# Co-Designing in the real world: Managing a multiple stakeholder design process with an NGO

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# Plagiarism Declaration

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# Abstract

Many ICT4D research projects work in collaboration with NGOs in order to meet their development objectives and to increase their interventions' effectiveness. Herein, aspects of co-design are often applied, where the intention is to include all stakeholders as equal participants in the design process. However, collaborating with NGOs and with users who have reduced access to technology can be challenging. As a result, the ideals of co-design are not easily achieved, due to the vastly differing backgrounds of stakeholders in ICT4D projects.

In this thesis, an explicit approach for managing the varying interactions between stakeholders is proposed and described through a case study. The approach was derived from ethnographic action research and participatory design methodologies, led by practical consideration from real-world constraints. The approach is structured around an interactive design process that includes the stakeholder groups in unique ways at each phase of the design process, in order to maximise the contributions in a way that respects their backgrounds and areas of expertise.

The proposed approach was evaluated through its implementation in the design of a mobile recordkeeping application, in collaboration with an NGO in Cape Town, South Africa. The NGO comprises of two stakeholder groups: the staff and the micro-entrepreneurs who they empower. The NGO's focus is to provide training and support over a two-year process to women from low-income communities, by teaching them how to manage their own businesses to become socially and financially independent. The objective of this case study was to design a mobile application that aligned with the recordkeeping curriculum of the NGO and meet the specific requirements and constraints of the target users.

Through the implementation of the design approach, the students and staff were able to provide useful and complementary contributions towards the design of the system. A one-month field study of the application with a group of 21 student participants revealed that the system was a suitable solution and appropriately met the needs of the NGO and the end-users. The final evaluation of the stakeholders' reflections on the design process revealed that it was an appropriate design process to have followed. The results further identified that care must be taken to clarify expectations at each stage of the design process, especially when external factors change, and to frequently communicate with all stakeholders involved.

The design approach proposed and employed during this research project, and the unique way that it allowed the stakeholders to contribute, will benefit future ICT4D research projects that are faced with stakeholder groups that vary significantly, where traditional equal participation is not possible.

# Dedication and Acknowledgements

This thesis is dedicated to the late Gary Marsden, my Honours and initial Masters supervisor, my friend and my mentor. Thank you for your incredible impact in my life, for believing in me, encouraging me and inspiring me. You played a huge role in shaping my career choices and I will carry the influence you've made on me throughout life. Continuing with this research without you has been one of the hardest things I've ever done. I hope that by finally finishing it, I honour your memory. I know that you would be proud.

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I want to especially thank Paul, my wonderful husband, for the incredible role you've played in helping me make it through this journey. I know this Masters has in many ways been nearly as hard for you as it's been for me. Thank you for your constant faith, love and sacrifices, and for supporting me relentlessly.

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***"…being confident of this, that he who began a good work in you will carry it on to completion until the day of Christ Jesus."*** *– Philippians 1:6 (NIV)*

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# 1. Introduction

There are numerous challenges facing researchers in the field of Information and Communication Technology for Development (ICT4D), particularly in cross-cultural contexts, resulting in many partially successful and unsuccessful technological interventions [1]. Participatory methods, such as co-design, are widely used in this field to include the influence of local factors on the design and development of systems, improving its likelihood of success [2] [3]. Co-design is derived from participatory design (PD) and user-centred design (UCD) [2], stemming from Sanders' research on PD and co-creation [4]. Herein, ensuring that all stakeholders participate throughout the design process is considered foundational to increasing the relevance and sustainability of ICT4D interventions [5] [2] [3].

Practically, ensuring equal participation of all relevant stakeholders in the design process is not always possible [4] and not always necessary [5]. This is evident in the ICT4D space where stakeholders often come from different backgrounds and cultures, and have varying levels of experience and expertise that influence their ability to participate. Furthermore, full participation in the design of an ICT intervention requires all stakeholders to have a particular level of experience and insight into ICTs, which is not always the case in ICT4D user groups [6]. However, even in such situations, the users have valuable contributions to make towards the design of the intervention. The question thus arises in our context: can we use multiple stakeholder groups as participants in a co-design process?

In this dissertation we provide an example of how this can be done, by looking at a case study working with an NGO that trains micro-entrepreneurs in Cape Town, South Africa. The case study illustrates the success and struggles of co-designing with multiple groups of stakeholders in unique ways. In doing do, the form of each stakeholders' involvement in the design process was varied according to their respective areas of expertise and availability. Their contributions in the different iterations of the design process were combined and used to inform the outcome of the final application.

The objective of the case study was to create a mobile application to assist micro-entrepreneurs in running their businesses. The application was required to address some of the challenges and realities of these micro-entrepreneurs that other existing business applications do not accommodate. In addition, it needed to align with the curriculum taught at the partner NGO and to be appropriate for use in their training program.

Research has found that in similar projects it is typical that only one of the three core stakeholder groups participate in the design process: the micro-entrepreneurs – the users; the NGO staff – as proxies and teachers; or external experts in the field – in the role of consultants [7]. In this research we want to intentionally include both the NGO staff and student micro-entrepreneurs in all stages of the design processes, while gaining insight from other experts when relevant. In doing so, we use a variation and combination of the traditional participation methodologies, led by practical consideration from real-world constraints and learnings from related literature, as discussed in Section 2.5.

This dissertation will discuss the implementation of the multi-stakeholder design process in the development of an application for micro-entrepreneurs, reflecting on impact that the various contributions from participants had on the design process.

## 1.1 Motivation for Case Study

Micro-enterprises represent a major source of income for many people in the developing world [8] [9]. However, these businesses are run primarily as a source of sustenance and tend to remain small [10] [11]. While the accepted definition of a micro-enterprise is that it has less than five employees [8] [12], most micro-enterprises in the developing world are run single-handedly by a self-employed entrepreneur [8]. The latter are the focus of this research.

Micro-enterprises play a significant role in the economy of most nations [13] [14]. Particularly in rural and semi-urban areas, micro and small enterprises (MSEs) are often the primary economic players, providing employment to a large portion of the population [8] [11] [15]. Of particular note is Ghana, where MSEs comprise about 70% of the country’s enterprises [8]. However, most MSEs do not show significant growth [13] [11].

Research into the lack of growth and productivity of micro-entrepreneurs identifies the following issues, discussed in turn below: micro-entrepreneurs face a lack of funding [11] [16] [17], have inadequate accounting practices [17] [9] and do not have continued training and support [17] [16]. While the use of mobile ICTs has been found to aid in the success of MEs, they are not adopted fully, if at all, due to numerous constraints [18] [19] [15] [20].

### 1.1.1 Lack of Funding and Accounting Practices

It is widely agreed that financing is one of the central needs for MSEs [11] [17] [21]. This was shown in a study by the World Bank, which revealed that, of the enterprises surveyed, 90 percent cited lack of financing as a hindrance to new investments [22]. The inability to meet credit worthiness levels of financial institutions significantly limits access to funds. There are common underlying trends that cause credit rejection, including the lack of adequate financial records [22] [17].

When focusing specifically on rural South Africa, Ngassam et al. [23] found that small business owners often do not have adequate business knowledge, particularly in the area of accounting. This has been confirmed in similar studies of problems facing small businesses in South Africa [21] [9]. The studies found that formal recordkeeping is done on paper, if at all [23]. It has been identified that, due to local informal business owners’ lack of these skills, they are losing market share to foreign refugees [24].

Mashapa and van Greunen [25] recognize that while there are many computer software applications available to help entrepreneurs with their business processes, most are poorly designed as they fail to consider the expertise, or lack thereof, of the end-user. The need for a focus on usability is especially important for systems designed for users from developing countries [25], particularly when those users have had limited prior exposure to technology [11].

### 1.1.2 Lack of Continued Support

McPherson's study [26] on the growth of MSEs in southern Africa found that micro-entrepreneurs who had higher levels of experience and training in business, achieved high growth rates in their businesses. This need for better training and support is widely recognized as essential for helping MSEs grow [17] [27] [28]. Situational analyses on the current training of MSEs in South Africa found that the training that is being provided is not adequate for entrepreneurs' needs [29] [17] [27] [28]. On average, current training is not sufficient to enable the business owners to deal with their business management issues [30] [17] [9] [16].

Roy et al. [11] raised a similar concern for MSEs in urban West Africa, reporting that the reasons for starting MSEs in that context are often very different from those in high-income environments. The found that the training available is usually modelled on more affluent settings, therefore, due to the differences in context, the training offered is often not adequate for the needs of the micro-entrepreneurs.

Smith and Perks [27] found that most micro-entrepreneurs in the informal sector acquire the majority of their skills through experiential learning after start-up. Most entrepreneurs are reported to prefer hands-on training to traditional training methods and therefore on-going support is needed to help MSEs grow [27] [16]. It has been recommended that training be kept simple, with participatory approaches being applied where the entrepreneurs are able to share their insights on business issues of mutual interest [28] [29]. This type of support should be continued after the businesses are launched, not just prior to or at start-up, as is often the case [29] [31] [27].

Confidence in business, especially for those with less experience, is another key issue raised as a challenge facing small businesses [16]. In order to overcome this, continued training and mentorship is recommended [27]. This could be in the form of networking between fellow micro-entrepreneurs or through an on-going mentorship relationship with business professionals and role models. Mentorship and networking are reported to be of critical importance for MSEs' survival and growth [27] and non-profit organisations (NPOs) are recommended as a possible support system to provide this post-startup support and mentorship [16] [11].

### 1.1.3 ICT Solutions for Micro-Entrepreneurs

The use of ICTs has potential benefits for micro-entrepreneurs; however their adoption and extent of use is not as high as it could be [15] [19] [32] [13]. A number of studies have been conducted that look at the barrier of adoption of ICTs for micro-entrepreneurs. These include poor infrastructure; high financial costs of technology; poor technical literacy; limited knowledge and awareness; and the difficulty of integration of ICTs into the business process effectively [19] [15] [18] [20]. Steyn et al. [19] highlighted that these factors are not uniform, and emphasised the need to look at the individual businesses' unique makeup of situational and environmental factors that affect their adoption of technology.

Mobile phones are the most common form of ICTs available to micro-entrepreneurs [13], especially those from lower-income communities [33] [34]. The increased access to technology in this way has led to mobile phones becoming central to many ICT4D interventions, with the development of many applications and services [35] in a large variety of fields, from health to education and business and beyond [36]. Financial interventions in particular, such as M-PESA, have seen noticeable adoption in specific regions [36]. However, it is reported that the prevalence of mobile applications relevant for social and economic development is still inadequate [35]. The development of business applications has been predominately focused on high-end devices, which are inaccessible to many low-income micro-entrepreneurs, due to their cost, energy consumption and dependence on Internet connectivity [35] [37]. Furthermore, those who do have access to high-end mobile phones may not be using them to their full potential due to a lack of knowledge of what is available and how best to make use of them [19].

Baguma et al. [35] describe an application called MyShop, tested in Uganda with 30 micro-entrepreneurs, which aimed to overcome some of these challenges. It is a mobile business application developed for low-end Nokia phones to manage the cash transaction and basic recordkeeping of micro-entrepreneurs. The project's conclusion pointed to the potential benefit of business management applications for micro-entrepreneurs. They recommended that such applications be developed with the usability and utility of the target micro-entrepreneurs as the focus. Specifically, these applications need to be sensitive to the context of the micro--entrepreneurs, have a low learning curve, add value to the businesses and provide a positive user experience [35]. The MyShop application's design was used as a starting point for the current study. The features of the existing application were modified and extended to meet the needs of the micro-entrepreneurs of the NGO in the present study.

## 1.2 Case Study Focus

The case study used in this study was to design a mobile business application that would address some of the problems facing micro-entrepreneurs in resource constrained situations. This was done in partnership with an NGO in Cape Town, South Africa, called The Clothing Bank (TCB). This NGO targets women from low-income communities who are struggling as a result of structural unemployment in South Africa and supports them through self-employment. They train the women through a two-year business-focused curriculum while providing mentorship and support. Their goal is to enable the women to grow sustainable micro-enterprises and reach social and financial independence. TCB state: "Our model is uniquely holistic as we embrace the whole woman and work on ensuring that she has the mind-set and tools that are needed to manage a sustainable business" [38]. This NGO was selected as a partner for this research as it was able to address and meet the need of on-going training, mentorship and support for new micro-entrepreneurs.

TCB recognized that many of their students struggle with managing their finances on paper, due partially to poor numeracy education and a fear of numbers. They also have specific circumstance that need to be accounted for, including their business models, financial means, literacy level and technical experience. Thus, in this research, a mobile application was designed to address some of these needs, in collaboration with the staff and micro-entrepreneur students at the NGO.

## 1.3 The Stakeholders

There are two broad stakeholder groups that joined the researcher in the design and development of the application. The first group is the NGO staff, which includes the leadership team and training staff. The second group is the students who are enrolled in the NGO's training programme – the micro-entrepreneurs who are the intended end-users of the application.

### 1.3.1 The Clothing Bank Staff

The staff is comprised of two sub-groups of participants: the leadership team and the training staff, which includes business mentors. The leadership team is responsible for the running of the NGO and they oversee the administration of the organisation, the course curriculum and training facilities. The training staff and mentors have more personal engagement with the micro-entrepreneurs. They run the classes and have a good knowledge of the personal struggles facing each of the students. The mentors have particularly good insight here, as a result of the one-on-one sessions that they hold with each student in their group every month.

These stakeholders primarily come from middle- to upper-income English-speaking communities and most have tertiary qualifications. They have wide exposure to technology and have access to their own computers and mobile phones. They have a good understanding of the content taught in the curriculum and many have backgrounds in accounting and business management.

### 1.3.2 Students at the NGO

The students who attend the NGO's training course are the second group of stakeholders. They are women ranging in age from mid-twenties to early fifties and are all mothers from low-income communities, who were previously unemployed. The students primarily speak English as a second or third language but are adequately fluent to engage in class. Many have not completed secondary school and their mathematical literacy is not at a high standard. They do not have reliable access to computers at home, but do receive basic computer training and have access to a computer room while at the NGO. Due to this limitation, the NGO teach a purely paper-based system of recordkeeping as part of their financial skills education. The technology that the students do have access to, however, is mobile phones.

The NGO has a new intake of students every few month, so at any point in time there are groups at various stages in the program on the premises. Within this stakeholder group are a subset of students called peer-mentors. These are students who are in an advanced part of the training process and have shown a particularly good grasp of the business concepts and practice. Each new group that starts at the NGO is assigned two peer-mentors who are able to assist, advise and support those in the group.

### 1.3.3 Difference between Stakeholder Groups

The two groups of NGO stakeholders have vastly different backgrounds in using technology and in their understanding of business practices. Here the staff are the experts. However, since the students are the intended end-users of the system, they are experts in understanding the real-life context in which the application will be deployed and the struggles that may arise. Furthermore, their level of understanding of technology and different level of exposure to it makes them best suited to give input on usability and user-experience requirements and identify possible areas of concern.

The differences in each group's ability to contribute to the design of the system, based on their areas of expertise and background, significantly affected the way in which they were able to participate in this research. Their education levels, cultural backgrounds and language levels also affected the type of participation that they could partake in, and whether they could participate together on the same activity or not. There is also hierarchy difference to consider between the groups, as the students fall under the leadership of the staff, and there are cultural considerations.

The researcher became the third type of stakeholder in this collaborative design project, bringing her background in research, commerce and software development methods to the table, as well as her experience with UI and UX design. The NGO had previously collaborated with other researchers. Disappointment in the outcomes and engagement approach of these previous projects, informed and influenced the relationship between the researcher and staff members in this project.

## 1.4 Research Question

Co-design is the broad methodology that we selected to guide the research process of this study, due to its effective use in ICT4D research [2]. In similar use cases, the inclusion of just one of the possible stakeholder groups as participants is common [7]. However, in this research, it was desired that the NGO leadership, mentors, peer-mentors and students all participate in the design process, so as to include contributions from their different areas of expertise in the design of the application. Using the development of the application with the NGO as a case study, we want to consider the question: **can we use multiple stakeholder groups as participants in a co-design process?**

Through the process of using participatory methods with multiple stakeholder groups, there are various areas of interest. These include: understanding the level of participation of the different stakeholder groups, at what points and to what extent they are best able to contribute, and the kind of activities that are most effective and suited to their different backgrounds and circumstances. We would also like to examine the power dynamics that are at play between the stakeholder groups, including between the researcher and staff, researcher and students, and between the staff and students. Furthermore, we want to consider the external factors that influence the different stakeholders' participation in the study, and how communication methods and timing affect the participants' involvement.

## 1.5 Research Procedure

The design process implemented in this case study consists of four phases that are discussed in depth in the following chapters: the research gathering phase, the low-fidelity phase, the high-fidelity phase and the evaluation phase. The two primary stakeholder groups participated in different ways during each phase of the design process, as illustrated in Figure 1.1, with the researcher facilitating and managing the design activities, data capturing and analysis, information sharing and the actual development of the application.

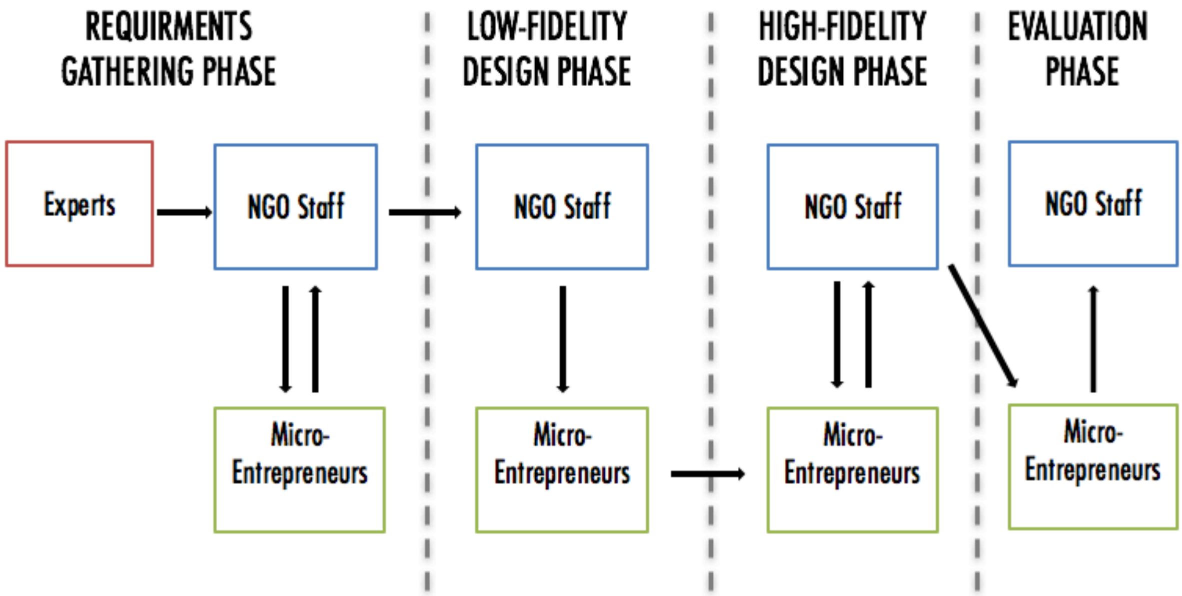



**Figure 1.1 The design process model**

The purpose of the design processes chosen was to try to allow the different stakeholder groups to participate at a point that best fitted their level of experience and in a way that they would be comfortable with. The activities in which they participated were selected during the course of the study, as it was discovered what was needed and what was appropriate. It was initially hoped that some co-design session would be possible where representatives from the different sub-groups of participants could all be present, but external factors, such as time, availability and administrative factors did not allow for this. As a result, the design process flexibly adapted to ensure that the stakeholder groups were included in a way that was practical and suitable to them at each stage of the process.

The requirements gathering phase – the first phase of the design process – is discussed in Chapter 3. At the start of this phase, entrepreneurial experts were consulted to give context to the problem space and insight into common struggles facing micro-entrepreneurs in South Africa. These findings were combined with the details gathered from the NGO staff, which provided understanding of the particular struggles of the micro-entrepreneurs who they train. Furthermore, a contextual enquiry [39] was conducted of the micro-entrepreneurs: through observing their interactions, studying training material and through a questionnaire. These discoveries and requirements were taken back to the NGO staff for their consideration, resulting in a prioritized list of features to include in the application.

The low-fidelity design phase, discussed in Chapter 4, is the second phase of the design process. It commenced with the NGO staff, comprising mainly of the leadership team, giving input on the visualization of features and flow of information through two co-design sessions. Certain aspects of the design were taken to the micro-entrepreneurs for their contribution through two focus groups. These focus groups allowed for confirmation and further discovery of key assumptions that had been made and important UI/UX elements that needed to be considered.

The third phase of the design process was the high-fidelity phase, which is discussed in Chapter 5. The resulting design specifications from the low-fidelity and requirements gathering phase were implemented iteratively in two high-fidelity prototypes. These were evaluated with small groups of micro-entrepreneurs, who gave insight on the design, user experience and usability of the system. Feedback from these sessions was factored into the following iteration of the application and taken to the leadership team for approval. At this point it was discovered that, in light of recent curriculum changes and student turnover, it was required that some key features be re-designed to better align with the new training material. The mentors were tasked with assisting here, giving input on what changes were needed, as they were the most familiar with the new material and the way the students were responding to it. The implementation and staff approval of these changes ended the high-fidelity phase.

The final phase of this research is the evaluation phase, discussed in Chapter 6. In order to test the effectiveness of the multi-stakeholder involvement in the design process, a one-month field trial with a group of the students was conducted. This involved the selection and training of participants, and the rollout of the application on test phones for them to use and implement in their daily business activities. During the field trial, the researcher observed their interactions with the app, monitored usage and iteratively addressed any significant bugs found. The participants' profiles were compared with the gathered data to look for possible influences in their usage behaviour. A final evaluation was thereafter run with the trial participants to establish whether the app was considered usable and effective for their needs. Evaluation with staff was also conducted to determine if the app was an acceptable solution to the needs of the NGO. If the resulting application was useful to the students and acceptable to the staff, and if both groups of stakeholders felt that they were able to participate in the design of the system, then it can be considered a success.

## 1.6 Thesis Overview

In this thesis, we discuss the implementation of a multi-stakeholder participatory design process by including the participant groups in different activities through each stage of the design process. In doing so, we reflect on the contribution that the different stakeholder groups make during the four key phases, namely: the requirements gathering phase, the low-fidelity phase, the high-fidelity phase and the evaluation phase. The methods used were led by practical consideration for the real world constraints encountered during the research and were tailored to be appropriate for the needs of the participants.

The following chapter examines relevant background literature in the field of participation and the impact of learnings from related studies on the methods used in this project. Following this, we commence the discussion of the case study, with chapters detailing the implementation and findings of each of the requirements gathering (Chapter 3), low-fidelity (Chapter 4) and high-fidelity phases (Chapter 5) in turn and the impact of the participants in each phase. The field trial and evaluation are discussed in Chapter 6, ending with a discussion on the various learnings gained in managing the multi-stakeholder co-design process.

We conclude in Chapter 7 with a summary of the key findings from this study, the answers found for the research question, the limitations of the study and future work that can build on what we have done.

# 2. Background and Literature Survey

In this chapter we examine related literature in the fields of participation and its application in 'for development' contexts with users from backgrounds with reduced access to technology. A particular focus is placed on looking at the handling of users and other stakeholder involvement in the design process. We begin with a discussion of different participation ideologies, including action research, participatory design, user centred design and co-design. Follow this, the definition of participation in different contexts is addressed. The focus then narrows to the 'for development' context, where the likes of ICT4D and HCI4D are examined, and learnings, constraints and suggestions from projects in this field on the inclusion of users and other participants in the design process are discussed. We then broaden our lens and explore a few specific models for multi-stakeholder management from other fields. The chapter ends with a reflection on the concepts, learnings and methods that are most applicable to this research project.

## 2.1 Participation Ideologies

There are a number of different design ideologies used in Computer Science and related fields that incorporate the notion of participation and emphasize the importance of stakeholders, especially end-user, inclusion in the design process. These concepts have been evolving and gaining traction since the early 1970s [4]. They include: action research (AR), participatory design (PD), user centred design (UCD) and co-design. An examination of each of these concepts in turn and their approach to stakeholder inclusion and participation are studied in turn below.

### 2.1.1 Action Research

Action research (AR) is a form of social research whereby the community or stakeholder group engages with a trained action researcher in an endeavour to improve an aspect of the participants' situation [40] while meeting rigorous scientific standards. Reason et al. [41] describe AR's focus as a combination of the benefits of action and reflection with theory and practice, through the means of participation, in order to create practical solutions to issues that are of real concern to people. Through doing so, the aim is to improve the lives of the individuals and their communities. The focus is on the combination of action, research and participation; making an impact and producing some change for and with the participants, while something is being studied and measured [42]. The process is cyclical in nature, beginning with a collaborative problem definition and plan [43].

The notion of action research stems back to the 1940s, from the influence of the psychologist Kurt Lewin who is often credited with first using and defining the term 'action research' [44]. In his 1946 paper on 'Action Research and Minority Problems', Lewin [45] describes action research as a study of the conditions and effects of different types of social action, wherein multiple iterations build on each other in a spiral manner, incorporating a combination of planning, action and reflection.

The impact that Lewin made was in allowing researchers to take new roles in their research, by encouraging researchers to take a more active role, rather than just observing from a distance. In addition, he upheld that research outcomes should include useful and workable solutions that benefitted the participants and not just the researcher [44]. Lewin also made contributions to the notion of stakeholder involvement and equal participation with his discussion of research with majority and minority groups, where the balance of power affects collaboration between stakeholder groups [45]. Lewin emphasized that in order to make a positive impact, both of the interacting groups need to be studied. This included looking at ways of lowering the over-inflated self-esteems of those in power and raising the self-esteems of those without power [45].

The ideology of action research began to gain traction in the United States in the 1970s via the spread of sociotechnical thinking, in parallel with the industrial democracy and the founding notion of Participatory Design taking root in Europe (see Section 2.1.2) [44] [40]. The political climate at the time shifted the focus to that of improving workers' productivity, rather than that of industrial democracy as was the case in Europe [40]. These concepts soon spread around the world, being used in Japan in the 1970s to improve production line issues and later into the "global south" for development technical interventions [44].

Action Research has evolved over the years and has been applied in a number of different ways and across a number of different domains. It also also been used in combination with and alongside other research methodologies, such as ethnography, and has been extended as the notions of participation design developed. Notable sub topics within AR include Participatory Action Research (PAR) and Ethnographic Action Research (EAR) which are discussed in turn below.

#### 2.1.1.1 Participatory Action Research

Participatory action research (PAR) is a branch of AR that looks particularly at the role of the participants, whereby they themselves are part of the process of collecting and analysing data and use this to inform the decisions on what action should next be undertaken [46] [47]. This process is corkscrew in nature, whereby each iteration builds on the previous reflective cycle [46]. The principles from PAR were a key influence in the methodology and thinking of Participatory Design [42]. However, being more of a research paradigm than a fixed methodology, PAR does not prescribe specific methods that should be used, but can include a variety of qualitative and quantitative tools [46].

A subset of PAR focuses on designing specifically with communities, sometimes referred to community-based PAR [47] and sometimes as community action research (CAR) [43]. PAR's use with communities is considered to be appropriate where: there is openness and cooperation with stakeholders; there is a need for something to be changed; social interactions are possible; the researchers have the ability to observe and monitor the impact of the changes made; and finally there is a means of comprehending what the community themselves believe is required [48]. Here the power dynamics between the researcher and participants are of particular importance, whereby equality of roles is desired, to the point where those who might in other studies be considered the research subjects, become themselves the researchers, deciding on the research direction and participating in data collection, analytics and next steps [46].

#### 2.1.1.2 Ethnographic Action Research

Ethnographic action research (EAR) is a methodology that was developed out of a combination of ethnography and action research techniques [49] [50]. It prioritizes obtaining a level of understanding of the local context in which the research is being conducted, rather than focusing solely on researching the project itself. This aids in the design, evaluation and monitoring of the project and leads to greater adaptability and sustainability. In addition it gives the researchers a better understanding of the complexities of the end-users' context and environment in which the project will be deployed [50]. Tacchi et al. [49] describes it as "a methodology that preserved the benefits of ethnography and drew on the strengths of participatory action research."

The ethnographic aspects of this methodology aim to give understanding of the various processes and social relationships surrounding the project. Understanding the relevant contexts that could influence the outcome allows for the project to include both stakeholders who impact on and are impacted by the project. The action research contribution towards this methodology ensures that these stakeholders are involved in the project appropriately [51] and promotes iterative cycles of observations, design, development and evaluation of solutions [50]. In theory, this methodology promotes applying participatory approaches where all stakeholders should participate through every aspect of the project, increasing the relevance of the project and their sense of ownership in the future of the project. Tacchi et al. recognize, nonetheless, that this is not always possible in practice [49]. However, no details were given of how to manage the varying levels of stakeholder participation.

### 2.1.2 Participatory Design

Participatory design (PD) emerged in the 1970s in Scandinavia during the workplace democracy movement, and in parallel in England in a slightly different form [51] [4]. The movement, driven by trade unions in Norway, Sweden and Denmark in partnership with academics [42], strove for a greater and more active role of the workers in industrial production. This resulted in the establishment of the Collective Resource Approach, which promoted the inclusion of workers alongside researchers and system designers [52]. Herein, users who would be affected by changes made to the system were included. They were equipped with resources, enabling them to contribute in an appropriate way, given their current situation [53].

PD spread over the following two decades, resulting in a number of different variations of PD practices coming into existence [51] [54] and it became a heavily relied upon approach in Human-Computer Interaction (HCI) and other related areas of Computer Science research [42]. The core goal of PD is to study aspects of human activity through cooperative partnerships with stakeholders in the design of artefacts and environments [42]. This should be done iteratively in order to allow those involved to refine and improve their understanding of the endeavour [42]. In traditional PD, end-users are included as full-participants, or partners, throughout the design process [4] [55] and this is emphasized through its theories and practices [2] [56]. One of the founding objectives of PD was to provide a middle ground for the tacit knowledge and experience of participants with the theoretical and more abstract knowledge of researchers [52].

In the 1970s, the focus was on workers getting more opportunities to participate and give input on system designs [54] [42]. In the 1980s there was a subtle shift in focus for PD research in Scandinavia towards helping users enhance their skills and improve the quality of outputs from the systems being designed. An example of this is the Utopia project [57]. These two focuses – workers influencing the design and use of systems, and on skills development – was the basis for the concept of user participation [54]. Subsequently, there have been many modifications to the methods and tools of PD. Exactly what participation looks like has been one of the primary aspects to evolve over time, ranging from focusing on system descriptions in the earlier days, to prototype development and interactive design sessions by the 1990s [54].

Bφdker [53] reflected on the state of PD in the mid 1990s and its development over the previous two decades. She reported that, while PD was maturing as a discipline and had gained widespread acceptance, questions had been raised regarding the real-life application of PD. Several problems were described, including: the limited number of users who experience the participation process; concerns regarding the balance of power and access to resources; the time-demands on user participants and the lack of adequate compensation; and the limited availability of resources for the education of users in PD projects.

### 2.1.3 User Centred Design

User centred design (UCD) is considered by some as a United States version of PD [4]. It is a framework of processes that focus primarily on the end-users' needs, wants and limitations during the design of a product. The key principles of UCD were coined in 1985 by Gould and Lewis as "early and continual focus on users; empirical measurement of usage; and iterative design" [58]. The user is considered as a subject in the design process [4], rather than a partner or active participant, and the emphasis is placed on the product being designed [59].

Early versions of UCD commonly included 'expert users' in the design process [4]. Herein, researchers studied passive users performing prescribed tasks and enquired about their thoughts on system ideas that had been proposed by others [4]. This is in contrast with the collaborative and closer partnership relationship established between researchers and end-users in AR and PD [60]. In further contrast with AR, UCD is considered to be cyclical in nature, whereas AR is seen of as more of a spiral [44]. The following diagram in Figure 2.1 visually represents these differences. Both, however, are considered to be iterative in nature and focus on building on the learnings of the previous iteration.

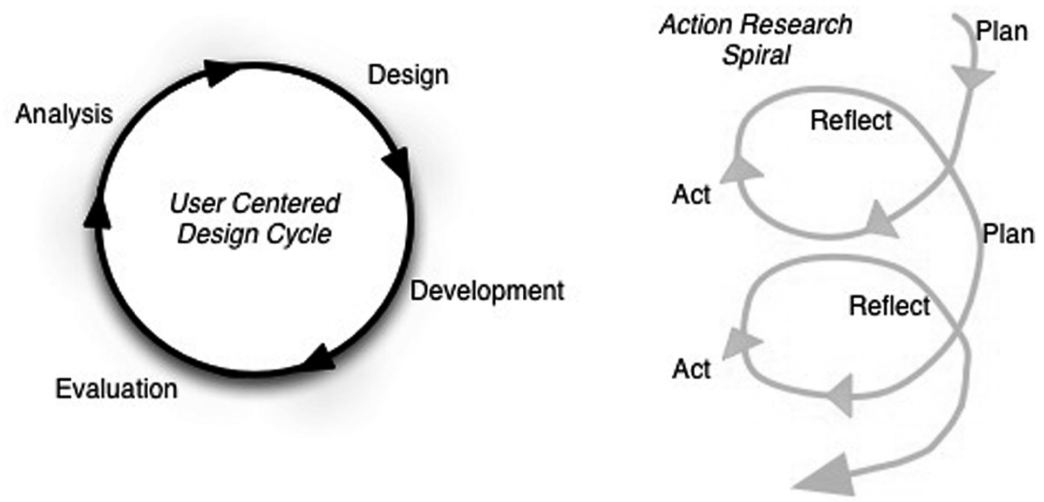



**Figure 2.1. Diagrams comparing the traditional processes of UCD and AR** [44]

Multiple iterations of the four stages of design, development, evaluation and analysis are encouraged before high-fidelity development of the final system is commenced [61]. This includes focus on understanding the end-users, the tasks that they perform and the environment in which they take place. Focus is also placed on the product to be developed, specifically the way in which its usage, usability and learnability can be empirically measured. Following a good understanding of the above, iterative design of the product is begun through prototypes, wherein each iteration fixes issues raised by users in the previous stage and progresses towards the final product [61].

In a review of the new landscapes of design, Sanders and Stappers [4] reflect that UCD is not able to sufficiently meet the complicated issues that researchers and designers are now faced with. They state that the field has moved beyond merely designing products for people to use. The focus is now on designing for the evolved way that people, communities and cultures interact, given the increased connectivity and availability of information which had previously been inconceivable.

### 2.1.4 Co-Design

The passive involvement of users in early version of UCD contrasts with the more active role that PD promotes. However, ideas from PD and UCD have influenced each other, and there is now less clear distinction between the different roles that the users take in participation [4]. This has led to the use of the term co-design, which builds on the theories and practices of PD and UCD, while aligning itself more closely with PD in respect of including users as active participants in the design process, not just subjects [2]. Including all stakeholders in the design process is considered a key principle of co-design, as it aids in higher adoption rates and outputs that better satisfy the requirements of the various stakeholders [62]. Co-creation is a term that is often used synonymously with co-design. Sanders and Stappers [4] differentiate them by describing co-creation as a broad term that encompasses at least two people creating something together. In contrast, they define co-design as the creative collaboration of designers with people who do not have formal design backgrounds, in a design development process.

The specific design methods employed between different co-design projects differs vastly, including contextual enquiries, prototyping, interviews, focus groups, drawing and artwork, discussions, acting, diary studies and games [62] [63] [64]. Stakeholders involved in the the co-design process often come from diverse backgrounds and contribute in their different areas of expertise. These can include researchers, designers, developers and potential end-users [64].

The goal of co-design is to ensure that the different participants are able to participate equally and allow each participant to contribute in a suitable way for their area of expertise [4]. This is not always easily achieved, as different people respond better to different forms of participation. In a study looking at developing co-design method for older adults and children [63], it was reported that methods that worked well for one group often frustrated the other group, leaving them disconnected and disinterested. Thus, it is not always effective to force all participants to collaborate in the same manner during co-design projects. This leads to the need to address how participation is defined and what participation in various forms of research looks like.

## 2.2 Definitions of Participation

In Muller et al.'s [51] reflection and discussion of PD in 1993, they discussed that the term 'participation' was being used in a variety of ways and was open to many different interpretations. This is still the case today, with the wide use of the term across disciplines. The understanding of what participation means differs among different societies around the world [65].

Bratteteig and Wagner [55] reflect that the differences in the application of participation is influenced by the intention behind the project's reasons for including participation. These can vary from the practical consideration that user participation makes the implementation of the designed system easier, to the more political mind-set that believes that users have a right to participate in matters that will affect their futures [55]. Halskov and Hansen's investigation [66] found that the papers' use of participation could be grouped into three broad categories: implicit participation – where no specific explanation of what the participation looked like was given; participation for including the users' points of view; and participation for the benefit of mutual learning.

Winschiers-Theophilus et al. [65] suggest that while the field of PD has been evolving over many years, it is centred on the benefit of active stakeholder participation in the design process. However, it has been found that the specific nature and manner for how stakeholders should participate has not been strictly defined, allowing for its application to differ between different research projects [65].

Vines et al. [67] discuss the involvement of users and other stakeholders in the field of Human Computer Interaction (HCI) and argue that research in this field is around 'configuring participation', where the structure that participation takes is influence by research objectives and influences of power. To this end they discuss who benefits from participation, what forms it takes and who is in control, and highlight the benefits of reflecting on these points in the formation of a new project that includes participation.

A literature review studying the diversity of participatory design research in practice from 2002 to 2012 found that the practical application of how users were included and what their participation looked like varied from project to project [66]. In a collaborative paper discussing the author's experiences with HCI4D research, it was reflected that even among their own work, what participation was defined as and the level of participation observed differed [68]. Vines et al. [67] extend this in highlighting that not only does the form and timing of participation differ between projects, but there are also often differences in the nature of participation over the course of a given project.

Participation can include the participants as equal owners of the design process with the researcher, collaborating and designing the systems together [68]. It can also be unaware participation [67], such as a researcher eavesdropping on participants [68]. The form that participation takes often changes over the different phases of the design process, according to practical consideration, and can range from ethnographic methods in be beginning stages to prototyping techniques in later stages [66].

## 2.3 Participation in 'For Development' Research

'For Development' or 4D research, focusing on socio-economic development of users and communities, branches across a number of research fields [69]. This has resulted in the likes of Information and Communication Technology for Development (ICT4D), sometimes referred to as ICTD, Human Computer Interaction for Development (HCI4D) and Mobile Communication Technology for Development (M4D). The fields of information systems (IS) and social design, while not including the '4D' in their names, incorporate similar research themes of co-design with communities [2]. In these fields, participatory methods – such as co-design – are commonly used and studied, but their approaches differ somewhat, shaped by their different research orientations [2]. The use of a combination of methods from these fields, led by practical considerations for the unique needs of the 4D project, can be effective in facilitating the relationship between the researchers and users, and allow for the inclusion of users across the whole design process [70].

### 2.3.1 Lessons from Participation in 4D Research

In a review of themes in ICT4D research with communities, having participatory design processes that focused on user engagement was identified as a key learning from early research in this field [71]. However, design processes that incorporate community participation is difficult, due to the number of different factors that need to be addressed, including: who participates, how they participate and why they participate [71]. Compounding this are the differences between the researcher and other participants, including tech vs non-tech backgrounds, differences in economic statuses, language barriers and other cultural disparities [71] [65] [70].

Discussing the lessons from co-designing with a community in Namibia, Lovborg et al. [72] reflect that regardless of the level of experience and understanding of cross-cultural participation and collaborative design with community that a designer or researcher might have, there is always a need for a change in thinking patterns, modifications of roles and ceaseless negotiation of protocols. They further state that these are not things that can be planned for or controlled, but ones that researchers need to be mindful of.

HCI4D looks at the struggles experienced in early ICT4D research, through the paradigm of the learnings from HCI, often making use of participatory techniques, such as UCD, PD and co-design [69] [73]. This field particularly focuses on how technology interventions can be designed to accommodate for the contextual requirements and specific user needs in cross-cultural environment [69]. Reflecting on the application of HCI4D in rural South Africa in the development of a communication solution for isolated healthcare workers, a number of learnings were identified [73]. It was highlighted that managing stakeholder expectations, process planning to account for the contextual needs, the choice of techniques that are appropriate for participants' backgrounds and culture are important considerations for this field of research [73] [70].

In similar reviews of the applicability of PD in the 4D context, the need for careful handling of the diversity of stakeholders, particularly regarding the different cultural and social dynamics, is emphasised [65] [74]. The differences in the way participants define their sense of self and their relationship with their community, levels of literacy and technical and situational skillset all affect their approach to participation [65]. As a result, the traditional use of PD in this context is not appropriate and requires a level of adaption to accommodate for these factors [74].

A study of the suitability of UCD methods for the 4D context highlighted the benefits of including aspects of Contextual Design [75], such as contextual enquiries and observational ethnography, to assist researchers in acquiring a good understanding of the users' needs and the relevant environmental context [6].

### 2.3.2 Cultural and Technical Barriers

Traditional participation methodologies, like UCD, make basic assumptions about the users who will be included in the design process [6] [76]. This includes that the users: understand their work processes sufficiently to contribute in the design process; understand the way that technology can assist in their lives; be able to comprehend abstract design concepts; and have enough technology experience to be able to participate in decision making [6]. However, in the 4D space where target users often come from low-income and technology poor backgrounds, this is generally not the case [77] [76]. As a result, because the form of participation is not applicable to the context [78], these users are not able to participate effectively in traditional methods in a design process, as they have difficulty contributing design ideas and relating to the design processes used [69] [56].

Participants without experience with computers struggle to co-design interfaces [73] and their lack of technical skills can pose challenges in being able to make a meaningful contribution towards the design of a system [78]. User in the 4D context are reported to also struggle with understanding the benefit of being involved in the design process [79] and often feel that it is a waste of their time [76] [56].

User interviews, when done in isolation, have been found to be problematic, as the responses gathered often contradict the logged data of users' interactions with the system in question [80]. Chetty and Grinter [73] highlighted this with an example where the users reported that they were using the system regularly and found it useful in their daily lives, but the logged usage data contradicted this finding. The motive behind these apparent exaggerations and sometimes outright lies, often rest in the cultural differences between the researcher and participants. This can be seen in Dell et al.'s paper "Yours is better!" [81], where the impact of the interviewer's difference in culture and social status from the participants was found to significantly bias the outcomes. The greater the difference, the greater the bias in favour of affirming whatever was believed to be created by, or favoured by, the interviewer [81].

### 2.3.3 Methods for Overcoming 4D Barriers

With an understanding of the barriers that can limit stakeholders, particularly users, from participating in classic forms of participatory methods, this section discusses some of the possible methods that these participants can partake in effectively.

Studies have found that while some users in the 4D space may not able to participate in traditional methods in the design process, they are often able to effectively contribute towards the evaluation of designs [69] [78]. It has been found that focus groups worked better to get the input of these users, as it allowed the participants to contribute ideas that build on one another's [6]. Customisation techniques, where users are exposed to a functional system or prototype and given the opportunity to customise it for their specific needs, is an approach that can also work well with participants who have low technical skills, as it requires minimal training [78].

Where it is possible, the intentional training and investment in technical skills of the various participants can allow for them to become active participants in the design process, in the classic sense of the term [78]. In longer-term research projects this has been shown to be effective [72]. Here, the use of training has allowed participants, who had originally been unable to take part in traditional co-design, to grow in their understanding of technology. In doing so, their capacity to be involved evolved and they were able to partake in more traditional forms of co-design.

#### *2.3.3.1 Real Access / Real Impact Framework*

Bridges.org are Digital Divide commentators and they have done extensive research into how ICT projects can be planned, managed and evaluated in the 4D context [6]. A result of their research is a framework called Real Access / Real Impact (RA/RI), which highlights key areas for consideration in ICT4D research [82].

The RA/RI framework includes a methodology called the "real access criteria" [82] that aims to provide guidance for ICT4D researchers. Particularly applicable points from this criteria include the importance of considering the physical access to technology, the appropriateness of technology and the affordability of technology and its use [6]. These include considering whether existing infrastructure is able to support the new ICT, whether it is suitable for the users and their context, and whether they are in the financial position to purchase and maintain it [82]. Other RA/RI criteria for consideration include the training needed to use the ICT, the local relevance of the content, its integration into daily life, the socio-cultural factors at play, the trust the users place in technology, micro- and macro-economic influences, as well as legal and political issues [82].

Reflecting on these criteria throughout the design process can assist researchers in overcoming some of the challenges of 4D research [6]. Its use has been found to address some of the shortcomings of UCD tools in their application in developing world contexts, by encouraging researchers to look beyond the immediate needs of the users, and also incorporate the contextual, cultural, economic and political factors in the requirements gathering phase [6].

#### 2.3.3.2 Prototyping in 4D research

The use of prototyping iterations, both at a low and high fidelity level, is used extensively in participatory methods [6] [83]. High fidelity prototypes have the downside of taking longer and being more expensive to iterate with, but provide benefits of being more realistic and easy for participants to interact with [6] [56]. Low fidelity prototyping, while being faster and more cost effective, provide difficulties in evaluating whether results are a result of the quality of the prototype or the design concept it is trying to emulate [84]. Especially for participants with limited technical exposure, low fidelity prototypes can be confusing, ineffectual and feel like a waste of time to the participants [76] [56].

Content Prototyping [77] is an attempt to overcome the challenges of including users with limited technology exposure in participatory process, by promoting the careful consideration of the prototypes used. It encourages that the prototypes should align with the understanding and frame of reference that the users currently have, being something that they can easily relate to [77]. Toyama [85] affirmed this in his reflections on HCI4D, where he stated, “designs shouldn’t inconvenience users or contradict their own preferences.” An example of using Content Prototyping is the creation of a slide show, combining drawings and other low-fidelity design ideas with recordings and voice-overs, to give the impression of functionality that the potential system could provide [77].

#### 2.3.3.3 Proxies and Local Facilitators

Non-governmental organizations (NGOs) are non-profit voluntary citizen groups whose goals are to support the public good by addressing various issues [79]. They are particularly important in developing regions where they provide welfare services not provided by the local government [1]. NGOs are useful stakeholders in ICT4D research as they can provide insight into the users’ needs, their cultural context and the social factors involved [1] [79]. This has been shown to be particularly effective by Marsden [39]. In the cases analysed by Gitau et al. [1], the NGO was included as a proxy for the end-user and the end-users were not direct participants in the design process. They reflected that there might be situations where the researchers need to engage directly with the end-users [1], but did not give examples of how this could be appropriately done.

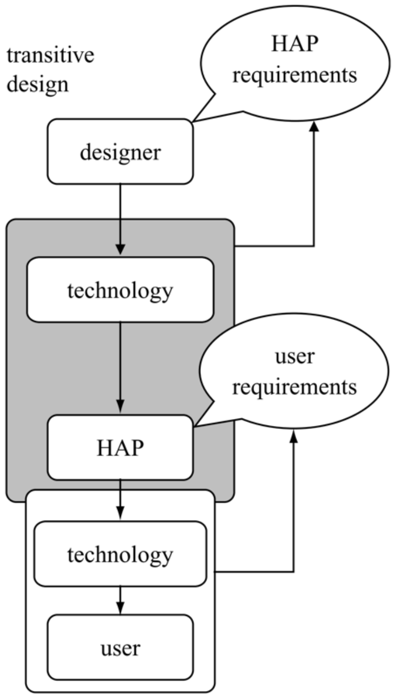



**Figure 2.2. The design process of including a HAP as a proxy for the user** [86]

Using Human Access Points (HAPs) is another proposal for co-designing where users are not able to participate effectively in a traditional collaborative design process [76]. This involves identifying members of the community who have the contextual understanding, as well as the required technical knowledge and exposure to enable them to be active co-designers of the system [76]. These members, referred to as HAPs, become proxies for the users in the study, representing their interest in the design process. Figure 2.2 above represents the proposed design process visually. A similar notion is proposed by Kam et al. [56], wherein they recommend the inclusion of local facilitators as cultural guides and local intermediaries to assist the researchers in their interactions with other participants. The key difference is that HAPs are used as a replacement for user participation, while local facilitators assist user participation.

## 2.4 Other Models of Stakeholder Involvement

Multiple stakeholder involvement, specifically focusing on who should be involved where and how the process can be managed, is a topic that spans a number of fields beyond that of ICT4D, HCI and other technology driven fields. This includes the fields of Ergonomics and Education. Herein, examples can be found of frameworks that incorporate the management of multiple stakeholders in the design process. Considering them is useful in understanding alternative structures that have been used in managing a complex design process with multiple groups of participants involved.

### 2.4.1 Multiple Stakeholder Management in Ergonomics

In the field of Ergonomics, research has been done to understand who should participate and how to include different participants in work place improvements [87]. Here it was found that the representation of all stakeholder groups in every stage of the project was not necessary in the context of a large company.

displayed their assumption of where the different stakeholders might be involved. This was tested in a number of projects and, while being close to reality, much variation was found. They concluded that in light of no particular guideline being in place for managing a participatory design process, their contribution was a first attempt towards creating such guidelines [87].

**Table 1. The theoretically predicted involvement of participants (stakeholders) in each step** [87]**.**


### 2.4.2 Design Based Implementation Research in Education

In the field of Education, design-based implementation research (DBIR) is an adaption of participatory approaches with design-based research [88] and implementation research [89] for use in designing educational interventions [90]. DBIR promotes a collaborative and iterative design process where the perspectives of multiple stakeholders are included in the different phases of design and development [90]. Here, the teachers and students are recognized as two groups of end-user. This relationship between stakeholders is similar to that experienced between the NGO staff and micro-entrepreneurs in our case study. However, the difference is that the staff members are not active end-users of the system, unlike teachers in most educational interventions.

An investigation was done of the gap that exists between the teacher and students regarding their involvement and perception of the design process [91]. The findings showed that these gaps are significant and can hinder development. Thus careful consideration is needed for managing the different stakeholders. Konings et al. [91] noted that it is dangerous to place too much importance on the students' current views on education. It is recommended that teachers be respected as the experts of curriculum [92], as students may not have fully grasped the content and its applications [91]. Taking this into account, including the students early on in the design process can lead to a greater acceptance and use of the intervention.

Reflecting on the fact that DBIR promotes the inclusion of multiple stakeholders, a 2014 review of DBIR education literature revealed that few examples could be found that included the perspective of students in the participatory design process [90]. Only more recently (2013 onwards), has the inclusion of students been emphasized in DBIR [90].

## 2.5 Application of Literature

Co-design is the participatory paradigm that has been chosen for use in this research. Due to its evolution with influences from both PD and UCD, we feel it is appropriate for use in this research. In particular, this is because it promotes the inclusion of all stakeholders as active participants in the design process, which can lead to a higher adoption rate with outcomes that better satisfy the requirements of the different stakeholder groups [62]. Since co-design does not require particular methods for use in each phase of the design process, it allows us the freedom to customise the participatory process to suit the various real-life constraints that are encountered. It further allows us choose activities that are appropriate for the different participants in each stage of the design process, taking into account their particular backgrounds and areas of expertise [64].

### 2.5.1 Participation of Staff

The inclusion of the NGO staff as active participants harnesses the benefits discussed in Section 2.3.3.3 of incorporating local experts in the design process. Unlike existing studies, where it is recommended that such participants be included as proxies for the end-users, we differ here by including the staff's participation alongside that of the students, albeit in different forms.

Because the staff are from a background that includes high exposure to technology and because their culture, home language and education level are similar to that of the researcher, they were able to participate as more traditional co-designers in this research than the students. As such, they participated in interviews – in their role as experts of the culture and context; brainstorming sessions for feature designs in the requirements gathering phase; co-design of the prototype – via an interactive slide show – in the low-fidelity phase; and explorative evaluations of the prototype with unstructured feedback, suggestions and improvement request in the high-fidelity phase. Throughout, they were given opportunities to alter aspects of the requirements, feature set and functionality of the application being developed.

### 2.5.2 Participation of Students

The students are the users in our case study. Their profiles (see Section 1.3.2 and Section 6.1.3) align with others in typical 4D research, indicating that traditional participatory methods might not be suitable for them. Drawing from the lessons discussed in Section 2.3 on the inclusion of users in a 4D research project, the following activities were selected for the students to participate in the different stages of the design process:

In the requirements gathering phase the students were included via contextual enquiry and observational ethnography. They were also included via a survey, with the purpose of gaining an overview of the users' mobile phone usage. In the low-fidelity phase the students were included in focus groups to hone particular contextual issues and design decision, allowing the students to build on each other's ideas in a constructive manner.

The high-fidelity phase involved iterating a vertical prototype, where the students were included in the evaluation of the designs of the prototype's core features. Of particular importance here was assessing if the prototype was effective for the various tasks and intuitive for users with minimal training on the system. During the evaluation phase, the longer exposure of the users to both the researcher and a functional prototype allowed them to evolve in their role of participants. In this phase they were not only able to identify issues with the current system, but towards the conclusion of the trial some of the participants were able to proactively make suggestions for improvement and propose new features.

### 2.5.3 Multiple Stakeholder Management

Since examples were not found in ICT4D literature on the practical management of a multi-stakeholder process, we take learnings from the fields of Ergonomics and Education. The examples discussed in Section 2.4 provide approaches that have been used in the management of multiple stakeholder participation in other areas. From Ergonomics we apply the learning that it is not necessary for every stakeholder group to be included in each stage of the design process, or included at the same time as others, for the outcome to be effective.

The field of Education provides insights into the interactions of teachers and students in the formation of educational curriculums and systems, via DBIR. This aligns fairly closely with our case study, but differs in the fact that the staff do not represent a second group of end-users, as is usually the case in DBIR. A significant learning relevant to our use case is that the staff should be respected in their role as experts of the educational content and given priority in decision making that relates to the impact of the curriculum on the system. The students do not yet have a full grasp of the subject. It was thus important for us to keep in mind that the system was required to be used by students who do not yet understand all that recordkeeping involves, but still need to be able to make use of its core functionality.

Aspects of the principles in the RA/RI framework, discussed in Section 2.3.3.1, guided the consideration of some of the non-functional requirements in the following chapter. In Chapter 3 we describe the methods used in the identification of the requirements for the application in our case study, discuss the findings and results obtained and end with a reflection of the participation process's implementation.

# 3. Requirements Gathering Phase

In this section we discuss the commencement of the case study, the process of requirements gathering for the design of the mobile application. A number of different techniques were combined to provide insight into the users' contexts and the factors influencing their businesses. This allowed for a list of requirements to be generated in collaboration with the stakeholders, detailing possible features for the proposed system.

## 3.1 Methodology

Unstructured interviews were conducted with three entrepreneurial training experts outside of the NGO to gain insight on common problems that are faced by micro-entrepreneurs in South Africa. These findings were used to help define the problem space and understand social structures influencing the success of micro-entrepreneurial businesses and added to the insights gained from the NGO leadership team.

A contextual enquiry [39] was then conducted at the NGO. Here the researcher spent time passively observing classes, watching the engagement between the NGO staff and students and actively building relationships with the various stakeholders. Informal interviews were also done to gather an understanding of common struggles faced by the students. The training material and resources, particularly regarding financial skills and recordkeeping, were reviewed to gain an understanding of the levels of literacy, numeracy and complexity of the course requirements. The objective for this was to aid in the understanding of the requirements for the proposed system and the core features that would be needed.

A survey of the students was conducted in order to gain insight into their mobile phone usage and exposure. This survey was then repeated towards the end of the study to assess changes over the two-year time period. The questions included their age, access to and ownership of a mobile phone and their brand of phone. Their mobile phone usage was also queried, including the daily time spent on their phones, airtime usage and which features they used most frequently. The survey questions can be seen in Appendix B and the contrasted findings between the two sets of results are discussed in Section 3.2.3.

Finally, a collaborative design session was held with the staff to refine the problem space and decide on the primary goals of the project. Here the staff acted as co-designers and were invited to provide input into the required features and informational content of the application. The session was led by the lead researcher with guiding questions, but allowed for discussion to flow around issues pertaining to the users and the ways in which the application could improve and support their businesses.

## 3.2 Findings

The primary findings from the various investigations conducted during the requirements gathering phase are outlined below. This includes the results of the interviews, contextual enquiry, the repeated survey and the initial design session.

### 3.2.1 Interview Findings

Through the interviews with the four key leaders of the NGO and three external entrepreneurial experts, common trends regarding problems faced by micro-entrepreneurs were identified via thematic analysis. These included: limited access to and experience with technology; security concerns; problems understanding money and making wise business decisions; the reality and impact of credit sales; and the difficulty of consistently tracking all financial information.

#### *3.2.1.1 Technology limitations*

One of the identified struggles affecting micro-entrepreneurs from low-income South African communities is their limited access to and experience with technology. The NGO has found that it was not possible to teach recordkeeping to their students on a computer, due to the very steep learning curve and impracticalities of not having computers at home. The staff observed that the majority of their students did not have high-end phones, thus having limited access to existing useful business applications. This was confirmed by the survey findings in Section 3.2.3.

Electricity access for charging phones was also identified as a common problem, thus requiring an energy efficient solution to be developed. Furthermore, the high cost of airtime and data in South Africa was raised as a concern. This meant that the application could not be heavily data dependent and would not be able to enforce regular online connectivity for daily use or backups.

#### *3.2.1.2 Security concerns*

Security was another concern raised. In South Africa, mobile phones are regularly stolen. Thus, the respondents insisted that it is imperative that backups be kept of all information. It was noted that because online backups are not plausible in this context, due to high data costs and unreliable access to airtime, offline backups would be required. It was suggested that this could be done using a removable memory card.

Due to the sharing of phones with family members and sometimes friends and neighbours, it was suggested that some users might want password protection to prevent the viewing or accidental editing of financial data by others.

#### *3.2.1.3 Business context implications*

The prevalence of credit sales creates additional struggles for micro-entrepreneurs. Their business context necessitates the provision of credit sales, without which they would lose customers. Because credit sales are risky, the NGO had previously attempted to encourage their students not to sell on credit. However, they have subsequently discovered that while being riskier, they are necessary for the business context and cannot be ignored. Thus, a system that easily track what money is owed and reminds users when customers' payments are due would be helpful.

Finally, the importance of remembering to capture all financial information was raised. Due to the context in which the sales take place, the micro-entrepreneurs often are not able to record all details of the transaction as it occurs. However, it was noted that more frequent recordkeeping would result in more accurate financial information, facilitating wise business decisions.

#### *3.2.1.4 Functional and non-functional requirements*

From the discussion in this section, the following list of functional and non-functional requirements arise for the application to be suitable for the context.

- The app needs to be built for a low-level mobile phone that is affordable to users
- The chosen phone needs to have good battery life
- The app should not be too big, due to space limitation of low-end phones
- The app should not require an active data connection, due to high data costs
- It should have functionality for easy offline backups of data
- Password security must be available to protect potentially sensitive financial data
- Credit sale consideration needs be included, with the ability to track customers who owes the user money
- Customizable reminders

### 3.2.2 Contextual Enquiry Findings

The contextual enquiry uncovered greater detail of the circumstances facing the micro-entrepreneur students. It provided confirmation of the insights from the entrepreneurial experts and gave additional insight and examples of key things that need to be considered. The findings include a low literacy and numeracy level for many of the students, the reality and prevalence of credit sales in the course of business, and the room for improvement in the capturing of financial records.

One of these observations was that the literacy and numeracy level of the students was relatively low and that they struggled with understanding aspects of recordkeeping concepts. This included both the practice of how to track certain information and an understanding of how to interpret the results. This was seen through their interactions, questions and ability to apply what was explained in their recordkeeping during class time.

Another observation – in agreement with the discussion in Section 3.2.1.3 – was the reality of credit sales and the management of customers who owed them money. The current paper-based system showed limitations in allowing the micro-entrepreneurs an effective way of managing this process. The students were tracking the amount of credit and cash for each payment in their recordkeeping books. The books did not have a section where they tracked the details for each customer owing them money separately. To do so, they were supposed to rely on their receipt books and make notes when a customer paid them some of the money owed. However, it was apparent that there was no way to see at a glance which customers owed them money, how much, and when these payments were due.

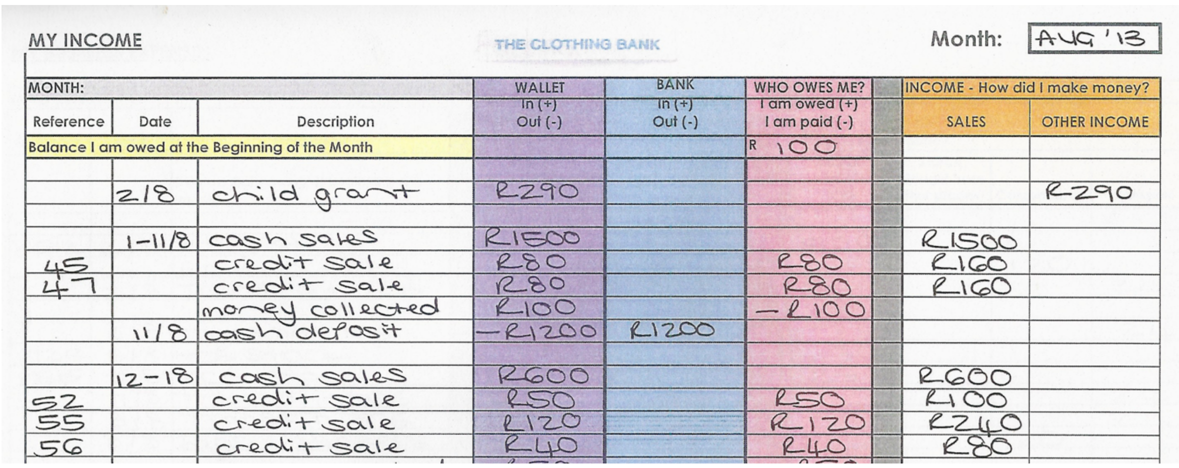
It was also discovered that many of the students were not thorough in managing their paper-based records. Many displayed aversions to the process – coming from a combination of fear and lack of understanding – recording their transactions infrequently. This could be seen through the fact that, during their monthly recordkeeping classes, many arrived with incomplete records or were observed to be trying to fill in the details for that month's records at the start of class. Those who showed evidence of regularly maintaining their books used time in class to total their column and see where they were at financially. This meant that before class and during the month in question, the students were not seeing totals or summary information about their breakdown of financial information, such as total income, expense category totals and money owed to them by customers.

#### 3.2.2.1 Description of the paper-based recordkeeping system

During the contextual enquiry, the existing recordkeeping system used in the NGO's training programme and the supporting training material was examined. In 2013 the recordkeeping book that the women used to record their finances, called the Women @ Work book, followed a profit and loss system. It contained a number of different pages each month, with a budget vs actual comparison by month for each category on the first page. The second and third pages contained a debt and savings goal tracker, which encouraged the students to set personal debt repayment goals and saving targets for the following six months, using it to monitor their progress. Following this were three pages showing completed examples of monthly income and expense reports.

Each month's pages included a mentoring session template, and income sheet, a business expenses sheet, two pages for personal expenses and two pages for stock control.

The income and expense pages were designed as spreadsheets, where the students could write details of each entry in one row, with relevant values in the different columns. The columns for the income sheet included reference, date, description, wallet, bank and "who owes me?" This was followed by income change columns under the heading "How did I make money?" sales and other income. The sum of the wallet, bank and "who owes me" values for each row should equal the sum of the income columns, representing a simplified form of double entry bookkeeping.



MY INCOME

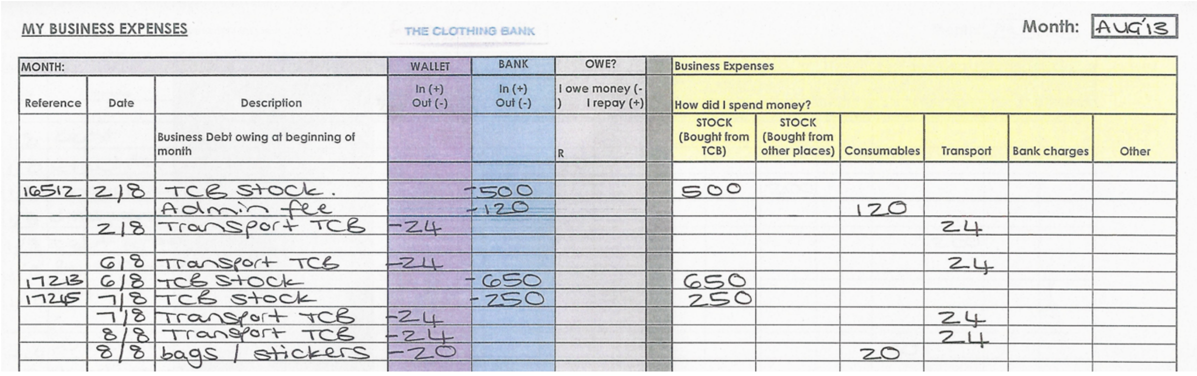
THE CLOTHING BANK

Month: AUG '13

| MONTH: | | | WALLET | BANK | WHO OWES ME? | INCOME - How did I make money? | |
|---|---|---|---|---|---|---|---|
| Reference | Date | Description | In (+) Out (-) | In (+) Out (-) | I am owed (+) I am paid (-) | SALES | OTHER INCOME |
| Balance I am owed at the Beginning of the Month | | | | | R 100 | | |
| | 2/8 | child grant | R290 | | | | R290 |
| | 1-11/8 | cash sales | R1500 | | | R1500 | |
| 45 | | credit sale | R80 | | R80 | R160 | |
| 47 | | credit sale | R80 | | R80 | R160 | |
| | | money collected | R100 | | -R100 | | |
| | 11/8 | cash deposit | -R1200 | R1200 | | | |
| | 12-18 | cash sales | R600 | | | R600 | |
| 52 | | credit sale | R50 | | R50 | R100 | |
| 55 | | credit sale | R120 | | R120 | R240 | |
| 56 | | credit sale | R40 | | R40 | R80 | |

**Figure 3.1. Example Income sheet from the Women @ Work book**

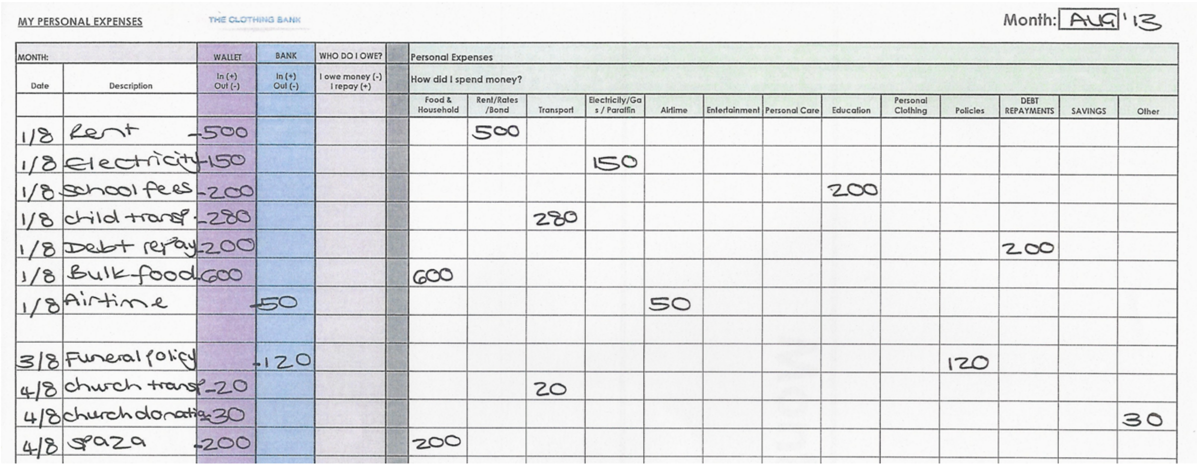
Similarly, the expenses sheets contained columns with the reference, data, description, wallet, bank and owe, followed by the list of expense categories relevant to business (see Figure 3.2) and personal (see Figure 3.3) spending.



MY BUSINESS EXPENSES — THE CLOTHING BANK — Month: AUG'13

| Reference | Date | Description | WALLET In (+) Out (-) | BANK In (+) Out (-) | OWE? I owe money (-) I repay (+) | STOCK (Bought from TCB) | STOCK (Bought from other places) | Consumables | Transport | Bank charges | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Business Debt owing at beginning of month | | | R | | | | | | |
| 16512 | 2/8 | TCB stock. | | -500 | | 500 | | | | | |
| | | Admin fee | | -120 | | | | 120 | | | |
| | 2/8 | Transport TCB | -24 | | | | | | 24 | | |
| | 6/8 | Transport TCB | -24 | | | | | | 24 | | |
| 17213 | 6/8 | TCB Stock | | -650 | | 650 | | | | | |
| 17245 | 7/8 | TCB stock | | -250 | | 250 | | | | | |
| | 7/8 | Transport TCB | -24 | | | | | | 24 | | |
| | 8/8 | Transport TCB | -24 | | | | | | 24 | | |
| | 8/8 | bags / stickers | -20 | | | | | 20 | | | |

**Figure 3.2. Example Business Expenses sheet from the Women @ Work book**



MY PERSONAL EXPENSES — THE CLOTHING BANK — Month: AUG '13

| Date | Description | WALLET In (+) Out (-) | BANK In (+) Out (-) | WHO DO I OWE? I owe money (-) I repay (+) | Food & Household | Rent/Rates /Bond | Transport | Electricity/Gas / Paraffin | Airtime | Entertainment | Personal Care | Education | Personal Clothing | Policies | DEBT REPAYMENTS | SAVINGS | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/8 | Rent | -500 | | | | 500 | | | | | | | | | | | |
| 1/8 | electricity | -150 | | | | | | 150 | | | | | | | | | |
| 1/8 | school fees | -200 | | | | | | | | | | 200 | | | | | |
| 1/8 | child transp | -280 | | | | | 280 | | | | | | | | | | |
| 1/8 | Debt repay | -200 | | | | | | | | | | | | | 200 | | |
| 1/8 | Bulk food | 600 | | | 600 | | | | | | | | | | | | |
| 1/8 | Airtime | | -50 | | | | | | 50 | | | | | | | | |
| 3/8 | Funeral policy | | -120 | | | | | | | | | | | 120 | | | |
| 4/8 | church transp | -20 | | | | | 20 | | | | | | | | | | |
| 4/8 | church donatio | -30 | | | | | | | | | | | | | | | 30 |
| 4/8 | spaza | -200 | | | 200 | | | | | | | | | | | | |

**Figure 3.3. Example Personal Expenses sheet from the Women @ Work book**

The mentoring template, see Appendix A was used during the student's monthly meeting with their mentor and included questions such as "Did I capture all my month transactions" and "Could I analyse my business to see how I could make improvements next month?". It included space for high level monthly statistics comparing their total stock purchase from the NGO two months ago and the previous month with how much they've spent so far that month and how much they intend to spend in the remainder of the month. There were also open-ended questions, including "Any issues with my current business" and "SMART goals for the next month". Space was also included for indicating personal issues and future plans for after their time at the NGO.

By 2015, the model used for recordkeeping had evolved. The key changes and their effect on the application's design are discussed in Section 5.6. However, the model discussed in this section was the starting point for the design process and used as a foundation for the functional requirements of the application.

### 3.2.3 2013 and 2015 Mobile Phone Survey Results

A survey was conducted amongst the students at the NGO in 2013 and 82 responses were collected. The survey questions can be found in Appendix B. The aim of the survey was to gain insight into the students' daily lives, mobile phone usage and habits. The same survey was given two years later, near the end of the research project, in order to see the changes over the duration of the research.

Figure 3.4 shows the age distribution of the micro-entrepreneurs at the NGO. It shows that there has been a decrease in the average age of the respondents; with 2015's survey revealing a much smaller percentage of respondents aged 46+. There was also an increase from 37.8% to 52.8% in the 25-35 year age bracket. The NGO staff indicated that this was a result of changing their approach to recruiting and particularly targeting younger applicants, which has evidently been successful.

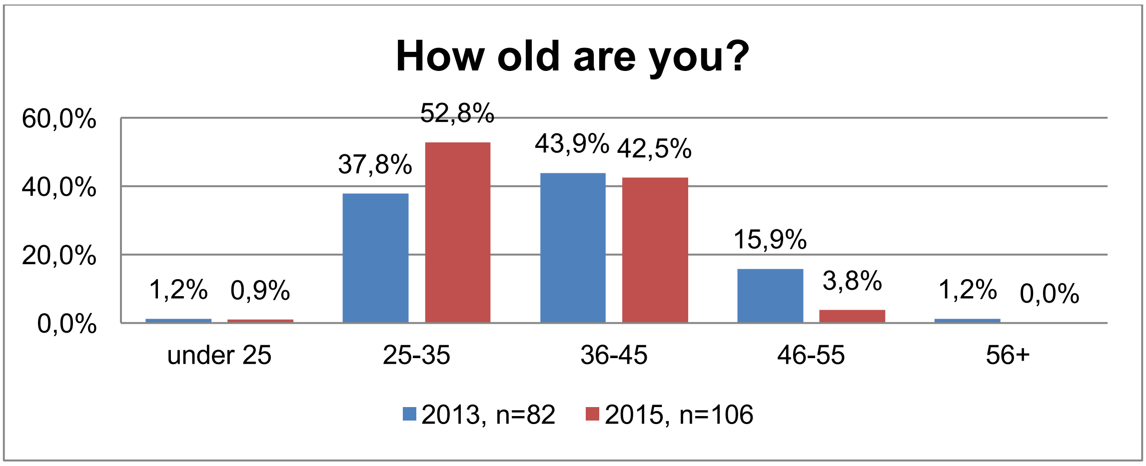



**Figure 3.4. Age Distribution of Entrepreneurs at the NGO in 2013 and 2015**

In both 2013 and 2015, it was revealed that approximately 98% had their own mobile phone. The survey further revealed that, in 2013, 42.7% owned Nokia phones, 25.6% owned Blackberry phones and 15.9% owned Samsung phones (see Figure 3.5). By 2015 these figures had changed substantially, with Nokia's market share decreasing to 22.4%, Blackberry decreasing to 15.9% and Samsung increasing to 25.2%. Another noticeable change from 2013 to 2015 was the increase in variety of brands represented, indicated by the Other percentage. These were 12 different brands represented that received a comparably small percent, less than 4% each, of the market share in either year. In 2013, Other brands comprised 11%, while in 2015 it had increased to 19.6%.

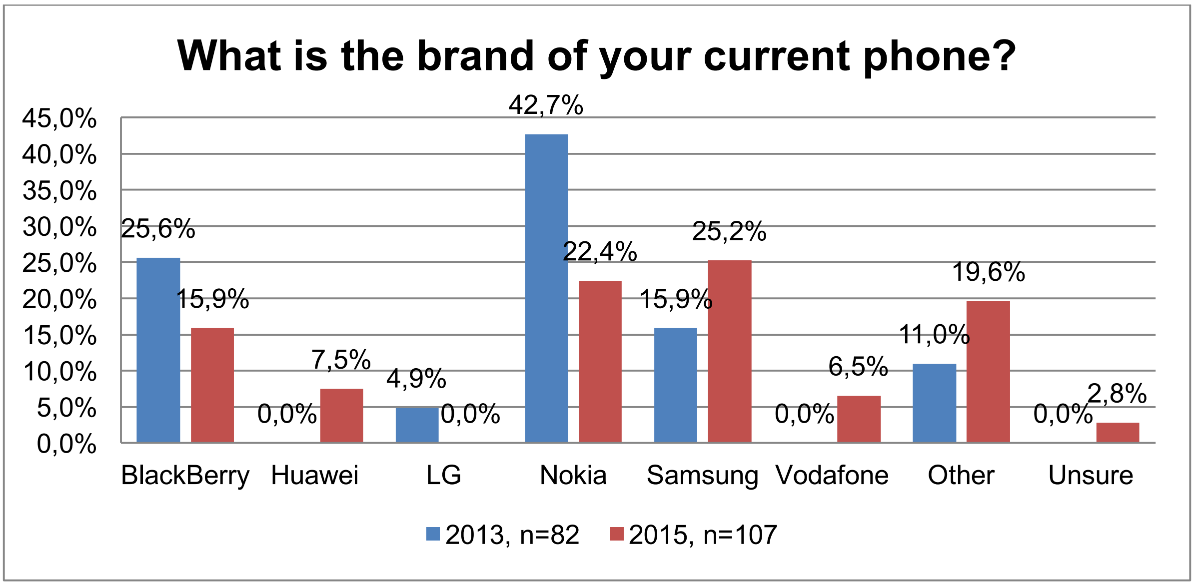



**Figure 3.5. Survey results of mobile phone ownership, 2013 and 2015**

While their mobile operating systems were not asked about, it can be inferred from the make and model numbers given. This was done from the 2015 survey findings, and the results are displayed in Figure 3.6. This shows that, by the end of 2015, more than half of the target users had Android phones. However, it must be noted that it is assumed that many of these are running old versions of Android. Many participants did not indicate their exact model number, but those who did indicated the likes of the Samsung S3 mini and the Samsung Galaxy Pocket (which comes with Android 2.3). Some of the Nokia phones were either running Windows Mobile, Nokia X or older operating systems, such as S40 – a derivative of Symbian. Those who gave model numbers for their Nokia phones indicated that they had, for example, Nokia Lumia, Asha or X phones. While Nokia X phones are compatible with some Android Apps, limitations and complications exist, which is why these phones were not included under the Android OS category [93].

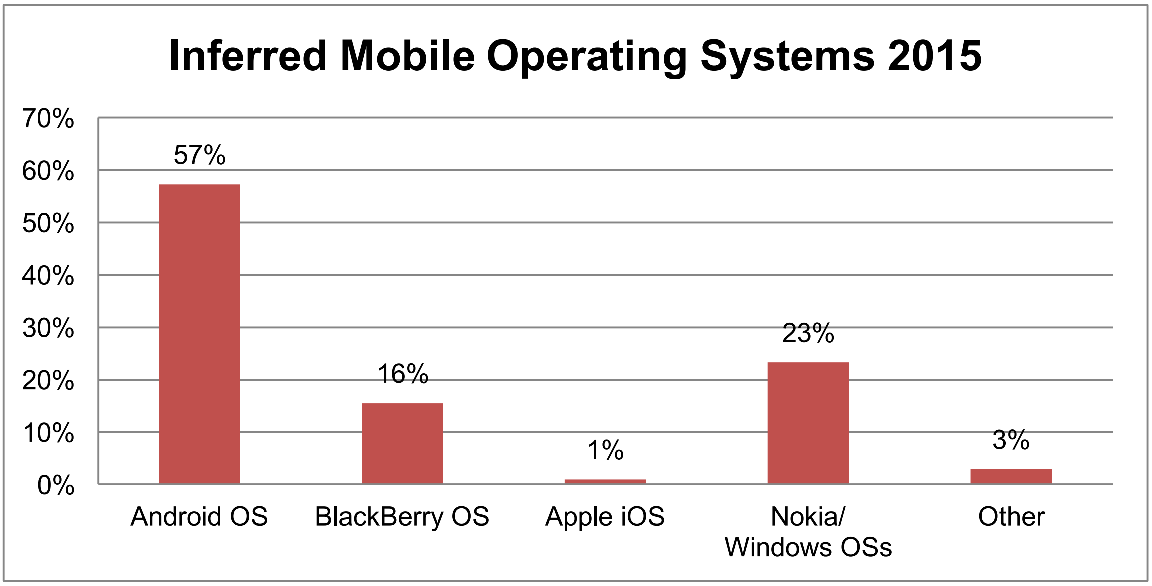



**Figure 3.6. Inferred Mobile Operating Systems from 2015 survey**

When questioned about the physical features of their phone, a problem with the possible interpretation of a question was discovered. One of the questions asked, *"Does your phone have a full (QWERTY) keyboard like in this picture?"* accompanied by the image in Figure 3.7. The intention was to find out whether or not the respondents' mobile phones had a physical and permanent keyboard.

**Figure 3.7. A picture of a permanent QWERTY keyboarded included next to the survey question, aimed to help in the respondents' understanding of the question.**

However, after the survey had been conducted it was discovered that some respondents had interpreted it as intended, while others had answered in the affirmative even when they did not have a permanent keyboard. This was done by firstly comparing the mobile brand and model number that the respondent indicated in previous questions with their responses to this question. It was further confirmed through questioning some of the respondents during a subsequent guided survey that included the same question. It was discovered that some respondents said yes because their touch screen phones displayed a keyboard that had all those buttons on the screen when they needed to type, while others answered yes only if their phone had a physical, permanent keyboard comparable to the one in Figure 3.7. Thus, the findings from this question cannot be interpreted as intended, as there is evidence that the respondents did not all interpret it the same way. The results can be seen in Figure 3.8.

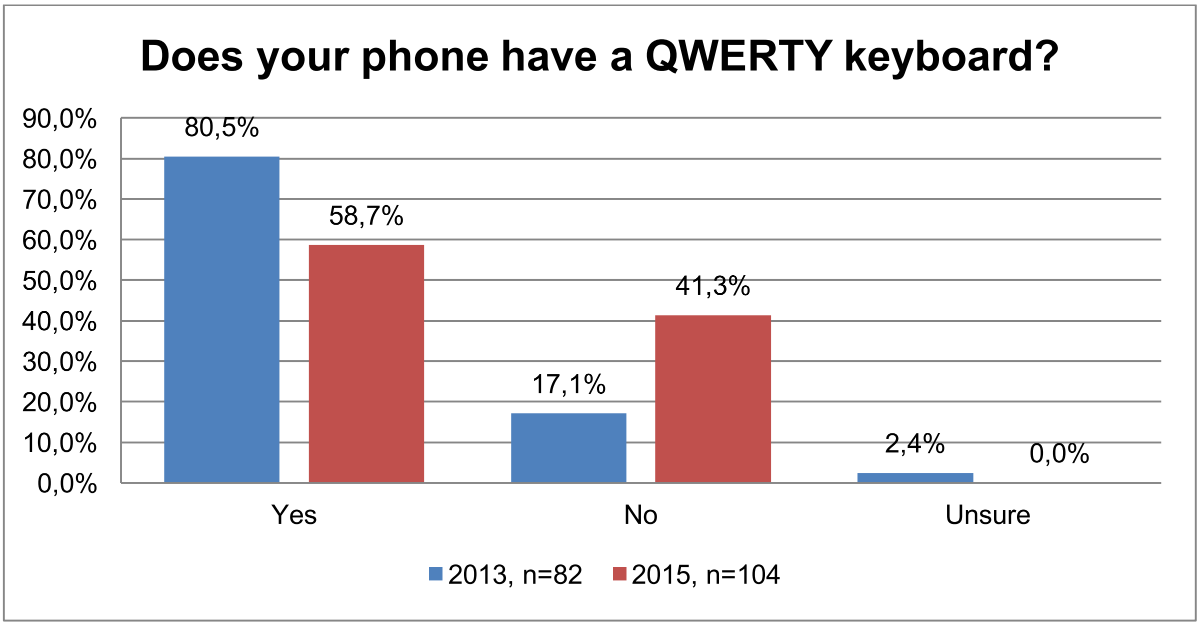



**Figure 3.8. Whether or not the respondents' indicated that their phone had a full QWERTY keyboard. This questions' interpretation was ambiguous.**

More insightful was the responses to the question “Does your phone have a touch screen?” Here there did not appear to be any ambiguity in the respondents’ understanding of the question. Figure 3.9 shows the change in touch screen prevalence between 2013 and 2015. At the commencement of this research, only 23,2% of the respondents indicated that they had touch screen phones. Within the research project’s two-year duration, this number had increased significantly, nearly tripling, to 63,5%. Interestingly, this is not a reflection of Smart phone prevalence. An analysis of the mobile phone makes and models, where given, revealed that many of the Nokia phones that can be considered Smart-feature phones, such as the Nokia X and Nokia Asha phones, included touch screens, but do not have full Smart phone functionality.

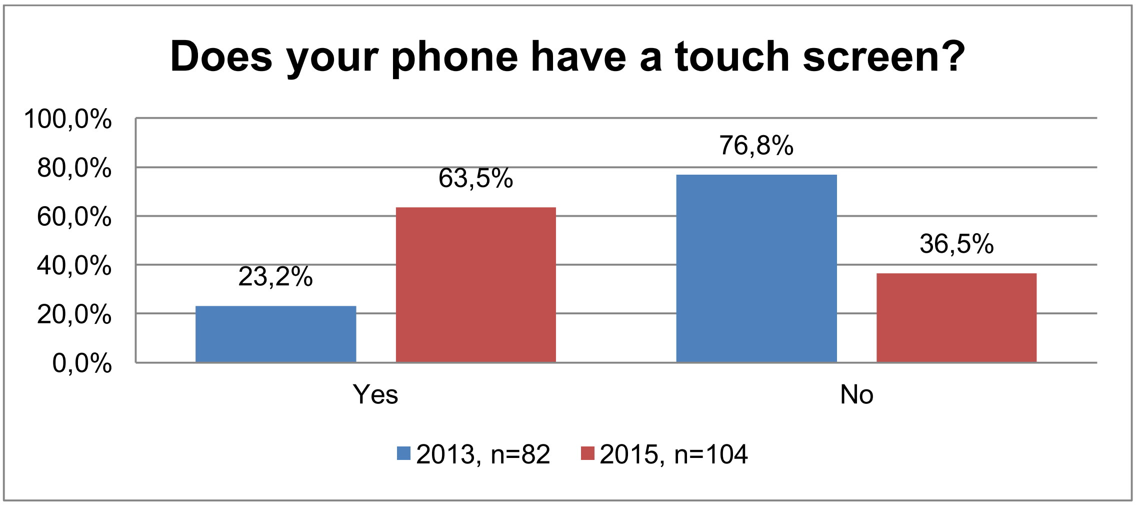



**Figure 3.9. Touch screen phone prevalence in 2013 and 2015**

The responses to the question “How much time do you spend on your phone every day?” revealed an anomaly at the 2-4 hour bracket. Figure 3.10 represents this. In 2013, there was an upwards trend in the length of time respondents spend on their phones daily, with more respondents indicating longer times than shorter times. In 2015, a higher percentage of respondents indicated the 10-30 min and 30-60 min brackets, while a lower percentage (6.9% in 2015 in contrast to 19,5% in 2013) indicated the 2-4 hours bracket. Interestingly, the >4 hour bracket also saw a slight increase in 2015. It is not apparent what caused this change. From the data, an estimated mean was calculated, using the midpoint x frequency. For the >4 hours bracket, 5 hours was used as the midpoint, as it was the same difference of 1 hours as the previous interval, a conservative estimate. The 2013 estimated mean was 2,3 hours, while the 2015 estimated mean had decreased slightly to 2,1 hours.

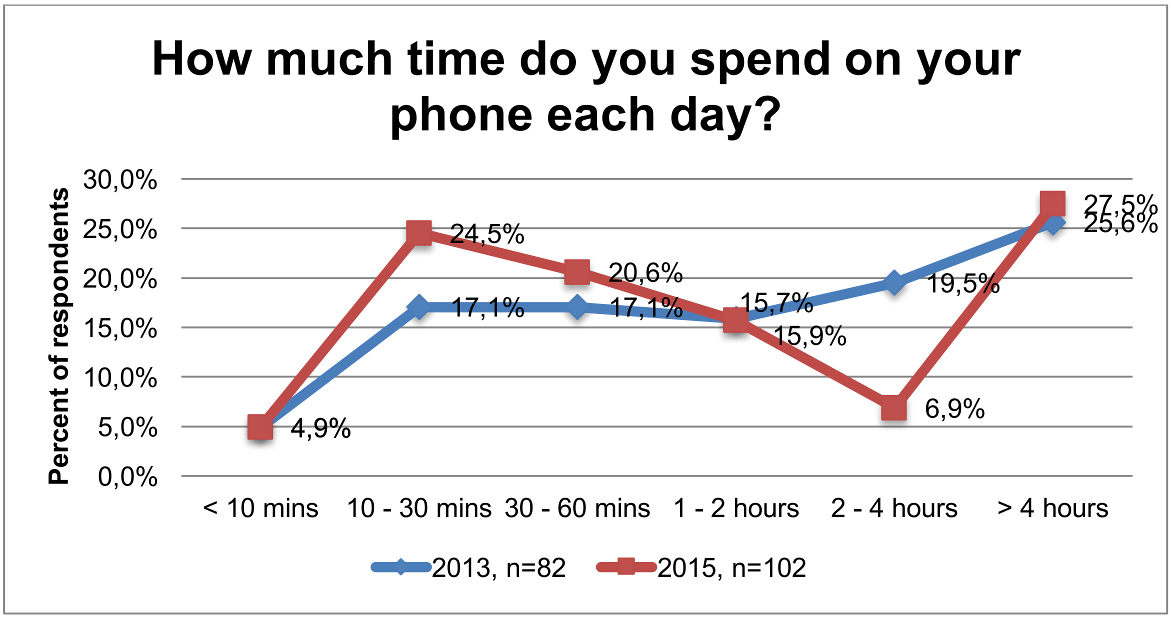



**Figure 3.10. The amount of time respondents indicated that they spend on their phone every day.**

The comparison of results between 2013 and 2015 to the question of the amount of money the respondents spend on airtime each month did not show any significant changes. As evident in Figure 3.11, the most popular answer for both years was R50-R100, with 45,1% in 2013 and 50,5% in 2015. From the data, an estimated mean was calculated, using the midpoint x frequency for each category. R250 was selected as the midpoint for the >R200 category, the same difference as the midpoint of the previous section as a conservative estimate. The results show the mean airtime has decreased from R102,87 in 2013 to R85,76 in 2015.

There are a number of factors that could influence the mean decrease in airtime, but we can only speculate as to exact causes. Possible reasons influencing this change could be the increase in use of data bundles (see Figure 3.13); the increased focus on educating the students about mobile phone usage at the NGO over the previous two years; and the average decrease in age of the respondents. The latter could infer different mobile phone habits, particularly a move to greater use of instant messaging and less use of traditional calling. Other external factors could also have played a role, including the decreasing cost of data [94] and more difficult financial times.

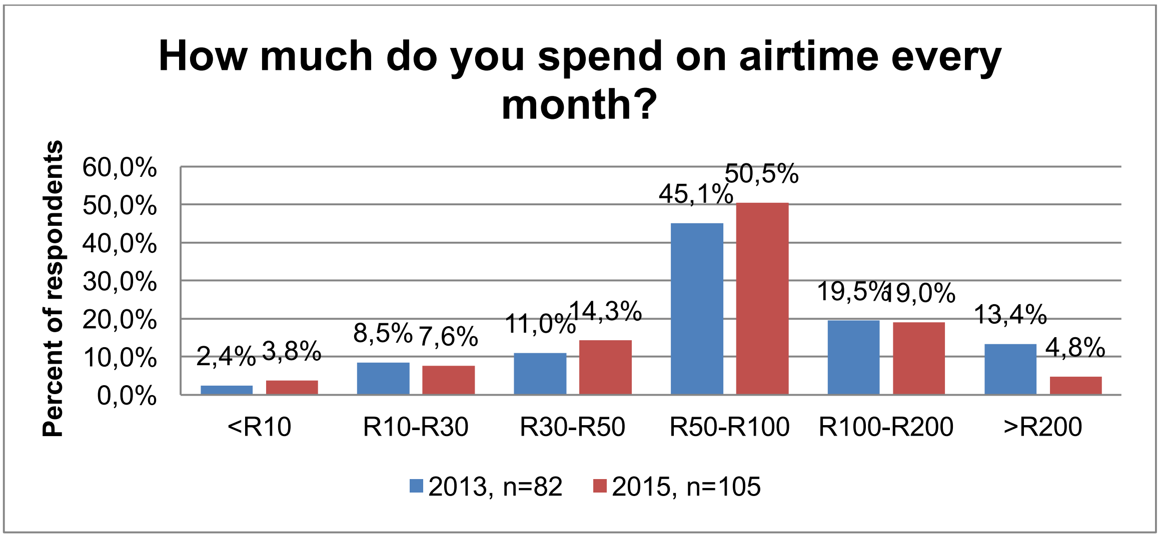
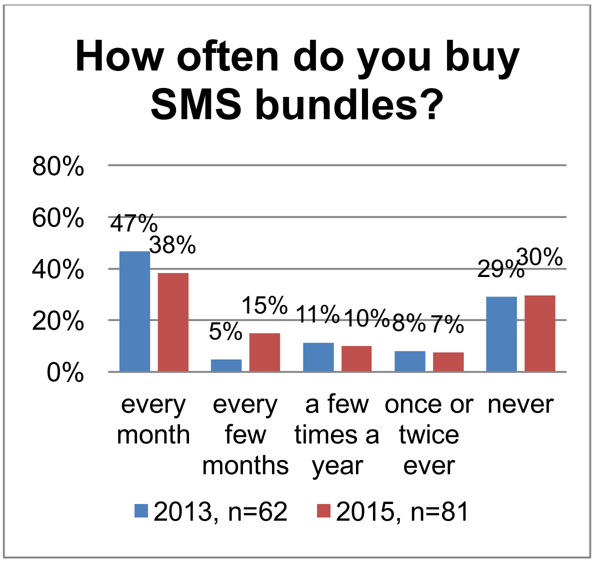



**Figure 3.11. The amount of money spent on airtime each month**

Questions about the use of data bundles and SMS bundles were possibly not read correctly. In an attempt to minimise the amount of space used for the questions, the two questions appeared next to each other on the page. In both years it was found that some people answered one of the two questions, rather than both, thus leading us to believe that they might not have realised that there were two separate questions. Thus, when reading the following two graphs, please take note of the differing numbers of responses for each year between the questions.



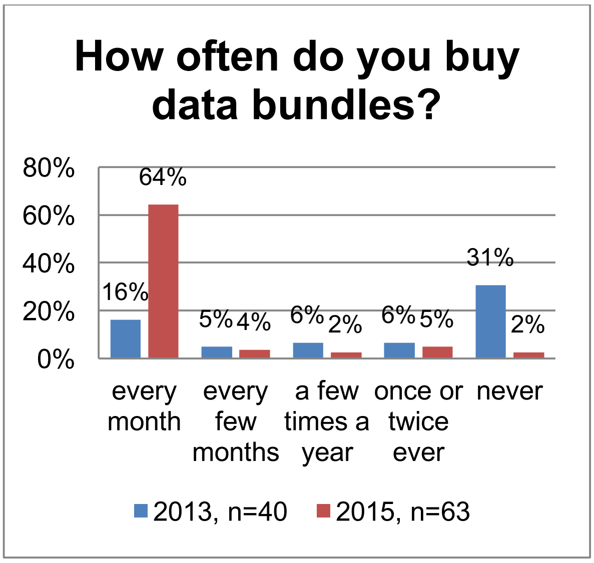




**Figure 3.12. SMS bundle responses**

**Figure 3.13. Data bundle response**

Figure 3.12 and Figure 3.13 show that of those who answered each question, there was a decrease from 47% in 2013 to 38% in 2015 of those who buy SMS bundles on a monthly basis, while there was an increase from 16% to 64% of those who buy data bundles regularly. This could explain the lowered mean airtime spending found earlier. It could also be a result of the increased awareness of the students to the benefits of data bundles, after the NGO intentionally started including training on this topic, alongside other possible factors such as a decrease in novelty of the phones, changes in costing structures by network providers, influences of inflation on the cost of other necessities, to list but a few.

Figure 3.14 below shows the use of mobile phones for business functions. There are some differences between the years. There was a 9% increase, from 83% in 2013 to 92% in 2015 in respondents reporting that they use their phone to tell clients about new stock. Through informal interactions it was discovered that this was primarily done via instant messaging, such as on mXit and Whatsapp. In some cases, SMSes were also sent to customers detailing new stock. There was a decrease in the percentage of those who use their phone to follow up with debtors, from 87% in 2013 to 76% in 2015. Using their phones to check bank balances increased from 66% in 2013 to 75% in 2015, a positive indication of an increased awareness of their financial situation. Making payments stayed relatively constant from 2013 to 2015, and a small percentage mentioned other activities that they used their phones for. These included various forms of marketing their business through social media, purchasing or ordering stock and utilities, taking photos of their products and asking customers for product requests.

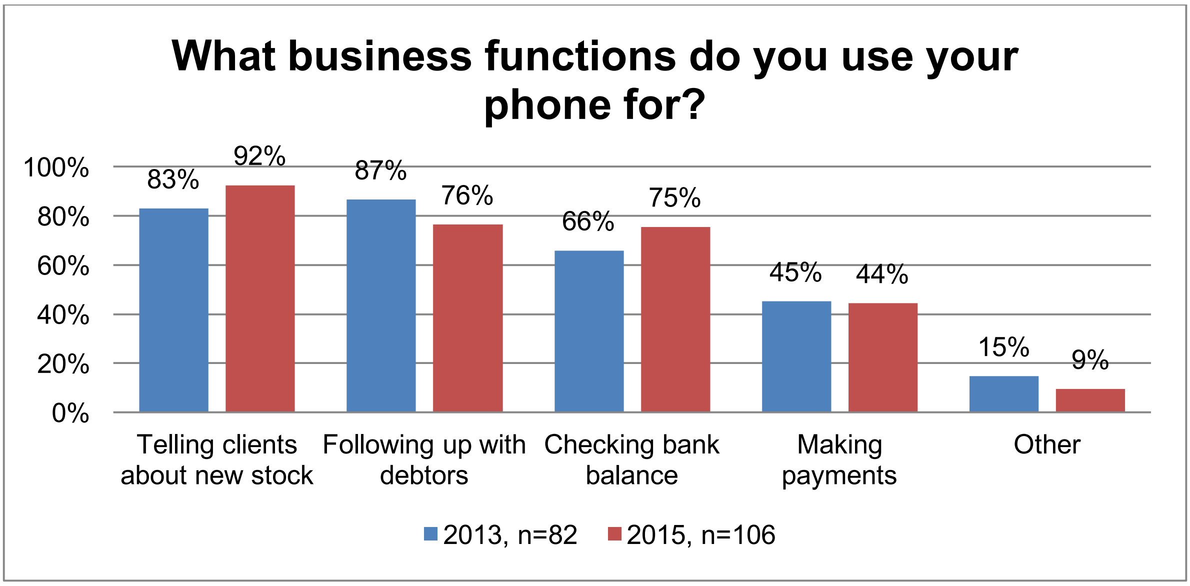



**Figure 3.14. The business functions for which the respondents use their phones**

In response to a question about which mobile phone features the students most frequently used, two very noteworthy and expected changes are apparent, visible in Figure 3.15. The percentage of respondents indicating that they regularly made phone calls decreased from 74% in 2013 to 63% in 2015, and the percentage that reported they frequently made use of instant messaging increased substantially from 51% in 2013 to 74% in 2015. Slightly less prominent, but also relevant is that Internet browsing increased from 33% to 41% and SMSing decreased from 51% to 42%. Minor changes were also noted, with camera usage, emailing, music and gaming changing by 5% or less.

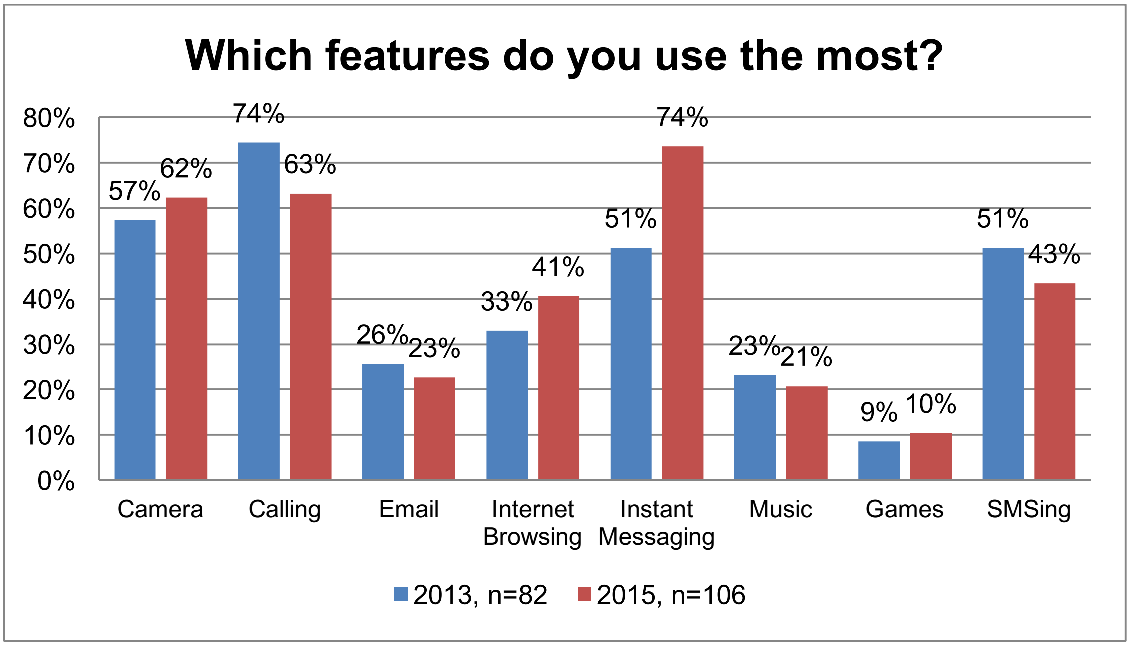



**Figure 3.15. Features frequently used on mobile phones**

#### *3.2.3.1 Requirements arising from survey*

In order to mitigate the compounding of the learning curve of the phone at the same time as learning to use the application, the choice of phone needed to be carefully considered. It was decided that the phone selected for the trial, and thus the one for which the designs should be focused, must be as familiar as possible to the users. Based on the 2013 survey data that was available during the requirements gathering phase, the following were considered requirements:

- A Nokia phone should be used
- The phone should have a QWERTY keyboard
- It should have low / no data requirements

The analysis of the data was only completed after the collaborative design session discussed in the following section and after initial work on the low-fidelity prototype had begun. As a result, these requirements were only factored into the second low-fidelity iteration.

### 3.2.4 Collaborative Design Session Findings

A collaborative design session was held near the start of the research, shortly after the contextual enquiry. It was initially hoped that this session would include a wider variety of stakeholders. However, only the members of the NGO leadership team were able to be present, due to external factors. During the session, the findings from the earlier parts of the requirements gathering phase were reviewed. This led to a discussion of possible features that could be included in the application. These ranged across a number of business topics, not focusing exclusively on recordkeeping.


**Figure 3.16. A photograph of the sticky notes representing the prioritized list of features generated during the collaborative design session**

The researcher led the design session and encouraged participation from all present. No contributions were excluded and all ideas were recorded on sticky notes, as seen in Figure 3.16. Once the suggestions had been exhausted, they were discussed in turn and ordered according to importance by general consensus. The final outcome from this session was a prioritized list of features that could be included in the application. It was understood that not all these features would be included in the final application and that they were likely to evolve and be refined over the course of the project.

The following is a summary of the list of features, in order of priority. Items 1 – 4 were considered very important, 5 – 6 were somewhat important, 7 – 8 were rated nice to have, and item 9 was deemed unimportant.

1. Basic recordkeeping functionality: tracking income, expenses, creditors, debtors and savings
2. The ability to ‘cash up’ and check whether the money on hand is reflected in the application
3. Business reports: to be shared with a mentor
4. Backups: online or offline
5. Reminders: of money owed, to ‘cash up’, to check on business progress
6. Budgeting: setting income, expense, sales and savings goals and getting notifications about them
7. Marketing tools: managing client lists and sending notification of new products
8. Visual and sound reminders: including ‘gamification’, leader boards and incentives
9. Calculator

This list of possible features for the application, supplements and builds on the functional and non-functional requirements those mentioned in Section 3.2.1.4 and Section 3.2.3.1:

- The app needs to be built for a low-level mobile phone that is affordable to users
- A Nokia phone should be used for familiarity

- The phone should have a QWERTY keyboard
- The chosen phone needs to have good battery life
- The app should not be too big, due to space limitation of low-end phones
- The app should not require an active data connection, due to high data costs

- Password security must be available to protect potentially sensitive financial data
- The app should have functionality for easy offline backups of data
- Credit sale consideration needs be included, with the ability to track customers who owes the user money
- Customizable reminders

## 3.3 Discussion of Multiple-Stakeholder Participation

A variety of different methods were combined during the requirements gathering phase, resulting in a list of requirements for the application. In this phase the stakeholder groups contributed in different forms and to varying levels. We want to reflect on the impact of the approaches taken in light of the multiple-stakeholder involvement. In this section we contrast the involvement of the staff and students, reflect on the power dynamics observed and assess the impact of external factors on participation. We end with a discussion of the influence of participation in this phase on the design process.

### 3.3.1 Contrasting Involvement of Participants

During this phase, the staff were more active as traditional co-design participants than the students, partaking in interviews, contextual enquiry observations, planning meetings and brainstorming sessions. In doing so they shared their knowledge of the course material and structure of the training program. Along with teaching experience and expertise in working with micro-entrepreneurs, this allowed them to provide good insights into the core features that the application would require. For those who participated, their involvement was found to be effective and appropriate for this stage of the design process.

In contrast, the students' backgrounds limited them from being active participants in this phase, as discussed in Section 2.3.2. In order to accommodate for this, they were included more passively, via being observed in the contextual enquiry phase, and through answering the cellphone survey. Their participation helped inform the level of language used in the application and the type of functionality required. The survey was effective in allowing a large number of the students to contribute towards the project without an extensive time investment or disruption of their schedule. Although the students received limited exposure to the overall purpose of the project, their participation allowed for key insights to be gatherings that informed the prototype designs in the following design phases.

### 3.3.2 Observed Power Dynamics

Power dynamics were observed between the stakeholder groups and sub-groups. The NGO is structured in a hierarchical manner, with members of the leadership team being in charge over the running and organisation of all activities. In respect of the organizational culture, it was necessary for the researcher to defer to their authority in communicating with the other participants about the various requirements gathering activities. She was not included in knowing what these communications involved.

Members of the leadership team were thus responsible for communicating with the mentors about the purpose of the project and their possible involvement in it. While the specifics of these interactions are not known, the leadership member's portrayal of the project would have influenced the mentor's perception of the project. The mentor's later reflection that they should have participated earlier in the design process is an indication that the communication in this phase was not effective enough in introducing all the stakeholders to the nature and benefits of the project. It further indicated that this phase could have been structured better in order to allow for the mentors to be involved.

### 3.3.3 Impact of External Factors

External factors, such as other commitments in and outside the NGO, played a role in influencing who participated and to what extent their participation occurred. The mentors, in particular, were likely affected by their part-time involvement at the NGO. This resulted in them only being present at the NGO for particular sessions and events, and not necessarily being available at times that suited the members of the leadership team and the researcher. The peer-mentors were similarly affected – due to their dual responsibilities as students and as peer-mentors – and their time availability could not be guaranteed. As a result, the mentors and peer-mentors were not able to participate in this phase of the design process. This negatively affected their attitude towards the project in later stages, as discussed in Section 6.3.3. Similarly, the nature of the training course, which involves students attending classes on different days and for different lengths of time – with a degree of turnover of students – meant that prolonged exposure and on-going interactions between the researcher and students was not possible.

### 3.3.4 Influence on Design Process

Regarding the rest of the design process, the staff's participation in the requirements gathering phase created a foundation for their involvement in subsequent phases. As more traditional co-design participants, they were able to build on their experience and contributions from the first phase is the rest of the study. It also resulted in a relationship forming between the researcher and the staff, whereby a level of understanding and spirit of collaboration was established. The absence of the mentors and peer-mentors' inclusion had a corresponding negative effect on later phases due to the lack of rapport being formed.

It was determined by the leadership, in confirmation of related literature (see Section 2.3.2), that including the students in traditional co-design sessions would not be appropriate. This influenced the decision to include the cellphone survey in this phase to gain input from the students, which proved to be effective. In light of this, and in order to gain more personalised and interactive input from the students in the next phase, it was decided that focus groups should be used. The aim of the focus groups was to confirm assumptions made by other stakeholders and gain insight from the students in a freer form than the survey had allowed.

## 3.4 Chapter Summary

This chapter discussed the requirements gathering process that was undertaken at the start of this project. A combination of different methodologies was used in order to gain a multi-faceted picture of the various factors that needed to be taken into consideration when designing an app for this context. These included interviews conducted with entrepreneurial experts, a contextual enquiry at the NGO, a survey of the students' mobile phone usage – compared from 2013 to 2015 – and a collaborative design session.

The findings raised technical limitations, security concerns, data constraints, educational and language restrictions, business model realities, prior mobile phone usage and business experience that shaped the requirements for the application. The requirements gathering phase culminated in a feature brainstorming session with the NGO leadership team in which these factors were discussed and a prioritized list of requirements was made. This list was used as the basis for the low-fidelity design phase, discussed in the following chapter.

In reflection of the multiple stakeholder participation, it was found that including the staff in traditional co-design functions was effective. The students participated in more passive ways, via contextual enquiry observations and a survey, which was appropriate for them in this phase of the design process. Learnings from this phase resulted in the inclusion of focus groups with the students in the follow phase. In retrospect, we have found that the management of communication and the structure of this phase, to accommodate for the influence of power dynamics and external factors, could have been improved.

# 4. Low-fidelity Design Phase

The goal of the low-fidelity design phase was to clarify the core features that would be included in the application and to expand on the specification of each, including user-interaction and the flow of information. Co-design sessions were held with the staff and focus groups were run with a subset of students as representative end-users. This resulted in two iteratively designed low-fidelity prototypes that visually represented the design choices thus far.

The leadership team evaluated the first prototype in a co-design session. During this session the prototype was edited and further revisions were subsequently made. Additional refinements arose from the two focus groups, whose objective was to clarify and test assumptions. In addition, contributions were made by HCI experts who gave input on the flow of information and navigational considerations. By the end of the first low-fidelity iteration, the data from the survey in Chapter 3 had been analysed, resulting in the decision to use a different type of phone than the one included in the initial designs. The combination of this decision with the findings from the activities in the first iteration led to the design of the second low-fidelity prototype. This prototype was evaluated by the leadership team and approved after some additional adjustments.

## 4.1 Methodology

In this section, the methodologies used for the low-fidelity designs, the co-design session and the focus groups are discussed in turn.

### 4.1.1 Low-fidelity Designs

From the finding of the requirements gathering phase of this project, a low-fidelity prototype was created to visually represent the potential features. This was done using hyperlinks in PowerPoint and taken to the staff for their input during the two co-design sessions. A template screen of a phone was used as the outline of the prototype, allowing the participants to perceive its size, orientation and limitations. The contents the screens were designed to align with key features and functionality from the requirements gathering phase, detailed in Section 3.2.4. The objective was to represent the flow of information and interaction of the features required. Text boxes were used to visually represent buttons and text inputs, while hyperlinks were used to link the interaction between slides. This gave the appearance of basic functionality. Placeholder icons were used in the second prototype to indicate where the final icons would be.

### 4.1.2 Co-Design Sessions

During the co-design sessions, the researcher led the discussion, using the questions in Appendix C as a guide, and encouraged participation from all stakeholders present. The leadership team comprised the primary participants in these sessions. The discussion relied on their expert knowledge of the content and course material included in the training course, as well as their years of experience working with micro-entrepreneurs.

The first and second low-fidelity prototypes were discussed in the co-design sessions and the participants were asked to give input and suggestions on the visual representation of the features, the flow of information, the choice of wording and the representation of information. This feedback, which is discussed in Section 4.2.1 and Section 4.2.2, was incorporated with the findings from the focus groups (see Section 4.2.3) and informed subsequent prototype designs.

### 4.1.3 Focus Groups

Two focus groups were held during the low-fidelity design phase to clarify assumptions and to ensure that the interests of the micro-entrepreneurs were being represented. It was important to prioritize the input of the students to avoid mismatches between the design and the reality of the use of the application [2]. A representative subset of users participated in the focus groups where concepts were discussed, allowing for potential flaws in logic and understanding of the users and the use of the application and to be addressed.

The objective of the first focus group was to get additional first-hand information on the daily context in which the micro-entrepreneurs operate their businesses. It was hoped that this would clarify assumptions that had been made during the co-design sessions regarding the business process, factors influencing their business, sales context, customers and money habits of the micro-entrepreneurs. Examples of questions discussed during the focus group include: "When you make a sale, what kind of records do you keep?" and "When people buy things on credit, how do you keep track of what they owe you?"

The second focus group's objective was to assist with the choice of wording for the interface and the design of the corresponding icons for the key features. This was to ensure that they were relevant and understandable to the end-users and that no gaps had formed between the staff's perception of what the users understood, and reality [2].

## 4.2 Findings

In this section we discuss the findings from the co-design sessions and focus groups. During these activities, the visual representation of features evolved and the flow of information was developed. Furthermore, the feature list was refined, with some features being excluded.

### 4.2.1 Co-Design Session 1 Findings

The first prototype was evaluated with the leadership team in a co-design session. This prototype had been created by the researcher out of the requirements gathered, and was presented via a laptop and projector. The group talked through the key features and functionality illustrated on each slide and made suggestions to alter and refine the prototype. More specific detail was added for the functionality of some features and changes were made to others. The information flow and details of what would be tracked at each step was discussed and supplementary specifications were given. The following describes some of the significant findings from the first co-design session.

The 'money owed' section, where the user views a list of which customers owe them money, was discussed as being particularly useful when portrayed visually. This is not something that the current paper system supported and the staff agreed that it would significantly aid the micro-entrepreneurs' business management. The navigation here was simplified, as depicted in Figure 4.1. On the left, the original design can be seen, where the user was required to click on the 'Options' button and then choose the desired action. On the right, the refined feature can be seen, where the graph has been removed and the possible actions are included within one screen.


**Figure 4.1. Changes made to the Money Owed feature**

Another adjustment made was to the way information was captured for income and expenses. The initial prototype required the user to click on 'Income + Expenses' on the menu screen. They were then taken to a sub menu screen where they could see a summary of the income and expenses for the month thus far in a graph. If the user then clicked on the 'Sales Income' button, they would be taken to a screen where they could enter the pertinent information for the desired sales income. This required them to select either cash or credit from a drop down menu and – if it was a cash transaction – to indicate whether the money from the sale was received in their bank or wallet. The original designs for these screens are illustrated in Figure 4.2.


**Figure 4.2. Prototype 1.1 navigation to enter sales income information**

The changes made during the first co-design session to the navigation of entering a transaction are displayed in Figure 4.3. Here the flow had been changed to assist the user in understanding and carefully considering whether the transaction was cash or credit and where the money went to as a result of the transaction. The participants felt that this would help educate the users on the important differences between credit and cash transactions and encourage them to reflect on where the movement of their money was occurring. Also depicted in Figure 4.3 is the removal of the graph from the sub menu screen. The group decided that the graph was not of significant value to the users and would likely lead to unnecessary confusion, while cluttering the screen.

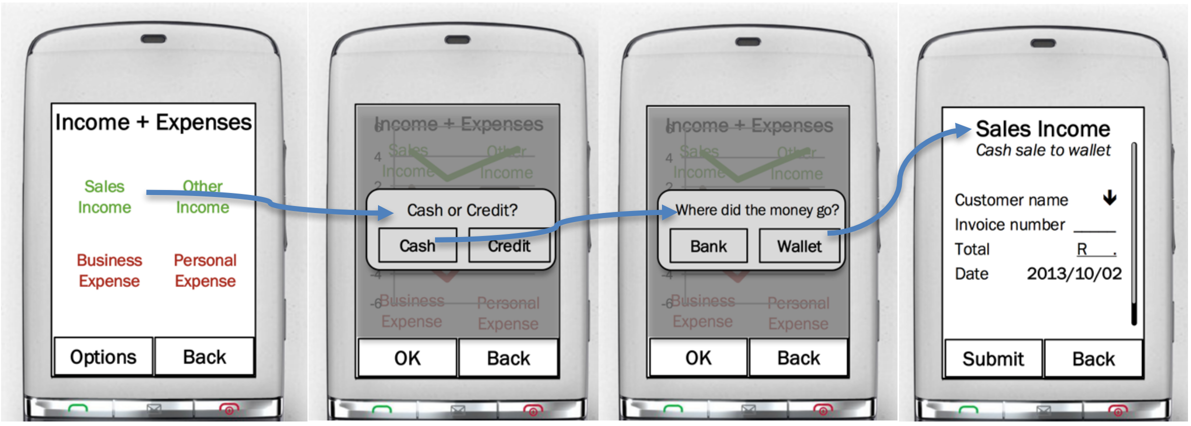



**Figure 4.3. Prototype 1.2 navigation to enter sales income information**

In conclusion of the first co-design session, it was agreed that the phone model would change from one with 12-button keypad to a QWERTY style keypad, in line with the findings from the survey done in Section 3.2.3. As such, the orientation of the screen changed and different navigation options were considered.

### 4.2.2 Co-Design Session 2 Findings

In light of the findings from the first co-design session and the change of phone model, a second low-fidelity prototype was designed and brought to the staff for consideration. In the process of this prototype's development, items 6 to 9 of the proposed features list (see Section 3.2.4) had been excluded as out of scope. Input had also been received from a group of HCI experts in the Computer Science Department of the University of Cape Town, which was factored in to some of the design decisions, most significantly the navigational menu bar.

The focus of the second co-design session was to confirm and improve the information representation and flow, and to discuss the choice of wording and the use of icons. The participants gave suggestions of possible word changes and icons, but the final decisions were made by the students during the second focus group. Figure 4.4 shows how the menu screen had evolved between these two sessions.


**Figure 4.4. Menu screen from the second low-fidelity prototype**

In this prototype, the bank and reports sections had been fleshed out substantially from the first prototype. Much discussion ensued around the information flow in these sections and how the functionality would work. Each screen was examined in detail and notes were made on missing information, such as how the users would track deposits that were made with credit transactions, as seen in Figure 4.5.


**Figure 4.5. Example of notes made on the second prototype during the co-design session**

Another significant concern raised was the need to allow users to edit and review transactions once they were made. It was initially decided that this would be included in a transactions history feature under the options button in the ‘Income + Expense’ screen, but this was later removed in the high fidelity evaluations and include in the reports section instead.

### 4.2.3 Focus Group Findings

The various assumptions made during the co-design sessions were assessed during two focus groups that followed. These assumptions related specifically to two primary facets: the way the micro-entrepreneurs actually ran their businesses outside of the NGO, and the relatability of the particular words and icons used in the low-fidelity designs. As such, two separate focus groups were held, allowing each facet to be examined in turn.

#### 4.2.3.1 Focus Group 1

The first focus group's objective was to gain first-hand accounts of the financial context and daily business practices of the micro-entrepreneurs. The researcher guided the discussed and made notes using the list of question in Appendix C. Five women participated voluntarily in the group. They conduct most of their business in isiXhosa, but one lady has English customers too. One participant indicated that she makes most of her sales near her home in Khayelitsha, a semi-informal settlement. Three reported previous experience selling clothes and jewellery, while the other two had no prior business experience.

Through being in the program, the participants said that they were learning confidence and skills in running their businesses. One participant said, "It's very helpful. We are now confident in what we are doing." Another who previously ran a business said, "The training here has helped us to understand why our past businesses have failed. We now know what went wrong before. We are always learning – from class and each other – how to improve our business".

Tracking who owed them money was considered very important, as many customers did not remember to pay them back. Some participants mentioned using messaging services on their mobile phones to remind customers when their payments were due.

The participants did not make sales every day. However, on a good day they indicated that sales ranged between 5 and 15 items. These were either made to friends and family or at a stand, for example near a taxi rank or train station. When asked how often they track their sales, the participants indicated that they strove to track their sales daily, but usually did not achieve it. One participant admitted that she often did not track regularly and struggled at month-end to remember all her sales.

The primary contributions of this focus group toward the application design included confirming assumptions regarding business structure and context, and emphasizing the need for thorough tracking of credit sales. It further confirmed the reality that the users were not tracking their financial information as regularly as the NGO wanted, and that the impracticalities of tracking in their books was noted as a significant factor in this.

#### 4.2.3.2 Focus Group 2

The purpose of the second focus group was to discuss the wording of the various options and buttons in the application and to decide on appropriate icons to represent them visually. There were four participants in the group. Two of the ladies who participated were new to the NGO but had experience running their own businesses before. The other two had been in the NGO's training program for nearly two years. They were given a number of different scenarios and then asked to discuss a term that might summarize it and design an icon to represent it.

The researcher gave the participants five scenarios in turn and facilitated the discussion around what word or phrase would appropriately sum it up and what a corresponding icon would look like. A graphic designer was thereafter tasked with illustrating these icons. The outcomes can be seen in Table 2.

**Table 2. Scenarios, terms and icons**

| Scenario | Term & Icon Required | Icon |
|---|---|---|
| You write down all the information relating to income and expenses in your business. For example, a customer buys a pair of shoes from you on credit; or you pay taxi fare; or you receive a social grant; or you get your hair done. | **Transaction**<br><br>Two hands: one giving notes of money and one giving a bag of unmarked goods. |  |
| You want to track the money that people pay you back for credit sales, or money that you pay to suppliers/stores when you buy something on credit. | **Money Owed**<br><br>One dark skinned hand giving notes of money |  |
| You count up your money at the end of the day/week, check your bank balance and write down the totals. | **Cash Up**<br><br>Old-school supermarket till |  |
| You keep track of the money that you deposit and withdraw from the bank, and any money that you save in other places (eg stokvel). | **Banking**<br><br>Bank building with the word “bank” on top, or a credit card picture |  |
| You add up all the totals for each category (eg groceries, total sales, taxi fare) and want to see how your business is doing and how your personal spending is doing. | **Reports**<br><br>A picture of a document statement, e.g. bank statement or income statement |  |

There were five other terms used in the prototypes taken directly from the NGO’s training terminology that also required icons. For these, the term was discussed and a requirement for an icon was agreed upon by the group. Table 3 contains the summarised choices and ultimate icons.

**Table 3. Preset terms and icons**

| | |
|---|---|
| **Income – sales and other**<br><br>Notes of money with a green "+" sign |  |
| **Expenses – business and personal**<br><br>Notes of money with a red "-" sign |  |
| **Deposit**<br><br>Banking icon with a green "+" sign, or an arrow showing money going in |  |
| **Withdraw**<br><br>Banking icon with a red "-" sign, or an arrow showing money going out |  |
| **Savings**<br><br>A picture of a safe with a very big padlock on it. |  |

These terms and icons were used in the ensuing high-fidelity prototypes, described in Chapter 5.

At the conclusion of the focus group the participants were shown the high fidelity prototype that was under development and the concepts of the different features were explained. This was done to gauge the initial reactions of potential users to the app. The overall reaction to the possibilities of the app was a positive one. One of the participants said, "You can do it (recordkeeping) even while you're in the taxi! You're just playing with your phone, it'll be easy." While another said, "It's a brilliant idea!" and a third exclaimed "Hey, it's good! Technology!". One participant was concerned about the cost of data and questioned, "Will this also need the Internet?" When informed that it would not require an Internet connection to use, the enquirer responded, "Is it? Wow! That's nice, I like it!"

## 4.3 Discussion of Multiple-Stakeholder Participation

Learning from the requirements gathering phase, no attempt was made to include the stakeholder groups together in activities during this phase. Instead, co-design sessions were held for the staff and focus groups for the students. During the low-fidelity design phase both groups of stakeholders were given comparably significant importance in their contributions towards the design of the application. However, their contributions differed significantly in content and required different methods to gain their input. In this section we contrast the participation of the stakeholder groups, reflect on observed power dynamics and the impact of external factors, and discuss the influence that varied participation in this phase had on the design process.

### 4.3.1 Contrasting Involvement of Participants

Building on the foundation formed in the requirements gathering phase, the staff again participated in traditional co-design methods during this phase. This included design sessions, refining features and iterating the requirements. The staff's roles at the NGO and expert knowledge of the course material enabled them to make valuable contributions. In addition, they made suggestions based on their insight into what the students would understand and how they would react to certain flows. However, because the staff and researcher's understanding of the system was more extensive than the intended end-users, they were prone to overlooking things that might not be easily understood by the students.

In light of this, the students' contribution focused on testing assumptions that had been made regarding the workflow and the environment in which the app would be implemented. In addition, they contributed icon designs and phrasing for key features of the app. This was done via focus groups, which was effective in allowing a small group of students to interact with the researcher in a non-threatening manner. They were not given an opportunity to comment on other aspects of the system, such as which features they wanted included. This was intentional and done to respect the staff as experts of the curriculum [92] and the students' relative lack of experience with recordkeeping requirements [91]. However, the students' input was given priority over the staffs for the more practical aspects of which terminology should be used and the real context in while the app would be used, where the students were the experts. The combination of input from the staff and student was found to be effective in the low-fidelity phase of the design process.

### 4.3.2 Observed Power Dynamics

Due to the rapport that had been developed between the researcher and staff, the design sessions in this phase were comparatively less structured and more creative than in the previous phase, with the participants readily making contributions and volunteering suggestions. As a result, the researcher did not need to guide the discussion as much, allowing for more freedom of ideas to be shared.

The staff were responsible for interfacing between the researcher and students. A staff member assisted the researcher by identifying possible students and encouraging them to participate. Some appeared hesitant to participate, but at the staff member's urgings, most agreed. One student in particular did not appear to be a very willing participant. When the researcher was later alone with the participants, she again explained the purpose of the focus group and encouraged them to only stay if they felt comfortable doing so. At this point, the unwilling participant elected to withdraw. This shows the power that the staff member had in compelling the student to initially say yes to participating when she in did not wish to do so.

No existing relationship existed between the students and researcher and they were initially quite closed and hesitant to participate. Once they understood that their involvement would not involve substantial effort, they appear to relax and became more active in their participation. By the end of each focus group, the discussion was flowing freely and they had begun volunteering information and having discussions among themselves, rather than only answering direct questions posed by the researcher. This shows the impact of establishing a comfortable atmosphere with willing participants, which was successfully achieved in this phase of the design process.

### 4.3.3 Impact of External Factors

In light of the findings from the previous phase, the strategic choice of participation methods for this phase of the design process resulted in external factors having less impact. The staff were able to participate and build on their previous involvement, however the mentors were again unfortunately not involved. The use of focus groups with random subsets of students did not rely on the availability of specific participants that might otherwise have been affected by scheduling conflicts.

### 4.3.4 Influence on Design Process

The choice of participation activities was effective and appropriate for the stakeholder groups in this phase of the design process. The staff were able to build on their prior involvement and the students were able to contribute in a non-threatening manner. Their various contributions were able to be combined into the prototype iterations in this phase and the next. The deference to each group in respect to their respective areas of expertise resulted in useful input from both groups without significant conflicts in the findings.

The success of including small groups of students in focus groups influenced the decision to include the students in pairs during the user-evaluations in the high-fidelity phase. Furthermore, the observation of the influence of the staff in forcing the unwilling participation of a student resulted in adjustments being made to the method of recruitment of student participants in the next phase.

## 4.4 Chapter Summary

In this chapter, the initial design of the application was iterated on, using low-fidelity prototypes made with a slide show. The iterations included input from both the staff and the students, at different points and to varying degrees. The staff actively participated in co-design sessions, discussing the more detailed aspects of the information flow and screen designs. The students participated in small focus groups to address key assumptions and finalise design decisions, particularly which icons and terminology that best represented key features. The combined contributions were used to inform the design of the high-fidelity prototype described in the following chapter.

During this phase, the stakeholders were strategically included in activities that allowed them to contribute towards the design in line with their respective areas of expertise. The careful selection of interactions mitigated external factors that had a stronger influence in the previous phase. Power dynamics were observed to influence participation. Furthermore, the benefit of relationships formed in the previous phase and the atmosphere created during the focus groups resulted in more voluntary and enthusiastic participation from those involved.

# 5. High-fidelity Design Phase

In this chapter, the development of the application is described and the methodology used for the prototype iteration evaluations is discussed. The findings from the evaluations and their implications for the application's development are then examined. The NGO's course material and approach to recordkeeping evolved over the duration of the study, requiring some late adjustments to the features and flow of information. After considering each of these in turn, a detailed description of the final application that was used in the ensuing field study is given. The chapter concludes with a reflection on the participation of the stakeholder in this phase of the design process.

## 5.1 Methodology

The findings from the low-fidelity design phase were incorporated into the development of a vertical high-fidelity prototype on the selected mobile phone: the Nokia Asha 201. The phone's selection was influenced by the 2013 survey results, discussed in Section 3.2.3, that found Nokia phones and QWERTY keyboards were the most used by the respondents. The prototype was developed initially as a vertical prototype, focusing on one key feature. Entering transactions, prioritised as the most critical feature in Section 3.2.4, was developed with focus on the user interface and required behaviour. Once the first feature had been developed, it was evaluated with a representative sample of end-users to study the initial usability and user-experience of the system, using the 'thinking aloud in pairs' approach [95], followed by the Intrinsic Motivation Inventory (IMI) measurement device [94], discussed further in Section 5.3. At this stage, various members of the NGO staff were shown the progress of the system, but were not asked for formal feedback.

Influenced by findings from the first user evaluation, the high-fidelity prototype was further developed and the system was extended to include additional features. A second user evaluation was then conducted, followed by an additional session with the staff to get feedback on the progress of the application. During this session the staff was asked for their insight on the application, to ensure that all their requirements were adequately met. Hereafter, additional meetings were required to make and approve adjustments to the application to realign it with changes in the course material, followed by final approval and acceptance of the application for the trial.

## 5.2 High Fidelity Development Process

In this section, the two development iterations of the application's high-fidelity prototype are described in turn. An in-depth explanation of the final application with screenshots can be found in Section 5.7.

### 5.2.1 High-Fidelity Prototype Version 1

The first version of the high-fidelity prototype was a vertical prototype focusing primarily on the main feature of the application: capturing transactions. The prototype allowed the user to see the five high level menu items: transaction, money owed, cash up, my money and reports, as shown in Figure 5.1. However, only transaction and cash up were functional during the first iteration.


**Figure 5.1. Main menu screen from the high-fidelity prototype**

Transactions, the first item on the prototype's main menu, comprised four different types, mirroring the NGO's training material. There are two types of income – sales income and other income; and two types of expenses – business expenses and personal expenses. The prototype's transactions menu screen is displayed below in Figure 5.2.

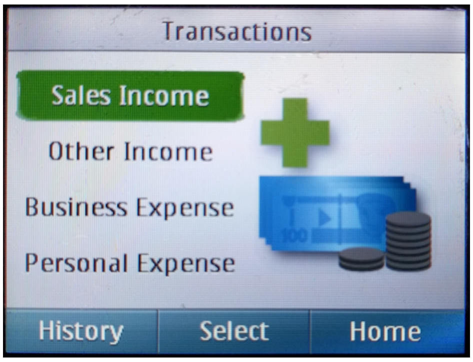
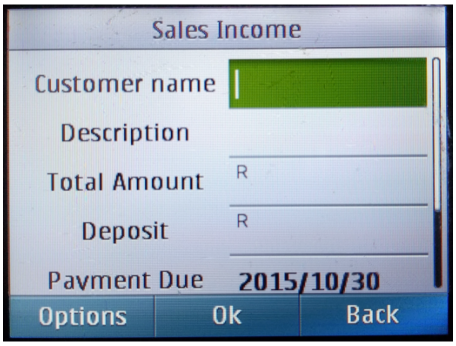



**Figure 5.2. High-fidelity prototype transactions menu screen**

Once a transaction type was selected, the prototype displayed a form that showed the required fields for the type of transaction that the user needed to capture that had been refined during the low-fidelity phase. These included the customer's name, a description of the sale, the total amount, the deposit amount (if necessary), the next payment date and the transaction date. The sales income entering screen can be seen below in Figure 5.3.



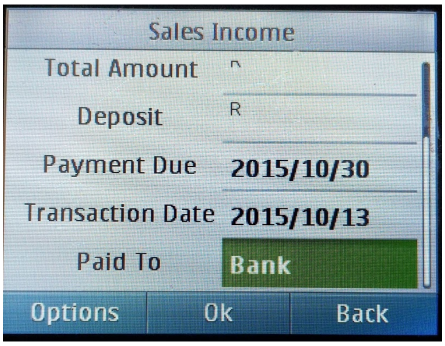




**Figure 5.3. High-fidelity prototype sales income screen**

Cash up, as shown in Figure 5.4, was included in the vertical prototype as this feature did not come directly from the NGO's training material, raising the possibility that the users may not understand its purpose. The findings from the ensuing evaluation (see Section 5.4.1) confirmed the assumption that the users did not understand the purpose of cash up as it has been implemented.

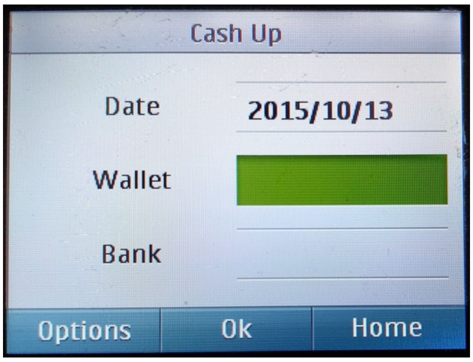



**Figure 5.4. High-fidelity prototype cash up screen**

For the high-fidelity prototypes, the frontend functionality for transaction capturing was implemented, allowing the users the ability to type in the necessary information, but the backend component to store and use this data had not yet been developed. The backend was added after the second high-fidelity prototype was complete, ensuring that all frontend components and data needs had been adequately considered. For the purpose of the vertical prototype, the data entered by the users was tracked in log files for later inspection.

The purpose of the first high-fidelity prototype was as a proof of concept test to assess whether or not the users were able to use the core functionality in the way that was initially designed by the other stakeholders. Bugs were expected during this stage of development and the process helped highlight usability issues, such as unexpected button presses that caused the app to crash, and other design considerations, such as choice of wording and icons that needed addressing. The findings (see Section 5.4.1) show that the users were able to navigate the app with a little guidance and were successfully able to capture the required details for the transactions, supporting the viability of the design. The findings from the first prototype were used to influence improvements on the same features in the next prototype, as well as to influence the implementation of additional features.

## 5.2.2 High-Fidelity Prototype Version 2

The second high-fidelity prototype extended from and improved on the development of the first prototype. Herein the obvious bugs causing the app to crash intermittently were dealt with. The transactions menu was expanded to handle the specifics of the four subcategories better, refining some terminology and making some features more uniform. The functionality of money owed and my money sections were developed, following the specifications established during the previous design stages. Screenshots of their respective functionality are shown below in Figure 5.5 and Figure 5.6.

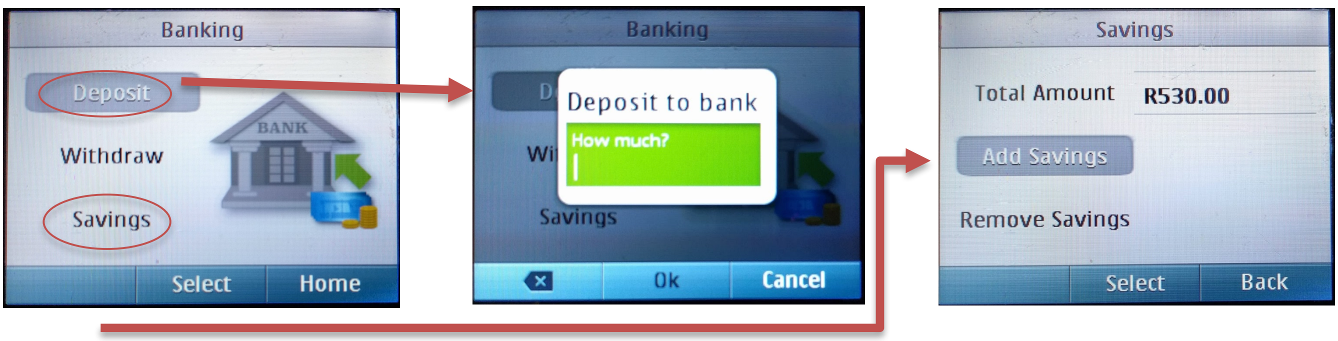



**Figure 5.5. Screenshots from the My Money / Banking feature**


**Figure 5.6. Screenshots from the Money Owed feature**

In addition, the settings menu was incorporated, allowing the user to enter the name of their business, use password protection and do backups onto a memory card. The reports section, relying on the backend of the other sections being fully integrated, was not implemented during this prototype.

The purpose of the second high-fidelity prototype, like the first, was to test the initial reaction of users to the logic, navigation and input requirements of each of the features developed. For this, a similar evaluation was conducted to assess the usability of the feature set and to discover any potential problems. The evaluation methodology and findings for both high-fidelity prototypes are discussed in the following two sections.

## 5.3 Evaluation Methodology

The objectives of the high-fidelity user evaluations were to assess the end-users' first impressions of the system and to identify any design flaws. A number of evaluation techniques were combined in order to obtain informative feedback from the participants. This included a usability test with a list of scenario-based tasks, in conjunction with the thinking aloud in pairs approach, known as constructive interaction.

Thinking aloud [96] is a usability engineering method that requires the participants to think aloud continuously during the system's evaluation [95]. Hearing the participants' thoughts allows the researcher to gain insight into their views of the system and any misconceptions that may arise. Constructive interaction is a variant of the traditional think aloud approach, which involves having two participants working together on the same system [95] [97]. As it is more natural to think out loud when attempting to solve a problem with another person, this approach allows for comments and engagement to be less forced [95]. It results in more utterances and provides a better understanding of encountered problems [97].

The participants, a subset of students from the NGO, were initially given a survey to gather information on their personal background mobile phone usage and business experiences (see Appendix D). The researcher then gave the participants a brief walk-through of the system, allowing them to become familiar with the key features. Next, the participants were given a list of tasks to complete using the application. These mirrored typical daily business situations. One mobile phone was shared between the two participants and they were encouraged to take turns using the phone and discuss their choices together.

Each group was given a strategically pseudo-random list of tasks to complete (see Appendix E and Appendix G). The ordering was randomized for each group, with the aid of a random number generator. The output was pseudo-random as some adjustments were made to ensure the same sequence of tasks did not appear twice and that tasks were relatively well spread. The first, second and last tasks were the same for all users, as required by the logic of the tasks. Randomization was used to help normalize the learning effect that could enable participants to complete later tasks easier than earlier tasks.

The evaluations were concluded with a guided questionnaire, using the Intrinsic Motivation Inventory (IMI) measurement device founded on research by Ryan [98]. IMI's purpose is to assess the participants' subjective experience of doing evaluation tasks [99] [100]. In this evaluation, six key factors were assessed: interest/enjoyment, perceived competence, effort/importance, pressure/tension, perceived choice and value/usefulness. The questionnaire comprised of three questions selected from each of these subscales (see Appendix H). The questions were customized to be directly relevant to this evaluation, as recommended by McAuley et al. [99].

An audio recording of each evaluation was taken, in addition to observations recorded via pen and paper by the researcher. Furthermore, a log of every main action taken by the participants was recorded on the phone to give insight into user behaviour when the audio recording and researcher observations did not suffice.

## 5.4 Findings

The findings from the two rounds of user-evaluations of the high-fidelity prototypes are discussed in turn in this section. The findings revealed bugs that needed to be fixed and specifications that needed refining, while confirming the application's overall usability.

### 5.4.1 First High-Fidelity Iteration Evaluation

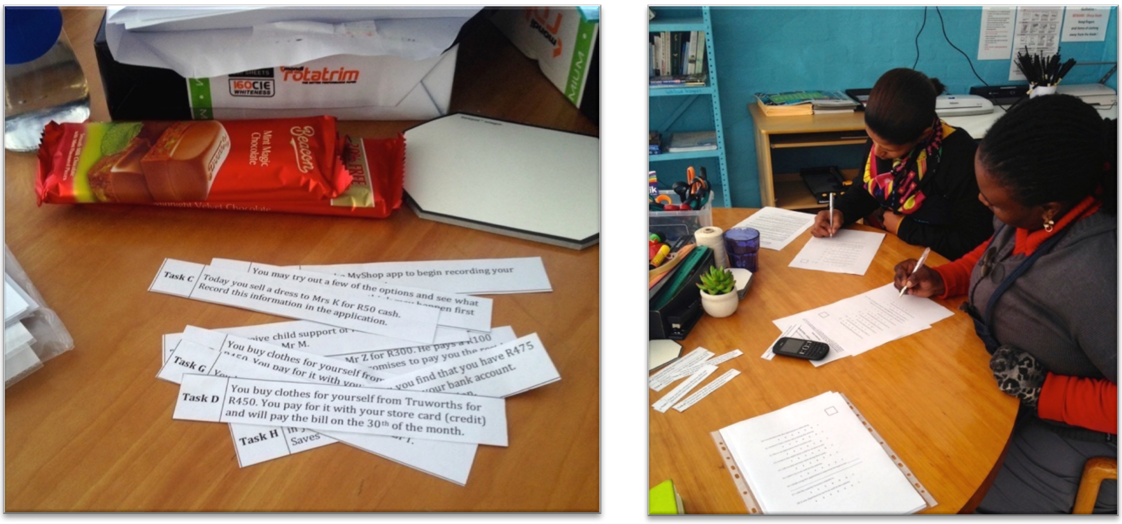



**Figure 5.7. Photographs from the first evaluation**

The first evaluation was run with five groups over three days, with two student participants in each group. The results of the survey, completed by the participants at the start of the evaluation, are contained in Table 4 below and the original questions can be found in Appendix D. The participants already knew each other and were comfortable working together, aiding the effectiveness of constructive interaction. This was done by ensuring that they were in the same group at the NGO, as indicated by their start date in the programme. As the intake of training groups is staggered during the year, some groups had been in the programme for longer than others. This allowed us to see how participants responded with varied levels of training and experience.

The participants came from a cross-section of ages, from below 25 to 46-55 years old. While all indicated that they were comfortable speaking English, it was apparent that there was some discrepancy in how fluent some of the participants were. Furthermore, some appeared more comfortable using the prototype's mobile phone than others. This corresponded with some to their indicated ease of use of their personal phones – for example the participant who answered 'difficult' displayed difficulties with the test phone too – as well as to which of them owned a similar phone to the prototype phone.

**Table 4. Evaluation 1 participants background survey results**

| # | Start | Age | Brand | Model | Touch screen? | QWERTY keyboard? | Own phone ease of use | English | Prior Business Experience |
|---|---|---|---|---|---|---|---|---|---|
| **1A** | Feb-14 | 25-35 | BlackBerry | 9300 | No | Yes | Quite Easy | Comfortable | <1 year |
| **1B** | Feb-14 | 25-35 | BlackBerry | 8520 | No | Yes | Quite Easy | Comfortable | <1 year |
| **2A** | Jul-12 | 25-35 | Nokia | ? | No | 12-key | Very Easy | Very Comfortable | <1 year |
| **2B** | Jul-12 | 25-35 | BlackBerry | ? | No | Yes | Quite Easy | Comfortable | >1 year |
| **3A** | 2012 | 46-55 | Nokia | E2 | No | Yes | Very Easy | Very Comfortable | None |
| **3B** | 2012 | 46-55 | Nokia | Asha 201 | No | Yes | Difficult | Very Comfortable | >1 year |
| **4A** | Nov-13 | 36-45 | Nokia | X2 | No | Yes | Very Easy | Comfortable | >1 year |
| **4B** | Nov-13 | 36-45 | Nokia | X2 | No | Yes | Quite Easy | Comfortable | None |
| **5A** | Jan-14 | < 25 | Nokia | ? | No | 12-key | Very Easy | Comfortable | >1 year |
| **5B** | Jan-14 | 25 - 35 | Nokia | ? | No | 12-key | Quite Easy | Very Comfortable | No |

During the first group's evaluation, a bug was found that caused the application to crash regularly. This affected the time taken for each task, as the system needed to be frequently restarted. However, it did not appear to affect the participants' enjoyment of the application. The bug was corrected that night and a more robust prototype was used for the remaining four groups. Overall, the participants were able to successfully complete the majority of the tasks with minimal assistance. It was observed that the participants experienced difficulties with the concept of cash up, however. A number of minor bugs were identified and navigational concerns were raised. Some terminology was also noted that needed changing, including possible ambiguity and more descriptive interface prompts.

The concluding questionnaire, following the style of a guided interview, revealed that the participants mostly had a positive perspective of the application. The summary of the IMI questionnaire results is shown in Table 5. The participants rated their agreement to 18 questions – three from each factor – from 1 to 7, where 1 meant "not at all true" and 7 meant "very true". The results have been normalized for questions phrased in the negative, for example "I thought this was a boring application to use". The captured results can be found in Appendix I.

The results were then analysed to give an indication of the participants' subjective experience using the prototype to complete the tasks. Table 5 shows the outcome, grouped by the six IMI factors. Due to the small sample size and subjective nature of the way the findings were gathered, conclusive results cannot be drawn from this data, but some inferences can be made by comparing the mean and standard deviation of each of the factors.

**Table 5. Summary of IMI results for evaluation 1**

| Factors | Min | Max | Mean | Std Dev |
|---|---|---|---|---|
| **Interest/ Enjoyment** | 5 | 7 | 6.93 | 0.3651 |
| **Perceived Competence** | 6 | 7 | 6.93 | 0.2537 |
| **Effort/ Importance** | 4 | 7 | 6.77 | 0.6789 |
| **Pressure/ Tension** | 1 | 7 | 5.70 | 1.8782 |
| **Perceived Choice** | 3 | 7 | 6.73 | 0.9072 |
| **Value/ Usefulness** | 6 | 7 | 6.90 | 0.3162 |

Interest/Enjoyment, Perceived Competence and Value/Usefulness scored the highest mean results and had the lowest standard deviations. This shows that the participants believed that they were able to adequately use the prototype on their first exposure to it, they found the experience to be positive overall and they saw potential value in using the system in the future. Pressure/Tension scored the lowest mean and the highest standard deviation. This indicates that some participants did not feel relaxed while undertaking the evaluation. This was evident to the researcher in the body language emitted by some of the participants. Using an unfamiliar system for the first time is evidently not a comfortable experience for everyone. However, it was encouraging to see that even those who did not find the experience stress-free indicated that they believed the system to be of potential value and that they appeared to be able to use it more comfortably as time went on.

### 5.4.2 Second High-Fidelity Iteration Evaluation

The findings from the first evaluation were used to inform changes to the high-fidelity prototype. The prototype was extended to include additional features, as described in Section 5.2.2. A second evaluation was then conducted, following the same structure as the first. Five groups of participants, in pairs, were observed doing an extended list of randomized tasks on the second high-fidelity prototype, followed by completing the IMI questionnaire. The tasks can be found in Appendix G. Once again, a number of bugs were identified during the evaluation and minor improvements were suggested. The summary of the IMI questionnaire results is shown below in Table 6. The detailed findings are available in Appendix J.

**Table 6. Summary of IMI results for evaluation 2**

| Factors | Min | Max | Mean | Std Dev |
|---|---|---|---|---|
| **Interest/ Enjoyment** | 5 | 7 | 6.80 | 0.5509 |
| **Perceived Competence** | 5 | 7 | 6.47 | 0.8193 |
| **Effort/ Importance** | 3 | 7 | 6.53 | 0.9732 |
| **Pressure/ Tension** | 2 | 7 | 6.03 | 1.1592 |
| **Perceived Choice** | 3 | 7 | 6.53 | 1.0417 |
| **Value/ Usefulness** | 6 | 7 | 6.70 | 0.4830 |

As with the first evaluation, some of the users indicated that they felt an element of pressure and tension while completing the tasks. However, the mean increased and the standard deviation decreased from the first evaluation, indicating that this was less of an issue in the latter evaluations. Perceived competence decreased by 6.64% from 6.93 to 6.47 between the first and second evaluations. This indicates that the wider variety of tasks might have resulted in users feeling less satisfied with their performance during the evaluation. The means for the other four factors changes by between 1,88% and 3,55%.

Two of the questions were open-ended, rather than requiring a rating to be given. These questions particularly related to uncovering the participants' perception of the application's uses and relevance to their lives. In response to the question "I think using this application could help me to…", one respondent wrote "understand my business and recording every sale that I have made quickly soon after sale", while another said "do my women at work book [paper recordkeeping] thoroughly and it's very easy and quick with cellphone". The answers primarily focused on the topic of the core functionality of the application, ease of use and assistance. In answer to "I think using this application is important because it can…" the answers were broader, including concepts of the basic functionality, improved accuracy, efficiency (time savings and tracking on the go), security (backups) and awareness of business's financial position. The full responses can be found in Appendix J.

In conclusion, while a few found the tasks stressful, the finding from these evaluations indicate that the participants were able to use the system with minimal initial training to complete the given list of tasks, while raising a few bugs and design challenges that needed to be addressed. The participants reported finding the application interesting and recognized its usefulness for their businesses. Their answers to the open ended questions revealed that they grasped the general purpose of the application and recognised its benefits.

## 5.5 Meeting with NGO Staff

An additional assessment of the high-fidelity prototype took the form of an unstructured meeting, similar to the co-design sessions, with the leadership team. The meeting commenced with a progress report of the application's development. Some design decisions were also mentioned and feedback from the user evaluation was conveyed. One staff member's question, "Now tell me, what was the general ladies' feeling about using the phone as a tool?" expressed the staff's curiosity in participants' reception of the application. They were pleased that the evaluation indicated that the women had a positive experience using the system and expressed interest using it within their businesses.

Mobile phones containing the application were distributed to the staff and they were given the opportunity to test the different features and provide feedback. Initially there was some confusion and apprehension with using a QWERTY keyboard style phone, especially with navigation, as most of the staff did not owns phones with such keyboards. However, after some minor assistance they were able to use the application.

Some of the comments recorded include:

- "Oh it's lovely. I think it's divine."
- "It's nice, I like it a lot. It's very simple."
- "It's intuitive."
- "There's nothing scary about this."

During this time some minor bugs were identified. These included: a UI element that flickered during navigation; an instance where the users had to click twice before they could scroll down the view; the date field being text and thus being error prone; the category section not working correctly; and a missing prompt in the repayments section. These bugs were dealt with during the final development of the application.

Suggestions were also made to better clarify certain aspects and improve the comprehension and impact of particular features. These included terminology concerns, such as the recommended change of the word 'move' to 'transfer' in the money section; improvements in user experience – such as using green for adding savings and red for removing savings – and prompts to confirm the movement of money after it is entered; and a feature addition of a detailed breakdown of all the money moved in the bank, wallet and savings sections that would reflect the user's bank statement. These suggestions were taken into account during the application's final development iteration, but some were excluded after discovering that they did not align with the changes to the course material – for example the removal of bank and wallet tracking – as described in the following section.

Some time was spent discussing the final feature that had not yet been developed – the reports section. Included in this was the need for the application to be able to export the data in a way that mirrored the paper style of recordkeeping currently in use. This was required, particularly for the trial, in order for the users to be able to return to their old way of recordkeeping if they wished at the conclusion of the study, without losing any business records. It was subsequently decided that the data would be saved to the phone's memory card in .CSV format, as the phone was not able to support PDF writing. These files would then need to be printed from the memory card, via the NGO's computer lab.

Overall, the leadership team was satisfied with the application's design and development. They indicated that it aligned with the training material and would benefit the students in managing their finances efficiently. Approval was given for the final version of the application to be developed and a plan was put into place for the final evaluation of the application in a pilot trial, as discussed in Chapter 6.

## 5.6 Additional Changes Before Trial

During the course of this research study, the NGO was evolving their training material. Initially it was believed that a group who were familiar with the older teaching material would be available to evaluate the final prototype, however this was not feasible at the time of the field study. Thus, the course material changes needed to be factored in to the application's design in order for it to be usable by the group of participants. These changes were decided on during a meeting between the researcher and two of the staff mentors who had close contact with the identified possible student participants for the trial.

### 5.6.1 Motivation for Changes

At the beginning of 2015 the NGO implemented a new recordkeeping system that was a simplification of their previous model, removing some tracking that they had found to have little benefit. For example, the new system did not track whether the money came or went from the user's bank or wallet. They also removed some aspects of double entry accounting practice that had previously been included. They streamlined the process, focusing on a cash flow report rather than profit and loss, as they found that their students were better able to relate to the totals that these reports generated. The primary changes and their motivation are discussed below.

#### *5.6.1.1 Cash flow as opposed to income statement*

The NGO's initial focus was to teach the principle of not selling on credit, but the reality was that their students were continuing to have a high proportion of credit sales that led to many businesses not being sustainable after a few months. Thus, the recordkeeping approach needed to be altered in order to highlight the negative effect of credit sales on business. The previous approach focused on an Income Statement using accrual, resulting in the students reporting sales money that had not been (and may never be) collected, and seeing an unrealistic healthy profit at the end of the month. Thus, a cash flow approach was taken, where the students only reflected on their business's growth in terms of actual money received during that month. This would give them a better idea of the expenses that they could afford for the coming month.

#### *5.6.1.2 Omit bank, wallet and savings columns*

In order to reduce the complexity of the recordkeeping process, the bank, wallet and savings columns were removed from the income and expenses sheets. The reason for removing the double entry was because of the learning barrier in understanding which columns should include positive and negative values and the totalling of these values. Following from this, the tracking of money movements was also removed, as it was felt that these could be adequately monitored via their bank statements. Below are three visual comparisons between the old and new methods of recordkeeping.

Figure 5.8 shows the old approach to tracking business expenses. In contrast, Figure 5.9 shows the new approach. The bank and wallet columns are removed, simplifying the need to monitor where the money was paid from and effectively removing the double-entry system. The reference column was also removed, as it was found that this served little purpose and the description column could be used for any required references.

| MONTH: January | | | WALLET In (+) Out (-) | BANK In (+) Out (-) | Business Expenses How did I spend money? | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Ref | Date | Description | R | R | Cost of Stock (TCB Invoices) | Consumables | Transport | Bank charges | Other |
| | 2 Jan | Taxi fare to TCB | -15 | | | | -15 | | |

**Figure 5.8. Old system of recording businesses expenses**

| | | How did I spend money? | | | | | |
|---|---|---|---|---|---|---|---|
| Date | Description | COST of STOCK (bought from TCB) | COST of STOCK (bought from other sources, including TCB Trading) | Consumables (plastic bags, price stickers etc) | Business Transport | Bank charges | OTHER Business Expenses |
| | | | | | | | |
| | | | | | | | |

**Figure 5.9. New system of recording businesses expenses**

Similar to the changes in the business expense sheet, the old system for personal expenses (shown in Figure 5.10) was simplified into that shown in Figure 5.11, by removing the bank and wallet tracking. In addition, savings and policies were moved into this section, even though they are not traditionally expenses. However, it was felt that they reflected personal money used which was not readily at hand, and fit better with personal expenses than the alternatives.

| MONTH: | | WALLET In (+)/ Out (-) | BANK In (+)/ Out (-) | Personal Expenses How did I spend money? | | | | |
|---|---|---|---|---|---|---|---|---|
| Date | Description | R | R | Food and Household | Rent | Transport | Electricity | Airtime |
| 2 Jan | Airtime purchase | | -100 | | | | | -100 |

**Figure 5.10. Old system of recording personal expenses (abridged)**

| Date | Description | Personal Expenses | | | | | | | | | | | Policies and Savings | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Food & Household | Rent/Rates /Bond | Personal Transport | Electricity/Gas /Paraffin | Airtime | Entertainment | Personal Care (doctor bills, medicine, beauty or hair treatments) | Education Creche, school, college fees; school books & stationery; school uniform | Personal Clothing | Debt Repayments (paying off loans & store accounts) | OTHER Personal Expenses | POLICIES - [illegible] | SAVINGS - [illegible] |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

**Figure 5.11. New system of recording personal expenses**

Sales income was also streamlined, removing the reference, bank and wallet columns and simplifying the money owed concepts. Personal debt was removed entirely, and the focus was shifted to a division of money that was received during the sale, after the sale (cash collections) and the amount still to be collected (credit sales). The handling of other income did not change. These changes can be compared in Figure 5.12 and Figure 5.13.

| | | | WALLET | BANK | DEBTORS | CREDITORS | INCOME - How did I make money? | |
|---|---|---|---|---|---|---|---|---|
| Ref | Date | Description | In (+) Out (-) | In (+) Out (-) | Who Owes Me? (+) Who paid Me? (-) | Who do I owe? (-) Who did I pay? (+) | Sales | Other |
| | 4 Jan | Lay-bye sale – Mrs Brom | 100 | | 500 | | 600 | |

**Figure 5.12. Old system of recording income**

| | | SALES | | | |
|---|---|---|---|---|---|
| Date | Description | CASH SALES - Amount customer pays you in cash or by EFT | CREDIT SALES - Amount customer still owes you (includes lay-bys) | CASH COLLECTIONS- Amount customer repays you for goods previously bought on credit/ lay-by | OTHER INCOME - Social grants; Maintenance payments etc. |
| | | | | | |
| | | | | | |
| | | | | | |

**Figure 5.13. New system of recording income**

### 5.6.2 Clarification of Changes

A meeting was held between the researcher and a member of the leadership team, during which the changes to the recordkeeping approach were discussed. It was decided the application would need to be adapted to reflect the latest recordkeeping system in order to be the most relevant to the NGO going forwards. Furthermore, since the NGO had observed that the students were managing the new recordkeeping system with less difficulty, it would be more beneficial for the NGO if the application represented their most evolved recordkeeping system rather than one that they had discovered did not suit the needs of the students as well.

In order to determine exactly what changes needed to be made for the application to conform to the new recordkeeping approach, a meeting was scheduled between the researcher and two of the NGO's mentors, who directly interact with the students regularly and closely monitor their recordkeeping. At this meeting the mentors walked through the application and discussed possible changes that could be made. Some of the obvious changes had already been made by the researcher in light of the high level changes that had been pointed out previously, such as removing the bank/wallet prompts. The additional changes primarily affected the frontend, involving the movement of a few features and renaming of others. The list of changes are discussed below and a detailed description of the final application is given in Section 5.7.

### 5.6.3 Summarised List of Changes

The first change was to the layout of the main menu. Instead of separating out the distinction between different type of transaction, the focus was shifted to separating money coming in to the user and money going out from the user. The money section that contained the details of the bank, wallet and savings was removed, as it would no longer be tracked. The money owed section remained as a point of reference and credit tracking, but the users would be able to track money paid to them from a customer in the money in section too. The reports section would also remain as a menu item, but its contents would be altered to reflect the new paper reporting approach. The concept of cash up was removed from the application, as it made little sense with the removal of tracking from where money was coming and going.

The money in section was required to include sales income, cash collections and other income; while the money out section would include business expenses and personal expenses. The concept of 'total amount' and 'deposit' were replaced with 'cash amount' and 'credit amount'. Policies and savings would be added in as a category within personal expenses. Within the sales income section, the users would be asked "Have you received all the money for this sale?" This would take them to either the cash sale or credit sale capturing screen. The money owed screen was altered to only include creditors and not debtors. The reports section was required to show the following summary items with their totals for the selected time period:

- Cash Sales [as Sales Income]
- Cash Collections
- Other Income
- Business Expense
- Personal Expense
- Debt repayment
- Policies
- Savings
- Net Money In/Out [in place of total]
- Cash still owing [total outstanding credit sales]

When the user clicked on any of the summary items, they would be taken to a detailed list of all the entries that were incorporated in the total, including the ability to edit or delete individual entries. A final feature was required to be included – the ability for the user to enter an opening balance for existing customers who owed them money.

### 5.6.4 Design Confirmation Meeting

Once the required changes and additions had been made, a meeting was held between the researcher, a mentor (a staff member) and two peer-mentors (advanced students). The purpose of the meeting was to examine the changes that had been made since the previous meeting with the mentors and to get the peer-mentors' opinions of the application for the first time. In addition, peer-mentors provided inputs on an appropriate way to introduce the application to the users and made suggestions around what incentives would be most suitable to motivate the trial participants to use the app. The application was approved without any required changes and the peer-mentors agreed that it would be beneficial for the students to take part in the trial. An amount of R250 (~$20) or the choice to keep the trial phone was concluded as a reward for participating in the trial. This was later increased to R300 (~$25).

## 5.7 Final Application Description

In this section, the final application is described in detail, explaining each feature and the flow of information in turn. The application is 631 kilobytes in size and was placed on the trial phones in the phone's main menu, for easy access. Once opened, the app's main menu is displayed, containing the four main sub-sections, as show in Figure 5.14 below. They are: money in, money out, money owed and reports, each described in turn in the following four sections. The menu screen further contains an options button, containing general settings, backups and a help section.

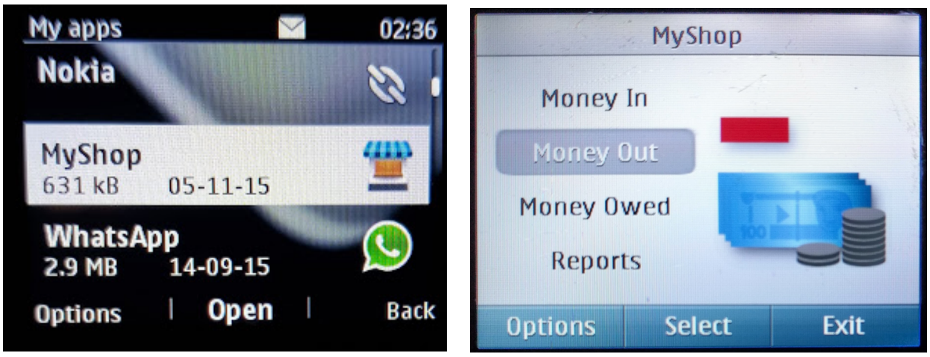



**Figure 5.14. The MyShop application and main menu screen**

## 5.7.1 Money In

The money in section is where the user captures all the money that they receive. This is broken down into sales income, cash collections and other income, as shown in Figure 5.15 below.


**Figure 5.15. The money in menu screen**

### *5.7.1.1 Sales Income Flow*

The first action within the money in section is the ability to capture sales income. Herein the user is first asked if they have received all the money for this sale. If they click 'yes', they are taken to a sales income screen which contains place for the customer's name, a description of the sale, the cash amount received and the transaction date. The transaction date is automatically filled with the current date, which the user can change if need be. This can be seen in the second screen of the flow below in Figure 5.16. When complete, the user can click 'save', where a dialog is displayed summarising the entered values for confirmation.

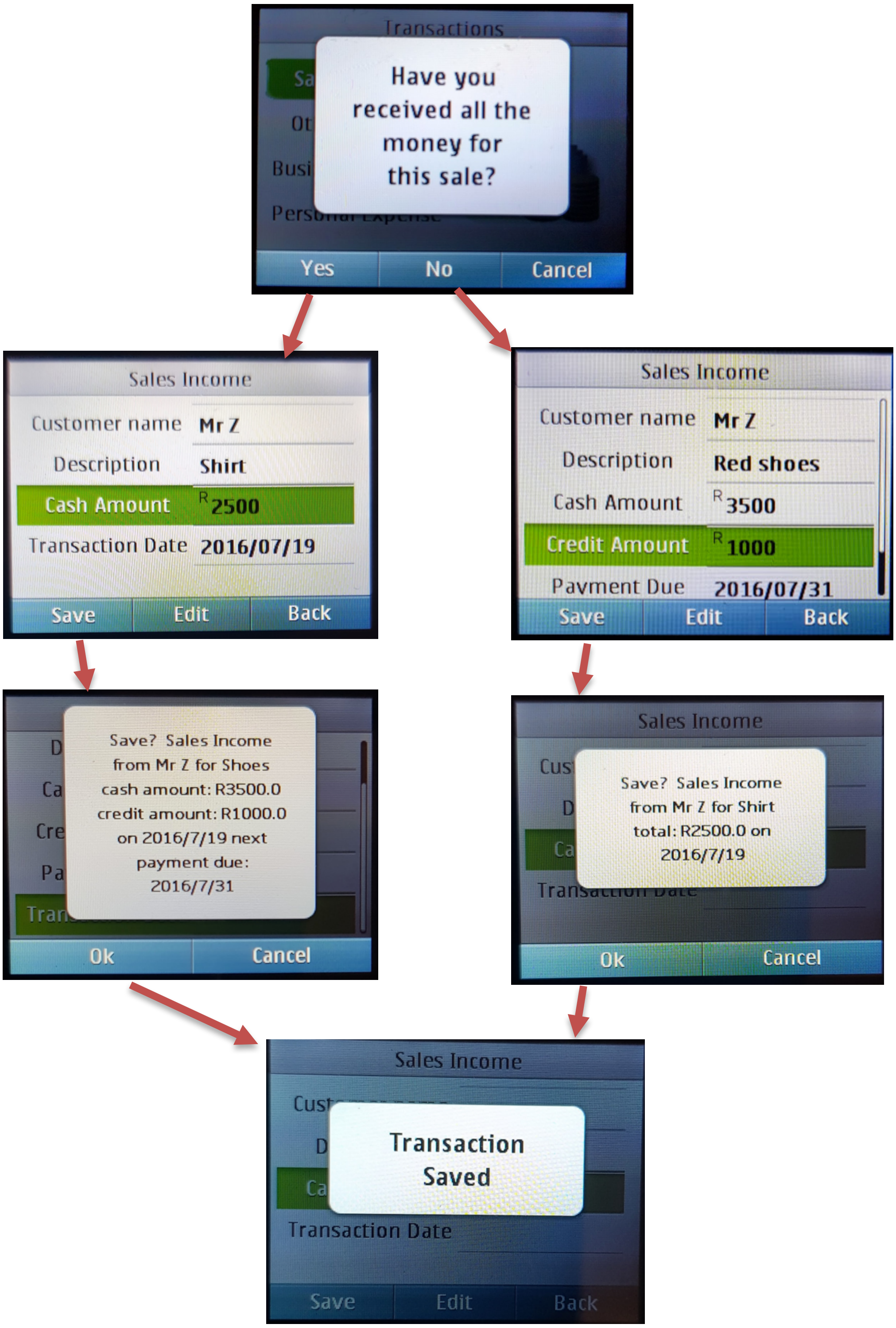



**Figure 5.16. The Sales Income flow**

If the user indicates that they had not received all the money for the sale in question, they are taken to a slightly altered sales income screen, shown in the first screen of the second row of Figure 5.16. Herein the user is prompted to enter the credit amount still owed by the customer and the date on which the repayment of the balance is due. Upon clicking 'save', a similar confirmation summary dialog is displayed. Once saved successfully, both types of sales income display a temporary 'transaction saved' popup.

#### 5.7.1.2 Cash Collection Flow

The second action under the money in section is cash collection. Herein the user can capture any money paid to them by debtors from sales made on credit, including the customer's name, the amount paid, the date the payment was made and the date the next transaction is due. If the user enters the flow from the money in section, they are required to fill in the customer's name correctly, according to their previous interactions with this customer. The application then uses this name to look up any existing transactions and update the amount still outstanding, if any. However, if they enter this flow via the money owed section (see Section 5.7.3), the customer's name is prefilled.

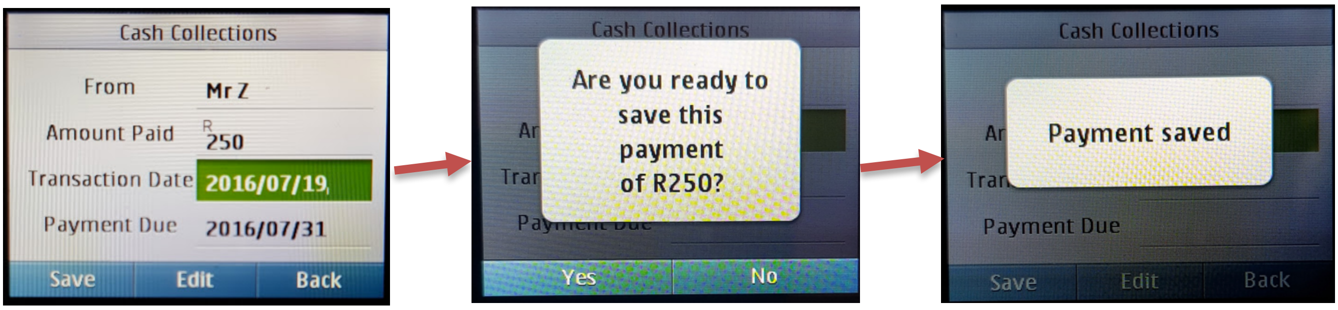



**Figure 5.17. The Cash Collection flow**

#### 5.7.1.3 Other Income Flow

The final action in the money in section is the ability to record income received from sources other than sales income. There is no limit to what this can include, but example use-cases include social grants and child support. Similar to the sales income flow, the user is prompted to enter who the money came from, a description of what it was for, the amount received and the date on which the transaction occurred. In contrast to the sales income flow, however, this section does not allow the user to track money that is owed to them from other sources.

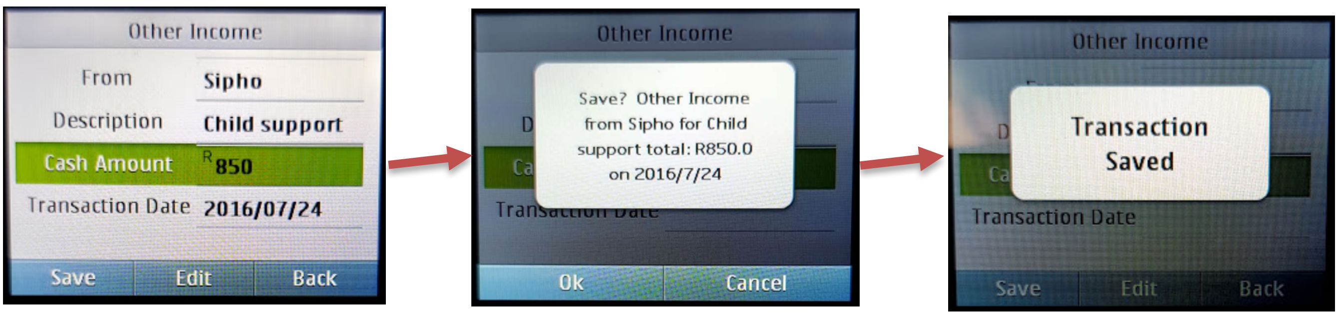



**Figure 5.18. The Other Income flow**

## 5.7.2 Money Out

The second section in the main menu screen is money owed, wherein the user is able to track business and personal expenses that they incur. The menu screen, where the user can select the type of expense that they wish to enter is shown below in Figure 5.19.

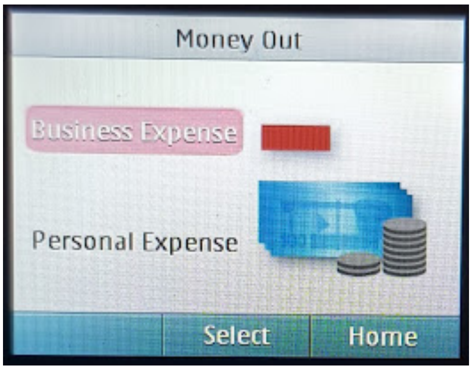



**Figure 5.19. The Money Out options**

The business and personal expense flows are very similar, differing only in the categories that they include. The business expense flow is shown in Figure 5.20. Similar to the income flows, the user is asked to enter to whom the money was paid, the amount paid (cash only), and the transaction date. The main difference here is that the user is required to select the category under which the expense falls, instead of providing a description. The list of categories is the only difference for personal and business expenses, and directly follows the columns used in the NGO's paper based system. If required, the user can click 'options' while the category list is displayed and they are given the choice to add, edit or delete categories to better suit their business needs.


**Figure 5.20. The Business Expense flow**

## 5.7.3 Money Owed

The money owed section is third in the main menu, showing the user a list of all their customers who currently owe them money. The flow, as shown in Figure 5.21, is the most complex of the application, and the one in which the most bugs were prevalent.

If the user selects an outstanding amount, they are displayed a screen that shows a breakdown of all credit interactions with this customer. Negative amounts are used to show payment made and positive amounts represent credit sales. The user can see the date on which each transaction occurred and, via the options menu, edit or delete any, as needed. Also via the options menu, the user can click 'Add', a shortcut that takes them to a new credit sales income flow (see Section 5.7.1.1) with the user's name prefilled. From the customer payment history screen, the user can also click 'Receive', which takes them to a new cash collection flow described, as described in Section 5.7.1.2.


**Figure 5.21. The Money Owed flow**

Also available from the money owed summary screen is an options menu with six: overdue, hide zeros, refresh, new, delete, delete all. The hide zeroes, refresh, delete and delete all options were added during the trial period to address some of the issues and suggestion identified by the participants.

The first option is ‘overdue’, which provides the user with a summary list of the customers who have outstanding payments. The user is also able to clean up the summary screen by hiding all the customers who have finished their repayments, via the ‘hide zeroes’ option. The ‘refresh’ option recalculates all payment balances; in case the user has edited transactions that are not reflecting correctly. ‘New’ allows them to load a customer, into the money owed section, who already has a positive credit balance.

Finally, the ability to ‘delete’ one customer and ‘delete all’ gives the user the ability to clean up the money owed screen if the application is struggling with memory or if they want a clean start. This does not delete the transaction from the reporting section for the period in question, but only removes them from the money owed list. Clicking ‘refresh’ will once again display and update all customers, recalculating their totals.

### 5.7.4 Reports

The reports section, displayed in Figure 5.22 below, gives a cash flow summarised overview of the user’s money. Structured to mirror that NGO’s paper-based recordkeeping system, it displays summative values for the current period’s sales income, cash collections, other income, business expenses, personal expenses, debt repayments, policies and savings, followed by the net money at that point. The user is able to change the period for which the data is summarized by clicking on ‘Calendar’ and selecting the day, week, month or year about which they are interested.


**Figure 5.22. Cash flow report summary**

Upon selecting any of the summative cash flow values, the user is able to see the transactions which make up the total. In Figure 5.23 below, an example is shown of the sales income, cash collections and business expenses for the report displayed above. In the case of business and personal expenses, summarized values are shown for each of the categories. Once selected, the expenses that make up the total in question are displayed. If any of the transactions are selected, they open the relevant flow via which they were created, with all the values filled in. This allows the user to see all the transaction details and to edit them if required.

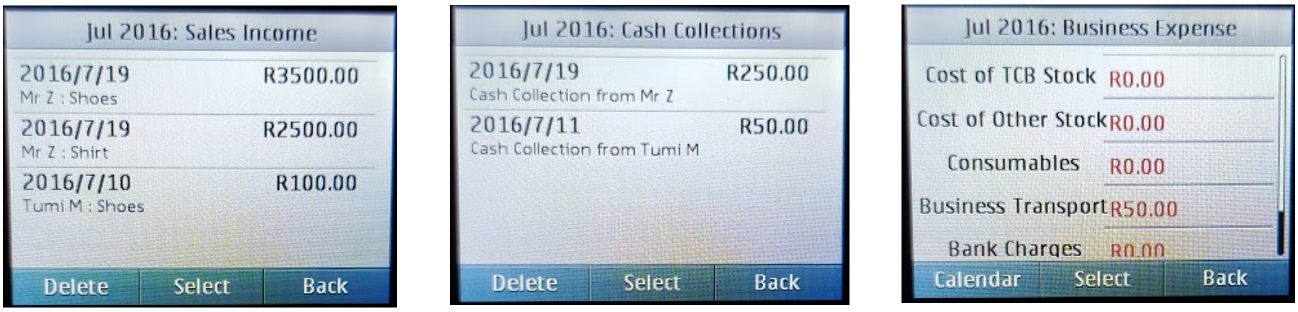



**Figure 5.23. The cash flow report details**

## 5.7.5 Main Options

In addition to the main capturing and reporting features discussed in the previous sections, the main menu also includes an options button, which allows the user to edit the general and password settings for the application, manage backups, learn how to use the application and see the details about the application's developer and version number. The list of options is displayed in Figure 5.24.

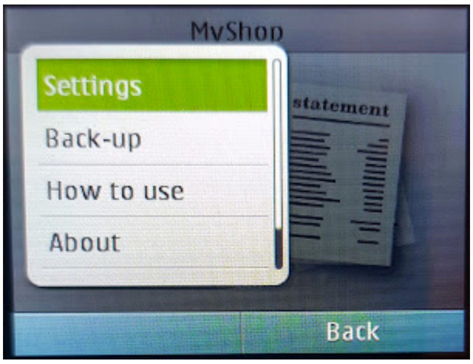



**Figure 5.24. The main options menu**

### *5.7.5.1 Settings*

Under settings, the user is able to customise the name of their business, change currency and language used in the application, as well as enable or disable password protection. These features are shown below in Figure 5.25.

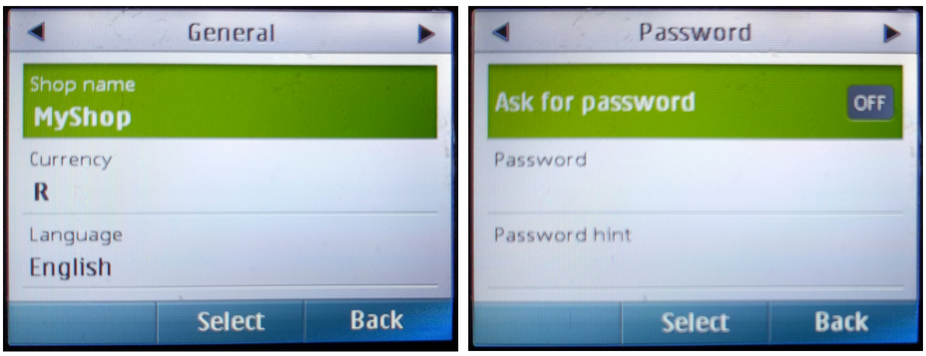



**Figure 5.25. The general and password settings**

#### 5.7.5.2 Backup

Also included in the options menu is the ability to manage the application's backups. The user can set a backup schedule, which prompts the user to do a backup weekly or monthly. They are able to trigger a backup of their current records to the phone's memory card and restore to a previous backup version if required. These flows are displayed in Figure 5.26 below.

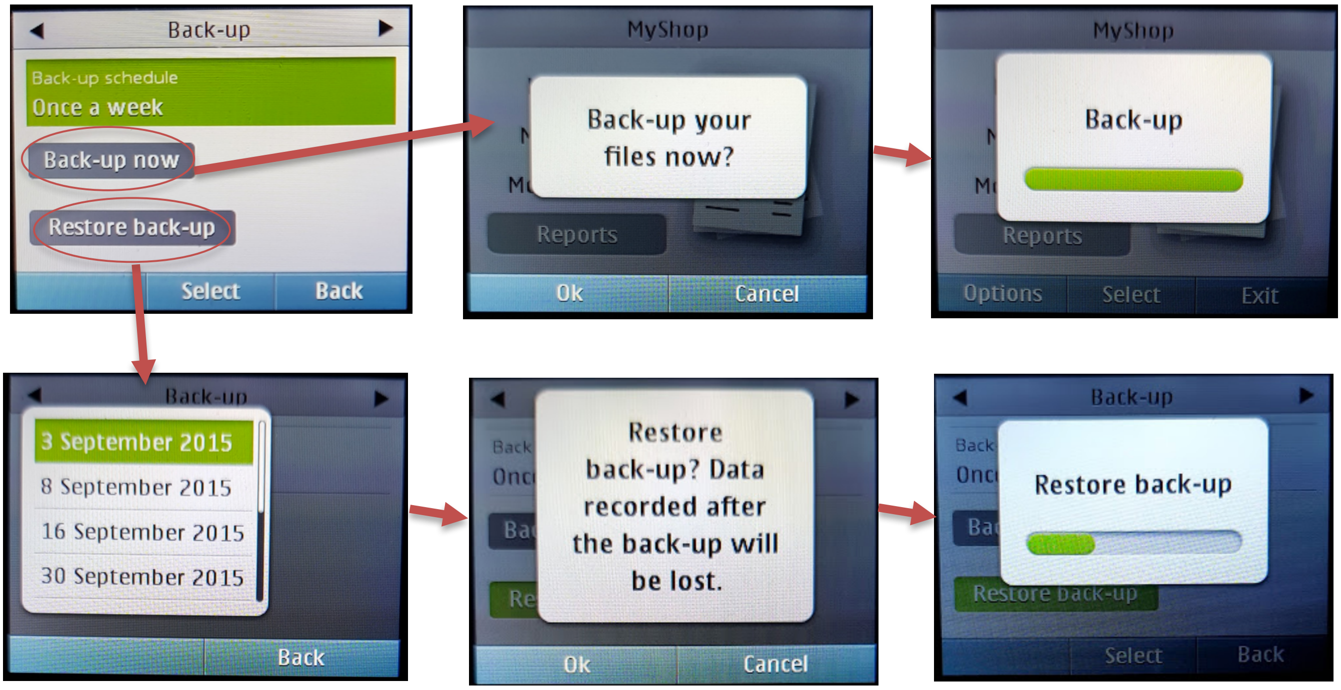



**Figure 5.26. The backup and restore flows**

#### 5.7.5.3 How to use

The 'how to use' option provides the user with a description of each section of the application, from a high level overview of the application's purpose to a detailed description of the key functionality in each section. The descriptions are shown below in Figure 5.27.

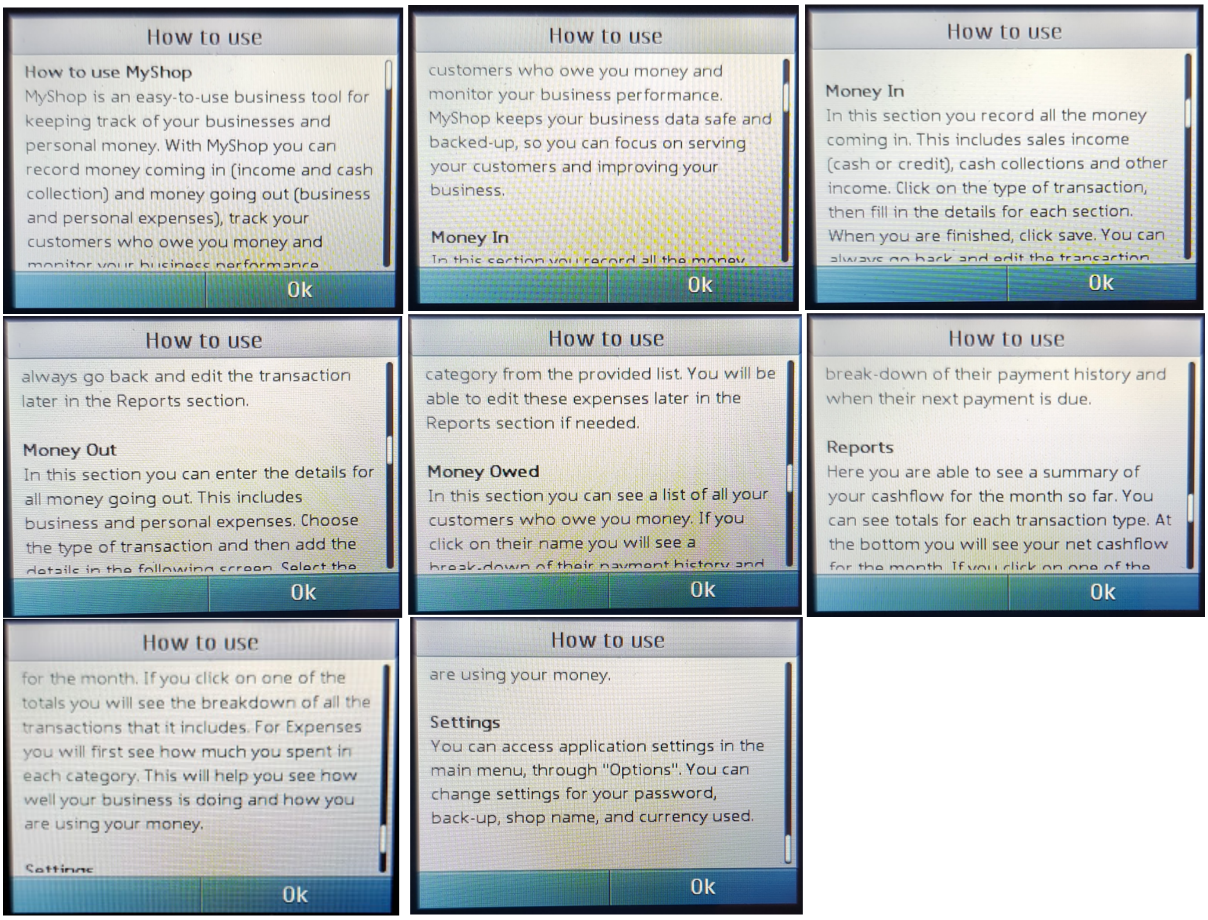



**Figure 5.27. The 'how to use' description**

### *5.7.5.4 About*

The final option from the menu screen is the about dialog, which shows the name of the application, the version number, the copyright owners and developer's email address, as shown in Figure 5.28.

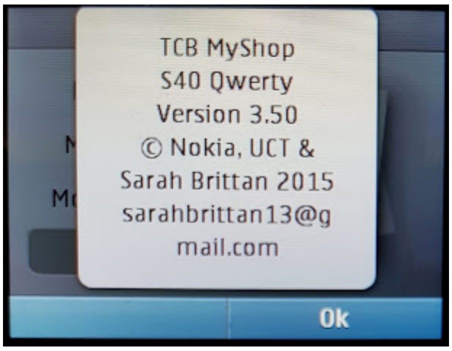



**Figure 5.28. The about application dialog**

## 5.8 Discussion of Multiple-Stakeholder Participation

During the high-fidelity phase, all the stakeholder groups were represented, with each sub-groups having an active role to play. In this section we discuss the forms and influences on the participation of each group, the power dynamics observed, the effect of external factors and the impact that multiple-stakeholder involvement had on this phase and the rest of the design process.

### 5.8.1 Contrasting Involvement of Participants

The leadership team, mentors and students all partook in this phase of the design process at different times. The leadership team participated in one meeting, receiving feedback from the user evaluations and had an opportunity to run through the application's features and give feedback. Their identification of bugs that caused the app to crash suggests that the user evaluations may not have been exhaustive enough, or that the student did not have enough freedom to interact with the app fully. The user evaluations focused around a prescribed list of tasks that guided the participants' interactions with the system. In contrast, the staff were given uninhibited use of the application, leading to their identification of additional bugs. Furthermore, the staff provided a number of suggestions that were not mentioned by the student participants. These point to their greater level of expertise with mobile phones and their more advanced understanding of recordkeeping.

The mentors were included for the first time as active participants during the curriculum adjustment meeting where the app was examined and required changes were determined. They were included at the leadership team's urging because they mentored the groups that used the new recordkeeping system, and thus had a better grasp of its specifics than those in the leadership team. While expressing that they should have been included earlier in the design process, the mentors were able to confirm that the core features of the app adequately aligned with the requirements. Their participation also involved their initiative to include the peer-mentors in the approval meeting and their agreement to allow and encourage their students to participate in the ensuing trial. As such, the mentor's inclusion was very valuable, highlighting the benefit that might have been gained if they had been involved earlier.

The students were involved during the high-fidelity user evaluations. They attempted a list of prescribed tasks using the app, while thinking aloud with their partner. At the end, they gave feedback and suggestions for the application. These participants were the best possible test users, as they were representative end-users. They knew the same amount of recordkeeping that the intended users would. They had a specific level of technology exposure that influences their interactions with the app that could not be tested as effectively by other stakeholder groups. The feedback that they gave provided significant influence on the design of the application, particularly from a usability perspective, between the high-fidelity and evaluation phases. Thus their inclusion in this phase as evaluators of the app's usability was crucial. In combination with the feedback gained from the leadership team and mentors, the inclusion of the different stakeholder groups' perspectives in this stage of the design process was beneficial to the quality of the final application.

### 5.8.2 Observed Power Dynamics

The dynamics between the students and researcher were somewhat similar to the previous phase, differing in the level of ease that the students and researcher interacted. During the evaluation sessions, the participants appeared less comfortable with the researcher than the participants in the focus groups had been. This could be due to the use of the words 'evaluation' and 'tasks' which made it feel like they were being tested. The researcher verbally reassured the participants both at the beginning and over the course of the session that they were helping her test the app, and that they were not being evaluated. However, this appeared to only partially alleviate their discomfort and is evident in the Pressure/Tension score being the lowest of the IMI factors, as seen in Section 5.4. Further investigation of how this could have been better managed is needed for subsequent research that includes users from this context in usability evaluations.

A staff member was involved in helping the researcher recruit participants for the high-fidelity evaluations. However, she was not one who had participated in the project at any earlier phase, and thus left the explanation of the purposes of the study and what their participation would involve to the researcher. In learning from the recruiting of an unwilling participant for the focus groups, the researcher made an effort to ensure that the students understood that their participation was entirely optional and that they were free to withdraw at any point if they felt uncomfortable. None who agreed to participate chose to withdraw. This shows that the change in recruitment process was more successful than the previous phase in attracting willing participants.

### 5.8.3 Impact of External Factors

Significant external factors during this phase were the NGO's evolution of the course curriculum and the turnover of students, resulting in adjustments being needed and additional meetings required. This necessitated an extension in the timeline of the project. Personal and professional circumstances led the researcher to have less time to dedicate to the research project than initially expected. These factors, and the resultant time away from the NGO, may have given the staff the impression of decreased interest and commitment to the project.

In reflection, there is a need to main regular communication with stakeholders in the design process when situations require a change in the timeline, as it was not adequately managed during this phase of the design process. As these circumstances are not uncommon in academic research, it is necessary for future researchers to put a plan in place to mitigate for possible time away from the stakeholders in order to lessen the negative impact that may ensue.

### 5.8.4 Influence on Design Process

The app's development happened offsite and required a substantial amount of work between the high-fidelity evaluations and the trial. This was because the backend of the features had not previously been developed, as the focus had been solely on the user experience and visualisation of features. It is probable that the staff did not understand the extent of the work still required, as the app appeared to be near completion to them. This shows a danger of using high-fidelity prototypes, as it gives the impression of functionality that is actually not fully developed, resulting in a mismatch of assumption about the effort needed to complete the system by the different stakeholders. It is recommended that the amount of work needed on the system between the high-fidelity and final version be emphasised to stakeholders in future work.

The leadership team's participation in only one activity during this phase resulted in them not being actively involved for an extended period of time between the feedback meeting and the end of the trial. This had a negative effect of breaking momentum and eroding the rapport that had been built between the researcher and staff. Compounding this was the impact of external factors on the researcher. As a result, the staff's attitude towards the project in the evaluation phase was not as enthusiastic as it had previously been. By the time this was recognised, it was not possible to mitigate the effects significantly. The leadership team did, however, agree to participate at the end of the evaluation phase during the staff feedback session. It is thus important for subsequent multi-stakeholder project to identify breaks in participation of a group of participants and look at ways of mitigating the negative effect that this can have.

The effectiveness of the mentors in identifying important changes needed for the app between the user-evaluations and the trial affirms the benefits of their inclusion in the design process. In the following phase they actively managed the students involved in the trial and interacted closely with the researcher. Their inclusion in this phase, while being slightly less positive than it might have been if a relationship had already been established, created a foundation for their participation in the evaluation phase.

## 5.9 Chapter Summary

In this chapter, we discussed the high-fidelity development of the recordkeeping application through a number of iterations with corresponding evaluations. Development commenced with a vertical prototype, focusing on the user interaction of entering transactions. A user evaluation followed, using constructive interaction with a prescribed list of tasks, concluding with a questionnaire using IMI. The results indicated that the users were able to adequately complete the given tasks with minimal training, but felt somewhat stressed while doing so. The participants indicated that they felt the system would be beneficial to use in the future. A second prototype was then developed, expanding the feature set with the insight gained from the first evaluation, followed by a similar evaluation. The results indicated that with more varied tasks to complete across a greater number of features, the users were less confident in their competence using the app, but showed an adequate grasp of the applications' intended use and benefit.

Following the user evaluation, the NGO staff gave input on the application, suggesting some feature refinements and identifying bugs. A number of changes were requested by the staff in ensuing meetings to realign the core features with the recent changes in recordkeeping training material, during which the mentors and peer-mentors participated for the first time. This resulted in the final application that was used in the ensuing field study that is discussed in the following chapter.

The impact of the varied participation of the stakeholder groups resulted in the identification of different bugs and usability issues by each group. The combination of the different activities thus led to aspects being evaluated that might otherwise have been overlooked. The leadership team's lesser involvement in this phase and delays in the project timeline negatively affected the dynamics between the staff and researcher. The inclusion of the mentors was beneficial to the evolution of the app in light of the curriculum changes, and allowed for a relationship to be formed between the mentors and researcher that positively impacted the evaluation phase.

# 6. Field Study and Final Evaluation

The app designed in the duration of this research was evaluated in a one-month field trial at the NGO. Twenty-one student participants used the app in their daily lives, using it for their recordkeeping and financial tracking. This chapter discusses the details of how the participants were selected, the training that they received, the usage and behaviour findings and the final evaluation of this study with the participants and NGO staff. It concludes with a discussion on the effectiveness of how the different stakeholders were including during the whole design process.

## 6.1 Selection of Participants

The selection of participants was done from a subset of the NGO's students who had started the training program at the beginning of that year, which was 2015. As the approach taught for recordkeeping at the NGO had changed since the commencement of the research, the app had been adapted to adhere to the latest requirements, as discussed in Section 5.6. Thus, the participants needed to come from groups who had learnt the new approach, rather than the old approach. There were two groups that met this qualification for inclusion in the study. Each group had between 20 and 25 students. A demonstration of how the app worked was given to each of the two selected groups and the students were given an opportunity to try it out for approximately 10 minutes. This was either done in pairs or alone, depending on the number of students in the group and availability of phones.

The students were then invited to volunteer to participate in the trial. It was communicated that there were only 20 places in the trial and the final participants would be selected with insight from the mentors and by a lottery if needed. The available funding for purchasing trial phones allowed for 23 phones, one for the developer, 20 for the participants and two backup phones in case of theft, damage or other needs. The students then indicated their interest in participating in the trial to their mentors. 19 of the students did so. In addition, the peer-mentors who work with the two groups were invited to participate in the trial. Of the four peer-mentors invited, three volunteered. The 22 applicants who expressed interest were invited to attend the training session, as it was foreseen that there would be some withdrawals. A list of the candidates' contact numbers was obtained from the NGO's database and the candidates were invited to attend a training session a few days later. After some adjustments, discussed in the following section, 21 participants joined the trial.

### 6.1.1 The Selection Process Findings

The selection process began with the potential participants being introduced to the researcher by their mentor, who remained in the room during the demonstration. There were two different NGO groups who were invited to participate, namely 1501 and 1502. The first group, 1501, had been in training at the NGO for three months longer than the second group. Thus, these students were expected to have a better grasp of recordkeeping and more experience with running a business. The 1501 group was invited first. This session was somewhat disrupted by students arriving late and some of the explanations having to be repeated. The room was quite small, and there were not enough chairs for everyone, so some students had to leave to go and look for chairs, further compounding the distractions.

In addition, all 16 of the students present from 1501 were together in one room. Since there were only 10 demo phones, some of the phones had to be shared between two students. It was not expected that sharing phones would negatively impact the willingness of the students to participate in the trial, as it had worked successfully in the high-fidelity prototype evaluations. However, it is possible that some of the students did not have as much exposure to the app as others, because it was not possible to monitor a fair sharing of the phones, which able to be done in the high-fidelity evaluations. The mentor for 1501 facilitated the sign-up process for her group. Towards the end of the demonstration, while the students were trying out the app, a piece of paper was passed around the room where the students could sign-up if they were interested in being part of the trial. Six students signed up.

In contrast, the mentor running the demonstration session for 1502 decided that it would be more suitable to split her group into two so that they would have better exposure to the app. This was done at her discretion and not suggested by the researcher. As a result, each of the students in the two 1502 sessions had access to their own phones during the demonstration. The room was, as a result, less crowed and there were fewer disruptions to the sessions. The mentor encouraged each of the students to participate in the trial if they wanted to, and then proceeded to ask them in turn if they would like to be part of the trial, while she wrote down their names. At this point, the researcher stepped out of the room so as not to bias the process by the ladies feeling embarrassed to say no to the trial in front of her. The result was a much higher number of students indicating their willingness to be part of the trial. In total, thirteen ladies signed up from 1502, more than double the number from 1501.

In the end, three of the six students from 1501 and 12 of the 13 from 1502 who signed up participated in the trial. In addition, three other ladies from 1502 who were not present at the demonstration approached the researcher, saying that they had heard about the trial and wanted also to be part of it. This resulted in fifteen participants from 1502 taking part in the trial. Peer-mentors filled the remaining three spaces in the trial, bringing the total number of participants to 21.

### 6.1.2 Discussion of the Selection Process

There are a number of factors that could have influenced the difference in the number of students who signed up from each group, resulting in more than double the number of interested students in the second group. As there were multiple differences in the way the demonstration and invitation to participate was done between the two groups, it is not possible to say with certainty which factors had the greatest affect, if any. However, it is worth contrasting the differences, as they could provide an indication of what motivated more of the students from the second group to join the trial. These factors may be worth consideration for future research that requires users to be invited to participate in a study via a demonstration.

The 1501 session was a larger group, resulting in a more crowded, noisy and disruptive space. The researcher was not able to assist each person to the same extent that she was able to do in the smaller 1502 session. Due to the higher number of candidates in the 1501 session, the phones had to be shared between two people in some cases, resulting in less direct exposure to the app than in the 1502 sessions. The mentor's attitude towards the trial and level of encouragement for the students to participate in the trial, while being hard to measure, appeared to be more positive in the 1502 groups.

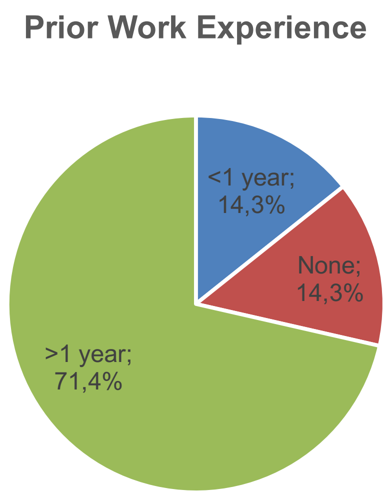
In addition, the means by which the candidates were invited to participate in the trial was different between the two groups. The 1501 students were given a piece of paper to sign-up on, while the researcher was present in the room. However, since there was no familiarity between the researcher and the 1501 students, it is not expected that the researcher's presence in the room had an effect here. In contrast, in the 1502 sessions the mentor asked each student in turn if she was interested in being part of the trial, while encouraging them that it would be a good learning experience for them. The researcher left the room for this in an attempt not to bias the outcome. The pressure of having to say no in front of their peers, however, might have influenced some to sign-up who might not have otherwise done so. The 1502 mentor agreed that this was probably the case for the one student who did not attend the training, as it was apparent that she was not very comfortable using the phone and was struggling with recordkeeping in general. Furthermore, the mentor's encouragement for them to participate could have aided some in believing that they would benefit from and enjoy being part of the trial. This shows the impact of power dynamics at play between the mentors and students, and the strong influence that the mentors have in their ability to encourage and influence the behaviour of their students.

Finally, there was a difference in the length of time that the two groups had been in training at the NGO. This 1501 group had three months more experience in running a business and were more advanced in their understanding of recordkeeping. The newer 1502 group had learnt recordkeeping more recently and thus it is possible that some were struggling more with the book-based recording process and felt that the phone would make this easier for them. This was supported by later findings in the research (see Section 6.4.2) that revealed that all those in 1501 continued doing their recordkeeping using their books throughout the trial, while many of the 1502 participants opted to rely only on the phone for their recordkeeping during the trial.

### 6.1.3 Participant Profiles

At the start of the ensuing training session that commenced the trial, the participants were given a survey to fill in to gain insight into their personal situations, business experience, mobile phone usage and expertise, among other things. Dimensions of these profiles were tested alongside the evaluation findings to look for possible influencing factors in user behaviour and adoption of the app, discussed later in Section 6.4.2. The questions can be seen in Appendix K. In this section we discuss the key findings from the survey.

The majority of the participants speak isiXhosa as their first language, while two speak Afrikaans as their first language. These are both local South African languages. They all indicated that they were either comfortable (48%) or very comfortable (52%) speaking English. While they were all conversationally proficient in English, many were not fluent, which was apparent in the final evaluations (see Section 6.5.2).



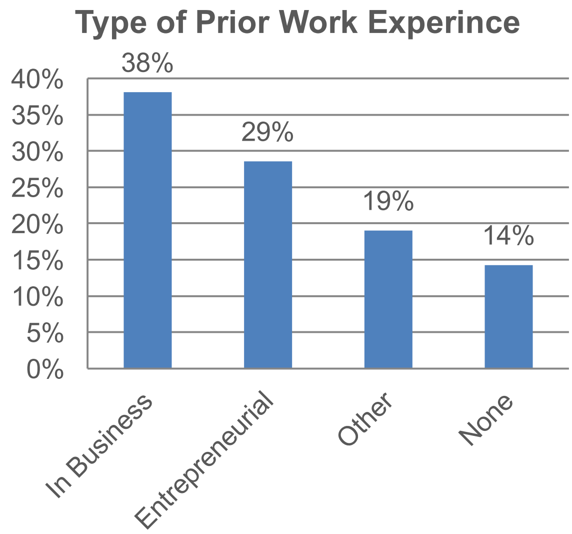




**Figure 6.1. Work experience prior to starting at NGO**

Figure 6.1 above shows that the majority (71,4%) had more than a year's prior business experience, while 14,3% had less than a year's experience and 14,3% indicated that they had no prior business experience before joining the NGO. When asked about the kind of work that they did before coming to the NGO: 38% indicated working within a business, for example as a receptionist or as a sales assistant; 29% said that they were doing entrepreneurial work, such as selling clothes; 19% indicated other types of work, such as cleaning; and 14% had no prior work experience.

Regarding their personal lives, 38% indicated that they were single, 14% were currently living with a partner and 48% were married. They are all mothers, with an average of two children each. The participants live with anywhere from 2 to over 7 people in their households, as seen in Figure 6.2 below.

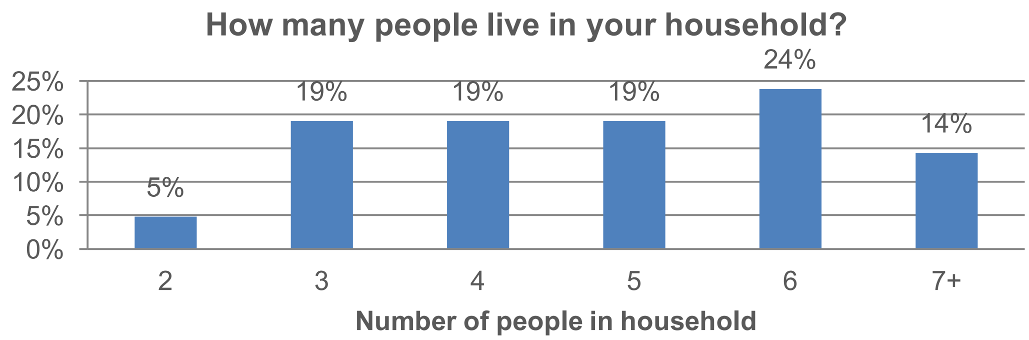



**Figure 6.2. Number of people in household**

Regarding their education level, 95% had completed grade 11, with 67% having completed grade 12, and 24% having done additional training after school, towards diplomas and certificates. This information is represented graphically in the following graph. Figure 6.3 shows the percentage of participants who indicated the given education level as the highest that they had completed.

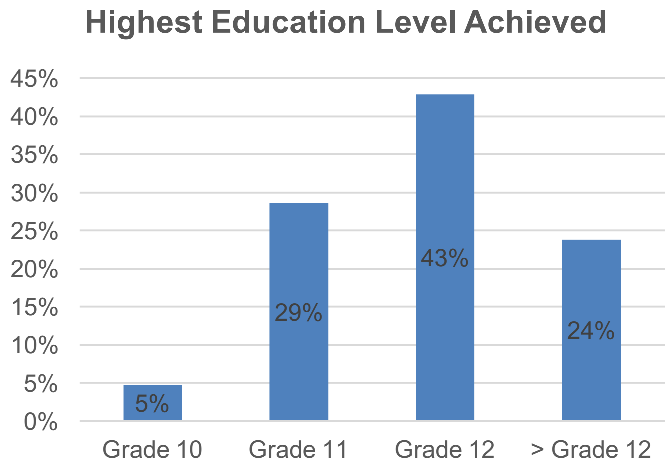



**Figure 6.3. The highest level of education achieved by the participants**

When profiling their phone use at the time (September 2015), the most popular mobile brand was Nokia with 38%, followed by Blackberry with 24%. Samsung accounted for 19%, while the remaining 19% had other brands, including Huawei, Alcatel and Mobicel. The majority (62%) indicated that their phones were not smart phones, while 38% said that their phones were smart phones. This can be seen in Figure 6.4. Interestingly, this did not correlate to the prevalence of touch screen devices. Here, the percentages switched, with 62% having touch screens and 38% not having touch screens. This is due to many of the Nokia feature phones (such as the Asha, Express and X ranges) having touch screens while not being considered smart phones. This is displayed in Figure 6.5.

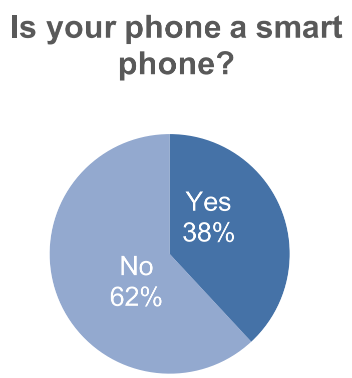



**Figure 6.4. Percent of participants with smart phones**

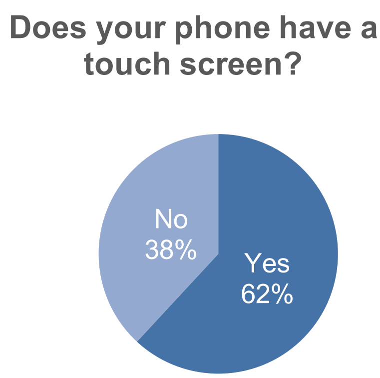



**Figure 6.5. The percentage of participants who had touch screen phones**

## 6.2 Initial Training

Training on how to use the application was given to the participants at the commencement of the trial. The specifics of the structure of the training process and its outcomes are discussed in this section.

### 6.2.1 Training Methodology

Training was done in two sessions, comprising students from each of the two groups in turn. The first group only had three candidates who attended (one peer-mentor and two students) and thus more one-on-one training was possible than with the following group. Nine candidates attended the second training session (one peer-mentor and eight students). Apologies were received from the final peer-mentor and three of the other students.

Those who could not attend the initial training were invited to contact the researcher to set up an alternate training time. This was done with four of the initial candidates the following week, with four new candidates requesting to join. Those who attended the three training sessions filled all 20 participant places in the trial. Two weeks into the trial it was discovered that one of the initial candidates who did not attend the training had not received the training invitation message and requested to join the trial midway. An additional phone was available, so she received private training and was permitted to join the trial.

During the training, the participants were first given a survey to fill in, which included a number of demographic, education, business and mobile phone experience related questions. These were written in collaboration with a researcher from the University of Cape Town's Economics Department in order to profile the participants in the study. The survey questions can be found in Appendix K. The results can be found in Section 6.1.3.

Following the survey, the participants were each given their trial phones and associated number for the study and shown how to find and open the app on their phones. The training then continued through each of the app's features, demonstrating how it worked and allowing the participants a chance to start entering their relevant financial information for the month thus far. This also included capturing all customers who owed them money at the beginning of the month as opening balances. The researcher observed their progress, giving assistance when needed.

At the close of the training session, the attendees were each given an ethical consent form and information sheet about the study, as seen in Appendix L. They were given a chance to read through the information sheet, which outlined the purpose and nature of the study, and asked if they had any questions. They then signed and returned the corresponding consent form, while keeping the information sheet. This concluding the training session.

As a result of different personal situations, some of the participants were not able to complete the training and were encouraged to attend additional one-on-one training sessions over the following days. Some, but not all, made use of this opportunity.

### 6.2.2 Training Findings and Discussion

Due to the various constraints, the amount and depth of training received by the various participants was not equal. The first group was smaller than the second, resulting in more attention being given to each participant. These were the participants who came from the group that had been at the NGO for longer, and thus were more experienced with recordkeeping too. Those four participants who were not able to make the first two sessions attended a later training date and thus also received training in a smaller, more personal setting. The researcher was curious to discover whether the unequal initial training would have a substantial effect on the performance of the users during the course of the study. There was no conclusive evidence to indicate that this was the case. Due to the opportunity for those who were struggling to receive additional ad hoc support during the course of the study, as discussed in the following section, those who wished for more training were able to seek it out.

## 6.3 Ongoing Support and Updates

Ongoing training and support was offered to all participants. The researcher was at the NGO during many of the times that the participants were present, so they could get assistance during breaks and after classes, shopping and mentor sessions. Two WhatsApp groups were formed (mobile social chat application) for the participants and researcher, one for each of 1501 and 1502. They were encouraged to ask questions and get assistance from one another and the researcher. This was used sparingly, with those who desired assistance more often sending the researcher a private message, asking to meet at the NGO instead.

While additional support was offered equally to all participants, some participants made more use of it than others. The reasons for this can only be speculated about, but those who asked for assistance appeared to do so with enthusiasm for the application and a desire to excel at using it. Those who were either fully capable of using it without assistance and those who appeared to have difficulties using the app – or were not outwardly positive about it – were those who did not seek much assistance.

The researcher also visited the participants informally during their various activities at the NGO and enquired about their experiences using the app. When difficulties were raised, support was provided and additional demonstrations and training were given. This was not done uniformly, but was offered on an as-needed basis to everyone.

During the study the researcher attempted to check the logs and data on each of the user's phones weekly. This was not always possible, but every effort was made to gain regular insights into the adoption of the app. More details on those findings are discussed in the following section. However, when it was observed that a participant was falling behind, incorrectly entering data or experiencing a problem, the researcher took time to seek out those participants and give them input and assistance where possible.

## 6.4 Reponses to and Usage of App

As is common with the rollout of a software prototype, a number of bugs with the app were discovered during the first week, and smaller issues were noted later on. The most serious bug was to do with values entered in the money owed section (see Section 5.7.3 for a description of this feature) that did not correctly update the amounted owed by the customer. This did not affect all users uniformly, as not all users made equal use of credit sales in their businesses. The various issues were dealt with in turn and updated versions of the app were given to the participants when they attended activities at the NGO and submitted their phones for review. The integrity of their data was maintained and the researcher was able to assist in removing accidental duplication where it had occurred. As some participants did not submit their phones, and not all participants attended the NGO on the same day, there were times when all the participants did not have the exact same version of the app. This had the possibility of causing them to not have a uniform experience using the app, specifically regarding the money owed bug. The impact of this bug on the participant's experience with the app is considered in Section 6.4.2.

Progress notes were made during the weekly check-ins of the researcher's impression of their adoption of the application at that point. These are subjective findings, but were influenced by the number of transactions in comparison to other users, the number of duplicate entries and obvious missed information and the kinds of questions asked by the participants. Also included here was the evidence of whether or not they were possibly being affected by bugs in the system. These are discussed further in the following sub-sections.

### 6.4.1 Usage Statistics

Time-stamped logs were stored on the users' phones of their activity on the app, which allowed for a calculation of the number of unique days the application was opened, the amount that they used the app and data that was logged, in case of issues with the report creating. Figure 6.6 below shows the number of unique days that each participant made use of the app during the course of the trial. There is quite a big range between the highest, who made use of the app on 32 days, and the lowest, who only used the app on 2 days. Some of the outliers and what might have influenced these variations is discussed below.

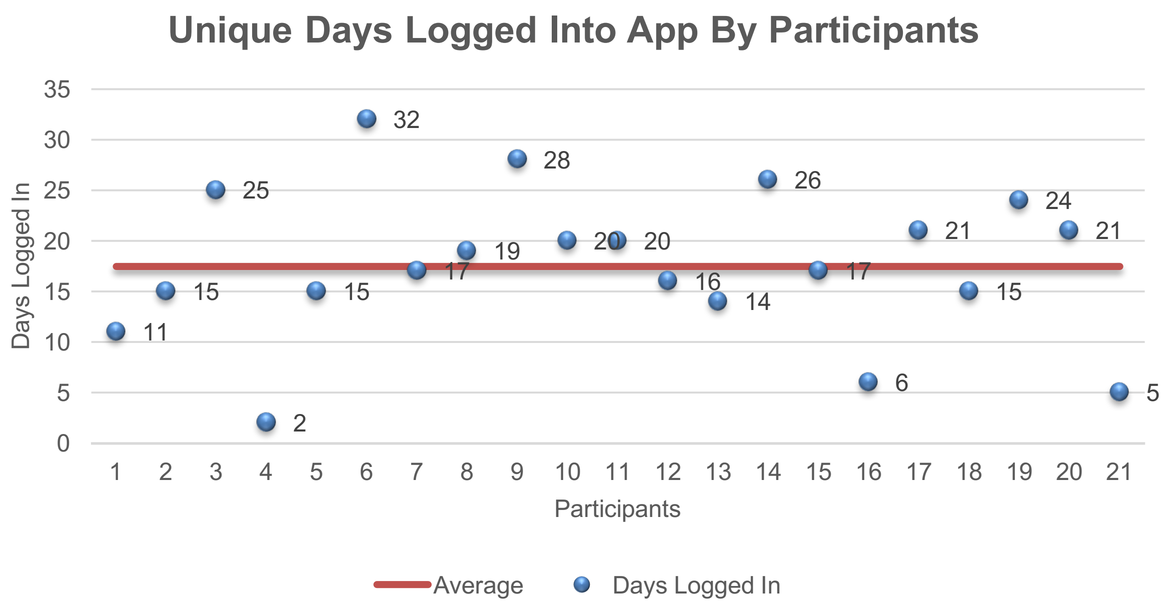



**Figure 6.6. Number of unique days logged into the app by each participant**

Participant number 4 is an interesting case study. She was one of the peer-mentors, encouraged by the mentors to participate in the trial. She did not show visible enthusiasm, and showed signs of joining out of obligation rather than free choice, yet chose to remain rather than withdrawing. She was one of the oldest of the participants and indicated in question 17 of the initial survey that she found her current phone very difficult to use. In addition, she was already very comfortable and accomplished in doing paper-based recordkeeping. This was to the extent that she was sent to Johannesburg for a few days during the trial to represent the NGO as a success story and share her personal journey and her business development through her time with the NGO. This too possibly affected her focus on being involved in the trial and might be a reason for her being such an outlier. It is also noted that the two days represented in Figure 6.6 for participant 4 using the app were days when the researcher checked in with her and asked if she had any questions. If this had not happened, it is possible that she would never have attempted to use the app at all.

Participant number 6 logged in on nearly every day of the trial. She was a participant who showed enthusiasm for the app from the beginning and at every check-in she was marked as having evidence of excellent progress. She was from the 1502 class who had been at the organization for the least amount of time and thus was less used to the paper-based system than the 1501 and peer-mentor participants. From Figure 6.7, below, it can be seen that she was also above average with the number of transactions that she entered in total on the app - a total of 83. Her average number of transactions per day was 2.6. This indicates that she was not necessarily entering a lot of unique transactions every time she used the app, but was possibly using it to enter transactions soon after they happened and checking the app for the state of her business.

In contrast, participant number 18 logged the least number of transactions, as seen in Figure 6.7, but she still used the app on 15 unique days, which was close to the average usage of 17.5 days. In discussions on participant 18's progress with her mentor, it was discovered that she had been quite sick during the trial and had not been able to make as many sales as she usually did. This illustrates that there are personal factors affecting participation in the study that influence the usage and adoption of the system, as well as the design, functionality and training provided. This participant came for a consultation with the researcher, expressing concern that her report section showed a negative cash flow total for the month that far, in red. She said, "Red is bad, right?" and asked for advice on how to improve it. She left with a more positive attitude when she realised that this was an indicator that she had bought a lot of stock that month but had not yet made enough sales or done cash collection from the previous month, due to her illness. She reflected that if she did a big sales push, her numbers would increase by the end of the month. This shows the impact of having summative totals available for the users during the month, rather than only at the end of the month, as had been the case with the paper-base system.

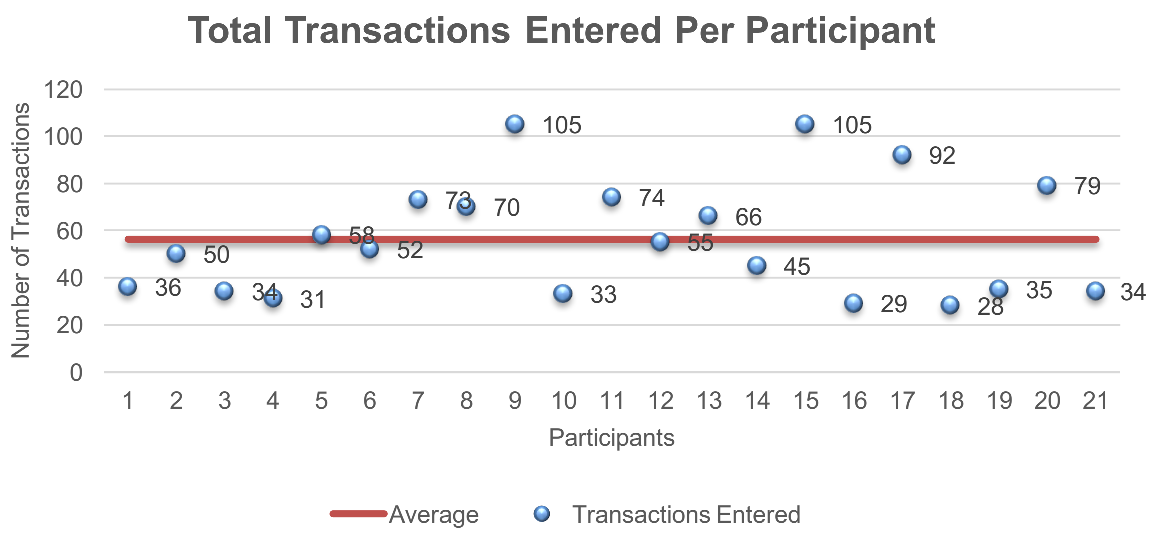



**Figure 6.7. Total number of transaction entered by each participant**

The students buy their stock from the NGO's warehouse. The NGO tracks the monthly stock purchases of each student and uses this value as a benchmark for the student's business progress. This was the only reliable data available that could be used to estimate the accuracy of the data entered on the app. A comparison was made between the amount that the NGO had on record for purchases of business stock from their warehouse and the numbers recorded by the users on their app under the 'TCB stock' category. The measurement was calculated by first subtracting the NGO's total monthly sales record for each participant from the value of 'TCB stock' in their Business Expenses report generated by the app. This difference was then divided by their average recorded TCB stock recording to get the blue bars in Figure 6.8. The red bars were calculated by dividing their recorded difference by the group's average transaction, in case their lack of recordings skewed the data too much. The NGO does not track the purchases of peer-mentors (participants 1, 4 and 12); thus their average discrepancies were not computable.

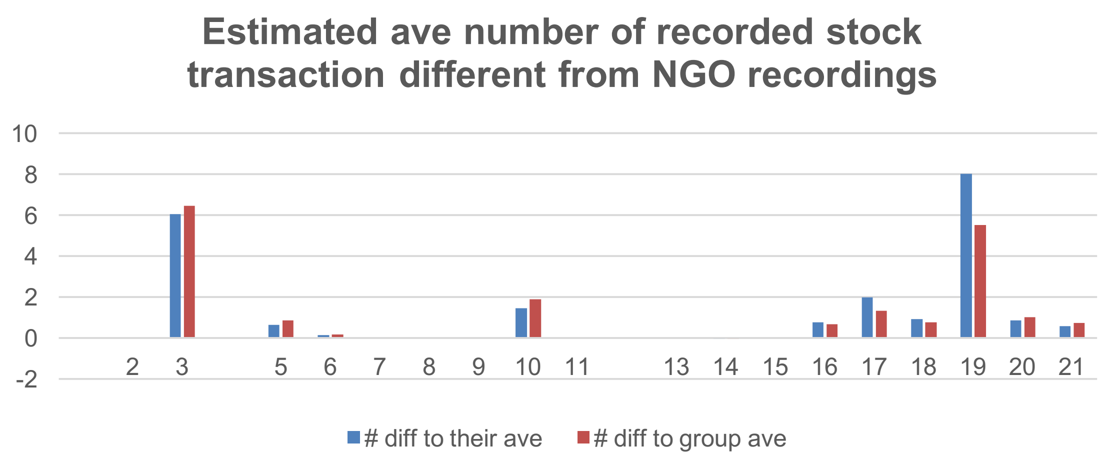



**Figure 6.8. Estimated average number of recorded stock transaction different from NGO recordings**

The results were then categorised into three group groups: ‘accurate,’ where the difference was less than 0.05 average transactions, ‘one transaction out’, where their recorded transactions were within approximately one average transaction difference from the NGO’s recordings, and ‘not accurate’, where the difference was more than one transaction out. The follow graph in Figure 6.9 illustrates these categories. Here it can be seen that from the 18 participants’ data used in the calculations, 45% were accurate with their data entering, 33% were close to being accurate, having missed approximately one transaction, while 22% were more than one transaction out in their records. Combined, this puts 78% of the users within one transaction from the NGO’s values. While this sounds promising, it is hard to say for sure how accurate their other data entering was as the NGO does not track other data that it could be compared to.

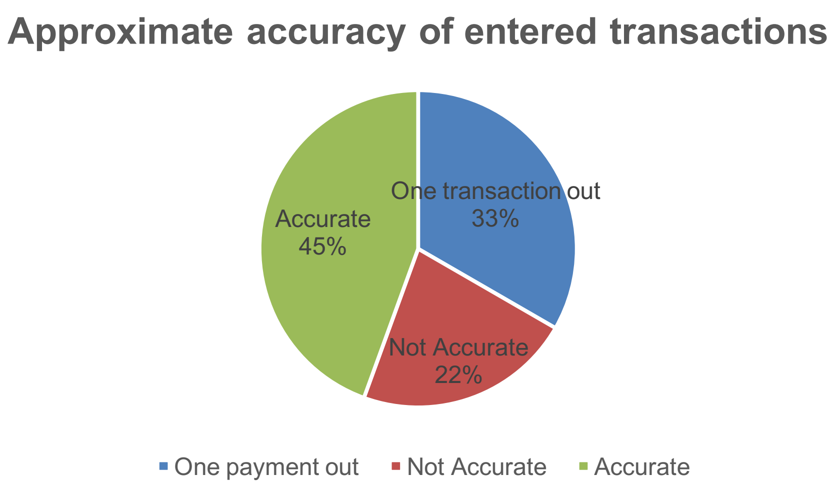



**Figure 6.9. Accuracy Compared to TCB Sales Records for the month, n = 18**

### 6.4.2 Insights from Usage Data

From a combination of the collected data above and further investigations into the possible reason for particular outliers, it was found that personal factors definitely could have played a large role in these participants’ usage of the app. The influence of bugs on the users’ confidence in the app was also a factor that might have influenced the outcomes reported in the previous section. During the trial, the researcher made notes of those who were affected by the money owed bug (see paragraph 1 of Section 6.4 for a description of the issue), and an analysis was done comparing those who encountered the bug and the prevalence of this in the accuracy groupings of Figure 6.9. The peer-mentor participants’ data was excluded from this analysis since they were not included in the accuracy statistics.

It was found that twelve of the eighteen student participants were affected by the money owed bug during the study. 75% of those with accurate estimated expenses experienced the bug, 67% of those who were nearly accurate experienced the bug and 50% of those who were not accurate experienced the bug. Of those twelve who experienced the bug, seven or 58% sought out help from the researcher during the study. Of the six who weren’t affected, only two sought out help. While it would not be logical to assume that the bug positively influenced the accuracy of the users, it might be an indicator of their usage of the system. Those who used the system more extensively were more likely to have accurate expense results and were also more likely to encounter the bug in the money owed section. The data affected by the bug was not included in the accuracy estimate statistic.

When looking at the possible relationship between those who came for help and who scored accurate estimated expenses, it was found that 63% of those who were considered accurate came for help, 50% of those considered nearly accurate came for help and 25% of those not accurate sought out additional help during the course of the study. While the sample size for these groups is too small to prove correlations, it could be inferred that coming for help had a positive effect on accuracy, or that those who took the time to seek help were also more meticulous in their recordkeeping.

In a similar comparison of the accuracy versus total transactions entered, it was found that those who scored in the accurate category had the highest average total number of transactions. They had a combined average of 73.5 total transactions each, while the not accurate and nearly accurate groups had averages of 48.5 and 46.7 respectively. When comparing accuracy with average number of transactions entered per day, those in the accurate group were found to have entered 3.92 per day, while the not accurate group had entered 2.15 transactions per day on average. These two findings further indicate that the greater amount of usage of the app was a factor that possibly correlates with accuracy.

In consideration of other personal factors that might have influenced the accuracy scores, a comparison was made of the accuracy groups and the survey results discussed in Section 6.1.3. This was done by averaging the results for each of the factors, grouped by each of the accuracy levels. No strong association was found between many of the personal factors and the accuracy, for example education level, prior business experience, English proficiency or relationship status. The number of children and number of people living in the household had a moderate association with inaccuracy – where those in the not accurate group averaged 3 children and averaged approximately 6 people in their household, while those in the other groups averaged 1.85 children with 4.5 people per household. The reported ease with which they used their current phones did not appear to have an effect either. However, the type of their previous phone might have contributed, as well as the amount of time that they reported to spend on their phones on average each day before the study, as discussed below.

All of those in the not accurate category reported having touch screen phones before the start of the trial while 67% of the nearly accurate and 50% of the accurate groups had previously been using a touch screen. Of the accurate group, 63% had previously been using a phone with a Qwerty keyboard, while only 17% of nearly accurate and 25% of the not accurate group previously had a Qwerty keyboard phone. This shows a possible relationship between the familiarity of the trial phone, which was a Qwerty, non-touch phone, and the accuracy success of the participants. Another indicator of past phone experience affecting the study was the reported average time spent on their phones before the study. Those who fell into the not accurate group reported an estimated average of 55 minutes spent on their phones per day prior to the study, while those nearly accurate reported 128 minutes and those accurate reported an estimated 135 minutes per day. This indicated that those who were more regular phone users prior to the trial had greater success with respect to accuracy during the trial.

Due to the fact that the peer-mentors' data was not available for the accuracy calculations and because the 1501 group was much smaller than the 1502 group, it is hard to draw conclusions from the different groups' usage behaviour, since the sample size of 1501 is not big enough. However, it was observed that those who relied mainly on using the application ended the study more positive about its benefits over the paper-based system, and those who continued with both, or reverted to only the paper system were less enthusiastic about the application at the trial's conclusion.

Participant number 2 is an interesting case study. While initially maintaining both recordkeeping systems, over the course of the trial it was observed that her enthusiasm for and use of the application faded. The following are possible influences on her changing behaviour. She was from 1501, the group that had been at the NGO longer, and her mentor had indicated that she was very adept at recordkeeping. Initially she showed great enthusiasm for the app and came for multiple one-on-one sessions. These often involved her talking through what she had done, checking that all was correct, and getting assistance with a few minor things that were not working properly. This included recovery from the money owed bug. Her business mentor indicated that during the course of the study she had to deal with some personal matters that arose, which took her attention off her work. Along with the others in the 1501 group and the peer-mentor participants, she continued doing manual recordkeeping for the duration of the study, using the app to compare for accuracy. However, her use of the app waned during the study, ending in her only using the paper recording process.

The findings discussed in this section lead to a reflection of the possible influencing factors that resulted in some users spending more time on the app and finding it more beneficial. It appears that those who successful used the application and reported to find it helpful spent more time using the app than the paper-based system, while those who struggled with the app spent less time using it. The fact that they found the system beneficial might have influenced the amount of time they spent using it. Alternatively, the fact that they used the system more might have resulted in them finding it more beneficial over the course of the trial.

When reflecting on the possible reasons why they might have spent more time using the app and finding it more helpful, their previously confidence with the paper-based recordkeeping system could have been a factor. Those who were confident with the paper-based system might have seen less need to invest time into the app, resulting in both a decreased amount of time using the app and a lower recognition of the app's benefits. In contrast, those who had previously struggled with the old system might have been more motivated to reap the potential benefits that the app offered. This may have resulted in them investing more time in the app and finding it useful in overcoming some of the difficulties that they had experiences with the old recordkeeping system.

## 6.5 Final Participant Survey - SUMI

At the conclusion of the field study, a debriefing session was held for the participants of the study. The NGO contact person, a member of the leadership team was present for this meeting with the researcher, but the other staff members, while invited, were not able to attend. The session was held during an extended lunchbreak for the participants on the day that most of them volunteered at the NGO. Only one participant was not able to attend. The session was communicated as being a feedback session and prize giving, where various awards would be given out and cake would be shared.

### 6.5.1 Methodology

When considering how to measure the effectiveness of the designed application, it was decided that the user experience and usability of the system should be measured. A number of different methods for such evaluation were investigated. The main three contenders, which aligned with the intended purpose of the study were: SUMI, the Software Usability Measurement Inventory [101]; SUS, the System Usability Scale [102].; and Attrakdiff [101], which assesses how users feel about the system they have been using.

The SUS gives a high level overview of a user's subjective usability of a system [103]. One of the factors in favour of using SUS is that it has been used extensively [104] and studies have been done on the effect of slightly altering the traditional questions to make them more accessible to those who are non-native English speakers [104]. The results showed that using synonyms for words that would not be familiar to the respondents, for example replacing 'cumbersome' with 'awkward', did not significantly alter the results [104]. This is something that would be necessary for the users of this study, as their English was not fluent. Upon further inspection it was found that while SUS has strengths that would lend itself well to this study, it was too simple and summative, not allowing enough depth of analysis to be done from only 10 questions. Furthermore, it only focuses on the usability and learnability of the system, ignoring other aspects of user experience [105].

Attrakdiff was another evaluation methodology considered. It provides a subjective analysis of the users' experience using the system [106]. It was first written in German and later translated to English and Swedish for other studies [102]. The initial papers explaining its formation and usage of Attrakdiff are in German [106], making it difficult to research fully. While a paper was found that explained how it was translated into English and subsequently used [99], the language of the questions in the survey were beyond the reach of the study participants and thus it was deemed unsuitable.

It was decided that the most appropriate user experience evaluation methodology for this study was SUMI [107]. In contrast to SUS, SUMI is a lot more in-depth, including 50 internationally standardised questions that can be surmised into five key traits of the user experience of the system, which are broader than just usability [108]. The 50 questions are followed by 5 broader questions, for example "What do you think is the best aspect of this app, and why?", which give additional insight into the users' personal experiences [109]. Altogether, these measure the different facets of the users' attitude towards and their satisfaction level of the system [110] and can identify problem areas in which users struggle [109]. Herein questions are asked in a random order, getting input on the efficiency, affect, helpfulness, control and learnability of the software from the users' experience.

**Efficiency** refers the users' feelings regarding their ability to do the required tasks well with the app. **Affect** measures the degree to which the user finds the system enjoyable and stress-free to use. **Helpfulness** is a measure of how much the users feels the app is able to help and assist with their recordkeeping. **Control** is an indicator of the degree to which the users feels in control while using the app. And finally, **learnability** indicates the degree to which the user feels that they are able to start using the app and easily learn new features [109].

### 6.5.2 Application

In order to use SUMI for this study, an academic licence was obtained and permission was acquired to make a small modification to the questions to make them more understandable to the participants. In particular, Dr J Kirakowski, the creator of SUMI, agreed in an email to the researcher to allow the word ‘software’ to be replaced with ‘app’. In response to the request he said, “I think 'app' would work: people have used words like 'system' and it didn't seem to make any difference to the profiles. So long as the respondents know WHAT it is that the question is referring to. It's the verbal nuances of the effects of the app/system/software on the respondent that need careful handling.”

For each of the questions, the user responds with either agree, undecided or disagree. The full questionnaire given to the participants can be found in Appendix M. Examples of questions included are:

- The app hasn't always done what I was expecting.
- The app presents itself in a very attractive way.
- Either the amount or quality of the help information varies across the app.
- It is relatively easy to move from one part of a task to another.
- It is easy to forget how to do things with this app.

In addition to the standard 55 questions asked, two questions were added at the end of the questionnaire to gain further information specific to this study. They are “Has using the app changed your recordkeeping in any way? If so, how?” and “Have your clients seen you using the app? If so, how did they respond?”.

According to Arh and Blazic [109], the SUMI questionnaire usually takes about ten minutes to complete. However, in the case of this study the participants struggled with understanding some of the questions and needed explanations to answer them accurately, for example they struggled to understand, “The app allows the user to be economic of keystrokes”. Thus the questionnaire took closer to thirty minutes for the average participant in this study.

The SUMI questionnaire was administered at the start of the prize giving ceremony, thus incentivising the participants to complete all the questions. Only one participant was not able to attend, resulting in 20 questionnaires being completed. The findings from the questionnaire are discussed in the following section.

### 6.5.3 Findings

Once the questionnaires were completed, they were captured by the researcher into SUMI’s evaluation program. This program uses the input to compare the results against the average scores in its standardization database [6]. The highest score is 73 and 50 is the mean from the SUMI database, with a normal distribution and a standard deviation of 10. IQR stands for inter-quartile range and represents the range within which the theoretic true score lies for 95% of the users in this study. The results of this study are as follows:

**Table 7. SUMI Summary Statistics**

| | Mean | St Dev | Median | IQR | Minimum | Maximum |
|---|---|---|---|---|---|---|
| **Global** | 62.75 | 6.34 | 64.0 | 10.0 | 50 | 70 |
| **Efficiency** | 57.90 | 10.55 | 55.5 | 12.5 | 31 | 72 |
| **Affect** | 65.35 | 5.70 | 64.0 | 11.0 | 55 | 72 |
| **Helpfulness** | 62.15 | 5.81 | 63.0 | 9.5 | 50 | 70 |
| **Controllability** | 60.40 | 8.57 | 61.0 | 10.0 | 34 | 72 |
| **Learnability** | 64.80 | 5.77 | 66.0 | 8.0 | 52 | 71 |

List of potential outliers in the data:

| **ID** | **Scale** | **Score** |
|---|---|---|
| 19 | Controllability | 34 |
| 20 | Efficiency | 31 |

The results are illustrated visually in the boxplot in Figure 6.10 below.

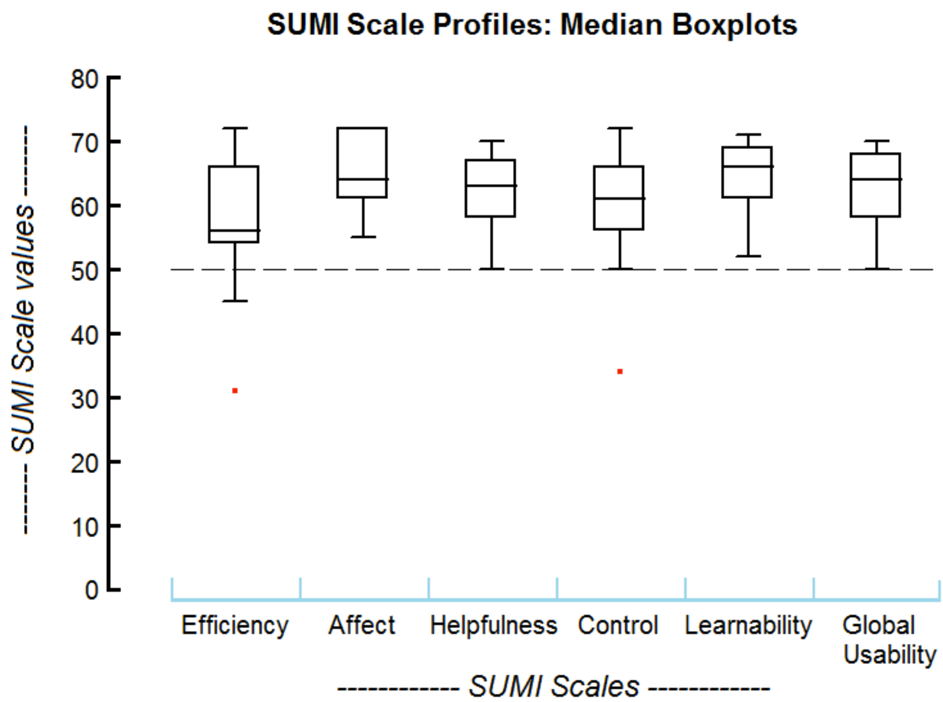



**Figure 6.10. SUMI Scale Profiles: Median Boxplots**

In this study, the global usability mean was 62.75, which means that the users rated the system's overall usability substantially higher than the systems that are contained in the SUMI database. Nearly all of the values are higher than the expected 40-60 range. This indicates that the system was either very usable, or that the users were not completely honest in how they answered the questions. The latter possibility will be discussed further in Section 6.5.4. The outliers could either be users who had a particularly difficult time with some aspects of the app, those who were significantly more honest than the other participants, or those who misunderstood the questions.

The app scored the highest for Affect, Learnability and Helpfulness, while scoring comparatively lower for Controllability and Efficiency. This indicates that the users found the system to be easy to use, learn and benefit from more than they found it something they felt in control of while using and effective at doing what was required. The latter is likely as a result of some of the bugs experienced during the course of the trial that frustrated some users.

SUMI also provides a consensus analysis for each answer and shows the strength with which the users reached that verdict. The full results can be found in Appendix N. Here are some of particular note:

- **Positive Results:**

Item 28 The app has helped me overcome any problems I have had in using it.
Verdict: Agree! *Strength: 99.9*

Item 40 I will never learn to use all that is offered in this app.
Verdict: Disagree! *Strength: 99.9*

Item 31 It is obvious that user needs have been fully taken into consideration.
Verdict: Agree! *Strength: 99.8*

Item 7 I enjoy the time I spend using this app.
Verdict: Agree! Strength: 99.7

Item 2 I would recommend this app to my colleagues.
Verdict: Agree. Strength: 98.9

- **Negative Results:**

Item 21 I think this app is inconsistent.
Verdict: Agree! *Strength: 99.8*

Item 49 Getting data files in and out of the app is not easy.
Verdict: Slightly disagree! *Strength: 99.7*

Item 38 Error messages are not adequate.
Verdict: Agree! *Strength: 99.4*

Item 43 Either the amount or quality of the help information varies across the app.
Verdict: Agree. *Strength: 95.2*

Item 4 This app has at some time stopped unexpectedly.
Verdict: Tend to agree? Strength: 52

The highlighted positive results indicate that the users were near-uniform in their agreement that the app assists them when they experience challenges, that they are able to learn to use what it had to offer, that they could tell that users' needs had been taken into account in the app's design and that they enjoyed working with it and would recommend it to other.

The highlighted negative results show room for improvement in the consistency of the app, particularly in the help and explanation of error messages and the number of crashes. It also indicates the need to improve the way data is imported and exported. In this study, the researcher assisted quite substantially with data exporting, and most of the users were not able to do this unaided.

Here are a few highlights from the broader questions included at the end of the SUMI questionnaire. The full set of open-ended question responses can be found in Appendix O. These give insights into the users' perception of the app's purpose:

**What, in general, do you use this app for?**

- "For recordkeeping so that I know exactly if my business is growing or failing. It's much easier than using a book."
- "To record my money and transactions in my business and it helps me to remember people that are owing me."
- "It keeps my recording up to date and I record every day, because your phone is always with you."
- "For my business, it's helpful for my business and [it is] easy to see if I make lot of money or need to push."

**What do you think is the best aspect of this app, and why?**

- "The best aspect is to have record of every money you used, to know what's going on with your business and you carry it with you all the time."
- "It saves a lot of my time."
- "It has been helpful to my business recording. Made my life very easy. Would love to continue with it."
- "Money Owed in case a customer wanted to know their balance it was easy to check."
- "Money coming out, it's easy to record as soon as spend money, I don't forget to do it."

**What do you think needs most improvement, and why?**

- "It just says error in the middle of recording and you have to start over again"
- "Money Owed because sometimes it shows that you have people owing even though I have recorded that they have paid"
- "I think it's the speed of the phone"
- "Money Owed section because sometimes when you do cash collection on a person it doesn't clear sometimes it adds up the amount"
- "That the people that they owed you last month and they pay at the end of that month must not appear on the following month"
- "Yes, always shows the customers that has paid already instead of showing the new client owing and the minus customers"

**Have your clients seen you using them app? If so, how did they respond?**

- "They saw and they congratulated me and said I am up with technology."
- "Yes they were so impressed saying that I am on the ball!"
- "Yes they saw me. They said it make my life easier. They also want it for their businesses."
- "Yes, because if I did any sales and I show them and one customer try to rob me and I show on my app the amount and it was helpful for me."
- "Yes, they told me I'm growing as a business woman."
- "Yes, they were excited they didn't know what I was doing but I explained to them and they were amazed."

- “They were too surprised so they can see I'm a really business woman.”

### 6.5.4 Reflection of Using SUMI

There are a number of things that need to be considered when looking at the effectiveness of SUMI in measuring the user experience of this app. The first is that the participants needed assistance in understanding some of the words used in the questionnaire. This resulted in the researcher, who was well known to the participants by this stage, staying in the room while they filled in the questionnaire and walking around to assist those who had questions. This has the potential to have biased the outcome of the survey. Firstly, the way in which the researcher answered and interpreted the questions might have swayed the users towards what was perceived to be a favourable response, or her presence in the room alone, or the knowledge that she would read them later might have had this effect.

Furthermore, during this time the researcher observed that some participants, who had struggled to use the app effectively during the trial, were answering questions favourably when the truth appeared to be contrary. It is thus likely that since the researcher was known to the participants and it was understood that the survey results would be used towards her education, they might have answered the questions in a more favourable light. This is despite multiple reassurances that there was no wrong answer, that honest feedback would assist in the improvement of the system and that the truth was what was most desired, even if it was negative. The attitude of wanting to please the researcher with exaggerated positive answers was affirmed by one of the mentors who said, “But you know we get that a lot, it’s not unexpected... The ladies don’t want to upset you.”

Due to the potential bias, it is not advisable to draw strong conclusions from the absolute scores of the SUMI results, but rather to look at areas of comparable strengths and weaknesses, given that all questions were similarly biased. In that light, it is evident that despite initial problems for some of the users getting started with the app, most found it to be enjoyable to use, easy to learn and something from which they would benefit in their businesses. The users’ feeling of being in control and app’s efficiency are areas that can be improved.

The open-ended questions gave the users space to write their own feelings down. It was interesting that different things stood out as highlights for the general use of the app and best aspects of the app. For the use of the app the answers centred around the ability of the app to give them easy and instant access to their records for capturing, for reference and for summary data such as total sales and expenses. The prior paper-based system was significantly lacking in this regard. A variety of different responses were given for the best aspects, including that it is mobile and accessible in the moment, it makes their lives easier, it helped customers know how much was owed and allows the user to know the financial state of their business at all times.

The question regarding what needs the most improvement received a lot of feedback about the money owed section. It is apparent that this section would benefit from a redesign, from fixing bugs to increasing usability. Some suggestions raised by the users are to make editing entries easier, fix problems with duplicate entries and incorrect totals, and looking at the order and timing that customers are presented in this view.

The final question regarding their clients' impression of them using the app highlighted some very important outcomes. One user explained in person to the researcher that a customer had insisted that they owed less money. Because the user was able to show the client the date and amounts of previous payments, she was able to prove the amount still outstanding and she said that the app had saved her from being robbed. The responses further indicate that the clients were impressed with seeing the users track their business on their phones and it elevated the clients' perceptions of the users being real and growing business women.

## 6.6 Evaluative Feedback from Staff

In order to conclude the design process with the NGO, a meeting was held with the key stakeholders from the staff who had been involved in some way in the course of this study. The meeting commenced with a presentation on the stages of the process over the course of the two years, detailing what happened at each step and who was involved. The staff were then given a survey to fill in regarding their personal involvement in the study and their thoughts on the success of the trial, followed by a time of open-ended discussion.

### 6.6.1 Process Evaluation Survey

The intention of the survey was to gain information from each of the staff participants into their perceived level of involvement in the duration of this design process, and to reflect on whether they felt their level of involvement was appropriate or not. They were also asked for their insights of the final application produced and their opinions of the impact of the study. Responses were received from seven participants: three from the leadership team, two from mentors and two from peer-mentors. The individual responses can be found in Appendix P.

The respondents all indicated some level of participation in the project, ranging from formal meetings, to information interactions, to direct participation in the trial. Most of the feedback given indicated that the respondents were happy with the level and means of their individual involvement, given their role in the organisation. Regarding the timing of their involvement, the mentors and peer-mentors indicated that they should have been involved earlier in the design process. This would have aided in their more practical experience being contributed during the higher levels of the design stages, leading to more meaningful and timely contributions.

The respondents saw their suggestions in the final app (where relevant) and did not report on any significant features missing that were included in the project scope. The one peer-mentor did, however, include additional features that she felt would be nice to have in the app for the future, now that the core functionality was established. The staff reported that errors in the app were off-putting to some of the users who were disheartened by the app after encountering bugs. While this is an unfortunate side effect of doing iterative, fast development with active users, it is something that should be carefully taken into consideration when working with participants who are not confident technology users. In response to the question "*In your opinion, did the app do what it needed to do?",* five of the seven responded with yes, while the others mentioned the effect of bugs limiting the app's ability to do what was needed at times.

Regarding the insights that the respondents picked up from the users, the feedback was largely positive, although the issues with bugs and the phone's slowness and low memory were also mentioned. Regarding the positive responses, the convenience of the app, the enjoyment and learnings gained by the participants were highlighted. One respondent said, “They felt very positive. They were very proud of their involvement in the trial. They enjoyed working in the development process.” and “For most of them I feel that they loved the app. They used it actively and it complemented the recordkeeping process.”

For future projects of this nature, the staff recommended that better planning of what would happen at the end of the trial was needed, that communication regarding the time frame should be improved and that the timing and depth of involvement of some participants should be increased to allow for more timely and effective contributions. Regarding the overall process, one of the leadership team said, “Sarah approached the design in collaboration with participants. Really participatorily developed.”

### 6.6.2 Retrospective Feedback Session

An open discussion was held with the staff from the NGO who were involved in this project. This was to give them a platform to reflect on the process in greater detail than the survey allowed and talk about anything regarding the project that they deemed of significance. Due to various constraints, only four of the leadership team were able to attend the discussion.

Participant 1 reflected on the process that was undertaken over the two years and expressed that she felt the NGO had been used and had not received what they expected as an outcome of the study. This highlighted a significant communication issue in the different expectations given and understood during the course of the study. She has envisioned receiving a functional long-term supported app, which the NGO could implement into their program from that point on. However, this was beyond the scope of the project, which could only deliver a working prototype. When Nokia was actively supporting this research, it was hoped that they might be interested in taking the research further and building something more sustainable after the conclusion of this study. However, when Nokia was acquired by Microsoft, the changing circumstances were communicated and some additional options were discussed. Participant 2, who was the point person for this project, confirmed that this had been done and that she was well aware of Nokia no longer being actively involved.

Participant 1 participant further expressed that the duration of the project took longer than anticipated and that the periods where the researcher was offsite developing the prototypes and doing auxiliary research were too long. This is fair and the researcher acknowledges that she could have more effectively explained these lapses in visibility and delays in the project roadmap. Overall, Participant 1 reflected, “I’d absolutely love to have an app! I think that’s one thing you have proven is that it can add value and I think the design … is great. So yes, we have a framework to work within, but beyond that I don’t think we’ve got something that’s going to survive without support.”

Reflecting on the impact of the project on the participants, the Participant 2 said, “I went to the meeting when Sarah [the researcher] handed out the awards ... And for me what was fascinating about that meeting is that they were literally sitting there, these people who, who live where they do, and they were almost co-collaborators on the development … And so I think that for those 21 women, who were involved in the trial, this has definitely added to their self-esteem growth.” And later, “I wish you could all have been in that meeting! It was it so empowering to see these women engaging with Sarah as equals. You can't take away from that."

Regarding the final app, the Participant 1 said "I mean we're pretty satisfied … with the final version that the women are working [with]. So if we got something like that, supported, we would be satisfied." The others agreed, saying, "It added value to women's lives." Participant 1 continued, "Yes! So that's one thing that's the positive out of here, is that you've developed a great app, in collaboration, that is going to die unfortunately. That's the sad part of it."

When discussing the impact that the project has had on the participants, the participants said that, "It empowered them," and that, "The ladies loved it. They got it. And I think that was the beauty about it." To conclude Participant 2 said, "I do think value has been added. I really do. I think you've made a very strong impact. And I do think that we would have been sitting in a very different situation, had not Nokia gone dead. And that is something that was completely beyond your control."

### 6.6.3 Staff Feedback Key Findings

Upon reflection on the staff survey and feedback discussion together, key findings arise regarding the project's organisation, the staff's participation, the effectiveness of the final app produced and the impact that participation had on the participants of the trial.

The project planning, which began with the expectation of a more traditional co-design process, was not adequate for this structure of multi-stakeholder participation. The timeline of the project's duration was not fixed and thus expectations of the extent of involvement were not clearly understood. A definite plan for what would happen at the end of the trial was also not clearly stated early enough – in the perspective of the staff. It was necessary for the evaluation form to remain flexible as the prototype evolved, however, until an understanding of the best way to evaluate the developed app could be assessed. Communication between the researcher and staff could have been improved to set and adjust expectations as circumstances changed and to ensure important facts were clearly understood by all.

Regarding staff involvement, the leadership team felt that their involvement was sufficient, while the business and peer-mentors felt that they should have been included earlier in the process. While they had been invited to attend earlier sessions, their lack of buy-in at those stages could speak to communication shortcomings, in that they did not have a clear understanding of what the sessions involved and the benefit of attending them. This should be examined further for future projects were multiple stakeholders are present. In retrospect, the staff felt the process had been participatory in nature and something that they were given the opportunity to partake in to their level of choice and availability.

Concerning the app developed during the course of the study, the staff considered it to be a success overall, with some shortcomings. The final product met the core requirements, supported the existing recordkeeping process and was effective at adding value to the users' lives. The shortcomings of the app were the technical bugs that existed during the trial and the memory constraints with the phone that caused it to crash regularly for some users. The lack of on-going support for the app at the conclusion of the trial was also a negative for them.

Finally, in regards to the participants of the trial, the staff noted that their involvement in the study empowered the individuals, building their confidence and self-esteem. They were able to engage with the research as equals, as “almost co-collaborators on the development” and were proud of their participation.

## 6.7 Discussion of Multiple-Stakeholder Participation

In this section we discuss the impact of the different stakeholders’ participation both in the evaluation phase and over course of the project as a whole. In the same light, we reflect on the power dynamics observed and the influence of external factors, here and across the other phases. We end with a short reflection on the impact of using multiple stakeholders over the duration of the project and identify some of the strengths and weaknesses that it brought to this project.

### 6.7.1 Participation of students

In the requirements gathering phase, the students participated passively, by being observed in the contextual enquiry and by answering the cellphone survey. These influenced the choice of phone that the prototype would be designed for and confirmed some of the functional and non-functional requirements that other activities had raised. In the low-fidelity phase the students participated in focus groups that were designed to answer particular questions and evaluate assumptions that been made in the prior design activities. The students’ involvement in the high-fidelity phase included participating in task-driven use of the app, evaluating their experience and impressions via a guided questionnaire at the end.

The students participated as the trial participants in the final evaluation stage of the design process. Their bug reporting and feature improvement suggestions contributed towards the multiple small updates of the app during the trial. The impact of their suggestions being implemented so quickly appeared to have a positive effect on their willingness to contribute further, and their input began to change from just reporting bugs, to making suggestions for improvements and eventually requesting new features that they would like. This shows the impact of doing fast iterations in the prototype trial stage with participants who – influenced by their background and prior limited exposure to technology – were not able to contribute as constructively towards features earlier in the design process.

During each stage of the design process, different groups of students took part, influenced primarily by availability and student turnover over the two-year duration of the study. As such, each activity that involved their inclusion required the project to be introduced again and could not build on a previous relationship with the researcher and understanding of the project, as was possible with the staff. However, this did not appear to have a negative impact on the student’s ability to participate in the given activities.

The benefits of using the students as participants in each phase was rooted in the fact that they were all representative end-users and had the specific knowledge, background and technology exposure that the intended users of the system would have. In this light, they were able to confirm and provide further insight on things that were speculated, assumed and generalised by the staff and researcher. The possible negative effect of not having on-going involvement with the same group of students was mitigated by the intentional choice of the activities in each phase, aimed particularly at areas where they could most effectively contribute.

### 6.7.2 Participation of staff

The staff participated actively in all phases of the design process, building on their existing involvement with the project at each point. In the requirements gathering phase the leadership team were involved in the interviews, feature brainstorming, deciding who would participate in the sessions and in interfacing between the researcher and students. In the low-fidelity phase they participated in traditional co-design sessions, iterating the requirements and visualisation of the various features. In the high-fidelity phase after the user evaluations, the leadership team reviewed the prototype, discussed a feature that was yet to be developed, making suggestions and identified bugs. The mentors participated in the review of the app for required changes in light of the updated curriculum and approved it – and access to their students – for the trial.

The staff's participation in the trial and final evaluation phase was driven by their observations and interactions with the trial participants. They assisted with the selection of students as participants for the study and partook in the follow up evaluation discussion meeting and questionnaire. The mentors were involved more actively, as they supervised the business progress of the trial participants and were able to observe the impact that being part of the study had on the student participants. In evaluating the impact and success of the whole project, the staff participated in a review session, discussed in Section 6.6. Here they contributed their insights on the trial, the impact it had on the students and reflected on their participation over the course of the whole project.

The strength of the staff as participants at all stages of the design process was driven by their position as experts of the course material and their experience training micro-entrepreneurs. Thus, they were aware of the common situations and pitfalls that the students experience in tracking their businesses and maintaining their recordkeeping. The interplay between the leadership team and mentors, particularly after the mentors' inclusion in the high-fidelity phase, allowed for their different strengths to be utilized. However, in retrospect it would have been beneficial for the mentor to be included earlier in the design process. Overall, the inclusion of the staff was able to resemble traditional co-design participation and their contributions significantly shaped the design of the application.

### 6.7.3 Observed Power Dynamics

The observation of power dynamics was evident in all phases of the design process, while being more prevalent between stakeholder groups in some situations than others. A staff member assisted in recruiting student participants for the low- and high-fidelity phases. In the low-fidelity phase, the staff member's encouragement to participate resulted in an unwilling participant agreeing to be involved. This was adjusted in the recruitment of participants for the high-fidelity evaluations by getting the assistance of a staff member who was not involved in the project. This allowed the researcher to explain the purpose of the study and emphasise that only voluntary participants were desired. This provides evidence that the way in which the students were introduced to the project influenced their willingness to be involved. The power that the staff member had to encourage participation when it was not desired, should not be overlooked in cases where willing participants are needed.

Between the researcher and students, the dynamics were more relaxed in the focus groups once the students realised that they were just there to discuss their lives and provide creative suggestions. In the high-fidelity evaluation, however, the students appeared less comfortable with the researcher, and we believe this is a result of them feeling like the researcher was testing them, due to the use of the words ‘evaluation’ and ‘tasks’. During the trial there was a prolonged relationship between the researcher and students, allowing for a level of trust and camaraderie to develop between them. By the SUMI evaluation, instead of feeling like they were being tested on their use of the app, they instead portrayed evidence of believing that they were grading the researcher on her development of the app, in sharp contrast to the high-fidelity evaluations. The atmosphere and use of wording thus has an influence over the attitude of the participants and should be carefully considered.

During the trial, power dynamics were observed strongly between the mentors and the students in the influence that the mentors’ different approaches to recruiting participants for the trial had. As discussed in Section 6.1.2, the mentors each presented the study in a different way, and the result was a greater number of participants coming from the second group. In the first group, the access to the demo phones was less, the distractions greater and the attitude of the mentor was less encouraging for participation. The second mentor, however, made adjustments to ensure the students had greater access to the demo phones and less distractions, while being more positive and encouraging in her presentation of the benefits of joining the trial. The impact here of asking each student in turn and repeatedly saying that they should participate, possibly played a large role in the participants’ decision to say yes. Not many students were comfortable saying no to her face and in front of their peers, as she is someone who they respect and is in authority over them. In contrast, the first group was made aware of the study, but told that they should only sign up if they really wanted to, and a signup form was passed around the room. Here the impact of less encouragement and less discomfort in saying no resulted in fewer participants signing up.

The early phases of the design process included regular collaboration between the researcher and leadership team, resulting in positive rapport and momentum being built. This relationship deteriorated after an extended break in their interactions, discussed in Section 5.8.3 and Section 5.8.4. Another influence in the breakdown of this relationship can be linked to a member of the leadership team’s reflection that she felt that the NGO was being ‘used’ towards the end of the design process, as purely a means to getting an academic qualification for the researcher. This staff member’s expectation that the study would result in a fully-fledged application, supported in an ongoing manner after the conclusion of the research, points to a significant misalignment of expectations. This occurred after the withdraw of Nokia’s input, when it was acquired by Microsoft. The feeling of being used was not shared by the others in the leadership team, who had been involved more consistently in the project. They reflected on the positive benefits and empowerment that being part of the trial had brought to the participants and the learnings that the NGO had gained on the potential success of such an invention.

### 6.7.4 Impact of External Factors

External factors influenced the participation of stakeholders in the design process in a variety of ways. In the requirements gathering and low-fidelity phases, the influence of commitments in and outside the NGO impacted who was available to participate in the various research activities. In the high-fidelity phase the influence of the change in curriculum and turnover of students resulted in substantial changes to the application being required. For the researcher, the influence of the app's development time, academic involvement at her university and other personal factors caused a delay in the commencement of the trial and influenced the staff's perception of her commitment to the project.

A variety of external factors influenced the participants in the trial. Personal factors, such as sickness and family responsibilities, impacted the students' ability to achieve their sales targets, their attendance time at the NGO, their access to assistance and software updates of the app. The impact of being involved at the NGO in other ways, such as the peer-mentor who went to Johannesburg as an NGO representative, similarly limited their participation.

Communication issues, such as the researcher receiving an outdated list of students' phone numbers, also had an impact, as some students who had expressed interest in the study did not receive the message inviting them to the training session, and thus thought that they had been excluded. It would have been better if the researcher had requested contact detailed for the students when they signed up for the trial.

Overall, while external factors are difficult to predict and plan for upfront, learnings from those experienced in this project point to the need for good communication channels between the stakeholder groups when they do arise, allowing for those involved to adjust their expectations and align their understanding of what changes will be made as a result. This was not adequately achieved in this project.

### 6.7.5 Influence on Design Process

It was not practical for all stakeholders to be involved in the same way throughout the different stages of the design process, therefore adjustments were made to accommodate for their various availabilities and potential contribution areas. In the requirements gathering phase the findings from the different activities each contributed something unique, while confirming some things raised in the other activities. In the low-fidelity phase the staff and student participants were deferred to for different aspects that aligned with their areas of expertise: the staff as experts of the curriculum and course requirements, and the students as experts of the context in which the app would be used.

In the high-fidelity stage, the stakeholder groups also included the mentors and peer-mentors. The inclusion of these subgroups, alongside the leadership team and students, allowed for assessment of the various aspects of the app from a more diverse number of perspectives. The structured nature of the user evaluations in the high-fidelity stage was by itself not exhaustive enough to identify some obvious bugs. The staff, given uninhibited access to the app during their review session, uncovered issues that had not been experienced by the student evaluators. However, this did not result in the app being bug-free by the commencement of the trial, but did allow for many usability issues to be raised before the users began implementing it in their daily business process. This shows the effectiveness of getting stakeholders with different backgrounds and perspectives to assess the app, as they were able to identify issues and make suggestions that the others had not brought up.

A particular downside of using multiple stakeholder groups was the difficulty in managing communication, knowledge sharing and expectations between the groups. The times spent focusing on activities that did not involve the staff resulted in a break of continuity for them and a lack of momentum for them regarding the project. This had a negative impact on their subsequent involvement in the design process. However, this was not an issue for the student group, as each activity involved a new subset of participants. The late inclusion of the mentors and peer-mentors, while benefiting the project, resulted in them feeling dissatisfied with their exclusion earlier and lowered their buy-in to the project from what it might otherwise have been. Future projects that include multiple stakeholder groups should take careful note of periods where one subset of participants might not be actively included and look for ways of mitigating the deterioration in participation that can follow.

## 6.8 Chapter Summary

In this chapter the details of the field trial and final evaluations with the users and staff are discussed. The findings showed that those who used the app more regularly, sought out help during the trial and had similar phones prior to the study were more likely to have captured their transactions accurately. The users found the app comparably stronger regarding its ease of use, learnability and helpfulness than regarding their sense of control using the app and its effectiveness. They indicated that using the app made their lives easier and highlighted its portable and accessible nature, while elevating them in the opinion of their customers.

The staff agreed that the final app met the core requirements and supported the existing recordkeeping process. The technical bugs and phone's memory constraints were a negative, as was the lack of ongoing support at the conclusion of the trial. They further indicated that project's planning and communication could have been improved. The staff indicated that being part of the trial had empowered the participants, built their self-esteem and allowed them to relate as equals with the researcher and be collaborators in the app's development.

A reflection on the effectiveness of the multiple stakeholder design process, both in this chapter and over the duration of the design process, uncovered the beneficial interplay of the different types of interactions that were tailored to suit the participants. The impact of power dynamics and external factors is acknowledged and recommendations for future projects are given. Of particular note is the need for better management of communication between stakeholder groups when circumstances necessitate a change in the project timeline and possible outcomes. In the following chapter, broader conclusions will be drawn from the overall learning of this research, in light of the whole design process.

# 7. Conclusion

Researching with users from cross-culture and disadvantaged contexts, particularly when these users have limited experience with technology, poses challenges in including them as active participants in a co-design process [2]. This is particularly difficult when other stakeholders from more affluent backgrounds are also included, resulting in the need for careful management of both stakeholder group's involvements to ensure that they are relevant and appropriate for the participants involved. Through the use of a case study with an NGO training micro-entrepreneurs from disadvantaged backgrounds, we explored the answer to the question, "can we use multiple stakeholder groups as participants in a co-design process?" through the development of a mobile recordkeeping application.

## 7.1 Summary of Design Process

In order to accommodate for the different needs and requirements of the stakeholder groups, variety of design methodologies were combined, directed by practical considerations. This resulted in complementary ways for the stakeholders to participate in the design process. The design process included four key phases: the requirements gathering phase, low-fidelity design phase, high-fidelity design phase and evaluation phase.

To accommodate for various constraints experienced, and in order to include both the staff and students as participants in the design process, adjustments were made to traditional co-design ideals of including all stakeholders equally in the design process [77]. In doing such, the staff were honoured as experts of the training programme, curriculum requirements and knowledge of common struggles faced by their students over time. In doing so, we included them in participation pertaining to understanding the larger problem space, defining and refining the feature requirements, gaining access to students in an appropriate manner and assisting the researcher in the planning and rollout of the trial. On the other hand, the students were honoured as experts of their real-life context for which the app was being designed. To this end they were given opportunities to participate in a manner that included confirming assumptions about usage and limitations, how features should be represented visually and other usability and user experience factors. Managing this process and ensuring that input was shared appropriately between the stakeholder groups required adjustments to be made during the course of the project, and which necessitated a flexible project plan.

The study ended with a one-month trial of the application integrated into the daily lives of twenty-one student participants. The purpose of the trial was to assess the viability of the designed solution as a supporting tool of the NGO's training process and to thus confirm whether the multiple stakeholder design process had resulted in an acceptable outcome. The participants' adoption and usage of the app were closely monitored for correlations with their experiences during the trial and personal situations. It was found that users who made more regular use of the app, who approached the researcher for assistance and who owned similar mobile phones before the study, had higher accuracy in capturing transactions. At the conclusion of the trial, the participants answered a SUMI questionnaire, providing insight into the usability and learnability of the system. The results showed that they rated the app higher for its ease of use, learnability and helpfulness than they did for its effectiveness and their feeling of being in control while using it. In answer to open-ended questions they reported that the app's strengths lay in its accessibility in being used anywhere, its assistance in making their lives easier and its impact on improving their customers' perception of them.

In a separate evaluation, the staff affirmed the app's success in aligning with the requirements of the training course and assisting the users with their recordkeeping. Bugs and the phone's memory limitations were highlighted as shortcomings, alongside the lack of ongoing support for the app after the trial. The staff affirmed the impact of the participatory approach with the students, highlighting the positive effect that this had on empowering and building the self-esteem of the trial participants, allowing them to relate as equals with the researcher and be collaborators in the app's development.

## 7.2 Research Findings

We began this research with the objective of answering the question, "can we use multiple stakeholder groups as participants in a co-design process?" In doing so we wanted to understand the forms and levels of participation that would be appropriate for the different stakeholders in each phase of the design process, and uncover what influenced this, reflecting on the power dynamics between the groups and the effect of external factors on participation. We particularly wanted to consider the impact of the interplay of the stakeholder groups on each phase and the effect that this had on the design process as a whole. The case study we presented and corresponding reflection on these aspects in each chapter allows for answers to these questions to be given.

It was found that equal participation of all stakeholders in all activities was not possible in this context, but that it was possible to include the different stakeholder groups in some way in each of the design phases. The types of involvement that were appropriate for the students ranged from passive interaction through being observed and answering surveys, to more active involvement in focus groups and prototype evolutions, and finally as full participants in the final trial, giving critical feedback on the usability and effectiveness of the app. Due to scheduling and turnover factors, different groups of students were included at each point in the design process, requiring a more tailored activity that had a specific focus and objective, and where an in-depth understanding of the previous aspects of the design process was not required.

The staff, on the other hand, were able to participate in a more traditional co-design style, with the same group being present over multiple sessions, harnessing and building on previous learnings. Their involvement took the form of: interviews; brainstorming sessions; feature discussion and designing; reviewing and giving feedback on the prototypes; and facilitating access to the students. Their participation was influenced by their knowledge of the course curriculum and experience working with the user group for a prolonged period of time, while having a good understanding of technology. The relationship between the staff and researcher deteriorated after an extended break in their interactions – due in part to external factors – that negatively influenced the enthusiasm with which the staff approached their participation towards the end of the design process.

External factors and power dynamics influenced who participated in some stages of the design process, how they participated and had an impact on the relationship dynamics between the groups. The way the project was presented by various staff members influenced the freedom that the students felt in agreeing to participate at different points in the process. The students' interactions with the researcher were also affected by power dynamics. In some activities they were relaxed, relating to her more as an equal than as a superior, but in the case of the high-fidelity evaluation they perceived the researcher as testing them, which created more of a distance between them. In the case of the final user-experience evaluation at the conclusion of the trial, the close relationship that had formed between the researcher and students inverted this effect, resulting in them giving exaggeratedly positive answers in an effort to please the researcher.

In the phases of the design process, the impact of including the stakeholder groups in different ways had a positive effect on the outcome of the application. The respective perspectives and expertise of the different groups allowed for them to provide unique and supportive contributions towards the design of the app. This shows the effectiveness of getting stakeholders with different backgrounds to assess the app, as they were able to identify issues and make suggestions that the others had not brought up. A weakness of the approach taken was on the side of managing expectations and communication between the stakeholder groups. The staff were not involved during some lengthy sections of the high-fidelity phase and the trial. As a result of this discontinuity there was decline in the participation and engagement of the staff in the later stages of the project. Because different student groups were included in each phase, these breaks did not negatively impact the students' participation.

## 7.3 Answer to Research Question

Having examined the forms of participation that took place with the different stakeholders; the power dynamics and external factors that influenced this; and the interplay between the groups in Section 7.2, we conclude that it is possible to use multiple stakeholder groups as participants in a co-design process, as demonstrated by this case study. However, the process needs careful management and was found to be effective in a scenario where the stakeholder groups were not required to participate together in the same design sessions. The resulting application developed in our case study was found to be useful to the students and acceptable to the staff in terms of alignment with the NGO and students' needs. Both groups expressed agreement that their participation towards the design was beneficial. Thus, with the limitations discussed in the following section in mind, we conclude that the design of the recordkeeping application using multiple stakeholder groups in the co-design process was a success.

## 7.4 Limitations of Study

The fact that this study did not have design sessions that incorporated representatives from more than one group is a possible limitation on its influence on the field of co-design, where researchers may feel that all participants should be included in each design session for it to be considered true co-design. This was, however, a strategic decision for this research, where the impact of varying these interaction was a key focus of our investigation.

A difficulty recognised in this study is in the management of communication between stakeholder groups. The staff, comprised of the leadership team and mentors, both expressed frustrations with aspects of the projects' communication. For the leadership team, this frustration was centred around the changing project plan, necessitated by various factors, and the impact this had on their expectations of the project's timeline and outcomes. For the mentors it was rooted in their lack of involvement at an earlier stage in the design process, due to not being adequately made aware of the benefits of their earlier participation and meeting times not taking their schedules into consideration. The students were influenced by communication in the way it impacted their agreement to participate in the various stages of the design process. The inadequate management of communication resulted in a misalignment of expectations between various stakeholders during the design process. Had this been handled better, the results of the study might have been impacted.

Limited results could be drawn from the user-evaluations in both the high-fidelity phase in Chapter 5 and trial phase in Chapter 6 of the study. In this study it was found that both under-familiarity and over-familiarity with the researcher biased the attitude of the participants towards the evaluation. The impact of bias was also identified on the way students answered guided questions, in light of needing assistance in understanding what the questions meant. This was recognised in both the high-fidelity and evaluation phases, resulting in the respective usability and user-experience factors being compared, rather than the outcomes being interpreted as standalone results.

Power dynamics were observed in a number of cases and attempts were made to avoid the influence of one group of stakeholders over the other, which was seen to unduly influence the more vulnerable group's participation in the study. This was not always achieved, and it is not clear whether it is possible or necessary to try to eliminate the impact of power dynamics in a multi-stakeholder process.

The very specific target group that the NGO recruits – mothers in Cape Town, South Africa between the ages of 20 and 45 from disadvantaged backgrounds who had previous been unemployed – limits of this study's generalisability. While it is a merit of the study in uncovering the specific needs of this particular user group and strengthened the effectiveness of using small subgroups of students as representative end-users, it is not clear to what degree the identified requirements and findings can be generalised to other groups of entrepreneurs.

## 7.5 Future Work

Reflection on the design process used raises some areas that require further research in future work. These include: studying the effective management of communication in a design process incorporating multiple stakeholders; ways to mitigate bias and manage the influence of power dynamics; and the comparative impact of a similar design process with different types of stakeholder groups and in different settings.

More work is needed in the area of communication management between stakeholder to understand what forms of communication are best suited for allowing the participation and outcome of participation desired by all involved, and the best ways that this can be managed.

As discussed in Section 7.4, the influence of bias tainted the reliability of some of the evaluation findings. Future work is needed to assess the impact of guided questionnaires on the quality and accuracy of answers given, and how the perceived purpose of the evaluation impacts the way in which the respondents answer the questions. Further research would be beneficial to discover an appropriate way to maintain the desired level of familiarity with the subjects without negatively impacting their design contributions. Furthermore, future work could include a study of how the evaluations can be conducted to maintain the integrity of the results.

In the case of this study, the hierarchical structure of the organisation and varied backgrounds of the participants automatically created different dynamics between the groups. It would therefore be interesting to look at the natural power dynamics at play in different scenarios with different stakeholder groups and assess whether their impact on the design process is significant enough to warrant adjustment, and how it can best be accommodated so as not to influence the results of participation too greatly.

Regarding the multi-stakeholder design process utilized, it would be interesting to compare the results found in this study with comparative studies containing a similar makeup of staff and students in the design of a different type of system. Furthermore, the different configurations of stakeholder groups in other areas would provide an interesting comparison, such as the dynamics between employees and employers; management, staff and clients; and NGOs, volunteers and community members.

It would also be interesting to study the impact of using a different combination of participatory methods from this study, not assuming that this particular combination of activities used is the most effective. Investigation can also be made on the impact of the timing of the different interactions, the extent that continuity and delays impact the results and the order in which the activities occur between the stakeholder groups.

## 7.6 Contributions

This dissertation provides an explicit example of doing co-design research with multiple stakeholder group. We adapted the design process to uniquely suit the needs of the stakeholders, with careful consideration for appropriate interactions, given their backgrounds and areas of expertise. The learnings during each phase of the design process and important reflection for future researchers to take into consideration have been documented. This provides a foundation that can be built on by future researchers in the fields of co-design, participation and ICT4D.

The output of the design process in this research was the development of a prototype business application that was found to adequately meet the usability and recordkeeping needs of an at-risk group of micro-entrepreneurs. These designs can be built on and extended, making adjustments and modernizations with the evolution of technology and its greater accessibility to groups of users such as these.

Furthermore, this study provides an in-depth profile of micro-entrepreneurs, some generalizable and some specific to the developing context, identifying key needs and struggles that they face. Included here are the cellphone survey results, with a repeat dataset from the same user group two years later.

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# Appendices

## Appendix A Mentoring Session Template

**MENTORING SESSION**

NAME: ______________________ GROUP NO: ____________

DATE: ______________________

**RECORD-KEEPING**

| | Yes | No |
|---|---|---|
| 1 Did I capture all my month's transactions on: My Income, My Business Expenses and My Personal Expenses sheets? | | |
| 2 Did I transfer all monthly totals to my Budget vs. Actual sheet? | | |
| 3 Did I track my actual monthly DEBT REPAYMENT against my DEBT GOAL TRACKER? | | |
| 4 Did I track my actual monthly SAVINGS against my SAVINGS GOAL TRACKER? | | |
| 5 Could I analyse my business to see where I could make improvements next month? | | |
| 6 Did I understand everything? | | |

**Comments**

______________________

______________________

______________________

**MY BUSINESS**

| | Month | Amount |
|---|---|---|
| **Two months ago** - Total of my TCB Invoice Values from month before last | | |
| **Last month** - Total of my TCB Invoice Values from last month | | |
| **Current month** - How much have I spent from the 1st day of this month to today? | | |
| **Current month** - How much am I planning to spend from today until the last day of this month? | | |

Any Issues with Current Business?

______________________

______________________

______________________

Any Opportunities?

______________________

______________________

Marketing Plan?

______________________

______________________

SMART GOAL for next MONTH (Specific, Measurable, Achievable, Realistic, Time Bound)

______________________

______________________

______________________

**PERSONAL**

Any Current Issues?

______________________

______________________

______________________

Future Plans after TCB?

______________________

______________________

**GENERAL COMMENT:**

______________________

______________________

Your Signature: ____________

MENTOR Signature: ____________

Next Women@Work Appointment: ____________

# Appendix B Cellphone Survey used in 2013 and 2015

## Cellphone Survey

1. **How old are you?**
   - Under 25
   - 25 – 35
   - 36 – 45
   - 46 – 55
   - 56 or order

2. **Do you own a cellphone?**
   - Yes
   - No
   - No, but I borrow one from a family member

3. **What brand/make is your phone?**
   - BlackBerry
   - HTC
   - Huawei
   - iPhone
   - LG
   - Motorola
   - Other (please specify) ____________
   - Nokia
   - Sony
   - Samsung
   - ZTE
   - Unsure

4. **If you know the model of your phone, please write it below:**
   *(eg, Nokia Asha 302 / Samsung S3 / Blackberry Z30)*

   ___________________________________

5. **Does your phone have a touch screen?**
   - Yes
   - No
   - Unsure

6. **Does your phone have a full (QWERTY) keyboard like in this picture?**
   - Yes
   - No
   - Unsure

7. **Overall, how easy/difficult do your find it to use your phone?**
   - Very difficult
   - Difficult
   - Ok
   - Quite easy
   - Very easy

8. **How much time do you spend on your phone each day?**
   *(for calling, messaging, music, gaming, or anything else)*
   - Less than 10 mins
   - 10 – 30 mins
   - 30 – 60 mins
   - 1 hour – 2 hours
   - 2 – 4 hours
   - More than 4 hours

**9. How much money do you spend on airtime every month?**

- Under R10
- R10 – R30
- R30 – R50
- R50 – R100
- R100 – R200
- Over R200

**10. How often do you buy SMS and data bundles?**

*SMS bundles:*

- Every month
- Every few months
- A few times a year
- Only once or twice before
- Never

*Data bundles:*

- Every month
- Every few months
- A few times a year
- Only once or twice before
- Never

**11. If you use your phone for business, tick all the things you use it for:**

- Letting clients know about new stock
- Following up with people who owe me money
- Checking my bank balance
- Making payments
- Other (please specify) ______________________________
  ______________________________________________

**12. Which of these phone features do you use the most? (choose up to 3)**

- Camera
- Calling people (voice)
- Email
- Internet browsing
- Messaging applications like mXit, BBM or Whatsapp
- Music
- Playing games
- SMSing

**13. How important are these parts of a cellphone to you?**
**Give each a value from 1 to 5.**

*(1= not important, 3 = sort of important, 5 = very important)*

_ Functionality (eg camera, touch screen, buttons, battery life)
_ Name of brand
_ Look and feel
_ Applications (eg calculator, mXit, BBM, Whatsapp, games)
_ Connectivity
_ Price of phone

**14. What kind of phone would you like to get next?**

*Either describe it or give the brand/make and model number.*

______________________________________________
______________________________________________
______________________________________________
______________________________________________

# Appendix C Focus Group 1 Questions

## GROUND RULES

**1. WE WANT YOU TO DO THE TALKING.**

- We would like everyone to participate.
- I may call on you if I haven't heard from you in a while.

**2. THERE ARE NO RIGHT OR WRONG ANSWERS**

- Every person's experiences and opinions are important.
- Speak up whether you agree or disagree.
- We want to hear a wide range of opinions.

**3. WHAT IS SAID IN THIS ROOM STAYS HERE**

- We want folks to feel comfortable sharing when sensitive issues come up.

**4. WE WILL BE RECORDING THE GROUP**

- We want to capture everything you have to say.
- We don't identify anyone by name in our report. You will remain anonymous.

## Questions

1. Who do you sell to and how do your clients pay you? (Cash, credit, layby)

2. Where/how do you sell and what do you take with you when you go?
- What kind of records to you keep and when do you write them down? What information is important to remember about each sale?

3. Where do you keep your money? (Bank, wallet, other savings)
- How often do you move money between these places?

4. How often do you add up how much money you have?
- What would be the reason for wanting to do so regularly?
- If you knew how much money you were supposed to have, what would you do if you found out that some money was missing?

5. Do you separate your business money from your personal money or keep it all together?
- If you could separate it, why would you want to and how might you do it?

6. When people buy on credit, do they always remember to pay you back?
- How do you remember who owes you money?
- What would help you in remembering? (phone reminders, smses etc)

7. What information do you keep about your clients?
- How do you store this information
- What do you do with it?

8. How do you find the Women at Work module?
- What do you find easy?
- What do you think is more difficult?

9. Women @ Work:
- Do the summaries that you make help you? How so?
- What summary information about your business would you like to know?

10. Anything else about running your business that you'd like to share?

# Appendix D High-fidelity evaluation background questionnaire

## Initial Survey

1. **When did you start at TCB? ________________________________**

2. **How old are you?**
   - Under 25
   - 25 – 35
   - 36 – 45
   - 46 – 55
   - 56 or order

3. **Do you own a cellphone?**
   - Yes
   - No
   - No, but I borrow from family

4. **What brand/make is your phone?**
   - BlackBerry
   - HTC
   - Huawei
   - iPhone
   - LG
   - Motorola
   - Other (please specify) ________________
   - Nokia
   - Sony
   - Samsung
   - ZTE
   - Unsure

5. **If you know the model of your phone, please write it below:**
   *(eg, Nokia Asha 302 / Samsung S3 / Blackberry Z30)*

   ______________________________________________

6. **Does your phone have a touch screen?**
   - Yes
   - No
   - Unsure

7. **Does your phone have a full (QWERTY) keyboard like in this picture?**
   - Yes
   - No
   - Unsure

8. **Overall, how easy/difficult do your find it to use your phone?**
   - Very difficult
   - Difficult
   - Ok
   - Quite easy
   - Very easy

9. **How comfortable do you feel speaking in English**
    - Very comfortable
    - Comfortable
    - Sort of comfortable
    - Uncomfortable
    - Very uncomfortable

10. **Did you have business experience before coming to TCB?**
    - Yes, more than a year's experience
    - Yes, less than a year's experience
    - No
    - Other ______________________________

## Appendix E Table of the tasks given during Evaluation 1

| | |
|---|---|
| **Task A** | Open the MyShop app to begin recording your money for the day. |
| **Task B** | You may try out a few of the options and see what they do. Discuss what you think may happen first before you try it. |
| **Task C** | Today you sell a dress to Mrs K for R50 cash. Record this information in the application. |
| **Task D** | You buy clothes for yourself from Truworths for R450. You pay for it with your store card (credit) and will pay the bill on the 30$^{th}$ of the month. |
| **Task E** | You receive child support of R500 in your bank account from Mr M. |

| | |
|---|---|
| **Task F** | You sell shoes to Mr Z for R300. He pays a R100 deposit in cash and promises to pay you the rest by the 25th of the month. |
| **Task G** | You buy stock from TCB for R400 via EFT. |
| **Task H** | It's the end of the day; you find that you have R475 in your wallet an R2100 in your bank account. Saves these values in the application. |

***Evaluation 1: Sudo-Randomised Task Order:***

**Group 1:** A, B, F, C, G, E, H, D, I
**Group 2:** A, B, D, G, H, C, E, F, I
**Group 3:** A, B, C, H, E, D, F, G, I
**Group 4:** A, B, H, D, F, E, G, C, I
**Group 5:** A, B, G, E, D, F, C, H, I

# Appendix F Table notes taken during Evaluation 1

| | **Group 1** | **Group 2** | **Group 3** | **Group 4** | **Group 5** |
|---|---|---|---|---|---|
| **A** | Some confusion | Fine, no problems<br>Question about opening prompt | All good | Fine | Fine |
| **B** | No problem with nav menu<br>On credit questioned<br>Down on fully paid | Talking through each thing. No problem with prompts.<br>* Reports crashed! | Researcher showed them around | Fully or ~~credit~~ or **not** suggestion<br>Backups? | Guided by researcher |
| **C** | Top selected, name first. Went down in order | Description 'cash sale' rather than 'dress' | Back button crashed in TEF<br>Scrolling down was a problem<br>Delete/back<br>Ok at begin/save | Fine | No problems |
| **D** | ~~Paid~~ **to**<br>"Didn't pay anything" | Deposit (bank) – with bank card<br>But no deposit in app<br>Problem entering date with text not numbers, got it eventually | Some discussion around deposit<br>No initial selection | Pressed Ok on it to edit<br>Maybe change to save?<br>Originally held on table and clicked with figure. Question about | Date issues! User deleted full field to type in again. Then had issues with the format |

| | | | | | |
|---|---|---|---|---|---|
| | | | | back button. Question about R450. | |
| **E** | All good | Went to personal expense | Personal Expense first. Prompted and then went to Other Income | Pressed up to select 'Bank' instead of middle | Used back for delete. First clicked options. Need to select first item automatically |
| **F** | Starting typing before selected something. Tried to make caps. Interesting order: Total, description, name, deposit, dates "Doesn't say what we still owe" | All good | Credit = not paid fully | All good | First went to business expense, then changed to Sales Income |
| **G** | Right Nav click – caused a bug | No problems | Credit = not paid fully | Fine | 'Ok' clicked to select item to type Description? What did you buy? Stopped to describe to friend about how cool the app is! |
| **H** | Confusion as to where to go. Report? "What you have" End Totals? Summaries? Profit/Loss etc | Personal expense clicked first. Problem with **'cash'** up first Considered reports/statements<br><br>Possible new term: 'End of day money' | Tried Reports first, then cash up next | Pressed 'Email' button for home. Discussion about Reports or Cash up. Chose cash up after discussion | Cash up confusion. Then went to reports. Then back to cash up.<br><br>App crashed when they went back to cashup. |
| **Extra notes** | Main issue was errors from navigation. Null pointer exception for every unexpected button click. Some terminology may need to be relooked at: Cash up? Overall they had little problems capturing the transactions. All question and choices seemed fine. Menu was fine too. Options button never pressed. | | | | |

# Appendix G Table of the tasks given during Evaluation 2

| | |
|---|---|
| **Task A** | You may try out a few of the options and see what they do. Discuss what you think may happen first before you try it. |
| **Task B** | Thando pays you R30 towards the money that he owes you from his purchase earlier this month. Record the payment. |
| **Task C** | You sell a dress to Mrs Kumalo for R50 cash. Record this information. |

| | |
|---|---|
| **Task D** | You buy clothes for yourself from Truworths for R450. You buy it on your store card and will pay the bill on the 30th of the month. |
| **Task E** | Tumi bought a dress from you for R130. You think you might have made a mistake when you typed it in. Check how much you entered and correct it if needed. |
| **Task F** | You sell shoes to Mr Zulu for R300. He pays a R100 deposit in cash and promises to pay you the rest by the 30th of the month. |
| **Task G** | You pay R50 back to Peter Moses. You bought something from him on credit in the past. |
| **Task H** | You have a lot of cash in your wallet so you deposit R400 into the bank. Capture this in the app. |
| **Task I** | You move R200 of your money from your bank into a separate savings account for your children's school fees. |
| **Task J** | You buy stock from TCB for R400 via EFT. |
| **Task K** | You decide to change the name of your business. Rename it on your app too. |

| | |
|---|---|
| **Task L** | Doing backups is so important! Back up all your information onto your memory card now. |
| **Task M** | Sipho wants to know how much money he owes you and when his next payment is due. Show him the breakdown of his past payments. |
| **Task N** | It's the end of the day; you find that you have R475 in your wallet an R2100 in your bank account. Saves these values in the application to check if you've missed anything. |

***Evaluation 2: Sudo-Randomised Task Order***

**Group 1:** A, C, E, F, J, H, I, B, D, K, G, M, N
**Group 2:** A, M, H, G, B, K, I, C, J, E, D, F, N
**Group 3:** A, G, M, F, D, H, K, C, E, I, J, B, N
**Group 4:** A, F, K, D, I, G, M, H, E, C, B, J, N
**Group 5:** A, J, B, I, D, H, G, E, C, F, M, K, N

# Appendix H Intrinsic Motivation Inventory Questionnaire

## Questionnaire

For each of the following statements, please indicate how true it is for you, using the following scale:

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| *not at all true* | | | | | | *very true* |

1. I put a lot of effort into this activity.

   1 2 3 4 5 6 7

2. I think using this application could help me to ______________________________

   ______________________________________________________________________

3. I thought this was a boring application to use.

   1 2 3 4 5 6 7

4. I was anxious while working on these tasks.

   1 2 3 4 5 6 7

5. I am satisfied with my performance on this application.

   1 2 3 4 5 6 7

6. I was relaxed while doing these tasks.

   1 2 3 4 5 6 7

7. I enjoyed using this application.

   1 2 3 4 5 6 7

8. I did this activity because I had to.

   1 2 3 4 5 6 7

9. After working with this application for a while, I felt competent.

   1 2 3 4 5 6 7

10. I would describe this application as interesting.

**1 2 3 4 5 6 7**

11. I believe I had a choice about doing this activity.

**1 2 3 4 5 6 7**

12. This is an application that I couldn't use.

**1 2 3 4 5 6 7**

13. I believe this application could be of value to me.

**1 2 3 4 5 6 7**

14. I did not feel nervous while doing these tasks.

**1 2 3 4 5 6 7**

15. I didn't try to do well at this activity.

**1 2 3 4 5 6 7**

16. I think using this application is important because it can ____________

______________________________________________________________

17. I did this activity because I wanted to.

**1 2 3 4 5 6 7**

18. It was important to me to do well in this activity.

**1 2 3 4 5 6 7**

# Appendix I Evaluation 1 IMI questionnaire results

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | I put a lot of effort into this activity | I think using this application could help me to… | I thought this was a boring application to use | I was anxious while working on these tasks | I am satisfied with my performance on this application | I was relaxed while doing these tasks | I enjoyed using this application | I did this activity because I had to | After working with this application for a while, I felt competent | I would describe this application as interesting | I believe I had a choice about doing this application | This is an application that I couldn't use | I believe this application could be of value to me | I did not feel nervous while doing these tasks | I didn't try to do well at this activity | I think using this application is important because it can… | I did this activity because I wanted | It was important to me to do well in this activity |
| 1A | 6 | Record every income & business expenses | 1 | 1 | 7 | 4 | 7 | 1 | 7 | 7 | 7 | 1 | 7 | 7 | 1 | can help me record everything | 7 | 7 |
| 1B | 7 | Do my recordkeeping faster and anywhere | 1 | 1 | 7 | 7 | 7 | 1 | 7 | 7 | 7 | 1 | 7 | 2 | 1 | make it easier for me | 7 | 7 |
| 2A | 7 | Keep track of my business anytime of the day! | 3 | 1 | 6 | 4 | 7 | 1 | 6 | 7 | 7 | 1 | 7 | 6 | 4 | improve my business and also be savvy | 7 | 5 |
| 2B | 6 | Update by business and my personal expenses | 1 | 2 | 7 | 7 | 7 | 1 | 7 | 7 | 7 | 1 | 6 | 1 | 1 | store my personal and business information safely | 7 | 7 |
| 3A | 7 | To do my recordkeeping safely with no mistakes | 1 | 5 | 7 | 7 | 7 | 1 | 7 | 7 | 7 | 1 | 7 | 7 | 1 | help me a lot on my true recordkeeping | 7 | 7 |
| 3B | 7 | Record for my business | 1 | 5 | 7 | 7 | 7 | 1 | 7 | 7 | 7 | 1 | 7 | 7 | 1 | help me to all my book keeping | 7 | 7 |
| 4A | 7 | Record all my expenses and customers owe me | 1 | 3 | 7 | 3 | 7 | 5 | 7 | 7 | 7 | 1 | 7 | 3 | 1 | help me to see all my expenses and all customers owing me my income and sales | 7 | 7 |
| 4B | 7 | Run my business very easy and stress free, because I'll be recording every information of my business and personal | 1 | 3 | 7 | 7 | 7 | 4 | 7 | 7 | 7 | 1 | 7 | 7 | 1 | help lot of people to save their information without using pen and paper, where sometimes you lose it | 7 | 7 |
| 5A | 7 | My business & recordkeeping | 1 | 1 | 7 | 7 | 7 | 2 | 7 | 7 | 7 | 1 | 7 | 7 | 1 | help me a lot to improve my business | 7 | 7 |
| 5B | 7 | Record my money | 1 | 1 | 7 | 7 | 7 | 1 | 7 | 7 | 7 | 1 | 7 | 7 | 1 | help me not to forget it will remind me who owes me | 7 | 7 |
| *Ave* | *6,8* | *7* | *1,2* | *2,3* | *6,9* | *6* | *7* | *1,8* | *6,9* | *7* | *7* | *1* | *6,9* | *5,4* | *1,3* | *7* | *7* | *6,8* |
| Normalized | 6,8 | 7 | 6,8 | 5,7 | 6,9 | 6 | 7 | 6,2 | 6,9 | 7 | 7 | 7 | 6,9 | 5,4 | 6,7 | 7 | 7 | 6,8 |

# Appendix J Evaluation 2 IMI questionnaire results

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *I put a lot of effort into this activity* | *I think using this application could help me to…* | *I thought this was a boring application to use* | *I was anxious while working on these tasks* | *I am satisfied with my performance on this application* | *I was relaxed while doing these tasks* | *I enjoyed using this application* | *I did this activity because I had to* | *After working with this application for a while, I felt competent* | *I would describe this application as interesting* | *I believe I had a choice about doing this application* | *This is an application that I couldn't use* | *I believe this application could be of value to me* | *I did not feel nervous while doing these tasks* | *I didn't try to do well at this activity* | *I think using this application is important because it can…* | *I did this activity because I wanted* | *It was important to me to do well in this activity* |
| **1A** | *6* | *do my women at work book thoroughly and it's very easy and quick with cellphone* | *7* | *1* | *6* | *6* | *5* | *5* | *5* | *5* | *6* | *1* | *6* | *6* | *1* | *make things easier and remind you where you put money wrong* | *5* | *5* |
| **1B** | *5* | *it will help to record every thing that I'm doing in my business* | *7* | *2* | *6* | *5* | *7* | *1* | *5* | *7* | *4* | *3* | *7* | *7* | *1* | *change the way I was doing before in to my business* | *7* | *7* |
| **2A** | *6* | *understand my business and recording every sale that I have made quickly as soon after sale* | *7* | *2* | *6* | *7* | *7* | *1* | *7* | *7* | *7* | *1* | *7* | *7* | *1* | *be helpful just you can save everything but use backup to save the information* | *7* | *7* |
| **2B** | *7* | *keep my record instead of carrying a book and pencil* | *7* | *1* | *7* | *6* | *7* | *1* | *7* | *6* | *7* | *1* | *7* | *7* | *1* | *help me even on the taxi while I'm on my way because I will capture our details for clients* | *7* | *7* |
| **3A** | *7* | *do my work very good and quickly* | *7* | *2* | *5* | *7* | *7* | *1* | *7* | *7* | *7* | *1* | *6* | *4* | *1* | *help me to do my work right all the time* | *7* | *7* |
| **3B** | *7* | *to do my records right and neatly* | *7* | *2* | *5* | *6* | *7* | *1* | *7* | *7* | *7* | *1* | *7* | *7* | *1* | *help me to know how my business is doing and to keep records* | *7* | *7* |
| **4A** | *7* | *maintain my business transactions* | *7* | *2* | *7* | *7* | *7* | *1* | *7* | *7* | *7* | *1* | *7* | *5* | *1* | *manage my business very well* | *7* | *7* |
| **4B** | *7* | *record everything about my business* | *7* | *3* | *7* | *7* | *7* | *1* | *7* | *7* | *7* | *1* | *7* | *7* | *1* | *help me to know how my business is doing* | *7* | *7* |
| **5A** | *5* | *I think is the best for me because it doesn't waste my time* | *7* | *6* | *5* | *6* | *7* | *1* | *7* | *7* | *5* | *1* | *6* | *4* | *5* | *save my savings and my wallet as well* | *5* | *5* |
| **5B** | *7* | *to record all my transactions and expenses* | *7* | *2* | *6* | *6* | *6* | *1* | *7* | *7* | *7* | *1* | *7* | *7* | *1* | *help me keep record of my business expenses* | *7* | *7* |
| Ave | *6,4* | *7* | *7* | *2,3* | *6* | *6,3* | *6,7* | *1,4* | *6,6* | *6,7* | *6,4* | *1,2* | *6,7* | *6,1* | *1,4* | *7* | *6,6* | *6,6* |
| Normalized | 6,4 | 7 | 7 | 5,7 | 6 | 6,3 | 6,7 | 6,6 | 6,6 | 6,7 | 6,4 | 6,8 | 6,7 | 6,1 | 6,6 | 7 | 6,6 | 6,6 |

# Appendix K    Initial Survey for Trial Participants

## Cellphone App Trial – Participant Information

1. **What is your name?** ________________________________________

2. **Which TCB group are you in?** _________________________________

3. **What is your first-language?**

   ____________________________________________________________________

4. **How comfortable do you feel speaking in English**
- o Very comfortable
- o Comfortable
- o Sort of comfortable
- o Uncomfortable
- o Very uncomfortable

5. **Did you have business experience before coming to TCB?**
- o Yes, more than a year's experience
- o Yes, less than a year's experience
- o No
- o Other ______________________________________

6. **What type of work did you do before coming to TCB?**

   ________________________________________________________________________

## Demographic Information: (please tick the answer that most applies to you)

7. **What population group do you belong to?**

| | |
|---|---|
| | AFRICAN/BLACK |
| | COLOURED |
| | INDIAN/ASIAN |
| | WHITE |
| | OTHER |

8. **What is your present marital status?**

| | |
|---|---|
| | MARRIED |
| | LIVING TOGETHER |
| | WIDOW/WIDOWER |
| | DIVORCED OR SEPARATED |
| | NEVER MARRIED |

9. **Do you have children?**
   - Yes How many children? ________________________
   - No

10. **What is the highest level of education that you have successfully completed?**

| | |
|---|---|
| | GRADE 8/STANDARD 6 |
| | GRADE 9/STANDARD 7 |
| | GRADE 10/ STANDARD 8 |
| | GRADE 11/ STANDARD 9 |
| | GRADE 12/STANDARD 10/ MATRIC |
| | NTC I |
| | NTC II |
| | NTC III |
| | CERTIFICATE WITH LESS THAN GRADE 12/STD 10 |

| | |
|---|---|
| | DIPLOMA WITH LESS THAN GRADE 12/STD 10 |
| | CERTIFICATE WITH GRADE 12/STD 10 |
| | DIPLOMA WITH GRADE 12/STD 10 |
| | BACHELORS DEGREE |
| | BACHELORS DEGREE AND DIPLOMA |
| | HONOURS DEGREE |
| | HIGHER DEGREE (MASTERS, DOCTORATE) |
| | OTHER |

11. **How many people live in your household?**
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - >7

12. **How much money do you usually earn each week, money and year?**

| Weekly | Monthly | Annually |
|---|---|---|
| ○ None<br>○ R1 - R46<br>○ R47 - R115 | ○ None<br>○ R1 - R200<br>○ R201 - R500 | ○ None<br>○ R1 - R2 400<br>○ R2 401 - R6 000 |
| ○ R116 - R231<br>○ R232 - R346<br>○ R347 = R577 | ○ R501 – R1 000<br>○ R1 001 - R1 500<br>○ R1 501 = R2 500 | ○ R6 001 - R12 000<br>○ R12 001 - R18 000<br>○ R18 001 - R30 000 |
| ○ R578 - R808<br>○ R809 - R1 039<br>○ R1 040 - R1 386 | ○ R2 501 - R3 500<br>○ R3 501 - R4 500<br>○ R4 501 - R6 000 | ○ R30 001 - R42 000<br>○ R42 001 - R54 000<br>○ R54 001 - R72 000 |
| ○ R1 387 - R1 848<br>○ R1 849 - R2 540<br>○ R2 541 - R3 695 | ○ R6 001 - R8 000<br>○ R8 001 - R11 000<br>○ R11 001 - R16 000 | ○ R72 001 - R96 000<br>○ R96 001 - R132 000<br>○ R132 001 - R192 000 |
| ○ R3 696 - R6 928<br>○ R6 929 or more<br>○ Don't know<br>○ Refuse to answer | ○ R16 001 - R30 000<br>○ R30 001 or more<br>○ Don't know<br>○ Refuse to answer | ○ R192 001 - R360 000<br>○ R360 001 or more<br>○ Don't know<br>○ Refuse to answer |

## Cellphone Information

**13. What brand/make is your phone? BlackBerry**

- HTC
- Huawei
- iPhone
- LG
- Motorola
- Nokia
- Sony
- Samsung
- ZTE
- Unsure
- Other (please specify) __________________

**14. If you know the model of your phone, please write it below:**
(eg, Nokia Asha 302 / Samsung S3 / Blackberry Z30)

________________________________________________

**15. Does your phone have a touch screen?**

- Yes
- No
- Unsure

**16. Does your phone have a full (QWERTY) keyboard like in this picture?**

- Yes
- No
- Unsure

**17. Overall, how easy/difficult do your find it to use your phone?**

- Very difficult
- Difficult
- Ok
- Quite easy
- Very easy

**18. Is your phone a smart phone?**

- Yes
- No
- Unsure

**19. How much time do you spend on your phone each day?**
*(for calling, messaging, music, gaming, or anything else)*

- Less than 10 mins
- 10 – 30 mins
- 30 – 60 mins
- 1 hour – 2 hours
- 2 – 4 hours
- More than 4 hours

**20. Which of these phone features do you use the most? (choose up to 3)**

- Camera
- Calling people (voice)
- Email
- Internet browsing
- Music
- Messaging applications like mXit, BBM or Whatsapp
- Playing games
- SMSing

# Appendix L Ethical Consent Form for Trial Participants

Department of Computer Science, University of Cape Town

## Masters Research Study - Sarah Brittan

### Information Sheet

**Purpose of the Study:** As part of the requirements for my Masters Degree at UCT, I have to carry out a research study. The study is focused on monitoring the use and adoption of a mobile application (app) for doing record keeping at The Clothing Bank during the month of September 2015.

**What will the study involve?** The study will involve a number of different activities, including today's training. You will be given the app to try out for the rest of the month. Your usage of the app will be monitored and I will be able to see your business and financial information that you type in on the phone. At the end of the one-month trial I will do an interview with you and ask you to fill in a questionnaire about your experiences using the app. You will then get a reward if you have completed the study. This will either be a R250 TCB shopping voucher or the choice to keep the trial phone for your personal use.

**Why have you been asked to take part?** You have been asked to participate because you know the TCB cash flow Women at Work system the best and are able to use the app for your daily business transactions.

**Do you have to take part?** No, participation is completely voluntary. I want to make sure that you understand exactly what will happen and feel comfortable taking part. On the following page is a consent form that I would like you to sign saying that you are choosing to take part in this trial. You are welcome to leave this study at any point, before or after the trial starts. If so, you will need to return the phone that you are given and continue doing your record keeping in your Women at Work books as before.

**What will happen to the information that you give?** The data will be kept confidential (private) and will only be used for this study.

**What will happen to the results?** The results will be written in my report. My supervisor, a second marker and the external examiner will see them. The report may also be read by other students or by the public via the Internet. The study may also be published in a research journal or conference proceeding.

**What are the possible disadvantages of taking part?** The trial will involve you to dedicate some time to learning the new app and doing your record keeping in a new way. If your phone gets lost or stolen, you will loose anything that you have not backed up. If your phone gets lost if you will to pay a R150 fine or give a police report number if it is stolen.

**Who has approved this study?** The Ethics Department at the University of Cape Town has approved this research study. The Clothing Bank leadership has also agreed to it being done at TCB.

**Any further queries?** If you need any further information, you can contact me: Sarah Brittan on sarahbrittan13@gmail.com or 082 765 2421.

If you agree to take part in the study, please sign the following consent form.

# Consent Form

- I …………………………………………… agree to participate in Sarah Brittan's cellphone app research study.
- The purpose and nature of the study has been explained to me in writing.
- I am choosing to participate – no one is forcing me to.
- It is ok for Sarah Brittan to be audio-record the things I say during the meetings.
- I understand that I can leave the study, without consequences, at any time, whether before it starts or after it has started. I will just need to return my trial phone.
- If my trial phone gets lost or stolen, I agree to pay a R150 fine.
- I understand that when Sarah writes about me in her report she will not use my name. My participation is anonymous.
- I understand that things that I say during the interviews and meeting in this study may be quoted in Sarah's report and any future publications if I give permission below, but that they will not be linked back to me. Please tick one:
  - I agree to quotation/publication of extracts from my interactions
  - I do not agree to quotation/publication of extracts from my interactions
- If I give permission below, I agree to allow Sarah Brittan to take photos of me during the study to use in her report. Please tick one:
  - Yes, she can take and use photos of me in her report
  - No, I do not want photos of me in her report

Signed ………………………………………. Date …………………..…….

2

# Appendix M SUMI questionnaire for participants of the field study

## Software Usability Measurement Inventory – SUMI

### MyShop TCB App Evaluation

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**NB** The information you provide is kept completely confidential. Your honest feedback is appreciated.

This questionnaire has 50 statements. Please answer them all. After each statement there are three boxes.

- Check the first box if you generally **AGREE** with the statement.
- Check the middle box if you are **UNDECIDED**, or if the statement has **no relevance** to your app or to your situation.
- Check the right box if you generally **DISAGREE** with the statement.

In checking the left or right box you are not necessarily indicating strong agreement or disagreement but just your general feeling most of the time.

There are also eight general questions at the end.

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**Trial Phone Star Number:** ☐

| ***Statements 1 - 10 of 50.*** | **Agree** | **Undecided** | **Disagree** |
|---|---|---|---|
| 1. This app responds too slowly to inputs. | ○ | ○ | ○ |
| 2. I would recommend this app to my colleagues. | ○ | ○ | ○ |
| 3. The instructions and prompts are helpful. | ○ | ○ | ○ |
| 4. This app has at some time stopped unexpectedly. | ○ | ○ | ○ |
| 5. Learning to operate this app initially is full of problems. | ○ | ○ | ○ |
| 6. I sometimes don't know what to do next with this app. | ○ | ○ | ○ |
| 7. I enjoy the time I spend using this app. | ○ | ○ | ○ |
| 8. I find that the help information given by this app is not very useful. | ○ | ○ | ○ |
| 9. If this app stops it is not easy to restart it. | ○ | ○ | ○ |
| 10. It takes too long to learn the app functions. | ○ | ○ | ○ |

| ***Statements 11 - 20 of 50.*** | **Agree** | **Undecided** | **Disagree** |
|---|---|---|---|
| 11. I sometimes wonder if I am using the right function. | ○ | ○ | ○ |
| 12. Working with this app is satisfying. | ○ | ○ | ○ |
| 13. The way that system information is presented is clear and understandable. | ○ | ○ | ○ |
| 14. I feel safer if I use only a few familiar functions. | ○ | ○ | ○ |
| 15. The app documentation is very informative. | ○ | ○ | ○ |
| 16. This app seems to disrupt the way I normally like to arrange my work. | ○ | ○ | ○ |
| 17. Working with this app is mentally stimulating. | ○ | ○ | ○ |
| 18. There is never enough information on the screen when it's needed. | ○ | ○ | ○ |
| 19. I feel in command of this app when I am using it. | ○ | ○ | ○ |
| 20. I prefer to stick to the functions that I know best. | ○ | ○ | ○ |

| ***Statements 21 - 30 of 50.*** | **Agree** | **Undecided** | **Disagree** |
|---|---|---|---|
| 21. I think this app is inconsistent. | ○ | ○ | ○ |
| 22. I would not like to use this app every day. | ○ | ○ | ○ |
| 23. I can understand and act on the information provided by this app. | ○ | ○ | ○ |
| 24. This app is awkward when I want to do something that is not standard. | ○ | ○ | ○ |
| 25. There is too much to read before you can use the app. | ○ | ○ | ○ |
| 26. Tasks can be performed in a straight forward manner using this app. | ○ | ○ | ○ |
| 27. Using this app is frustrating. | ○ | ○ | ○ |
| 28. The app has helped me overcome any problems I have had in using it. | ○ | ○ | ○ |
| 29. The speed of this app is fast enough. | ○ | ○ | ○ |
| 30. I keep having to go back to look at the guides. | ○ | ○ | ○ |

| *Statements 31 - 40 of 50.* | Agree | Undecided | Disagree |
|---|---|---|---|
| 31. It is obvious that user needs have been fully taken into consideration. | ○ | ○ | ○ |
| 32. There have been times in using this app when I have felt quite tense. | ○ | ○ | ○ |
| 33. The organisation of the menus seems quite logical. | ○ | ○ | ○ |
| 34. The app allows the user to be economic of keystrokes. | ○ | ○ | ○ |
| 35. Learning how to use new functions is difficult. | ○ | ○ | ○ |
| 36. There are too many steps required to get something to work. | ○ | ○ | ○ |
| 37. I think this app has sometimes given me a headache. | ○ | ○ | ○ |
| 38. Error messages are not adequate. | ○ | ○ | ○ |
| 39. It is easy to make the app do exactly what you want. | ○ | ○ | ○ |
| 40. I will never learn to use all that is offered in this app. | ○ | ○ | ○ |

| *Statements 41 - 50 of 50.* | Agree | Undecided | Disagree |
|---|---|---|---|
| 41. The app hasn't always done what I was expecting. | ○ | ○ | ○ |
| 42. The app presents itself in a very attractive way. | ○ | ○ | ○ |
| 43. Either the amount or quality of the help information varies across the app. | ○ | ○ | ○ |
| 44. It is relatively easy to move from one part of a task to another. | ○ | ○ | ○ |
| 45. It is easy to forget how to do things with this app. | ○ | ○ | ○ |
| 46. This app occasionally behaves in a way that can't be understood. | ○ | ○ | ○ |
| 47. This app is really very awkward. | ○ | ○ | ○ |
| 48. It is easy to see at a glance what the options are at each stage. | ○ | ○ | ○ |
| 49. Getting data files in and out of the system is not easy. | ○ | ○ | ○ |
| 50. I have to look for assistance most times when I use this app. | ○ | ○ | ○ |

51. **What, in general, do you use this app for?**

52. **How important for you is the kind of app you have just been rating?**

- Extremely important
- Important
- Not very important
- Not important at all

53. **How would you rate your app skills and knowledge?**

- Very experienced and technical
- I'm good but not very technical
- I can cope with most apps
- I find most apps difficult to use

54. **What do you think is the best aspect of this app, and why?**

55. **What do you think needs most improvement, and why?**

56. **Has using the app changed your record keeping in anyway? If so, how?**

57. **Have your clients seen you using them app? If so, how did they respond?**

58. **Please choose ONE as a reward for your participation in this trial:**

□ I would prefer to keep the phone

□ I would prefer to get a R300 TCB shopping voucher

# Appendix N SUMI consensual analysis

Item: 24 This app is awkward when I want to do something which is not standard.
Verdict: Disagree! *Strength: 99.9*

Item: 28 The app has helped me overcome any problems I have had in using it.
Verdict: Agree! *Strength: 99.9*

Item: 40 I will never learn to use all that is offered in this app.
Verdict: Disagree! *Strength: 99.9*

Item: 9 If this app stops it is not easy to restart it.
Verdict: Disagree! *Strength: 99.9*

Item: 15 The app documentation is very informative.
Verdict: Agree! *Strength: 99.9*

Item: 8 I find that the help information given by this app is not very useful.
Verdict: Disagree! *Strength: 99.9*

Item: 45 It is easy to forget how to do things with this app.
Verdict: Disagree! *Strength: 99.9*

Item: 21 I think this app is inconsistent.
Verdict: Agree! *Strength: 99.8*

Item: 31 It is obvious that user needs have been fully taken into consideration.
Verdict: Agree! *Strength: 99.8*

Item: 12 Working with this app is satisfying.
Verdict: Agree! *Strength: 99.8*

Item: 37 I think this app has sometimes given me a headache.
Verdict: Disagree! *Strength: 99.8*

Item: 7 I enjoy the time I spend using this app.
Verdict: Agree! *Strength: 99.7*

Item: 49 Getting data files in and out of the system is not easy.
Verdict: Slightly disagree! *Strength: 99.7*

Item: 13 The way that system information is presented is clear and understandable.
Verdict: Agree! *Strength: 99.7*

Item: 48 It is easy to see at a glance what the options are at each stage.
Verdict: Agree! *Strength: 99.6*

Item: 6 I sometimes don't know what to do next with this app.
Verdict: Disagree! *Strength: 99.5*

Item: 38 Error messages are not adequate.
Verdict: Agree! *Strength: 99.4*

Item: 2 I would recommend this app to my colleagues.

Verdict: Agree. *Strength: 98.9*

Item: 25 There is too much to read before you can use the app.
Verdict: Disagree. *Strength: 98.9*

Item: 17 Working with this app is mentally stimulating.
Verdict: Agree. *Strength: 98.8*

Item: 11 I sometimes wonder if I am using the right function.
Verdict: Disagree. *Strength: 98.3*

Item: 42 The app presents itself in a very attractive way.
Verdict: Agree. *Strength: 98.1*

Item: 36 There are too many steps required to get something to work.
Verdict: Disagree. *Strength: 97.9*

Item: 19 I feel in command of this app when I am using it.
Verdict: Agree. *Strength: 97.8*

Item: 3 The instructions and prompts are helpful.
Verdict: Agree. *Strength: 97.6*

Item: 27 Using this app is frustrating.
Verdict: Disagree. *Strength: 96.9*

Item: 39 It is easy to make the app do exactly what you want.
Verdict: Agree. *Strength: 96.9*

Item: 30 I keep having to go back to look at the guides.
Verdict: Disagree. *Strength: 96.8*

Item: 50 I have to look for assistance most times when I use this app.
Verdict: Disagree. *Strength: 96.8*

Item: 47 This app is really very awkward.
Verdict: Disagree. *Strength: 96.1*

Item: 43 Either the amount or quality of the help information varies across the system.
Verdict: Agree. *Strength: 95.2*

Item: 23 I can understand and act on the information provided by this app.
Verdict: Agree? *Strength: 92.2*

Item: 33 The organisation of the menus seems quite logical.
Verdict: Agree? *Strength: 90.9*

Item: 26 Tasks can be performed in a straight forward manner using this app.
Verdict: Agree? *Strength: 90.5*

Item: 5 Learning to operate this app initially is full of problems.
Verdict: Disagree? *Strength: 90*

Item: 22 I would not like to use this app every day.

Verdict: Disagree? *Strength: 89*

Item: 16 This app seems to disrupt the way I normally like to arrange my work.
Verdict: Disagree? *Strength: 88.8*

Item: 35 Learning how to use new functions is difficult.
Verdict: Disagree? *Strength: 88.6*

Item: 1 This app responds too slowly to inputs.
Verdict: Agree? *Strength: 85.9*

Item: 46 This app occasionally behaves in a way which can't be understood.
Verdict: Disagree? *Strength: 85.3*

Item: 14 I feel safer if I use only a few familiar functions.
Verdict: Disagree? *Strength: 81.9*

Item: 44 It is relatively easy to move from one part of a task to another.
Verdict: Agree? *Strength: 81.6*

Item: 29 The speed of this app is fast enough.
Verdict: Agree? *Strength: 76.7*

Item: 34 The app allows the user to be economic of keystrokes.
Verdict: Agree? *Strength: 71.2*

Item: 32 There have been times in using this app when I have felt quite tense.
Verdict: Disagree? *Strength: 66.4*

Item: 18 There is never enough information on the screen when it's needed.
Verdict: Disagree? *Strength: 53.5*

Item: 41 The app hasn't always done what I was expecting.
Verdict: Slightly disagree? *Strength: 53*

Item: 4 This app has at some time stopped unexpectedly.
Verdict: Tend to agree? *Strength: 52*

Item: 10 It takes too long to learn the app functions.
Verdict: Disagree~ *Strength: 49.3*

Item: 20 I prefer to stick to the functions that I know best.
Verdict: Disagree~ *Strength: 25.9*

# Appendix O SUMI responses to open-ended questions

## 51 - What, in general, do you use this app for?

- For my business and everyday use
- To record my money and transactions in my business and it helps me to remember people that are owing me.
- Only for recordkeeping -> month coming out and in, money owed and reports
- Money in and out
- I used this app for keeping information about my business to know how much money I spend and how profit I have made to keep record
- For money in and money out, check report, money owed
- Money in and money out and checking my reports
- Internet, calls, sms, facebook and whatsapp. I also used it as my mobile radio
- All the transactions of my business
- Sales, cash collections
- Recording my business money and also sales
- I used the app for times when I'm on the road then I don't need to walk with my book.
- For recording the sales
- Recordkeeping -> money coming in, money going out and money owed
- For my financial recordkeeping and to manage my cash flow money in money out
- /
- For my business only
- /
- Whatsapp
- For recordkeeping so that I know exactly if my business is growing or failing. It's much easier than using a book

## 52 - How important for you is the kind of app you have just been rating?

| | n | G | E | A | H | C | L |
|---|---|---|---|---|---|---|---|
| Extremely important | 14 | 61.4 | 55.7 | 64.1 | 61.4 | 57.9 | 64.0 |
| Important | 6 | 66.0 | 63.0 | 68.2 | 63.8 | 66.3 | 66.7 |
| Not very important | 0 | | | | | | |
| Not important at all | 0 | | | | | | |

## 53 - How would you rate your app skills and knowledge?

| | n | G | E | A | H | C | L |
|---|---|---|---|---|---|---|---|
| Very experienced and technical | 6 | 63.7 | 59.3 | 67.3 | 62.7 | 60.2 | 67.5 |
| I'm good but not very technical | 12 | 63.5 | 57.8 | 65.1 | 62.2 | 63.6 | 64.5 |
| I can cope with most apps | 2 | 55.5 | 54.0 | 61.0 | 60.0 | 42.0 | 58.5 |
| I find most apps difficult to use | 0 | | | | | | |

## 54 - What do you think is the best aspect of this app, and why?

- The menu is quite logical
- To record information regarding money in and out of my business
- Every aspect of this app is the best, because whatever you record you can always come back to see if you recorded right.

- It saves me time. It made recordkeeping easier for me cause I can record sometimes without struggling with calculations
- The best aspect is to have record of every money you used, to know what's going on with your business and you carry it with you all the time.
- I found it all been the best and important to me
- It saves a lot of my time
- It is the best because it helps you with the calculations and also keep the record in order for you and it makes it easier to transfer the information to the women at work book
- Saves time for recordkeeping and it's a lot easier
- If you lost your women at work book you still have the phone as a back up
- Same as above ?Recording my business money and also sales?
- Money Owed incase a customer wanted to know their balance it was easy to check.
- You can take your phone anywhere but for the book you have to keep it at home so it makes it easier to store the customers
- Money coming out, it's easy to record as soon as spend money, I don't forget to do it.
- It's user friendly and it portable and mobile so you capture all the transaction as you make because it's always with you. You do not need to reach home to record your expenses.
- It is easy and fast
- It has been helpful to my business recording. Made my life very easy. Would love to continue with it.
- It's saving time and make life easy for me and improve my bookkeeping and not to stress when I use it.
- It saves time, I record everything coz it's always with me
- It's very helpful because it's mobile. Wherever I go I am able to capture even if I am no at home

## 55 - What do you think needs most improvement, and why?

- People that owed you money and paid by be deleted instantly from the app
- It just says error in the middle of recording and you have to start over again
- It keeps my recording up to date and I record every day, because your phone is always with you
- Money owed sometimes it gives problems
- So far for me I'm satisfied with it because it is helpful
- For the phone to enable me to edit money owed after capturing or typed the amount which was not correct
- Money Owed because sometimes it shows that you have people owing even though I have recorded that they have paid
- I think it's the speed of the phone
- Money Owed section because sometimes when you do cash collection on a person it doesn't clear sometimes it adds up the amount
- Money Owed needs to be updated
- That that people that they owed you last month and they pay at the end of that month must not appear on the following month
- The Money Owed because it sometimes showed wrong totals.
- Yes always shows the customers that has paid already instead of showing the new client owing and the minus customers
- Money coming in, if the app can show when last did I make a record so that I can see where I should start

- Money owed need more attention. When you are owed by a person for the second time one should be able to add to that person. Currently it does not want/allow you to add or delete when you make an error.
- When you are doing your transactions and the error message comes on the screen
- Nothing. I am satisfied with everything
- I think we must you most of the time and use this app because it will help us also, to be get more use on the computer when we print our records
- It's too slowly and sometimes it goes off
- If you can just make things easier for us, like for instance if I want to go to wherever it can allow me immediately

## 56 - Has using the app changed your recordkeeping in anyway? If so, how?

- Yes, changed my recordkeeping now even when I don't have my book with me I can check on my app.
- Yes, it made or improved my recordkeeping, it made me to be consistent with recordkeeping.
- Oh yes, good it did change because I capture every day unlike when I was writing in a book.
- Yes, It makes recordkeeping fun and easy to do.
- Yes, since using this app I record every day, anywhere if there is someone who buys an item.
- Yes very much, I don't forget to record my money.
- Yes because the app is always in my bag so it's easy for me to record immediately
- It made it easier for me because I can record sometime without struggling with calculations
- I record everything because it's always with me
- Yes it makes it easier for me to record in the book and also I don't waste time to record the customers
- Yes, because now I can do it instantly, anywhere and anytime.
- It changed a lot because now I record every day because my phone is with me all the time
- No
- Yes, made my recording very easy. Loved it
- Yes absolutely – I am now up to date with my recording on my book. I used to forget to write on my book but now this phone is amazing.
- I am now able to record immediately because I sometimes cannot write immediately
- Yes, I was so lazy to do my recordkeeping. I always did it at the last moment but now I do my records every day.
- Yes, it did because when I was using a book sometimes I used to not do it because of time. Now I used it every day.
- No
- Yes it's easy and efficient

## 57 - Have your clients seen you using them app? If so, how did they respond?

- They saw and they congratulated me and said I am up with technology
- Yes. I see you upgraded
- Yes they did and they liked it a lot and showed interest

- No
- Yes they were so impressed saying that I am on the ball!
- Yes they saw me. They said it make my life easier. They also want it for their businesses
- Yes they do. So convenient because you record the sale immediately.
- Yes they were very impressed and always said it’s a nice idea
- There were too surprised so they can see I’m a really business woman
- Yes, they were excited they didn't know what I was doing but I explained to them and they were amazed.
- Yes. It’s unique and nice
- Yes. Wow, because it’s new to them
- No because I record after the sale
- No
- Yes, they asked me how did I get that app
- Yes. They said it easy to record my money. Since I have a stand carrying a book sometimes I forget.
- Yes, they told me I'm growing as a business woman.
- No, except my family members who were impressed with it.
- Yes, they were so impressed of this new technology
- Yes, because if I did any sales and I show them and one customer try to rob me and I show on my app the amount and it was helpful for me.

# Appendix P Feedback from staff

- ## Leadership Team Member 1

  - Questionnaire not completed or returned

- ## Leadership Team Member 2

  - **Level of input:** Informal interactions, formal meetings, facilitated researcher's interactions with participants
  - **Kind of input given:** Contact person for project
  - **Stage of input to project:** Initial brainstorming, enabled focus groups, enabled prototype evaluations, aware of trial and engaged with those in trial
  - **Did you see your suggestion in the final app?** n/a
  - **Anything unexpected in app?** n/a
  - **Anything that was left out of app that should have been included?** n/a
  - **Was the amount of involvement appropriate:** Yes
  - **Was the timing of involvement appropriate**: Yes
  - **Was the frequency appropriate:** Yes
  - **Communication means for project:** Face to face, email, phone calls, phone messages
  - **Was communication means appropriate:** Yes
  - **Insight into how the trial participants responded to the app:** For most of them I feel that they loved the app. They used it actively and it complemented the recordkeeping process.
  - **Feedback received from participants:** They felt very positive. They were very proud of their involvement in the trial. They enjoyed working in the development process.
  - **In your opinion, did the app do what it needed to do?** Yes
  - **What about the design process worked well from your perspective?** n/a
  - **What changes would you suggest for future projects like this?** n/a

- ## Leadership Team Member 3

  - **Level of input:** Information interactions
  - **Kind of input given:** Made suggestion for the app
  - **Stage of input to project:** Initial brainstorming, proposing and refining features
  - **Did you see your suggestion in the final app?** Yes
  - **Anything unexpected in app?** No
  - **Anything that was left out of app that should have been included?** No
  - **Was the amount of involvement appropriate:** Yes
  - **Was the timing of involvement appropriate**: Yes
  - **Was the frequency appropriate:** Yes, I am happy with the frequency of my involvement
  - **Communication means for project:** Face to face
  - **Was communication means appropriate:** Yes
  - **Insight into how the trial participants responded to the app:** Excellent
  - **Feedback received from participants:** They loved being part of the project, learnt a lot and applied what they learnt.
  - **In your opinion, did the app do what it needed to do?** Yes, indeed

- **What about the design process worked well from your perspective?** Based on feedback, everything ran smoothly
- **What changes would you suggest for future projects like this?** Nothing at this stage.

## Leadership Team Member 4

- **Level of input:** Information interactions with the researcher
- **Kind of input given:** Observer
- **Stage of input to project:** Initial brainstorming
- **Was the amount of involvement appropriate:** Yes
- **Was the timing of involvement appropriate**: Yes
- **Was the frequency appropriate:** Yes
- **Communication means for project:** Face to face and email
- **Was communication means appropriate:** Yes
- **Insight into how the trial participants responded to the app:** Positive response from all participants. Good feedback and learnings all round. Would like to continue to use the app.
- **Feedback received from participants:** Personally I haven't been involved on a deep level
- **In your opinion, did the app do what it needed to do?** Despite a few bugs – Yes.
- **What about the design process worked well from your perspective?** Sarah approached the design in collaboration with participants. Really participatory developed.
- **What changes would you suggest for future projects like this?** I would like to give more time and understand the bigger picture. It's my responsibility not have done this.

## Mentor 1

- **Level of input:** Information interactions, formal meetings, facilitated interactions with participants
- **Kind of input given:** Made suggestion for the app, noticed and pointed out things that needed correcting and gave approval for app's design and features.
- **Stage of input to project:** Refining the initial prototype, suggestion for final ages, approval of app before trial, aware of trial and engaged with those in trial.
- **Did you see your suggestion in the final app?** Yes
- **Anything unexpected in app?** No
- **Anything that was left out of app that should have been included?** No
- **Was the amount of involvement appropriate:** Yes
- **Was the timing of involvement appropriate**: Yes
- **Was the frequency appropriate:** Yes, I am happy with the frequency of my involvement
- **Communication means for project:** Face to face, email
- **Was communication means appropriate:** Yes
- **Insight into how the trial participants responded to the app:** Only had two participants – one loved it a, one lost faith in it upfront when there was a bug.
- **Feedback received from participants:** /
- **In your opinion, did the app do what it needed to do?** Yes
- **What about the design process worked well from your perspective?** /

- **What changes would you suggest for future projects like this?** Better communication on time frame. Has no heard from Sarah for months and then contacted and put under time pressure to complete trial in the next 8 weeks.

- ## Mentor 2
  - **Level of input:** Formal meetings, facilitated researcher's interactions with participants
  - **Kind of input given:** Made suggestions, pointed out things that needed correcting, gave approval of design and/or features
  - **Stage of input to project:** Initial exposure to mentors, suggestion of final changes, actively part of trial, engaged with those in trial
  - **Did you see your suggestion in the final app?** Yes
  - **Anything unexpected in app?** Just that the "who owes me" didn't work properly.
  - **Anything that was left out of app that should have been included?** No
  - **Was the amount of involvement appropriate:** Yes
  - **Was the timing of involvement appropriate**: No I should have been involved earlier. The level of stress before trial was too high.
  - **Was the frequency appropriate:** Yes
  - **Communication means for project:** Face to face, email, phone calls
  - **Was communication means appropriate:** Yes
  - **Insight into how the trial participants responded to the app:** They generally loved it – found it very beneficial
  - **Feedback received from participants:** Regular feedback
  - **In your opinion, did the app do what it needed to do?** Yes
  - **What about the design process worked well from your perspective?** Loved the excel reporting – clear to read and knew that totals were accurate.
  - **What changes would you suggest for future projects like this?** Decide what happens at the end before the trial starts

- ## Peer-Mentor 1
  - **Level of input:** Formal meetings
  - **Kind of input given:** Noticed and pointed out things that needed correcting
  - **Stage of input to project:** Actively part of trial, aware of trial and engaged with those in trial
  - **Did you see your suggestion in the final app?** Yes
  - **Anything unexpected in app?** Yes it sometimes frustrated me because when I want to capture everything sometimes it does not allow me.
  - **Anything that was left out of app that should have been included?** No
  - **Was the amount of involvement appropriate:** No, I could have been more involved
  - **Was the timing of involvement appropriate**: No, I think that I need more time in the app
  - **Was the frequency appropriate:** No, I was less involved than I would have liked to be
  - **Communication means for project:** Phone calls, phone messages
  - **Was communication means appropriate:** Yes
  - **Insight into how the trial participants responded to the app:** /
  - **Feedback received from participants:** None
  - **In your opinion, did the app do what it needed to do?** Not always

- **What about the design process worked well from your perspective?** Yes, it did work well
- **What changes would you suggest for future projects like this?** No changes at all. If I can only have more time so that I can understand everything.

- ## Peer-Mentor 2
  - **Level of input:** Information interactions, formal meetings
  - **Kind of input given:** Made suggestion for the app, noticed and pointed out things that needed correcting
  - **Stage of input to project:** Actively part of trial
  - **Did you see your suggestion in the final app?** Yes
  - **Anything unexpected in app?** Error messages that keep on popping up almost every time you insert information.
  - **Anything that was left out of app that should have been included?** Yes, I think to WhatsApp or message the customers. Act as a proof of payment.
  - **Was the amount of involvement appropriate:** Yes, because I could see that some of the features that I suggested were implemented in the new version
  - **Was the timing of involvement appropriate**: No, I should have been involved earlier. To avoid challenges that we had experience and the late involvement delayed the progress that we could have made with the app.
  - **Was the frequency appropriate:** Yes, I am happy with the frequency of my involvement
  - **Communication means for project:** Face to face, email, phone messages
  - **Was communication means appropriate:** Yes
  - **Insight into how the trial participants responded to the app:** Some like it because it's convenient. Some do not like it because it's very slow and does not have enough space [referring to the phone's memory].
  - **Feedback received from participants:** App is too slow and [phone] does not have enough capacity.
  - **In your opinion, did the app do what it needed to do?** Yes/no. The new version at least tried to serve the purpose and to be user friendly but I wish there could be added features like money owed so as to track our debts and WhatsApp message and bank linked.
  - **What about the design process worked well from your perspective?** /
  - **What changes would you suggest for future projects like this?** Involvement of the relevant people early enough to incorporate ideas and for other suggestions, as given above.