. One participant stated, ‘The application is good and is provided in a local language. We, however, insist that local examples and detailed explanations of issues be provided to enhance comprehension.’ The clarity of the interface was also positively reviewed by the participants. A representative view was that ‘This application is very clear and self-explanatory. We can fully understand what is going on in it.’ However, the participants also pointed out that the navigation interface could not be accessed by those who were not literate. Moreover, they criticized the long lag between switching on the application and opening it for use. The participants thought that the slowness negatively affected the first impressions of the application and could put off potential users.

Regarding enthusiasm, the focus group participants appeared motivated to use the application for self-training. Most of them were excited by the possibility of accessing training materials in the format of their choosing. One participant commented, ‘This application seems to have incorporated physical training into mobile phone. It is really interesting and appears to have been designed to fit our working environment and activities.’ The participants were eager to access the learning materials in the application, as indicated by one participant:
We are highly interested in seeing and using this application to access knowledge from MFIs. We are excited to hear and see our loan officers speaking to us using examples from our daily practices and our photos in the application.

Another stated, ‘We are proud and excited to see a technology that suits our working environment.’

Ex-ante evaluation of the pilot prototype
The participants were asked to reflect on the prototype’s match with the previously identified user requirements for the MBMF training application. The purpose of this discussion was to analyze whether the pilot prototype’s features fulfilled the requirements of its end users. The participants also recommended areas of improvements for the prototype.

MBMF mobile training application user requirements
The focus group participants were excited to find that they could access the training materials anytime and anywhere and could download and save learning materials on their mobile devices for offline viewing. One participant commented, ‘It is possible to view training materials anywhere, without a need to attend classes. This means that we do not have to close our small businesses to attend training at specific places.’

The participants highly appreciated the use of Kiswahili language. One commented, ‘We are very excited to see that this application operates in Kiswahili, our national language.’ However, a few participants criticized some use of English in the prototype.

The participants highly appreciated the use of the existing infrastructure to deliver the training materials. The usage of the existing infrastructure was commented to reduce reverting the wheel and appreciating the usage of a well-known and user-friendly services to enhance training to MBs.

The focus group participants indicated that the availability of training materials in video, audio, and text formats suited their different working environments and catered for the needs of different types of users. Moreover, the participants also reported that symbols and figures were important for expressing items and concepts not necessarily conveyed in the spoken or written word.

Recommendations for improvements
The participants were not completely satisfied with the promptness of the prototype and aspects such as the interface and navigation features. A few thought that mobile phone training could not match physical contact between trainers and trainees. Others observed that some examples in the application were foreign and outdated. Some participants were worried about network problems and the length of time taken to download the application. Some pages, videos, audios, and lectures were perceived as very long and therefore boring. The participants recommended for concise presentation of materials, such as smaller files with few contents. One participant commented, ‘We are comfortable with the time used to read, watch, or listen to a particular content before either moving to other activities.’

The participants suggested for the inclusion of enabling features of viewing other users’ comments, responses, and questions about the shared materials. One participant stated, ‘The application could provide instant feedback and the possibility to view comments and questions and to share views with other trainees.’ A few respondents proposed for the inclusion of detailed explanations of the content instead of the bullet-point presentation dominating the written materials. The participants also recommended that the interface should allow the correction of wrong selections without forcing the users to restart the application. One participant commented, ‘It would be good for the application to provide a chance to correct a wrong option instead of restarting the process whenever a wrong move is made. This will save time for users who have not mastered the application.’

Table 2: Summary of the focus group discussions.

<table>
<thead>
<tr>
<th>Usability aspects</th>
<th>Focus group discussions responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attractiveness</td>
<td>The participants enjoyed the opening training materials in the video, audio, and text formats and the possibility to receive training in their preferred format. The participants found the layout and interface of the prototype to be attractive but recommended adding photos depicting their operation. The participants showed enthusiasm for the prototype because it suited their business environments. The participants felt that the prototype was attractive to use. The use of Swahili in the prototype provided a sense of ownership.</td>
</tr>
<tr>
<td>Perspicuity</td>
<td>The Swahili language used to present the materials was found to be simple and understandable.</td>
</tr>
<tr>
<td>Enthusiasm</td>
<td>The participants were highly eager to receive learning materials from the MFIs. The MB owners were enthusiastic about hearing and seeing loan officers speaking to them through the prototype and giving relevant examples of activities.</td>
</tr>
<tr>
<td>Recommended</td>
<td>There should be opportunities to ask questions and get instant feedback as in physical contact. The designers should strive to shorten the application’s opening time and address network problems, which both affect first impressions of the prototype. The content in the learning materials should be presented in detail rather than bullet form. The developers should use local examples and give detailed explanations of business undertaking. Navigation within the application is somewhat complex and needs to be simplified. The interface of the application could be improved with sound and video, especially during opening the application. The application could be simplified to allow anyone to open it without assistance from colleagues or loan officers.</td>
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<tr>
<td>improvements</td>
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</table>
Some participants proposed that the application be designed to notify users of updates, as WhatsApp does. Finally, the participants recommended using symbols and figures to supplement the audio and text material, particularly for people with disabilities. Table 2 summarizes the findings of the focus group discussions.

**Discussion**

The purpose of this study was to evaluate the extent to which features of pilot prototype developed under frugal innovation confirm the earlier identified user requirement and assess the users’ perception on its usability criteria. The identified requirements and usability aspects based on the concrete implementation of a training application developed specifically for delivering training materials to MB owners in Tanzania using few resources.

**Features of the frugal innovated pilot prototype in relationship to user requirements**

Among the criteria evaluated in the usability study were the featured of pilot prototype in relations to user requirements identified in the earlier DSR stages. During the demonstration and evaluation of the application in work environments, the end users were given the opportunity of discussing whether the prototype’s features met the user requirements. The study confirmed that the pilot prototype met the initial user requirements identified by Gomera and Oreku (2016), such as small-sized materials, use of Kiswahili, different delivery methods for materials deliverance, and the usage of a mobile phone as the medium of application. Moreover, characteristics of the MB owners, such as their education level, time constraints, and inability to concentrate on long presentations, were all taken into account to improve the application.

The positive perception of users towards features of pilot prototype in relation to identified user requirements confirms the relevance of frugal innovation within the DSR framework in sparse resource societies. The relevance of frugal innovation within DSR framework consists of the small and multidisciplinary project team, different practitioners’ formality, and different education level. The frugal aspect cemented the concepts of user ownership and rigor of the research on design process, and inclusion of a small multidisciplinary team to realize objective and societal consideration for positive results.

Under user *ownership, and rigor research* in the frugality process, these concepts react to the challenge raised by Tran and Ravaud (2016), that with frugality, the designer may end up with innovations not as effective as those used in high-income settings but often represent solutions that may support their interaction. This was to make sure that the designers do not act in a vacuum; they triggered the activity called research (Micaelli et al. 2016). The aspect that the designed solution strengthens the interaction between two institutions (one being well organized i.e. the MFI and the other operating in informality MBs) confirm on that the frugal innovation is for all level of practitioners.

As for the inclusion of small and multidisciplinary team to realize objective, the concept of frugal innovation for inclusion regardless of the development level reacts to the argument of Mendoza and Thelen (2008) and is confirmed by Acosta et al. (2008) that, although, frugal innovation might have the potential of being inclusive, it is not inherently so. Moreover, the practice inclusion of different actors was important as a precaution pointed out by Papaioannou (2014), that, frugal innovation can involve resource limited in the design, development and evaluation process, yet it might equally be that multinationals design that end up jeopardizing local users.

Moreover, as for *the aspect of societal consideration for positive results*, the response of participants to the feature of pilot prototype realized that the frugal innovation considered the caution given by Tran and Ravaud (2016), that researchers and practitioners should remain aware that frugal innovations may be developed on mistaken beliefs and may end up with negative impact to users. The systematic procedures, care in design and development process, and evaluation of the pilot prototype of MBMF mobile training application were found important before a widespread utilization. Therefore, this study found that with frugal innovation, there is a need of transforming a set of formal institutions’ and informal institutions’ needs, expectations, and constraints into solutions that may support their interaction.

**Attractiveness, perspicuity, and enthusiasm for the pilot prototype**

The concepts, which were used to evaluate the usability of the pilot prototype included, attractiveness, perspicuity, and enthusiasm. The study confirmed that the potential users were attracted by (1) the ways in which materials could be viewed in the application; (2) the ways in which training took place in the application; (3) the appearance of the application (MB owners’ interactions with the application); and (4) the multimedia design of the application. However, researchers confirmed that the application’s appearance could be improved, for example, by adding photos of MB owners.

The prototype’s interface was confirmed to be clear and easy to use and used a language, which is intelligible to the potential users. However, the navigation of the application was described as complex. Most of the MB owners failed to follow the process of downloading the application for it to open. Developers, therefore, should improve the navigation and speed of the final application.

The MB owners were found to enjoy the application’s multimedia format, the simplicity of the language used, and the flexibility of the training. Consequently, the participants were eager to get access and using the application. Most of the MB owners were enthusiastic about a mobile application that could provide training in their field of business. Given the findings of Kessy and Temu (2010) and Berge et al. (2012) that low-level and informal business owners devoted much time to business undertakings and did not have time for training, the MB owners’ positive reactions to the MBMF mobile training application,
Therefore, demonstrated that having access to training on their own time motivated them to use the application. The study confirmed that MB owners were eager to access MB owners’ training via mobile phones after demonstration the application in their work environments.

**Recommended improvements**

The findings indicate that some recommended improvements are of high priorities, thus, a new version of MBMF mobile training application based on the pilot prototype is needed. These recommendations based on the revealed features of pilot prototype against the defined user requirement and the assessed usability aspects.

High priority is given to the recommendation that the application offers the possibility of asking questions and getting instant feedback as in physical contact. The application should have a platform for online conversations for trainees and trainers to ask questions and share experiences in order to replace the need for physical contact. The platform should also allow trainees to share experiences among themselves. Such an active communication with trainers could strengthen lending relationships.

Other priorities in future development are to shorten the application’s opening time and simplify navigation. These improvements should be made together because they can save time and affect first impressions of the attractiveness of using the application. Network problems are not a priority because they must be addressed at the national policy level. However, short loading time and simple navigation can minimize their impacts. A third high-priority improvement is using only Kiswahili rather than a mix of Kiswahili and English. Kiswahili was one of the basic user requirements identified, so its exclusive use in the application should be considered.

The medium-priority improvements of the pilot prototype for the MBMF mobile training application are one, adding sound and video to the interface, especially during the opening of the application, this would help users who are not able to read follow the instructions and be able to use the application. Two, simplifying the application so that everyone can open it without the assistance from colleagues or loan officers, thereby facilitating access to the training anywhere and increasing the usability of the application.

Lower priorities include the recommendations to present the content of the learning materials in detail rather than bullet points. The presentation of detailed materials or summaries though is determined by particular MFIs’ wishes. The application is intended to deliver materials prepared by MFIs’ training departments based on their customers’ needs. Another low priority regarding operational aspects is that the developers should utilize local examples and give detailed explanations. The MFIs determine what to offer to MB owners, and the materials studied were designed for the pilot prototype rather than the final application.

**Conclusions, study limitations, and future research**

This paper contributes new understanding on the use of frugal innovation and end users’ involvement in designing and developing technological solutions in resource-constrained societies. We analyzed MB owners’ perceptions about using the pilot prototype of the MBMF mobile training application. The results show that the potential users appeared quite receptive to, were excited by, were proud of the MBMF mobile training application, and were willing to use it in their business endeavours. The prototype was easy to use, it employed a simple it used accessible language, had a pleasant appearance, and effectively enabled training in different places. The application’s multimedia design and patterns of interactions were enjoyable. Reducing the application opening time, enabling instant feedback, adding a discussion forum, and exclusively using Kiswahili could improve the prototype.

Our study underscores the importance of societies’ resource constraints in the development of specific, targeted technological solutions such as the MB owners’ training application. The study also highlights that, potential users’ characteristics, working environments, and weaknesses are highly important to the design and development of interactive products. The study shows that, limited resources, co-design, and users’ perceptions should be considered in the design process. Economic utilization of scarce resources and the use of design thinking in the DSR stages, along with technological acceptance evaluation of a pilot prototype, can help motivate users’ perceptions on usefulness and ease of use of the artefact. Regarding the adoption of DRS in developing the MBMF mobile training application, the study found that owners of informal businesses are highly interested in tailor-made software, which carters for their needs.

The study reinforces the importance of incorporating potential users’ views into improving a designed artefact. The pilot prototype of the MBMF mobile training application is shown to be a viable frugal innovation in the DRS framework delivering a tailor-made solution to sparse resource environment. This leads to a new model focusing on human centric, sparse resources setting, and rigor research procedures that may well contribute to innovation processes in the emerging economies. Therefore, the study opens a new avenue in ICT in developing a good-enough, affordable, and relevant solutions by applying a complete DSR framework using few resources.

This study evaluated the pilot prototype of the MBMF mobile training application. However, only a particular application was studied. The results, therefore, have limited comparability to other technological solutions for the same practical problems. Moreover, only a few selected aspects (attractiveness, perspicuity, and enthusiasm) were evaluated. The study thus focused on limited usability aspects, and other perspectives could have provided additional results to support future work.

Concerning future research, systematic studies on various application areas are needed to develop a comprehensive framework for mobile training applications for low-income earners. This study emphasizes the importance of applying the design thinking approach to focus users’ attention on the frugal innovation of artefacts in societies with extremely limited resources. Usability study is important because it shows how users are
impressed, motivated, and feel about a product. Moreover, conducting usability studies with participants with low education and income levels can influence product design, use, and overall success. Finally, additional usability evaluations and other studies are still needed to gradually improve the MBMF mobile training application and develop a comprehensive training environment that satisfies the learning needs of MB owners.

ORCID
William Clifford Gomera http://orcid.org/0000-0002-4856-6682
Jarkko Suhonen http://orcid.org/0000-0002-3501-6286
Matti Todre http://orcid.org/0000-0003-1037-3313
Solomon Sunday Oyelere http://orcid.org/0000-0001-9895-6796

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