Reflecting on Video: Exploring the Efficacy of Video for Teaching Device Literacy in Rural Kenya

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ABSTRACT

Substantial interest is focused on using video to disseminate agricultural information to rural farmers in the developing world. This paper explores the effectiveness of using this approach to improve rural farmers' device literacy—that is, their ability to use mobile phones for purposes other than making and receiving voice calls. Findings from our pilot evaluation, conducted with women farmers in rural western Kenya, suggest that videos combined with facilitators can be useful for improving women's confidence in sending text messages, using 'm-agriculture' applications, unsubscribing from services that deduct their mobile phone airtime, and, in general, increasing their awareness of the mobile Internet and its related services (i.e., Facebook and Google). More significantly, our findings also reveal underexplored issues that hinder women's mobile phone use: in particular, their concerns about losing money to Safaricom (Kenya's dominant mobile network provider), and the challenges that result from a wide variety of mobile phone screen interfaces. These findings encourage ICTD researchers and practitioners to pay greater attention to corporate power structures affecting mobile phone use, to recognize that rural farmers' information needs encompass more than just agricultural material, and to raise questions about scalability of instructional video.

CCS Concepts

• Human-Centered Computing → HCI Design and Evaluation Methods →Field Studies.

Keywords

Agriculture; Kenya; mobile phones; rural; Safaricom; video; women.

1. INTRODUCTION

Video has become an accepted medium that is widely used to educate smallholder farmers in sub-Saharan Africa about a variety of topics, including best agricultural practices [3,13], food preparation [5], and rice processing [43]. Perceived benefits of video are that it combines both visual and verbal communication, is useful for teaching skills, and offers a cost-effective and scalable way to deliver standardized information to large groups of people [6,9,13,36]. While video's allure is clear, what is less clear is whether video lives up to its promise of being a scalable training solution that can supplement overburdened extension services—and whether farmers even retain information acquired by viewing videos. At the same time, we also investigate video's effectiveness in teaching farmers skills that are not necessarily related to agriculture—specifically, how to improve their "device literacy," that is, the ability to use mobile phones for purposes other than making and receiving voice calls [37]. To this end, we conducted a multi-stage study that included formative studies of rural farmers and their mobile phone usage practices, a small-scale pilot evaluation of video clips, and a follow-up study.

The rest of this article is structured as follows. First, we review studies examining mobile phones and farmers, in particular 'm-agriculture' efforts (i.e., mobile applications which are intended to improve farmers' livelihoods by providing them with pertinent information) which have not been widely adopted [4,12,15,26,39]. We then review prior studies examining the effectiveness of video in educating farmers about agricultural practices [3,13,43]. Next, we present our research conducted at multiple sites in Western Kenya, the first phase of which was a formative investigation of women and their mobile usage practices, which guided the development of a series of storyboards. The storyboards were then—in collaboration with Nairobi-based video production company and consultancy Mediae.org—translated into video clips. In the following stages, we conducted a mixed-method pilot evaluation study to explore whether watching the videos improved our respondents' confidence in using their phones for purposes other than making/receiving voice calls. Two months later we conducted a follow-up survey study to assess respondents' longer-term retention of the content presented in the videos.

Our findings offer further evidence to suggest that videos are an effective educational tool; however, we also discovered that the success of our approach may be attributed to the presence of skilled moderators, in addition to the videos. Specifically, the women in our study needed help applying the handset skills shown in the videos to their own mobile phones; this serves as a reminder that video is not a replacement for face-to-face interactions. More significantly, our detailed analysis of women farmers and their interactions with their mobile phones—learned while showing the videos—lead to novel findings that counter those from prior research. Specifically, we found that, contrary to reports in prior research [11,20], the women in our study were not intimidated by technology; rather, their mobile-phone-related anxieties stem from fears of losing airtime and/or credit to Safaricom, Ltd., their network provider. We also learned that the influx of "China-makes," with their various screen interface designs, complicated our efforts; specifically, the teaching of

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'conceptual abstraction' — that is, the ability to transfer content featured in the videos to real-world tasks — was more difficult than anticipated [19].

These findings motivate a discussion that encourages ICTD researchers and practitioners to pay greater attention to corporate power structures affecting mobile phone use when developing m-agriculture services, to recognize that rural farmers' information needs encompass more than just agricultural material (i.e., not just market prices, weather forecasts, etc.), and to raise questions about scalability of instructional video.

2. LITERATURE REVIEW

2.1 Rural Farmers and Mobile Phones

Widespread mobile phone ownership among sub-Saharan Africa's smallholder farmers means there is an opportunity to provide them with pertinent information that could help them grow more crops, sell them, and make more money. In Kenya, falling handset prices and improved cellular networks have resulted in widespread ownership throughout the country and it is estimated that more than 80% of Kenyans, including most rural farmers, have mobile phones [8]. Academic researchers, technology companies, entrepreneurs, governments and NGOs are working to harness the information dissemination possibilities that accompany pervasive mobile phone ownership and are developing mobile applications and services that send farmers information.

Described as "m-agriculture," example services include *MFarm*, a market information system (MIS) designed by three entrepreneurial Kenyan software developers, that sends farmers pricing information upon request; *iCow*, a USAID-funded agricultural information platform created to help Kenyan dairy farmers increase their outputs; and *Kilimo Salama*, a crop insurance program operated by mobile network operator Safaricom [12]. These, like most m-agriculture applications, rely on (Short Message Service) SMS or the (Unstructured Supplementary Service Data) USSD protocols to send brief (160 characters or less) messages that communicate timely and simple information such as market prices, weather forecasts or planting advice. These protocols are perceived as suitable for sending farmers information because they require less bandwidth than a voice call, which makes sending a text message less expensive than calling. Interoperability also drives the use of SMS and nearly all mobile devices, including basic and feature phones widely owned in rural sub-Saharan African, are capable of receiving messages [15].

M-agriculture applications are often promoted as tools that empower smallholder farmers, are supported by hundreds of thousands of dollars from funding agencies, and are frequently touted in mass media outlets, including *The Economist*, *Wired Magazine,* and *The Guardian,* for "revolutionizing" agriculture in developing countries (see: [1,14,32,35]). However, systematic studies of these mobile services and their impact on rural farmers' livelihoods are few, and a recent review of research examining the topic suggests their impact is "mixed" [26], while Burrell and Oreglia argue their perceived benefits are a 'myth'—motivated by an optimistic narrative about "technology's transformative possibilities for (…) rural populations in the Global South," rather than by the rural realities affecting farmers and their information-seeking practices [4]. Our research builds upon these prior efforts by providing additional empirical evidence which details rural farmers' use, and non-use, of m-agriculture services. This contributes to the community's understanding of how farmers use their mobiles phones, a gap in knowledge that has led to technical interventions which have "failed to gain traction" [12].

2.1.1 Device Literacy and M-Agriculture Services

Our research also contributes to the ICTD community's understanding of why m-agriculture services have not been as successful as was hoped. Reasons include farmers' limited awareness of them, which is attributed to poor marketing by their developers [8]. Findings from other studies suggest that the market efficiency models underlying MIS are at odds with rural farmers' existing approaches to determining pricing information [4,39]. These researchers also begin to link understood barriers to mobile phone use in developing regions, in particular device literacy, or farmers not knowing how to perform basic mobile phone operations, to the limited uptake of MIS and other m-agriculture services.

Within the ICTD literature the usability barriers novice and low-literate users encounter when using their mobiles phones, in particular those related to using SMS, are mostly understood. Crandall observed that farmers in rural Kenya prefer making voice calls to sending text messages, and attributes this to their limited "skill level," writing that the farmers she observed "did not know about the reply option" on their phones [7]. Findings from Medhi *et al.'s* research demonstrate that activities such as navigating hierarchical menus, scrolling, and language difficulties non-English speakers face when they encounter commands (e.g., create message, sending options, delete etc.) limit phone use in Kenya, and in other developing countries [18,20]. These researchers propose design guidelines (i.e., "Avoid requiring nonnumeric text input" and "Avoid menus that require scrolling") meant to improve mobile interfaces so that novice and low-literate users can better use their phones to access information. To date, handset manufacturers have not implemented these recommendations, and findings from our exploratory research suggest navigating hierarchical menus and scrolling, in addition to other barriers, continue to prevent people from using their handsets to access pertinent information via SMS [41].

We wanted to investigate an alternative approach to solving this problem, and speculated that video would be an effective tool that could be used to improve rural farmers' device literacy. Video has been used in prior research to teach people computer skills [28], and within the ICTD research community researchers have used video in Bangalore's informal settlements to teach people how to "navigate a [desktop] computer application" [21], but to our knowledge there have been no previous efforts to use the medium to teach rural farmers how to use their mobile handsets.

2.2 Videos as an Educational Tool

Video has many benefits: it combines both visual and verbal communication methods making it suitable for low-literate populations; producers can create voice overlays in specific local languages [36], they can be shown almost anywhere at any time, when and where the proper audio and visual equipment is available, "rewind" and "stop action" enable viewers to learn at their own pace, they can be used to deliver consistent information to many people and, finally, their cost-per-adoption is less expensive than the traditional extension system [6].

Recognizing these benefits, a growing number of research projects use videos as a component of their agricultural training programs. Notable examples of this research include the "Digital Green" project [13], which uses live-action video to disseminate agricultural information (e.g., better ways to treat and store seeds, manage nurseries, manage diseases and pests) to smallholder

farmers in India. Evaluations of this approach suggest that video-based training is more effective than a traditional extension system in increasing the adoption of some agricultural practices.

Scientific Animations Without Border (SAWBO), a University of Illinois at Urbana-Champaign based program, focuses on creating educational animated videos to enhance rural farmers' learning—examples include step-by-step instruction that show farmers how to harvest 'neem seeds' that can be used to create a natural pesticide (i.e., harvesting the seeds, selecting good seeds, drying them in the sun, grinding the seeds, preparing pesticide from the powder, and spraying the solution in crops). The videos shown are three-dimensional graphics animations that last three minutes and include human characters in an "environment within which the topic can be properly explained" [3]. Evaluations of these videos in Ethiopia suggest that their participants were "open to the use of animation as an educational tool and as a pathway for their social improvement and economic advancement." In Ghana, video, in particular "video viewing clubs" which involve 25-30 farmers watching films with a trained facilitator proved to be an effective way to provide low literacy populations with skills, information and knowledge on complex technical topics [9].

Findings from these pilot efforts are encouraging, but longer-term studies that investigate farmers' abilities to remember the content in the video after watching them are needed. We begin to address this gap by presenting findings from our evaluation, and findings from a follow-up study (conducted two months after showing the videos) to assess our respondents' longer-term retention of presented content. Our research also builds upon these prior studies of video in ICTD, by exploring if this successful approach can be extended to improve rural farmers' device literacy.

3. FIELD SITES AND DATA COLLECTION METHODS

The study presented here occurred in three stages that involved the U.S.-based researchers travelling to Kenya in September 2014 and June 2015 to collect data with the assistance of our Kenya-based collaborators. In the first stage, we conducted focus groups with women to explain our project, to understand challenges they had when using their phones and to ask them what content they would want to include in videos. Findings from this stage guided the development of storyboards, and then of the video clips that we evaluated during stage two. During this field research trip, we also administered a pre-and-post survey and asked respondents to comment on the videos. The third stage (August 2015), was a follow-up survey study to assess respondents' retention of the content presented in the video clips.

In Kenya, similar to many countries, agriculture accounts for the overwhelming majority of rural development. We interviewed and observed residents living in poor undeveloped communities, who are fairly representative of the low-income mobile phone owners living in other rural regions in Kenya. Our field sites were in Bungoma and Homa Bay counties, both of which are in Western Kenya near Lake Victoria, 6-8 hours by bus from Nairobi. These are agrarian areas, where limited employment opportunities mean incomes are typically low; however, as is the case throughout much of Kenya, mobile phone ownership is high [8]. Low-skilled workers in the region typically earn a wage of about KES 150-200/day (USD 1.45-2.00/day) [24].

The fourth and fifth authors are from, and currently live in, these counties. Both are known within them, and relied on contacts made through their personal and/or professional pursuits to recruit study participants, and to organize sessions. We recruited women with different levels of familiarity with mobile phones to participate in our group interviews, in order to get a broad understanding of the challenges they face and insight into different learning styles. We focused our efforts on women because they tend to be less capable of using their phones (compared to men) and may benefit the most from having access to agricultural, and other forms of information (i.e., maternal health and family planning services as well as legal advice and crime reporting) via mobile phones [2].

Simiyu and Othieno also moderated the group interviews, and in both instances they explained the purpose of the sessions and then asked respondents for informed consent; by and large, individuals were happy to take part. They also administered the follow-up survey (Stage 3) via phone (i.e., calling each study participant and asking her questions). Throughout the project, respondents were encouraged to speak in the languages they were most comfortable with (i.e., in Bungoma county typically Swahili and Bukusu; in Homa Bay typically Luo). The American and Chinese researchers—who mostly speak English—did not moderate sessions, and took field notes and photographs to document respondents' interactions with their mobile phones during sessions.

3.1 Stage 1: Formative Video Content Research

Building on our exploratory study of rural Kenyan farmers and their mobile phone usage practices [41], and with financial support from USAID's "Development Innovation Ventures" (DIV) program[1], we returned to our sites in September 2014 and conducted nine women-only group interviews four at sites in Bungoma County, and five in Homa Bay county (total: 67 participants).

A desire to treat our respondents as active agents in developing the video content guided this stage of our project; we used qualitative research methods, or those generally considered useful for allowing marginalized individuals' voices to be foregrounded in research [31]. Findings from our exploratory study influenced the development of an interview protocol which we used in all sessions, but we also kept the sessions open-ended and conversational to allow for the discovery of unexpected themes.

We began group interviews by collecting some demographic information (i.e., age and level of education) and then asked women questions about the handsets they owned, what they used—and did not use them for—and how they learned to perform mobile phone tasks. More detailed questions included asking respondents to describe which buttons they most often pressed, to recall the last time they used certain applications, such as M-Pesa, and to tell us what they wanted to know about mobile phones, and ICTs more broadly. We digitally recorded sessions, which lasted 1.5-3 hours. Each woman received 100 KES (about $1) of mobile phone airtime as compensation.

Data analysis began in the field, and included writing fieldnotes and discussions among the authors about similarities, and differences pertaining to phone use that emerged during each

[1] A grant program that provides up to $100,000 to support "innovative ideas, pilots and test them using cutting-edge analytical methods, and scales solutions that demonstrate widespread impact and cost-effectiveness" (https://www.usaid.gov/div/about).

Figure 1: Storyboard

session. The fourth author translated and transcribed the recorded interviews and with the first author, they adopted an iterative, inductive analysis approach [33] to identify consistent problems participants encountered when using their handsets as well as frequently mentioned topics that women wanted to see in the video clips.

3.1.1 Video Storyboards

Our preliminary findings deepened our understanding of the benefits of phone ownership, and about the frustrations surrounding having a handset, they also guided the development a series of storyboards (Figure 1) that were used when filming the video clips evaluated during Stage 2. Here we describe key findings from Stage 1, and how they motivated these storyboards:

Beyond "Red and Green Button" Use: Our respondents primarily used their handsets for receiving (and occasionally making) voice calls, a findings that is consistent with other studies of mobile phone use in rural Kenya [7,25]. Although all respondents knew that sending a text message costs less than calling, they preferred this mode of communication because it was immediate (i.e., they did not have to wait for a reply), those with limited literacy were also able to communicate, and—we discovered—most knew how to use their phones for this purpose, with many telling us it just required pressing the "red and green buttons," or those typically used on a handset to make and/or receive a call. This finding, paired with general interest among respondents in learning about other handset buttons and features, in particular sending an SMS to multiple recipients, and unsubscribing from "Premium Rate Services" (henceforth PRS) guided a storyboard that featured step-by-step instructions on how to compose a text message, especially the multiple skills necessary for performing activities.

This storyboard also provided instructions on how to unsubscribe from PRS—information women in all sessions begged us for. Safaricom Ltd., Kenya's dominant mobile network provider, offers these services (also known as "GetIt411") which send subscribers Bible quotes, breaking news, and job posts via SMS; however, this information also costs money, and women were critical of PRS because they ate away their mobile airtime, leaving some with negative balances on their handsets. Subscribing to these services is easy and requires inputting a short code (an abbreviated four digit-number that is used as an "address" for text messages). Women frequently told us they accidentally became subscribed to these services as a result of, e.g., lending their handset to a friend or relative.

Few knew how to unsubscribe from PRS and when developing the storyboards we realized how complicated this process was, in particular for users accustomed to pressing just a few buttons on their phones and who rarely accessed other services embedded in their phones. Unsubscribing involved entering a short code, navigating five different menus, answering queries by inputting a number, scrolling to the bottom of menus, translating unfamiliar terms (i.e., "Selfcare" and "International Voice Bundles"), and selecting an option which provides no feedback to confirm that users have actually unsubscribed.

Introduction to Mobile Agriculture Services: Although all of our respondents owned handsets that could be used to access m-agriculture services (i.e., iCow, MFarm and Kilimo Salama), none did, and most were unaware that they could use their phones to receive agricultural information—a finding that offers additional support for studies that suggest phones are perceived as communication devices, rather than information delivery platforms [39] and that provides further evidence suggesting that limited marketing of these services hinders their adoption among rural farmers [8]. However, there was interest in learning about the possibilities these applications offered, indeed, agriculture was central to most of our participants' livelihoods and the ability to access relevant services was appealing.

These findings motivated a storyboard that introduced, and marketed *iShamba*, a new (introduced in 2015) m-agriculture service developed by our collaborators (see: http://www.shambashapeup.com/ishamba) and requires users to join (a process that involves texting the word "join" to a short code). After joining subscribers receive SMS with weather, market price information and "helpful tips;" unlike, similar m-agriculture services, subscribers can also access information in their local language by talking to an expert in Mediae's call center. Having the option to ask a person questions in their language of choice was appealing to women in our study, many who preferred making voice calls and speaking in Luo and Bukusu, rather receiving SMS messages is English and Kiswahili—as is typical of most m-agriculture services. Our storyboard introduced iShamba, demonstrated how to send the word "join" to the short code, and featured images representing the content subscribers could access (e.g., advice on raising livestock and planting maize).

What is the Internet?: Women in all of the groups told us they wanted to know more about Facebook, and to a lesser degree Google, although—as has been reported elsewhere—there was confusion about the distinctions between these sites and the broader Internet [22,38]. They had learned about these ICTs from their children, or via snippets of information heard on the radio, and were curious to know more. Although the majority of our respondents had never used, let alone seen, the Internet and its accompanying services, most imagined that it was something that could be used for accessing information, exchanging pictures, downloading music, and for "making friends," especially ones from "other countries."

Respondents' nascent awareness of the Internet and desire to know more about it, motivated a storyboard that explained the Internet as a "the world's largest network of interconnected group of computers," and included information on how to access it (i.e., using an Internet-enabled phone or at a cyber café) and also featured content that explained Facebook as a service that lets "farmers connect to other farmers," and Google as service that let's you "ask simple questions and get answers."

3.2 Stage 2: Pilot Evaluation of Video Clips

Our collaborators translated the storyboards into a series of three-to-six-minute video clips (two versions, one in Swahili and the other in Luo). Most featured simple phones, similar to those women owned, and step-by-step instructions that demonstrated: how to send an SMS, how to register for iShamba, and how to unsubscribe from PRS. Local imagery and music were also integrated into the videos with the intention of making them both entertaining and educational. Voice-over narration accompanied the images of the phone, sample instructions included:

When you are composing a message look for the keypad button with the letter you want to use. You may have to press the two or three time to get to the appropriate letter.

And

Next scroll to select "Premium Services" on your screen and press "OK." Then scroll to "My subscription" and again press "OK." You will see an option to "Unsubscribe" scroll to this option and press OK.

In June 2015, we returned to our four field sites near Bungoma Town and our five sites near Homa Bay, to update respondents on the project, and to show the video clips to the 67 women whose experiences shaped their development. We used a combination of qualitative and quantitative methods to assess their effectiveness in teaching women how to perform operations on their mobile phones and to also introduce them to the Internet and some of its accompanying services. A short questionnaire was developed that was administered before showing women the videos, and immediately after the workshop participants were asked to re-rate their confidence in accomplishing simple tasks on their mobile phones. When administering the surveys, moderators also conducted short interviews with respondents to assess their baseline mobile phone skills. They asked women if they had previously sent SMS messages, if they had ever received agricultural information via SMS, and gauged their awareness, use, and/or basic understanding of PRS, the Internet, Google, and Facebook. Respondents received copies of the photographs taken of them during Stage 1, and 100 KES Safaricom scratch card as compensation, and so that they could try out the activities in the videos (i.e., sending SMS messages).

Viewing sessions took place in the same homes, churches and community centers where we conducted our initial group interviews. We used an AAXA P4X Pico Projector, which was chosen because of long-lasting battery and bright projection; the projector was equipped with two external speakers and a tripod. Videos were shown in order of the complexity: we began by showing how to send an SMS, then introduced the iShamba, followed by how to unsubscribe from PRS, and concluded with the introduction to the Internet video. Following each viewing, women were asked if they wanted to see the video again, and they mostly answered "yes," and frequently asked us to slow the pace of the videos so they could better follow the instructions.

In-between video showings, our moderators, as well as other members of the research team, individually interacted with nearly every participant, demonstrating—on their handsets—how to perform tasks shown in the videos, troubleshoot errors (i.e., USSD connection time-outs when unsubscribing from PRS) and to answer questions not included in the videos (i.e., How to switch from one SIM card to another, when sending an SMS?).

Group interviews were translated and transcribed, and the approach which guided the analysis of our qualitative data during Stage 1 was also used during this stage. For our survey, we used a simple three-point scale to assess confidence levels (not confident, somewhat confident, confident) in using SMS, unsubscribing from PRS as well as in knowledge of the Internet, Facebook and Google. Comparisons of confidence and knowledge levels before and after the videos helped us to assess short-term gains from exposure to the videos and moderated discussions.

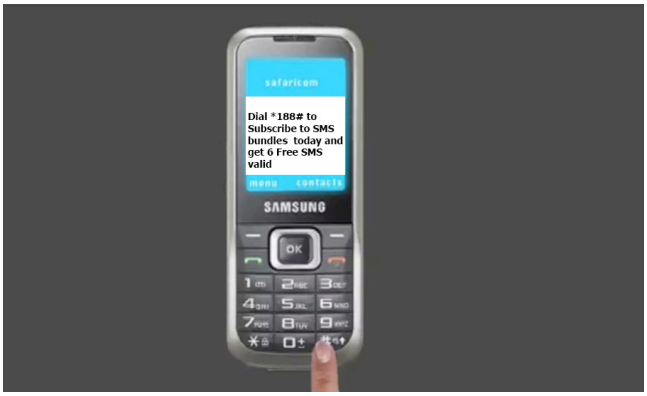

Figure 2: Image from Video Clip

3.3 Stage 3: Follow-Up Survey

To investigate if long-term retention improved after watching the videos, the fourth and fifth authors contacted each participant to administer the same post-survey used in the prior stage, two months after showing women the clips. They had mobile phone contact information for 62 of the 67 women, and were able to reach and complete a short interview with 46 of them (74% of those for whom we had contact information). Survey questions re-assessed participants' confidence levels in sending SMS messages and unsubscribing from PRS, whether they retained knowledge of what the Internet, Google, and Facebook are, and checked to see if participants had successfully received any follow-up texts from the iShamba service.

4. FINDINGS

Before we discuss the impact of our video clips, we describe our participants and the mobile phones they owned. We then present findings from our surveys which suggest that our video clips increased women's confidence in performing the operations shown in the clips. Findings from our follow-up survey offer additional evidence suggesting the longer-term impact of our videos on knowledge retention. Themes that emerged from our qualitative analysis also offer support for the effectiveness of videos, and (as has been reported in prior studies [9]) suggest that videos alone may not be sufficient for learning. Specifically, our observations suggest that pairing skilled moderators with the videos is necessary for improving women's abilities to operate their handsets. We also found that our respondents' fears of losing mobile airtime/credit to one of Safaricom Ltd.'s airtime-deducting services (i.e., PRS and Skiza Tunes) hindered their mobile phone use; this identified challenges that can be attributed to the influx of low-quality and counterfeit phones (i.e., "China-makes") into Western Kenya.

4.1 Overview of Women and their Handsets

Our findings come from 67 women who participated in the study; roughly all who attended the first session were also at the second session where the video clips were presented. Fifteen of these women were in their 20s, 21 were in their 30s, 19 were in their 40s, 12 were in their 50s and 60s, and one was 70. Nearly all

Table 1: Participants' (n=67) Pre-Workshop Mobile Experience

Mobile experience	% Yes
1. Have sent an SMS	59%
2. Have received agricultural information via SMS	29%
4. Familiar with Safaricom's premium services	52%
5. Know what Internet is	29%
6. Know what Google is	6%
7. Know what Facebook is	20%

reported their primary residence as being in a rural area and identified as smallholder farmers, holding one to five acres of land. Although, as is common, many also engaged in other income-generating activities, including selling charcoal or produce at local markets. Most women under the age of 40 had primary school education, a few had attended secondary school; four were college educated professionals. All of these women spoke Kiswahili and some English, while those who were older than 40 generally had lower education levels, were less fluent in Kiswahili and English and most comfortable speaking the local dialects (Bukusu or Luo).

Feature phones called "kaduda" were the most common handsets owned, three-quarters of which were sub-standard "China-makes" with Bird, Itel, G-Tide, and Tecno brands. These devices are relatively inexpensive, costing the equivalent of $10 to $16—less than the $35 for which an original basic handset sells. Unfortunately, their life expectancy is dismal compared to original models. We did encounter some original Nokia and Samsung handsets; however, more common were the low-quality counterfeit Nokia 1100 models, which have become increasingly common in rural parts of Kenya [8]. Six women used their handsets to occasionally access the mobile Internet, but most did not because they lacked an appropriate handset model, money to buy bundles, knowledge (and is some instances) the desire to use the mobile Internet. The majority of women told us they had small amounts of airtime available on their phones (e.g., 2-6 KES) at the time of our session: "zero zero" was a typical response to our question about the amount of credit, and we encountered women with negative airtime balances.

4.2 Overview of Survey Findings

The surveys completed prior to the video screenings provide some sense of participants' mobile phone competencies, as shown in Table 1. Slightly more than half (59%) had sent a text message in the past, and most (85%) had deleted a text message. However, participants' experience level with more advanced features and services was quite limited. More than three-fourths (76%) had never sent a text to multiple recipients and 71% had not used their phones to obtain agricultural information via SMS and roughly half (48%) were unfamiliar with premium SMS services. Similar to what we learned during Stage 1, most women reported not knowing what the Internet (71%), Google (94%), or Facebook (80%) were.

The initial pre-and-post video session surveys suggest that viewing and discussing the video clips increased participants' confidence in using their mobile phones, primarily among the women who had not previously engaged in a particular mobile

Table 2: Reported Gains in Selected Mobile Phone Confidence Levels, Knowledge, and Experiences

	Before	Post1	Post2
Confidence sending SMS:			
Never sent SMS	1	2.70	2.56
Had sent SMS before	2.86	2.89	2.86
Confidence unsubscribing from PRS:			
Unfamiliar with PRS	1.03	2.17	1.67
Familiar with PRS	1.59	2.86	2.13
Percent who know about:			
Internet	29%	82%	66%
Google	6%	44%	63%
Facebook	20%	53%	62%
Percent receiving ag. info. via SMS	29%	NA	51%

task (Table 2). On a confidence scale ranging from 1 to 3, where 1 meant not confident, 2 meant somewhat confident, and 3 meant confident, women who had never sent a text message before increased from 1 to 2.70, approaching the confidence levels of those who were experienced in sending SMS (2.86 prior to the screenings and 2.89 after). For one type of competence, unsubscribing from PRS, both those who were familiar with premium rate services and those who were not reported gains in confidence in this task.

The results from the second post-survey administered two months later suggest that much information from the screenings and discussion was retained over time. Confidence scores for sending texts remained high, implying that women continued being able to accomplish these tasks. There was some drop in confidence levels with regard to unsubscribing from premium rate services, which is not surprising given the greater complexity in accomplishing this task as well as the lower frequency with which someone might attempt to do it. The proportion who knew what the Internet was dropped slightly, while the proportion knowing what Google and Facebook are increased over time. Finally, more than half of the women had successfully enrolled in the iShamba service and were receiving agricultural information via text at the time of the second post-survey.

4.3 Videos plus moderators

Here we present qualitative findings based on our observations and analysis of the group interview discussions. These findings, like those from our surveys, suggest that video can be useful in teaching women to use their phones. Older women in the groups were excited to send SMSes for the first time, and individuals who had lost money to PRSes were grateful to know how to unsubscribe from these services. Many women were eager to join iShamba, and wanted to know more about the Internet. Respondents appeared to appreciate the clarity of the technical messages and language used in the videos; the length of the clips also seemed appropriate, and viewers watched them attentively for their full duration of two to five minutes. At the conclusion of each session respondents were asked to comment on the videos, and positive remarks—similar to this one—were typical:

I say much thanks to your team for what you have done today, we have seen and learned more. For my case I have not known what is the Internet — I have never gone there, but from today onwards am going to use it.

Other respondents asked our research team to continue using the videos to teach people in other parts of the country how to use their mobile phones; one woman said:

I am so glad that you are educating people from Karachuoyo and many other places. Please ensure you take this good message to many parts of Kanyada I have realized that many people both old and young need this information.

The frequency and consistency of these comments were encouraging; however, we also encountered women who told us they wanted "pamphlets," because—unlike with videos—they could access the information on a paper flyer after we left and the projector was gone. They could also share a flyer with someone who had not attended the workshop. These comments, and others, reveal some shortcomings of using video to improve device literacy: in particular, we learned that videos alone may be insufficient because users may encounter problems that are not accounted for in the videos. Here we describe these problems.

4.3.1 Conceptual Abstraction and "China-makes"

Findings from prior evaluations of using video to teach technical skills to people with limited education suggest that 'conceptual abstraction'—that is, the proficiency required to not only comprehend the instructions demonstrated in the video, but to transfer that learning to real-world tasks which may not be identical to the training scenario—can be far more difficult than anticipated [19]. Some respondents found it challenging to transpose the instructional patterns from the videos onto their own handsets, because the interfaces shown in the videos were too different. Comments, such as this one were typical:

I have a Techno and it has different arrangements from the phone in the video.

Women relied on us to 'translate' the instructions in the videos to their handset's "arrangements." Previous researchers have commented on the influx of substandard and low-quality 'China-make' phones into areas like where our study took place; as in those other instances, the presence of China-makes affected our research [40,42]. Women had a range of different models with a hodgepodge of interfaces, and although all the handsets were capable of the activities shown in the videos, the steps required to perform these activities varied from one model to the next. Some models required users to first access their handset's menu before composing an SMS (a process that typically required navigating multiple screens), while others allowed the composition of a message by pressing a single button on the phone's keypad. Our video demonstrated how to change a mobile phone's text entry options (i.e., switching from the complicated T-9 predictive text entry to the more intuitive 'individual letter selection' mode); as with sending an SMS, different phone models performed this task in different ways. On some devices, changing the input style could be accomplished just by pressing the "#" button two or three times; on others, users had to navigate to the "Option" or "Settings" screens, whose access required searching through multiple hierarchical menus—a process that can be very difficult for novice phone users [20].

Lexical inconsistencies posed another hindrance to our respondents' attempts to apply the information in the videos: our demonstration model was a Samsung GT for which confirmation of a choice required selecting 'OK'; however, other models asked users to select 'Confirm' or 'Select.' Similarly, some handsets used 'Exit' where others used 'Back', or 'Compose' where others used 'Write.' Even the simplified icons could differ (a closed envelope vs an open one), as could the order of operations (should the recipient's phone number be input before the message is written, or after).

Unsubscribing from PRS required first navigating to "Safaricom's services," which appear in any handset with a Safaricom SIM card. On some models these settings are located behind a puzzle icon, on others behind a toolbox icon, and on still others behind a folder icon—and in all cases, users must then navigate hierarchical menus and then scroll to the bottom of a list of rarely-used applications (i.e., Memo, Converter, and Stopwatch) to find the Safaricom selection, and then the unsubscribe options. The process is made even more complicated by the USSD protocol. Unlike SMS which follows a store-and-forward oriented message transaction; USSD provides session-based connections [27]. It was common for sessions to "time out" when women were working to unsubscribe from PRSes, after which they had to start the complicated unsubscription process over from the beginning—a confusing and unintuitive situation for many respondents. Such observations draw attention to problems with the USSD protocol, which have been overlooked in recent studies that praise the protocol for being easy to use and suitable for performing complex task (such as unsubscribing from PRS) [29]. Finally, the videos made other, more subtle assumptions about users' knowledge—for instance, that they knew how long to press a keypad button when entering a letter.

Members of the research team—all whom are experienced mobile phone users—were able to figure out how to apply the instructions shown in the videos to the various handset models, and patiently showed the participants how to perform the operations. We speculate that if we had not been present and capable of providing each woman with personal assistance, our video would have been perceived as less effective than indicated in the surveys. Creating videos that accommodated the many interfaces we encountered would be time-consuming and costly, to the detriment of the features which make video a useful information dissemination method in the first place. Finally, our findings are a useful reminder that video is not a replacement for face-to-face communication, a traditional pre-ICT aspect of Kenya culture, because people will continue to communicate face-to-face [23].

4.4 A Desire to Learn and Fear of Losing Airtime

A key finding to emerge from our sustained engagement with the women was that few were fearful of using ICTs or were uninterested in experimenting with their devices—a characterization reported in other studies. Dodson, *et al.*, write that a "fear of sophisticated devices" complicates Berber-Muslim women's ability to use mobile phones [11]. Similarly, Medhi *et al*. argue that "intimidation of technology" and anxieties about breaking them hinder mobile phone use, particularly among marginalized user groups, such as the women in our sessions [18,20]. We observed that many of our participants' phones were broken; fractured screens, missing buttons and cracked cases were typical, but this did not prevent them from using the devices. Furthermore, women's fear or anxieties about technology appeared to come from other sources, in particular a fear of losing money to Safaricom. In two women's words:

There are those message, which deduct money like the ones I am sent, so when Safaricom sends you money gets deducted like 10 shillings, 20 shillings. That business is with Safaricom and it continue and it cannot be removed.

And

I have songs, how do I remove them? When I put money it goes, when you borrowed the song (…) when you hear, they are singing good, oh what is this? And money goes.

Worries about unknowingly subscribing to PRS, or one of the service provider's other airtime deducting applications (i.e., Skiza Tune, a service which allows users to purchase songs with which to customize their phones' ring-tones) appeared to restrict many from interacting with the phones, exploring its features, and otherwise engaging in activities which might help them learn how to use more of its features.

5. DISCUSSION

Our results are consistent with prior studies that suggest there are some benefits in using video to disseminate information to rural farmers; however, videos alone are not sufficient and will likely be more impactful if deployed in conjunction with skilled moderators. Our findings, in particular, the details about women farmers and their frustrations with their handsets provide nuance, missing from studies about how they use and want to use ICTs. More significantly, these findings offer the ICTD community new perspectives on the kinds of information farmers may need and insights into alternative ways to provide this information.

5.1 Other Information and Multi-Dimensional Users

Thus far, efforts to use ICTs—in particular, mobile phones—to deliver rural farmers information have focused on a narrow range of content (i.e., crop prices, weather forecasts, and tips about best agricultural practices). Although our respondents expressed some interest in this information, they were mostly interested in learning about other, non-agricultural topics.

Women wanted more information about how to use their phones, and about the frequent loss of airtime which they attributed to PRS. This suggests an opportunity to provide them with information about Safaricom's pricing schemes—and, obviously, more straightforward ways for them to unsubscribe from credit-consuming services. This finding is significant, and suggests the limitations of adopting a deficit-model—that is, an approach which (similarly to what we implemented in our research) implies that there is a deficit in women's knowledge about ICTs and assumes that once that deficit is addressed, women will be able to effectively use ICTs [17]. We see that even if women learned how to use their phones, other factors—specifically, ones traditionally overlooked in ICTD (i.e., the corporate power structures which shape the use of mobile products and services [16])—may continue to hinder ICT use. This finding also provides support for Irani*, et al.'s* argument that "(t)he potential consequences of bringing resources and people in line with the interests of powerful capital and commercial actors" must be "recognized and analyzed in ICT4D literatures."

Our "Introduction to the Internet" was just that, an introduction, and women wanted more information about it; however, awareness is a necessary condition for ICT adoption and our videos seemed to successfully introduce our respondents to the Internet, Facebook, and to a lesser degree Google. Providing "the two thirds of the world that doesn't have Internet access" with access is typically framed as overcoming technical challenges, exemplified by the Facebook-led project Internet.org [44]. However, findings from each stage of our study suggest that rural residents will face other obstacles after these technical ones are overcome. Specifically, in addition to details like how to create a strong password or manage an online identity, they need information about how to access the Internet in the first place. Finally, our respondents also need to know how to manage complex pricing strategies affecting mobile Internet use—specifically, how to manage data bundles. As has been argued in other research, they would also significantly benefit from interfaces that clearly indicate how much airtime is being deducted during the use of mobile services [30].

There is a broader lesson for the ICTD community here. M-agriculture has a tendency to direct attention to a single dimension of farmers' lives—specifically, the planting, growing, and selling of crops. However, farmers are humans, and humans live complex lives; ultimately, they need access to a broader range of information than just what is provided by m-agriculture services.

5.2 Reconsidering Scale

Video is perceived as a scalable medium, which is why it is so widely used. This makes it attractive to funding agencies that use scale to assess whether a project (such as this one) has succeeded or failed. However, Toyama has observed that technology is seductive precisely because it is so easy to scale [34]. We see that video is useful for creating an awareness about ICTs, and for providing a starting point to uncover deeper usability problems encountered by our respondents when using their mobile phones; but, knowing whether the medium is, by itself, an effective learning tool for improving device literacy, remains an open question that requires more research. A similarly open question is whether improved device literacy would lead to greater uptake of m-agriculture services.

This conclusion may be disagreeable for development organizations and others interested in using video to educate rural farmers; however, our hope is that, by not naively embracing video as a panacea, resources can be allocated elsewhere—in particular, to training people. Our research team wondered if a better use of USAID's funding would have been to pay our moderators to travel to rural sites (such as where we collected data) to regularly meet with women and teach them about ICTs and ICT use. Admittedly, this would be (in Toyama's words) "exactly the expensive investments that development organizations hope to avoid through technology;" [34] however, our findings suggest that this may have potential.

6. LIMITATIONS AND FUTURE RESEARCH

A number of limitations should be kept in mind when interpreting our results. While purposive sampling was used to select people who represented a variety of opinions, the full range of views and beliefs may not be reflected. In addition, data was collected by 'outsider' researchers, with the aid of Swahili and Luo translators; this likely influenced the nature of the information respondents shared, in particular response bias, the tendency of to offer responses they think the evaluator expects or desires [10]. Our qualitative findings cannot be generalized beyond our sample; however, they provide new perspectives on insufficiently-studied constraints affecting mobile phone use in rural sub-Saharan Africa—constraints which are most likely not unique to the women we encountered.

This was a pilot study and there is need for more conclusive studies of video, which should include samples of both women and men with which to assess learning and device literacy, a year or more after the training. Furthermore, as noted in our discussion, technological interventions should be supplemented by efforts to train people. Continued effort is necessary to understand the ways in which phone use is affected by for-profit corporations and the technologies they develop; this is particularly important in light of

corporate efforts to bring greater portions of the developing world online. Finally, based on our research, we believe that researchers and funding agencies should reconsider developing more m-agriculture services, accept the limitations of video and mobile technologies, and, instead, focus on other problems—most notably, improving infrastructure and women's access education in rural Kenya.

7. CONCLUSION

This project contributes to a growing number of pilot studies that assess the effectiveness of video as an education tool, and also presents original findings about rural farmers and their mobile pones experiences. Our findings extend prior research by demonstrating the possibilities of using videos to teach rural farmers how to use their mobile phones. The combination of video, plus effective and patient moderators who can carefully explain and demonstrate the skills and subskills required to perform mobile operations, appears to have the most potential in addressing a problem that will likely persist as more and more complex technologies become present in rural Kenya—i.e., not only how to teach people to use ICTs, but how to navigate the larger structures in which they operate.

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